7. PRESENT SITUATION AND FUTURE PROBLEMS ON FARM MECHANIZATION IN THAILAND

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General description

The degree of farm mechanization in Thailand is still very low. The number of tractors used on the farm land is also small comparing to the existing farm land. The estimated number of all types of tractor in Thailand (by the end of 1969) is 30,400 units: 25,000 units are farm tractors and the rest of 5,500 units are industrial and crawler tractors. Farm tractors used in Thailand are divided into 2 types: four-wheeled type (22,000 units), and two-wheeled type (9,000 units). The popular size of four-wheeled tractors is 50–69 horse power. The total cultivable areas in Thailand is 25.8 million acres. Therefore, the ratio of the present farm tractor and cultivable area is about 1,180 acres per tractor.

The availability of upland areas that need to be cleared and modern technology as well as the market demand for corn, jute, and cotton are some of the special factors in increasing farm mechanization at significant rate. The import of four-wheeled tractors has been constant at the average rate of 3,150 units per year since 1964. However, it is expected that the import of four-wheeled tractors will be slightly increased at the conservative rate of about 15–18% per year during the period of 1968–1972.

Two-wheeled tractors have been popular for Thai agriculture for the last 2–3 years. They have been used widely in the deep muddy soil of rice transplantation. The average rate of the growth of these two-wheeled tractors has been about 40–45 per cent during 1968–1972. It is also estimated that this type of machinery will be produced locally before 1975. Now the rate of local production is about 3,000 units per year.

There is a trend to use higher horse power for four-wheeled farm tractors in Thailand, despite the recent popularity of the low horse power or two-wheeled tractors. Although the higher horse power tractors are more expensive, yet they are increasingly considered to be necessary due to the requirements caused by hard soil in Thailand and the scale of commercial operations in peak season.

Thai agriculture depends mostly on natural rainfall, and it lasts only a few months. Moreover, individual farm area is rather small and not match with the high capability and expensive equipment as farm tractors. Therefore, the persons who own the equipments by operating custom farm services to their neighbours farms. These custom farm service operators have to migrate from their places and look for the possible custom farm service incomes. According to the survey, it is found that about 90% of the equipment owners are working within their home provinces, and the other 10% have to migrate to other provinces. The average coverage radius of custom service territory found from the survey is ranging from 40–80 kilometres.

Custom farm service or contractor farm service is just a recently flourished agribusiness in Thailand. It has been developed from the farmer's idea to maximize the use of his purchased tractors. About 90 percent of tractor owners are farmers who

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Table 1. Tractors imported into Thailand

	Tractors, other than steam		Track tractors, other than steam	
	Units	1000 Baht	Units	1000 Baht
1957	267	14, 385	71	15, 304
1958	384	18, 056	57	11, 673
1959	445	18, 026	102	27, 464
1960	855	26, 246	75	21, 134
1961	1, 487	46, 578	152	55, 296
1962	1, 353	51, 856	185	49, 342
1963	1, 922	77, 550	327	116, 677
1964	3, 446	146, 012	418	137, 648
1965	3, 047	136, 111	473	186, 038
1966	3, 872	162, 906	705	245, 411
1967	4, 305	192, 909	1, 393	374, 698
1968	3, 610	161, 938	1, 494	315, 775
1969 (Jan.-Novem.)	2, 326	109, 002	707	189, 504

Source: Thailand Customs Department. 20 Baht = US $ 1

also work as custom farm service operators. Farm tractors which they have posseessed seem to be the most expensive property they have in the farm, probably they are more expensive than their own farm land. They usually purchased on long term instalment from the local tractors dealers. The first down payment is about 30 percent of the purchased price. Time for payment of the balance on contract for 4 wheel tractor is about 12–18 months and interest rate is officially 15 percent annually. Most of the credit for tractor purchasers is from tractor agent in Bangkok.

An average operator usually has 1–5 tractors and 1–2 pieces of implements for each tractor such as a disc plow or disc tiller, and disc harrow. The services obtained from tractor contractors are predominantly tillage operation. This is mainly done by using disc tiller and disc plow, rice threshing by treading and corn shelling are also done by tractors. Common rate of work on flat rice land for 50–60 horse power (four-wheeled tractor with 3 disc plows) is 0.423 acre per hour, with 7 disc tiller is 1.4 acres per hour, and 0.73 acre per hour with the same implement on rough upland fields.

Plowing charges are varying according to soil conditions and types of implement used. Plowing charge for paddy field with 7 disc tiller is about 12–15 baht per rai, whereas plowing charge for dry land with 3 or 4 disc plow is about 30–35 baht per rai. However, the custom service charges are not the same in different regions, and it also depends on the degree of competition in each area, too. The rapid increase in number of farm tractors has created a lot of trouble to the custom farm service operators, because they have to migrate farther and offer cheaper services to other customers. Besides the custom farm service operators have to face another problem in collecting custom farm service charges from their customers. The rate of service charges are shown in Table 2.

Seasonal pattern of farm equipment use

Farm tractors are chiefly used for the preparation of soil for paddy and corn

Map 1.


Chiengrai
Mao-hong-sorn
Chiengmai
Lam phoon
Lampang
Prae
Nan
Uttaradit
Sukhothai
Tak
Pitsanuloke
Kampaengpet
Pichit
Petchaboon
Nakornsawan
Utbai-thani
Lopburi
Saraburi
Supan buri
Ayuthaya
Kanchanaburi
Bangkok
Prachinburi
Chachoengsao
Ratburi
Cholburi
Pethuri
Rayong
Chantburi
Trat
Pracbuab kirikan
Nongkhai
Loei
Udorn Thani
Sakol nakorn
Nakorn panom
Khonkaen
Kalasin
Chaiyaphoom
Maha sarakam
Roi – et
Ubolrajdhani
Sisaket
Nakornrajsima
Burirnm
Surin
N
Regions of Thailand
Chum porn
Ra nong
Surattani
Pang nga
Nakorn sithamraj
Krabi
Phuket
Trang
Pata lung
Satool
Songkla
Pattani
Yala
Naratiwart
KILOMETERS
0 20 50 100 150

Table 2. Custom from service charges by regions

Regions	Types of services				
	Plowing service charges (Baht/Rai)			Shelling (Corn)	Threshing (Paddy)
	3-4 Disc	7 Disc	Rotovator	Baht/Tom	Baht Tang
1	N.A.	15-20	N.A.	—	—
2	25-30	13-20	N.A.	N.A.	0.20-0.25
3	20-25	15-20	N.A.	N.A.	0.15
4	30-35	20-25	N.A.	N.A.	N.A.
5	25-35	15-25	40-60	15	0.30
6	30-35	15-20	N.A.	50	0.25
7	20-35	15-25	N.A.	N.A.	N.A.
8	25-40	20-25	N.A.	N.A.	N.A.
9	20-30	15-20	N.A.	N.A.	N.A.
10	30-35	20-30	30-40	—	—
Average	25-33	16-23	30-60	15-50	0.25

Note: 1 Tang=20 Litres
1 Rai =0.4 Acre
Source: Thailand Farm Mechanization

productions, other significant crops that can also be observed are kenaf, sugar cane, cassava, cotton, and tobacco. The tilling season of these crops varies from one region to another, due to the different climatic conditions of the region. The pattern of farm tractor used by regions and primary crops are shown in Table 3.

Cost to farmers of hand labor, animal power versus farm machinery

Cost commparison of using hand labor, animal power and farm machinery is the most important aspect to be considered by farms. Farm machinery costs are usually cheaper to work on a large scale farm. In Thailand labor cost in farming is quite cheap and of a temporary employment basis. Farm laborers are usually hired with daily wage rate of per unit of work. The cost of farm labor is slightly deviated according to types of crop and region. The cost of farm labor to plow paddy land is ranging from 10–15 baht per rai (0.4 acre) whereas it costs 20–30 baht for plowing one rai of dry land.

Cost of hiring animals together with farm labor

In general, Thai farmers keep 2–3 buffaloes for their farming, but sometimes these buffaloes are not sufficient especially during the plowing season. Farm tractors are also very busy by this time and farmers can not wait any longer because of the very short period of rain. Therefore, they have to hire buffaloes together with their owners to plow for them. Farmers generally plow paddy fields twice and harrow one or two times when using farm labor and buffaloes. The service charge to plow with one buffaloe and its owner is about 20–25 baht per rai, and it takes one day to finish one rai. The cost is shown in Table 4.

Relative cost to farmers of farm mechanization

The cost of custom farm services in Thailand is presently lower than the cost of hiring farm labor and draft animals to accomplish the same tasks. While many farm tasks are performed by unpaid members of the farmers families, typically farm

Table 3. Farming cycle for major crops by region

Region No.	Type works	Months start service by crops										
		Paddy	Corn	Cotton	Kenaf	Tobacco	Cane	Peanut	Garlic	Bean	Cassava	Rubber
1	Tilling	3–6	—	—	—	—	—	—	—	—	—	—
	Planting	6–7	—	—	—	—	—	—	—	—	—	—
	Harvesting	11–12	—	—	—	—	—	—	—	—	—	—
2	Tilling	3–7	2–4	4–7	—	—	1–4	—	—	—	1–3	—
	Planting	5–7	5–7	8–9	—	—	1–4	—	—	—	5–6	—
	Harvesting	11–2	11–2	11–2	—	—	12–4	—	—	—	1–4	—
3	Tilling	5–7	—	—	—	—	2	—	—	—	—	—
	Planting	8–9	—	—	—	—	5	—	—	—	—	—
	Harvesting	12–4	—	—	—	—	12–1	—	—	—	—	—
4	Tilling	4–5	—	5–7	—	—	11–1	—	—	—	11	—
	Planting	5–6	—	6–8	—	—	11–1	—	—	—	—	—
	Harvesting	12–1	—	12–1	—	—	9–11	—	—	—	2–5	—
5	Tilling	4–6	3–6	5–7	—	7–8	—	—	—	8–9	—	—
	Planting	5–7	3–6	6–8	—	8–9	—	—	—	8–9	—	—
	Harvesting	12–3	8–10	10–12	—	11–12	—	—	—	1–2	—	—
	Corn shelling	—	8–12	—	—	—	—	—	—	—	—	—
6	Tilling	6–7	4–5	—	—	8–9	—	12–1	10–12	8–9	—	—
	Planting	7–9	5–6	—	—	9–10	—	1–2	10–12	—	—	—
	Harvesting	12–2	9–10	—	—	12–1	—	4–5	3–4	12–1	—	—
7	Tilling	3–4	—	—	—	9–10	—	—	—	—	—	—
	Planting	5–6	—	—	—	10–11	—	—	—	—	—	—
	Harvesting	11–1	—	—	—	12–1	—	—	—	—	—	—
8	Tilling	3–7	2–4	6–8	12–4	—	—	—	—	—	—	—
	Planting	6–8	4–5	8–9	3–5	—	—	—	—	—	—	—
	Harvesting	12–1	8–9	1–2	9–11	—	—	—	—	—	—	—
	Corn shelling	—	8–9–10	—	—	—	—	—	—	—	—	—
9	Tilling	4–5	—	—	2–4	—	—	—	—	—	—	—
	Planting	5–8	—	—	3–5	—	—	—	—	—	—	—
	Harvesting	12–2	—	—	9–10	—	—	—	—	—	—	—
10	Tilling	8–10	—	—	—	—	—	—	—	3–4	—	1–3
	Planting	10–11	—	—	—	—	—	—	—	4–5	—	5–7
	Harvesting	4–5	—	—	—	—	—	—	—	7–8	—	N.A.

labor, animal and custom service are employed in the peak season. Farmers also spend their free time through the use of custom service in order to earn additional income from other employment.

Usually tractors in Thailand operate 7–12 hours a day or 18–20 hours during peak season which is more common now. Annual hour of operation is about 1360 typically 22 percent of farm tractor utilization is for equipment owner's own farm and 78 percent is custom service operation. According to the survey 58 percent of the tractors being used are found in the central region of the country with the bulk of these in the upper central plain area. The next largest region of tractors being used is in the Northeast with 11 percent of the tractor population.

The average costs of repairs and maintenance are varied with the degree of utilization in each region. For example region 5 where the tractor are used heavily with rice, corn and other upland crops, the average cost per one tractor is about US $700 per year. It costs only US $310 per year in region 1 where farm tractors are used for paddy field only. The average maintenance and repair costs of a farm tractor and its implement are about US $540 per year.

Tractor's part are available at local dealers particularly the local dealers who supply farm tractors to their customers. Annual sales of the spare parts is about 20%

Table 4. Cost to farmer of hand labor, animal power, versus farm machinery

Type of farm works	Power Sources		
	Cost of hand labor	Cost of hand labor plus animal power	Cost of farm tractor & implement
A. **Tilling**			
— Paddy land	10–15/Rai	20–25/Rai	12–20/Rai
— Dry land	20–30/Rai	40–50/Rai	30–35/Rai
B. **Planting & Seeding**			
— Rice transplanting	8–15/Rai	—	—
— Corn seeding	2– 4/Rai	—	N.A.
— Cotton seeding	2– 4/Rai	—	—
C. **Cultivating**			
— Rice field	—	—	—
— Corn field	5– 8/Rai	—	N.A.
— Cotton field	5– 8/Rai	—	—
— Kenaf field	—	—	—
— Sugar cane	5–10/Rai	—	—
D. **Harvesting**			
— Paddy	10–20/Rai	—	N.A.
— Corn picking	10–12/Rai	—	N.A.
— Cotton picking	10–20/Rai	—	—
— Kenaf cutting	8–10/Rai	—	—
E. **Others**			
— Paddy threshing	8–10/Day	0.5–0.6/Tang	0.3/Tang
— Corn shelling	8–10/Day	N.A.	15/Ton

Note: one tang=20 litres
one rai =0.4 acre
Source: Survey

of the tractors sales. The total import of tractor spare parts (including crawler tractors) during the last 5 years (1963–1967) was 351.7 million baht.

The rapid expansion of the use of tractors is the cause of many changes and development in Thailand. Technical development for small manufacture and local workshop has been geared to improve the production of attached implement, corn sheller, simple 2 wheeled tractor and power puddling machine. These locally made implements are very popular and well recognized among the users. The prices are cheaper than imported goods and quality suitable for local working conditions. There are also many local manufacturers of water pump. These locally manufacturers are mainly located in Bangkok and Thonburi. They produce small centrifugal pump, and low lift pump, which are cheaper than imported units.

The simple farm machines made by local manufacturers are powered by 6–12 hp. engines most of which have been imported from other countries. The gasoline engines, the major source of power for low-lift pump, centrifugal pump, boats, and puddling machine, are mostly imported from the United States and West Germany. The diesel engines, for two-wheeled tractor, centrifugal pump, and some processing machines, are mostly imported from Japan and the United Kingdom. Both gasoline

and diesel engines are increasingly important in transitional stage of mechanization in Thailand. Figures from table 5 has shown that the number of small engines imported for agricultural use during 1966–1969 has risen steadily. The annual increase is approximately 40 percent.

Table 5. U.S. exports of small engines to Thailand

	1966		1967		1968		1969 (Jan.-August)	
	Units	$	Units	$	Units	$	Units	$
Gasoline engines, n.e.c., 6 brake hp and under	20,833	762,642	17,848	697,664	33,948	1,181,070	11,850	372,204
Gasoline engins, n.e.c. over 6, not over 10b hp	12,293	739,348	30,445	1,270,939	25,088	1,174,025	9,811	553,722
Gasoline engines, n.e.c. over 10, not over 50b hp	222	36,739	429	62,532	135	21,923	135	22,422
Total	33,348	1,538,739	48,732	2,031,135	59,171	2,377,018	21,796	948,348

Source: US Department of Commerce—FT 410 Reports. 20 Baht=US $1

Japan export internal combustion engines, other than aircraft to Thailand

	1966		1967		1968	
	Units	(1000) ¥	Units	(1000) ¥	Units	(1000) ¥
— International combustion gasoline engines for land, with a rating not more than 30 hp	14,272	233,549	15,572	290,866	17,631	318,627
— International combustion diesel engines for land, with a rating not more than 30 hp	17,040	747,406	25,237	1,064,604	38,134	1,670,642
— International combustion engines for land, with a rating not more than 30 hp n.e.s.	1,952	45,825	242	5,035	320	9,687
Total	33,264	1,026,780	41,051	1,360,505	56,085	1,998,956

Source: Japan Export Statistics, Ministry of Finance, Japan. .06 Baht=¥1

Problems concerning using implements with certain kind of soil

In Thailand we do not have much problem with soil preparation. In general the work is done in dry condition. Disc plow or rotavator is used where mold board plow is not applicable. Rotavator is being used widely in the North and the South where sufficient natural and irrigated water supply is available. However, due to abrasive nature of soil, a set of rotavator blade that cost about US $50 normally tolerates 80–90 hours of operation. Therefore, the custom farm service operators have to charge around US $7.50 per acre which is a high price. However farmers in the North are still willing to pay for hiring rotavator since the return for there major crops i.c. tobacco, soybean and vegetables is satisfactory enough. But it is not worth using rotavator for crop such as rice and corn because the price of hiring rotavator is twice as much as of disc plow (US $7.50 v.s US $2). Therefore water irrigation method and crop pattern have much influence on the use of farm implements.

As most economic crops in Thailand are grown under rain fed condition, weeding has been one of the major problems that farmers are compelled to face the costs of

eradication and control measures to save the crops in time. The shortcomings of conventional weed control through man and animal power are due to lack of labor during the period of peak demand, low efficiency of performance per unit area, and increasingly high cost of labor force. In general, approximately one third of expenses starting from plowing to harvesting is devoted to weeding. In particular case, conventional weeding costs for an acre of corn, tapioca, and sugarcane are US $10, US $15 and US $17.5 respectively.

According to the results of preliminary trials of the use of power tiller for weeding in sugarcane and pineapple plantation, an imported model of 9 hp power tiller costs only US $1.25 to weed an acre of sugarcane which could be compared to US $3 for the same amount of work done by a man and a buffalo. Moreover, the power tiller could save the farmer much time and effort usually spent for weeding. An average farmer could, therefore, work 4–5 times faster than he normally does with the aid of an animal.

During last decade most of the engineering research work carried out by the Engineering Division, Rice Department, was emphasized to develop mechanization on rice production. Some of the machines being used by farmers today are simple puddling machine, thresher and water pump, which have been designed mainly to suit the specific farming conditions in the country and to be operated and serviced by operators with limited skills. To cope with water supply and control measures a feasibility study project on cloud seeding is now under way. The preliminary results of the study has so far been considered satisfactory. In view to increase processing and storage efficiency to improve grain marketing in the world markets, priority of future research projects would be given to research on economical use of locally available materials for better processing and storage of grains.

Socio-economic problems related to farm mechanization in Thailand

According to our experiences in Thailand, it appears that farmers in this country do response to economic incentive. Hence, it is reasonable to believe that they try to maximize the returns from their resources. Therefore, if the cost structures of farm production are considered farmers will try to find the optimum mix of farm resources. Since the size of the farm is too small and the credit is too scarce, farmers seldom own the big tractors. The hired ploughing for the big tractor seems to be a reasonable source to using it. The use of hired ploughing tractor owned by crop dealers, and a few big farms seem to be spreading wider and wider. The limitation of this kind of business will be most concerned about the crop calendar; the more intensification takes place in a small size of farm, the more limitation will occur for the hired tractor.

1) Changes of number of agricultural labor force and number of farm house-holds in the past ten years.

From table 7 the percentage of agricultural labor force is decreasing gradually, as agricultural labor force occupies 81.6 percent in 1960 and now it is approximated only 76 percent. However, it happens that from 1960–1970 the agricultural labor force has been increased 2 million persons; in 1960 the labor force engaged in agriculture was 10.3 million but now it becomes 12.5 million. Therefore even the percentage of agricultural labor force is decreased but the absolute number of agricultural labor force is still increasing. Since the cultivated area is almost limited, the size of farm will be smaller. It would be expected that in the next decade the size of farm per family will be smaller than now. If this is the case, the farming system must be intensified in order to increase the farm income.

2) Changes of average farm wage rate per day in the past ten years.

Table 6. Thailand imports of small internal combustion, engines, diesel & semi-diesel engines

		Total		U.S.A.		Japan		U.K.		W. Germany		Austria		Others	
		Units	(1000)	Units	(1000)	Units	(1000)	Units	(1000)	Units	(1000)	Units	(1000)	Units	(1000)
Internal combustion, piston engins, n.e.s.	1966	45,016	61,495,434	25,372	28,614	11,468	11,363	551	8,741	1,447	2,638	5,565	8,584	664	1,555
	1967	57,977	73,268,540	38,093	38,627	17,096	21,274	359	5,213	1,525	3,551	384	1,673	540	2,931
	1968	79,275	92,606,841	38,466	34,548	26,225	26,453	996	5,913	2,122	3,898	8,768	17,108	2,698	4,687
	1969 (Jan.-June)	36,323	40,096,245	19,767	15,702	11,339	12,378	555	4,522	1,312	2,296	1,550	2,967	1,800	2,231
Diesel & semi-diesel engines	1966	29,967	169,525,646	1,934	20,434	21,563	79,836	3,446	34,844	1,437	21,273	255	3,418	1,332	9,721
	1967	47,889	167,169,485	587	6,621	28,385	92,356	11,996	39,965	608	10,632	77	1,888	6,236	15,707
	1968	44,829	183,706,991	405	10,935	37,640	105,447	3,751	38,878	825	17,360	460	1,744	1,748	9,343
	1969	25,025	99,035,164	428	2,210	17,782	49,643	4,037	23,303	756	12,936	57	811	1,965	10,132
		(Metric Tone)													
Parts of internal combustion piston engines, n.e.s.	1966	1,943	113,166,118	288	23,181	943	43,044	308	17,089	188	16,583	8	671	208	12,598
	1967	2,332	149,948,725	365	29,964	1,052	54,818	362	20,970	258	24,817	6	572	289	19,808
	1968	4,109	199,487,114	756	34,008	2,240	89,406	351	22,721	382	29,024	9	3,499	371	20,829
	1969 (Jan.-June)	1,622	102,913,537	116	13,166	940	51,005	152	10,909	188	16,808	3	287	223	10,739
Parts of diesel and semi-diesel engines, n.e.s.	1966	172	15,993,231	35	4,944	58	3,490	36	3,205	29	3,750	0.1	1.6	14	602
	1967	365	23,196,871	37	4,669	204	8,595	57	4,422	47	4,448	0.2	11	20	1,052
	1968	186	16,153,213	43	4,978	46	2,794	42	3,446	29	3,325	—	—	26	1,610
	1969 (Jan.-June)	82	6,421,026	15	1,467	32	1,942	21	1,138	9	1,494	—	—	5	380

Note: 1961 figures (Jan.-June) are obtained from Port of Bangkok only, provincial ports are not included.
Source: Customs Department, Bangkok.

Table 7. Number of agricultural labor force in 1961-1970.

Year	Ag. labor force (1000 person)	Total labor force (1000 person)	Percent of ag labor force & total labor force c/2
1961	10, 540	12, 980	81. 2
1962	10, 750	13, 280	80. 9
1963	10, 960	13, 580	80. 7
1964	11, 170	13, 900	80. 4
1965	11, 390	14, 220	80. 1
1966	11, 610	14, 560	79. 7
1967	11, 820	14, 970	78. 9
1968	12, 030	15, 390	78. 2
1969	12, 240	15, 840	77. 3
1970	12, 450	16, 390	76. 0

The wage rate in the local area tends to be increased. In 1960 the average wage rate was about 8 baht per day and became 10 baht per day in 1964. However, in the early of 1969 up to now, during the peak period of transplanting and harvesting season, 12 baht per day frequently occurs to be prevailing rate. The main reason will be summarized as follows.

(a) Since the percentage of labor force engaged in agriculture is decreasing, the redundant labor in the local area is diminished.

(b) Even the absolute number of labor force engaged in agriculture is larger, but the size of farm is smaller. Therefore, these people have to intensify their farm to achieve a higher farm income in the small farm area.

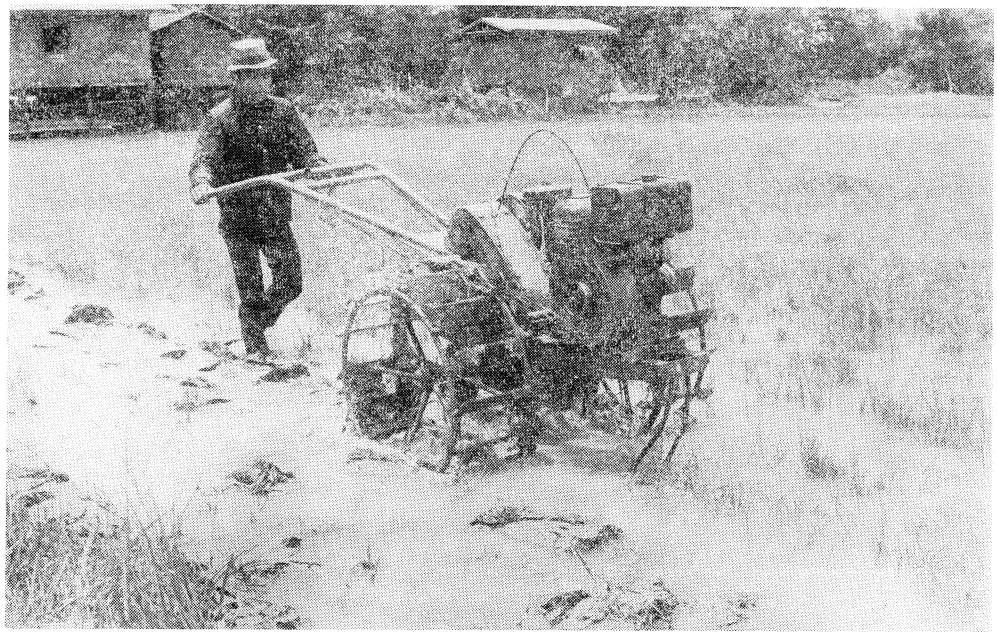
(c) Changes of numbers of agricultural machinery and implements being used on the farm in the past ten years.

Table 8. Number of wheeled tractors imported to Thailand during 1959–1968.

Year	Two wheeled tractor	Four wheeled tractor
1959	8	437
1960	25	830
1961	15	1, 472
1962	22	1, 331
1963	125	1, 797
1964	124	3, 322
1965	245	2, 802
1966	585	3, 287
1967	848	3, 457
1968	800	2, 810

Source: Thailand Customs Department

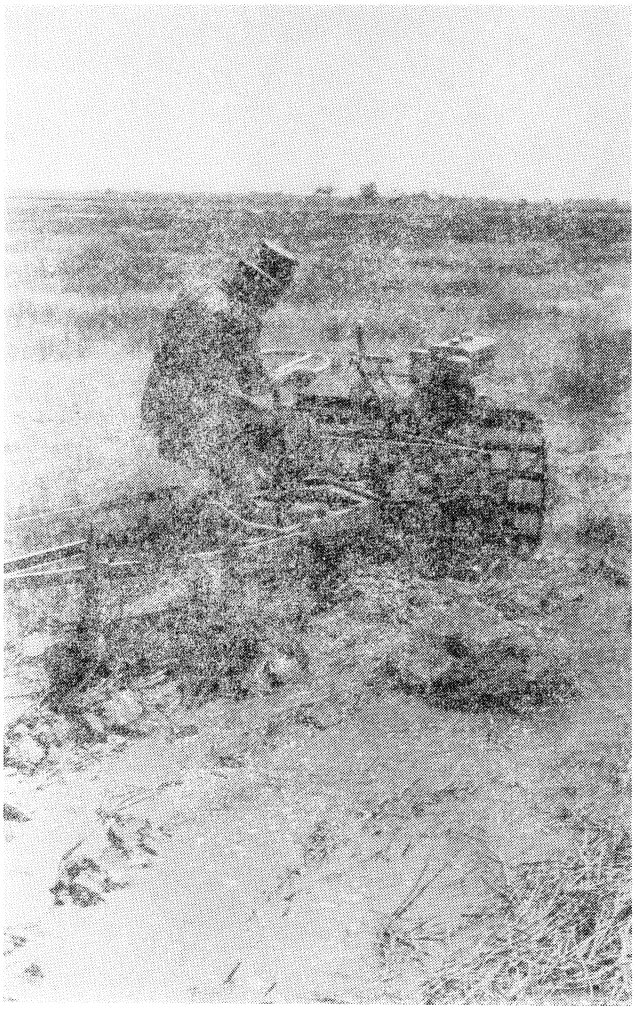
From 1959 to 1968 the four wheeled tractor imported to Thailand is about 19 percent increased annually. Most of them being used as hired tractors for custom



A hand-made walking tractor operating with one moldboard plow.

A hand-made puddling machine with depth and steering control units.

plough in extent to which, paddy threshing becomes more and more practical. Recent survey reported that 32 percent of paddy farm in the central plain using custom plough and 42 per cent of the total farm being engaged in both custom plough and own buffalo plough, 26 percent of the rest still use draft animal. The farm using custom plough is the farm that has the size smaller than 20 rai and larger than 80 rai on average. The reason why small farms prefer to use a custom plough is to get the job done more quickly and the difficulty of raising buffaloes in term of time-consuming (one person has to devote most of his time to take care of animal). If two wheeled tractor is taken into account, surprisingly the import of two wheeled tractor shows the marvelous increase from 1965–1968. The small farms try to intensify their farm through mechanization by using simple tool and small tractor. Besides the imported two wheeled tractor, the home made two wheeled tractor supplies to the farmer use



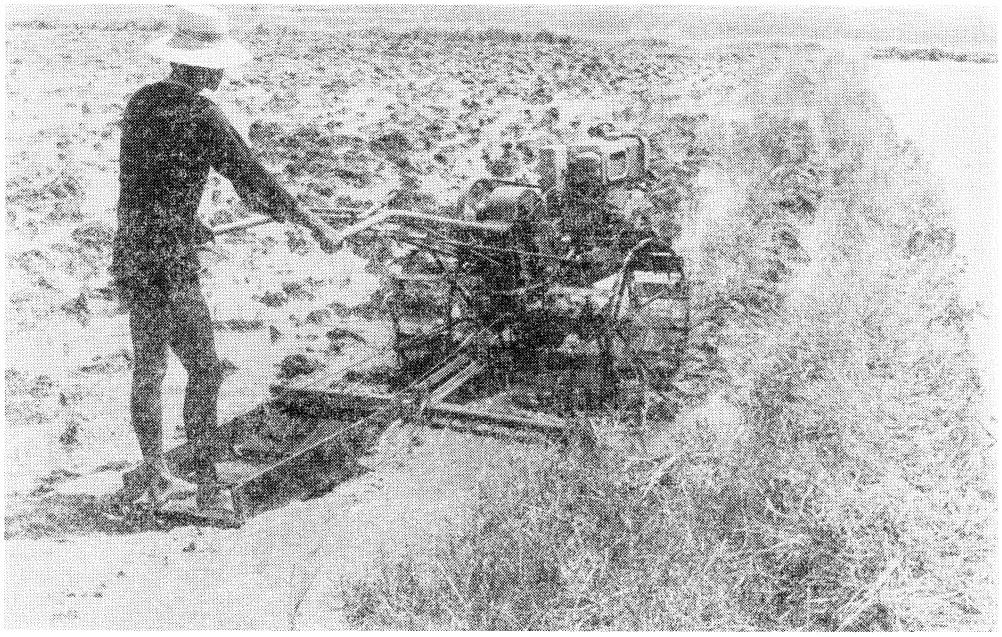
A hand-made two-wheeled tractor being attached with 2 moldboard plows.

The Depth of plow is partly controlled a board under operator's seat.

total of 3,000 tractors per year since 1967. However we can realize that in the past ten years the rate of increase of two wheeled tractor is about 48 percent which is higher than that of four wheeled tractor. Furthermore the number of home made two wheeled tractor is four times greater than the imported one in 1967 and 1968, because the price is four times lower.

3) Plicies for farm mechanization

According to the main policy of the government that is to increase the farm income of the farmer, the intensification of farming is emphasized. In other words the labor savings machine with low price is recommended in order to reach a new pattern of intensified farming. But the substitution of machine for labor can be realized if and only if there is physical feasibility and the price ratio of the two factors are favorable to the farmer.



A hand-made two-wheeled tractor shown working with a set of harrow.
The ski-like board is for operator's convenience for moving in the mud.

Discussion

S. Morishima, Japan: (1) Do you have any experience in the use of the Japanese type of short bottomed plows with the curvature changeable moldboard (*Jiyubera* called in Japanese) which is driven by a buffalo? (2) How do you employ the polw moldboards covered with the chemical compound in Thailand soil?

Answer: (1) We have no experience in the use of the Japanese short bottomed plow type. We use only the native moldboard plows of the animal drawn type and the local made moldboard plows of the two wheeled tractor type. (2) Moldboard plows are used in the limited area because it is very hard to use them in the dry condition of soil. I am sure that in the irrigated area most farmers prefer to the use of moldboard plows.