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EXECUTIVE SUMMARY

The main objective of this document is to clarify the recent focusing point of Japanese agricultural water related professionals.

Overview of National Policies : The most fundamental Japanese agricultural law is “Agricultural Basic Law”. This Agricultural Basic Law is presently under reformation. The Old Agricultural Basic Law was mainly concerned with the production of foods, whereas the New Agricultural Basic Law will include multi–functional roles of agriculture and rural areas. The idea of these multi-functional roles includes preservation of the national land and the environment, providing beautiful landscapes, creation of resident-friendly countryside, etc.

Present Status of Water : Japanese land consists of four islands, all surrounded by the sea. The total land area is 370 thousand square kilometers. Honsyu-island is the largest of the four islands. The shape of this island is long and narrow, having most of the large cities of the country. In the island, a mountain range goes horizontally through the center of the island, like a backbone. Most of the rivers in the island run perpendicular to the mountain range, resulting in each river having a small basin area and very steep slopes. Japanese annual average precipitation, 1,700 mm, is rather evenly distributed through out the year; Japan has no distinct dry period. The water use is fully developed through history, and droughts occur frequently.

Present Status of Food : As for foods, Japan is importing a large part of its consumption from abroad. The self sufficiency rate has decreased from 73% in 1965 to 41% in 1997 when calculated by calorie basis.

Present Status of Rural Development : One important point for agriculture is pursuing a potential Japanese food production increase. The establishment of a production infrastructure, and support for agriculture in hilly and mountainous (disadvantageous) areas are essential.

Another important point is to realize the multi-functional roles of rural areas.

Future Scenarios and Aims : Other than the quantity of water resources, a lot of stress is put on the notion of a sound water circulation. The Liaison Committee among Ministries and Agencies was set up in 1998, in order to obtain consensus among those various ministries and agencies for constructing a sound water circulation system.

Challenges for the Future : Measures for preserving water environment (water quality, ecological system, landscape, etc.) need to be developed. Therefore, a new support system should be established to maintain and manage irrigation facilities in the community, and to strengthen the functions of water for the community through the effective use of agricultural water.

1. OVER VIEW OF NATIONAL POLICIES AND DEVELOPMENT PLAN

The Agricultural Basic Law established in 1961 has long been serving as the fundamental philosophy and basic guideline for formulating policies on Japanese agriculture. In those past years, the agricultural environment has been experiencing more severe situations, such as the decreasing food supply capability, the dwindling farm workforce, aging of core farmers, increased abandonment of cultivation of farm lands. In order to secure a same and comfortable life for the general public in the coming 21st century, it is important to secure a stable food supply and support the fulfillment of multi-functional roles of agriculture through the sustainable development of agriculture and rural areas in Japan.

The existing Agricultural Basic Law is being revised.

2. PRESENT STATUS OF WATER

2.1 WATER RESOURCES

2.1.1 Precipitation

Japan is located in the Asia monsoonal area, which has one of the highest precipitations in the world. Japan has an average annual precipitation of 1,714 mm, according to data gathered from 1,300 sites around the country by the National Land Agency from 1966-1995. Japan thus receives twice the world average for annual precipitation of about 970 mm. However, the annual per capita precipitation is only 5,200 m^3/year-person, or about one-fifth the world annual average of 27,000 m^3/year-person. Thus, Japan's precipitation is not really abundant compared with that of other countries.

2.1.2 Potential Water Resources

The amount of potential water resources of Japan is about 420 billion m^3 for a normal year and about 280 billion m^3 for a dry year.

Japan normally experiences heavy rains in the rainy season in June and July, and during typhoon season in August and September. Japan has a generally steep topography and relatively short rivers. Therefore, considerable portion of potential water resources is not used, and flows directly into the ocean. The amount of actual water resources is about 60% to 70% of potential, in dry years, while it differs from region to region depending on topography, geology and distribution of

precipitation over time. Small islands and peninsulas, in particular, have greater per capita potential water resources due to their smaller populations, but rainwater flows into the ocean fairly rapidly in these areas because they rarely have large rivers. It is therefore more difficult to develop water resources effectively in such areas.

In a dry year, potential water resources are approximately 70% of those of a normal year, on average; less in Kyushu and Okinawa, more in regions of with heavy snowfall, such as Tohoku and Hokuriku.

Precipitation data from 1956 to 1995 shows that the potential water resources in dry years have declined in these years. For example, from 1956 to 1975, one year per decade had annual potential water resources of 335 billion m^3. By contrast the same amount of potential resources was seen every four years from 1976 to 1995. This decrease in potential resources may be a cause of water shortage in these years.

2.2 WATER RESOURCES USAGE

2.2.1 Current State of Water Use

A total of approximately 91 billion m^3 of water used in 1993, based on the amounts taken from reservoirs. A breakdown of the total water used shows that roughly 32.4 billion m^3 is used in municipal areas for domestic, commercial, and industrial purposes, and about 58.6 billion m^3 for agricultural use.

Domestic and commercial use of water has been on an upward trend since 1975, but has increased more slowly in recent years, declining slightly in 1993. The amount of water used in industry declined until the first half of 1980's, due in part to the increased use of recycled water. Industrial usage later turned upward, but has fallen in both 1992 and 1993. Total municipal water use was nearly flat until the latter half of 1980's, and has increased slightly since 1987, with changes in lifestyle and the economic expansion of the period, but decreased in 1993.

Use of water in agriculture is nearly unchanged in recent years because reductions in the amount of land under rice cultivation have been offset by an increase in irrigation for other crops.

2.2.2 Agricultural Water

(1) Agricultural water Usage

Water use for agriculture has recently been flat nationwide, with a slight decrease in rice paddy irrigation offset by an increase in irrigation for other crops.

Irrigation of rice paddies, which takes up the largest portion of agricultural water usage, dropped only slightly, in spite of decreased rice paddy acreage, partly because of the increased water use per unit area in paddies and the lower rate of recycling due to the digging of separate canals for irrigation and drainage. Demand for water in rice paddies is seen from mid-April through September, with peaks during tillage before the crop is transplanted, and in the season after mid-summer drainage. Water use during tillage in particular, has risen recently. There is a small demand for water during seasons other than the ones mentioned above, for secondary crop farming and crop rotation.

Irrigation for other types of crops is expected to continue to increase because the area land with access to irrigation is increasing and in many cases, agricultural chemicals and fertilizers are mixed with the water that is used to irrigate these fields. The supply or water to green-houses particularly, has increased steadily in recent years, and their growing popularity has increased the demand for water in winter.

Water usage in livestock farming is expected to continue to increase because of the growth in the number of livestock.

Aquaculture is also growing, although it accounts for a small portion of all agricultural land. Water culture, which is a form of liquid culture, is the main form of liquid culture in terms total area.

Irrigation channels have traditionally served several functions in agricultural areas, such as supplying water to wash crops and agricultural machinery, fire protection and preservation of the rural environment. To maintain and promote the use of such functions, various approaches are being taken in the improvement of irrigation channels, including construction of recreational areas, with trees and shrubs planted along irrigation channels.

3. PRESENT STATUS OF FOOD

Present status of food is brought out in the "Report Submitted to the Prime Minister by the Investigative Council on Basic Problems Concerning Food, Agriculture and Rural Areas" as summarised, is given below:

A. Serious problems facing food, agriculture

(1) With the expanding gap between supply and demand structures of food, the food self-sufficiency ratio has been decreasing. (Self-sufficiency ratio, which was 73 % in 1965, dropped to 41 % in 1997 when calculated by calorie basis.)

(2) Use of farmland is becoming less efficient, and the overall vitality of core farm work forces is weakening.

B. Public expectations of food, agriculture and rural areas

(1) Securing a stable food supply.

(2) A secure supply of a large variety of safe and high-quality foods. The sound development of food industries.

(3) Strengthening Japan's agriculture and supplying foods at reasonable prices.

(4) Further introduction of market mechanism and stabilization of farm management

4. PRESENT STATUS OF RURAL DEVELOPMENT

This present aims of rural development as stated in the "Report Submitted to the Prime Minister by the Investigative Council on Basic Problems Concerning Food, Agriculture and Rural Areas" are:

A. Pursuing Japanese agriculture's development potential

(1) Renovation of the agricultural structure for generations to come

(2) Fostering a variety of motivated farmers and assisting them in developing their businesses

(3) Effective fulfillment of the role of agriculture in preserving the cyclical function of nature

(4) Establishment of a production infrastructure

B. Enabling agriculture and rural areas to fulfill their multi-functional roles

(1) Paying attention to the multi-functional roles of agriculture and rural areas (Multi-functional roles such as preserving the national land and the environment, and providing a beautiful landscape, etc.)

(2) Comprehensive improvement measures to create beautiful, resident-friendly countryside

(3) Public support for the agriculture in hilly and mountainous areas (disadvantageous areas)

5. FUTURE SCENARIOS AND AIMS

5.1 INTRODUCTION

Future Administration in Irrigation Regarding Water Circulation in Catchment Areas is discussed in this section.

5.2 WATER CIRCULATION IN CATCHMENT AREAS

In the process of running off to the ocean, water for irrigation is drawn from rivers and underground to places where people live and work through networks of canals in catchment areas. The water also forms the water environment of the region.

The used water is returned from the places where people live and work to rivers and underground, and is recycled at the places where people live and work located downstream of rivers through rivers and underground. By repeating this cycle many times, a broad water environment across a wide catchment area is formed that supports our production and lives. In rice growing agriculture, water is recycled in the tertiary and secondary canal levels many times by irrigation and drainage canals.

5.3 ROLE OF AGRICULTURAL WATER USE IN WATER CIRCULATION SYSTEM

Agriculture, forestry and fishery activities are maintained by utilizing the reproductive power of nature itself, and rely on the natural environment including the air, water and soil. Industrial activity is also based on the circulation of natural materials. The rural environment forms the basis of semi-artificial, semi-natural, or secondary nature, which is formed by humans using nature continuously for agricultural production.

Japan has much precipitation and steep mountains cover 70% of the land, so the country is prone to disasters. However, to prevent floods, forests and agricultural lands which account for most of the land use in catchment areas contribute as follows through sound production activity by farmers and forestry workers :

(1) prevent soil erosion and debris avalanche;

(2) help the percolation and storage of precipitation; and

(3) return most of the water to rivers eventually.

Forests, agricultural lands and coastal areas have various functions including purification of water, preservation of various biota, conservation of the natural environment, and landscape greening.

Use for irrigation accounts for two thirds of the water requirement, and extensive networks of irrigation canals have been built that comprise much of the water circulation system in catchment areas.

While much of the surface water runs off into the ocean due to the steep and short rivers caused by topography, agricultural lands and networks of irrigation canals on the ground reduce such water run-off by retaining the water. This effect helps to stabilize surface water and ground water

in the downstream region of the area. Agricultural water use thus serves to preserve water, not just use it for irrigation.

In addition, agricultural water use helps to purify water through natural purification in paddy fields and irrigation canals as well as form the basis of the ecosystem by its process of circulation and recycling. Furthermore, water for agriculture is used not only for irrigation, but also for general water use in the region including melting snow, fire-fighting, conservation of the ecosystem and landscape, and other functions in the region.

The basic structure of land and water usage is the result of activities of people who have protected farm lands and forests and managed water as a part of farming and forestry. Because these activities have been continued and communities have been maintained, Japan's rich green land is productive, and the water circulation system in catchment areas has been secured by using water for irrigation.

In considering policies for building a sound water circulation system, the various roles of forests, farmlands, coastal areas, agriculture, forestry and fishery must be properly considered.

5.4 ISSUES CONCERNING SOUND WATER CIRCULATION SYSTEM

In Japan, agriculture, forestry and fisheries are controlled to stabilize the food supply, to develop agricultural, forestry and fishery villages, to preserve the land, and to contribute to the growth of the economy and society. Such management has, directly and indirectly, supported many functions such as conservation of the land and environment of forests, farmlands and coastal areas.
However, in line with recent changes in economic and social conditions, catchment areas have also been changing drastically. Such change includes :

- development of urbanization, with farmers and non-farmers living alongside each other in agricultural and rural communities, decrease of area of water and greenery (forests, farmlands, ponds and lakes where algae are planted, tidal lands and so on), and increase of area where water cannot percolate into the ground;
- delay of growth and thinning of forests, abandonment of cultivation of farm lands, and careless irrigation management caused by worsening depopulation and aging, poorer management of agriculture and forestry due to declining prices of agricultural products and wood (less incentive to manage agriculture and forestry by farmers and workers in the forestry industry);
- increase of outflow of pollutants which degrade the water caused by improved living standards and changes in industrial structure.

Some regions clearly witness the problems including less stable flow in the rivers, less water resources and groundwater, water pollution in closed water areas, decrease of aquatic livestock, loss of landscape, and others. Such problems concern various fields in order to secure a sound water circulation system in catchment areas.

Necessity of Maintaining Functions of Forests and Farmlands

(1) Decrease of forest area, delay of growth and thinning of forests, decrease of farming area (especially, paddy fields), abandonment of cultivation of farm lands, declining water storage capacity in catchment areas due to change of cropping from rice to other crops, less stable river flow, and cultivation of water resources and groundwater

(2) Increase of water demand for environmental reasons (creation of pleasant waterfronts, dilution of household drainage and so forth), caused by urbanization and farmers and non-farmers living alongside in agricultural and rural communities

(3) Weakening of Land Improvement Districts (In Japan, a water users' association is called a Land Improvement District or LID) which would preserve the water circulation system by maintaining irrigation facilities, and resulting careless management of water

(4) Lowering of functions including purification of water, conservation of ecosystem, formation of traditional landscapes by agricultural water, and increase in concrete lining of canal and pipes to boost agricultural productivity

Coping with Tight Water Demand

(6) Because of the trend of less precipitation in recent years and difficulties of developing new water resources, the water system cannot meet demand, so existing water resources must be reorganized to use water more effectively.

Coping with Water Pollution

(7) Water pollution in agricultural water, public water areas and groundwater due to various types of waste water from households flowing into agricultural canals, improper treatment of livestock excrement, improper use of chemical fertilizers and agrochemicals, and others (especially, water quality deterioration is serious in closed water areas such as lakes and marshes, inland seas and bays)

(8) Natural recycling, which is a core function of agriculture, should be promoted (restructure the recycling system).

5.5 CONSIDERATIONS FOR SOUND WATER CIRCULATION SYSTEM

(1) Establishment of Objectives of Sound Water Circulation System

A sound water circulation system means that quantity and quality of water are secured when the water is used by recycling among rivers, underground and the places where people live and work. This requires the following:

(1) Ensuring the various functions of forests and farm lands, including the stable flow of rivers, cultivation of water resources and groundwater, and water purification

(2) Stable use of water by developing and maintaining water resource facilities

(3) Treating water pollutants caused by production and living activities

(4) Preserving biota, the natural environment, and landscape

(2) Role of Irrigation in the Water Circulation System

In order to build a sound water circulation system, it is essential that the ministries and agencies concerned and those living in catchment areas (irrigators, inhabitants and so on) recognize the role of forests, farm lands and agricultural activity in the water circulation system.

It is necessary to quantify the circulation of irrigation and functions of cultivating water resources in each catchment area. Furthermore, it is also necessary to promote awareness that irrigation is one water use and that being just a water consumer is superficial. Using water for agriculture means creating it, not just consuming it.

(3) Importance of Autonomous Approach in Catchment Areas

Each catchment area has its own topography, social and economic conditions, and historical background of water. So, not only water use but also the types of water circulation vary among

catchment areas. Sound water circulation is achieved through sound economic and social activities by the people who live in the area. An independent approach by the inhabitants is required. For these reasons, the construction of a sound water circulation system should be approached as a problem for the local people; a consensus is required among the stakeholders, including those who use directly water in the catchment areas, fishermen, and other interested parties. It is neither sound to regulate by national standards, laws and regulations, nor to use compulsory administration. Therefore, an autonomous approach in the catchment area is the basis of a sound water circulation.

Sound production and living activities support sound water circulation, and so every approaches by those who actually use water are important. It is necessary to form a consensus and common objectives for actions among water users. The administration (central and prefectural governments) should neither mandate these objectives nor regulate, but should cooperate with water users and the local people. The administration should also deal with the issues that cannot be addressed by water users and the local people, and should support the self-governing activities in catchment areas by listening to the needs of these people.

(4) Defining the Roles of Land Improvement Districts

Close cooperation is needed among private water users, the local people, and the “public” municipal governments. But, a sound water circulation system cannot be built through cooperation with the private and public sectors alone. The “communal” existence of Land Improvement Districts is very important.

In Japan, irrigation has been managed by people in the villages, and farm villages have been formed under irrigation orders based on rules developed over time. So, the environment in Japanese traditional farm villages is preserved mainly by the water users’ associations originally established for allocating agricultural water,. Diversion facilities which were used to allocate water to tertiary canals in the community and ditches in each field were managed by each community, and the management was based on the principle of “communal activity” symbolized by compulsory services, while water users’ associations have managed main headwork and canals, and distributed water properly to each community. These compulsory services in each community were not confined to management of water, but covered all things including management of water for households and farm roads required in the community.

Land Improvement Districts have gathered much know-how about how to manage the environment in Japanese traditional farm villages. But due to the critical situation facing agriculture and farm villages including low prices for agricultural products, urbanization and farmers and non-farmers living alongside in agricultural and rural communities, depopulation and aging, Land Improvement Districts are being forced to operate on a weaker financial basis and less communal function within the community.

On the other hand, with the progress of urbanization and farmers and non-farmers living alongside in the community, irrigation management must play an ever greater role, including dealing with larger inflows of sewage from households, and providing water areas for recreation. Therefore, municipal governments are increasingly becoming involved to the management of irrigation facilities. However, in districts where farmers and Land Improvement Districts are minor, it is difficult to reach agreement to support Land Improvement Districts by the municipal governments.

Therefore, Land Improvement Districts must urgently be positioned not only as entities for managing agricultural water but also for managing the environment and resources in the community. It is also necessary to restructure the community in the region where farmers and non-farmers live together, and to build a system that they can manage by themselves in coordination with the Land Improvement Districts. Private farmers and non-farmers, communal Land Improvement Districts, and public municipal governments must share the roles and

cooperate with each other. Since irrigation supports a sound water circulation system, preservation of the environment of agricultural villages should become a nationwide movement by people including city-dwellers, with Land Improvement Districts as the driving force. The active management of local resources and environment must be considered carefully.

(5) How to Coordinate Irrigation (Allocation of Water Resources)

Allocation of water resources in the existing system of the River Act has generally been decided by the river administrator, Ministry of Construction, for the public interest. Ministry of Construction is responsible for granting permission to use irrigation. However, the irrigation situation, including the higher demand for water for water use per hectare, the trend of repeated water shortages, and new demand for water for the environment and others, is changing, and it is also becoming difficult to develop new water resources. It is thus important to restructure the surface water use system, and also to utilize limited water resources effectively.

However, coordination of irrigation, that is, allocation of water resources, cannot be managed centrally and appropriately by the public river administrator, because it is different from flood control. Coordination of irrigation is based on coordination among various irrigation parties. This coordination is result of the self-governing function in basin areas. Irrigation coordination associations, therefore, is needed to be established for negotiating and coordinating among all of the water users (not necessarily for the whole system) who are involved in order to allocate water properly over a wide area. In doing this, the departments and agencies for irrigation, and the river administrator should serve as advisers, and should generally reflect the intentions of water users summarized by the irrigation coordination association in the management of agricultural water use and river management. This falls into line with the demand for minimum involvement by the government (to reduce administration costs) in recent years.

(6) Role of Agricultural Administration — Preservation of Farm Lands and Forests on Hillsides and Mountainous Regions

From the viewpoint of the water circulation system, hillsides and mountainous regions conserve the land by preventing soil erosion, floods, as well as cultivate water resources by forests and farm lands because of their locations. The various functions of such forests and farmlands protect economic and social activities in the downstream areas.

Farming of hillsides and mountainous regions is being abandoned due to aging of people and depopulation. Because the water circulation system must be secured, it is necessary to preserve farm lands by taking measures including conserving terraced paddy fields, preventing the abandonment of agricultural lands, and managing agricultural lands in uncultivated.

6. CHALLENGES FOR THE FUTURE

1) Water Quality

It is important to continue improving sewage treatment plants in agricultural village projects.

It is also important to decrease the environmental load by encouraging the recycling of resources through re-use of treated water for irrigation, and encouraging people to return sludge, kitchen garbage and livestock excrement to farm lands.

Regarding pollutants from so-called non-point sources, that is, livestock excrement, measures are needed for pollution sources. These measures include the development of an environment-friendly agricultural system, enforcement of proper treatment of livestock excrement, and promotion of recycling. For polluted water of low density and polluted groundwater, it is difficult to take similar measures as for the treatment of sewage in urban areas. Measures such as using

water hyacinth and ditch weeds, purification through gravel, and use of local resources such as charcoal, suitable for the agricultural areas should be developed.

2) Ecological System and Landscape

Improvement of agriculture and farm villages has to be designed to increase productivity, and project measures have emphasized rationality, soundness and economy because the projects have sought to alleviate the burden on the beneficiaries (farmers). However, as people become more interested in environmental problems, projects to raise the value of farm villages by focusing more on harmony with agricultural environment have become more common.

Therefore, it is essential to restore the functions of agricultural water, such as preserving recreation and ecosystem. Projects must increasingly consider harmony with the natural environment, together with the problems of sharing the costs in order to preserve agricultural land and the environment.

3) Water for the Community

Agricultural water is not used only for irrigation water, but has many uses for the community including improvement of the village environment. Hence, the importance of agricultural water is increasing as urbanization progresses and farmers and non-farmers live alongside in agricultural and rural communities.

Therefore, a new support system should be established to keep and manage irrigation facilities in the community, and to strengthen the functions of water for the community through the effective use of agricultural water by re-using.

Emphasis should be placed on promoting a system for reusing irrigation and restraining water pollutants in the whole community by using water purification ponds with aquatic plants and the like.

Report of Japanese Podium Application With Comments for Model Improvement

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The uniqueness of Podium is that it is handled with the macros of a spreadsheet application. The consequences of changes in variables are shown graphically. Podium is aimed exclusively at the analysis of various scenarios. For this purpose, it is very successful in supplying a common platform for discussion to different countries.

Podium is designed to provide the direct consequences of economic and environmental changes that will affect the water balance in 2025. To derive these consequences, all that is required are data in 1995 for a set of variables and their rate of growth to the year 2025.

The simplicity of this model makes it very useful for providing what-if implications.

1. RUNNING THE JAPAN MODEL

We ran the Japan model with some assumptions and elaboration of default data. Details of these are discussed in the appendixes.

Running the model, we found the annual water productivity rose from 1.14kg/m^3 to 1.53kg/m^3. The consumptive use fell from 7.14km^3 to 6.45 km^3.

However, we must remember that this improvement is largely resulted from the increase of yield from 4.48 t/ha to 6.01 t/ha.

2. LIMITATIONS OF THE MODEL

The most important problem of the model is that cereal's requirement and production (demand and supply) are determined independently. This problem is related to international trade.

The model permits a difference between cereal consumption and production. This difference must be cancelled out by the foreign trade factor. However, there are no restrictions posed on trade. If there is a cereal shortage, that country can import as it wishes without reducing other countries' imports. This means that there can be many sets of variables that make cereal production and requirement equal.

Price is what the model does not handle. We know Podium is unique and powerful because its structure is simple and concise. However, more beneficial possibilities can be provided if foreign trade restrict to some extent our demand and supply of cereal. In other words, the problem here is how to deal with the price of goods and the connection between countries.

Another problem we noticed is that average values for the amount of water resources in a country are limited in significance, while those for food are always meaningful. This is because water cannot be transported for long distances without a fairly large amount of investment for constructing canals. Food prices, on the contrary, tend to be averaged in a country because food is easily transported from places where prices are lower to where prices are higher. Maybe in the next step of the development of the Podium model, possible future water projects will have to be considered. In deriving the conclusion for the Vision for "Water for Food," this point has to be taken into consideration.

Podium may be controversial in its model structure, but what we really need is a common platform for the discussion of future water balances, which Podium provides.

APPENDIX 1 : SOME NOTES ON RUNNING THE JAPAN MODEL

We need to note on some assumptions and data revisions.

The data revision policy is that if default data are based on the FAO statistics, then they are used. For the data that have been “estimated,” other national statistics are used.

1. FOREIGN TRADE

It is taken as given that cereal requirement and the production (demand and supply) should be equal. It seems that Podium does not necessarily require this condition, however, the assumption is quite natural in order to derive a meaningful result.

We assume that a shortage of cereal can be met by an increase in imports.

2. KINDS OF CEREALS

Cereals are taken as being divided into the categories of “rice” and “other cereals,” Rice consisted of more than 90% of area harvested in 1995. Other cereals were mainly wheat and barley. Maize, millets and oats were far less than 1%, while area growing buckwheat was about 1% of the total.

3. IRRIGATION

The irrigation intensity was assumed to be 100%. This is because the intensity of the area used has been slightly less than 100% in recent years. Rice production was assumed to be done with irrigation while other crops were grown in rain-fed areas.

4. SEASONS

Rice is regarded as being produced in the wet season, while the production of other cereals is divided into two seasons.

Data Source

[1] Ministry of Agriculture, Forestry and Fisheries of Japan, The Statistics Agricultural Land Use, 1995, 1996

[2] FAOSTAT, http://apps.fao.org/

[3] Ministry of Agriculture, Forestry and Fisheries of Japan, Census of Agriculture, 1995

ESTIMATING YIELD IN JAPAN MODEL

Step 1 : Target Cereals and their Harvested Area

We assume cereals of Japan are classified as rice and other cereals. As shown in the Table 1, the other cereals are grown in only 10% of the total cereal area. They mainly consist of wheat and barley.

Summarizing Table 1, Table 2 gives the area for rice and other cereals grown in the paddy fields fields.

Table 1. Harvested Area for Cereals (ha)

	1,994	1,995	1,996	Total
Rice	2,212,000	2,118,000	1,977,000	6,307,000
Millets (Paddy fields)	200	200	200	600
Millets (fields)	200	200	200	600
Wheat and barley	115,500	113,700	117,800	347,000
Wheat and barley	98,700	96,500	97,700	292,900
Oats (Paddy fields)	542	594	750	1,886
Oats (Fields)	611	492	472	1,575
Maize (Paddy fields)	16	6	4	26
Maize (Fields)	153	114	98	365
Buckwheat (Paddy fields)	10,100	11,800	15,300	37,200
Buckwheat (Fields)	10,100	10,800	11,100	32,000
Total	2,448,122	2,352,406	2,220,624	7,021,152

Source: Statistics of Agricultural Land Use, 1995,1996, Ministry of Agriculture, Forestry and Fishery

Millets appear in the FAO statistics. We could not find the equivalents in our statistical source. We assumed they can be divided half for the paddy fields and the other half for the fields.

Table 2. Harvested Area for Rice and the Other Cereals (ha)

	1,994	1,995	1,996	Ave. (1,000ha)
Rice	2,212,000	2,118,000	1,977,000	2,102
Other than rice	236,122	234,406	243,624	238
Paddy fields	126,358	126,300	134,054	129
Fields	109,764	108,106	109,570	109
Total	2,448,122	2,352,406	2,220,624	2,340

Other cereals than rice can be grown in fields and paddy fields. Paddy fields for the other cereals can be (1) converted from rice production because of the diversification policy, and 2) secondary crop to the rice production. We assume here that the former is in the wet season and the latter is in the dry season.

For the other cereals grown in the fields, we just assume half of them is in the wet season, and another half is in the dry season. We also assume rice is produced in the wet season.
We assume rice is grown in the irrigated area and the other cereals are grown in the rain-fed area.

We have the statistical data of paddy fields which are used for the other crops than rice in the secondary season (Table 3). By this table we can assume the area for the other cereals grown in the paddy field

Table 3. Paddy Fields Used for the Other Crops than Rice in the Secondary Season in 1995 (ha)

Paddy fields for rice	2,094,879
Paddy fields for secondary crop	103,061
Percentage of paddy fields for secondary crop	4.9%

Source : Census of Agriculture, 1995, Ministry of Agriculture, Forestry and Fishery

The assumptions on the division of land are shown as Table 4. Table 5 gives the actual value derived from the assumptions and data given thereby.

Table 4. The Division of Cereals

	Wet	Dry
Irrigated	Rice	None
Rain-fed	A	B

A. Half of the other cereals in the fields, and the other cereals in the paddy fields by the diversification policy.
B. Half of the other cereals in the fields, and the other cereals in the paddy fields as a secondary crop

Table 5. The Area of Cereals (1,000ha)

	Wet	Dry
Irrigated	2,102	0
Rain-fed	177	61

Step 2 : Irrigation Intensity

Table 6 gives the percentage of agricultural land use. We assume the irrigation intensity is 100%.

Table 6. Percentage of Agricultural Land Use

	1993	1994	1995
Paddy fields	99.1	98.6	96.1
Fields	101.0	100.3	99.4

Source : Statistics of Agricultural Land Use, 1996, Ministry of Agriculture, Forestry and Fishery

Step 3 : Yield

Table 7 is the production of cereals.

Table 7. Production of Cereals (t)

	1994	1995	1996	Total
(1) Cereals, Total	15,787,290	14,121,900	13,668,250	43,577,440
(2) Cereals (Rice Milled Eqv)	10,800,282	9,648,045	9,362,560	29,810,887
(3) Cereals ther than rice	811,290	686,900	738,250	2,236,440
Rice, Paddy	14,976,000	13,435,000	12,930,000	41,341,000
Wheat	564,800	443,600	478,100	1,486,500
Barley	224,800	218,200	233,200	676,200
Maize	420	300	250	970
Oats	2,570	3,000	2,000	7,570
Millet	700	700	700	2100
Buckwheat	18,000	21,100	24,000	63,100

Source : FAOSTAT(www.fao.org)

To evaluate the yield as rice milled equivalent, we have the conversion rate from the total of 1) and 2) in the Table 7 as 29,810,887 / 43,577,400. Table 8 shows the production calculated as this. Table 9 and Table 10 is the yield we need.

Table 8. Production of Cereals as the Rice Milled Equivalent (ha)

	1994	1995	1996	Total
Rice	10,244,930	9,190,748	8,845,283	28,280,961

Table 9. Yield (t/ha)

	1994	1995	1996	Total
Rice	4.63	4.34	4.47	4.48

Table 10. Yield (t/ha)

Yield		Wet	Dry
Irrigated		4.48	To be Computed
Rain-fed		To be Computed	To be Computed

Step 4 : Required Data Revision

		1995	2025
1.	Irrigation Intensity	100.0%	100.0%
2.	Rain-fed Intensity Deriving from Table 5…	134.6%	134.6%
3.	Percentage of Irrigated Area with Cereals Regarding all and only the paddy field is irrigated…	77.6%	77.6%
4.	Irrigated Yield S2/S1	100.0%	100.0%
5.	Import (million tons) Assuming all the cereal shortage can be cancelled out…	9.94	10.07