11. SOCIO-ECONOMIC CONDITIONS FOR FARM MECHANIZATION IN JAPAN

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Introduction

The purposes of this report are to review most of the main aspects of the farm mechanization development in Japan and to show the soico-economic conditions by which the farm mechanization has been influenced.

The development of farm mechanization in Japan has been closely interrelated with many socio-economic conditions inside and outside agriculture. Japanese agriculture is fundamentally characterized by the following several aspects:

1) The rice production is, by far, the mainstay of agricultural production and rice farming is the most predominant type of farming. For example, a little less than 60 percent of the total arable land in Japan consists of paddy fields and about 88 per cent of the total farms is growing rice crops. This is mainly because Japan belongs to the East-Asia monsoon belt with a large rainfall.

2) The average size of farm in arable land is negligibly small, a little over than one hectare. There is no great changes in the distribution of farms by the size of farm (Fig. 1).

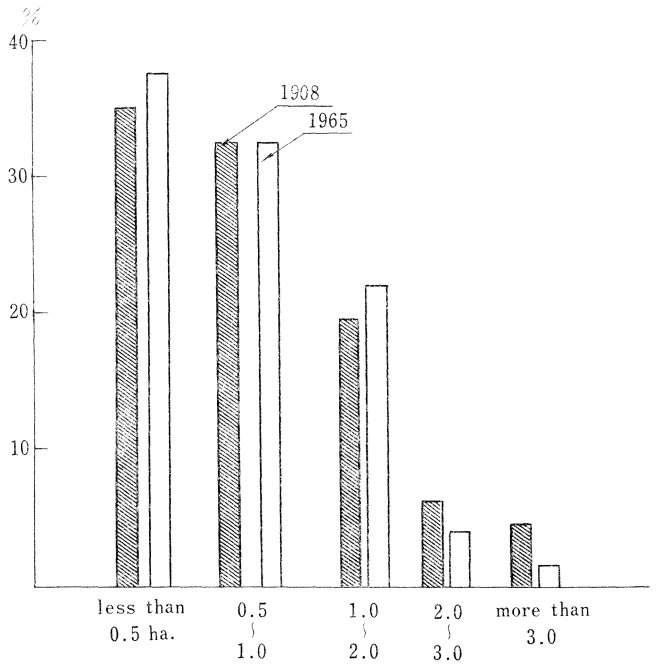

Fig. 1. Changes in percentage of farms by size in arable land.

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3) The third aspect is that family type farm is predominant. Most of farm labor is supplied by family member including operator, wife, sons, brides, daughters, etc. This is a significant feature of Japanese family type farms as compared with American family type farms where wife and daughters are not considered to be farm labor resource.

4) The next characteristics is the fact that very intensive farming is carried out through intensive labor, fertilizer and chemicals application.

5) Finally, Japanese agriculture is so called "village agriculture" which is characterized by the facts that fragmented patches of farm land are scattered mostly within village and collective action of farmers is required to maintain the farm roads, ditches, irrigation facilities, etc.

The above mentioned characters of Japanese agriculture has influenced the development of farm mechanization in the following directions:

1) Farm mechanization has been mainly developed on farms of rice farming.

2) The size of machines used on farms is relatively small.

3) There is an unbalanced or uneven progress of mechanization. This means the facts that a large amount of human labor is required to do farm operation in spite of introduction of farm machines.

However, these characteristics of farm mechanization have been changing especially in recent years. The changes are being brought about by the changes in level of wage and labor situation, the development of commercial farming, land tenure system, social capital investment for land improvement, and technical conditions both in manufacturing and in farming. In other words, the progress of farm mechanization depends closely on the degree of social and economic development.

Historical review of farm mechanization before World War II

The farm mechanization, in the narrow meanings, has rapidly developed since World War II. However, it may be useful for us to review of the development of farm mechanization before World War II. Generally speaking, there are two steps for farm mechanization. The first step is the change from human labor to that of animal power using some implements. The second step is the conversion of animal power to mechanical power. The mechanization considered in this report covers both of the two steps.

The development of farm mechanization in Japan was rather delayed as compared with the progress in rice greeding and fertilizer application techniques. The level of productivity of Japanese agriculture after the Meiji Restoration as measured by yields per unit of land or per man was probably not very different from level of productivity which persists to this day in many parts of Asian countries. Farm technology was focused on increase of land productivity with neglect of labor productivity. Under such circumstances, the farm implements prevalent in the Meiji Era were nothing more than simple farm tools. It was in 1899 when one-way short-bottom plow, one of the most representative animal drawn plow was completed and started to extend into many parts of the country. As short-bottom plows were stable and able to do shallow or deep plowing, the paddy field acreage plowed with them increased rapidly. At the end of the Meiji Era, about 60 per cent of the total paddy field acreage was plowed with the short-bottom plows. Through the speeding up of timely operation and deep plowing with the introduction of short-bottom plows, rice yield per unit area was increased significantly. This increased use of animal-drawn plows can also be attributed to the following factors.

1) Water-logged paddy fields were converted into dry ones and field conditions became better than before by the land consolidation works started in 1900.

2) Organic fertilizers such as fish-cakes or oil foots were introduced and came to

Table 1. Percentage of paddy fields plowed with animal drawn plows to the total acreage

Year	Percent
1904	53.9%
1914	59.9
1924	67.4
1934	74.2
1946	74.8

Source: "Agricultural Development in Modern Japan" edited by Takekazu Ogura, page 417.

be applied liberally. Thus deep plowing become important to raise efficiency in the use of fertilizer.

In the threshing operation, comb-toothed threshers were used for long period. In the 1900's foot-pedal rotary threshers appeared and came into wide use after the end of World War I. Power threshers which were almost similar to those prevailing after World War II came into use gradually after World War I. The leading implements used for rice culture after World War I were irrigation and drainage pumps, huskers, threshers (foot-pedal threshers and power threshers), plows (animal-drawn short-bottom plows, power-tillers) and weeders (hand rotary intertillage weeders). Most of these farm machines and implements were operated by hand or animal power, but some were run with petroleum engines or electric motors. The use of power in the period was confined mainly to stationary machines such as irrigation or drainage pumps, threshers, huskers or winnowers.

During the World War I marked progress was made in the urban industries, the farm labor was absorbed by urban industries, and the commercialization of farming was promoted. Taking advantage of these trends, farm machinery and implement making industry made a good start and mass production was carried out. Under such circumstance, hand labor gave way to mechanization. During the World War II there was a serious shortage in the supply of farm labor which gave a great impetus to farm mechanization. However, because of lack of fuel and production materials, the manufacturing of farm machines and implements was restricted and the distribution was kept under the Government controls. In spite of these conditions, the farm labor shortage occasioned the second stage of the growing use of farm machinery.

From the Meiji Restoration until the end of World War II the farm mechanization in the broader meanings was progressed at a very slow pace. This slow tempo of mechanization might be attributed to the following factors; 1) Although the expansion of the non-agricultural sectors of economy was very rapid during this period, it sufficed only to absorb the increment to the total labor force brought about by population growth. It was not rapid enough to cause a significant reduction in the agricultural labor force. 2) Obstacles for farm mechanization are not only limited to the labor, natural and technical conditions but also to social conditions. Land tenure system is a particular factor. The pre-war land tenure system in Japan was chracterized by a wide spread of tenancy farmers accompanied by heavy rent. Under the circumstance, most of tenant farmers could not accumulate capital or fund for introducing farm machinery. 3) In this connection, commercialization of rice which is one of the most important farm products in Japan was carried out not by farmers themselves but by landlords who gathered a large amount of rice as rent from tenant farmers. The landlords took

leaderships of mechanization in husking or hulling operations. On the other hand, the farmers themselves in the double cropping areas were interested in introduction of power threshers which also were used for wheat threshing. Because the landlords did not levy rent on wheat production and labor in the peak season due to the clash between for transplanting of rice seedlings and harvesting of wheat could be distributed by using power threshers. 4) The price of farm machinery was relatively higher as compared with the wage rate under the over population in rural districts.

Factors affecting farm mechanization after World War II

Although farm mechanization in Japan is yet in its infant stage, mechanical technology has rapidly developed and mechanization has been spreading over the whole range of farm operations since World War II, especially since 1950. Table 2 shows rapid increase in the number of various farm machines.

It may be convenient to split the development of farm mechanization after the last war into three phases basing on the type of machines introduced on farms.

1) The first stage covers a period from 1945 until 1955. During this period, animal-drawn machines such as double mouldboard plows, power threshers, power huskers, etc. were improved and came into wide use on farms. Plowing has been becoming increasingly mechanized. Thus animal-drawn plows gave gradually way to power-tillers.

2) The second stage covers a period from 1956 until 1965. During this period,

Table 2. Number of major agricultural machines in use, from 1927–1968

(1,000 units)

Year	Power threshers	Hullers	Power-tillers	Power sprayers	Tractors
1927	30	39	—	—	—
1931	56	77	0.1	—	—
1933	67	95	0.1	0.4	—
1935	92	105	0.2	1	—
1937	129	108	1	2	—
1939	211	133	3	5	—
1942	357	180	7	—	—
1945	352	177	—	—	—
1947	444	199	8	7	—
1949	764	348	10	11	—
1951	972	—	16	20	—
1953	1,269	540	35	44	—
1955	2,038	690	89	87	—
1957	2,283	—	227	155	—
1959	2,459	800	514	305	—
1961	2,703	—	1,020	361	7
1962	2,832	—	1,414	436	11
1963	2,982	—	1,812	565	—
1964	3,085	827	2,183	704	24.8
1965	3,048	—	2,490	851	36.0
1966	—	—	2,725	1,126	38.5
1967	3,297	1,008	2,971	2,091	57.9
1968	—	—	3,030	1,939	124.3

Source: Year-brock of Agricultural Machines by Shin Norinsha Co., 1970.

small sized farm machines such as power-tillers, power dusters, power sprayers, semi automatic power threshers, driers, etc. were introduced extensively on farms.

3) The third stage covers a period from 1965 until present time. Since 1965, large type riding tractors, harvesting machines (combine harvester, binder, etc.), transplating machines, have been introduced on farms, though it is still at experimental basis.

It should be emphasized that the land reform played a great role for the development of farm mechanization. Ownership of land is closely related to the social and economic conditions of the farmers. Land reform has key importance to the modernization of agriculture, because it could bring the necessary incentive to the farmers to raise their productivity and enable them to use more input materials including farm machinery and implements. Japan has carried out land reform during 1947–50, and most of the farmers became owner cultivators. At present, about 95 percent of agricultural land is cultivated by owner farmers. After the land reform, the farmers have more concerned about their farm management using more fertilizer, farm implements or machinery and pesticides which made their production better and contributed considerable to their economy.

For several years, soon after World War II, the economic conditions were somewhat different from ordinary course of economic progress in order to recover from the war damage. Since 1955, a very rapid development in secondary and tertiary industries brought about acute shortage of agricultural labor. The economic conditions surrounding agriculture have completely begun to change. Wage rate rose at a higher rate among all the factors of production. This brought about a rapid exodus of young people and even heir on the farms from rural district (Fig. 2). The developed technology and the various type of labor saving machines have been improved and extended into the farms. The serious shortage of labor was one of the major factors which induced the

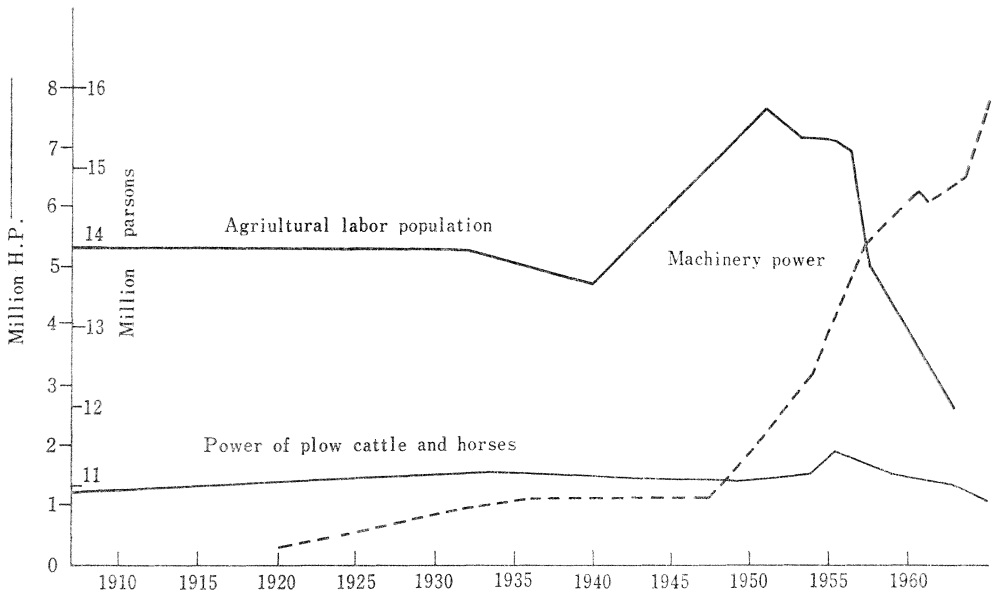


Fig. 2. Historical change of agricultural labor population and powers used in agriculture. (Keizo Tsuchiya, "The role and significance of mechanization in Japanese Agriculture" *Journal of the Faculty of Agriculture, Kyushu Univ.*, Vol. 16, No. 2).

introduction of farm machinery. Since 1960, along with the high economic growth in Japan, farm population has decreased rapidly (around 3 percent per annum) and labor force has for the first time begun to decline in absolute numbers. Agriculture in Japan is no longer characterized by an abundance of labor. During this period, investment in farm machinery and other types of farm equipment has become significant.

Despite the rapid decrease in the number of farm labor through the movement from agriculture to other industries as a result of the explosive expansion of industries (Fig. 3), the total number of farms in Japan has fairly been constant. This is because city industries did not offer opportunities of stable employment to the old people from rural districts and thus these people could not leave farms entirely (Table 3).

During the decade from 1955 to 1965, the average size of farm remained almost constant. But the number of farms of less than 1.0 hectare was considerably decreased,

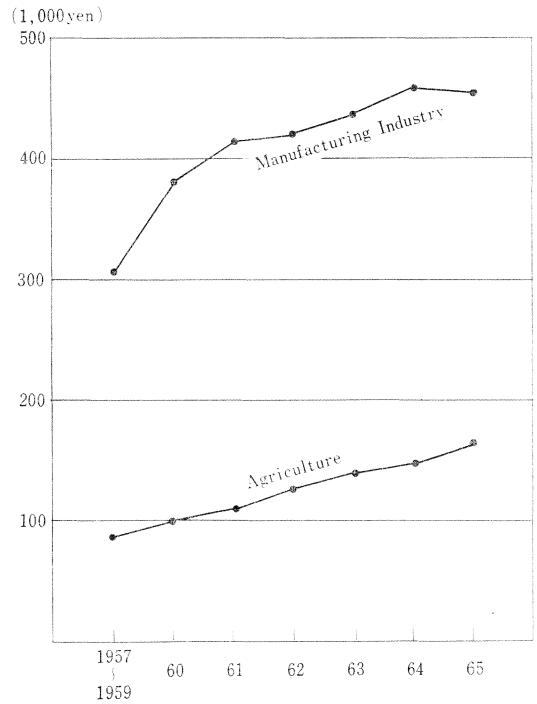


Fig. 3. Net national income per capita.

Table 3. Changes in farm population, farm workers, farms, and arable land.

	1955	1968	Index of 1968 (1955=100)
	thousands	thousands	
Farm population	3,634	2,721	74.9
Farm workers	1,715	970	56.6
Farms	603	535	88.7
Arable land	625 ha	590	94.7

Source: Agricultural Statistics, Ministry of Agriculture and Forestry, Japan.

whereas the number of farms of more than 2.0 hectares was slightly increased. The smallness of farming became obstacle to save labor which was absorbed by other industries, and to use farm machinery efficiently to fill the gap of labor shortage. It caused widening of the gap of per capita income between agricultural sector and non-agricultural sector, or that of productivity between two sectors.

Intensification of farming in relation to farm mechanization

Among the Asian countries, Japan has the highest labor productivity and also the highest land productivity. The reason for the high productivity of labor and land in Japan is intensive farming, frequent utilization of land within a year and raising of more yield of crops from unit area of cultivated land. Family labor force would be able to be employed as fully as possible mostly by means of intensification. The more intensive the farming is, the severer becomes the rush season. Therefore, it is important to make higher the labor efficiency particularly in busy season. If labor becomes scarce factor with the expansion of part-time farming, this is especially true.

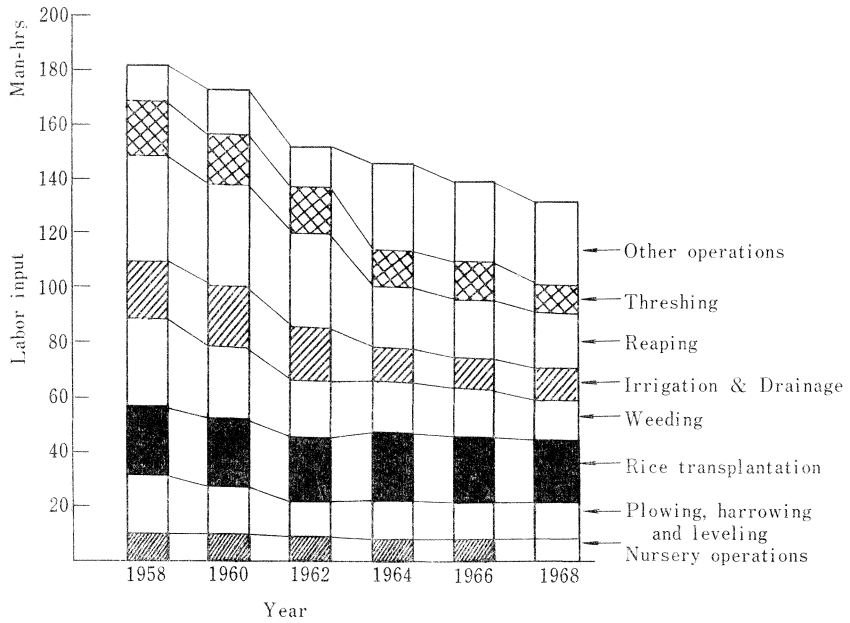
It should be noticed that there are several ways to make higher the labor efficiency as the following; 1) mechanization 2) using chemicals, 3) improving field conditions in its broader meaning, 4) operation at most favorable season as much as possible, and 5) improving work method. Mechanization is one of the most important ways to make higher the labor efficiency. Originally speaking, out of the two categories in agricultural mechanization is representing the technique of the former. The mechanization in the stage which the pressure of labor on land is serious and size of farm is small, introduced more machinery for the intensification of farming, or to utilize land more and to raise yield per unit of land by way of speeding up farming operation and saving the peak labor in busy season. In other words, at first, mechanization influenced the land productivity, which also indirectly influenced the labor productivity.

Farm mechanization and changes in the labor conditions on farms

Farm mechanization which starts with the introduction of more power to farms may affect the labor conditions on the farms through the following several phases; 1) quantitative saving of labor, 2) speeding up of the operational works, 3) reducing the drudgery of farm work, especially liberating women from hard works, and 4) changing seasonal distribution of labor and farming pattern. All of these would closely relate to the agricultural production and productivity, thus raising income and welfare of the farm people.

However, after World War II, especially after land reform, the democratization of the rural community has changed economic and social attitudes of the farmers. The growth of non-agricultural sectors invited the outflow of most of the second and third sons on the farms, in some cases, even the heir of the family. This made serious shortage of both family and hired laborers in rural districts, especially in the busy season. This induced mechanization of large scale farms in particular, first, and even small sized farms have started to introduce farm machinery in the recent years.

The mechanization was adopted in plowing, pest and insect control, and weeding operation, but transplanting and harvesting operations which require the most labor have not yet been fully mechanized. Farm operations are still using quite a large amount of human labor, and the labor peak is concentrated on transplanting and harvesting operations which require the most labor. (Table 4). (Fig. 4). In this case, it should not be forgotten that part of the mechanized operations still have considerable portion of human labor attached to machinery utilization. For example, the utilization of power-tiller saved not only human labor but also draft animal by being used in the operation



Source: Survey Report of Cost of Rice Production, Ministry of Agriculture and Forestry.

Fig. 4. Changes in labor hours of rice growing per 0.1ha.

Table 4. Change in labor requirements for rice growing

(per 0.1 ha)

Year	Hand-labor	Animal-power	Mechanical power
	hrs.	hrs.	hrs.
1950	204.6	14.3	3.5
1556	183.3	11.8	5.3
1960	171.5	8.3	7.5
1963	146.0	3.3	11.7
1965	141.0	1.5	14.4
1967	125.0	0.7	17.6

Source: "Survey report of rice production cost" by Ministry of Agriculture and Forestry, Japan.

such as tilling, harrowing, puddling, transporting, etc.

There are, however, many other subsidiary operations which require considerable amount of human labor. In order to solve the serious shortage of labor in the busiest season, hired labors or mutual exchange of labor among the neighbors have been used so far but at present even those are becoming difficult. If farmers try to enlarge size of farm in arable land under the present level of technique, the part of operations mechanized can raise their efficiency. However, at the same time, the labor requirements of the progresses which have not been mechanized as yet would be increased with the expansion of size of farm. An unbalanced or uneven progress of farm mechani-

zation will be found more on large scale farms than on small scale farms. This means that expansion of size of farm is not only remedy for making higher the efficiency of farm mechanization. In order to enlarge the size of farm and to increase the use of machinery in an efficient way, the systematic development of mechanization will be required. The decrease in number of people engaging in agriculture has been so rapid that the change in farm operational pattern adaptable for the shortage of labor could not catch up with the rapid economic growth.