7. COUNTRY REPORT OF JAPAN

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"Japan is the abundant reed fields and a country of good rice crop", it was told so in our mythology. Although almost of these reed fields had been converted into paddy fields by cultivation during more than 2000 years, the whole acreage of the paddy fields distributed all over the country is barely equal to that of the island of Taiwan. The rice culture, however, has been advanced there to the extent that this small island country could produce sufficient rice for the population of more than 110 millions.

The present status of rice culture, field condition and water management for irrigation and drainage will be described hereunder, and the history and future prospect of the rice culture in the country will also be discussed.

1. Present status of rice culture and water management in Japan

(1) Area of paddy field, number of farm household and farm scale

The area of paddy field in Japan is 3.27 million ha which corresponds to 58% of arable land and less than 9% of the whole area of the country, this small percentage being due to the steep geographical features of the country.

The acreage of paddy field increased by 250 thousand ha during 70 years from 1880 to 1950, but it showed decreasing trend after 1970.

The population engaged in agriculture was 12 millions in 1965, but it decreased to 6.24 millions at present and its percentage for the total working population has now decreased to 12%. Consequently, saving of labor became necessary in recent years.

The average cultivated area per farm household is 0.82 ha in 1970. The percentage of the farmers whose cultivation area is less than one ha is 69.6%, therefore most of the farmers are petty. Although the percentage of large farmers whose cultivation area is more than two ha was only 6% at the time of the Farm Land Ownership Reformation in 1945, it is increasing recently with the reduction of the farm population.

(2) Rice balance of supply and demand and yield per unit area

The total production of rice has augmented yearly, that is, 8.95 million tons in 1950 and 14.45 million tons in 1967.

In 1972, the yield of rice per ha attained 4.56 tons on the average over the country. This amount is two times as much as that of 90 years ago and 1.5 times compared to that of 50 years ago. The average maximum yield per ha of every prefecture during last 20 years reached the seven ton mark, while the highest one attained 10 tons.

(3) Yield increase and water management

The increase of rice production in Japan has been mainly dependent upon the yield increase and upon the fact that the rice culture has become possible even in the region of higher latitude. As to the factors contributing yield increase, adequate water management (irrigation and drainage) and soil improvement are considered to be important nowadays, while breeding, fertilizer application, control of damage caused by diseases and insects were formerly regarded as the important technical factors.

Major aspects of field water management in Japan may briefly be described as follows. Deep flooding condition is kept only during the stages of rooting and booting, and midseason drainage or intermittent irrigation is conducted to control the outbreak

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of root rot and lodging and to maintain roots in good vitality for a long while. This is the present water management for stable high-yielding culture. The midseason drainage is a technique to dry the surface of paddy fields by draining away flooding water for seven to ten days after the maximum tiller number stage at the beginning and middle of July.

In a general way, continuous flood irrigation had formerly been managed from the transplanting stage until the draining stage of residual water one month after the heading time. This method was adopted for the sake of weeding and nutrients replenishment as well as water supply by flooding.

Although the districts with the stable yield of rice, originated from the tropics, had formerly been limited to the regions under N.36° because of climatic conditions, they are now extended up to N.44° (Hokkaido) owing to the breeding of cold weather-resistant varieties, improvement of techniques of seedling raising in protected rice-nursery and prevention of cold summer damage by deep flooding etc.

On the other hand, as a rare example in warm regions, plot to plot irrigation of cold water has been carried out to keep the paddy field at the optimum temperature of 25 to 30°C.

The direct sowing method has been devised as the more labor saving techniques than transplanting culture. Although this method is not yet so widely practiced because of unstable yield and imcomplete systematization of the techniques, the method offers an important problem for Japanese agriculture.

(4) Water management and farm land consolidation

The conditions to realize effective water management are security of water resources, perfection of irrigation and drainage facilities, proper size and shape of farm lot, appropriate degree of land leveling, good physical and chemical properties of soil and completion of agricultural roads. Many land improvement works have been carried out throughout the country. However, one half of the total paddy field acreage is still remaining to be improved to make the efficient water management possible. Therefore, improvements of physical conditions of lots by means of separation of irrigation and drainage system, underdrainage, subsoil improvement, soil drying through drainage of residual water are required to introduce new techniques such as enlargement of lot, full use of large power farm machinary, midseason drainage, intermittent irrigation and depth of flooding water adjusted properly to different growth stage.

Existence of ancient land reclamation work is inferable from the oldest remains of the paddy field cultivated 2000 years ago at Toro in Shizuoka prefecture (N.35°).

Since Japan is a country of mountainous topographical features and the farming scale is generally rather small, the standard area of one lot paddy field is 30a (100×30m), as shown in the attached figure. Irrigation ditches, drainage ditches and farmyard paths are situated along the shorter sides of lots, and a group of 10 to 20 odd lots make a farm block (a larger unit of the field).

As an extraordinary example, in Hachirogata Polder (which was reclaimed from the bottom of a lagoon, and labor-saving rice culture with large power farm machinery and many related studies has been conducted there for ten years), the area of a lot is as large as 1.25 ha, and a farm block consists of 24 lots.

Comparing the maximum yields of the last six years in every prefecture between well-drained and ill-drained paddy fields, the yield of well-drained paddy field was 1.4 times as much as the ill-drained one. The importance of drainage was thus proved.

Underdrains for reformation into well drained paddy fields are generally arranged at intervals of 10–20 m and at a depth of 1 m, being parallel to longer sides of lots, although it depends on soil texture. In the case of low permeability of soil, mole drains are additionally made so as to cross with the underdrains.

One of the advantages of the midseason drainage is to develop cracks in the surface soil, and these cracks become permeable path for water to make underdrainage more effective. The high permeability caused by the midseason drainage reduces injurious substances, such as H_2S and organic acids, accumulated in the soil and results in good development of roots. Excessive permeability, however, has an adverse effect such as leaching of fertilizer. Excessive permeability, therefore, is not good for the plants at the early stage of growth. This is the reason why the excessive permeability must be reduced by effective surface soil puddling (Shirokaki in Japanese).

(5) Habitual water use

Frequent in-field water management in recently developed cultivation system tends to increase water requirement, but sometimes it is quite difficult to obtain new water right because of causing confusion of vested water rights.

As to the habitual distribution of irrigation water, the water is distributed in regular sequence from the farms of the upper stream to those of the lower stream or in irregular sequence at the period of ordinary water discharge, but, at the period in droughty water discharge, water distribution has to be controlled by means of rotational irrigation (Bansui) or by a person in charge of regulation of water use. Bansui is a type of water management for systematic water distribtuion in right time with a sequence in order to prevent irrigation disputes among the farmers in the same compartments.

One peak of irrigation requirement is at the time of preparation of paddy field, the duty of water at this time being 100 to 200 mm, and another peak is at the stage of reflooding after the midseason drainage.

As the results of studies and experiences for many years, the optimum duty of water has been established in Japan, and its quantity is estimated to be about 15 to 25 mm per day, the security for supplementary water for intake being necessary.

Although not so much notice has been taken of water quality, water-intake in the polder by sea irrigation water causes a problem of water salinity. The problems of water pollution have also risen recently.

2. Prospect of water management

(1) Distress of water resources

Owing to rapid economic growth and change of living standard, the demand of urban water has greatly augmented. The total water demand reached 90 hundred million m^3 in 1970, and it is presumed to attain 1,160 hundred million m^3 in 1985, whereas the increase in the demand for agricultural water may be comparatively small.

As the present discharge of river is in the hands of the vested water rights, further water resources must be secured by means of pumping-up of ground water or storage by dams. Remaining dam sites, however, are not in favourable geological conditions, and pumping-up of ground water is also now strictly limited because of land subsidence.

Consequently, rationalization of agricultural water use, which is about 66% of present water consumption, is now required. The research on different water requirement and water volume for management in every growth stage is to be carried out and the prevention of water loss and the method of repeated use of agricultural water are to be established.

(2) Water pollution

The increased inflow of industrial and urban sewage into the river, lake and canal results in pollution of agricultural water. The damaged area augmented up to 190,000 ha in 1969 while it was 100,000 ha in 1958.

The figures of damage appear either as hindered growth of plants or as inappropriate materials for foods (such as cadmium contained in rice). The mechanism of damage

has been compounded of deteriorations of physical and chemical properties of soils, inactivation of soil microbes, injury by excessive nitrogen and evil effect of heavy metals.

Based on the present results of investigations, the Ministry of Agriculture and Forestry established, in 1970, the standard of agricultural water quality as an index of desirable water quality. Onthe other hand, the Environment Sanitation Agency established the effiuent standard based on the Law of Prevention of water Contamination. This latter standard, however, seems incomplete to realize, by itself, the standard of agricultural water quality. It is, therefore, desired to clarify the influence of pollutant on crop plants and the circulation mechanism of pollutant and, then, to establish pollution control technics (from the point of engineering) and countermeasure technics against injuries (from the point of variety, cultivation and water management).

(3) Labor-saving in rice culture

Working hours for rice culture has greatly been reduced recently by utilizing farm machinery, agricultural chemicals and saving labour of water management. Recent average of working hours in the country is 900 hr per one ha while it was 1,730 hr in 1960's.

As an effective labor-saving method, the direct sowing cultivation has been practiced on about 50,000 ha fields, and the working hours per ha have been reduced to 170 to 500 hr. It is expected in the future that the working hours per ha will be 230 to 240 hr by the small machinery system and around 120 hr by the large machinery system (40 PS).

Diffusion of utilization of the power tiller and tractor remains nearly on the same level and that of the reaper and combine is still gradually increasing. The use of rice-planter is rapidly spreading recently.

There are many caess in which the investment for these agricultural machinery becomes too excessive compared to the scale of agricultural management, putting pressure upon the latter. This is a problem to be solved.

Enlargement of lot, construction of farm road and increase of bearing capacity by improved drainage are necessary for the introduction of farm machinery.

In respect of farm land consolidation which is required due to such necessity, the change in duty of water, water management for mechanized farming and irrigation and and drainage system should be studied.

As to the direct sowing cultivation, there are many problems of water management as related to germination and seedling establishment, weeding, fertilizer effect and control of over-luxuriant growth. Studies must be advanced and techniques must be developed to solve these problems. Especially, drainage facilities must be completed as a prerequisite condition for the establishment of water management techniques.

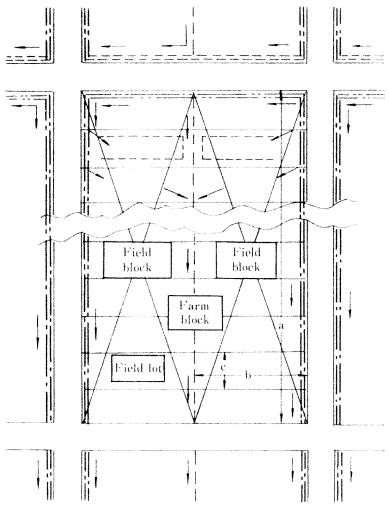
(4) Intensive utilization of paddy fiields

As to rice, self-sufficiency has been fully (100%) maintained owing to the decreased consumption caused by the changes of diet of people and the increased yield caused by improvements of farm land and production technology. But most of the major agricultural products such as wheat, soybean and feedstuff must be imported at present.

The cropping rate of paddy fields in winter has now sharply decreased to 8.7% while it was 34.4% in 1960. Although the main factor of this decline in percentage is low profitability of second crops, concurrence of cropping seasons, ill drainage of paddy fields and difficulty of mechanization are also other factors.

As a policy of agricultural administration, conversion of paddy fields into dry fields, rotational use of paddy fields and second cropping are planned to elevate the general self-sufficiency.

For the implementation of these measures, many problems in water management may come out, such as optimum soil moisture control for the growth of each crop



(A) TYPICAL EXAMPLE

Irrigation lateral

Irrigation ditch

Drainage lateral

Drainage ditch

Border

Branch farm road or path

UNDERDRAINAGE

Range of dimension:

a 300–600m

b 100–150m

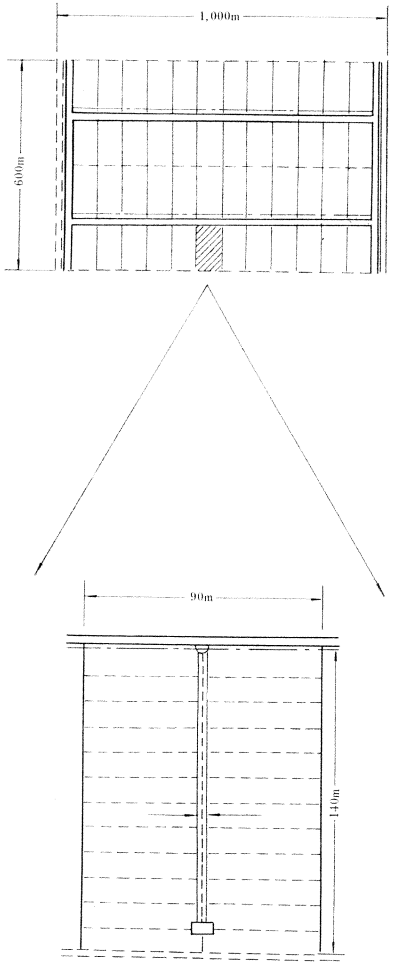
c 30–60m

Area range of blocks

Fi. I. 0.3–0.9ha

Fi. B 3–9ha

Fa. B 6–18ha



(B) HACHIRŌGATA POLDER

Fig. Definition and size of farm land blocks in paday field

plant, groundwater level and its controlling measures, drainage of surface water to prevent flooding, technical development to increase permeability of soils, measures controlling soil moisture for mechanized farming, countermeasures against the augmented water requirement caused by the increased permeability and water management systems combined for various crop plants.

(5) Distributing pipe for water management

The use of the pipe for irrigation is spreading because of the advantages of labor-saving in water management, conservation of water quality, prevention of water loss, easiness of mechanized farming and economical use of field areas.

The project area of piping is 20,000 ha in 1971 while it was 3,000 ha in 1969, extending to many regions year by year.

At present, however, many problems are still remained to be solved economically and technically with the irrigation piping, such as considerable expenses of construction, clogging with debris, lack of adaptability to the change of water requirement (especially, the water use is greatly restricted for the large water requirement concentrated at the time of the puddling and of reflooding after midseason drainage) and inequality in amount of water between the hydrants at the beginning and end of pipeline. A "Pipe-Network-Rotation" method is now practiced in many regions where the return flow of drained water is available.

As a study of underground irrigation, controlling methods of the ground water level and soil moisture by means of reutilization of water returned through the underdrain pipe to maintain bearing capacity for mechanized farming are now investigated. These methods, however, are yet unaccomplished for practical use.

Japan also has many problems for the future of the nation and its people. Confining the problems only to agriculture, land and water, there are so many difficulties as mentioned above. This is because not only too much knowledge, labor and material (i.e. expenses) are needed for rice culture but also too many social problems such as the system, side job, health, eduaction and pollution are closely related to rice culture.

Among the complicated and difficult socioeconomic problems around rice culture in Japan, one of our most important problems is to know what are the fundamental bases which enabled maintenance and development of rice culture through a long-period of our history and what is necessary or unnecessary to make them everlasting.

This may be the way to keep the proper features of Japan forever, "the abundant reed fields and a country of good rice crops", and to increase the friendship in good cooperation with other rice producing countries.

3. Question and Answer

Shiro Okabe, Japan: I understand that the Chao Phya Irrigated Agriculture Development Project has a fairly large size of the project area and has a considerable complexity of natural and socio-economic conditions. I would think the Project would require a fairly long period (presumably 15 or 20 years or more) to achieve its finally projected crop yield and production. Don't you think that it is necessary to divide the project implementation into a couple of phases; each of them should have its own target to be achieved, having a sequence of the development from lower target to higher one? Could you briefly give us your implementation program in this matter, if available?

Answer: I fully agree with your suggestions, the distinction between high yielding areas which the farmers obtained after Land Consolidation must concern cost recovery by means of the amount of money or term of repayment duration.

The IBRD team will come to discuss on this matters on September 1975 with the Ministry of Agriculture's Committees.

The results which I obtain, I will inform or delivery to you immediately.

Shiro Okabe, Japan: During the period of 1966–1969, common irrigators were paid by the Government to promote their O & M activities. As from 1970, however, this support has been changed and stopped in some projects. I understand the Thai farmers have never experienced to pay any amount of money for using irrigation water in growing rice. How are the reactions of the farmers to the charging at present, and how would they be in the near future?

Answer: When the Project have Water User Association, the common irrigators already phased out. In some project R.I.D. still have the common irrigators which depends on the technical know-how of Water Use Engineering or some of rehabilitation works are being done at present.

Now water charges for the farmers in Thailand at present.