IRRIGATION AND DRAINAGE IN JAPAN

3rd Edition

JAPANESE SOCIETY OF IRRIGATION, DRAINAGE AND RECLAMATION ENGINEERING

IRRIGATION AND DRAINAGE IN JAPAN

(3rd Edition)

By

International Affairs Commission of The Japanese Society of Irrigation, Drainage and Reclamation Engineering

Japanese Society of Irrigation, Drainage and Reclamation Engineering

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To Our Readers:

This book basically focuses on the spectrum of activities that JSIDRE members are involved in, and introduces the various "land improvement projects" in which these capable engineers participate, both in Japan and abroad. It also provides outlines of organizations that are closely related to irrigation and drainage projects, together with their functions, and background information, and is intended to provide quick and concise answers to your questions on these subjects.

In the third edition, the obsolete data of the second edition, such as statistics, and office addresses, etc., is replaced with current data. However, the statements and descriptions of the second edition are kept as they were.

M. Okamoto

Contents

Chapter 1

Land Improvement Project Systems and JSIDRE

1-1 Main characteristics of Japanese land improvement projects

In Japan, the Agricultural Structural Bureau, Ministry of Agriculture, Forestry and Fisheries is responsible for projects to cultivate virgin land, develop agricultural land, consolidate agricultural land plots or construct irrgation and drainage facilities, including reservoirs, barrages, pump stations, canals, etc. for improving agricultural productivity. They are now also active in constructing such infrastructures in rural areas as community roads, domestic water supply systems, sewerage systems, etc. Such projects are called "Tochi Kairyo Project Systems", "Nogyo Kiban Seibi Project Systems", or "Nogyo Doboku Project Systems". In English, they are "Land Improvement Project Systems", "Agricultural Infrastructure Improvement Systems", and "Agricultural Civil Engineering Project Systems", respectively. Japan is richly endowed with high temperature and rainfall, both of which are essential for growing paddy rice. As per-acre yield of paddy rice is higher than any other field-grown crop, Japanese land owners and farmers wished and still wish to have as large a paddy field as possible to grow rice. It has, therefore, been the most important task for Japanese land improvement engineers to develop irrigated, not rain-fed paddy fields.

To construct facilities necessary to develop irrigable paddy fields and irrigate them, engineers with knowledge of civil engineering have continued to be irreplaceable.

At colleges and high schools, students who wish, after graduation, to engage in such civil engineering-oriented works as mentioned above are educated through a course different from common civil engineering. These students are also taught subjects related to agriculture, in addition to civil engineering subjects. Also, college teachers conduct studies and research necessary for land improvement projects. Such studies and research are also conducted at agricultural experimental stations of the Ministry of Agriculture, Forestry and Fisheries.

Some of the students graduating from a land improvement course at college will join the Ministry of Agriculture, Forestry and Fisheries, or a prefectural organization to engage in land improvement projects. In Japan, unlike some other countries, students graduating from a civil engineering course at college, do not join, as a rule, the department responsible for land improvement projects of the Ministry of Agriculture, Forestry and Fisheries or prefectural offices to engage in land improvement projects. Given these special circumstances, a group consisting of engineers (public officials and employees of related private companies) who have knowledge of civil engineering related to irrigation and who are engaged in land improvement projects for the Ministry of Agriculture, Forestry and Fisheries or prefecture, and college teachers, whose studies are directly or indirectly related to such projects and who teach land improvement engineering subjects, was formed.

Many of the above are the members of the Japanese Society of Irrigation, Drainage and Reclamation Engineering (JSIDRE).

1-2 Japanese Society of Irrigation, Drainage and Reclamation Engineering

1-2-1 Establishment, organization and finance

The Japanese Society of Irrigation, Drainage and Reclamation Engineering was established in 1929 and was approved as a corporated body in

1970. The Society originated from the Japanese Society of Land Consolidation which was established in 1907, and still has headquarters in Tokyo. There are six branch offices.

Its 1989 membership consisted of 12,393 regular members (educational institutions 583, government agencies 1607, prefectural agencies 6875 consultants and others 2721), 228 student members and 379 supporting members.

The expenses of the Society are fully covered by membership fees (1989 annual membership fee for a regular member: 7,200 yen), funds made available to the Society to conduct studies, and revenues from publishing activities. Supporting members are private companies and others who cooperate in the activities of the Society, and each pays a membership fee of 70,000～130,000 yen a year.

A monthly journal is distributed at no cost to all members, and members may participate in activities of the Society at a special discount cost.

1-2-2 Activities

(1) Publishing of three journals

A monthly journal (in Japanese), bimonthly reviews of research papers (in either Japanese or English), an English journal to be published twice a year.

(2) Publication of books, materials and manuals on land improvement engineering.

(3) National and branch conferences, lectures and workshops.

(4) Award honors for excellent research and projects.

(5) Conduct studies commissioned by the Ministry of Agriculture, Forestry and Fisheries or other agencies.

(6) Academic exchange with foreign countries.

In addition to the above, the Society collects and keeps materials and

books as reference sources for the members.

There are annual, national and branch conferences, where research papers are given. At the national conference in 1988, about 262 papers were presented, and a total of 267 papers were presented at branch conferences. These papers cover broad areas, ranging from basic research in land improvement engineering to applied studies directly related to specific projects.

Table 1 Study groups in the JSIDRE

Study groups	Members	Adress
Applied Hydraulics in Agricultural Engineering	174	Department of Rural Engineering, College of Agriculture, Ehime University, Tarumi, Matsuyama, 790
Soil Physics	208	Department of Agricultural Engineering, Faculty of Agriculture, Iwate University, Ueda, Morioka, 020
Irrigation for non-paddy crops	450	Department of Agricultural Engineering, Faculty of Agriculture, Kyushu University, Hakozaki, Higashi-ku, Fukuoka, 812-81
Materials & Construction	500	Department of Regional Environmental Science, Faculty of Agriculture, Osaka Prefectural University, Sakai, Osaka, 591
Rural Planning	509	Laboratory of Rural Planning, The National Institute of Agricultural Engineering, 2-1-2, Kannondai, Tsukuba, Ibaraki, 305
Irrigation	1,590	c/o Prof. S. Sato, Tokyo University of Agriculture, 1-1-1, Sakuragaoka, Setagaya-ku, Tokyo, 156
Soil and Water Conservation	340	Department of Environmental Technology, Faculty of Agriculture, Kochi University, Monobe, Nankoku, 783
Applied Hydrology	173	Department of Environmental Management Engineering, Faculty of Environmental Science and Technology, Okayama University, Tsushima-Naka, Okayama, 700
Bioholonics	68	Arid Land Research Center, Tottori University, Hamasaka 1390, Tottori, 680
Rural and Farm Road	135	Japanese Institute of Irrigation and Drainage, NN bld. 1-21-17, Toranomon, Minato-ku, Tokyo, 105

Lectures and workshops, which are extension services of the Society are held more than 20 times a year, all over the country.

The Japanese Society of Irrigation, Drainage and Reclamation Engineering covers a number of fields. In order to deepen studies and research in individual fields, members and experts in a specific field come together to form a study group to intensity and consolidate research and feedback.

These study groups are shown in Table 1.

Chapter 2

Background

2-1 Geography

2-1-1 Location and land area of Japan

Location: Japan is located in the temperate zone which is at the east end of the Asia monsoon zone, and spreads from northeast to southwest. It consists of the relatively large islands of Hokkaido, Honshu, Shikoku, Kyushu and a large number of other small islands.

Land area: Total and four main islands:

Total	378,000 km²
Hokkaido	83,500
Honshu	229,000
Shikoku	19,000
Kyushu	42,000

Land area by land classification:

Agricultural land	5,470,000 ha
Forest	25,290,000
Wilds	290,000
Water surface	1,310,000
Roads	1,090,000
Housing land*	1,530,000
Others	2,800,000
Total	37,780,000

As shown above, Japan is mostly covered with mountains, and is richly endowed with forest. Housing land*, which is land for not only

residences but also shops, offices and factories, accounts for only 4% and factory land for only 0.4% of the total housing land.

2-1-2 Temperature and precipitation

The last 30 (1951~1980) year average monthly temperature and precipitation for seven cities (Sapporo, Sendai, Tokyo, Kanazawa, Nagoya, Okayama and Fukuoka) where regional offices of the Ministry of Agriculture, Forestry and Fisheries are located, are shown in Table 2 and 3.

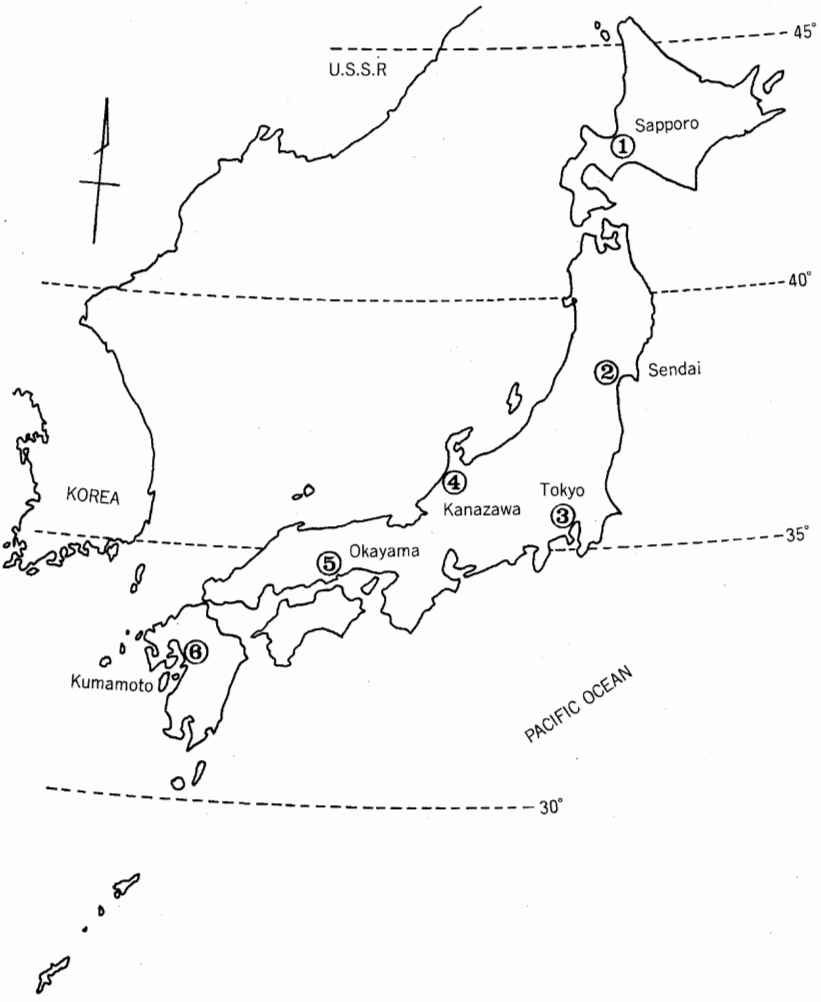

Figure 1 Japan.

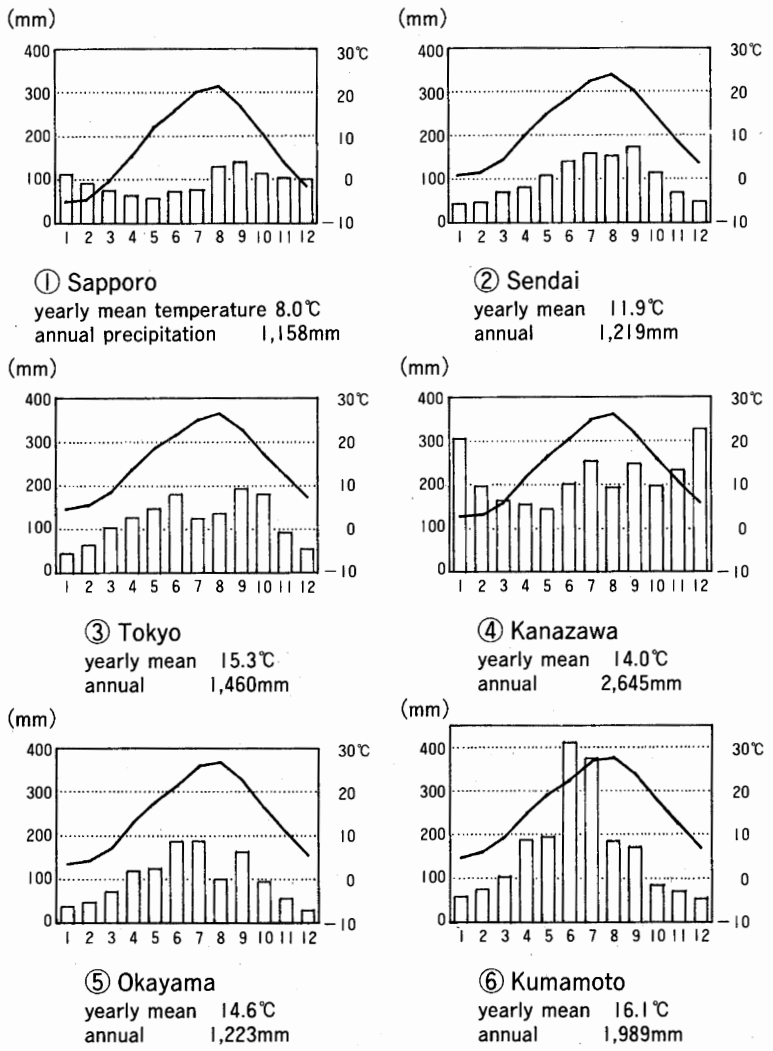

Figure 2 Temperature and precipittation (rainfall and snow).

2-1-3 Land improvement projects characterized by climatical conditions

The Japanese rainy season, called "Baiu" or "Tsuyu", is generally June and July, though somewhat differnt depending on the region. After the rainy season, there also is heavy rain in most years when a typhoon comes.

Fortunately, the hot summer (June through August) and the rainy

Table 2 Regional offices of the Ministry of Agriculture, Forestry and Fisheries

Office	Adress
Hokkaido Development Bureau:	Kita 8 Jyo, Nishi 2-1-1, Kita-ku, Sapporo, 060
Tohoku Regional Agricultural Administration Office:	3-3-1, Hon Cho, Aoba-ku, Sendai, 980
Kanto Regional Agricultural Administration Office:	No. 3 Godo Tyosha BLDG, 1-3-3, Otemachi, Chiyoda-ku, Tokyo, 100
Hokuriku Regional Agricultural Administration Office:	2-2-60, Hirosaka, Kanazawa, 921
Tokai Regional Agricultural Administration Office:	1-2-2, Sanno Maru, Naka-ku, Nagoya, 460
Kinki Regional Agricultural Administration Office:	Shimochojya machi Sagaru, Nishitoin Dori, Kamikyo-ku, Kyoto, 602
Chu-Shikoku Regional Agricultural Administration Office:	1-4-1, Shimoishii, Okayama, 700
Kyushu Regional Agricultural Administration Office:	1-2, Nino Maru, Kumamoto, 860
Okinawa General Office:	2-21-7, Maejima, Naha, 900

Table 3(1) Temperature (average: 1961～1990) (℃)

City	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Sapporo	−4.6	−4.0	−0.1	6.4	12.0	16.1	20.2	21.7	17.2	10.8	4.3	−1.4	8.2
Sendai	1.0	1.3	4.2	10.0	14.9	18.3	22.0	24.1	20.1	14.4	8.9	4.0	11.9
Tokyo	5.2	5.6	8.5	14.1	18.6	21.7	25.2	27.1	23.2	17.6	12.6	7.9	15.6
Kanazawa	2.9	2.9	6.0	12.1	17.0	20.8	25.2	26.6	22.1	16.1	10.8	6.0	14.1
Nagoya	3.7	4.3	7.6	13.8	18.4	22.0	25.8	27.1	23.1	17.0	11.5	6.2	15.1
Kyoto	4.0	4.5	7.6	13.9	18.7	22.4	26.5	27.7	23.4	17.1	11.5	6.5	15.3
Okayama	4.6	5.0	8.2	14.4	18.9	23.1	26.9	28.4	24.2	17.3	12.0	6.8	15.8
Kumamoto	4.9	6.1	9.6	15.4	19.5	22.9	26.9	27.6	24.0	18.1	12.3	7.0	16.2
Naha	16.0	16.3	18.1	21.1	23.8	26.2	28.3	28.1	27.2	24.5	21.4	18.0	22.4

Table 3(2) Precipitation (rainfall and snow) (average: 1961～1990) (mm)

City	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Sapporo	107	94	81	62	54	66	68	142	137	115	98	100	1129
Sendai	41	48	68	93	108	133	150	164	186	103	69	35	1204
Tokyo	45	60	99	125	138	185	126	147	179	164	89	45	1405
Kanazawa	293	195	156	147	150	207	250	171	247	202	265	305	2592
Nagoya	42	63	110	150	157	217	212	145	211	114	70	40	1534
Kyoto	50	65	110	151	153	247	234	142	202	112	69	39	1581
Okayama	30	59	95	93	137	213	134	73	185	75	40	18	1159
Kumamoto	59	78	121	159	202	392	392	189	157	89	73	49	1967
Naha	113	106	162	152	243	252	190	258	168	150	116	123	2036

season come together. Thus, it is possible to grow paddy rice each summer, once a year. In winter, however, temperatures are too low to grow paddy rice.

Judging from the figures of average rainfall, it may appear that there is no need for Japan to irrigate fields as it has suficient rainfall in the summer/rainy season. It is not the case, however. From early times, people in Japan have been very active in irrigation. In some years, the total rainfall does not reach the average and causes some deficit in irrigation water requirement. In those cases, irrigation is required. Also, even if rainfall is sufficient in terms of total monthly or irrigation season rainfall, irrigation may be desired if a dry spell occurs during that period and there is no rainfall when it is needed.

2-1-4 Population, and its density and regional distribution

The 1993 Japanese total populatioin amounted to 125 million. Its population density is 334 persons per square kilometer. In view of that, Japan is mostly covered with mountains and has a limited inhabitable land area; this population density is said to be high in world comparison.

The population is not evenly distributed in Japan, and is instead concentrated in such big cities as Tokyo (11.8 million), Osaka Prefecture (8.7 million), Aichi Prefecture, which has Nagoya (6.8 million), and Kyoto Prefecture (2.6 million), and industrialized regions. In the coastal zone extending from Metropolitan Tokyo to the northern part of Kyushu island, about 70% of the population is concentrated.

Overpopulation in urban regions on one hand and underpopupulation in rural areas on the other, resulting from the concentration of population, is one of the most important problems in recent years which needs to be solved. The total population of the cities with more than 100,000 people was 65.0% in 1990.

The 1993 farmers' households are shown in Table 4.

Table 4 Farmers' households (thousands)

Prefecture	Total households (1990)	Farmers' households (1993)			
		Total	Full-time	Part-time	
				Class 1	Class 2
Hokkaido	2,015	79	37	30	12
Aomori	453	72	12	21	39
Iwate	426	88	9	14	65
Miyagi	692	82	6	13	64
Akita	358	82	7	15	60
Yamagata	341	67	5	18	45
Fukushima	604	106	9	16	81
Ibaraki	830	122	17	16	89
Tochigi	571	76	9	11	56
Gunma	600	62	12	13	37
Saitama	2,028	75	9	12	55
Chiba	1,797	96	15	18	64
Tokyo	4,694	12	1	2	10
Kanagawa	2,818	24	2	5	16
Niigata	705	114	7	15	92
Toyama	312	49	2	3	44
Ishikawa	359	37	3	2	32
Fukui	233	37	2	2	33
Yamanashi	262	32	7	8	17
Nagano	655	112	17	13	82
Gifu	601	65	4	3	57
Shizuoka	1,115	70	11	17	43
Aichi	2,161	79	10	10	60
Mie	545	60	5	3	52
Shiga	351	46	2	2	43
Kyoto	894	34	4	4	27
Osaka	3,040	19	2	2	15
Hyogo	1,775	93	10	6	77
Nara	411	25	3	3	19
Wakayama	344	33	10	5	18
Tottori	179	34	4	5	25
Shimane	235	44	5	3	36
Okayama	608	76	11	5	60
Hiroshima	974	65	13	4	48
Yamaguchi	535	49	10	4	35
Tokushima	258	35	8	6	22
Kagawa	321	42	5	5	32
Ehime	511	56	13	9	34
Kochi	289	30	10	7	14
Fukuoka	1,624	79	15	10	54
Saga	250	40	6	8	26
Nagasaki	502	41	9	9	23
Kumamoto	575	76	22	19	35
Oita	409	53	12	7	34
Miyazaki	391	51	16	11	24
Kagoshima	657	83	31	13	39
Okinawa	363	28	10	4	14
Total	40,670	2,835	447	429	1,958

2-1-5 National economy and agriculture

(1) GNP

The 1992 GNP of Japan presented by producers' price was 420,809 billion yen.

Industrial distribution of GNP is as follows:

Agriculture, forestry and fisheries:	10,199 billion yen.
Manufacturing:	129,507
Construction:	46,959
Wholesale and retail:	59,272
Transportation and Communication:	29,042
Services:	75,586
Governmental services:	35,678

(2) Agricultural products

1992 agricultural products in Japan were as follows:

Total of all production:	11,215 billion yen	(100%)
Rice:	3,323	(30%)
Vegetable	2,404	(21%)
Hens and chickens	754	(7%)
Raw milk	797	(7%)

(3) Foreign trade

Japan is poor in natural resources, but is a highly industrialized nation. The country imports enormous amounts of raw materials, processes them into industrial products, and exports part of them. Thus, Japan is actively engaged in foreign trade. Japan also imports large amounts of such food as wheat, feed, fish, etc.

The major export items of 1993 were, in the order of monetary amounts, such transportation equipment as Passenger cars (5,250 billion

yen) general machinery (9,226 billion yen), electric machinery (7,560 billion yen), Iron and Steel (1,613 billion yen). Total exports during the year amounted to 40,202 billion yen.

The major import items in industry sectors during the same year were, also in the order of monetary amounts: oil (3,139 billion yen), machinery (3,412 billion yen), chemical industry products (1,942 billion yen), textile products (1,833 billion yen), natural gas (1,089 billion yen), metal materials (778 billion yen) and textile materials (171 billion yen). Total imports amounted to 26,826 billion yen.

(4) Import of agricultural products and self-sufficiency rate

Rice is the only crop that Japan can self-sufficiently produce. It imports other cereals, feed and others in large amounts each year as represented by the 1993 figures below:

materials	×1,000 tons	×1,000 million yen
wheat	5,814	126.7
maize(feed)	11,988	167.1
fruits and vegetables		568
coffee and cocoa	403	82.9
meat	1,666	757.6
raw cotton	528	76.2
wool	133	55.0
fish and shellfish	2,711	1,551.3
timber		1,130.8

Imported food, fish and timber shares about 28% of total import on a monetary basis

As a result of imports of large amounts of agricultural products, its self-sufficiency rate (the proportion of domestic production to cover domestic consumption) has declined to 12% for wheat, and 4% for soybean in

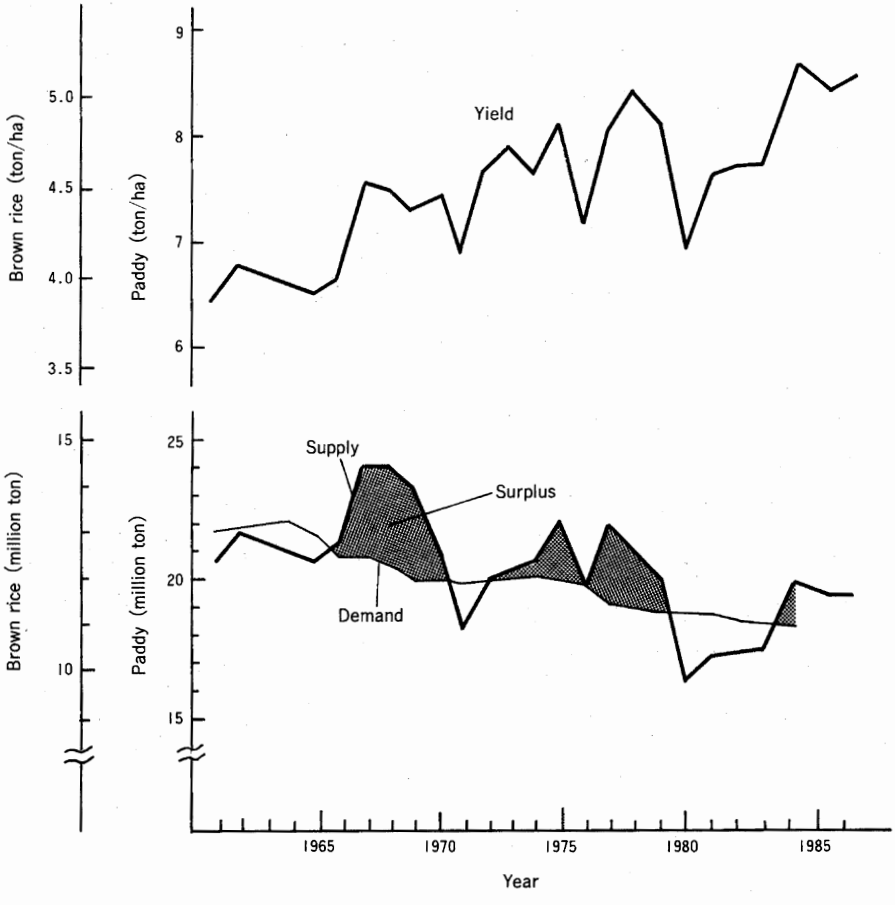

Figure 3 Cultivated land.

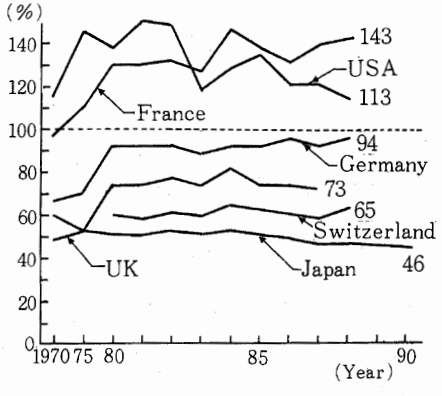

Figure 4 Trend of Self-sufficiency ratio in calorie-supply base
(Source: Food consumption statistics, OECD)

1992.

Japan has become the biggest country in the imports of agricultural products and its calorie self-sufficiency has declined from 79% in 1960 to 46% in 1990.

These figures are small even compared with other industrialized countries as shown below, and the government hopes to improve it. In 1993, the calorie basis self-sufficiency (%) in industrialized countries were:

U.S.A. 113, France 143, West Germany 94, United Kingdom 73, Japan 37.

2-1-6 Farmers and farming land

(1) Number of farmers and farming households

Statistics for the number of farmers and farming households for 1965, after the country was more or less stabilized after the disorder of the Second World War, and that for 1993 are compared below:

	Total population (×1,000)	Farmers' family (×1,000)	(%)	Total households (×1,000)	Farming households (×1,000)	%
1965	98,275	30,083	30.6	24,082	5,665	23.5
1993	124,764	13,107	10.5	43,077	2,834	6.6

As shown above, farmers and farming households have dramatically decreased in this country, as in other industrialized countries.

These farmers and farming households may be classified into full-time farming households and part-time farming households from the standpoint of degree of dependency on farming.

Here, full-time farmers refer to those farmers fully engaged in farming, Class 1 part-time famers to those farmers who have some other job in

addition to farming and who earn more money from farming, and Class 2 part-time farmers to those farmers who have some other job in addition to farming and who earn more from that job.

	Total farming households (×1,000)	Full-time farming households (×1,000)	Part-time farming households (×1,000)	(Class 1) (×1,000)	(Class 2) (×1,000)
1960	6,057	2,078	3,979	2,036	1,942
1993	4,403	447	2,388	429	1,959

As shown above, most of today's farmers are part-time farmers, and moreover are Class 2 part-time farmers who earn more money from work other than farming.

(2) Agricultural land

According to the classification made by the Ministry of Agriculture, Forestry and Fisheries, agricultural land area by type is as below:

Paddy field	2,781 (×1,000 ha)	(1993)
The other field	2,342	
Ordinary field	1,243	
Orchard land	439	
Pasture	661	
Total	5,125	

(3) Average agricultural land holding size

Excluding Hokkaido, the average Japanese farming household holds farm land of about 1 hectare. Generally, the farm size gets smaller as you move from the northeast region to the southwest region.

Table 5 Agricultural land (1993)

Prefecture	Total geographical area (km^2)	Agricultural land (ha)					
		Total	Paddy	Non-paddy			
				total	ordinary	orchard	pasture
Hokkaido	83,520	1,206,000	240,600	965,350	422,900	3,950	538,500
Aomori	9,247	168,100	90,500	77,600	32,500	26,900	18,200
Iwate	15,277	171,600	101.000	70,580	31,500	6,880	32,200
Miyagi	7,292	147,600	118,000	29,660	19,000	3,310	7,350
Akita	11,435	158,900	134,800	24,110	13,800	4,220	6,090
Yamagata	9,327	135,000	104,800	30,220	12,700	13,300	4,220
Fukushima	13,784	176,400	114,800	61,600	36,500	18,400	6.700
Ibaraki	6,094	193,000	109,200	83,770	72,000	10,600	1,170
Tochigi	6,414	138,500	107,900	30,690	23,300	4,410	2,980
Gunma	6,356	90,600	33,400	57,230	40,300	14,600	2,330
Saitama	3,799	94,300	55,700	38,568	30,500	7,910	158
Chiba	5,150	145,200	85,900	59,348	53,900	4,500	948
Tokyo	2,164	10,500	577	9,896	7,650	2,040	206
Kanagawa	2,402	25,500	5,390	20,182	14,700	5,410	72
Niigata	12,112	189,900	167,300	22,580	17,400	3,600	1,580
Toyama	4,252	65,800	63,100	2,739	1,690	763	286
Ishikawa	4,197	49,900	41,600	8,298	5,400	1,960	938
Fukui	4,192	45,300	41,200	4,071	2,990	774	307
Yamanashi	4,254	30,500	10,100	20,450	4,520	14,800	1,130
Nagano	13,133	131,000	67,500	63,530	36,900	22,000	4,630
Gifu	10,596	65,700	49,700	15,940	8,550	5,900	1,490
Shizuoka	7,235	85,800	29,300	56,380	18,000	36,600	1,780
Aichi	5,138	89,400	52,600	36,690	29,200	6,880	610
Mie	5,778	70,400	53,900	16,446	8,540	7,790	116
Shiga	4,016	58,900	54,000	4,923	3,310	1,500	113
Kyoto	4,613	35,600	28,200	7,391	3,740	3,580	71
Osaka	1,869	17,500	12,600	4,905	1,220	3,680	5
Hyogo	8,381	86,900	78,400	8,509	5,340	2,630	539
Nara	3,692	26,600	19,100	7,490	2,910	4,560	20
Wakayama	4,725	40,100	13,900	26,153	2,590	23,500	63
Tottori	3,494	40,700	26,700	14,000	8,660	4,200	1,140
Shimane	6,628	46,500	36,100	10,325	6,610	2,760	955
Okayama	7,091	83,100	63,500	19,620	13,000	5,120	1,500
Hiroshima	8,467	71,700	51,100	20,630	9.870	9,200	1,560
Yamaguchi	6,106	59,700	47,800	11,907	5,420	5,920	567
Tokushima	4,145	37,300	22,900	14,450	6,400	7,770	280
Kagawa	1,882	38,400	29,900	8,428	2,860	5,520	48
Ehime	5,672	69,700	28,700	40,996	6,780	34,000	216
Kochi	7,107	35,100	26,200	8,823	3,740	4,830	253
Fukuoka	4,963	102,700	78,100	24,523	9,210	14,900	413
Saga	2,440	64,400	47,100	17,274	5,620	11,540	114
Nagasaki	4,112	59,800	27,100	32,685	22,100	10,400	185
Kumamoto	7,216	136,100	79,000	57,080	26,800	22,700	7,580
Oita	6,338	69,400	46,100	23,350	11,000	9,320	3,030
Miyazaki	7,198	74,700	40,000	34,720	27,100	6,290	1,330
Kagoshima	9,167	138,000	45,100	92,850	75,200	14,900	2,750
Okinawa	2,255	46,700	944	45,730	38,900	2,740	4,090
Total	377,835	5,124,500	2,781,411	2,342,690	1,242,820	439,057	660,813

(4) Population, number of farming households, and agricultural land by prefecture

As stated above, the average farm size is about only 1 hectare in Japan, owing to a thorough agricultural land reform which was implemented during the occupation of Japan after the Second World War.

Under the Agricultural Land Reform, carried out from 1945 to 1947, any farmer was prohibited to own more than 5 hectares in Hokkaido and 3 hectares in other regions, to break up the land-owner system. Any farming land exceeding the limit was purchased by the government, and sold at low prices to tenant peasants who had been actually cultivating it.

The subsequent drastic inflation meant that the tenant peasants acquired the land almost at no cost. In this way, all the Japanese farmers became land-owner farmers of small farm size after the Second World War.

During the pre-war period of the land-owner system, no land improvement project was implemented as it was meant to be for the interest of land owners. In other words, no attention was paid to improve the labor productivity of tenant peasants, and only projects to improve land productivity were carried out to increase the income of land owners from farm rent.

As a result of the Agricultural Land Reform, however, it has become possible to implement land improvement projects to improve labor productivity as well as land productivity, since all farmers have become land holding farmers.

(5) Irrigation rate

Paddy fields are almost 100% irrigated. There are few rain-fed paddy fields in Japan. Contrarily, the irrigation rate for non-paddy fields has just exceeded 10%, only recently.

Chapter 3

Administration and Finance

3-1 National system

Japanese government follows the three power system of legislation, administration and judicature, each of which is independent from the other.

The judiciary branch consists of the Supreme Court, high courts, district courts, family courts and summary courts.

The legislative powers are vested in the Diet which is the sole law-making body and consists of the House of Representatives and the House of Councilors. Both representatives and councilors are elected by the people.

Administrative powers are vested in the hand of the Cabinet, which has eleven ministers: (1) Justice, (2) Foreign Affairs, (3) Finance, (4) Education, Science and Culture, (5) Health and Welfare, (6) Agriculture, Forestry and Fisheries, (7) International Trade and Industry, (8) Transport, (9) Posts and Telecommuniations, (10) Labor, (11) Construction, and the Agency for Home Affairs.

Japan is divided into 47 prefectures and further into about 3,000 cities, towns and villages.

Each prefecture, city, town and village has its own assembly and head. Both head and assembly members are elected by the residents.

3-2 Ministry of Agriculture, Forestry and Fisheries and the Agricultural Structure Improvement Bureau

(1) Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries consists of five bureaus, three agencies and numerous sections, as listed in Table 6.

Land improvement projects are administered and managed by the Agricultural Structure Improvement Bureau.

Table 6 Organizational Structure of the Ministry of Agriculture, Forestry and Fisheries

- Ministry of Agriculture, Forestry and Fisheries
  - Minister's Secretariat
  - Economic Affairs Bureau
  - Agricultural Structure Improvement Bureau
  - Agricultural Production Bureau
  - Livestock Industry Bureau
  - Food and Marketing Bureau
  - Food Agency
  - Forest Agency
  - Fisheries Agency

(2) Agricultural Structure Improvement Bureau

The Agricultural Structure Improvement Bureau is organized as shown in Table 7. Titles of individual departments and sections are also described there.

Table 7 Organizational Structure of the Agricultural Structure Improvement Bureau

- Agricultural Structure Improvement Bureau
  - Agriculture Administraition Department
  - Planning Department
    - Regional Planning Division
      - Planning and Coordination Office
      - Rural Development Policy Planning Office
    - Resources Division
    - Project Planning Division
  - Construction Department
    - Design Division
      - Construction Planning and Coordination Office
      - Overseas Cooperation
    - Irrigation & Drainage Division
    - Land Improvement & Consolidation Division
      - Land Improvement & Consolidation Project Promotion Office
    - Land Development Division
    - Disaster Prevention Division

(3) National Office and Regional Offices of the Ministry

There are 6 offices of the Ministry of Agriculture, Forestry and

Fisheries for the efficient administration of the policies of the Ministry in respective regions. Each regional office has departments and sections roughly similar to those of the Ministry located at Kasumigaseki in Tokyo, to carry out respective works in each region.

The Hokkaido region has no regional office of the Ministry, but has a integrated organization similar to the national government to administer affairs of not only the Ministery of Agriculture, Forestry and Fisheries, but also such other ministries as the Ministry of Construction. Within it, there are deparatments and sections to carry out works assigned to the Agricultural Structure Improvement Bureau.

Within the region covered by each regional office, there are ten to thirty five national offices (total 133) to conduct government-operated land improvemenat projects. Such national offices are closed when the construction project is completed.

3-3 Related administrative organizations

(1) Prefecture

Each prefecture also has departments and sections in charge of land improvement projects. Generally, there are two to three departments in charge of land improvement projects in a prefectural office. Land improvement engineers implement land improvement projects in their prefectural area, with the advice and guidance of the Agricultural Structure Improvement Bureau and related departments and sections of the respective regional office of the Ministry of Agriculture, Forestry and Fisheries.

Prefectures with peculiar agricultural products have special departments such as Department of Apples, Department of Oranges, etc.

(2) Sharing of projects with other ministries, agencies, public corporations, etc.

Land improvement projects are one type of public services. To be more specific, it is one of the civil engineering services. What organization

of government carries out what public service depends on individual countries. In Japan, public services are shared, for example, flood control and highway projects are executed by the Ministry of Construction, harbor projects by the Ministry of Transport, municipal water supply projects are conducted by cities under the supervision of the Ministry of Health and Welfare.

(3) Public corporations

Public corporations are extra-government organizations. In addition to those mentioned below, there are a number of public corporations, including the Japan Highway Public Corporation, to perform public services. Of those public corporations, a large number of land improvemnet engineers work for the following two public corporations:

1. Agricultural Land Development Public Corporation

The Corporation cultivates forests and wildernesses to develop new agricultural land. It has its headquarters in Tokyo, and about 3 branch offices and 20 project offices are distributed all over the country. The Corporation has 586 employees, and its projects amounted to 32.8 billion yen in 1987. In terms of reclaimed land, it reclaimed 2,100 ha of pasture land each year. Since 1982, it has been qualified to carry out services abroad, too.

2. Water Resouces Development Public Corporation

The Corporation is responsible for construction, operation and maintenanace of reservoirs, barrages and canals on the six major river basins, specially designated by law. As the services provided by the Corporation are comprehensive, the land improvement engineers on leave from the Ministry of Agriculture, Forestry and Fisheries and the civil engineers on leave from the Ministry of Construction are working together. There are also engineers directly employed by the Corporation. It has its headquarters in Tokyo, 4 regional branch offices and 54 offices for operation/maintenance and construction of water resources facilities. It has about

2,000 employees, of which 60% are engineers, and its annual construction services amounted to 149.2 billion yen in 1988, and operataion/maintenance services to 15.7 billion yen, on the average from 1980 through 1986.

3-4 Finance

(1) Government

The government budget of 1994 was as below:

total: 40,854.8 billion yen

Ministry of Agriculture, Forestry and Fisheries 3,418.8 billion yen

Agricultural infrastructure development 1,168.3 billion yen

references:

River projects: 1,193.5 billion yen

Sewerage projects: 1,050.4 billion yen

Road projects: 2,494.7 billion yen

Harbor projects: 353.2 billion yen

(2) Land improvement project budget

The Agricultural Structure Improvement Bureau spent 1,168.3 billion yen on various land improvement projects, and the contents of projects by type will be described later. As mentioned above, the portion of the budget that the Agricultural Structure Improvement Bureau spent on land improvement projects accounts for 34% of the total budget of the Ministry of Agriculture, Forestry and Fisheries and 13% of the total budget of all public survices.

(3) Investment on each menu for land improvement projects

The costs of land improvement projects are paid from subsidies by the national government and prefectures, and by direct payment of farmers, who are the beneficiaries.

The total investment in projects in 1994, including not only funds

provided by the government and prefectures but also those paid by farmers is as below:

total: 2,024.4 billion yen

irrigation and drainage projects: 394.0 billion yen

land consolidation projects: 250.2 billion yen

farm and rural roads projects: 286.5 billion yen

non-paddy agricultural land development projects: 104.7 billion yen

rural infrastructure development projects: 423.3 billion yen

Chapter 4

Land Improvement Projects

4-1 Land Improvement Law

(1) Outline of Land Improvement Law

In Japan, land improvement projects are carried out under a law called the Land Improvement Law. This law was initially enacted and enforced in 1949 to combine and improve two pre-war laws: the Land Consolidation Law and the Irrigation Association Law:, and has gone through several revisions in response to social changes.

This law states the objectives and goals of land improvement projects, the way to implement projects, and the organization and management of Land Improvement Districts (farmers associations to operate and maintain facilities which are to be formed upon completion of construction works).

(2) Purposes and benefits of land improvement projects

As for the purposes of land improvement projects, the Land Improvement Law states, "land improvement projects aim through the development of agricultural infrastructures (agricultural land and accompanying social infrastructures), to (1) increase land and labor productivity, (2) increase total agricultural production, and (3) improve the agricultural structure by means of diversification".

In the article for the Long-Term Plan for land improvement projects in the Land Improvement Law to be described later an expansion of farm size (or agriculture business scale) is added to the three items mentioned above for the improvement of agricultural structure. As a result of these projects, it is expected that the improvement of agricultural structure will

be realized, the country will be richer, village economies will be revitalized and the natural environment will be better preserved.

4-2 Menu of land improvement projects

The Agricultural Structure Improvement Bureau provides various projects as land improvement projects. Today, projects cover a wider variety than imagined from the word "land improvement project". When the law was enacted, projects coverd only reclamation, irrigation, drainage and land consolidation, which were thought to directly contribute to the expansion of agricultural land and to the improvement of both land and labor productivity and safety to natural disaster. Subsequently with change in social conditions, projects were requested to cover development of infrastructures for daily life of people living in farm villages, including local roads, ditches, sewage, parks, meeting houses, etc, in addition to the development of facilities for agriculture.

Today, the Bureau provides the following projects:

1 irrigation and drainage
2 agricultural land consolidation
3 farm and rural roads
4 comprehensive development of non-paddy agricultural land
5 comprehensive development of rural areas
6 disaster protection
7 reclamation of agricultural land
8 reclamation from sea or lake bottom

4-3 Long-term plan

The Ministry of Agriculture, Forestry and Fisheries enforced the Fundamentals of Agriculture Law in 1961. The law aims to promote diversification and expansion of farm size or the scale of an agricultural operation in it. In accordance with the Law, the "Prospect of Long-Term

Demand for and Supply of Agricultural Products" was prepared. The government policies related to land improvement projects have been made along the line of this Prospect.

As land improvement projects need a considerable amount of funds and a long pregnant period for the completion of planning, design and construction, the government must make decisions on the priority of individual land improvement projects on the basis of long-term prospects of agriculture.

In response to the long-term prospect of supply and demand as mentioned above, the Land Improvement Law was revised in 1964, and long-term plans started to be made for land improvement projects. These long-term plans are made by the Ministry of Agriculture, Forestry and Fisheries, to be approved by the Cabinet.

These long term plans describe the goals of the land improvement projects, the area of agricultural land to be covered by the projects on the basis of the long-term plan, the necessary amount of investment for individual land improvement projects within a certain period as established in the long term plan. The long-term plan which established the goals of projects during the specific ten years started in 1965. Today, it is in the third phase. The total investment is 30,400 billion yen, and the proportion of achievement to the goal in 1988 was 35% (10,637.2 billion yen).

4-4 How to proceed with a project

In Japan, the Land Improvement Law provides the way to proceed with a land improvement project.

(1) Project findings

For project findings about land improvement project, survey offices specified for land improvement projects findings and establishsed in each

district by the Agicultural Structure Improvement Bureau conduct, on a continuous basis. All the costs and expenses for this survey are paid by the national government. Prefectures also cooperate in these project findings. The engineers of survey offices study the desires and conditions of cities, towns and villages in a potential project area and discuss these with the Land Improvement District. In this way, they find a candidate district for a project. In Japan, as most irrigated land is managed by the existing Land Improvement Districts, it will be almost unnecessary to newly establish a Land Improvement District for future land imprvement projects (an irrigation project in this illustration). The details of organization and functions of a Land Improvement District will be described in a later section.

(2) Preliminary survey

At this stage, after a survey is finished, a Land Improvement District designates a district for which a project is expected to be carried out, and requests the Agricultural Structure Improvement Bureau to make a direct survey on the district, on the assumption that the project will be implemented. This survey is called "District Survey".

It takes three to five years to finish the survey. All costs and expenses are paid by the government. The survey consists of "Basic Survey" to obtain data on the natural, social and economic background of the district surveyed, and data necessary to design irrigation facilities, and "Benefit Survey" to study the effects of the project. On the basis of such data, the engineering feasibility of the project is examined, a "rough plan" is made, and project costs are estimated. While the survey is progressing, the Land Improvement District repeats lobbying to the government so that the project will be actually implemented and realized. In lobbying, that more than 90% of the farmers who will be the beneficiaries of the project possibly agree to pay part of the expected project costs is a prerequisite.

(3) General implementation plan

When the Agricultural Structure Improvement Bureau judges, on the basis of the "District Survey", that the project will be feasible, it makes more precise estimates of project costs and structural designing. It takes about two to three years. This work is called "General Implementation Design". The costs will be paid by the farmers upon completion of the projects. A considerable part of costs is paid from subsidies from the government and the prefecture, however.

The land improvement engineers of the Agricultural Structure Improvement Bureau and the prefecture present information on a basis of the achievements of the work so far carried out, to the farmers and the Land Improvement District. If the Land Improvement District and the farmers give an informal consent to the proposed project after presentation, the project will move to next stage.

(4) Application

The budget of the Japanese government is prepared on a yearly basis, and is approved by the Diet. It is therfore essential that more than ninety percent (though two thirds under the law) of farmers expected to be the beneficiaries of the project agree to implementation of the project (that means that the farmers will pay part of the project costs), immediatly after the budget requested by the Agricultural Structure Improvement Bureau is included in the budget prepared by the Ministry of Finance and is approved by the Diet. Upon satisfaction of this prerequisite, the Land Improvement District officially presents to the government an "Application for Implementation of Project" based on the Land Improvement Law.

At this stage, the Agricultural Structure Improvement Bureau opens an office for the project.

The government again makes the decision whether to implement this project or not. The government asks professors and experienced engi-

neers their views on the project, and makes the decision.

Then, the plan of project is publicly announced to let those interested review the project documents. Any objections are properly handled. Finally, the project plan is confirmed, and the local office of the Agricultural Structure Improvement Bureau begins construction work.

The above is the case of a irrigation project operated by the national government. However, most part of the above discussion almost applies also to those projects by prefectures.

4-5 Characteristics of the way to proceed with a project in Japan

Below, the way the Agricultural Structure Improvement Bureau proceeds with a land improvement project is compared with other countries methods.

(1) Menu method

Various menus are provided in term of contents and benefits of facilities to be constructed by a project, and an organization such as the Land Improvement District may select what they need to meet their requirements from the menus.

(2) Main body of a project related to its scale

The main body to implement a land improvement project is either the national government (Ministry of Agriculture, Forestry and Fisheries), a prefecture or a Land Improvement District, though there are some exceptions.

Except for reconstruction from disasters, responsibility for a project is determined by the scale of that project. The scale is defined not by project costs but by the acreage of agricultural land which will receive benefit from this project. For example, an irrigation and drainage project will be implemented by the Ministry of Agriculture, Forestry and Fisher-

ies, if the beneficiaray paddy acreage is more than 3,000 ha of paddy, or by the Land Improvement District if it is less than 200 ha of paddy. Such criterium figures for beneficiary agricultural land area differ depending on the type of project. For instance, a reclamation project will be a government operated project if the beneficiary agricultural land acreage is larger than 400 ha.

As will be mentioned below, the proportion of subsidy by the government or a prefecture differs depending on the type of project and the scale of a project, that is, who implements the project.

(3) Subsidies

The costs of land improvement projects are, as a rule, paid by the beneficiaries. Part of the costs is paid by the farmers, who are the direct beneficiaries. To be more specific, the costs remaining after the subsidies from the government and the prefecture will be paid by the farmers with a long term low interest loan. Generally, the loan had an annual interest of 3.5 to 5.5%, and was paid back in 15 years with 2 years of deferment after completion of construction works in case of government operated irrigation and drainage projects.

Operation and maintenance of completed facilities will be commissioned to a Land Improvement District in almost all cases. No operation and maintenance costs are subsidized by the government or the prefecture, and the farmers (members of the Land Improvement District) have to pay them. In order to reduce the burden of operation and maintenance costs of the farmers, a service was started in 1975 by which the government gives subsidies to cover part of those costs only in special cases, but the total subsidies amount only to 1,600 million yen a year.

(4) Standardization of engineering

As land improvement projects are public projects to be implemented

with tax revenues, facilities to be constructed by projects of the same type have to be standardized throughout the country. Therefore, the Agricultural Structure Improvement Bureau has prepared manuals to be followed when planning projects and designing facilities so that there will be no discrepancies in the level, capacity and density of facilities to be constructed through land improvement projects to be independently implemented in various parts of the country. These manuals are called "Planning and Design Standards" and have been published by the Japanese Society of Irrigation, Drainage and Reclamation Engineering.

This system of adopting such standardized engineering has other advantages. Standardization eliminates differences among the engineers in charge. Moreover, any engineer can get the results if he has a certain degree of background. On the other hand, such standardization has the disadvantage of making it difficult to take advantage of experience in planning and designing. In Japan, experienced executive engineers participate in planning and design, taking into consideration newly developed technology and social and natural charateristics of the region where the project is to be implemented, in order to cover this demerit. Also, as the manuals adopt as criteria only those technologies whose safety and economy have been guaranteed, there will be no need of apprehension that structures of poor quality may be constructed, as far as design and construction works are reviewed with reference to the manuals.

(5) Method of judging the effects of projects

Since the Second World War, the Agricultural Structure Improvement Bureau has been using "Cost Benefit Ratio" (BC Ratio) as the criterium to judge the economical feasibility of land improvement projects. Thus, Internal Rate of Return (IRR) method is not used.

In calculating the BC Ratio, the problem is what items should be included in the calculation. The current method of the Agricultural

Structure Improvement Bureau includes only those benefits which are direct results of the project, but does not include those benefits of indirect and secondary results. For instance, as benefits resulting from an irrigation and drainage project for paddy field, water shortage at the time of dry spell will be eliminated and reduction in rice production caused by water shortage will be eliminated since reservoirs, barrages and canals will be constructed. With the improvement of drainage of water-stagnant paddy fields by construction of draining facilities, wheat or barley may be grown as a second crop in winter seasons, whereas it was not possible to do so on damp paddy fields. Later, as project costs increased, these two benefits became insufficient by themselves to justify a project, i.e. to get a figure of BC Ratio larger than one, in some cases. Then, benefits of reducing work hours necessary for water management resulting from construction of irrigation facilities was included in the calculation. Effects of irrigation and drainage projects, such as stabilization of prices of agricultural products, secondary effects of construction investment on regional economy, improvement of hygienic conditions, suppression of flood runoff, or gradual infiltration of groundwater resulting from irrigation are not covered in these calculations yet.

Chapter 5

Related Organizations

5-1 Related academic societies

Many of the members of the Japanese Society of Irrigation, Drainage and Reclamation Engineeing are carrying out research in their respective fields, as well as being members of other academic societies. Major societies are listed below, and information about them is given in the Table 8.

Table 8 Related academic societies

Society	Members	Adress
The Society of Agricultural Meteorology	702	Division of Environmental Science and Landscape Architecture, Faculty of Horticulture, Chiba University, Matsudo, Matsudo-City, 271
The Society of Agricultural Machinery, Japan	1,489	BRAIN, 1-40-2, Nisshin cho, Omiya, 331,
The Society of Agricultural Structures, Japan	503	c/o National Food Research Institute, Tsukuba, Ibaraki
The Society of the Science of Soil and Manure, Japan	2,096	6-26-10-202, Hongo, Bunkyo-ku, Tokyo
Research Association of Soil Physics, Japan	743	NODAI Research Institute, Tokyo University of Agriculture, Sakuragaoka, Setagaya, Tokyo, 156
The Japanese Society of Rural Planning	890	5-16-9, Honkomagome, Bunkyo-ku, Tokyo, 113
Japan Society of Civil Engineers	26,212	Yotsuya 1, Shinjuku-ku, Tokyo
The Japanese Society of Soil Mechanics and Foundation Engineering	13,180	2-23, Kanda-awaji-cho, Chiyoda-ku, Tokyo

5-2 Organizations of engineers

Members of the Japanese Society of Irrigation, Drainage and Reclamation Engineeing are active in planning, surveying, designing, and construction of land improvement projects, not only as researchers and teachers, but also as public officials in the government and prefectures, and employees of construction and consulting companies. Also, organizations for special objectives have been established.

5-3 Private companies

Private companies engaged in land improvement projects may be roughly classified into two groups. They are consulting and construction companies.

Consulting companies get orders from the government to conduct surveys, make plans, and to design facilities necessary for the implementation of that project.

Construction companies carry out actual construction work in accordance with the design thus prepared. In Japan, it is not the custom to employ some other consultants to supervise construction work. Engineers of the government or prefecture supervise the work.

5-4 Land Improvement District

(1) Origin

Under the Land Improvement Law, in order to apply for a land improvement project or in order to operate and maintain facilities constructed through a project, farmers must organize a farmers' organization called "Land Improvement District". In many cases, however, there are already irrigation associations of farmers which were estabished more than some hundred years ago, and these associations have been active as water users' organizations prior to the Second World War.

Another predecessor of the "Land Improvement District" is the "Land

Consolidation Association", which was an organiozation of land owners for agricultural land consolidation projects.

Of course, in those areas where a project is to be implemented and where there were no agricultural land or irrigation facilities prior to the implementation of the land improvement project (such as a reclamation or irrigation project to be implemented to construct completely new irrigation facilities) a "Land Improvement District" has to be established when applying and implementing the project.

For convenience of explanataion, the following discussion takes up a "Land Improvement District" which commands such a wide area as thousands ha of paddy fields and has had many years of history in paddy field irrigation. "Land Improvement Districts" of such type have been popular in each prefecture.

(2) Organization

Prior to the Agricultural Land Reform, only land owners were allowed into the membership of an "Irrigation Association" or "Land Consolidation Association", and no tenant peasants were allowed to join. In the case of a "Land Improvement District," tenants, too, are allowed to join. As a result of the Agricultural Land Reform, however, almost all farmers have become land-holding farmers, and it may be said that all the members of a "Land Improvement District" are land owners in the project area.

The director and trustees of a "Land Improvement District" are elected by the farmers who are the members of the "Land Improvement District."

A Land Improvement District with a wide command area (for example, more than one thousand ha of paddy field) has its own office building and full-time employees.

(3) Functions

Major functions of a Land Improvement District are as follows:

1. applies for a land improvement project,

2. repays project costs,

3. is responsible for operation and maintenance of major irrigation and drainage facilities, such as main canals and laterals. But irrigation canals below the tertiary canals or ditches are operated and maintained by farmers of informal water users' groups. These groups are frequently called "Mura", and coincide with the smallest communities of farmers.

(4) Finance

Most of the construction costs of a project applied by a "Land Improvement District" are, as mentioned before, subsidized by the government and a prefecture. Contrary, the operation and maintenance costs, which go to operate and maintain the irrigation and drainage facilities, personnel costs, meeting expenses, clerical expenses etc, are all covered by the fees paid by the member farmers. Therefore, the membership fee may be considered as the water charge.

The membership fee is determined not on the basis of the quantity of water supplied from the irrigation facilities managed by a "Land Improvement District," but on the basis of the acreage of paddy field to which water is supplied. A typical annual amount is fifty thousand yen per hectare of padyy field, which is equivalent to 0.3 ton of paddy rice, or about 3% of total yield now in Japan.

The member farmers are in many cases obliged to work with no pay to clean canals or to carry out maintemance work on tertiary or quartic canals.

5-5 Education and research

(1) Type

In Japan, six years of elementary school and three years of junior high school are compulsory. Thereafter, there are three years of high school and two years of junior college or four years of college. A number of colleges have two years of master courses and additional three years of

doctor courses. Land improvement engineering is being taught at a number of colleges, junior colleges and agricultural high schools.

Information is given in Table 9.

Table 9 University and colleges (land improvement engineering oriented)

University	Department	Faculty members	Adress
Hokkaido University	Department of Agricutural Engineering, Faculty of Agriculture	10	N9W9, Sapporo, 060
Obihiro University of Agriculture and Veterinary Medicine	Department of Agro-Environmental Science	12	Inaba-cho, Obihiro, 080
Kitasato University	Faculty of Engineering for Animal Husbandry	15	Towada, Aomori, 034
Hirosaki University	Department of Agricultural System Engineering, Faculty of Agriculture	9	Bunkyo, Hirosaki, 036
Iwate University	Departmemt of Agricultural Engineering, Faculty of Agriculture	14	Ueda, Morioka, 020
Miyagi Agricultural College	Department of Agricultural Engineering	7	Hatadate, Sendai, 982-02
The Akita Prefectural College of Agriculture	Department of Agricultural Engineering	6	Ohgata-mura, Akita, 010-04
Yamagata University	Department of Bioenvironment, Faculty of Agriculture	12	Wakaba, Tsuruoka, 997
Ibaraki University	Division of Agricultural and Environmental Engineering, School of Agriculture	9	3-21-1, Chuo, Ami, Ibaraki, 300-03
Utsunomiya University	Department fo Environmental Engineering, Faculty of Agriculture	14	Mine, Utsunomiya, 321
Chiba University	Division of Environmental Science and Landscape Architecture, Faculty of Horticulture	(Division Members 24) 11	Matsudo, Matsudo-city, 271
The University of Tokyo	Department of Agricultural Engineering, Faculty of Agriculture	16	Yayoi, Bunkyo, Tokyo, 113
Tokyo University of Agriculture and Technology	Department of Agricultural Engineering, Faculty of Agriculture	13	Fuchu, Tokyo, 183

University of Tsukuba,	Institute of Agricultural and Forest Engineering	8	Tsukuba, Ibaraki, 305
Tokyo University of Agriculture	Department of Agricultural Engineering, Faculty of Agriculture	24	Sakuragaoka, Setagaya, Tokyo, 156
Nihon University	Department of Agricultural Engineering, College of Agriculture and Veterinary Medicine	20	Kameino, Fujisawa, 252
Meiji University	Department of Agriculture, Faculty of Agriculture	8	Higashimita, Tama, Kawasaki, 214
Shinsyu University	Department of Forest Science, Faculty of Agriculture	5	Minamiminowa, Nagano, 399-45
Niigata University	Department of Production and Environment Science, Faculty of Agriculture	19	Igarashi, Niigata, 950-21
Toyama Prefectural University, College of Technology	Department of Agricultural Technology, Section of Agricultural Engineering	7	Kosugi, Toyama, 939-03
Ishikawa Agricultural College	Department of Agricultural Engineering	9	Suematsu, Nonoichi, Ishikawa, 921
Gifu University	Department of Land and Water Engineering, Faculty of Agriculture	9	Yanagido, Gifu, 501-11
Mie University	Department of Irrigation, Drainage and Reclamation, Faculty of Bioresources	17	Kamihama, Tsu, 514
University of Shiga Prefecture	Department of Biological Resources Management, School of Environmental Science	4	Hassaka-cho, Hikone, 522
Kyoto University	Division of Science and Technology on Regional Environment, Graduate School of Agricultural Science	16	Kitashirakawa, Sakyo, Kyoto, 606-01
Osaka Prefectural University	Department of Regional Environmental Science, Faculty of Agriculture	9	Sakai, Osaka, 591
Kobe University	Depertment of Environmental Information and Bio-Production Engineering, Faculty of Agriculture	13	Rokkodai-cho, Nada, Kobe, 657
Tottori University	Department of Agricultural Engineering, Faculty of Agriculture	5	Minami 4-101, Koyama-cho, Tottori, 680
	Department of Environmental Science, Faculty of Agriculture	4	Minami 4-101, Koyama-cho, Tottori, 680

	Arid Land Research Center	4	Hamasaka 1390, Tottori, 680
Shimane University	Department of Regional Development, Faculty of Life and Environmental Science	9	Nishikawazu, Matsue, 690
Okayama University	Department of Agricultural Sciences, Faculty of Agriculture	11	Tsushima-Naka, Okayama, 700
	Department of Environmental Management Engineering, Faculty of Environmental Science and Technology		Tsushima-Naka, Okayama, 700
Yamaguchi University	Department of Environmental Sciences in Agriculture, Faculty of Agriculture	5	Yoshida, Yamaguchi, 753
Kagawa University	Department of Agricultural Engineering, Faculty of Agriculture	16	Miki-cho, Kagawa, 761-07
Ehime University	Department of Rural Engineering, College of Agriculture	13	Tarumi, Matsuyama, 790
Kochi University	Department of Environmental Technology, Faculty of Agriculture	13	Monobe, Nankoku, 783
Kyusyu University	Department of Agricultural Engineering, Faculty of Agriculture	16	Hakozaki, Higashi-ku, Fukuoka, 812-81
Saga University	Course of Environmental and Information Engineering, Faculty of Agriculture	11	Honjo, Saga, 840
Miyazaki University	Agricultural Environment and Development Engineering Course	9	Gakuenkibanadai Nishi 1-1, Miyazaki, 889-21
Kagoshima University	Department of Environmental Sciences and Technology, Faculty of Agriculture	14	Korimoto, Kagoshima, 890
University of The Ryukyu	Department of Agricultural Engineering, College of Agriculture	12	Nishihara, Okinawa, 903-01

(2) Organization of courses

With college, as an example, the organization of a standard course is introduced.

Most Japanese colleges have some "Faculty" to cover specified fields of science or engineering. Many colleges or "Faculties" of agriculture have

a department or course to teach land improvement tengineering. Faculty members are professors, associate professors and assistant professors.

A typical classification of land improvement engineering in college, from a viewpoint of teaching and research, is as follows:

1. Water-related technologies:

Hydraulics, hydrology, hydraulic design of hydraulic structures such as dams and canals, applied hydraulics, appplied hydrology, and planning of irrigation and drainage projects.

2. Soil- or earth-related technologies

Soil physics, soil mechanichs, earth works for reclamation of agricultural land or for land consolidation, improvement of soil property by earth works.

3. Civil engineering- or design/construction-related technology

Applied mechanics, structural mechanics, properties and usage of materials such as concrete.

At a number of colleges, some organizational modifications have been effected recently. Prior to such modifications, many colleges had a "Department of Agricultural Engineering", consisting of four units of teaching and research, with the addition of a unit for agricultural machinery to the three units described above.

(3) Curriculum

A typical curriculum to teach land improvement engineering at a college is as follows.

Classroom teaching is almost exclusively in Japanese. Textbooks and references books are also mostly in Japanese. Some faculty teach foreign students in English personally and informally accoding to circumstances.

(4) Employment

After graduation from college the graduate may:

1. take a national examination or a prefectural examination to

become a government official and work as a land improvement engineer for the Agricultural Structure Improvement Bureau in the Ministry of Agriculture, Forestry and Fisheries, or in the prefectural Section of Land Improvement Project.

2. join a private company, either construction or consulting.

3. work for a public corporation as an engineer, or teach at an agricultural high school, or work at a private company in a different field. Others may join a graduate course to become a professor, a researcher, or an executive engineer.

(5) Graduate schools

Graduate students get more advanced education, and conduct research to write a masters thesis or dissertation.

(6) Foreign students

These colleges and graduate schools accept a number of foreign students. Many of them are on scholarship from the Japanese government. Some are on their own government scholarship, and others are on their own.

The minimum years of schooling are, like Japanese students, four years of college after graduation from high school, two years of masters course, and three more years of doctors course.

(7) Junior colleges and high schools

Education being offered at and studies being made at junior colleges are almost the same as those at colleges.

In Japan, most high schools are regular high schools. There are also high schools of engineering, commerce and agriculture. Only a few agricultural high schools offer courses on land improvement engineering. The subjects they offer are similar to those offered at colleges introduced above.

(8) Special research institutions attached to colleges

Some colleges have a research institute which are predominantly

involved in overseas regional problems in a land improvement engineering field:

1. Kyoto University Southeast Asia Research Center

The Center was established in 1965 to conduct comprehensive studies on the developing countries, especially Southeast Asia. Its studies are more comprehensive than simple regional studies, as they cover studies in the field of natural and social sciences. The Center has an office both in Bangkok and Jakarta where researchers are always stationed.

Table 10 National Research Institute of Agricultural Engineering

Director General
Research Planning and Co-ordination Division
Department of General Administration
Dept. of Rural Improvement
- Laboratory of Rural Planning
- Laboratory of Rural Settlement Planning
- Laboratory of Aquatic Environment Conservation
- Laboratory of Rural Sewage
- Laboratory of Operation and Management System

Dept. of Regional Resources
- Laboratory of Hydrology and Water Resources
- Laboratory of Groundwater Resources
- Laboratory of Land Resources
- Laboratory of Regional Energy Resources

Dept. of Land Improvement
- Laboratory of Paddy Fields Soil and Water
- Laboratory of Field Irrigation
- Laboratory of Multi-purpose Fields Management
- Laboratory of Land Reclamation and Conservation
- Laboratory of Structure and Material in Agrciultural Buildings
- Laboratory of Environmental Control in Agrciultural Buildings

Dept. of Hydraulic Engineering
- Laboratory of Water Management System
- Laboratory of Dams and Headworks Hydraulics
- Laboratory of Canal Hydraulics
- Laboratory of River and Coastal Engineering
- Laboratory of Hydrodynamic Control and Analysis

Dept. of Structural Engineering
- Laboratory of Structures Analysis
- Laboratory of Construction Materials
- Laboratory of Soil Engineering
- Laboratory of Engineering Geology

Adress: 1-2, Kannondai 2-chome, Tsukuba, Ibaraki, 305

2. Tottori University Arid Land Research Center

The Institute was estabished in 1958. In addition to the studies of sandhill, studies of agriculture in semi-arid and arid region, are being made.

5-6 National Research Institute of Agricutural Engineering

This is the Ministry of Agriculture, Forestry and Fisheries' research institute for study of land improvement engineering.

Its organization is shown in Table 10.

The Institute conducts studies to solve various problems which may occur when planning a land improvement project, or designing and/or constructing facilities for the project; it also studies various problems which may develop. The 1995 budget was about 1,586 million yen, including research funds on commission.

5-7 Other research and experiment institutes

Land improvement engineers also work for other governmental or prefectural research or experiment institutes, in addition to the research institutes described above.

National Institute of Agro. Environmental Sciences
3,486 million yen, 220 staff and technicians

National Agriculture Research Center
5,958 million yen, 319 staff and technicians

National Research Institute of Fisheries Engineering
823 million yen, 62 staff and technicians

Chapter 6

International Cooperation

6-1 International academic societies

The members of the Japanese Society of Irrigation, Drainage and Reclamation Engineering join international academic societies as well as domestic ones in their respective fields. They also attend international conferences.

(1) International Commission of Irrigation and Drainage (ICID)

The ICID has a membership of 80 countries including Japan. A number of members of the Japanese Society of Irrigation, Drainage and Reclamation Engineering are active members of ICID. The secretariat of the domestic committee is an executive official of the Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries. The secretariat of the domestic organization, to support the activities of the domestic committee, is within the Japanese Institute of Irrigation and Drainage (JIID). Some Japanese professors and engineers attend the general conference of ICID and its various meetings and task force meetings.

The address of the Japanese domestic committee is:
c/o JIID. Toranomon NN Bilding, 1-21-17, Toranomon, Minato-ku, Tokyo

6-2 Official Development Assistance (ODA)

As the developing countries do not have sufficient capital, technological and human resources, the developed and industrialized countries cooperate to supplement such deficiencies. Such cooperation is generally

called economic cooperation. Funds for economic cooperation channeled into the developing countries may be classified into the following four groups, according to the DAC: (1) official development assistance, (2) other official flows of government funds, (3) flow of private funds, (4) donation by private and non-profit organizations.

As ODA, there are country-to-country (bilateral) donations, contributions and financing to international organizations and government loans between two countries. As for country-to-country donations, there are free financial cooperation and technological cooperation.

(A) JICA (Japan International Cooperation Agency)

(1) Organization

JICA, established in 1974, is an official agency which is responsible for the technical cooperation aspect of Japan ODA programs. The headquaters are in Tokyo, and have sections as shown in Table 11. JICA has established 73 overseas offices in 71 countries as stated in Table 11. It has also a number of affiliated organs and branch offices in Japan, including Tukuba International Agricultural Training Center, and Institute for International Cooperation.

Table 11 Japan International Cooperation Agency (JICA)

Japan International Cooperation Agency:	Shinjuku Mitsui Bldg., 2-1-1, Nishi-Shinjuku, Shinjuku-ku, Tokyo
Secretariat of Japan Overseas Cooperation Volunteers (JOCV):	4-2-24, Hiroo, Shibuya-ku, Tokyo
Tsukuba International Center:	3-6, Koyadai, Tsukuba-shi, Ibaraki-ken
〈ASIA〉	
Bangladesh:	Plot No. NW(c)1, Road No. 62/63, Gulshan, Dhaka-1212, Bangladesh
Brunei:	No. 6, Simpang 80-45, Kg. Pengkalan Gadong, Bandar Seri Begawan, Negara Brunei Darussalam
Cambodia:	House No. 157, Street No. 71, Phnom Penh, Cambodia
China:	Room No. 1111, Beijing Fortune Building 5, Dong San Huan Bei-Lu, Chao Yang District, Beijing 100004, People's Republic of China
India:	2nd Floor, DLF Centre, Sansad Marg (Parliament Street) New Delhi-110001, India
Indonesia:	JI. M. H. Thamrin 59, Jakarta Pusat, Indonesia
Malaysia:	Suite 18.1W, 18th Floor, Wisma Sime Darby, Jalan Raja Laut 50350, Kuala Lumpur, Malaysia
Myanmar:	Technical Cooperation Section, Embassy of Japan, No. 17, University Avenue, Yangon, Myanmar

Nepal:	Tripureshore, Kathmandu, Nepal
Pakistan:	House No.1 St. No. 61, F-6/3, Islamabad, Pakistan
Philippines:	12th Floor, Pacific Star Building, Senator Gil J. Puyat Avenue, Extension Corner, Makati Avenue, Makati, Metro Mania, Philippines
Singapore:	Room 801, RELC Building 30, Orange Grove Road, Singapore, 1025
Sri Lanka:	Hotel Taj Samudra 6th floor, 25 Galle Face Centre Road, Kollupitiya, Colombo 3, Sri Lanka
Thailand:	1674/1 New Petchburi Road, Bangkok 10310, Thailand
⟨MIDDLE EAST⟩	
Egypt:	World Trade Center 10th Floor 1191 Comiche El Nile St. Boulak, Cairo, Arab Rep. of Egypt
Jordan:	18, Al-Mutanabbi, Jabal Amman, Amman, Jordan
Morocco:	BUREAU DE LA JICA AU MAROC, 28, Rue Béui Boufrah, Lotissement Ghandouri, Souissi, Rabat, Maroc
Saudi Arabia:	Japanese Embassy Premises Diplomatic Quarter, Riyadh, Saudi Arabia
Syria:	Al-Aqaad Building, 3574 Sharkashiah, Abdul Kader Al-Jazaeri, Abouromaneh, Damascus, Syria
Tunisia:	BUREAU DE LA JICA EN TUNISIE, 18, Rue Ahmed Rami 1002 Tunis-Belvedere, Tunisie
⟨AFRICA⟩	
Cote d'Ivoire:	Boulevard Carde, Des Bureaux, A L'lmmeuble les-Harmonies, M1 6eme Etage, Abidjan Plateau, Cote d'Ivoire
Ethiopia:	House No. 1163, Kebele 08, Woreda 23, Addis Ababa, Ethiopia
Ghana:	B182, North Labone, Accra, Ghana
Kenya:	Utumishi Co-op House, 3rd Floor, Mamlaka Road, Nairobi, Kenya
Malawi:	Area 13-Plots 5 and 6, Lilongwe 3, Malawi
Nigeria:	Cowrie House, Plot 27/29 Adeyemo Alakija Street, Victoria Island, Lagos, Nigeria
Senegal:	BUREAU DE LA JICA AU SENEGAL, Immeuble SDIH, 3, Place de l'Independance, Dakar, Senegal
Tanzania:	Plot No. 28, Kingsway Estate, Bagamoyo Road, Dar es Salaam, Tanzania
Zambia:	Plot No. 59B Mutandwa Road, Roma, Lusaka, Zambia
⟨SENTRAL AND SOUTH AMERICA⟩	
Argentina:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON, Dr. Ricardo Rojas 401, Piso 8, 1001-Buenos Aires, Argentina
Bolivia:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON EN BOLIVIA, Final Avenida 20 de Octubre No. 2689, La Paz, Bolivia
Brazil:	ESCRITORIO ANEXO DA EMBAIXADA DO JAPAO, Scs Quadra 01, Bloco F, Ed, Camargo Correa, 12° Andar, Brasilia, Brasil
Saõ Paulo:	ESCRITORIO ANEXO DO CONSULADO GERAL DO JAPAO EM SAO PAULO, Rua Sao Joaquim, 381-6 Andar, Liberdade, Saõ Paulo, Estado de Saõ Paulo
Chile:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON, Av. Anderes Bello 2777, Piso 27, of 2701, Providencia, Santiago, Chile
Colombia:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON, Calle 72, No. 10-07, Piso 7, Santa Fe de Bogota, Colombia
Dominican Republic:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON, Av. Bolivar No. 818, Santo Domingo, Republica Dominicana
Honduras:	MISION TECNICA DEL JAPON, Calle Santa Rosa, Colonia Lomas Del Mayab, Case N° 1346, Tegucigalpa, M. D. C., Honduras
Mexico:	Aristoteles 77-403, Chapultepec Morales, Mexico, D.F. 11560
Panama:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON EN PANAMA, Torre Swiss Bank, Calle 53, Urbanizacion Marbella, Panama
Paraguay:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON OFICINA EXTERIOR EN PARAGUAY, Presidente Franco Y Ayolas, Edificio Ayfra 11° Piso, Asuncion, Republica del Paraguay

Peru:	AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON, Av. Angamos Oeste 1381, Santa Cruz, Miraflores, Lima, Peru
〈OCEANIA〉	
Australia:	Level 16, AMP Center, 50 Bridge Street, Sydney 2000, Australia
Fiji:	3rd Floor, Dominion House, Suva, Fiji
Papua New Guinea:	Shop 7A, Second Floor, Garden City, Lot 4, Section 18, Angau Drive, Boroko, N.C.D., Papua New Guinea
Western Samoa:	Mulivai, Apia, Western Samoa
〈OTHERS〉	
Austria:	Prinz Eugen Strasse 8 (Wohlleben Gasse 3-5) 1040 Wien, Austria
Canada:	ANNEX OFFICE, CONSULATE GENERAL OF JAPAN AT TORONTO, National Bank Building, 150 York Street, Suite 1120, Toronto, Ontario, Canada, M5H 3S5
France:	BUREAU DE JICA EN FRANCE, 4-8, Rue Sainte-Anne, 75001 Paris, France
U. K.:	45 Old Bond St., London W1X 2AQ, U. K.
U. S. A.:	900 19th Street, N. W., Suite 350, Washington, D. C. 20006. U. S. A.

(2) Services

Technical cooperation is the main service of JICA, and aimed at transfer of technology and knowledge that serve socio-economic development of the developing countries. JICA carries out variety of programs to support nation building of the developing countries through such technical cooperation.

JICA has about 1,200 staff menbers working both in Japan and at its overseas offices.

JICA's program include;

1) Technical Cooperation
   - Training in Japan
   - Dispatch of Experts
   - Provision of Equipment
   - Project-type Technical Cooperation
   - Development Study
2) Dispatch of Japan Overseas Cooperation Volunteers(JOCV)
3) Training and Recruitment of Qualified Personnel for Technical Cooperation
4) Survey and Administration of Grant Aid Programs
5) Development Investment and Financing

6) Support for Japanese Emigrants

7) Disaster Relief

JICA's Budget amounts to 169,248 million yen in fiscal 1995, and all budget come from the national government.

During fiscal 1994, JICA accepted 8,834 trainees, dispatched 3,046 experts, 6,004 members of missions, and 2,410 overseas cooperation volunteers, and offered 5,540 million yen for grant aid assistance programs.

(B) Overseas Economic Cooperation Fund (OECF)

(1) Organization

The OECF was established in 1961. It has seven departments, two offices and twelve overseas representative offices.

It has 248 employees. All its funds come from the national government.

(2) Services

The major services of the OECF may be classified into the following three categories:

1. direct loan: loans to foreign governments, including local public corporations and local governments.

2. general projects: loans to and equity investment in Japanese corporations engaged in development projects overseas.

3. cooperation with other donator organizations: contribution to buffer stock under international commodity agreeement.

In addition to the aforementioned services, it conducts post-evaluation to confirm whether the expected effects have been realized. It has also started to conduct surveys and plan modifications to promote realization of project effects.

Land improvement engineers participate in these services of OECF, too.

6-3 Japanese embassies and international organizations

(1) Overseas, Japanese engineers from the Agricultural Structure Improvement Bureau are working as attaches at Japanese embassies. They are working as intermediates for matters related to agriculture, forestry and fishesries between Japan and the country where they work. Currently, land improvement engineers of the Ministry of Agriculture, Forestry and Fisheries are working as attaches at the Japanese embassies shown in Table 12.

Table 12 Japanese embassies with in-house land improvement engineers

Philippines:	375, Sen. Gil J. Puyat Ave. Makati Metro Manila, Philippines
Thailand:	1674, New Petchburi Rd. Bangkok, 10310, Thailand
Cambodia:	No, Moha Vithei Preah Norodom, Sangkat Phsar Thmey 3 Khan Don Penh, Phnom CAMBODIA
Myanmar:	No. 100. Natmauk Road, Yangon MYANMAR
Viet Nam:	No. 61 Truong Chinh Road, Phuong Quarter Dong Da District, Hanoi, Socialist Republic of Viet Nam
Sri Lanka:	No. 20, Gregory's Road, Colombo 7, Democratic Socialist Republic of Sri Lanka
Pakistan:	Plot No.53-70, Ramna 5/4 Diplomatic Encave 1, Islamabad, Pakistan
China:	7, Ri Tan Road, Jian Guo Mei Wai, Beijing, People's Republic of China
Egypt:	3rd floor, Cairo Center Building, 2, Abdel Kader Hamzza Street, Garden City, Cairo, Arab Republic of Egypt
Bangladesh:	Plot No. 110, Road No. 27, Block-A, Banami Model Town, Dhaka, 13, Bangladesh
Turkey:	Resit Galip Caddesi 81, Gaziosmanpasa, Ankara, Turkey
Colombia:	Carrera, No. 74-21, (Piso-8) Edificio Seguros Aurora, Bogota, Colombia
Chile:	Av. Providencia 2653, 19-Piso, Casilla 2877, Santiago, Chile
Netherlands:	Tobias Asserlaan 2, 2517 KC, The Hague, The Netherlands
Poland:	Ul. Willowa 7. Warsaw, Poland
U. S. A.:	(Consulate general of Japan at San Francisco) 50, Fremont Street, 23rd Floor, San Francisco, California 94105, U. S. A.
Dominica:	Torre BHD, 8 Piso Avenida Wiston Churchill, Esquina Luis F. Thomen, Santo Domingo, Republica Dominicana
Honduras:	Segunda Avenida, Frente Plazoleta del Arobol de Guanacaste, Colonia Reforma Tegucigalpa, D. C., Honduras, C. A.
Bolivia:	Calle Rosendo Gutierrez No. 497, esq. Sanchez Lima, La Paz, BOLIVIA
Ivory Coast:	Immeuble Alpha 2000 Tour Al 8eme Eyage, Avenue Chardy, Abidjan, Cote d' Ivoire (01 B. P. 1329, Abidjan 01)
Tanzania:	Plot No. 1018, Upanga, Dar Es Salaam, TANZANIA
Zimbabwe:	18th Floor, Karigamombe Centre, 53 Samora Machel Avenue Harare, ZIMBABWE
Nepal:	Panipokhari, Kathmandu, Nepal

(2) International organizations

Japanese land improvement engineers are also working for FAO,

(headquartered in Rome with Asian regional offices in Bangkok) the Asian Development Bank in Philippine, International Irrigation Management Institute in Sri Lanka, Asian Institute of Technology in Tahiland, and many other similar international organizations.

6-4 Agricultural Development Consulting Association (ADCA)

ADCA was established in 1977 with the guidance of the Ministry of Agriculture, Forestry amd Fisheries. Its members are those of consulting companies and others which are strongly interested in overseas agricultural development and have an intensive will to participate in it. As of 1986, forty seven companies, including manufacturing and trading companies, and twenty two consulting companies are supporting members.

The Association is actively conducting project finding surveys, surveys for master plans and feasibility studies for overseas agricultural development in such land improvement-oriented fields as development of water resources, reclamation of agricultural land, agricultural land consolidation, irrigation and surface- and subsurface-drainage, integrated rural planning, and studies and extension of agricultural development technologies.

6-5 Tropical Agriculture Research Center

The Ministry of Agriculture, Forestry and Fisheries has about thirty research institutes. The Tropical Agriculture Research Center was established in 1970 as a liaison for overseas studies. As of 1986, 95 researchers were working for the Center. They are studying agriculture and forestry of tropical and sub-tropical zones.

6-6 Others

JALDA (Japanese Agricultural Land Development Agency) began to conduct agricultural land development projects overseas in 1982, and the

JIID (Japanese Institute of Irrigation and Drainage), established in 1978, has also such functions as acceptance of trainees, drawing up of technical manuals, etc.

Chapter 7

Paddy

Paddy rice is a major crop in Japanese agriculture, the most popular profitable crop for farmers to grow, and occupies the widest acreage of agricultural land among all crops in Japan, and has been and still is staple food for Japanese.

7-1 Varieties

The paddy rice varieties being grown in Japan are not the Indica varieties, which are internationally popular, but the Japonica varieties, grains of which are short, roundish, sticky and sweet.

Owing to efforts of the past several decades to improve varieties, mainly at government experiment centers, more than ten tons of paddy

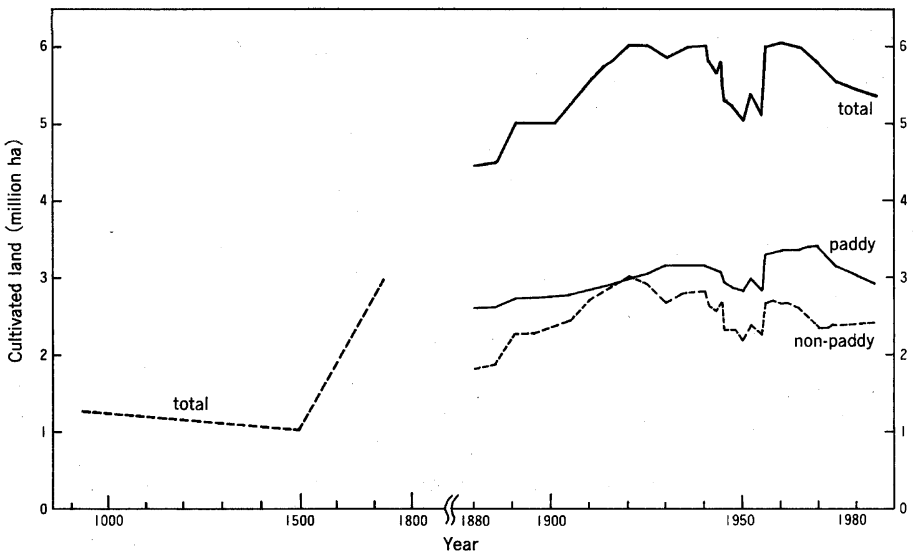

Figure 5 Agricultural land.

yield per hectare can be harvested nowadays. A number of modern varieties, i.e., high yielding varieties, have been developed. Also, low-temperature resistant varieties have been developed.

Today, farmers wish to have varieties which taste best to consumers, even though the yield is less, and studies are progressing to develop such varieties.

7-2 Increase against time in paddy field and rice yield

Both acreage of paddy field and average rice yield have increased year after year up to now.

Generally, yield is represesnted in terms of brown rice yield in Japan, though it is expressed by paddy yield internationally. The unit conversion coefficient is a little over sixty percent.*

*Japanese farmers express yield, using a peculiar domestic measurement unit "hyo", in terms of hyo/1000 m^2. A hyo of rice is equivalent to 60 kg of unhusked brown rice, the number of "hyo", harvested from a paddy field of 1000 m^2 is directly converted to paddy yield which is expressed by ton/ha.

7-3 Reasons for increased yield

During the past one hundred years, the paddy yield of rice has achieved a drastic increase from 4 ton/ha to 10 ton/ha. And the following three reasons might be pointed out:

1. Improved quality and function of agricultural chemicals such as fertilizers and pesticides, as well as increased application.

2. The efforts to modify and improve varieties have produced those varieties which are not collapsed by a heavy application of fertilizers and produce a higher yield. Moreover, varieties, which may be grown in low temperature areas of the north, and which are highly resistant to low temperatures, have been developed, resulting in an increased area where paddy rice may be grown.

3. The effects of land improvement projects may be pointed out. Loss

of paddy rice production due to water shortage in years with insufficient rainfall, and also loss caused by floods with heavy rainfall has been reduced owing to irrigataion and surface drainage projects. Also, subsurface drainage projects have succeeded in lowering the groundwater level and thus in improving soil conditions. Land consolidation projects have been effective for improving water management at the farm and plot level. With the progress of civil engineering and land improvement projects, which here means to reclaim virgin land so as to develop new paddy fields and to construct irrigation facilities such as dams and canals, the total area of paddy fields increased. Theses land improvement projects have been implemented through government subsidies and farmers' self support.

7-4 Agricultural inputs

An average application of agricultural inputs in rice growing in Japan in 1993 was:

fertilizer

nitrogen N: 85.4 kg/ha

phosphorus P_2O_5: 94.0 kg/ha

kalium K_2O: 81.7 kg/ha

7-5 Food control system, demand for and supply of rice

During the Second World War, the national government established a system to purchase rice at the price set by the government from farmers and to supply it to consumers at an inexpensive price in order to secure a stable supply of rice.

With an increase in rice production after the War, the actual functions of the system have undergone changes. The government always purchases the rice produced by farmers at a specific price. Moreover, the government purchasing price is so calculated to guarantee farmers the

production costs including their living costs. This high purchasing price has encouraged farmers to grow rice, and rice production has increased. Meanwhile, consumer taste has changed for food, and rice consumption has decreased. As a result, the demand-supply balance for rice has been disturbed, and rice has become excessive.

7-6 Excessive production, reduction of planting field, well-drained paddy field

The difference between the selling and purchasing price of rice, which is contolled by the government, are made up for from the national budget. As this make-up amount has become enormous, the government has limited the amount of rice to be purchased at the specified price. Even with this, excessive production of rice has not stopped, and the government has asked farmers not to grow rice in some of their paddy fields. The farmers unwillingly responded to the request. This is called "reducing planting paddy field". The farmers who did not grow rice in cooperation with this policy received subsidies according to the area of field not used to grow rice. In 1988, the area of paddy fields where no rice was grown amounted to 27% of total paddy fields.

For increasing croping intensity, it is desirable to grow crops other than rice, including wheat and vegetables, in the paddy fields. In order to grow such crops other than rice, drainage of paddy fields must be improved. Those paddy fields with improved drainage to allow production of any crop are called "(well-drained) field to be able to grow non-paddy crop as well as paddy rice". They are provided with subsurface drains and/or open channel drains for better drainage.

7-7 Mobilization of agricultural land

The majority of Japanese rice growing farmers have jobs other than farming. A considerable proportion of these farmers have no successors

to continue farming. Even today, some farmers lend to other farmers their paddy fields. Japanese farmers think it is wise management of their assets to continue to hold their farming land, instead of selling it. As a result, transaction of agricultural land is very rare, and when it is sold, its price is very high. As the rent is relatively low, those farmers wishing to increase their cultivating area choose to do so by borrowing land. As the Japanese rice production cost is considerably high in international comparison, the government has been working hard to reduce the cost. This expanding cultivating area by borrwing land has a merit of improving labor and capital productivity, and reducing rice production costs. The government, therefore, encourages such lending and borrowing of agricultural land, calling it "mobilization".

Chapter 8

Miscellaneous

8-1 Agricultural machinery

Japanese farmers who have become land-holding farmers as a result of the Agricultural Land Reform wished to improve labor productivitiy, in addition to the improvement of land productivity. Agricultural machinery of many types have come to be used in large number (prior to the Second World War, almost no agricultural machinery was used.) In paddy fields, small walking-type tractors were first used. Subsequently, relatively large tractors (30 to 50 horse power) were introduced. Then, combines suitable for paddy rice harvesting were developed and spread. As for rice transplantation, which is a bottle neck as it requires the most intense amount of labor, transplanting machines have been developed, and the problem of labor peak period has been solved to some extent.

For non-paddy crops, orchards, and green houses, too, a number of machines and equipment have been introduced.

The following are statistics of machines owned by farmers: transplanting machinery for paddy: 50.9 sets/100 farmers' households, combine for paddy: 29.8 sets/100 farmers' households, tracter (larger than 15 HP): 33.9 sets/100 farmers' households.

8-2 Irrigation projects for non-paddy crops

In the global scene, irrigation for non-paddy crops is the mainstream. In Japan, irrigation for paddy rice has been implemented for all paddy fields. The first irrigation project for non-paddy crops was done only after the Second World War, however. Prior to that, Japanese agricultu-

ral land, other than paddy field, was entirely rain-fed. After the war, the first large-scale irrigation project for non-paddy crops was started in Kanagawa Prefecture, next to Tokyo. It was a furrow irrigation project to provide facilities for vetables and crops. But the facilities were lost because expansion of the Tokyo urban area led to conversion of agricultural land to housing land.

Later, irrigation by sprinklers started at mandarin orange orchards. It was discovered, however, that in Japan, which is situated in the humid region, the number of days requiring supplemental irrigation to make up water for soil moisture deficit in mandarin orange orchards during a dry spell is extremly limited. In order to increase the frequency of using sprinklers, they were used to apply pesticides dissolved in water. This method has not only reduced the work of farmers but also has been preferable from the standpoint of farmers health, i.e., prevention of intoxication from pesticide.

In the irrigation ditricts of the Toyokawa Water Supply Systems, trickle or drip irrigation within green houses has become popular, together with the sprinkling method.

As mentioned above, world popular irrigation methods such as furrow or basin irrigation methods are being rarely used in Japan.

Irrigation facilities are also being used for purposes other than application of pesticides. For instance, they are used to prevent damage from cold and frost, and to protect wind erosion caused by strong winds. Irrigation facilities are being effective for diversifying crops, in addition to supplying water to moisture deficient soil due to drought. With construction of irrigation facilities, farmers start to grow vegetables, fruits and flowers which are less-drought resistant, but which are more profitable, instead of past crops and vegetables which are highly drought-resistant but less profitable.

For construction of such irrigation facilities, the government and

prefectures provide subsidies. Operation and maintenance costs are paid by the farmers themselves.

8-3 Earth works in reclamation projects

The majority of Japanese agricultural land is paddy fields which, unlike other types of non-paddy agricultural land, require land leveling and construction of embankment and ditches for irrigation and drainage. As a result, Japanese land improvement engineers are highly experienced in works handling an enormous amount of earth to reclaim agricultural land, not seen in Europe or in the U.S.A. For reclamation or land consolidation projects, such engineering methods as will return fertile surface soil onto the agricultural land, level the surface with a proper scale with minimum moving volume of soil, make a too permeable soil layer (like a volcanic ash soil layer) less permeable by constructing an less permeable soil layer beneath the surface layer and then cultivated skillfully using civil engineering machineries to develop a paddy field with less percolation, have been developed.

Such excellent earth work technologies are being appplied to cultivate steep-sloped land to develop fields, orchards or pastures.

8-4 Projects of reclamation from sea or lake bottom

In Japan, like in the Netherlands, parts of estuaries, lakes and bays have been reclamied to develop new paddy fields. Today, with excessive production of rice, it has become less necessary to reclaim land to increase paddy fields, and there are also less candidate land areas for reclamation, resulting from higher reclamation costs. There are also problems of natural conservation. Presently, therefore, only a few reclamation projects are progressing.

Japanese land improvement engineers have, however, produced 34,700 hectares of agricultural land through reclamation projects such as, includ-

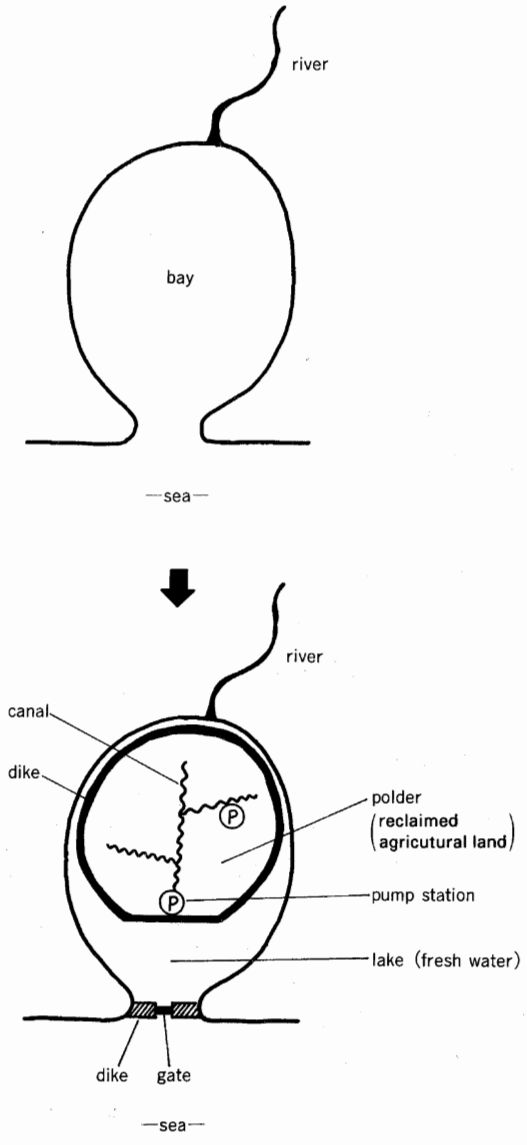

Figure 6 Sea bottom reclamation double dike system.

ing only those carried out after the Second World War, Hachirogata (15,800 ha) and Kojima Bay (1,060 ha), utilizing not only those technologies learnt from the Netherlands but also the state-of-art technogies of the time. Thus, Japanese land improvement engineers have shown positive achievements in a number of reclamation projects, and have accumulated

know-how of reclamation technologies.

In recent years, a number of projects have been completed, in which double dikes were constructed in a bay or lake to replace the seawater between the dikes with runoff flowing into it to creat an "artificial fresh water lake". This water will be used as an irrigation water resources for newly reclamated agricultural land created through the reclamation project.

8-5 Disaster prevention projects

When agricultural facilities such as diversion dams, bridges, pumping stations and canals are destroyed or agricultural land is damaged by floods, land slides or other natural disasters, they will be repaired or the facilities will be reconstructed. In that case, almost all of the construction costs will be paid by the government (92~95%). In 1987, such costs amounted to 64.8 billion yen.

8-6 Projects related to water and soil pollution

The Agricultural Structure Improvement Bureau also provides a menu of land improvement projects for water- and soil-quality conservation.

In rapidly urabanizing districts, plants and houses have been constructed and waste discharged from them have flowed into irrigation canals to pollute irrigation water. When this water pollution exceeds the specified level (1 ppm for nitrogen concentration, for instance), that district will be qualified to get an implementaion of water pollution counter-measure project and the government and the prefecture will pay the project costs. The farmers will usually not be required to pay any of the costs.

When the soil is polluted with Hs (arsenic) discharged from factories, a project of a different kind will be implemented. In this case, the

polluting factory will be required to pay some part of the costs. No farmers will be required to pay.

8-7 Community sewerage systems and other infrastructures

Recent land improvement projects in Japan have expanded their coverage from the past projects for developing agricultural production to develop such infrastrucures as dams, canals, farm roads, reclamation of land, consolidation of agricultural land, etc. to projects to develop infrastructures for living in agricultural villages.

The typical case is a project called "Community Sewerage Project". It constructs a sewerage system to collect sewage from the community and treat it. Since 1963 up to 1987, 152 systems, covering 93,000 people, have been constructed in rural communities.

In addition, community roads, meeting halls, parks etc. have been constructed in rural communities through this new project menu.

8-8 Concept of irrigation water requirement for paddy

To construct an irrigation system for paddy, the capacity requirement of irrigation facilities has to be estimated. In the authorized manual used for land improvement projects in Japan, the components of capacity requirement are as follows:

The water requirement for a paddy plot is the sum of the evapotranspiration which is the total of the evaporation from the surface of ponded water in the plot, transpiration from rice plants, and deep percolation. This sums is called by the special term of "Gensuishin" in Japanese, which means "decrease of water depth". The sum may be measured from the reduction of ponded water in the plot.

The water requirement obtained by substracting "the designed effective rainfall" to be expected in "the design year" from the aforementioned sum is a net requirement. Then, a loss of 15% is normally added to this

net requirement to get a gross water requirement, i.e., diversion requirement. This figure of 15% may appear too small in view of actual conditions, but the diversion requirement will coincide with the actual water requirement, as experienced irrigation engineers estimate the net requirement, taking into consideration the actual conditions in the project area.

The diversion requirement for paddy in Japan ranges at maximum from 10 to 80 mm/day during the growing stage, but typically from 20 to 30 mm/day. During the paddling and transplanting stage, 100 to 150 mm of water is considered necessary. The design year is so selected that the rainfall during the design year may be less than that to be encountered once every ten years, calculating from the past records of rainfall in the project district. The effective rainfall during the year is calculated from the rainfall during the design year according to established rules authorized by the Bureau. In Japan, not only the Ministry of Agriculture, Forestry and Fisheries but also all ministries and agencies concerned with water supply, including the Ministry of Construction adopt the drought year to be encountered with above-stated probability "design year".

8-9 Water management under a paddy irrigation system

(1) On-farm water management

To irrigate the paddy plants growing in a paddy field, the water diverted, for instance, into paddy fields of several hundreds or several thousands or more has to be distributed through a long and complex network of waterways at uncountable numbers of distribution points, and the necessary amount of water has to be delivered when needed. Especially in a dry spell, it would be different to fairly and certainly distribute the scarce water to a large number of farmers. In Japan, such on-farm water management is performed by a Land Improvement District or voluntary groups of farmers which are a sub-organization of a Land Improvement District, distributing water through the tertiary canals and

farm ditches intensively distributed.

In Japan, popular paddy irrigation systems are such that the water diverted from the river is delivered to all the canals and to all the plots in command area both simultaneously and continuously.

In Japan, too, a large number of tanks or ponds have been constructed in the districts where available water may be scarce due to insufficient rainfall during the irrigation season. In such districts, and even in those districts where enough water can be diverted from the river in normal years, irrigation is done on a rotaional basis by canals or by paddy plot in a drought year with water shortage.

(2) On-plot water management

To realize a paddy yield of more than 10 ton/ha, such water management is necessary to drain the water above the ground level to dry the soil to some extent for aeration, instead of leaving the water in the plot to make it a pond.

8-10 Water rights: progress of urbanization and diversion of water rights

The economic growth and progress of urbanization after the Second World War have caused diversion of a large number of paddy fields into housing, office or factory land lots. As a result, it was thought best to divert some of the water for irrigation to water for the newly born cities.

In Japan, however, an approval from the Ministry of Construction has to be obtained under the River Law to divert water rights.

Diversion for irrigation prior to 1896 when the River Law was enforced was considered a traditional water right, already approved at the time of enforcement. In this way, the water rights of irrigation groups with a long history have been legally recognized.

In view of the definition under the River Law that river water is a

public asset, irrigation groups are prohibited to directly sell their water rights to cities. In reality, however, there have been a few cases of water rights being sold.

Today, projects have been started to reduce distribution loss by works (lining, installation of check gates on open channels or pipe lines to replace former open channel systems). The cities in turn pay the costs of modifying such irrigation facilities. Part of the irrigation water which has become unnecessary, due to decreased irrigation areas resulting from urbanization, are transferred to cities.

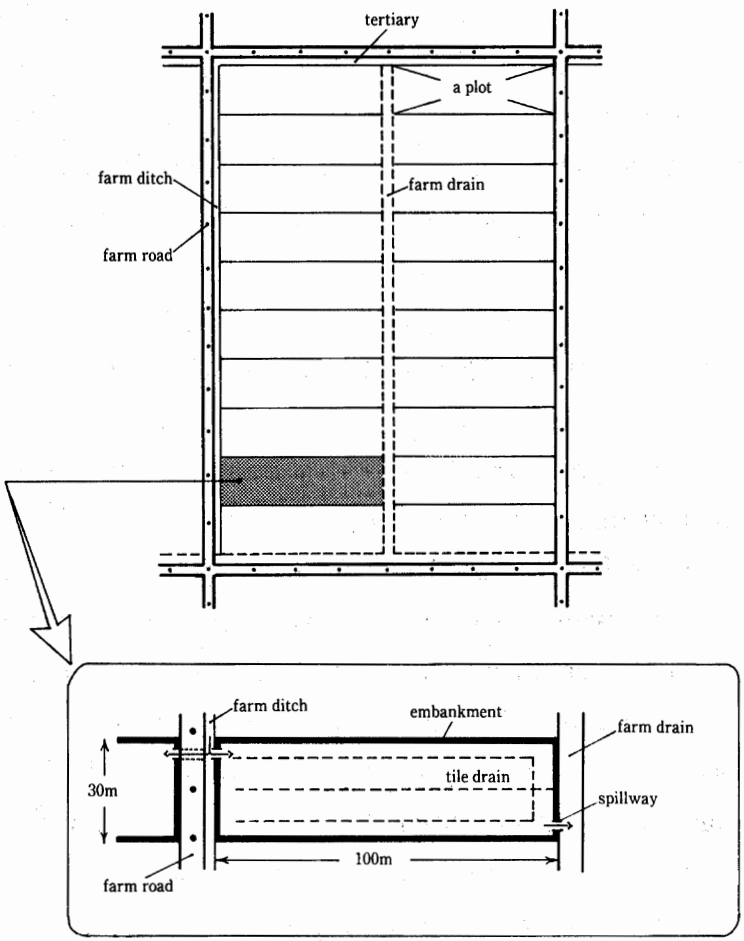

Figure 7 Standard paddy field layout after consolidation.

8-11 Standard plot size and its development for paddy field land consolidation projects

From around 1965 to recent years, a plot of 3,000 m² (30 ares) has been considered a standard size for paddy land consolidation projects. This basic size is 100 meters long and 30 meters wide, with a farm ditch, farm drain and farm road along the shorter side. These land consolidation projects with a plot of 30 ares as a srandard size have rapidly spread, and today paddy fields under such projects account for 45% of the total paddy fields. In comparison with the 1 hectare of paddy-land-holding of the average farmer in Japan, plots of 30 ares made it easy to consolidate dispersed plots and then to return it to those farmers participating in land consolidation projects. In alloting land, adjustment of participants' interests was relatively easy; plots of 30 ares were such that farmers could to some extent efficiently utilize their tractors and other farming machinery.

In recent years, however, to further effectively use of farming machinery and improve capital and labor productivity, land consolidation projects have started to make plots of at least 50 ares each.

8-12 Sophistication of irrigation and drainage facilities

Today, to save labor for operation and maintenance and to realize a precise water management, advanced and sophisticated equipment is installed or delivery canal systems are remote-controlled or automatic-controlled.

8-13 Drainage projects

For removing the surface water flooded into paddy fields, drainage pumps and/or canals have been constructed with such capacity to drain a rainfall of 100 mm/day in three days. Today, such capacity is considered insufficient, especially in paddy fields where paddy, non-paddy grains and vegetables are grown on a rotatioan basis. Ponded water is harmful for the

latter, and rapid drainage is essential. Even with paddy fields, subsurface drainage is required in many cases, and some paddy fields are provided with tile drains.