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2012 Modularization of Korea's Development Experience:

A Plan for the Development and Supply of Agricultural Water

2013

Ministry of Agriculture, Food and Rural Affairs

KRC Clean & Green RRI Rural Research Institute

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A Plan for the Development and Supply of Agricultural Water

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Preface

The study of Korea's economic and social transformation offers a unique opportunity to better understand the factors that drive development. Within one generation, Korea has transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience so unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights and lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2010 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience with the hope that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. This is a continuation of a multi-year undertaking to study and document Korea's development experience, and it builds on the 40 case studies completed in 2011. Here, we present 41 new studies that explore various development-oriented themes such as industrialization, energy, human resource development, government administration, Information and Communication Technology (ICT), agricultural development, land development, and environment.

In presenting these new studies, I would like to take this opportunity to express my gratitude to all those involved in this great undertaking. It was through their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank the KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time, keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedication of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professor Joon-Kyung Kim and Professor Dong-Young Kim for his stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

May 2013

Joohoon Kim

Acting President

KDI School of Public Policy and Management

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Chapter 1

Summary

This paper summarizes the processes in which Korean government and farmers have made strenuous efforts to realize a dream of "green revolutions" by banding with each other to overcome hardships and challenges and create something from nothing. It is intended to put the past in retrospect with sincerity and cool-headedness to take any lesson from it and thereby to use it as data for feedback for the new agricultural development; furthermore, it is meant to share the processes of making policies and developing techniques for agricultural growth through such international communication as seminars, workshops and conferences to provide materials related to developmental experiences for the purpose of food security and global agricultural development.

The birth of modern Korean agriculture dates back to the year of 1908, when the West Okgu Irrigation Farmer Cooperative, the first professional agricultural organization, was established. Of course, even before its establishment, there were a multitude of materials supplied about farming agricultural machines as well as publications of agricultural manuals and books. However, it can be said that the organization was the first to be established by the government in order to increase food productivity and control basic systems for abundant food production. From then to the period of Independence from Japan in 1945, a host of irrigation farmer cooperatives were established to make the best of agricultural water; nevertheless, Korean farmers had had their crops stolen by the colonial Japanese government. And after Independence in 1945 and the Korean War in 1950, the Korean government acted to depend on insufficient capital and poor techniques to restore destroyed and damaged irrigation systems and to solve the problem of food shortage. Moreover, the government have, for 100 years, pulled out all stops to be an agriculturally developed country which has fulfilled a dream of green revolutions by means of continuous investments in agriculture. Accordingly, this paper summarizes the processes of the development of Korean agriculture and its vision by time and by policy.

The wave of modernization over all industrial fields in South Korea in the late 1960s conditioned the country to undergo a wider range of changes in agriculture. So it did everything it could to acquire the infrastructure of agricultural production and improve the conditions for rural lives by refining related legal systems and organizations. Especially, this period was one in which the governments played a pivotal role in attaining self-sufficient supplies of rice, a staple food to Koreans, by focusing its efforts on implementing the projects for comprehensive agricultural development.

The mid-1980s witnessed Korean agriculture under the pressure of free imports of agricultural products from foreign countries, which put its agriculture and farmers in bigger difficulties. The government did its best to strengthen and repair the infrastructure for agricultural production lest there should be any lack of food, regardless of weather disasters. In the meanwhile, it promoted projects for adjusting the size of farming organizations to an appropriate level and, at the same time, it implemented projects for increasing income on extra-farming activities and bettering the rural life environments.

However, under the control of the IMF, in the late 1990s, the country underwent a drastic change in industrial structure, which incorporated the three state-controlled agricultural organizations—the Agricultural Land Improvement Cooperatives, the Agricultural Land Improvement Association, and Korea Farm and Fishing Village Corporation—into one organization, which made its entrance as the Korea Agricultural Infrastructure Corporation on January 1, 2002. Afterwards, there were a number of difficulties imposed on Korean farmers: WTO, UR and FTAs. In order to overcome these difficulties, the organization was reborn as the Korea Rural Community Corporation, working together with the Ministry of Farming, Forestry and Stockbreeding to make a continuous effort to cope with drastic changes in global agriculture.

Chapter 1

The Regional Characteristics of the Republic of Korea and its Change in Agriculture

The Regional Characteristics of the Republic of Korea and its Change in Agriculture

1. The Present State of Land and Water Resources

1.1. Land and Natural Environments

The Korean Peninsula, extruding southwards from the east of the Eurasian Continent, includes about 3,200 islands, 99,000km^2 in area, located from 124°11'-131°55' east longitude and 33°7'-43°1 north latitude. It it separated from Russia by the Abnok River, and from China by the Duman River. It is framed by the East Sea in the east; the Korean Straight in the south, facing Japan and the Pacific; and the Yellow Sea in the west, facing China.

The geographic features are as follows: its eastern land is high and its western land is low. The Taebaek Mountains run from north to south, located slanted towards the east; so its eastern areas are steep but its western areas are gentle. The Sobaek Mountains run between Yeongnam Area and Honam Area, which forms a lot of mountainous areas.

However, in general, the mountains are low. Hanlasan is 1,950m high and Seoraksan is 1,708m high, while most mountains are 500m-or-higher ones or hills, with slight slopes.

Most of the plains are activated in the west and south. Representatively, Anseong Plain, Yesan Plain and Honam Plain go towards the west; Naju Plain and Kimhae Plain are located towards the south; Ulsan Plain alone runs towards the east.

Most of the rivers and streams run towards the west and south. They flow so slowly that they played a key role as waterways before modern transportation systems were developed. They flow down in such a greatly curved way that they cause flood damage. The rivers that flow into the Yellow Sea include a few raised-bed rivers. For long after Independence, forests around the upper rivers were so devastated that soil was deposited, which caused

the rivers to be raised-bed ones. But into the 1970s, reforestation helped restore the upper rivers.

The coastal lines, surrounded by three seas, are long. The coastal lines on the East Sea are simple but the mountains on them are steep, forming a lot of scarps. In contrast, the coastal lines on the Yellow Sea and South Sea are so curved and the waters are so shallow that they have continental shelves developed. The mean tidal range there is so wide that in a low tide, you can see wider reclaimed areas, with an abundance of room for reclamation. The area around the Gyeonggiman Gulf is a good place to build a tidal power station.

The Korean Peninsula has a temperate climate. In winter, it has cold and dry weather; in summer, it has hot and moist weather. The temperature ranges from 5°C to 15°C on average (10-15˚ in the southern areas, 10-12°C in the midland, 5-10°C in the northern areas). Two thirds of the annual rain falls from June to September; the proportion of annual rainfall for the 6 months from October to March fall is just one sixth. The rainfall varies widely geographically. Jeju Island and the southern areas have rainfall in abundance (1,500mm); the inland areas have less than 1,000mm of rain. However, the Korean Peninsula has experienced a remarkable meteorological change over the past 100 years. In the same period, the average temperature has risen by 1.5°C. The days on which it is lower than 0°C, with frost, has decreased by as many as 30 days annually. Even the one-time amount of rain and snow has increased. While the days on which it rains or snows have decreased, the annual rainfall has increased. If it rain or snows, it does more than before. The days on which more than 80mm of rain falls have increased from 1.6 days to 2.3 days.

As the average temperatures on the Korean Peninsula have risen, the herbal ecosystem has gone through a remarkable change. According to the National Academy of Agricultural Science, the average temperature of Seoul in March in the 1930s was 3°C; cherry trees there came in bloom on about April 14. Of late, the same period sees the average temperature rising up to 6°C and the trees bear flowers around April 5.

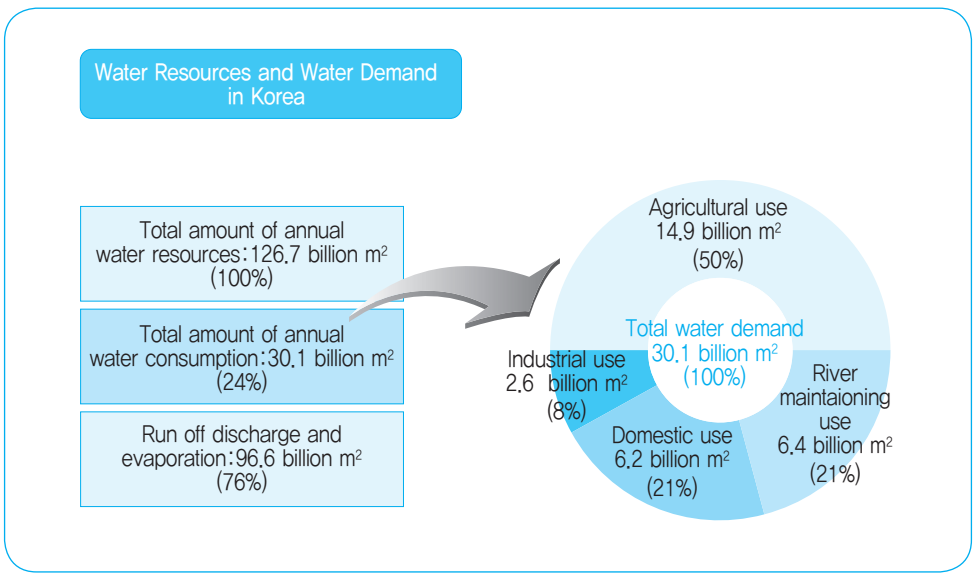
On the other hand, a scenario about the future climate on the Korean Peninsula by the National Institute of Meteorological Research predicted that 2100 will see another 6°C rise and that rainfall will increase by about 25%. Recent meteorological statistics reveal that the Korean Peninsula has experienced an abnormal climate. In 2002, when Typhoon Rusa ran through the Peninsula, Gangneung City has 871mm of daily rainfall, which set the highest national record in the history of meteorological observation. In 2003, Typhoon Maemi set the record for wind, at 60m/sec.

1.2. The Present State of Use of Water Resources

Water resources stem from rainfall. Korea's annual rainfall averages 1,283mm, which is 1.3 times higher than the global average value, and so Korea is interpreted as having an abundance of rainfall. But, in consideration of population density, 2,705m^3 of rainfall is allotted to each person, meaning that it reaches as little as 12% of the average value of the world. And it is not so, even in temporal and spatial terms, that the country has had difficulty acquiring stable water and frequently suffered flood disasters caused by floods. The rainfall has such a wide gap—ranging from 754mm to 1,683mm—that the country has experienced a lot of drought and floods.

The total amount of water resources from annual rainfall reaches 1,276m^3 but a matter of 80% of it disappears because of evaporation, infiltration, flooding and so on; the total amount of used water resources are 29.4 billion m^3 (23% of total water resources), as of 2006. With the amount classified by use, 15.8 billion m^3 or 50% of water resources are used for farming; 22% for domestic use; 9% for industry; and 21% for river maintenance.

Figure 1-1 | Status of Using Water Resource in Korea



In consideration of the link with drought, the characteristics of rainfall around the river basins of 10 rivers are as follows: The river basins around the Nagdong River and the Hyeongsan River have less rainfall (92-85% of the national average rainfall). The Yeongsan River has the fewest water resources in the five rivers, and rice paddies there account for just about 30% of the rice paddies in Jeollanamdo areas. Fifty-five percent of the paddies

are located in the southwest coastal areas, which makes it difficult to get agricultural water resources. This explains why these areas suffer more drought damage.

The fact that only 23% of water resources are used means that the rivers have little minimum flow except for ten days out of the year. Therefore, in drought, small and mid-sized rivers and streams there lack water. In contrast, as irrigation systems to make use of water resources, the fiver rivers have had multi-purpose dams and river mouth weirs constructed; small rivers have had small dams and reservoirs constructed in order to acquire life water or agricultural water. There were a host of water-raising systems and reservoirs constructed along the rivers. Recently, groundwater (including rock groundwater) has been exploited in preparation for drought or to acquire field water.

The country has 4 multi-purpose dams with the reservoir capacities of more than 1 billion m^3: Soyanggang Dam (2.3B m^3), Daecheong Dam (1.49B m^3), Andong Dam (1.25B m^3). There are also freshwater lakes formed by river mouth weirs built in the river mouths of the Anseong Stream, the SabgyoStream, the Yeongsan River, and the Nagdong River, which have laid the infrastructure for industrial development in the southwest areas, as well as making it possible to make multipurpose use of water.

This assumption of the amount of water resources has experienced several adjustments decade-by-decade by means of an average rainfall for the past 30 years, by setting a standard year: 114 billion m^3 in the 1970s and 1980s adjusted into 127.6 billion m^3 in the 1990s and back into 127.6 billion m^3 in 2000. This amount of water resources was calculated based on the total amount of by-month average rainfall for the past 30 years, on the premise that the whole country is divided into 10 river mouths, the south, east and west coastal areas, and Jeju Island.

2. The Change in Agriculture

2.1. The History of Agriculture

It is presumed that Korean agriculture originated from the age of primitive farming conducted by our ancestors who migrated from the continent to the Peninsula, instead of experiencing nomadic ages. In the past, it had been accepted that China was one of the areas from which farming originated. But the year of 1988 witnessed rice seeds from the Paleolithic Age found in Soro-ri, Oksan-myeon, Cheongwon-gun, Chungcheongbuk-do, which served as counterevidence to the existing theory.

The rice seeds named ‘Sorori rice seeds’ were those planted about 13,000 to 17,000 years ago as revealed by radiocarbon dating, indicating that the seeds are thousands of years older

than the rice seeds found in Hunan, China, planted 11,000 years ago, known as the oldest rice seeds. As the Sohori rice seeds became known as the oldest, a study of the origin and spread of rice farming in the Korean Peninsula and East Asia has experienced a remarkable change, too.

After achieving independence from Japan, the Korean government made and implemented a variety of policies for farming development. In 1949, land reform measures were implemented by the Land Reform Law. There were a lot of laws established and implemented for the purpose of farming development – in order, they were: the Farming Cooperative Laws, the Rural Village Promotion Law, the Stockbreeding Cooperative Law and others. After 1962, there were 6 five-year economic projects established and implemented, which helped the country experience an astonishing growth in agricultural productivity and food, along with the Saemaeul Movement and stage-based plans for food supply increases. At last, Korea achieved the independence of rice supply, as a result of remarkable growth in agricultural technology and with the help of the so-called green revolutions. In 1992, the five-year project for a new economy was established and implemented; 1995 witnessed the establishment and implementation of the Rural and Fishing Special Taxes in order to give Korean agriculture a global competitive edge, as Korean farmers were in serious crisis in the wake of the establishment of WTO policies.

2.2. The History of Agricultural Irrigation

Agricultural irrigation is referred to as many kinds of irrigation facilities and the accompanying management systems necessary to acquire and use water for farming. In Korea, dammed pools for irrigation, sluices, reservoirs, banks, waterways, and pumping stations are referred to as agricultural irrigation facilities.

Korean agriculture is focused on rice farming. The agricultural irrigation projects center on land improvement projects. The projects include irrigation, drainage, soil replacement, land consolidation and others. Dammed pools, sluices, reservoirs, banks, waterways, pumping stations, all of which are facilities built by these projects, are commonly referred to as agricultural irrigation systems. The rights to pull water into land and drain water from it is commonly referred to as the rights to agricultural irrigation. The purpose of agricultural irrigation was to improve land productivity, provide stability and improvement in farming management for each farmer, and maintain and improve food productivity in terms of the national economy. But in recent years, irrigation projects have been developed on a large scale as a result of an increase in demands for water resources in such various fields as hydroelectric power generation, industrial water and life water, as well as agricultural water. Even so, the direction of irrigation is set from the viewpoint of general land development.

The history of agricultural irrigation stands side by side with the origin of agriculture. In China, from the 8th century to the 3rd century B.C. there were large-scale artificial irrigation structures. In the ancient times, Egyptians controlled water to use it for farming. In Korea, the Age of Three Countries witnessed irrigation in use. In 138 A.D., in the dynasty of Shilla, the king ordered banks to be built nationwide. In 330 A.D., Byeoggol Bank was built in Gimje City, Jeollabuk-do; the bank's stone pillars and sluices remain to this day. By 1730, 3,575 riverbanks had been built. In 1782, there were 3,378 riverbanks. In 1909, the Ministry of Commerce and Industry announced that there were 2,781 riverbanks. During the Chosun Dynasty, King Taejong appointed an official for farming recommendation, who was ordered to supervise the construction of riverbanks. In 1662, Jeonsa, a public organization for controlling riverbanks, was established in order to supervise the construction of riverbanks in each province. In 1778, Jeonjeolmok, a book on reservoirs, was drawn up and handed out to each province in order to maintain and manage riverbanks thoroughly.

Chapter 2

The Summary of the Development of Irrigation

1. The Summary of Irrigation
2. The Processes of the Development of Water-utilization Infrastructure

The Summary of the Development of Irrigation

1. The Summary of Irrigation

1.1. The Summary of the 60-year Agriculture (Agricultural Policies) and the Infrastructure of Agricultural Production

The agricultural policies after Independence can be roughly classified into three policies: policies for food increase till the 1970s, policies for structural improvement in the 1980s and 1990s, and policies for rice production adjustment in the 2000s. In the process, a policy for price support to encourage food production and increase farmer income, the policies for modernization of production processes, and the policies for expanding the scale of management were made and implemented. In recent years, the policies for direct payment and a policy for eco-friendly farming were introduced to cope with the waves of free international trade of agricultural products and global competition.

Schematized, these processes will be as follows: 1) the policies for food productivity increase and land reforms until the 1950s → 2) the policies for food increase and for modernization of production processes from the 1960s to the 1970s → 3) the policies for structural improvement and for price support (expanding the size of management and land maintenance) from the 1980s to the 1990s → 4) the policies for adjustment of rice production in the 2000s (introduction of eco-friendly agriculture and a system for direct payment).

The maintenance and repair of the infrastructure for rice production conducted under the flag of these agricultural policies could be restarted and established by the aid until the 1950s. In the 1960s, the government added groundwater to agricultural water, based on the plan for development of all-weather agricultural water resources (a 7-year plan), which prompted the development of groundwater (pipe-shaped wells, infiltration galleries),

pumping stations, dammed pools, reservoirs, and the like. In the 1970s, the introduction of credit-based funds from IBRD and so on was activated, which led to large-scale comprehensive development for a multipurpose use: agricultural water, reclamation, land consolidation and others. In the 1980s, depending on evaluation of the freezing-resistance ability, the plans for development were further subdivided: new development, reinforcement development, preparations for drought and so forth. This gave birth to the 10-year plan and the expansion of facilities. In the 1990s, the policies were turned into those in which there was little financial burden to farmers. At the end of 1993, the Uruguay Round (UR) was signed, which led the government to focus its attention on intensive investment in farming, nominally providing an agricultural competitive edge for farmers.

However, under the system the WTO established in 1995, the policies for support of rice prices had to be given up and, instead, the policies for production adjustment had to be implemented. As a result, in the 2000s, the focus on irrigation began to shift from development to maintenance and reinforcement. The totally accumulated expenses of the projects from 1947 to 2007 reach 425 trillion won, which can be calculated as 569 trillion won, at 2007 values. The expenses have given birth to a land area of 2,370,000ha. The area includes the spaces stemming from the projects for irrigation and drainage (reservoirs, pumping and drainage stations, dammed pools, groundwater facilities), farmland acquired by reclamation, sectioning, waterways for farming and drainage, and farm roads, land consolidation, and so on.

2,100,000ha, excluding 270,000ha from making and maintaining fields, has been acquired by the maintenance of rice paddies. Because the areas from the land consolidation overlap with those from the development of agricultural water, 1,130,000ha, minus these areas, is really a result of the maintenance of rice paddies.

The development of irrigation, whose resources come from reservoirs, pumping and drainage stations, groundwater, and others, was dependent largely on a role played by the Land Improvement Cooperatives. This includes large-scale projects for development of agricultural water. The expenses of investment in the totally accumulated amount of 420,000ha account for about 80% of the total amount of investment. In addition, 1.7 trillion won, equivalent to 25% of the total amount of investment, was invested in projects for maintaining facilities dedicated to disaster restoration and repair, whose achievements were not calculated. In particular, investments in the projects for drainage improvement and repair have been gradually expanded for the purpose of disaster prevention through investment in social overhead capitals (SOC). The investments in drainage investment and repair in the 1990s and the 2000s increased twofold and threefold, respectively. The investments in the maintenance, including repair, of facilities increased by 12% in the 1990s and by 24% in the 2000s: an indication of a double increase. This suggests that if development and

maintenance projects are completed, more importance will be attached to maintenance than to new development.

The difference between investments up to the 1980s and investments in the 1990s and 2000s in achievement of investment is remarkably shown in the field of restoration of irrigation facilities from flood disasters. Global warming has recently had such an influence on the environment that abnormal climate frequently occurs, which causes severe rain storms. As a result, irrigation facilities have been immensely damaged, greatly increasing restoration expenses. In the 1970s, the expenses of restoration accounted for merely 5% of the expenses of development of agricultural water, 12% in the 1980s, 45% in the 1990s, and 106% in the 2000s. This is because the facilities have neared the end of their lifespan and because of frequent, severe rain storms.

Meanwhile, the total amount of 42 trillion won invested for the past 60 years includes 712.1 billion won invested until the 1970s (4.64tn won adjusted for inflation), suggesting that there was a wide gap in price index. In this view, it is assumed that if the projects for maintenance and development start from now, it will take nearly 100 trillion won to get the 60-year achievements.

1.2. The Change in Agricultural Villages

1.2.1. The Change in the Conditions for Agricultural Production

In the 60 years after Independence, Korean farming and the conditions for production have drastically changed. The areas of farmland increased by 328,000ha, from 1,970,000ha in 1950 to its peak of 2,298,000ha in 1970. Afterwards, it has been on the decrease. In 2005, it was 1,800,000ha, decreasing by 498,000ha. The farmers accounted for 55% of the entire population in 1965 but for just 7.1% in 2005, indicating that they have decreased by 48% for the past 40 years, numbering 3,434,000 people. 1,000,000 people, roughly one third of the farmer population, are people over 65.

Despite the fact that in this manner, the areas of farmland and the farmers have been on the decrease, food production has increased by 55%: from 3,702,000tons in the 1950s (the average value for 10 years) to 5,725,000tons in the 2000s. However, almost all agricultural products except rice and beans have been imported, indicating that domestic crop production is an extremely small portion of what is consumed. Rice production has been self-supplying since the mid-1980s. In contrast, barley production was self-supplying until the 1970s, but the ratio of self-supplying is at 50% or higher. As for wheat and corn, the ratio of self-supplying is less than 1%. As for beans, it is at less than 10%. These trends show that food production has been too dependent on rice. As for food crops, rice accounted for 55% or so

in the 1950s and 80% or higher in the 1985. The ratio of rice to food crops has since been on the rise, nearing 90%.

Rice paddies, the infrastructure for rice production, have, from the period of Independence to now, been maintained in the wake of the building of irrigation facilities, land consolidation, and so on. This has made it possible to acquire agricultural water and use machines to increase rice production. Irrigated paddies, accounting for merely 34% of all rice paddies in 1955, have increased to 78% at present. The land consolidation performed from 1964 has maintained and repaired 742,000 hectares of rice paddies. In addition, reclamation has created 217,000 hectares of rice paddies and fields, meaning that the projects for development and maintenance have laid the infrastructure for agricultural development.

Up to the present, there have been trends of production of food crops that were too dependent on rice production, because rice production has been expected to ensure stable farming income. But, there have been big differences in productivity according to climate conditions. Although rice has had an 80% or higher of self-supplying ratio, the year of 1980 saw it in decline by 1,976,000tons, because of drought and cold disasters. In 1995, rice declined by 563,000tons because of drought. Other climatic factors very often influence rice production, increasing by 400,000 to 500,000tons, compared to ordinary years. These describe the characteristics of Korea's rice farming.

1.2.2. The Change in Life Conditions

As for the living conditions in rural villages, farmers lived in a thatched house even up to the early 1960s. They were poor and obsessed with old traditions. In a word, they lived pre-modern lives. The military government, in the wake of the "5·16 Coup" in 1967, invigorated these rural villages.

The coup government promised that it could "urgently solve the problems facing people who had been troubled by despair and poverty." It energized all the societies including rural villages for renewal. It began in earnest to nullify all old institutions, for example, abolition of debts with high-rate interests. The coup government did everything to increase food productivity and farmer income, in addition to a movement for rebuilding the nation, which invigorated rural villages.

The Saemaeul Movement, under the motto of "Diligence, Self-reliance and Cooperation," in the early 1970s, acted as a catalyst for rebuilding rural villages in both mental and physical terms. It started from the sites in which there was restoration from water damage. On August 4, 1969, then-president Park Jeong-hee paid a visit to a village in Cheongdo-eub, Gyeongsangbuk-do, in the act of observing water-damaged districts. The village had its

roads and roofs greatly improved. Looking at it, the president asked the residents how it had improved so well. They gave a brief explanation of it. The villagers had volunteered to team up with each other to better and beautify their villages and improve their living conditions. The president witnessed a new model of rural development.

On April 22, 1970, taking the village as an example, President Park ordered a nationwide movement for village rebuilding to be performed, based on cooperation among related administrations, public servants and civilians. His instructions included about 10 plans for rebuilding villages: expanding roads, maintaining small streams, improving roofs. The government planned to promote the project for rebuilding villages in the agricultural off-season from October 1970 to June 1971. It handed out 335 bags of cement to each of the 33,267 villages free of charge. It encouraged villagers to have discussion with each other to make efficient use of the cement. The Movement went on in the direction of the trinity of mental development, environmental improvement and income increase.

The Movement in the 1970s, in which a song "Let's live a better life!" was sung by all villagers, achieved an astonishing accomplishment in the short-term. Every village had its thatched house, traditional walls and toilets improved, which had been a symbol of poverty. Almost every village was equipped with hygienic wells, water supply, village halls, village warehouses, and public bathrooms. A network of roads, including improved roads, played a key role in the distribution of food crops and prompted mechanization in rural villages. The Movement helped improve living conditions and farming and bring about a new atmosphere and life order, in addition to abolishing obsolete traditions and empty formalities stuck to by villages. Villages established their own new conventions to put off gambling and superstition and simplify such conventions as marital and funeral rituals.

2. The Processes of the Development of Water-utilization Infrastructure

2.1. The Rebuilding of Irrigation through Aid (the Late 1940s to the 1950s)

The key of the country's agricultural policies in the period of pre-industrialization, from Independence to the 1950s, lied in taking measures against food shortage and implementing land reforms. A system for purchase of food crops, the introduction of surplus food crops by US Public Law 480 (aided food crops), and plans for food increase were adopted as solutions to food shortages. The aided food crops started in 1956. They accounted for 2-3% of all domestic food crops, which made a great contribution to the food shortage solution

but which decreased the prices of domestic food crops and, as a result, worsened the rural economy.

The land reforms conducted from 1949 aimed to make farmers independent, following the principle that "The grower should be the same as the owner." By law, the government distributed land to each farmer for payment (allowing each farmer to take possession of 3 hectares). The land reforms, aimed to abolish the classes of landowners and instead establish a system for self-growing, laid the infrastructure for industrialization after the 1960s.

On the other hand, from the late 1950s, the 15-year maintenance of agricultural infrastructure was gradually expanded in the wake of the rebuilding of irrigation projects and the war restoration. Going through the establishment of the US-led military government, followed by the establishment of the Korean government, by the Korean War, the Korean government continued performing irrigation projects led by irrigation cooperatives. The programs included a project for the establishment of small and large districts. The government depended on funds and equipment supplied with the help of aid from the US-led military government, ECA, FOA, ICA, and others, to continue projects that had started earlier. The Joseon Farming Land Development Corporation and Joseon Irrigation Cooperative Association played a functional role in restarting these projects.

Table 2-1 | Supply Status of Major Instruments (late 1940s-1954)

(Unit : M/T, count)

Year	Source	Materials			Water Pumping Machine		Heavy Machines including bulldozers
		Cement	Steel	Gunpowder	Motor	Water Pump	
40s	U.S. Military Gov. ECA T/P	4,782 8,712 -	359 184 -	146 - 23	- - 78	- - 35	36 - -
1950	ECA T/P	5,630 -	686 -	- -	16 5	8 2	- -
1952	UNKRA T/P	39,856 14,310	893 500	59 30	- 1	- 53	8 -
1953	UNKRA T/P(Japan) T/P (Korea)	14,436 10,000 -	1,500 - 435	- 30 -	- - 2	- - 35	- 19 -
1954	FOA Procurement Service T/P	- - 3,750	- - 300	- - 2	- 3 38	- - 31	31 - -

2.2. The Plan-based Development in Pursuit of Agricultural Modernization (1960s to 1970s)

The agricultural policies implemented in the period of economically high growth, from the 1960s to the 1970s, were in pursuit of food production increase and modernization of production processes. The Second Five-year Economic Development Project, established in July 1966, was to put into practice the modernization of industrial structures, the establishment of self-sustainable economy, the stabilization of the market economy, food crop increase, and reforestation. And it was to gradually implement the plans, on the premise of laying the foundations for the establishment of a system for food self-supply and agricultural modernization, included in the Comprehensive Farming Development Plan established in April 1967.

The means of putting these policies into action included developing and spreading agricultural technology, educating about agricultural technology, forming farmland and performing land consolidation by means of reclamation, developing agricultural water, seed improvement, spreading farming machines, and so on. The Rural Modernization Project established in May 1970 was highly regarded, as it made a pivotal contribution to improvement to infrastructure for farming production and conditions for food crop production, based on the Rural Modernization Promotion Law established and published in the beginning of that year. In an attempt to develop rural communities, there were a lot of policies adopted: electricity supply, road improvement, and price support policies like the policy for high prices of rice and barley, to ensure the higher income of farmers.

On the other hand, the Samaeul Movement, which appeared in 1970, aroused the importance of life environments and economic desire in farmers. Spreading from place to place, it helped with improvements to roads, walls and roofs, which made an important contribution to improving rural environmental conditions.

The maintenance of agricultural infrastructure in this period was shown in such various ways as the establishment of projects for agricultural water, reclamation, and land consolidation (legal regulations established), along with mid-and-long-term plans. The most important tasks of the agricultural policies of the day were to increase food crops. For this purpose, in an attempt to conduct a national cause, there were projects for step-like reclamation conducted, incorporation of irrigation cooperatives, and new performance of land consolidation.

The 1960s saw seven laws established: the Land Improvement Project Law, the Reclamation Promotion Law, the Farming Land Creation Law, the Commonly Shared Water Reclamation, the Special Law on Incorporation of Irrigation Cooperatives, the Special Law on Clearance of Long-term Bonds for Land Improvement Projects, and the Groundwater

Construction Law. In particular, by dint of the All-weather Farming Water Resource Development Project established in June 1965, groundwater began to be exploited for agricultural use. However, groundwater caused some problems in terms of practicality, too.

The 1970s was helped by the projects established and implemented in this manner in the 1960s. In the 1970s, the agricultural projects were able to be more systematic than those in the 1960s, focusing more on maintaining the farming infrastructure. The introduction of foreign credits for acquiring project funds caused a drastic change to the way of conducting projects or at technical levels. In 12 areas in which such projects were conducted, like the Geumgang District and the Pyeongtaek District, careful consideration of project performance was provided in terms of policy: promotion of large-scale agricultural foundation development projects, and increase in the ratio of support for project expenses.

The credit-based projects at this time aimed to supply agricultural water to the reclaimed areas on the West Sea and the South Sea and to rain-fed paddy fields in the backcountry areas, and to conduct land consolidation and create reclaimed areas. The construction of river mouth banks, which turned seawater to freshwater by blocking the banks, was a symbol of the country's technological advances in agricultural civil construction. It used agricultural water pumped from a freshwater lake to turn rain-fed paddy fields on the coasts, which lack any water resources, into irrigated paddies.

In addition, in legal terms, the previous Land Improvement Project Law was replaced by the Rural Modernization Promotion Law; the Farming Land Creation Law by the Farming Land Expansion Promotion Law; the Special Law on Clearance of Long-term Bonds by the Special Laws on Raising up Farming Land Improvement Cooperatives.

2.3. The New Development through Using Irrigated Rice Paddies (1980s)

The purpose of the agricultural policies in the 1980s lied in increasing farmers' income by encouraging them to grow profitable food crops such as fruits and vegetables and feed livestock, and to perform complex agricultural management, rather than by means of policies for food crop increase and price support in the 1970s. In the 1980s (a period of economic stability), the agricultural policies attached more importance to support for rural industry, growth of vegetables and spices, and stockbreeding. In 1978, a policy for importing agricultural products freely was implemented. But, it caused the prices of agricultural and livestock products to decrease, which, in turn, worsened the rural economy and increased rural debts, depriving farmers of economic activity.

In attempts to cope with this worsened farming economy, in March 1986, a comprehensive measure for rural community economies was announced; a measure for reducing debts

from farmers and fishers was announced in March and December 1987; a comprehensive measure for rural community development was announced in April 1989. The purpose of these measures was to help rural communities experience a balanced economic growth side by side with industrialization and to depend on an immense increase in extra-farming income to significantly improve the rural income structure, improving their living conditions to levels found in urban areas by the 2000s.

The measure in 1986 included the promotion of development of extra-farming income resources such as the introduction of rural industry, the expansion of farming-fishing income resources, improvement of rural life conditions, the establishment of special funds for farming and fishing community development, in addition to improving systems for efficient promotion of the measures and reducing economic burdens on farmers and fishers.

The measures in 1970 covered the policies for expanding extra-farming and farming incomes, reducing the debt load of farmers and fishers, improving rural conditions, and others. For this purpose, they included as a means of policy the expansion of farming-industrial complexes, tax support for rural factories, the expansion of supply of farming funds, the strengthening of the projects for education of farming and fishing successors, the expansion of support for infrastructure of agricultural production, and the like.

Additionally, the three measures implemented in the 1970s were incorporated into the measure in 1989, whose purpose lied in promoting the improvement in agricultural structures, stabilizing prices of farming and fishing products, laying the foundations for their demand, developing extra-farming income resources, developing the rights to stay in rural communities, reducing from the debt load of farmers and fishers, providing a stable economy for them, and so forth.

The maintenance of infrastructure for agricultural products implemented in these directions of agricultural policies experienced a drastic change in the field of irrigation, along with investments in the existing projects such as the completion of large-scale and comprehensive development projects and the expansion of land consolidation projects. The setting of development plans based on a survey for evaluation of the freezing resistance ability of irrigation systems stimulated a variety of gradual developments by establishing a 10-year plan for developing agricultural water, under the establishment of a new concept of irrigated paddies.

Table 2-2 | 10-year Agricultural Water Plan

Year	Rice Field Area ('000/ha)	Classification ('000/ha)				Irrigation Field Area ('000/ha)	(%)
		Total	Port	Reinforcement	Portable Water Pumping		
1980	1,307	-	-	-	-	893	68
81	1,308	30	30	-	-	907	69
82-86	1,352	303	168	17	140	1,031	76
87-91	1,385	252	222	8	-	1,247	90
82-91	-	555	390	25	140	-	-

In 1987 and 1988, the country witnessed the appearance of the cause of democratization, which led farmers and fishers to refuse to pay taxes. As a result, the ways of operating farmland improvement cooperatives were significantly improved in two ways: first, the system for election of the leaders was revived, which had been put aside for 28 years after the establishment of the Farming Land Improvement Law in 1961. Second, the expenses of participating in a cooperative were significantly cut down (from 25kg/10a to 5kg/10a). This difference was compensated for by government subsidies.

In an attempt to relieve farmers and fishers of burdens, the un-refunded expenses of long-term debts partly incurred by farmers and fishers were paid with the help of government subsidies. Irrigation facilities were regarded as social overhead capitals (SOCs) and received support from government subsidies. The burden on farmers when land consolidation was conducted was reduced from 20% to 10%. In a word, there were epoch-making reforms in all the fields covering production base and maintenance.

These reformative measures increased the scale of investment in drainage improvement and land consolidation projects from the late 1980s. The investment in drainage improvement increased to 21.7 billion won in 1986, from less than 10 billion won; to 48 billion won in 1989. The investment in land consolidation increased from 24 billion won (annually on average) to 124.6 billion won in 1986 to 1989, indicating a more-than-5-fold increase.

2.4. Intensive Development for Having a Competitive Edge in Preparation for the Uruguay Round (1980)

As the 1990s started, it was highly likely that the UR, launched in 1986, would be signed. In this period, the agricultural policies went in the direction of a drastic improvement to agricultural structure and the achievement of a global competitive edge in agriculture to cope with the age of free trade. As the UR was concluded at the end of 1993, the key

tasks of agricultural policies were to restructure agriculture by implementing policies for production-neutral income increases, expanding production base, expanding the size of farmland, and so on.

The measure in 1991 concretized the 1989 plans to invest 42 trillion won in improvements to agricultural structure. 1994 witnessed two policies announced: the Measure for Rural Community Development and the Plan for Promotion of Agricultural Policy Reforms on June 14 and the Plan for Rural Community Special Tax Investment on July 4. They were successors to a series of comprehensive measures that started in 1989. The 42tn-won project for improvement to agricultural structure was to be completed in 1998, instead of in 2001. And at the same time, the measure planned to secure financial resources for investment by establishing the farming and fishing special tax worth 1.5 trillion won.

The policies for maintaining production base implemented in link with these agricultural policies were followed by the establishment of many kinds of related regulations and the implementation of new related projects. The related regulations include the Rural Community Development Special Law, the Rural Community Maintenance Law, the Law on Korea Rural Community Corporation and Farming Land Management Funds, the Farming Land Improvement Cooperative Law, and so forth.

In particular, the Rural Community Maintenance Law in December 1994 was a full substitute for the Rural Community Modernization Promotion Law established in 1970, regulating overall procedures for the maintenance of agricultural and fishing infrastructure, the improvement to rural life environments, the development of resources for rest, the maintenance of marginal farmland, and so forth.

Stimulated by the establishment of the WTO (January 1, 1995), the projects in the field of maintenance of production base in the 1980s (implemented pursuant to these related laws) focused investment on the development of agricultural water, drainage improvement, large-scale farming development, land consolidation, and so on, which helped reach the goal of maintaining the infrastructure of good farmland in the areas of agricultural promotion in 1998, earlier than planned. Furthermore, there were a host of projects newly adopted: land consolidation (1991), the development of agricultural water for fields (1993), the building and maintenance of farm roads (maintaining the infrastructure of fields), the widening and paving of existing roads mainly in land-consolidated areas (1994), the dredging of reservoirs, and so forth. More investment was put in the repair of roads in irrigation systems: a 5-fold increase, compared with investment in the latter part of the years.

2.5. Strengthening the Policies for Conservation and Management for Disaster Prevention (2000s)

The agricultural policies of the 2000s were characterized by the agricultural and rural community policies based on a mixture of agriculture and rural community. The Basic Rural Law announced in 2000 served as the basic policy concerning the direction of national policies as well as the direction in which agriculture and rural communities should go, covering the maintenance of the infrastructure of agricultural production, the appropriate sizing of farming, the promotion of agricultural mechanization, as well as accepting the principles of market economy and encouraging sustainable eco-friendly agriculture in consideration of its functions of public interest, in addition to policies for restructuring, stable supply of food crops at stable prices, improvement to distributional structures, and so on.

The key policies implemented based on these priorities were concerning the adjustment of rice production and the introduction of direct payment systems, in addition to the focus on farming's functions of public interest, support to areas with poor conditions, the development of eco-tourism for the expansion of rural-urban communication and income increase, and the development of resources for rest. In particular, based on the policy for adjustment of rice prices, there were three measures taken for putting restrictions on prices of rice purchased by the government (in 1993, 1997, and 2001). In 2005, the prices were cut by 16%. At present, the prices are autonomously adjusted by the Agricultural Cooperatives.

As the policies turned their focus from production increase to autonomous price adjustment, the development of irrigation systems for rice paddies has put its focus on the maintenance and repair of the existing facilities rather than on the development of new facilities.

In 2004, the project for ordinary land consolidation came to an end. Repair and maintenance of irrigation systems was expanded for the purpose of disaster prevention. Farmers, or beneficiaries, were exempted from expenses of facilities management. The Farming Land Improvement Cooperative incorporated the three organizations and transferred the systems for management, which were under its control, to the Korea Rural Community Corporation in order to enhance the efficiency of management of irrigation systems and water resources, in harmony with radical changes in international political situations and open trends.

Table 2-3 | The Chronological Summary of the Development of Irrigation Infrastructure

Chronology	Major Events
Late 1940s	• Restarting the projects for irrigation - Building central and provincial administrative organizations in charge of farmland improvement (September 1945) - Reviving the functions of Joseon Irrigation Association and Joseon Farm Land Development Corporation (October and December 1945) - Restarting the project for irrigation (March 1946) • The equipment for irrigation supplied by means of the aid provided by the US-led military government and ECA
1950s	• Activating irrigation projects by means of acquisition of project funds - Acquiring funds by means of the aid funds by the USA and the special funds for agriculture · Acquiring funds by means of UNKRA, FOA, ICA, and so on (allotting subsidies) · Acquiring project funds (subsidies) with repayment money by means of farmland reforms (Special accounting of farmland reform projects and for attributed farmland management projects) · Acquiring funds for irrigation (long-term bonds) by means of issuance of the national industrial restoration bonds (8 times, from 1954 to 1957) - Promoting projects centering the establishment of small and large districts (projects for irrigation and drainage) under the supervision of irrigation cooperatives
1960s	• Refining the institutions like the establishment of related legal regulations - Establishing the Special Law on the Incorporation of Irrigation Cooperatives (August 1961) · Incorporating 695 cooperatives into 198 - Establishing the Farming Land Improvement Project Law (December 1961) · Refining substitutes for old ordinances like the Irrigation Cooperative Ordinance, the Farming Land Improvement Ordinance, the Farming Land Development Corporation Ordinance - Establishing the Special Law on Clearance of Long-term Bonds for Farm Land Improvement (March 1963) · Taking a measure to clear part of the long-term bonds put in the irrigation cooperative projects (2 billion won)

Chronology	Major Events
1960s	• Establishing a plan for developing all-weather agricultural water resources (June 1965) - Setting the goal of the development plan: 357,000ha (7-year plan) - Conducting a basis survey of candidate locations to develop - Conducting a survey of the possibility of the existence of groundwater and developing pipe-shaped wells and infiltration galleries • Adopting projects for land consolidation (1965) - Including the expenses of land consolidation projects in government budgets for the first time • Introducing equipment and instruments such as machines for pumping and groundwater development, and dredgers; acquiring funds for irrigation by means of the reparations of Japan (from 1966 on) - Introducing materials: 4.4 milion dollars, project funds (subsidies) worth 30.7 billion won (1966 to 1975) • Setting new items of the unit projects for agricultural water development (from 1966 on) - Classifying the previous small and large district projects independently into such items as reservoirs, pumping stations, dammed pools, infiltration galleries, pipe-shaped wells, and others • Establishing plans for preventing drought and developing agricultural water (November 1968) - Establishing a plan for developing agricultural water of 418 hectares until 1973 in the wake of the great droughts in the Yeongnam and Honam Regions in 1967 and 1968
1970s	• Turning into a system for implementing projects for maintaining agricultural infrastructure in pursuit of rural modernization - Establishing the Rural Community Modernization Promotion Law (January 1970) · Establishing the Agricultural Promotion Corporation, which served as an agency in charge of comprehensive large-scale agricultural development • Implementing projects for comprehensive large-scale agricultural development by means of foreign credits (agricultural water development, drainage improvement, land consolidation, reclamation, and so forth) (from 1970 on) - Receiving credits from IBRD, OECF, ADB in order to develop 155,269 hectares in 13 districts - Developing large-scale agricultural water resources such as the Yeongsan River District, four dams (Naju, Jangseong, Damyang, Gwangju, whose irrigation areas are 34,500 hectares), freshwater lakes (Asan, Namyang, whose irrigation areas are 30,567 hectares) formed by river mouth weirs in the Geum River District and the Pyeongtaek District

Chronology	Major Events
1970s	• Introducing foreign credits from the AID (the Agency for International Development) in order to activate the agricultural water development projects • Implementing projects for powerful food crop production increase to cope with food crises - Implementing the Asan Development Project in order to acquire a food base (from 1974 on) - Establishing the Farming Land Development Promotion Law (1975) · Turning into a system for state-led development (from 1977) • Adopting the project for drainage improvement (1975) - Using government subsidies as expenses of farmland improvement projects for the first time • Incorporating cooperatives for the purpose of rational operation (266 cooperatives into 127) (1972)
1980s	• Enhancing the efficiency of management of irrigation systems and strengthening the management - Incorporating 123 cooperatives into 108, reducing employees from 4,390 to 3,808 (by 13%) (1981) - Establishing the regulations on management of farmland improvement systems (November 1986) · Establishing the Dept. of Irrigation System Management in the Agricultural Promotion Corporation, and conducting professional technical diagnosis of irrigation systems • Relieving the members of the Farming Land Improvement Cooperatives of financial burdens - Cutting the fees for the Cooperative (1988-1989) · Reducing the fees from 25kg/10ha in 1988 to 5kg/10ha in 1989 · Using the government subsidies for supplementing the expenses of cooperative operation (government subsidies for the fees for the cooperatives) • Adopting a system for supplementing the full expenses of farmland improvement projects (1989) - Developing large- and mid-scale agricultural water resources: fully supplementing with government subsidies - Developing small-scale agricultural water resources: 70% from federal government subsidies, 30% from local governments - Repairing the irrigation facilities owned by farming cooperatives: fully supplemented
1990s	• Returning to maintaining related ordinances and improving related legal systems - Establishing the Rural Community Promotion Corporation Law and the Farming Land Management Fund Law (April 1990)

Chronology	Major Events
1990s	· Expanding and restructuring the Korea Farming Promotion Corporation into the Korea Rural Community Corporation, allowing it a variety of functions of projects · Establishing regulations on investment of the farmland management fund in reclamation - Establishing the Special Law on Rural Community Development (April 1994) · Designating areas for agricultural promotion and regulating the direction of realizing the agricultural policies for structural improvement such as the maintenance of stay life scopes and procedures · Establishing the plans for rational use of agricultural water and making its promotion obligatory - Establishing the Rural Community Maintenance Law (December 1994) · Regulating the procedures for developing the living conditions in rural communities, resources of rest in rural community and marginal farmland as well as developing farming and fishing Production base - Establishing the Farming Land Improvement Cooperative Law (December 1995) · Establishing independent ordinances concerning the farmland improvement cooperatives pursuant to the Rural Community Modernization Promotion Law (Repealing the Rural Community Modernization Promotion Law) • Establishing the second 10-year agricultural water development plan (December 1995) - Investing 14 trillion won in developing 296,000 hectares out of 546,000 hectares for developing agricultural water (large- and mid-scale, small-scale, reinforcement development, in preparation for drought), comprehensive large-scale development, life water in rural community, repair of irrigation systems (from 1995 to 2004) • Adopting the project for field infrastructure focusing on developing field water (from 1994 on) - Supplying water by means of development of groundwater (mainly, pipe-shaped rock wells) centering on vegetables, special crops, fruit trees, flower fields - Pipe-shaped wells, pipelines, sprinklers, approaches, farm roads, sectioning, and so forth • Expanding the size of invested project expenses in maintaining the infrastructure of agricultural production in preparation for the UR (from 1995 on) - Reducing the period of use of 42 trillion won as expenses of rural community measures by 3 years (1992 to 1998) and increasing the government budgets by means of 15 trillion won of the rural special taxes (1995 to 2004), increasing investments from 1995 to 1999 three times more than the annual investments from 1990 to 1994

Chronology	Major Events
1990s	· Increasing the expenses of agricultural water development from 98.9 billiion won to 304.4 billion won (by 3.1-fold) · Increasing the expenses of repair of irrigation facilities from 47.1 billion won to 178.3 bllion won (by 3.8-fold)
2000s	• Incorporating related organizations (January 2001) - Incorporating the Farming Land Improvement Cooperative, the Associations of the Cooperatives, and the Farming and Fishing Community Promotion Corporation into the Korea Rural Community Corporation pursuant to the Law on Korea Rural Community Corporation and Farming Land Management Funds (established in February 1999) - Exempting full fees of cooperatives from 2000, and using the government subsidies and profits from construction work as the expenses of maintenance and management • Establishing the measure against drought (June 2001) - Establishing the Central Division of Drought Measure because of severe drought in the spring (June 5th to 20th), providing 287.4 billion won as expenses of drought measures • Revising the 2nd 10-year plan for rural community water (July 2001) - 14.345tn won, from 1995 to 2004 - Adding 1) water-pumping under-tow in preparation for drought, 2) reclamation on the coasts of the South Sea and the Yellow Sea, 3) automation and computation of water management facilities, 4) maintaining the field infrastructure • Establishing the long- and mid-term plan for the project aimed at maintaining the agricultural Production base (May 2002) - The total amount of investment worth 23 trillion won from 2002 to 2011 - Revising the same plan in February 2004; setting the years from 2004 to 2013 as the period of plan, with the total amount of investment to be 14.26t won (12% of the 119t won invested in the section of farming, forestry and fishing) • Establishing the Special Law on the Enhancement of Rural Community Villagers' Quality of Life and Rural Community Development Promotion (February 2004) - Establishing basic plans every five years to conduct comprehensive and systematic promotion of welfare, education, and regional development in rural communities - Incorporating projects related to rural communities conducted by the Minister of Farming and Forestry (Dept. of Agricultural Policy) and performing total functions concerning rural communities • Putting an end to the ordinary land consolidation project of the land consolidation projects (2004) - Putting an end to it in the spring of 2004

Chronology	Major Events
2000s	- Ratio of maintenance: 64% of the total areas of rice paddies, 90% of the maintenance-aiming areas (800,000 hectares), 82% of the areas of rice paddies of farming promotion • Establishing the 5-year basic plan for improving farmers' and foresters' quality of life and developing farming, forestry and fishing communities (April 2005) - Investing and financing 20.3t won from 2005 to 2009 • Establishing the Law on Korea Rural Community Corporation and Farming Land Management Funds (December 2005) - Establishing the Korea Rural Community Corporation (starting in January 2006) - Adding the tasks of the Farming Land Bank to those of the Korea Rural Community Corporation • Finishing construction work of blocking water at the Saemangeum Tide Embankment (April 2006) - Completing 81% of construction by 2006; investing 2,138,600,000,000 won (reparations included)

Chapter 3

The Restart of Irrigation Projects

1. The Change in Irrigation Systems
2. The Processes of the Restart of Water-utilization Projects
3. The Restart of the Projects, and Funding and Material Supply
4. The Establishment and Development of Mid- and Long-term Development Plans

The Restart of Irrigation Projects

1. The Change in Irrigation Systems

1.1. The Irrigation Systems in the Period of Independence

In the period of Independence, there were 598 irrigation systems left in the country, covering an area of 357,000 hectares. The complete irrigation systems were merely 257,000 hectares in area. The irrigation systems that remained unfinished covered 100,000 hectares in 93 districts. Only 70,000 hectares of irrigation systems, about one third of the small-scale irrigation systems of the 200,000 hectares constructed in the name of small reservoir construction projects from 1943 to 1945, were left completed.

Especially, at the end of the Pacific War (the late 1940s), the colonial Japanese government tried carelessly to construct irrigation systems, most of which remained unfinished. If they remained uncompleted, it was clear that they would cause tremendous flood disasters.

The end of the War caused the Korean Peninsula to have two governments (South Korea and North Korea) established. South Korea came to have 425 irrigation cooperatives (71%), with 188,000 hectares in area (53%). About half the irrigation systems in Gyeonggi-do, Gangwon-do, and Hwanghae-do came to belong to South Korea. It was unknown how many of them were left uncompleted. But, assumedly, they were 130,000-150,000 hectares in area.

1.2. The Change in the Management of Irrigation Systems

Irrigation systems, unlike other public systems, have their beneficiaries determined from scratch. Some of the expenses of construction should be incurred by the beneficiaries,

and so, in principle, the should also incur the expenses of maintenance and management. Accordingly, the irrigation systems have the same constructors and managers. This principle has been maintained for 90 years. But from 1989 on, the full cost of construction and 80% of the management expenses have been supported by the government. From 2000 on, all construction and management costs have been paid by the Korea Rural Community Corporation. In fact, the principle in which beneficiaries should pay the expenses has been abandoned. Accordingly, the description below is about the types of management by the irrigation cooperatives for 55 years after Independence. For 90 years, from 1908, in order to manage the irrigation systems, a lot of organizations were founded: representatively, the Farmland Improvement Cooperative (Irrigation Cooperative, Land Improvement Cooperative, Farmland Improvement Cooperative) and the Farmland Improvement Guild. Until the late 1990s, they were managed and maintained in a dual system—by the Cooperative and the local government, pursuant to the Rural Community Maintenance Law and the Farmland Improvement Cooperative Law (repealed in 1999). They were characterized by the fact that they were made up of just the beneficiaries (land owners). A cooperative, as a corporation based on the beneficiaries' voluntary organization, was responsible for constructing and owning an irrigation system, although a local government had nominally the same role. About half the cooperatives had a farmland improvement guild organized. Just before their incorporation, there were 12,025 irrigation systems under the control of 104 cooperatives. They had 959,000 members, covering 513,000 hectares in area. They were in somewhat good condition since the monies spent constructing the irrigation systems under the control of cooperatives were seven times higher than those spent constructing small-scale ones under the control of the local governments. For 55 years, from Independence to 1999, the cooperatives' members in charge of operation had operational difficulties. From the 1960s, almost every ten years, they had their cooperatives incorporated and abolished, or they experienced restructuring. They tried in vain to achieve rational management.

Of course, it was not a wise exercise in rational management to incorporate or restructure the organization. However, it was an effort to reduce financial burdens. The tasks of a cooperative are of seasonal character. It is difficult to generalize their tasks according to season like a company does. Their facilities are different in management difficulty. It is not rational to set a standard for calculating necessary workers by dividing the managed area by one management worker. Nevertheless, it has been used as a standard. In this country, the area that one regular worker can manage was 125 hectares; in 1996, it was 136 hectares. It looked like the cooperatives had attained rational management. As for Japan, one regular worker could manage 126 hectares; in Taiwan, he could manage 118 hectares.

In general, whether system management was in good or poor condition was dependent on whether to be given management expenses. The management expenses should, in principle, be incurred by the beneficiaries. According to expenses to be incurred, the amount was settled differently from district to district. It was inevitable to impose more fees on the beneficiaries who lived in an area with a pumping station or a drainage station than on those living in an area with a reservoir or a dammed pool. The standard for imposing them was differently set by a supervising organization from year to year. The imposed management expenses in the principle of "burdens by beneficiary" were 25kg/10a or so on national average; the beneficiaries near a pumping station should pay 30kg/10a. From 1989, the expenses were tremendously reduced: 5kg/10a (down from 10kg/10a in 1988). The insufficient amount was supplemented by government subsidies, pursuant to the Law (the insufficient amount of government subsidies was called government subsidies for fees of cooperative).

This measure was so welcomed by the beneficiaries because it relieved them of financial burdens and because it was easy for the cooperative in question to get their fees. As a result, it received the fees, 5kg/10a, from the beneficiaries. But the government failed to pay 20kg/10a, as government subsidies, to each of the cooperatives. For 5 years, from 1989 to 1993, they were short about 250 billion won (5.5kg/10a) and, from 1994 to 1996, they were short of about 100 billion won, which caused them to have difficulty managing the systems. In addition, lack of management expenses led to negligence in management of the irrigation systems, which acted as one of the factors that reduce equipment's lifespan and increase danger of disasters like flood. The operation of cooperatives in the 1990s was evaluated by financial autonomy made up of business (fee of cooperative + subsidies for fee of cooperative), of extra-business revenue, revenue on disposal of fixed assets; in addition, made up of business expenses and management expenses, mainly, internal business expenses, expenses of refunding loans payable, expenses of purchasing fixed assets; divided by total revenues minus subsidy revenues). The financial autonomy in the mid-1990s exceeded a mere 50%. For lack of basic revenue resources (fee of cooperative + subsidies for fee of cooperative), there were rarely cooperatives that achieved financial autonomy. Most achieved about 70% of the expenses of basis management (business expenses + management expenses). Most of the revenues were dependent on revenues on disposal of fixed assets, revenues on profitable business, or reparation revenues being incorporated into an urban plan.

2. The Processes of the Restart of Water-utilization Projects

As the Second World War came to an end in the wake of Japan's unconditional surrender, Korea was free of Japan's 36-year colonial control. Unfortunately, the Korean Peninsula had to experience division into two Koreas at 38° North Latitude. In South Korea, American forces stayed; in North Korea, Russian forces stayed.

In September 1945, America established its military government in Seoul. It acted to hold in check the attempt by autonomous political organizations to form a national power and succeed the government organizations and laws established by the colonial Japanese government. In September 1945, the US-led military government established the Dept. of Farmland Improvement in the Division of Farming and Commerce as a central organization in charge of irrigation administration. The also established the Dept. of Farmland Improvement in Division of Farming and Industry as a local organization. In October of that year, it revived the Joseon Farmland Development Corporation, an agency for farmland improvement and in December, it re-established the Joseon Irrigation Cooperative Association to make rapid preparations for restarting irrigation projects.

As the administrative organizations and their agencies in charge of irrigation tasks were established, they held meetings at which related public officials attended and declared the basic directives concerning the restart of farmland improvement projects. The basic directives were intended to give new guidelines to the operation of irrigation cooperatives and the Association, including problems related to the restart of irrigation construction work. The basic directives are summarized as follows:

First, concerning the restart of the construction work, 1) preferentially implementing the construction work uncompleted in the district of the Corporation, establishing a cooperative in a benefited district, and continuing the projects in progress; 2) focusing on implementing already-started work by an existing cooperative; implementing projects for disaster restoration, structural reinforcement (improvement work), electrical work, conversion to rice paddies, subsurface drainage; checking the facilities owned by cooperatives to establish a plan for improvement work; 3) with the projects implemented, raising the ratio of government subsidies; acquiring a usable amount from war supplies; 4) as for the construction work of commonly-shared waters licensed for agricultural purposes before 1945 and based on a permission of state-owned non-exploited land use, committing to the Association the restart of their construction work on the premise that they should help farmers establish themselves as independent; 5) improving the operation of existing cooperatives and restructuring the organization of the Association to let the Association restart improvement work and electric work, on commission from cooperatives.

Second, concerning the operation of a cooperative, 1) paying a salary to the leader(s) of a cooperative; restructuring the organizations; 2) imposing all fees to a farmland owner; letting the burdens by a tenant farmer (50%) be settled between the tenant farmer and the farmland owner; requiring its members to refund cooperative bonds in yearly installments; maintaining the system of reserves in preparation for disasters and insufficient revenues; 3) focusing on maintaining and managing irrigation facilities by the members' own will by continuing to promote agricultural improvement projects; actively promoting incorporation with adjacent cooperatives.

Third, concerning the Irrigation Cooperative Association and the Revived Irrigation Cooperative Association, 1) restructuring the organizations; committing the work of disaster restoration; 2) restructuring the cooperatives of the Revived Irrigation Cooperative Association; creating a model of agricultural improvement within a member cooperative.

Based on the directions of the US-led military government, in spring of 1946, the projects done by the Farmland Development Corporation - and only some projects for reclamation by the cooperatives - could restart by means of funding and material supply.

On the other hand, although some projects restarted and new directions of operation for irrigation cooperatives were set, some of the procedures for projects regulated by the Joseon Irrigation Cooperative Ordinance and the Joseon Farmland Improvement Ordinance had yet to be partly revised in a democratic direction. Accordingly, the Irrigation Cooperative Association selected 26 learned persons to form a committee of irrigation institution inspection, discussing "A Plan for Improving the Institutions for the Farmland Improvement Projects" on October 21, 1946.

The committee's discussion included the following: 1) incorporating the Joseon Farmland Development Corporation, a technical group for farmland improvement projects to form a new organization; 2) raising the ratio of government subsidies and introducing a system in which a cooperative's fees should be paid in kind in order to activate business; 3) restarting projects.

This plan was to create the future direction of the farmland improvement projects. It was to turn the practice of forced project implementation from the Japanese colonial period into a democratic project implementation, urging farmers to be relieved of burdens and projects to be actively implemented. The plan, in pursuit of self-reliance, was re-confirmed and adopted in the First Irrigation Cooperative Conference held on November 1st, 1946. Afterwards, it was recommended to the US-led military government. On January 15, 1947, there was a petition transferred to the Intrinsic Assembly, which was an opportunity to raise and spread irrigation farmers' voices.

In the meanwhile, the Irrigation Cooperative Association revived the function of its council to operate it democratically. The Farmland Development Corporation established the first irrigation cooperative in May 1946, trying to operate it democratically.

In June 1947, the Irrigation Cooperative Association was given the task of loan conversion for long-term bonds of the business expenses (an institution in which the Association borrows money in a block, in the place of individual cooperative members) invested in the irrigation cooperative projects, supplying funds and materials to the member cooperatives.

Furthermore, as the reason for the existence of revived irrigation cooperatives disappeared, the Revived Irrigation Cooperative Association did not have any reason to exist. So, the US-led military government permitted the two Associations to be incorporated into one organization. However, their incorporation was delayed.

3. The Restart of the Projects, and Funding and Material Supply

3.1. The Restart of the Projects

As mentioned above, the irrigation projects restarted in March 1946. That is, the projects by the Yongdan Project District and the Committed Project District of the Irrigation Cooperative Association restarted. Materials like cement, reinforcing bars, and gunpowder necessary in 1946 were supplied by the US-led military government from the colonial Japanese government's stock. From 1947 to 1948, the materials were supplemented by US surplus war materials.

Especially, 14 bulldozers, which were transferred from the US-led military government in 1947, made their first appearance in a construction site in 1948. They exercised an astonishingly powerful ability to dig and move soil; for people in April of 1948, this was a truly jaw-dropping sight to behold. As soon as 9 bulldozers were transferred in 1948, the Korean government allowed the Irrigation Cooperative Association to build a heavy machine factory in November of that year, which was expanded into the Korea Heavy Machine Manufacturing Factory in October 1949. The irrigation projects for the 3 years following Independence were led by the military government, which supported materials and equipment and instruments. At the same time, the success in irrigation projects was a result of Korean irrigation farmers' efforts. The administrative procedures in the wake of the restart of irrigation projects at the time were as follows: The projects could be largely classified into irrigation cooperative projects and farmland owner projects (commonly shared projects by irrigation farmers). The cooperative projects had to be preceded by the

establishment of a cooperative. The projects were divided into a large district, larger than 300ha, under the supervision of the central organization, and a small district, 300ha or less, under the supervision of local government. A supervising organization was in charge of things such as granting permission for projects, providing subsidies.

60% of the projects' expenses were covered by government subsidies (ordinary account). The expenses from 1948 to 1949 were large enough to account for about 3% of total government expenditures, indicating that government expenditures played a key role in the irrigation projects at the time of the establishment of the government.

3.2. Funding through Various Capital Resources

The irrigation projects which restarted after Independence experienced a change in the wake of the farmland reforms in 1949. Farmland owners had taken active part in irrigation before; land-owning farmers began to assume the role from 1949. However, on June 25, 1950, the Korean War broke out. It put the restarted irrigation projects in difficulty.

In 1951, at the height of the war, Yeongnam Region suffered a big drought; the region was devoid of water, worsening the situation of food. This situation brought the importance of irrigation home to the people, because it was regarded as a prerequisite to food crop increases. As the war situation got better and more stable in the latter part of 1951, the government acted to restart the irrigation projects which the war had brought to an end, providing government subsidies for irrigation. From 1950 to 1951 although the war waged on, 168 districts saw irrigation construction projects implemented.

3.2.1. Funding through the General Account

The restart of irrigation projects in their infancy after Independence relied on the general account for funding (subsidies). In 1952, the expenses came from the special accounting for farmland reform projects; from 1955, they were supplied from the special account for economic restoration. As a result, the general account came to have little role to play in funding.

However, for 2 years, from the establishment of the government to the outbreak of the Korean War, irrigation projects depended more on the general account for funding although the government was faced with financial difficulties. For example, the expenditure budgets in the general account in 1948 were 30 million won, 864,000 won of which was paid for irrigation projects (2.9%). In 1949, they totaled 91 million won, 2.84m won of which was paid for irrigation (3.1%). The general account gradually increased in size from 30m won in 1948, through 19.2 billion won in 1954, to 40 billion won in 1959.

3.2.2. Funding through the Special Account of Farmland Reform Projects

Irrigation projects were characterized by supply of an immense amount of money and materials. It was urgently necessary to acquire long-term investment funds. The farmland reforms conducted from 1956 brought about the appearance of a multitude of self-sustained farmers, who wanted to have more irrigation systems installed. So, on April 12, 1952, the Law on Special Account for Farmland Reforms was established, which allowed them enough funds. The revenues of the Account (funds to be refunded for distributed farmland) could be expended in irrigation.

This law aimed to do accounting of the funds necessary for refunding and reparation, and for managing the attributed farmland and the attached properties, intended to invest the funds on refunding for the distributed farmland in farmland improvement and rural community construction.

This account included the account for farmland payments and the account for attributed farmland. The former, acquired from the refunds for distributed farmland as revenue resources, was intended to be spent on management expenses necessary for reparation for farmland prices and performing the tasks of farmland reforms. The latter, with the exclusion of the attributed farmland management expenses, was intended to be spent on farmland improvement and rural community construction. After all, the refunds for attributed farmland were intended to be paid back to rural communities.

As this special account served as an investment fund, the farmland improvement projects were expanded and activated. The Ministry of Farming and Forestry converted the Division of Farmland into the Division of Farmland Management, which included the Division of Attributed Farmland Management to establish the Dept. of Farmland, Dept. of Improvement, Dept. of Reparation and Refunding, and Dept. of Disposal, the two former of which performed the tasks of farmland improvement, the two latter of which performed the tasks of farmland reforms.

Although the War was in full swing, long-term investment funds for farmland improvement were sufficiently prepared by means of the Special Account to continue the projects that had restarted in the early 1950s. As long-term investment funds were sufficiently prepared by means of the special account, the farmland improvement projects were increasingly activated. So, the establishment of the special account made a pivotal contribution to the restoration of rural communities. The special account was repealed in December 31, 1961. The funds, from government subsidies pursuant to the Special Account and invested in farmland improvement for 8 years, from 1952 to 1959, reached 1,391,000,000 won.

The subsidies pursuant to the Special Account were supplied through the account for attributed farmland management. The total expenditures from this account invested in farmland development accounted for about 75%; 84% of the investment funds from farmland development expenses were spent in irrigation cooperative projects.

3.2.3. Funding for Irrigation through Aided Capital by UNKRA, FOA, ICA and Others

In 1950, part of the investments of counterpart funds by aid organizations like UNKRA, FOA, and ICA started to be put in farmland improvement projects; but they stopped in 1952. In December 1953, there was an agreement: "A Joint Committee Agreement on a Plan for Economic Restoration and Financial Stabilization," signed between the Republic of Korea and the USA, which revived the counterpart funds. On March 12, 1954, there was an establishment and declaration of the Law on Special Account for Counterpart Funds whose purpose was to operate the 'won' funds (counterpart funds) that were imported as freely-aided money in order to revive Korea's economy and stabilize its finances. The Law allowed the Korean government to establish a special account to acquire funds necessary for economic restoration. It was named the "Economic Restoration Special Account," which was replaced by the economic special account pursuant to the Economic Development Special Account Law established on November 29, 1962. The economic special account allowed the government to acquire funds for farmland improvement projects (government subsidies) in 1955.

The government subsidies invested in farmland improvement from 1955 to 1960 pursuant to the Special Account amounted to 3,477,000,000 won, accounting for 64% of the subsidies in the same period.

The procedures for execution of the Special Account whose main financial resources were counterpart funds were complex: the government (Ministry of Farming and Forestry and Ministry of Restoration) and OEC needed to work together with each other to execute the budgets. This explains how difficult it was, then, to get funds.

3.2.4. Funding through Issuance of Government Bond for Industrial Restoration

Most of the financing-based funds, except the funds of Korea Industrial Bank, invested in farmland improvement from Independence to 1953, were dependent on the Central Bank's rediscounted funds. Its conditions for financing were to use high-interest short-term funds: two years of grace period and repayment within 3 years, 7.3%-to-15.0% annual interest. The farmers had to repay the funds, which presented a big burden to them. Accordingly, it was not desirable to put short-term financing in farmland improvement projects. In an

attempt to solve this problem, on September 28, 1952, the government established the Industrial Restoration Government Bond Law pursuant to related legal regulations in order to acquire urgently-needed industrial restoration funds and announced the Industrial Restoration Government Bond Special Account Law to operate the acquired funds from issuance of government bonds. In December 1953, it established the Korea Industrial Bank Law to found a financial organization which was to treat long-term development financing. The long-term bonds invested in farmland improvement projects after 1954 were dependent on the restoration funds. The tasks of financing the long-term bonds were assigned to Korea Industrial Bank.

The establishment of related ordinances in this manner permitted the government to acquire investment funds by means of funds on the issuance of industrial restoration government bonds. The long-term bonds were issued two times by the agreement from the National Assembly in March 1954. Until 1957, the total 8 bonds were issued, to be used as investment funds.

At first, the conditions for repayment were disadvantageous to farmers: a 2-5% interest rate; a 4.7-15.0%% lending rate; a 2-year grace period based on 3-year installment repayment; or a 5-year grace period based on 10-year installment repayment. The conditions were improved from January 1959: a 2% interest rate, 3.5% lending rate, and 15-year installment refunding. This measure was very conducive to operating irrigation cooperatives and implementing farmland improvement projects. The funds invested in irrigation by means of restoration funds reached 3,044,000,000 won, accounting for 49% of the total funds (6,167,000,000 won).

However, heading into 1958, the issuance of the bonds was suspended; on January 3 of the year, the Special Account Law was repealed. From 1958, the funds were replaced by investment funds from the attributed properties disposal special account (established on February 16, 1959) and the food crop management special account (established on May 8, 1950).

Additionally, the tasks of financing were transferred to the Agricultural Bank established in April 1958, pursuant to the Agricultural Bank Law established in February 1957. In May of this year, there was a contract signed between the Irrigation Cooperative Association and the Agricultural Bank on the tasks of long-term bond financing. As a result, the Association borrowed investment funds and allotted them to each of the irrigation cooperatives.

3.2.5. Aid-dependent Funding for Equipment

One of the biggest difficulties in promoting irrigation projects up until the 1950s was to acquire such materials as cement, reinforcing bars and gunpowder. At that time, it was

impossible to produce them in this country, and it was not an easy task to pay foreign currencies for the materials. So, dependence on the US-led military government was inevitable for materials. Without material aid from foreign countries, it would have been impossible to conduct irrigation projects.

In particular, Korea suffered severe inflation for 15 years from 1946 to the 1950s, which tremendously raised the wages of construction workers and the prices of materials for construction. It was more difficult to buy cement and reinforcing bars in the domestic markets. Reinforcing bars surged in price as much as twofold, even threefold, in one year, which increased the expenses of construction. Although a project neared completion, its expenses did not lessen. Furthermore, it was often the case that arrival of materials from aiding countries was delayed, which was a factor in delaying the completion of the construction work. The allotment of materials was individually conducted from district to district. The supply and demand for materials was under strict control.

4. The Establishment and Development of Mid-and Long-term Development Plans

4.1. The Plan for Development of All-weather Agricultural Water

In the early 1960s, many kinds of laws on farmland improvement were established, which paved the way for irrigation projects. But it was difficult to conduct such projects as irrigation and reclamation because aided investment funds such as ICA were reduced or abolished in the 1950s. The expense of agricultural water development spent until 1965 was merely half that in the late 1950s. To make things worse, the second 5-year development plan, starting in 1962, did not give full consideration to the development of agricultural water, which reduced investment and financing for it. This atmosphere cast a cloud over the expansion of irrigation systems.

The 1962-1963 harvest was the worst, in the wake of severe drought, and made it impossible to make an appropriate plan for supply and demand for food crops. The drought attacking the Yeongnam Region in 1964 drew public attention to the development of agricultural water. As a result, there was a systematic survey of the aspect of drought and the possibility of the development of agricultural water around Gyeongsangbuk-do. Based on this survey and analysis, a plan for nationwide development was made in June 1965.

This plan was named the All-weather Agricultural Water Resource Development Plan. It was intended to protect farmland against any drought, independent of rainfall-dependent farming, and to construct reservoirs, dammed pools, and groundwater systems to acquire agricultural water resources. This is evaluated as an eternal measure against drought.

This plan set the order of development of water resources: groundwater, followed by pumping stations, then dammed pools, then reservoirs. In principle, it was aimed to make 85% of the area of all rice paddies in the country "irrigated". It aimed to irrigate 1,050,000-hectare of 1,238,000-hectares of rice paddies, spending 115.417 trillion won over 9 years (1965 to 1973), newly developing 386,000 hectares and conducting a basis survey of candidate places to develop water resources.

What is to be noted here is that regarding investment funds, 115.4 billion won was almost a hundred times the annual average for investment funds, 11.6 billion won, for five years. In other words, this meant that investment funds of 11.6 billion won, equivalent to ten times the average investments for 9 years in the early 1960s were to be raised.

As soon as the Plan was reported to then-president Park Jeong-hee, he ordered the instrument of aid to be examined as a plan for making investment funds. When he paid a visit to Washington, he asked America to help with development aid. The officials at Washington gave an affirmative sign. Ultimately, his order led to the large-scale comprehensive agricultural development projects which started in 1970.

4.2. The Division of the Units of Irrigation Projects

Even after Independence, irrigation systems were consistently named "Irrigation improvement" or "Large-and small-district installation projects" under the supervision of irrigation cooperatives. It was the All-weather Agricultural Water Resource Development Plan established in June 1965 that set a unit of a water resource as its project unit. In other words, a reservoir, a pumping station, a dammed pool, or groundwater could be a unit of water resource, each of which was set as a unit for a project. This plan was stimulated by the worst drought around the Yeongnam Region, which prompted the classification of the possibility of development of irrigation systems. It was typified by the principle in which such water resources as groundwater, pumping stations, dammed pools, and reservoirs that are easy to develop - and possible to develop in the short-term - should be preferentially developed.

The Plan aimed to make maximally 80% of the areas of rice paddies "irrigated", newly developing 386,000 hectares of irrigated rice paddies in the planned years (9 years), and at the same time, conducting a basis survey of candidate places to develop water resources. What is to be noted here is that developing groundwater accounted for as much as 18% of the total areas to be developed. Although using groundwater as agricultural water was foreign to the public, the reason for setting this goal was that the then-president fastened his attention on groundwater.

However, it was necessary to use a water-lift machine to develop groundwater. Though it was impossible to produce it in the country at the time, the reason for adopting the plan was that it became possible to introduce water lift machines from Japan, pursuant to the Basic Treaty between Korea and Japan and others, signed on December 18, 1965.

4.3. The Start of New Development

4.3.1. The Development of Irrigation Systems by Means of Land Construction Projects

The irrigation projects after the 4·19 Democratic Revolution in 1960 were in consideration of economic efficiency. As the government led by the Democratic Party was established in August 1960, it declared the project of land construction on February 18, 1961. The project was to save urban unemployed persons and poor farmers and make the best of surplus resources. It included projects such as irrigation, foresting, bank and road construction, urban public works, and water resource development. It was to invest 4 billion won, based on the US surplus food crops (2 of PL 480) worth 10 million '*hwan***'[1] and the funds from the government general account (supplementary budget, April 1961). This plan spent 15.9b '*hwan*' (40%) on irrigation. This was used for continuous projects and repair of irrigation systems.

The project for land construction was aimed at expanding employment; investment in irrigation was put in building small reservoirs. This was because the Democratic regime adopted the project of small reservoirs that could evenly distribute their benefits to all farmers. The regime believed it wrong that the Liberty regime led by Lee Seung-man used the previous irrigation projects to win votes for the Liberty Party.

Before long, the Liberty regime was expelled by the military groups who led the 5·16 coup. The regime was replaced by the Military Revolution Committee, which declared that it would continue the previous land construction projects. The projects already under construction were given preference from an economic viewpoint. Intensive investment was put in a preferential project for completion. On June 1 of that year, the military government declared that the irrigation cooperatives and the Irrigation Cooperative Association's council should be "functionally" nullified (This measure lasted for 29 years. It was restored by farmers who demonstrated against taxation and bureaucratic operation in 1987).

1. ** Hwan is a now-defunct currency; on January 1st, 1961, one U.S. Dollar was worth approximately 1,000 hwan.

4.3.2. Projects for Returning to Farm by Means of Reclamation

The military government declared the first 5-year economic development plan on July 22, 1961. The plan was based on a 3-year economic development plan which had been prepared by the Liberty government. It aimed to lay the foundations for an autonomous economy and achieve industrial modernization. It was characterized by the establishment of a plan for investment and financing preceded by making focused policies. One of the 6 focused policies* was to "increase farmer income by means of increasing agricultural productivity," which became a key of agricultural policies.

The direction of agricultural policies was turned away from productivity increase and toward income increase. In particular, the plan of production in the section of agriculture paid more attention to things other than rice cultivation: an increase in stockbreeding, sericulture, and cultivation of special crops. The field of agricultural maintenance turned its eyes from irrigation, focusing on rice production, to reclamation.

On July 18, 1961, a project for returning to farm was announced as an urgent economic policy. The project was to encourage urban residents (mainly, staying in Seoul) to migrate to a site to be reclaimed: 1,228 households were moved to rural communities of 2,406 hectares in 24 districts. They were asked to work on the reclamation projects. After the projects were completed, each household was given 2 hectares of reclaimed land so that they could stay there as a farmer.

「* 6 Focused Policies: 1) acquiring energy resources like electricity and coal, 2) increasing farmer income and correcting the structural imbalance of the national economy by means of agricultural productivity increase, 3) acquiring the key industry and SOCs, 4) using surplus resources like increasing employment, preserving and developing land, 5) improving the balance of payment based on an increase in export, 6) promoting technical advancement」

2012 Modularization of Korea's Development Experience
A Plan for the Development and Supply of Agricultural Water

Chapter 4

Drought Disaster and Flood Disaster, and Irrigation Systems

1. Meteorological Disaster and the Change in the Measures
2. Drought and Flood Disasters Measure Law
3. The Measures against Drought and the Development of Groundwater

Drought Disaster and Flood Disaster, and Irrigation Systems

1. Meteorological Disaster and the Change in the Measures

1.1. Meteorological Characteristics and Meteorological Disasters

1.1.1. General Meteorological Characteristics

Korea, a peninsula located in the northeast of the Asian Continent, belongs to a zone of temperate monsoon climate. In the winter, it is cold and dry. In the summer, it is hot and moist. The average temperature ranges from 5°C to 15°C (11-15°C in the south, 10-12°C in the mid-region, 5-10°C in the north). The amount of annual rainfall ranges from 500mm to 1,000mm (1,283mm in South Korea; less than 1,000mm in North Korea). Two thirds of the rain falls in 3 months of the summer.

Rainfall is influenced by monsoons. Summer is the rainiest period, due to the southeast winds that blow then. The rainfall in the summer (June to August) accounts for 50-65% of the annual rainfall. In July alone, about 30% falls. Spring sees 15-20% of annual rainfall. The period needs enough water to grow seeds of rice and other food crops; but, in the spring, often, farmers are short of agriculture water because the spring has too little rainfall.

In the summer, rain falls intensively. In contrast, if the summer monsoon is suspended or delayed, or lingers too long in a high atmospheric pressure area, it rarely rains and thus there is drought; if the summer monsoon overlaps with a typhoon, it rains so heavily that there is wind and water damage. Agricultural disasters are classified into meteorological disasters and bio-disasters. Meteorological disasters include droughts, flood damage, wind damage, cold damage, hail damage, frost damage, tidal injury, and so on. Bio-disasters

include damage from diseases damage insects. The major disasters in Korea are droughts and floods, and diseases and insects.

In Korea, in 1904, a meteorological observation started. For 100 years, the country has suffered from 39 droughts and 40 floods. There was one drought and flood event almost every three years. The worst drought, in 1939, was the strongest blow to farmers who depended on rain-fed paddies to grow rice. South Korea harvested merely 1,060,000tons, just half the harvested crops in ordinary years (2,020,000tons). The 2-year droughts in 1967 to 1968 did enormous damage to farmers in the Honam Region. In 1968, the crops of rice decreased by 761,000tons, 18.2% of 1,195,000tons, the aimed amount; the field crops decreased by 483,000tons, 28.9% of 1,673,000tons, the projected amount (worth 52.5 billion won).

The rainy spell in the summer runs across the Korean Peninsula, from south to north or the other way around, to form a rain front until July, causing heavy rain to fall on the country. At times, the rain front overlaps with a typhoon, which pours heavy rain in affected areas. The two typhoons in July and August, 1987, dropped 8 times the normal amount of heavy rain and caused tremendous damage to the country, claiming people's lives (1,022 people were dead or missing). In addition, they 157,500,000,000 won worth of property damage (to farmland and irrigation systems, 1,074,700,000,000 won worth). In 1998, the typhoons and five-fold increase in heavy rain in June, July, and the end of September claimed 324 people's lives and caused 1,582,800,000,000 won in property damage (to farmland and irrigation systems, 227,700,000,000 won). The size of damage has been on the increase.

1.1.2. The Characteristics of Meteorological Phenomena Causing Drought Disasters and the Damage

Gamum, the Korean word for drought, is spelled 'Hanbal' in Chinese letters, meaning a ghost who brings drought. There is an old proverb in which Hanbal means a goddess who brings drought. In an age of gods, Hwangje (an ancestor of the Chinese) was at war with Chiu, who was an ancestor of non-Chinese peoples, and involved his daughter 'Bal' in the war. Bal, although she was a goddess, was very ugly and completely bald. But she had an abundance of heat accumulated in her body, so her body was as hot as a melting pot. The heat belched out by her could blow out any wind and fog. Hwangje wished to use this ability of hers to blow out wind, rain, and fog which were under Chiu's control. This explained why Hwangje called her. In this manner, with the help of his daughter, Hanbal, he was able to defeat Chiu. However, when the war came to an end, Hanbal had become too exhausted to go back to Heaven. Instead, she had to stay on Earth.

For this reason, the area in which she stayed had to suffer from severe drought, which prevented farmers from farming. So people called her Hanbal, reproaching her. Hwangje drove her out to the north and ordered Sukgyun, a god of fields, to keep his watchful eye on her. Nevertheless, she used to escape from Hwangje's view. An area to which she fled was sure to have drought. Whenever there was drought, people cleaned up riverbanks and ditches, praying, "Hanbal, please go back to the north!" They thought that only if Hanbal went back to Jeoksu, they could afford to avoid drought (According to an encyclopedia of an old proverb of drought).

Drought is defined in two terms: one is to define it in meteorological terms; another is to define it in hydrological terms. Meteorological drought is defined as a decrease in annual average rainfall in a designated area. It differs from country to country and according to socially-established relationships with a normal state as well. For instance, when the annual average rainfall in a specific region decreases by more than 60%, a meteorological office in India identifies the state as having "severe drought." However, in agricultural terms, greater importance is attached to the total amount of rainfall than to the annual distribution of rainfall. Although the total amount of rainfall is below average, if there is enough rainfall in the farming season, there is little damage to crops.

Hydrological drought occurs when natural systems for storing water (streams, rivers, lakes, aquifers, and others) and artificial systems for storing water (reservoirs, wells, canals, and the like) fail to store enough water to grow crops. Hydrological drought is always related to social phenomena. Artificial irrigation systems are dependent on following investments and efforts to maintain. The 19th-century droughts can be said to be disasters caused by the collapse of landscape, ignorance of traditional irrigation systems, the termination of autonomous common public work, and the state's negligence in investment in storing water. Drought correlates with the duration of time of lack of rainfall; in agricultural terms, the standard for comparison in degree can be expressed as difference between the number of consecutive days without rainfall (meteorological drought) and the amount of annual average rainfall during the period of irrigation (usually, the amount of average rainfall for 30 years) (hydrological drought). The number of the consecutive days with no rainfall ranges from 36 to 84, which can be called "Severe drought." The regions in which there was such severe drought include Gangneung (7 times), Pohang (8 times), Yeosu (6 times), and Daegu, an inland basin (6 times).

However, drought came from the late autumn to the winter. From spring to summer, the number of consecutive days without rainfull is less than that from the late autumn to the winter. Research into rainfall records – excluding Jeju Island, which is an outlier in terms of average annual rainfall in Korean territories – reveals the following. The number of consecutive days without rainfull during irrigation, June to September, ranges from 20

to 40. There were four severe droughts: in 1939, 1951, 1967 and 1968. In these years, Gwangju had too little rainfall: 48% (1939), 39% (1951), 40% (1967), and 45% (1968) of the annual average rainfall. As agricultural disasters, droughts typically result from lack of rainfall from May to August. The annual average rainfall during this period accounts for 60% of the annual rainfall. Drought is significantly marked by a high degree of regional polarization. Seoul falls into the category of an area with heavy rain. The city has 890mm of rain from May to August. In contrast, Pohang belongs to an area with the least rain. It has 570mm of rainfall during the period (Uleungdo Island excluded).

Although Korea is small, it is surrounded by three seas and has geographically complex conditions and features. So, rain falls differently from region to region. When the land is geographically divided into the central region, the Yeongdong region, the Honam region and the Yeongnam region, the Honam and Yeongnam regions have a wide gap in rainfall. The regions are characterized by irregularity of rainfall in the summer that causes droughts. A look at the regional distribution of rainfall in the years where severe droughts occurred reveals that the Honam region had merely 25% of the annual average rainfall in August and that the Yeongnam region suffered from severe drought, less than 50%. In 1968, the rainfall in June did not reach 50% of the annual average throughout the country. In particular, the Honam region had the least rainfall, less than 30%, from June to July, suffering from severe drought. In 1982, the central region had the least rainfall of 9.1mm (7%) in June. The regions had 20% or so, with no rival in rainfall in June.

Since 1904, Korea has used a modern way of observation to record the amount of rainfall. An analysis of 100 years of records of rainfall shows that 26 years had less annual rainfall but that 39 years had little rainfall in summer, which caused severe drought damage. This fact suggests that the summer has irregular rainfall, although the annual rainfall is at the level of a usual year.

In 1967 and 1968, the two consecutive droughts in summer occurred largely in the Yeongnam and Honam regions, which caused damage to rice crops, decreasing them by 774,000tons (419,000tons in 1967, 325,000tons in 1968). The rice crops decreased by 8% in 1967 and 18% in 1968, compared with the rice crops in 1966. In addition, in 4 years (from 1973 to 1975 and in 1978), there were five droughts. The harvests of rice decreased by 15,000-20,000tons in 20,000-60,000tons of rice paddies. Into the 1980s, the year of 1982 witnessed the severest drought, which decreased the rice harvests by 174,000tons. But, the three droughts in 1992, 1994 and 1995 had little influence on the harvests, because active measures were taken against drought. In general, the size of damage by drought is influenced by whether or not there are irrigation resources and how long it does not rain. But after the droughts in 1967 and 1968, many irrigation systems were installed and emergency measures against drought were systemized. Consequently, drought damage has drastically

decreased. In 1977, the area of drought-damaged rice paddies reached as many as 64,000 hectares, while damaged rice harvests were merely 15,000tons.

On the other hand, the degree of drought can be expressed by how much water reservoirs store or how much water in reservoirs is dried up. In general, reservoirs in the country are small and have a small amount of water stored, except reservoirs managed by the Korea Farmland Development Cooperatives and the Korea Rural Community Corporation (About 85% of the 17,894 reservoirs are small reservoirs, as of 2005). A small reservoir is built to make stored rain water flow into rice paddies. If it rarely rains after planting rice, the small reservoir is devoid of water. In 1994, on July 20, about 40% of the small reservoirs throughout the country became dried-up and the ratio of water storage throughout the country was 28%, compared to 76% in an ordinary year. As for the drought in the spring of 2001, 12% of the small reservoirs throughout the country became dried-up on June 16. Less than 41% of the small reservoirs recorded 30% of ratio of water storage.

1.1.3. The Characteristics of Meteorological Phenomena Causing Flood Disasters and Damage

Rain that falls for long in the summer is called Jangma in Korea. In Japan and China, spelled '梅雨' it is called 'Baiu' and 'Maeiju', respectively. 梅雨 was the symbol for rain that falls when apricots ripen. In Korea, *Jangma* begins in late June and ends in late July. The etymology of *Jangma* is as follows: The word '*Jangma*' originated from ancient Sanskrit, it is said. A Sanskrit dictionary by Oxford University (p. 428) reveals that 'jhan' means 'noise of falling rain', 'rain in large drops.' 'Ma' is a suffix that forms a noun. The combination is '*jhan ma*,' meaning 'sounds made by falling rain' and 'rain in large drops' (Jo Yong-heon, The Chosunilbo Daily, June 23, 2007).

The summer heavy rainfall in the country that entails flood disasters stems from a combination of a rain front with hot and moist air. Hot air with an abundance of moisture formed in the Pacific moves northwest to a low atmospheric pressure area in Central Asia to make a rain front. This is a period of rainfall. July, when Korea has the heaviest rain in the year, is the rainy season, or 'Jangma,' when southeast winds are active. In July, most of the regions have 140-150mm of rainfall, except part of the regions on the east coast, which have 200-400mm of rainfall. The Han River basin has the heaviest rain: 300-400mm. Regions other than the basin have 200-300mm of rainfall. August sees the Jangma fronts move north and die out. A hot and moist high atmospheric pressure area in the North Pacific has an influence on rainfall in August, when rainfall gradually dwindles in amount; but, there is very often heavy rain alongside a typhoon. As for the rainfall in August, Uleungdo Island, regions in the southeast coast, Daegu and Mokpo have 120-190mm of rainfall; the Central Region has 300-330mm of rainfall; others have 200-300mm of rainfall.

The heaviest rain (547mm a day) that entailed disastrous floods fell in Jangheung, Jeollanam-do, on July 2, 1981, when a typhoon ran across the Korean Peninsula. In July, 1987, Buyeo, Chungcheongnam-do, had 517mm of rainfall a day. Korea had 19 days when more than 400mm of rain fell daily. And for 2 days on end, on July 29 and 30, 1999, Geoje, Gyeongsangnam-do, had 636mm of rainfall; on September 2 and 3, 1987, Jangheung, Jeollanam-do, had 631mm of rainfall; on September 2 and 3, 1981, Goheung, Jeollanam-do, had 622mm of rainfall.

The major factors that cause heavy rain in the country include the shaping of a strong trough, the activation of a rain front in the wake of a collision between a cold airstream and a hot airstream, an influence by southwest winds that fetch turbulent air, and the long lingering of a trough. When daily rainfall exceeds 80mm or when the rainfall for 3 to 4 days on end exceeds 200mm, flooding is highly likely to occur. Heavy rain of 50mm or more falls about five times every year. The Seomjin River and the lower Nakdong River on the south coast have more than 80mm of daily rainfall three times a year. In the central west coast and the Han River basin, more than 80mm of daily rain falls twice a year. In the inland Yeongnam region and the Central east coast, more than 80mm of daily rain falls once a year. The meteorological center in Seoul witnessed 377mm of rain fall for 3 days on end, from July 10-12, 1925; for 3 days on end, from July 15-17 in the same year, 350mm of rain fell there. About 700mm of rain fell in a few days, which caused a deluge in the River basin that claimed some 700 people's lives and destroyed 100,000 houses. This disastrous accident can be called a true catastrophe when considering that that Seoul had a mere 300,000 citizens at the time.

Heavy rain also fell for 3 days on end, from July 21-23, 1987, in the lower Geum River, from Buyeo to Seocheon, Chungcheongnam-do. Jongcheon-myeon and Munsan-myeong, Seocheon-gun, had 684.1mm of rain and 678.6mm of rain, respectively. It was once-in-a-millennium rainfall event. The heavy rain killed about 130 people, caused 4.1 trillion won in damage, and created about 50,000 flood victims. It is called the "Jeongmyonyeon Deluge on the Geum River." In September 1990, heavy rain in the northeast of Gyeonggi-do fell in the upper Han River basin, affecting areas like Chuncheonm Inje, Hongcheon, Daegwanlyeong, and so on: 360-450mm of rain fell for 3 days on end. The rain produced 187,000 flood victims, killing 136 people and inflicting 730 billion won in property damage.

In July 1966, the Hantan River had 600mm of heavy rain, which destroyed Yeonchon Dam, killed 29 people, produced 16,900 flood victims and inflicted 4.3t won in property damage. From the end of July to the beginning of August, 1998, Seoul and Ganghwado Island had more than 1,000mm of heavy rain and the Jirisan Mountain suffered from a sudden deluge. The flood created about 24,500 flood victims, killed 324 people and inflicted 1.245t won in property damage. It was the worst damage in 20 years. In Gyeonggi-do

region, 300-800mm of heavy rain, along with a typhoon, fell, which produced about 25,000 flood victims, killed 27 people and did 1.049t won in property damage.

Jangma, a Korean word for a rainy spell, is referred to as a phenomenon in which rain continues to fall from the late June to July. A warm air mass in the south moves north to meet a cold air mass in the north, when a rain front appears from east to west between the two conflicting air masses. The rain front is called *Jangma* rain front. The rain front repeatedly moves northward or southward. It lasts one month and then is influenced by a high atmospheric pressure in the North Pacific and pushed up northward. Finally, at this time, scorching hot weather begins.

In a rainy spell, *Jangma*, more than 300mm of rain falls. Usually, so heavy rainfall causes flood. At times, the high atmospheric pressure in the sea of Okhotsk is too strong to prevent a *Jangma* rain front from nearing the Korean Peninsula, which provided it with a cool summer (in 1993, cold damage visited the Peninsula). When high atmospheric pressure in the North Pacific pushes up a rain front northward, *Jangma* ends too early, which invites drought (in 1994, there was a scorching hot summer). During *Jangma*, usually, 250-450mm of rain falls, accounting for 25% of the total annual rainfall. Often, more than 600mm of rain falls; less than 100mm of rain falls. A combination of a *Jangma* rain front with a typhoon will invite too heavy rain.

A typhoon is defined as a wind with strong storms whose fastest speed at the center is more than 17 meters per second. It is a tropical low atmospheric pressure that occurs in the west of the North Pacific. Every summer Korea is certain to encounter it. Typhoons affecting the country occur between July and September. Usually, a typhoon in July runs northwards along the coast of the Yellow Sea, through the Central Region. A typhoon in August moves southwards, compared to that in July, diagnostically through the Central Region, like Gunsan, Cheongju, and Gangneung regions. A typhoon usually runs through regions on the south coast. A typhoon attacking the country is a big vortex of tropical low atmospheric pressure that occurs in the northeastern Pacific, east of the Philippines. It turns in a counterclockwise direction and comes with strong winds. It originates at 5-20° north latitude, 125-155° east longitude. In summer, the temperature of seawater here is at about 25° so air is heated and goes up. This air is influenced by the power of the earth's rotation, which forms a typhoon. The strength of a typhoon differs according to the strength of upward airstreams when it occurs, and the strength and location of Pacific high atmospheric pressure. Most of the upward airstreams turn into a tropic low atmospheric pressure or a typhoon. But many disappear into thin air in the East China Sea. Every year has 27 typhoons on average. Among them, an average of 2.7 typhoons a year make landfall on the Korean Peninsula or vanishes just before doing so. 47% of the 2.7 typhoons visit in August. During the 36-year colonial Japanese control, the 6 most terrifying typhoons attacked Korea: on

September 7, 1914; August 7, 1923; August 18, 1926; July 28, 1933; July 12, 1934; and on August 21, 1936.

Usually, heavy rain in the period of *Jangma* triggers flooding. The average rainfall in the period ranges from 250mm to 450mm, accounting for 25% of the annual rainfall. The gap is very wide: from less than 100mm to more than 600mm. Typical damage by *Jangma*, or, heavy rain, stems from flooding, which inundates and breaks down houses and facilities, resulting in human and material damage. Heavy rain is referred to as shower-like rain that that falls heavily in a very short period of time. More than 30mm of rain per hour falls at intervals of 3 to 4 hours. Heavy rain is abrupt, sudden and local, which makes it difficult to give an accurate prediction. More than 10% of the annual rainfall falls at a time; the rainfall per hour exceeds 30mm; the rainfall per day exceeds 80mm. If the continuous rainfall exceeds 200mm, it causes flooding.

In Korea, heavy rain of more than 50mm usually occurs five times a year. More than 80mm of rain falls three times a year in the Seomjin River and the lower Nagdong River. More than 80mm of rain falls twice a year in the Central Region on the west coast and the Han River basin. More than 80mm of rain falls once a year in the Central Region on the east coast. A total of 296 typhoons have influenced Korea. 91% of them, or 270 typhoons, have landed from July to September.

1.1.4. Drought and Flood Disasters in accordance with Abnormal Climate Facing

El Nino is a phenomenon in which the temperature of sea water rises around the equator (from the coast of South America on the Pacific to the Central Pacific), irregularly at intervals of 2-7 years. From September to March, the temperature rises by 2-5 °C higher than that in an ordinary year. This phenomenon lasts for half the year or longer. It changes the distribution of energy in the Pacific, which, in turn, changes the flow of airstreams. As a result, there is abnormal weather in North America and Indonesia, the Philippines, Australia, and other regions, surrounding the Pacific, the tropical zones and the subtropical zones. In contrast, La Nina is the opposite phenomenon to El Nino. The temperature of seawater lowers for a long time. The terminologies, El Nino and La Nina, are of Spanish origin, indicating baby Jesus. They are so called, because they occur near Christmas off the coast of Peru and Equator. These phenomena cause Korea's winter seas to rise in temperature and its summer to see heavy rain. El Nino occurred in 1986-87, 1991-92, 1993-94, 1997-98, 2002-03. Relatively weak El Nino began in September 2004 and ended in the spring of 2005. From the middle of 2005, La Nina started. It lasted until March to June 2006. The El Nino in 1997-98 was strong enough to draw attention from the world. From 1990 to 1994, El Nino occurred very frequently. A year when El Nino breaks out is marked by the fact

that Jangma lasts long. Although it is not found that it correlates with the start of Jangma, assumedly, it highly correlates with the end of it. It has been known that El Nino and La Nina are in close relation with the frequent occurrence of abnormal climate from the 1970s (in particular, with droughts in quantitative and qualitative terms). An analysis of the trends of crop market, mainly the American crop market, reveals the following: 1) El Nino and La Nina are in close link with global abnormal climate including American droughts, 2) There has been upward tendency of their occurrence from the 1980s, which there was one occurrence every 4-5 years until the 1970s.

Of late, in 2002, El Nino broke out and there were a lot of abnormal weather events largely in the northern hemisphere. Central and western America, Canada, Australia, Indonesia and India were damaged by drought; in Europe, eastern Germany and the Czech Republic were damaged by flooding. Southern France suffered enormous damage from heavy rain, especially to agricultural products. The WMO defines abnormal climate as a monthly average temperature and monthly rainfall that have not been observed for the past 30 years. Agriculture has been systemized for average temperature conditions for the past 30 to 40 years; so, it is impossible or difficult to cope with abnormal climate beyond these conditions. The examples of abnormal climate facing the world are as follows:

Severe droughts in China killed 20,000,000 people (in 1811), 15,000,000 (1849), and 10,000,000 (1876). The 1988 drought attacking the Great Plains in America decreased crop production by 26% (the largest decrease since the 1930s). In the summer of 1994, rain did not fall for 100 days in Korea. The once-in-a-century abnormally high temperature and dry weather prompted the government to take nationwide measures against drought. In 1999, a great flood in the mid-Mississippi River basin in America caused enormous damage: people were killed and houses were destroyed.

1.2. The Change in the Measures against Drought and Flood Disasters

1.2.1. The Measures against Drought Disasters

For the past 40-50 years, the aspects of the occurrence of droughts have hardly changed, while the methods to overcome them has greatly changed over time. In the 1950s, when it was inevitable to depend on foreign aid for irrigation systems, the government had few if any measures against drought; all that it could do was to provide drought-damaged farmers with donations from foreign countries and all that the farmers could do was to re-plant seeds in damaged fields. However, into the 1960s, the country underwent a drastic change in how to overcome drought. There were so many strenuous efforts to find groundwater and build pumping stations. Pumping machines and hoses were used to supply agricultural

water. Although the year of 1965 saw groundwater being used as agricultural water, it was too premature to use groundwater as a measure against drought in the late 1960s. Before technology to explore and develop groundwater was developed, there were a lot of pipe-shaped wells built as an emergency measure without any precedent technical survey (as a measure against drought in 1967 and 1968). The wells could not afford to pump water up. Into the 1970s, when the foundations for fast economic growth were laid, agriculture experienced modernization. Technical organizations were depended on for overcoming drought. It was possible to put excavators and pumping machines in drought-damaged areas. An abundance of funds made it possible to take active measures against drought. Concurrently, the Agricultural Disaster Measure Law established in 1967 was implemented in 1970, which served as a legal basis for drought measures. Accordingly, in the 1970s, if there was a severe drought spread throughout the country, the National Drought Measure Center was brought into play to overcome drought. This organization was made up of public officials sent from all departments of the government so that they were able to take action to cope with any emergency situation. Pursuant to related ordinances, equipment and instruments, and human resources were brought into play; government subsidies were provided; there were activities for collecting donations including medicine. It became possible to develop simple water resources and supply water to drought-damaged farmers. In this manner, in the 1970s, the measures against drought began to be systemized. In the 1980s and the 1990s, funds to overcome drought were more abundant, which enabled the government to take action against drought. For instance, it was a usual task to develop groundwater resources in preparation for drought. More emphasis was placed on any measure taken beforehand, an indication that the national power got stronger. It was a reflection of the slogan "Drought without damage!" The following is a detailed description of the change in drought measures by time and characteristics. The most difficult challenge to Korean people after Independence was to acquire food. Food crops grown in the country could not meet the demands for food. To make things worse, if there was a drought through the country, food was too insufficient for the country. It had to depend on aid for food. All that drought-damaged farmers could do was to wait for the government to provide them with relief. And they had nothing to do but re-plant seeds.

Even in the late 1950s, rain-fed rice paddies accounted for about 60% of all rice paddies. Irrigation projects had to be dependent on foreign aid. It was inevitable to delay them. So the country had yet to overcome drought. Furthermore, the country could not afford to produce pumping machines, which made it impossible to make use of water from rivers. Farmers who lacked agricultural water had almost nothing to do but clean up waterways so as for agricultural water to flow well. In a word, the drought measures of the day were focused on aid. It was the Agricultural Water Development Plan, established in June, 1965, that came up with fundamental solutions to drought by means of active development of

agricultural water resources, indicating that the measure had an important turning point: from aid to development of agricultural water resources. The Plan adopted groundwater as an alternative to agricultural water. Preference was given to construction of pumping stations that were possible to build in a short period of time. At that time, there was an agreement signed between the Republic of Korea and Japan, which made it possible to introduce pumps and other machines and instruments for water development. Against this backdrop, the measures against drought in 1967 and 1968 were focused on using such machines to develop water resources and to pump and send water. As for an area that was impossible to develop water resources in, it was recommended that rice paddies should be converted into dry fields. After all, the measures against drought till the 1960s paved the way for actively overcoming drought into the late 1960s. But, in this period, such emergency means as riverbed excavation had to be dependent on human power, so it was inevitable that the speed of promotion was slow. On the other hand, in the latter part of the 1970s, except 1973, the weather was fairly good: an appropriate amount of wind and rain. The experience of failure in 1968 to 1970 gave little preference to groundwater as agricultural water. In 1977 and 1978, severe drought fell on the whole country. The key measures were to supply water for rice transplantation. According to regional characteristics, as part of the preceding measures, simple water resources were developed. It was systematic to place human power and pumping machines in an appropriate place.

The measures against drought in the period were characterized by an effective use of pumps and development of groundwater, as well as an attempt to come up with a variety of ways to send water up to a distant area. Instead, the funds supported by the government were not so sufficient that there were active measures taken by farmers themselves.

Too much emphasis was placed on an increase in food, and rice was the main income for farmers. So farmers spared no effort to save rice from drought. They had the wisdom to overcome drought. Based on these experiences, in the 1980s, drought measures were more focused on advance preparations for drought. The development of water resources was targeted at a small group of rain-fed rice paddies in the hinterland. Moreover, the policy for making a simple water resource, as an emergency measure, an eternal one (implemented from 1976) took root. The measures, or funds, supported by the government became much larger in scale than those in the 1970s. At the same time, machines for excavation, pumping machines, and hoses for sending water were in wide use. In this manner, as time passed by, the measures against drought became more efficient and tight. Local organizations came up with practical ways and ideas to overcome drought: storing water in a reservoir (the way to pump and store water made its first appearance as a way to overcome drought in Gyeongsangbuk-do in 1976), a high-performance 11-stage pumping machine, pumping and sending water across sea, storing water in a rice paddy; these were the most effective ways to make the best of agricultural water.

The droughts in 1994 and 1995 were representative of those in the 1990s. The measures against drought in this period were a kind of total war: all available human resources, budgets and machines were brought into play. All the departments of the government teamed with each other to provide administrative services. The National Drought Measure Center was run, made up of able public officials sent from all departments; all administrative systems were converted into those to support the effort to overcome drought. The key measures were to develop simple water resources and supply water, but the supporting measures by the government focused on an intensive development of rock pipe-shaped wells and dredging reservoirs (from the 1995 measures). 30.6 billion won of the 1994 fund (a total of 400 billion won) for drought measures was invested in development rock pipe-shaped wells. In 1995, 168.6 billion won of 388.5 billion won was invested in it; 95.6 billion won went to dredging reservoirs. In the 1990s, the all-people drought measure committee, made up of representatives, was established and run to support the efforts to overcome drought. Working together with journalists, they led a movement to support drought measures: raising funds, conducting PR with the public, and so on.

1.2.2. The Measures against Flood Disasters

The measures against flood disasters in the 1960s were characterized by the principle that a worker in charge of management of buildings or machines or an owner of them, that is, a person who was responsible for damage prevention, should be responsible for damage restoration "at his or her expenses." In the 1960s, residents worked together with each other to restore from damage for themselves. When damage was too large for the residents to be able to restore the buildings or machines, the government lent whole or partial support for restoration expenses.

In those days, the government had poor finances, so it had to use its subsidies to lend the least possible amount of support. For example, the government brought soldiers and their equipment and instruments into play. It used the budget to pay for the oil that was used to operate them. If farmland was damaged, the government sent only materials for emergency restoration.

In those days, there were not special standards for support. If severe damage occurred, the central government set a standard from situation to situation to provide restoration expenses. In 1965, the government established a three-stage restoration plan for the first time. The first stage was to take emergency measures - such as aid - against floods, communicable disease control, restoration of a network of guard communications, and others (emergency support of 95,000,000 won); the second stage was to provide money for materials and for re-transplantation in the fields that needed emergency help; the third stage was to establish a plan for restoration on an annual-equation basis, taking eternal measures according to the

result of survey, in the case of severe damage that was impossible to restore from without the government's support (using the government reserves to pay 698,000,000 won).

In the 1970s, the government's finances improved and the support systems by the government became more systematic. As a result, its support for restoration from flood disasters increased in quality and quantity. In the 1960s, the local governments had the same standards for calculation of restoration expenses; the different local governments had different ways of calculation. So, the calculated amount greatly differed from region to region. In order to improve these weaknesses, the government began to calculate the damaged amount and the money necessary for restoration based on the Standard for Calculation of Damaged Amount (approved by the National Disaster Measure Center, on May 6, 1970). On August 8 of that year, the government sent the 'Guideline for Wind-flood Disaster Restoration Project Implementation' to related departments and the local governments. With the economic growth in the 1980s, as use of land was maximized, more people came to live in sites vulnerable to disasters: coastal low land, high land, slanted land, and others. As facilities for living convenience like buildings increased, damage was on the rise in economic terms. As well, such abnormal climate phenomena as global warming, El Nino, La Nina caused more disasters: the Han River deluge in 1984; Typhoon Selma and the subsequent heavy rain, 1987; heavy rain in Yeongnam and Honam Regions and Typhoon Judy in 1989. The frequent occurrence of such disasters meant an enormous increase in restoration expenses. In 1987, Typhoon Selma ran through the Korean Peninsula and there was heavy rain in the Central Region for 2 months in July and August. It presented a great financial burden to local governments. It seemed that they could not restore public facilities because of financial difficulties. When the expenses of restoration did not exceed 2.5 billion won, the government would incur 50% of the expenses and the local government would incur the rest (50%); when they exceeded 2.5 billion won, the government would pay all the expenses based on government subsides. As a result, more dependence became placed on government subsidies than on local governments' money for restoration.

Into the 1990s, public opinion was that the system for replacement of local restoration expenses with government subsidies introduced in the late 1980s was irrational and that it did not square with the standard for support for disaster aid and restoration expenses. So the government laid a legal basis for establishing a new standard, revising the existing standard. In addition, in the past, support for restoration expenses was based on the principle of restitution. Now, sticking to the principle of restoration, if restoration for improvement was needed, it was possible to greatly increase restoration expenses.

2. Drought and Flood Disasters Measure Law

2.1. The Wind and Flood Disaster Measure Law/the Natural Disaster Measure Law

A look at the changes in the measures against floods, in legal terms, reveals that the measures have taken three steps—1) the regulations of the Wind and Flood Measure Committee, 2) the Wind and Flood Disaster Measure Law, and 3) the Natural Disaster Measure Law—whose contents and ways have shifted from focusing on disaster restoration to focusing on disaster prevention. The following is a brief description of how the measures have changed.

Until the early 1960s, disaster restoration was dependent on administrative measures whenever a disaster occurred. In the meanwhile, as the need for comprehensive measures for disaster restoration and prevention drew more attention, the Ordinance on the Wind and Flood Disaster Measure Committee (821 of the Government Ordinance) was established on June 16, 1962. It was only concerned with the establishment and operation of the Committee; the concrete procedures for performing disaster-measure tasks—say, for flood disaster restoration and aid—were to be regulated by the Committee. Consequently, the regulations by the Committee were insufficient for it to perform those tasks. In 1964, the Disaster Measure Basic Law (Tentative) was put up for discussion but it failed to bear fruit due to different opinions among government ministries. Three years later, on February 28, 1967, the Wind and Flood Measure Law was passed by the National Assembly.

This Law regulated more systematic and specific procedures for disaster prevention, restoration, and emergency measures against disasters, as well as the organizations for disaster prevention. It laid the foundations for supporting expenses of disaster restoration to local governments and public servants in charge of disaster prevention and restoration. At last, it took shape as a basic law.

Afterwards, on July 23, 1975, the Civil Defense Basic Law was established under the supervision of Ministry of Administration. The tasks of disaster control were incorporated into part of the civil defense. Accordingly, it became necessary to adjust the tasks concerning disasters to the civil defense systems; so, on December 17, 1981, the Law was amended. This amendment put the Committee under the control of Ministry of Construction from under the control of the Prime Minister and the kind and procedures for disaster-prevention plans took shape. However, with a view to making the tasks of disaster prevention developed and globalized, it was necessary to legalize the related procedures such as introduction of developed systems for disaster prevention, preparations for earthquake, and others. Another amendment of the Law was needed. On December 6, 1995, the Law was changed into

the Natural Disaster Measure Law, whose articles and clauses were drastically changed (Implemented on June 2, 1996).

2.2. The Farming and Fishery Damage Measure Law

Disasters inflicted on crops are inevitable, unavoidable and uncertain, so it is impossible to predict the possibility of occurrence, in terms of probability. In addition, disasters cover a wide range of areas and it is impossible to depend on reciprocal cooperation between community members to get over them. Therefore, it is necessary for the central government and local governments to struggle for emergency and permanent restoration. This situation caused the Agricultural Damage Measure Law to be established on January 16, 1967. This Law, pursuant to the Wind and Flood Disaster Measure Law, set the standards, but they had such different standards for aid that they were not practically conducive to farmers in economic terms. Accordingly, in order to minimize and overcome the weaknesses of the measures against damage to agricultural products and take permanent measures against it, the government replaced the Wind and Flood Disaster Measure Law with the Farming and Fishery Damage Measure Law on August 1, 1990. The former focused on supporting restoration of facilities from wind and flood disasters like floods, heavy rain, tsunamis; the latter focused on supporting restoration from droughts. However, as disasters such as as frost, hail, cold damage, tidal damage, freezing damage, insect infestations, in the wake of meteorological catastrophe, inflicted more damage to crops, it became necessary to set new standards for aid so that farmers felt it comfortable to grow crops. This influenced the government to make some legal safety devices. The fully amended Farming and Fishery Damage Measure Law contained the following: the help and support for damaged farmers were based on the newly established standards pursuant to this Law, except what was supported pursuant to other ordinances. In addition, the Ministry of Farming and Forestry would have an inspection committee established to inspect what damage restoration would be supported by the government.

On the other hand, comparison between the Farming and Fishery Disaster Measure Law and the Wind and Flood Disaster Measure Law shows that the latter accepts floods, heavy rain, storms, and tsunamis as wind and flood disasters, while the former includes many kinds of disasters like frost damage, hail damage, cold disasters, droughts, tidal damage, freezing damage, disease and insect damage among others, which were excluded from the latter. In addition, it accepted abnormal tides, red tides, tsunamis, storms, and other fishery products and fishery facilities accepted by the Fishery Product Damage Measure Inspection Committee. While the Wind and Flood Disaster Measure Law allowed the local governments to provide support for damaged facilities except agricultural crop damage and movables damage only when the damage exceeded a certain size, the Farming and Fishery

Disaster Measure Law did not calculate the damaged amount because a regional difference in price made it difficult to set a standard for calculation. Instead, it allowed the government to provide support for an area in which such disasters as droughts, floods, wind disaster, cold disaster, tidal damage, freezing damage, and disease and insect damage covered more than 50 hectares in a city or 'gun', and in which such disasters as forest disasters, hail disasters and snow disasters covered more than 30 hectares in a city or 'gun'. In addition, it allowed local governments to provide support for restoration when the damage in question was excluded from the central government's support. If agricultural facilities including farmland and livestock sustained damage worth more than 300,000,000 won, the central government had to provide support.

The procedures for giving support for crop damage were systemized, too. If a disaster occurred, it was reported to a director of the relevant administrative office, who was responsible for conducting emergency restoration. A precise inspection was jointly conducted by a public official, a director of a village, a village representative and a damaged farmer. The data collected from the inspection were reported to a mayor or town mayor, then to a provincial governor, then to the minister of Farming and Forestry. The minister, based on the collected and reported data and information, made a plan for restoration support, which was transferred to the review committee for inspection and discussion. The minister received the plan confirmed by the committee, which was taken back to the provincial governor for the purpose of damage restoration.

An inspection of damaged crops, after an emergency measure and a certain period of time passed, waited for a more precise inspection, which was jointly conducted by a public official, a director of the village, a representative of the village and the farmer who had suffered damage. They were based on the standard for calculation of damage ratio to calculate the degree of damage. The ratio of damage was applied differently, according to the stage of growth and the period of damage.

The inspection was conducted based on how to inspect and report agricultural disasters. The inspected crops covered almost all agricultural plants including rice, crops grown in dry fields, vegetables, fruit trees, crops for special purposes, and others. In addition, the inspected items covered livestock, silkworms, farmland, irrigation systems, vinyl houses, cattle sheds, silkworm raising rooms, and other agricultural facilities.

The support given to each damaged farmer depended upon how much they grew. The ratio of damage was referred to as the ratio of the damaged area regarded as having no harvest to the entire planting area.

The same law was, by nature, intended to be established for the purpose of aid, that is, helping a damaged farmer make a living and grow crops in the next season, not just for the

purpose of compensation for crop damage. Before September 22, 1994, farmers who owned less than 1 hectare of rice paddies or fields could receive support from the government; after that day, the farmers who owned less than 2 hectares of rice paddies and fields were given support by the government, too. What was somewhat problematic was that five hectares of damaged fields where fruit trees were planted and grown were looked upon as equivalent to damaged one hectare of rice paddies or dry fields where crops were planted and grown and that one hectare of damaged crop paddies and fields were regarded as the same as 15 cows or horses, 10 milk cows or deer, 100 pigs, mountain sheep or dogs, 6,000 ducks or chickens, or 2,500 rabbits.

For example, in fact, the 1993 drought inflicted severe damage to rice crops. But the damage to fruit trees and livestock was calculated in terms of farmland, which caused public complaints. As a result, there was an amendment to related ordinances, and on June 29, 1994, the Ministry of Farming and Fishery amended the ordinance (Regulation 178) to solve such problems.

The area of farmland for growing tobacco and ginseng was included in the size of farmers' owned farmland, while it was excluded from the calculation of damage ratio of the unit of crop growth. Fallow land was included in the calculation of the size of farmland and the damage ratio of the unit of farmers. If they were specially supported pursuant to the Tobacco and Ginseng Law, they were excluded from support, which was intended to lend more support to farmers.

In addition, excluding the cultivation on the river land from supportwas legalized, which removed the possibility of public complaints. The 1993 cold damage relieved farmers of financial burdens. If they suffered cold damage caused by too-low temperatures in the summer, they were supported, pursuant to the Ministry's special directions, which made it possible to predict the damage ratio based on the ratio of the damaged area to the rice-growing area.

When a plan for restoration support was made, the money for agricultural chemicals as a means of support was paid by calculating the area of insect- and pest-damaged farmland. The money for re-transplantation was paid differently according to the area of re-transplantation by the previous standard of more-than-70% damage. If farmers had the intention of re-transplanting, the money was paid only to the actually re-transplanted area. For indirect support, the government expanded the scope of supported farmland from less than 1 hectare to less than 2 hectares. If a farmer sustained damage to more than 50% of his crops, he could have the refunding of farming money delayed, or interest exempted for 2 years. If a farmer suffered damage to more than 80% of crops, he could receive aid for 3 months.

If a farmer sustained damage to more than 50%, his children in middle and high school could be exempted from tuition fees for 6 months, receiving rice crops free of charge. If a farmer suffered damage to more than 50% and 80%, he could receive five bags of rice and 10 bags of rice, respectively, free of charge, exempted from the fees of cooperatives.

3. The Measures against Drought and the Development of Groundwater

3.1. The Severe Droughts in Yeongnam and Honam Regions and Accompanying Measures

In 1967, the Central Region had enough rain to transplant rice from May to June; and Southern Region did so from May to early July. But there were droughts from the middle of July to October in the Southern Region. Especially, Jeollanam-do was depleted of drinking water, as well as agricultural water. A series of droughts and scorching-hot weather dried too many rice paddies and fields for farmers to grow crops any longer. The government spared no effort to supply water. Cars and ships were brought into play to supply drinking water to farmers on islands.

In July and August, the rainfall in the Gwangju region did not meet farmers' expectations; less than 40% of the usual annual rainfall. Even August and September had merely 17% of usual rainfall. The damage was too severe to grow rice in rain-fed rice paddies.

In 1968, a drought occurred even before rice transportation started. A *Jangma* rain front lingered long in the north of the Central Region, bringing an abundance of rain to the Yeongdong Region in the middle of July. In addition, the region had heavy rain as a typhoon ran across Busan in August. In contrast, the Honam Region had little if any rain from April; to make things worse, it had merely 22% (Gwangju) of average rainfall in June and July. The two months on end had merely 87.7mm of rainfall. The rainfall from January to May was 66% of the annual average. The ratio of water storage was 27%, that is, 50% of the annual average.

Around July 20, 1968, in Jeollanam-do, which experienced the severest drought, farmers could not afford to transplant rice. This challenge came home to the farmers and public officials, who came into play to develop groundwater and use a hoe with a short handle to transplant rice.

Naju-gun, in Jeollnam-do, was the widest plain, holding 42% the arable farmland. 6,534 acres could not be transplanted with rice. At this time, farmers in Yanggok-myeong, Naju, had the courage to make a well in the field, which was impossible to do in those days. They

dug down up to 5-6 meters to find water. After this, the way of making such a well, as a means of rice transplantation, came into use throughout the country.

The damage for the two years reached 73.4 billion won. The farmers reduced crops by 1,750,000tons; 16% of the target amount of production. In particular, the 1968 damage was 2.3 times that of 1967. 38% of farming households (895,000) were hit by the damage.

Facing these droughts, the government did everything it could, directly or indirectly, to lend support to damaged farmers. It paid 45.5 billion won in total, which accounted for 62% of the amount of damaged crops, and was about seven times the 6.7 billion won spent developing agricultural water. The direct support included irrigation projects, irrigation water support, road improvement, farming support, farmland tax support, exemption from all kinds of fees, and others, on which 26.9 billion won was spent; the indirect support included a credit-based supply of fertilizer, purchase of crops, support for money to small businesses, and so on, on which 18.6 billion won was spent.

For supplying irrigational water, 73,245 pumping machines in total were brought into play and 3.3 billion won spent in supporting money for oil. In addition, 3.2 billion won was used to buy 4,059 pumping machines. All machines—air compressors and fire trucks—that help with water pumping were brought into play for irrigation. Based on the plan for developing all-weather agricultural water resources, the development was promoted in earnest, with a large-scale well drilling machines imported (from Japan), which were used for well development.

3.2. The Development of Groundwater for Overcoming Droughts

As mentioned above, the "movement of making a well in the field" that made a debut in 1968 as a means of overcoming droughts in a village in Jeollanam-do began to spread throughout the country, going by the name of 'a man-powered well'. It was so named to be differentiated from a tube well (a machine-powered well) for which a well drilling machine was used.

The inspection of candidate sites in which it was possible to develop groundwater, started from June to August 1965, when groundwater was planned as an agricultural water resources, and took shape in 1966 and 1967, when groundwater was intensively developed. The background of intensive development of tube wells is described below:

When the drought in the Southern Region in early August 1968 was in full swing, then-president Park Jeong-hee ordered to his government the strong administrative guideline to a drought measure project. This was the 22nd Presidential Official Instruction, serving as a guideline for a plan for agricultural water development centering on groundwater.

The Instruction classified the stages of drought into three: first stage (impending emergency measures), second stage (the measures till June 1969) and third stage (long-term measures). It also specified how to conduct the plan, including the limits of tasks imposed on each administrative department like the Groundwater Development Corporation (tentatively named), ways to recommend side jobs for damaged residents, and others.

3.3. 2001 Drought Response Plan

3.3.1. Drought Response Plan Background

The Korea Rural Community Corporation (then the Korea Agricultural and Rural Infrastructure Corporation, KARICO), a specialized water management agency, had established a countermeasure plan situation room (operation periods: March-November) and launched a nation-wide emergency task at the situation room (on March 14th) in order to systematically respond to natural disasters such as drought or storm damage and floods in accordance with 2001 Rice Production Plan that was formulated in January. Farming preparation, placing a seedbed and water management for rice planting were among the major tasks of the situation room associated with water management. Prior to operation of the situation room, it educated 3,300 workers of its own water management in preparation for spring drought, released a water management guide booklet for stage-level farm watering on March 9, allowing thoroughly to cope with it.

As drought symptoms surfaced in Central region around middle of May, the drought countermeasure situation room was implemented in Kyunggi, Gangwon, and Chung-buk provinces, and it organized 11 responsible workers in total of 3 working teams called a measurement team, an assistance team and situation team in operation. The establishment of situation rooms had expanded into Chung-nam, Kyung-buk and Kyung-nam provinces, implementing stage-level situation response work and maintaining closed relationships with related agencies in accordance with detailed disaster prevention executive plans. Even in early June when the water reserve level dropped sharply due to continual days with no rain, there had been an extensive increase of the number of personnel to a total of 103 in 6 working teams of ground water, electricity, public works in addition to working teams; in the meantime, the situation room appointed its maintenance director to a team leader. On June 13th, the president took team leadership of the situation room, signaling its response at company level.

The situation room aimed to fully respond to drought and acted as substantially coping with the natural disaster by establishing stage-level countermeasures to different situations, maintaining cooperation with related agencies, mobilizing manpower, machines and technical assistance, and water supply. The organization declared an end to its role as the

central farm drought countermeasure agency led by minister of Agricultural and Forestry on June 21, a couple of days after the nation began to have precipitation on 18th. The government budget amounted to 277,924 million won in total until July 29th under the name of water development for drought preparation and disaster countermeasure in reserve fund. However, the Korea Rural Community Corporation paid 29,627 million won, 10% of the total amount until July 31st, an amount that was insufficient to smoothly push for drought countermeasure plans on infrastructure. There was an urgent need for securing a designated budget for reoccurrence of natural disasters.

3.3.2. Drought Response Plan Details

The 2001 drought response plan can be categorized into short- and long term measures. The short term plan focused on securing emergency water supply including river bed digging, tube wells and recycling water in order to plant rice at the right time, and minimize drought damage. The long term plan established a new water supply development for the purpose of future alignment of old infrastructure and enhancing agricultural water use in areas vulnerable to drought. The plans, both systematic and unsystematic, can come down to the 3 major projects against drought, including reserve water, water quality and water use development that the Korea Rural Community Corporation continues to push forward with. The following describes the projects in detail.

a. Short Term Measures

The short term measures include emergency water development, early water supply in construction areas, water supply except for agricultural infrastructure construction and in crop farms. For emergency water development, river bed digging was a representative example that was implemented in 252 districts in the spring 2001 drought, supplied water to 16,728ha of land, with temporary water pumps and storage at 163 districts supplying water to 10,610ha of land. In order to secure water, every possible method was mobilized. In addition, the short term measures had seen a great effect in the number of districts by maximization of recycled water use and water conservation measures such as limited water supply.

Early water supply at agricultural water infrastructure benefited 12,171ha over 35 stations such as Hajum Water Pumping Station and Kangwon Hongchon Reservoir, 13,073ha over 802 stations in terms of water resource and 22,842ha over 146 stations for crop farms. Among resources, machines that had been mobilized included 2,640 water pumps, 2,851 backhoes, 5,098 dump trucks, and 29,824 people in total mobilized including 7,911 people, 12,148 employees, and 4,344 military personnel.

Table 4-1 | 2001 Emergency Water Development Status for Spring Drought

Emergency Water Resource	No. of districts	Area (ha)	Remark
river bed digging, water siege, isogony development	298	17,093	
temporary water pumping station & storage	163	10,610	
simple bridge	87	4,991	piling gunny sacks
tubular wells (small, large)	202	697	large tubular wells (55 districts) optional for long term plan
others (watering, piling gunny sacks, dredge)	323	9,723	subject to reservoirs with low water levels
Total	1,073	43,114	

b. Long Term Measures

Based upon its evaluations of the unprecedented spring drought in 2001, the goal of the plan had been changed to that of completion of ongoing construction from extensive investment and development in the middle of the 2nd plan of the 10-year agricultural water resource plan (1995-2004). The new development plans were set for 269,000ha as a water supply resource of limited rice planting areas that are necessary for self-sufficiency and regular drought areas, as well as for 30,000ha of moderate inclined farms. Long term measures required annually increased investment fund by 550 billion won from the investment budget from 2001-2004, in order to develop suitable water supply resources for specific areas, strengthen water supply capability and secure water resources in the systematic development. Meanwhile, long-term measures had been established with the aim of addressing drought concerns through water management automation and enhancing efficiency in water resource use with watershed-based security of spare water resources (supplementary plan to the 10- year agricultural water resource plan, 2001.7).

3.3.3. Specialties and Examples

There had been a number of examples in which other related agencies as well as military agencies successfully overcame, and below are two representatives to be selected.

a. Examples of Drought Response by Branch Offices and related Agencies

In Yeon Cheon, Kyounggi province, closed water pumping stations were restored to supply areas unable to intake water due to lowered water levels, while supplying water resources to 90ha of reservoirs for agricultural use with a 650m-long hose connected to 2

double lift water pumps from water-rich reservoirs. In Central Kangwon district branch, in order to supply dry reservoir located in Cherwon-gun, 2 underwater pumps and a 4km- long transport tube were placed for 60ha-wide agricultural water supply. In the Hong Cheon district, river bed digging was implemented and 7 water pumps mobilized to supply 70ha of neighboring reservoir. In Cheon Won, Chungbuk province, implementation of river bed digging 600m underground at Jocheon, Kangweo-myeon, Chungwon-gun was performed and the water from it supplied with mobilization of a pump. At 10km away from Miho-chun, 4 lift water pumping led to supplying 5ha of Bongsan-ri, Kangweo-myeon, Chungwon-gun. Under the Geum River project, waters of Geum river and lake were taken from Nappo water pumping station and supplied 3,900 million ton of water through penstock to 15,000ha of farmland in the neighboring cities of Gun San, Ik San and Gim Jae in Jeonbuk province.

b. Examples of Drought Response by other Agencies

In Su Hwa, Heung An, Kyunggi province, its 697ha area reservoir, which had experienced low water levels, was supplied with 33 million tons of water by K-water Corporation. PyeongTaek branch implemented water lane dredge and alignment at Sokbul water pumping station with assistance of 20 dump trucks from Dae Lim Industry Co, Ltd., 4 backhoes and 22 dump trucks from Woo Jung Co. Ltd. Hwa Ong Si Hwa Business Project supplied agricultural water to 2ha areas in sangan-ri, seoshin-myeon, Hwasung-si with 2 sprinkler trucks from a construction company, while Yang Pyeong, Gwang Ju district branch, which saw difficulties in supplying to 151ha of Dae Pyeong reservoir area, were supplied with 4,500tons of agricultural water from tubular wells and collecting wells that were owned by a neighboring golf club house. Yeum Sung, Chungbuk district branch supplied 1 million tons of industrial water from a neighboring electronic company named Dong Bu to 80ha in Gamguk-myeon, Yeumsung-gun for transplantation use, while Chungbuk district office itself distributed 65 water pumps, which were granted by the Seoul Metropolitan Government to its own branches committing to sites of drought response.

c. Examples of Drought Response by Military Agencies

In PyeongTaek, Kyunggi province, 200 military forces from Korean Army Regiment 169, along with 80 from Regiment 99, were mobilized to remove water plants and dredge 41.2km for the purpose of smooth water supply. Paju district branch was also mobilized with 390military forces to remove water plants and dredge 17km for supplying with water, and 40 military forces working on 3,000km of irrigation removing water plants and piling gunny sacks.

In Seochun, Chungnam province, bulldozers and backhoes were provided by the military to dredge in order to secure water levels at reservoisr based in Heunglim-ri, Pangyo-myeon, Seochun-gun. In Non San district branch, 17 machines including dump trucks were provided by military and administrative agencies for the same purpose.

Chapter 5

Expansion of Production Base carried forward under Farming Village Modernization Policy

1. Farming Village Modernization Policy and New Laws
2. Extending Irrigation Facilities by Introducing Loan (Foreign Capital)
3. Hill Development & Drainage Improvement Projects to Cope with Food Crises

Expansion of Production Base carried forward under Farming Village Modernization Policy

1. Farming Village Modernization Policy and New Laws

1.1. Pilot Project aimed at Modernized Farming Villages

Since the middle of the 1960s, the term "Farming Village Modernization" started to be used. The definition of a modernized farming village is vague, but it is clear that farming village modernization was a part of national modernization, which was the ideology of President Jeong Hee Park at the time. However, the image of modernized farming village had not been realized and planned until 1969. As the Ministry of Agriculture and Forestry (MAF) started to convert the farming villages into new villages with forest development, improving life environment, increased income, and mechanized agriculture by arranging production bases (agricultural water, farmland adjustment, etc), the futuristic image of farming village was drawn.

This plan was launched Dec. 17, 1969 under the name of Farming Village Modernization Pilot Project. At Jeongchon-ri, Seonggeo-myeon, Cheonwon Gun, Chungnam (7.5km from the Cheonan interchange of the Gyeongboo expressway), President Park announced the Anseong & Cheonwon District Farming Village Modernization Pilot Project, along with 200 people such as house members, Economy & Science Council members, university professors, the press, the United States Agency of International Development (USAID), agriculture-related agencies, and domestically-related parties. There were 2 extra-large aerial views at the moment; one was a picture in which a helicopter was sprinkling agricultural pesticides along a well-arranged field and the other was an overview of the Anseong & Cheonwon Distric Farming Village Modernization Plan. The modernized view of farming villages was seen at a glance.

Meanwhile, the 2 plans were containing the blue print of modernized farming village as follows:

1) Organizing agricultural production base such as agricultural water development to prevent drought damage and land rearrangement for mechanized farming; 2) Maximizing land resources by developing underused forests; 3) Increasing farm household income with diversification and mechanization of farming; 4) Enhancing residential environment by improving & repairing rural houses; 5) Improving rural life by arranging agricultural roads, supplying electricity, and providing residential water; 6) Encouraging stockbreeding with building ranges through forest development; and 7) Improving shipment & distribution of produces by deploying joint markets and granaries. The farming village modernization plan containing theses factors was developed by selecting 2 districts of Anseong & Cheonwon district and Mihocheon district in Gyeonggi, Chungbook, and Chungnam provinces as the result of on-site surveys at each of seven candidate provinces except for Kangwon province. The projects of these 2 districts included 1) Organizing agricultural production bases such as agricultural water development for 3,228ha (reservoirs, pumping stations, and underground water) and arranging fields of 7,683ha; 2) Developing forest areas of 1,274ha (Grassland: 1,129ha, orchards, and conversion to upland); 3) Increasing income with peppers and greenhouses; 4) Arranging agricultural roads, supplying electricity, and enhancing rural life by improving and newly building houses; 5) Improving collection and distribution of produce by deploying joint markets and granaries. It was the first local-unit general development project by the Ministry of Agriculture and Fisheries.

It was all about farming villages, but the administrative system needed 7 ministries involved: the Ministry of Agriculture and Fisheries was responsible for developing agricultural water, arranging fields, developing forests, stockbreeding, projects to increase income, newly building houses, joint markets, and granary construction; the Ministry of Home Affairs was responsible for afforestation (timber forest, fuel forest, and fruit-tree forest), erosion control (hillside erosion control and wild-stream erosion control), and improving roofs; the Ministry of Construction (MC) was responsible for river improvement projects; the Health Department was responsible for residential water and cemetery parks; and the Ministry of Adjustment Project, Commerce, and Industry was responsible for electricity supplying project for farming village.

During the initial preparation in 1969-70, the Farming Village Modernization Agency deployed in the Federation of Land Improvement Associations conducted all the cooperation, and the main project was performed by 2 agencies deployed in the newly-launched Agricultural Development Corporation (ADC) in the beginning of February, 1970. Especially, the Anseong & Cheonwon District Pilot Project was carried out by employees of ADC who stayed at the site in tents during the very cold winter.

The pilot project lasted only 3 years (1970-1972) but left many examples. It was the superintendent of education for farmers, officials, and related organizations and an opportunity to teach what needs to be done for farming village modernization and what a modernized farming village was. In addition, it can be seen as a root for the 'General Development Project for Farming & Fishing Villages' in the 1980s, the 'Settlement Zone Development Project for Farming Village' in the 1990s, and projects to improve the lives of farmers and fishermen and to develop farming, fishing, and mountain villages in the 2000s.

1.2. Farming Village Modernization through Saemaeul Project

There happen to be desire for farming village modernization from the end of the 1960s. As the government designated 1965 a 'Working Year', several tasks aimed at farming village modernization appeared. Here are the main tasks: First, agricultural management must be viable farm and cooperative management and second, the obstruction factors for farming village modernization were structural characteristics of agricultural production such as small production and social & cultural underdevelopment and land rearrangement project was highlighted as the solution. Especially, the necessity of legislation to strongly promote land rearrangement projects and enlightenment to encourage social structure reformation and farmers' awareness was focused. It was said to be necessary to develop farming village in terms of community development in addition to a modernization approach from the view of the family system. However, the practical philosophy was established for farming village modernization in 1970. The Saemaeul Movement which was suggested by President Park to change farming & fishing villages was the thing. The movement spread rapidly among farming & fishing villages, cities, islands, mountains, families, and workplaces. The symbols of poverty such as thatched roofs, dirty walls, and toilets were improved and hygiene wells, water supply facility, community halls, community warehouses, and public baths were newly built. A road network was built for farming villages by paving and extending villages' roads and agricultural roads to connect them to national highways or local roads, to encourage agricultural produce distribution and agricultural mechanization. In addition, the foundation for increased agricultural production with agricultural water-supply system and land rearrangement projects was firmly established.

The movement became a historical event to overthrow the vicious cycle of poverty and recession and to promote development. The movement was conducted with all the villages from Oct. 1970 to June 1971, focusing on village environment improvement projects. The projects were lively and animated from the beginning by supplying a free 335 bags of cement (About 4.1 billion won) to each Dong to encourage the residents to perform what they wanted by themselves, with national spirit of self-help, cooperation, and diligence. 1971 was a careful test period for the Saemaeul project, and 1972 was the year in which

these projects were extended nationally based on the lessons learned from the previous year. In 1972, 16,600 villages were selected and 500 bags of cement and 1 ton of rebar were given to each village to encourage the self-help desire of the residents with environmental improvement projects and to learn the Saemaeul spirits through the work. Additionally, a Saemaeul leader training institute was established and taught Saemaeul leaders from all round the country with how to boost the spirits and to conduct the movement, to help them to bear core roles. In 1973, 34,665 villages were divided based on development level into 18,415 Basic villages, 13,943 Self-Help villages, and 2,307 Self-Reliance villages, and the movement was conducted according to the classification.

Considering the support, Basic villages were supplied with 500 bags of cement and 1 ton of rebar to ignite and develop self-help spirit with environment improvements such as growing new villages and improving agricultural road and roof and Self-Help villages were supported to increase nonfarm income with wage projects such as country development, small county development, and small stream management, in addition to environment improvement project. For Self-Reliance villages, it was attempted to improve the welfare and income of the residents through beneficial projects such as community afforestation, cultivating, and farm-family sidelines; cooperative projects such as group cultivation; and structural improvement projects as well as by establishing cultural & welfare projects such as telephone systems, standard housess, simple water supply systems, community telecommunication systems, and methane gas facilities. Farming & fishing village house and settlement structure improvement projects to improve residential environment of farming & fishing villages remodeled 2,618,000 houses with roof improvement projects, changing thatched roofs into roof tiles, slate, or tin roofs for 7 years from 1972 to 1978; from 1976, house improvement projects extended or rebuilt 273,000 houses; and from 1976, settlement structure improvement project enhanced residential environment in 3,147 villages.

1.3. Legislation of Farming Village Modernization Development Law

As mentioned above, at the start of the 1970s, farming village modernization projects or farming village Saemaeul project made farming villages new. However, production base arrangements such as agricultural water development or land rearrangement, cultivation, and reclamation required a lot of investment and technology, so it was difficult to conduct with national finances. To overcome the difficulties, a foreign loan was obtained for development capital for all-weather agricultural water source development plan in June 1965. A loan agreement was settled with the IBRD in May, 1969, but legal protection was required for the status of project enforcing agents and borrowing agents of the loan, for the agreement to be officially enacted. In other words, the Federation of Land

Improvement Associations based on Land Improvement Project Law was not enough to qualify as the borrower under international law. Thus, the Farming Village Modernization Development Law was legislated, replacing the Land Improvement Project Law, to meet the requirement. The law was legislated hurriedly to meet the enactment deadline of the IBRD loan agreement (Dec. 31, 1969). According to the law, the federation was elevated as a government investment organization; induction of foreign capital by the organization was guaranteed by the law; and the organization's status was changed from agency for measurement design or construction supervision to project enforcing agent. Additionally, its business scope was extended to include agricultural machinery fabrication, construction & improvement of repair facility and rural houses, building pilot farming villages, and entering overseas technological service market, beyond production base arrangement.

Thus, the law was proclaimed Law No. 2199 on Jan. 12, 1970 under the name of "Farming Village Modernization Development Law." This law became the basic law regarding production bases as the adjective law for production base arrangement project, until the beginning of 1990s. Consisting of 189 articles, the law can be classified as follows: First, regulations for procedures (establishment, notice, and approval of basic plan) required for arrangement & development of production base and plan changes and sharing for enforcement; second, appropriate adjustment between land owners for project target districts and disposal of replotting according to adjustment of partitions (land rearrangement), granting legal grounds for the relationship of rights accompanied by the enforcement; and third, regulations for organization and operation of the Land Improvement Association which was the enforcing agent for agricultural land improvement projects or maintenance agent for the installed facilities. Especially, the association was granted legal control over procedures such as establishment processes and articles of association; operation and management factors such as members, general meeting & representative meeting, business, and accounting; and existence of the association such as merger, division, or dissolution. Additionally, factors regarding administrative supervision was included.

2. Extending Irrigation Facilities by Introducing Loan (Foreign Capital)

2.1. Large Development Plan and Loan Negotiation

In the 1960s, irrigation, cultivation, reclamation, and land rearrangement were conducted as separate businesses, to develop agricultural bases, and only temporary measures were taken to annually repeated drought & flooding damages. In terms of food production, damage was more severe by drought than flood, and agricultural water development was

not effective because the irrigation project was launched as a political show but ceased due to limited government finances, so a long-term development plan was not developed.

In the past, agricultural water was sincerely needed in times of drought; financial support was provided for temporary measures without hesitation, but the consideration was not established under middle/long-term government budgets. In this situation, the all-weather agricultural water source development plan, which was established in June 1965, gained unusual attention of the ruler for the first time since independence and it resulted in foreign capital attraction to finance it. When President Park reported the development plan by MAF in June 1965, he ordered it reviewed and considered attracting foreign capital to finance it. With this, there were many plans developed with load assumed: one was to partially finance the plan with loaned capital and the other was to finance some capital to develop 5 new districts with the loaned capital. The latter was selected and a plan was made for each district, to apply for reserve loan on the premise that they would get an IBRD loan. Thus, loan negotiation progressed rapidly and the research group of borrowers visited Korea three times starting in Nov. 1965 to conduct research such as listening to comments on-site and from domestically-related organizations. In the process, the target districts were reduced to 3, and the IBRD loan committee adopted it in Jan. 1969. The government dispatched a loan negotiation body in Feb. 1969 and the loan agreement was finally signed on May 23, through presidential approval on Apr. 27 and consent of the national assembly on Apr. 30. The following shows the procedure:

These projects were evaluated with economical and technical feasibility studies based on international standards throughout the process. Exhaustive quality management was conducted for construction, with the result that agriculture-base development technology of Korea was grown to international level. With the first construction of an estuary dam, reclamation technology was swiftly developed as well as large pumping and draining system technology.

Until the IBRD loan was achieved in 1969, there was no international sense for techniques of production base arrangements or project enforcement processes. Especially, there was no precedent regarding economical and technical requirements for feasibility studies and loan repayment, so everything was new. Through multiple research projects by the IBRD before loan agreement, our engineers (engineers from the Federation of Land Improvement Associations) had a hard time to meet the requirements. As well, they had to be thoroughly evaluated and technically instructed by TAHAL-DPU (technical service team) after the IBRD loan.

Achievement of the IBRD loan became a turning point for the history of Korean production base arrangement technology, and ADB and OECF loans were almost simultaneously

achieved in 1974 by seeking diversified loans. The following are the requirements during the loan, partially cited from the agreements with the 3 organizations.

2.1.1. IBRD Loan

1) It is agreed that the bank will lend the amount of 45 million dollars to the borrower in multiple currencies, according to the agreement conditions.

2) The bank will open a loan account under the name of borrower and enter the loan amount as credit.

   - The loan amount can be changed any time with the condition of rights of cancellation & stoppage in the loan agreement, and the allotment of the loan amount can be changed any time with the conditions or separate agreement between the bank and the borrower.

3) The borrower has the right to be financed with the amount below according to the loan agreement, including material & service required for the project.

   - The requested amount to cover the amount paid according to Loan Allotment II, III, and IV specified in the agreement or the amount to be paid if the bank agrees – The requested amount corresponding to 41% of the amount paid according to Loan Allotment I specified in the agreement or to cover the amount to be paid if the bank agrees.

4) According to general article 5.01, the loan amount of Loan Allotment I & II specified in the agreement can be withdrawn in the currency of the guarantor or for the cost of materials or service produced or supplied by the guarantor. However, it can't be withdrawn to pay for the tax imposed on the materials or service by the guarantor or the affiliated organization.

5) The borrower will pay an annual commitment fee of 0.75% against the non-withdrawn loan principal.

6) The borrower will pay annual interest of 6.5% for the withdrawn loan principal and the balance.

7) Interest and other dues will be payable 2 times a year on Jun. 15 and Dec. 15.

8) The borrower will repay the loan principal according to the repayment schedule.

2.1.2. ADB Loan

1) The bank will agree to lend the corresponding amount of 19 million dollars to the borrower (Federation of Land Improvement Associations) in various currencies.

2) The bank will open a loan account in the account book with the name of borrower and deposit the amount. The loan amount will be withdrawn from the loan account in the deposit foreign currency. However, it is not available when the rights of cancellation & stoppage are exercised according to the loan agreement.

3) The borrower will pay a commitment fee of 0.75%. This fee will be charged from the 61st day of the loan agreement conclusion and will be imposed for the following loan amount quarterly (However, the withdrawn amount will be deducted): 1st 12 months - 2.85 million dollars; 2nd 12 months - 8.55 million dollars; 3rd 12 months - 16.15 million dollars; and lastly - total loan amount.

When canceling the loan amount, it is applied first to the loan amount on which the commitment fee is not imposed. If the canceled amount or the sum is bigger than the amount to which the fee is not imposed, the exceeding amount will be applied to the loan amount to which the fee is imposed.

4) The borrower will be payable the annual interest rate of 8.25% for the withdrawn outstanding issues.

5) Unless there is a separate agreement between the borrower and the bank, the fee for special withdrawal agreement by the bank, upon the request of the borrower, will be payable with the annual interest rate of 0.75% for the outstanding issues of the amount of special agreement.

6) Loan interest and other fees will be paid every 6 months on June 1 and Dec. 1 annually.

7) The borrower will repay the withdrawal of the loan principal according to the repayment schedule specified in the loan agreement.

2.1.3. OECF Loan

1) The fund will provide the borrower with a loan of up to 19.44b Yen (Japanese Yen) for the agricultural development project specified in the loan agreement, according to the articles of loan agreement and related regulations of Japan but will pay no more than the aforementioned amount according to the loan agreement.

2) The borrower will have to use the loan to purchase Japanese materials and services required for the project according to the allotment table specified in the loan agreement. Some of the loan can be used to cover domestic capital for the project unless it exceeds the amount specified in the agreement.

3) Under the loan agreement, final payment will be made by Dec. 31, 1979 and will not be paid after then.

4) The borrower will repay the loan principal according to the annual repayment schedule specified in the agreement.

5) The borrower will pay the fund with paid principal and the annual interest of 3.25%.

6) The borrower will pay the fund annually with the interest on Jun. 20 for the period from Dec. 20 of the previous year to Jun. 19 and on Dec. 20 for the period from Jun. 20 to Dec. 19. Before final repayment, the borrower will pay the interest on on Jul. 20 for the period from Dec. 20 of the previous year to Jun. 19 and on Jan. 20 of the next year for the period from Jun. 20 to Dec. 19.

Table 5-1 | Loan Amount and Conditions

Name of district	Loan Conditions				Agreed Date	Loan ($'000)	Withdrawal ($'000)
	Interest rate	Fee	Term Days	Repayment Days			
Total						318,650	311,387
IBRD						255,650	254,354
Gum River/ Pyeong Taek	6.50	0.75	7.0	23.0	69. 5.30	45,000	44,995
Yeong san River (1)	7.25	〃	6.0	23.5	72. 2. 2	48,000	48,037
Kyung ju	7.25	〃	7.0	17.5	74. 1. 4	2,650	1,331
Ni Ho Stream	8.90	〃	5.0	17.0	76. 8. 5	29,000	28,996
Ni Ho Stream	8.50	〃	3.5	13.5	77. 2.11	95,000	94,995
Non San	7.90	〃	4.5	12.5	78. 1. 4	36,000	36,000
ADB						63,000	57,033
Yim jin	8.25	0.45	7	19.5	74.12.27	19,000	18,878
Nam River	9.10	〃	7	20.5	76.12.29	32,000	25,544
Nak dong River	8.30	〃	7	20.5	77. 8.31	12,550	12,611
OECF						14,145	14,145
Gyewha Lake	3.25	-	7	18	74.12.26	2,867	2,867
Chang Yeong	3.25	-	7	18	74.12.26	2,543	2,543
Sapkyo Stream	3.25	-	7	18	74.12.26	8,735	8,735

2.2. Enforcement of Loan Project

The following describes project overview and features of the representative 5 districts among the large general development projects conducted with the loans.

2.2.1. Keumgang District - Large 2 Layer Pumping Facility

Even though the water-rich Keum River is in this area, the hilly areas are damaged by drought and the plain area is damaged by floods with a certain amount of rain. To improve this vicious cycle of natural disasters, water from Keum River was used as agricultural water. There were no well-irrigated paddy fields but there were 5,697ha of rain-fed fields, 3,200ha of partially irrigated paddy fields, 3,070ha of upland, and 1,092ha of forest. It was Nonsan plain zone across 2 provinces (Chungnam and Jeonbook) and 5 Guns (Booyeo, Gongjoo, Nonsan, Iksan, and Okgoo). To develop 12,148ha, 18.823m won was invested to extend 1 reservoir and to build 8 pumping stations, 4 draining stations, 494km of irrigation channels, and 12km of drains for 6,549ha of land rearrangement, 1,761ha of reclamation of paddy fields, and 3,838ha of irrigation improvement, for 7 years from 1970 to 1976. Especially, 6,549ha of the land rearrangement contributed to the Korean land rearrangement project along with 6,173ha in Pyeongtaek district. The Keumgang-district land rearrangement followed the general rules to start in the autumn and to finish in the spring for 4,854ha in 1973, following 1,685ha of arrangement in 1972. In addition, farmers came to prefer land rearrangement. Because it was not easy to finish the work within 4-5 months (excluding the cold period of January and February) and to designate the land without interrupting the farming. This project was able to be successfully conducted through rush work with the Agricultural Development Corporation, which mobilized the whole local branch (Keumgang branch) and on-site supervision of executives from headquarters. Considering that there was not enough construction equipment (bulldozers), and that national land rearrangement projects were conducted in Chungnam where the Keumgang district was located for average 1,719ha and in Jeonbook for 1,584ha, the project size of 1973 for Keumgang district was 3 times that of the others.

Additionally, the technology accumulated during the land rearrangement project and know-how to respond to documentation became a foundation for future project development, being used as a guideline. The project featured large pumping stations such as the Bongjeong and the Ganggyeong pumping stations to control water and drainage. The 2 stations were developed with a new model wherein the pumped water was pumped again in six 2-layer pumping stations. This development had significance because it was conducted with foreign capital along with the Pyeongtaek district. On May 23, 1969, after years of submitting preliminary applications for the IBRD loan in Sept. 1965, 17.185 million dollars (7.108 million won) of foreign capital was introduced and invested into the large general

development with an amount of 16,823m won, along with domestic capital of 9,715m won. There were some unprecedented features in the development process: First, it was relatively easy to introduce domestic capital due to the foreign capital so there was no problem with the construction; second, technological review and instruction were conducted by the foreign technology service group with international standards; third, WFP grain was supported free to minimize domestic capital use and farmers' burden; and fourth, there were consultative bodies (the Central Adjustment Committee led by the Deputy Minister of the MAF, the Local Committee led by provincial governors, and the Gun-unit subcommittee led by county governors) so that they were able to solve problems any time. The sum of working expenses was 9,544m won based on 1968 prices, but the actual amount almost doubled, reaching 16,823m won by the completion in 1977. The reason of increased investment was sharply increased material costs due to international oil crisis starting in 1972, and then increased labor costs and land prices resulting in highly increased land purchase cost.

At the moment, the expected effect of production-based arrangement around irrigation was represented in increments of rice and barley production, and the effect for the district was evaluated with increased production of rice of 34,538tons and of barley of 14,640tons.

2.2.2. Pyeongtaek District - Lake Asan, the First Estuary Dam

The vast Pyeongtaek plain, behind the estuary of Anseong stream and Balan stream which are located in middle-west coastal area, suffered from the vicious cycle of drought and salt damage, and simple drought caused severe upstream drought or countercurrent of seawater due to lack of water sources. To solve the problem, breakwaters were constructed at Asan bay at the estuary of Anseong Stream and Namyang Bay at the estuary of Balan Stream, creating a large freshwater lake and using it as a water source to improve the agricultural base for the Pyeongtaek District Development Project.

The Pyeongtaek plain zone stretches across 2 provinces (Gyeoggi and Chungnam) and 4 *Guns* (Pyeongtaek, Hwaseong, Asan, and Cheonwon) and it was planned to create all-weather farmland by deploying 2 freshwater lakes with the estuary dams, 20 pumping and draining stations, and irrigation & drainage channels of 993km (irrigation channels of 966km), targeting 6,173ha of land rearrangement, 2,682ha of reclamation of paddy field, conversion to paddy field of 1,808ha with hill development (slope development), and irrigation improvement of 7,756ha.

With the IBRD loan agreement in 1969, the construction started in Dec. 1970 and Asan & Namyang breakwaters, which were the main water sources, were completed in Dec. 1973 and irrigation & drainage systems, such as pumping & drainage stations and irrigation & drainage channels, were established in Nov. 1976. With total working expenses of 37,657m won, the project was significantly different from traditional water-source development which

installed small & middle reservoirs, pumping stations, or irrigation reservoirs and used them as irrigation sources. In other words, it stopped the tidewater by blocking the estuary and the undercurrent of fresh water inflowing from the inland as the first national attempt to construct estuary dam. Asan Bays estuary dam is called Lake Asan, and Namyang Bay's is called Lake Namyang. Lake Asan contains 123m tons of fresh water with a 2,564m-long and 8.5m-high breakwater, and was the biggest agricultural water source of Korea. Lake Asan was capable of supplying irrigation water to 14,415ha through 12 pumping stations and irrigation channels, and 104,000m^3 of residential and industrial water per day.

Meanwhile, the estuary dam construction for Lake Asan was a battle with 7-8m of water depth for mean tide, 9m of tide range, and the sea which provide 190m tons of tidal amount twice a day, but the last tide embankment construction was successfully completed in 2 years and 3 months. Here are the structural characteristics of Asan breakwater and a summary of the tide embankment construction. For Asan breakwater, Korea selected the structure of foundation ground, materials, and the last tide embankment construction, to secure safety against once-a-century marine conditions. For the foundation, the mattress method (which were made by sewing rice straw, straw bag, and polyester fabric to prevent scouring and gabion riprap work) was selected. The tide embankment construction was planned according to the marine water conditions by the construction stage and construction conditions according to equipment already held. The breakwater was constructed with a dot stacking method so 2,175m of soft ground was filled among 2,564m within 24 months (by Dec. 12, 1972). For the last tide embankment construction section of 224m, stopper stones and gabions were mainly used; there was some loss of input, but finally they were able to proceed with dot stacking without major problems. Last, they made best effort for the last 28m section to reinforce the profile for the big tidal period with 6.9m/s of estimated flow velocity and 5.4m of water-level difference, so they were able to block the tough seawater on Feb. 16, 1973. For the tide embankment construction, the gabion method using numerous 2-ton gabions was very helpful: the gabions were linked during the construction forming a force against the flow velocity. While progressing with stopper stones, they stopped and reinforced the bottom with gabions to prevent stopper stones from being washed away.

2.2.3. Gyeongjoo - Deokdong Dam with Horn-type Spillway

Deokdong dam, which is located in the Shinpyeong stream valley of Deok-dong (10km east of Gyeongjoo, the 1000-year capital of the Shilla Dynasty), had a 23m-diameter and 73m-circumference horn-type spillway and featured to exclude flood with preboring tunnel.

The dam was only 169m long so it was difficult to deploy the spillway to fill the dam. So it was planned to deploy it in a horn shape in the reservoir to exclude floods, and the horn-type spillway of 196ha itself became an attraction for tourists after completion. Deokdong

Dam was built for multi-purpose water supply (14.75 Mill m^3 of agricultural water, 30,000 m^3/day of residential water, and 10.18 Mill m^3 of tourism water among 32.7 million m^3 in total) such as agricultural water for surrounding farmland, residential water for Gyeongjoo City, and tourism water, as a part of the Tourism General Development Plan for Gyeongjoo District in 1972.

With the loan agreement with the IBRD in Jan. 1974, 1,280m won, 26% of the 4,916m won total working expenses, was invested in the development. It was a mid-sized project district targeting 1,140ha such as 794ha of irrigation improvement and 346ha of land rearrangement, but the Deokdong Dam was completed 2 years and 10 months from the start of construction on Feb. 1975, and so it is known as one of the quickest construction projects.

2.2.4. Stage 1 District of Yeongsan River - Large 4 Dams

Yeongsan River, which runs Southwest part of Korea, is one the 4 big rivers along with the Han River, Nakdong River, and Keum River, but it has relatively low flux compared to the others. The 4 dams constructed in the upstream of the Yeongsan River were relatively large among agricultural dams built in the 1970s. The 4 dams were named Lake Damyang, Lake Jangseong, Lake Najoo, and Lake Kwangjoo and are still maintained.

These 4 dams were developed as main water sources for 34,500ha in Jangseong and Najoo plains throughout Kwangjoo and Najoo cities, and Damyang, Jangseong, Kwangsan, Najoo, Hampyeong, and Yeongam *Guns*, and it was called the Stage 1 District of Yeongsan River. The development of the district, which was started in Apr. 1972 and finished in Nov. 1978, included 21,446ha of irrigation improvement, 10,351ha of land rearrangement, and 2,703ha of conversion to paddy fields through slope development.

Before the 4 dams were built, there were 97,900ha of rice fields out of 347,000ha around Yeongsan River and it was 30% of the rice fields of Jeonnam province. But the agriculture was unstable due to repeated droughts and flood damage. Water resources of 3.5 billion m^3 was formed with annual rainfall but only 310 million $m3^3$ of water used for agriculture, industry, and residents. Even the rice fields and upland were covered with red-clay water when daily rainfall was just over 150mm, and minor droughts caused severe damage.

The 4 dams were built as the fundamental solution: Jangseong Dam for the Joongboo plain of Jeonnam; Damyang Dam for the Northeast field, Kwangjoo Dam for the farmlands around Kwangjoo not reachable by the Damyang Dam; and Najoo Dam for Najoo in the Southwest and Yengam.

The 4 dams, which were main water sources of Stage 1 Development of Yeongsan River from Apr. 1973 to Mar. 1974, resulted in the flooding sacrifice of living base of many people and public offices. It was also the strong will of the residents who suffered from the drought

and flood damage. The following describes the project overview of the 4 dams and an aspect of flooding sacrifices:

a. Najoo Dam

Najoo Dam was stopping Daecho Stream from flowing into Jeseok River in an area of 8,460ha around Gooksabong (440m) in Dado-myeon, and was the biggest agricultural dam of Korea at the time. Comparing to the catchment area, the reservoir is bigger and the irrigation area is wide because the water of the Tamjin River was introduced through a 1,328-long tunnel in Mt. Seonwang. The dam is a core-type fill dam and features suit-type spillway controlled with 31m-high fill dam and 496m-long radial gate.

In the old days, the upstream was dense with forest so communist guerrillas were hiding until the last moment of the Korean War. Green tea is produced around Boolhoe Temple and Woonjoo Temple, and Dado-myeon is one of the best-known tea producers.

The water of Najoo Dam runs through Shinbook, Najoo, Gongsan, and Donggang which gave a hard time to farmers during the droughts in 1967 and 1968. While constructing Najoo Dam, 755 farm families and organizations such as elementary schools, township offices, police stations, post offices, and agricultural cooperatives had to move out. The total working expenses were 8.74 billion won for the dams and construction in the flooded plain part, and it cost 1.753 billion won to build the dam. The 31m-high dam, with 496m of fill, contained the biggest amount of 91.20 Mill tons.

b. Jangseong Dam

Jangseong Dam (36m high and 603m long), which is located at the corner of the Hwagyong bridge of Jangseong-eup, Jangseong Gun to Baekyang Temple in a national park, had the nationally biggest beneficiary area with 687ha upstream of Yonggang stream. Because of this dam, 7 villages including Deokjae-ri ,which was a seat of township office of Booksang myeon, and 593 households, township office, the school, post office, and police substation were sacrificed. The reservoir area of the dam was 4 times that of the Bookgap reservoir (160ha) which was the biggest reservoir in Jeonnam area, and the pondage was 85m tons. It was a water source supporting 13,400ha of frequently-drought-damaged area, with 97.79 billion won were invested (16.41 billion won for compensation, 16.70 billion won for dam construction, 59.81 billion won for land rearrangement and irrigation channel, and 487m won for road relocation). Especially, Wangbuddle tree, which was national monument No. 80 of Bongdeok-ri; and Palmojeog, which was a local cultural asset, were submerged; and 593 households had to leave their legacies such as rice fields, upland, and houses. The water of the dam was transferred to Shinkwang-ri through a 3.5m-wide and 1.5km-long tunnel with an intake tower that pulls out 13.7ton/s and was supplied to Najoo fields of Hampyeong after running 160km. To supply about 13,000ha of water to Nammyeon plain of Jangseong,

Wolya plain of Hampyeong, Hanam plain of Kwangsan, and Noan plain of Najoo, tunnels were constructed in 26 places with 6km long in total, and inverted siphons were deployed in 25 places with 5km long in total for helping people cross shallow places like streams. The water from the Gunner plain of Jaseong-eup runs across the Hwangryong River through an inverted siphon and reaches the foot of a mountain in Yeosan-ri through a 4km-long tunnel in the hillside of Mot Hill. With the water running 160km with the irrigation channel after running around the hillside for 50km, the forest land of 1,141ha that was only left with trees due to lack of water became farmland, and ranges and orchards were also found.

c. Damyang Dam

Damyang Dam, which is located Daeseong-ri, Keumseong-myeon (1.2km northeast of Damyang-eup), has the highest height (46m) and the shortest length (317m) among the 4 dams. It has a reservoir area of 405 ha.

This dam was constructed at "Dokaebi Darimok" because there were many stones at both sides of valley. This dam submerged 366 households and 6 villages in Deungyong-myeon: Dorim, Worgye, Sanseong, Yongchi, Yongyeon, and Cheonghong. In addition, the elementary school, post office, police station, and 6km-long Damyang-Soonchang local road had to be moved out. The reason why this sacrifice was undergone was that the water from the valley to Yeongsan River caused too much damage to the residents. This dam stored 65m tons of water from Mt. Choowol, which is located upstream of Damyang-eup, thus eliminating muddy streams or floods. In addition, it was difficult to fill the amount only with the water from the area of 4,720ha upstream, and so a tunnel was constructed from Yeongyeon-ri upstream, to Woljeong-ri, Goorim-myeon, Soonchang Gun, Jeonbook for 726km to lead the water of Seomjin River. It cost 16 billion won to build this dam, which irrigated 6,245ha of land for 10 towns across Damyang, Janseong, and Kwangsan, and 5,668m won was invested in the irrigation system and land rearrangement.

d. Kwangjoo Dam

Kwangjoo Dam is located at Boonhyang-ri, Nam-myeon, Damyang Gun (12km north of Kwangjoo city). Its full water level reached Choonghyo-dong, Kwangjoo city, storing the water from Mt. Moodeung in Kwangjoo. This 25m-high and 505m-long dam irrigated 3,155ha composed of rice field around Moojeong-myeong, Damyang-Gun and Kwangjoo city and had relatively smaller beneficiary area compared to others. However, it is located around Kwangjoo and at the foot of Mt. Moodeung (a provincial park), so it had the biggest potential as a tourism resource.

Upstream of dam, Sikyeongjeong (where Songgang Jeongcheol who was a mater of lyric literature wrote Seongsanbyeolgok is located), and Choonghyodong is located 500m away across it. In Choonghyodong, where General Deok Yeong Kim was born, and Jiseokri,

cultural heritage and remains of Namdo are concentrated, such as Sosoewon which is a typical Korean garden. This dam submerged 210 households and some remains from the New Stone Age including 30 dolmens and menhirs.

Meanwhile, the Stage 1 district of Yeongsan River didn't only include the aforementioned 4 dams. Originally, the development was planned in 5 stages so we will take a general view on the overall development plan with 5 stages. The reason why general development around Yeongsan River wasn't referred to by place names but with stages was that the long-term plan was supposed to be achieved in stages for the large water system, the Yengsan River water system.

The previous stage of the development plan started in 1962 when a UN special fund started a reclamation resource survey. The survey found out the current state and development resources around Yeongsan River so a development plan was established at the end of 1965. In Aug. 1970, President Park ordered the establishment of the 4 River Basin (Han, Nakdong, Keum, and Yeongsan Rivers) General Development Committee to set the development direction by water system unit. Thus, through multi-year basic study for production base general development of 126 thousand ha around Yeongsan River to find out main facilities and investment scale, the plan was divided into 5 stages with technological review by areas. Overall, it was planned to connect 10 dams in the upstream area of the Yeongsan River, an estuary dam which blocked the coastal area of Mokpo, and 11 breakwaters linking small islands around Mooan, Shian, Yeongam, and Haenam, to build 5 freshwater lakes, 56 pumping stations, and a 572km-long main line of water.

Stage 1 was to build 4 dams in the Yeongsan river upstream to store 250m tons of water and irrigate 34,500ha of farmland; Stage 2 was to build a freshwater lake of 250m tons by blocking the estuary of Yeongsan River which is located before Mokpo port; Stage 3 was to undercurrent 378m tons of water from Yeongsan River by blocking Masan Bay between Yeongam Samho peninsula and Haenam Hoewon peninsula; and Stages 4 & 5 were to build freshwater lakes by blocking Mooan, Hyeonkyeong, and Jido bays in the West Sea and then to bore the hillside between a school and West Sea bays so that they could store 537m tons of water from Yeongsan River. With all the stages completed, 4 dams and 6 freshwater lakes would store 14.33bn tons of water and the amount would be enough to irrigate 100,000ha of farmland so the Yeongsan River basin will be an all-weather agricultural area without concerns about water even if there were no rainfall for 3 years. As well, 31,000ha of newly reclaimed land and 6 sea-like-lakes with 1,500-3,500ha of flooded area would be established. If people wanted to go to Haenam Hwawon from Yeongkwang Gunnam, they had to run 600km along the coastline, but after the project was completed, the distance would be reduced to 150km along the breakwater. Additionally, the land route between Hwawon and Mokpo would be reduced from 200km to 12km. This project would

establish 31,000ha of farmland with the tideland and change 5,368ha of forest into rice field extending the farmland, resulting in increased rice production of 313 thousand tons, which could feed the total population of Jeonnam for 5 months.

2.2.5. Gyehwado District - The First Large-scale Reclamation

There are 2 reasons why this reclamation is meaningful. One is that the reclamation boasted the biggest scale at the moment, and the other is that there was competition about jurisdiction between the MAF and MC. Before 1960, license for reclamation for public waters was mostly for agriculture under the sole jurisdiction of the MAF. But in Jan. 1962 after 5.16, the Public Waters Reclamation Law was enacted and it became the jurisdiction of the newly-established Homeland Construction Agency. At the moment, the provisory clauses described that the things related to farming and fishing were under the jurisdiction of the Minister of Agriculture and Forestry but the Homeland Construction Agency became the MC and the law was revised afterwards mandating that all the reclamation licenses be under the jurisdiction of Minister of Construction. So all the data of the MAF had to be transferred to the MC so even reclamation for farmland development had to be licensed by Minister of Construction. Meanwhile, the MC took this opportunity to take reclamations to establish farmland as their projects (the Department of Irrigation and Reclamation was established to take the job).

Gyehwado reclamation project was the first and the last reclamation project carried out by the MC according to the revised Public Waters Reclamation Law, and it was called the Dongjin River Irrigation Reclamation Project. The project was started in 1963 to establish 2,500ha of farmland with 3,968ha of reclaimed land, which was the biggest scale nationally. However, they wanted to transfer internal reclamation of paddy field work to the MAF after constructing breakwaters and reservoirs for 6 years. This caused the conflict between the MAF and MC resulting in mediation by Blue House and revising the reclamation law. With the revision, the license of reclamation for public waters for agriculture came under the jurisdiction of the MAF.

Thus, the MAF took it over in 1973 and conducted internal reclamation of paddy fields in 1974 as a part of large-scale agricultural general development project with the OECF (Overseas Economic Cooperation Fund of Japan) loan. The following are the project overview and the progress including the outskirt construction under the jurisdiction of the MC.

It was to establish 2,500ha of farmland by building 2 breakwaters at both sides of Gyehwado island on the coastal waters of Haengan-myeon, Booan Gun, Jeonbook to connect them with the shore and reclaiming the inside. The main projects of the outskirt construction were breakwaters, headraces, and reservoirs: Breakwater No. 1 (9,254m) was

built from Gyehwado to Anseong-ri, Donjin-myeon, Booan Gun; No. 2 (3,556m) was built until Euibok-ri, and a headrace of 67km was built using the effluent of Chilbo Power Plant as the agricultural water; a reservoir was built to store the water. Working expenses were 5,686m won (paid by the MC), and all the construction was started in 1971 but left alone until 1974. In 1973, the MAF tried to establish 2,500ha of rice fields with the internal reclamation of paddy field acquired and carried by itself. Main work included constructing 176km of irrigation channels, 176km of main-line roads, 10.6km of waterproof agents, and 3 pumping stations as well as deploying 141km of drains, including 7.7km of main drainage lines, and connecting it to 279ha of reservoir to control it. For the main-line road, the ground was soft so politex was applied on the circle ground to prevent settlement; the profile was established with 90cm-deep Ganseokto; and the road was covered with 50cm-deep Yeokjilto, to harden the road. In addition, many new methods were developed and applied: the private ditch was elevated higher than the rice field facilitating water supply; pin blocks were attached to main drainage line; and the slope of the irrigation channel was lined with soil cement to reduce construction costs. The soil cement lining adopted to protect the slope of irrigation channel was especially helpful to secure the safety (because the area was made up of fine sand), and to reduce the cost.

Table 5-2 | Large-scale Development Projects by Loan

Name of district	Area (ha)	Project Amount (million)			Loan Provider	Agreed Date
		Total	Domestic Capital	Foreign Capital		
Total (13)	155,269	1,013,238	792,051	221,187		
Geum River (L-Pumping)	12,148	16,823	9,715	7,108	IBRD	69. 5. 22
Pyeong Tak (Asan Lake)	18,419	37,657	26,154	11,503	〃	69. 5. 22
Yeong san River (1) (4 Dams)	34,500	81,238	58,602	22,636	〃	72. 2. 2
Kyung ju (Duk Dong Lake)	1,140	4,916	3,636	1,280	〃	74. 1. 4
Gyewha Lake (L-Reclamation)	2,500	12,521	6,942	5,597	OECF	74. 12. 26
Sapkyo Stream	24,700	232,000	212,491	19,509	〃	74. 12. 26
Chang Yeong	2,269	17,358	11,823	5,535	〃	74. 12. 26
Ni Ho Stream	11,554	104,871	85,079	19,792	IBRD	76. 8. 5
Yim jin	7,185	45,807	34,900	10,907	ADB	76. 12. 27

Name of district	Area (ha)	Project Amount (million)			Loan Provider	Agreed Date
		Total	Domestic Capital	Foreign Capital		
Nam River	5,754	61,903	44,242	17,661	〃	76. 12. 29
Yeong san River (2)	20,700	281,084	218,159	62,925	IBRD	77. 2. 11
Nak dong River	3,600	23,029	13,848	9,181	ADB	77. 8. 31
Non San	10,800	94,031	66,460	27,571	IBRD	78. 1. 4

2.3. Saemaeul Loan for Agricultural Water Development

With the all-weather agricultural water source development plan of Jun. 1965, the project started to become active again. While the government budget support didn't increase, demands increased gradually so it took 5-6 years to complete development for 1 district. Compared to this, the large-scale general development project conducted with the IBRD loan since 1970, was performed smoothly according to the process planned. At the beginning of 1973, national large/middle-sized projects were carrying out construction slowly and continuously for 71,062ha in 106 districts, without an annual guarantee of the working expenses. The project requiring 38.4 billion won in total cost 12.5 billion won until 1972, and the remainder was 29.5 billion won after 1973, but the budget for working expenses (subsidy and long-term bond) in 1973 was only 3.9 billion won.

Around that time, President Park ordered the assessment of development capital needs and establishment of a loan plan including the development candidates or project district under enforcement for the agricultural water development project or large-scale general development projects. According to the order, the Ministry of Agriculture and Fishing started loan negotiations while looking for loan providers and assessed the development capital needs for the working expenses of development-intended spots with research & design completed and for new target areas of the large-scale general development project including the remaining working expenses after 1973, for the district of agricultural water development project which had progressed slowly until then. With the AID, IBRD, ADB, and OECF of Japan, they tried negotiations and accelerated the introduction of loans through International Economic Consultative Organization for Korea (IECOK).

Thus, on Sept. 1, 1974, a loan agreement was made with the AID for the project. Following this, loan agreements with the IBRD and OECF were made one after another, on the project. Until 1978, the total loan capital was 225 million dollars including 25 million dollars from AID, 82 million dollars from IBRD, and 118 million dollars from OECF. So the total amount of more than 500 million dollars was introduced to the large-scale general development project since 1970, including 219 million dollars from IBRD and ADB and 14m Yen from OECF.

With the loans, working expenses for the project were increased 5 times to 27.8 billion won in 1978 from the annual 5 billion won until the previous year, extending the project considerably.

The following describes the introduction process of the loans by the loan providers:

2.3.1. AID Loan

In 1973, the AID loan application was made for the remaining working expenses for 106 districts, it was aimed to rely on the AID loan of 13 billion won (32,500 thousand dollars) corresponding to 50% of the remaining working expenses of 25.9 billion won, from 1974 to 1976. USAID/K, to which the preliminary loan application was submitted, reviewed the project plan for 3 districts (Shingok district of Gimpo Gun, Gyeonggi-Do - 15,926ha; Neungseo district of Yeojoo Gun - 2,026ha; and Imjin district of Pajoo Gun - 676ha) with the Korean government in May of that year and selected 88 relatively large-scaled and more effective districts.

Thus, in Oct. of the same year, the loan application was submitted to AID headquarters requesting a loan of 30 million dollars for the 88 districts (65,874ha of development area). After receiving the loan application, AID dispatched a research group to conduct a feasibility study in Mar. 1974 and confirmed 66 investment-efficient and large-scaled districts (48,716ha of development area) as loan target areas, signing a cash loan agreement of 25.7 million dollars with Korean government on Sept. 11 of the year. The loan conditions were a 10-year grace period (2% annual interest rate) and full amortization for 30 years (3% annual interest rate), and they were more advantageous conditions than those for large-scale general development projects. With the loan, the agricultural water development project was conducted in the 66 districts, for 3 years from 1974 to 1976.

Table 5-3 | AID Loan-supported Irrigation Expansion Project (early 1973)

Facility	No. of district	Area (ha)	Water increase (M/T)	Project Amount (million)		
				Total	until 1972	after 1973
Total	106	71,062	99,866	38,367	12,460	25,907
Reservoir	64	25,908	4,205	18,755	6,306	12,449
Water Pumping	24	37,908	47,384	14,981	4,789	10,192
Pumping/Drainage	24	857	1,505	1,085	169	916
Drainage	10	3,079	5,557	2,092	912	1,180
A Reservoir for Irrigation	4	3,505	4,995	1,415	279	1,136
Collecting Conduit	1	563	220	39	5	34

2.3.2. IBRD Loan (Saemaeul Loan)

Following the above-mentioned AID loan, the Ministries of Agriculture and Fishing, Home Affairs, Health, Commerce and Industry, Construction, and Korean Forest Service tried to introduce the IBRD loan together under the name of "Saemaeul Project" in 1976. The target projects included irrigation facility expansion of 14,000ha, hill development of 4,500ha, agricultural road construction of 850km, small-scale water supply systems for 2,000 villages, telephone systems for 30 households, and hydrological investigation or special design & study to develop water resources. In Jan. 1976, the preliminary loan application was submitted to the IBRD, which then studied the feasibility of the loan and agreed to provide the loan with the board of directors on Mar. 5 signing the agreement with Korean government on Mar. 19. The loan consisted of 34.5 million dollars for construction cost, 21.4 million dollars for materials and equipments, and 4.1 million dollars for other items. Of the funds, the Ministry of Agriculture and Fishing had jurisdiction over 29.149 million dollars including 15.9 million dollars for agricultural water development projects of 14,000ha in 65 districts, 3.8 million dollars for hill development of 4,500ha, and material & equipment costs of 29.149 million dollars.

The loan capital was lent by the National Agricultural Cooperative Federation to the Farmland Improvement Association. The limited amount was 30% of the construction costs for each district. Repayment would be made in 35 years including a 5-year grace period with a 3.5% annual interest rate, in full amortization. It was regulated that the association would set and collect union dues from the beneficiary, which is sufficient to repay the loan including an annual maintenance management cost.

This Saemaeul loan contributed significantly to agricultural water and hill developments. However, the drought damage dealt a big blow to the rice production in 4 areas of Yeongnam and Honam with rice production in 1976-1977. In 1976, summer (June-August) rainfall was considerably los comparing to a normal year, and the rainfall was only 61% and 69% of a normal year in Chungnam and Jeonnam respectively. In 1977, there was extremely low rainfall: 47%, 56%, 57%, and 60% of annual norms in Jeonnam, Gyeonggnam, Gyeongbook, and Jeonbook respectively; but in August, it was nationally around 50% except for Jeju. The drought raised the needs for agricultural water development again, and they relied on loans to finance the project. Thus, the IBRD loan was additionally introduced to the agricultural water development sector of Saemaeul project. The loan agreement was made between the Korean government and the IBRD on Mar. 13, 1978 amounting to 52.922 million dollars. Unlike the first one, the conditions were a 4.5-year grace period, 12.5 years of repayment, and a 7.45% annual interest rate. This loan helped to build agricultural water supply facilities for 9,192ha in 36 districts, for 6 years from 1978 to 1983.

2.3.3. OECF Loan (Commodity Loan from Japan)

While the performance of agricultural water development project was proven with the successive introductions of loan capital, the government started to diversify the loan providers again and to look for more advantageous loans; it introduced a commodity loan rather than a cash loan under the name of "Agriculture Promotion Loan" from Japan. When the commodity was introduced as a loan, the government was able to sell it and put it in the budget to invest it as working expenses.

For the commodity loan, the government made loan agreements with OECF Japan three times: on Dec. 24, 1975; Jun. 10, 1977; and Jan. 31, 1978 amounting to 117.837 million dollars. The 1st 39.706 million dollars were invested in agricultural water development for 27,862ha in 16 districts; the 2nd 50.858 million dollars were invested in 10,234ha in 40 districts; and the 3rd 27.273 million dollars were invested in 4,124ha in 15 districts. With the 3-stage loan, the project was conducted over 42,120ha in 71 districts, for 8 years from 1976 to 1983.

3. Hill Development & Drainage Improvement Projects to Cope with Food Crises

3.1. Global Food Crisis

Entering the 1970s, the energy crisis due to Middle East War was followed by a global food crisis in 1974. The crisis was mainly caused by abnormal climate in 1972, resulting in globally poor harvest including the Soviet Union, and additionally by food export restrictions by the US. With the skyrocketed price (6.01 USB/bushel) in the USA's Chicago wheat market in Dec. 1973, the global food crisis spread. Thus, food became a strategic product, and those countries which relied on imported food started to secure domestic food bases for security.

The World Food Conference was held in Roma Pilazo de Concressy with 3,000 representatives from 30 countries, to discuss global food evaluation, increase of food production, nourishment improvement, and global food security plans. But the Rome conference didn't provide measures against starvation because of different interests between the poor and the rich, and the West and East; it rather just confirmed that the problem was a common issue for humans. At the time, the amount of food stored was just enough for 3.9 billion people to have for 27 days, and it was a third of 1961 when it was 95 days. Therefore, it was necessary to extend agricultural farmland, improve and arrange existing farmland, develop new kinds of produce, control population, develop alternative foods, fast, and cooperate globally. The food crisis, which was one of the most interesting issues all

around the globe, didn't exclude Korea. At the moment, Korea relied on imported 3 billion tons of rice, wheat, corn, and beans, so it was essential to solve the problem by extending absolute farmland and increasing production from the existing farmland. In other words, Korea developed hills to extend the absolute farmland for an extensionally extended food base as a coping method. At the time, farmland was encroached upon by about 20,000ha every year from 1968 to 1972, due to industrialization from the beginning of 1970s and resulting in 78,000ha of converted land for other purposes. Because of that, extending and securing the food base and improving the production conditions were magnified as national supreme tasks expected to be achieved by developing hills.

3.2. Hill Development and Enactment of Special Law

Cultivation, which was taken arbitrarily by the private sector since 1967, was converted into planned development by the government from 1972. The cultivation was called 'Hill Development'. In 1972, the first attempt was made for 603ha to be used to establish a bean complex in 4 districts: Yeojoo (Yeojoo-eup, Yeojoo Gun, Gyeonggi), Taean (Taean-eup, Taean Gun, Chungnam), Iksan (Wanggoong-myeon, Iksan Gun, Jeonbook), and Shinbook (Shibook-myeon, Yengam Gun, Jeonnam). Subsequently, a hill development pilot project was conducted for 485ha around the Icheon district of Gyeonggi province in 1974, and they tried to build a base for extending food base by converting the existing dot development cultivation into complex development through the large Honam hill development project of 2,000ha around Gohang, Jeonbook province. Throughout the pilot projects for developing complexes, necessity was raised to introduce a new system and to establish an organization for it. As the focus of development had moved from stair-wise dot development to large-scale complex cultivation in 1972-1973, the Department of Cultivation was newly established within the Agricultural Development Corporation on June 27, 1974 to exclusively take responsibility for the research, design, and construction method development, researching national cultivation target places and establishing techniques to develop complexes. The organization was extended and reformed as Farmland Extension & Development Technology Group on Dec. 27, 1974 and they deployed 1st, 2nd, and 4th local technology group for Chungcheong, Jeonra, and Jeju provinces respectively where the cultivation target places were concentrated. At that time, they took drainage improvement as an implicit farmland extension so they were responsible for it.

The main jobs of the technology group were to conduct preliminary exploration to the target place for complex cultivation and drainage improvement, basic study, final design, construction supervision, and establishment of farming plan. With the study, design, and development for extending food base explicitly, the Farmland Extension & Development Acceleration Law on Apr. 11, 1975. The law was a government-suggested regulation

reflecting strong development policy led by the government to cope with food crises. It was deliberated and confirmed at the National Assembly on Dec. 8, 1974 but officially passed on Apr. 11, 1975. This law, which consists of 10 chapters and 66 articles, was applied to a cultivation project from 1975 and featured as follows: 1) Extending cultivation target scope by changing the exclusion condition from the existing 20 degrees or more to 30 degrees or more; 2) establishing and confirming basic development plan through basic study and notifying it as a development area; 3) carrying out development through action program establishment and approval, and if it is determined as a proper cultivation site, direct government development was made possible by purchasing privately-owned uncultivated site; 4) establishing new regulations regarding disposal of replotting; 5) using soil conditioners for the developed farmland; and 6) ordering cultivation by proxy to prevent poor farming of the development farmland.

According to the law, there were 2 types of cultivation procedure: The one was basic procedure and the other one was procedure for direct government development. The basic procedure can be schematized as follows: 1) Selection of development target site, 2) Basic study, 3) Notification of basic plan decision (Development-accelerated area), 4) Establishment of action program, 5) Approval for cultivation, 6) Development. 7) Disposal of replotting. The most important item was '3) Notification of basic plan decision' and it required a complex procedure from establishing the basic plan and discussing it with the Ministry concerned, to deliberation of development committee, resolution of Cabinet meeting, and presidential approval. For direct government development, the Agricultural Development Corporation became a project-enforcing agent as a proxy for the government and announced the notification on the determination of direct development site by the government through 1) and 2).

Meanwhile, there were 4 kinds of cultivation methods considering geographical conditions: Natural slope method, Improved natural slope method, Slope method, and Stair-wise method. Among them, the natural slope and improved natural slope methods were mainly applied. With the natural slope method, farmland was established by cultivating the gentle hills with a slope of around 15%, without changing the original topography. The improved natural slope method was to grade the slope, correct rolling conditions of the ground, or improve the soil stratum. It was to grade slopes of 15-25% to 15% or less by dismantling the slope with cutting and embankment, to improve land utilization and make mechanized farming available. Because many variable factors work complexly for developing hills, there were difficulties in the study and design processes, and the construction was also complex and required carefulness. Farming can be started after finishing logging, moving the graves in the target area, building road networks such as access way and agricultural road, removing tree roots, leveling, deploying drainage system, applying soil conditioner,

and final plowing as well as topography measurement, provisional replotting, conclusion survey, and final replotting. The following schematizes the process:

1) Construction preparation (Area marking & measurement), 2) Logging (Logging boundary marking), 3) Moving graves (Checking cemeteries for those with/without surviving family or friends & Grave moving notice), 4) Sod collection, 5) Building road networks (Access way & agricultural road), 6) Uprooting & Exclusion of wood roots, 7) Special leveling, 8) Drainage system (Drain, drainage hole, catch canal, and diversion furrow), 9) Applying soil conditioner, 10) final plowing & Clod breaking, 11) Geological measurement, 12) Provisional replotting, 13) Conclusion survey, 14) Final replotting

As mentioned earlier, the changes of system for cultivation project can be summarized as below:

1) Cultivation projects started as a small (2ha) development of land owners according to the "Cultivation Acceleration Law", enacted and proclaimed in 1962, and the project became to need approval in 1967 as "Cultivation Acceleration Law" was replaced with "Farmland Development Law".

2) According to "Farmland Development Law" in 1972, there was an attempt at complex-type development for 505ha in 4 districts from Gyeonggi, Chungnam, Jeonbook, and Jeonnam selecting the city and *Gun* governments as enforcing agents.

3) Agricultural Development Corporation conducted pilot project for Icheon district of Gyeoggi-Do (309ha) and Gochang district of Jeonrabook-Do (2,211ha) in 1974.

4) As "Farmland Development Law" was replaced with "Farmland Extension & Development Acceleration Law" in 1975, it was an owner-development method; the enforcing agents were the city and Gun governments; the project was conducted by requiring consent according to Farmland Development Law; and the finance consisted of 60% of government subsidies, 30% of loan, and 10% from owners themselves.

Table 5-4 | Summary of Agricultural Land Expansion Developments by Year (Reclamation, Mountain Developments)

Year	Related law	Scale	Developer	Execution	Capital
1962	Reclamation Promotion law	small	Land owner	-	Land owner
1967	Agricultural land law	large	〃	-	〃
1972	〃	〃	〃	*Si/Gun*	subsidy 100%
1974	〃	〃	〃	*Si/Gun*, ADC	subsidy 60%

Year	Related law	Scale	Developer	Execution	Capital
1975 -1976	Agricultural land law & Agricultural land expansion promotion law	〃	〃	*Si/Gun*	subsidy 60%, loan30% others 10%
1977 -1980	Agricultural land expansion promotion law	〃	〃	ADC	subsidy 60%, loan 40%
1981 -1982	〃	〃	Direct development by government	*Si/Gun*	〃
1983 -1987	〃	General/ Restricted areas	〃	〃	subsidy 60%, loan 40%, subsidy 70%, regional tax revenue 30%

3.3. Diffusion of Double Cropping with Improved Drainage

If the basic requirement of rice cultivation is to secure water, the one after cropping the rice harvest is smooth drainage. Since 1972, an increasing utilization ratio of existing farmland as well as extending the food base by developing hills became important tasks, because improving drainage meant an implicit extension of farmland.

Drainage improvement is a kind of water management to avoid excess water to maintain appropriate moisture conditions for crop growth. In general, drainage is divided into surface drainage and subdrain: the former is to control surface effluent of frequently flooded area due to geographical condition, through draining station, catch canal, or drain, and the latter is to build an underdrain network to promote soil drainage mainly for paved road.

At that time, the focus was more on the water development to solve water shortages due to drought than on the drainage. However, the increased barley production in the 1970s had more potential if drainage condition was improved, and it was a cause for decreased production of rice cultivation in frequently flooded area. As the land rearrangement project was almost finished in the early 1970s, the drainage problem was raised.

Irrigation channels and drains were separated and sections or agricultural roads were arranged, but there were many places with unstable drainage systems and especially, double cropping of some places was interrupted by bad drainage even in the same section.

To enhance the altitude usage of drainage culverts with trenchers, and to increase working efficiency of agricultural machinery, drying rice paddies were essential to subdrains

and the technique had to be developed hurriedly. With the conditions, the government separated the budget for drainage improvement working expenses in 1975 and set 2 billion won as the starting point. With the underground water development for production base arrangement being followed by a full subsidy system, the project was started with basic study focusing on surface drainage. It was a priority to find the target area in 1975 when the drainage improvement project was launched. The government ordered all the provincial administrative bodies to study and report about target areas. Based on these reportss, technical team from the Agricultural Development Corporation were to study and review the feasibility. The reported target area was 107 thousand ha and 45% of it (48,894ha) was distributed in Jeonbook province. In addition, it is important to say that most of it (46,727ha) was in agricultural development areas.

Jeonbook province was the cradle of Korean irrigation projects in the early days but also had a problem with drainage because of the flat topography. The reported target area for drainage improvement mostly consisted of frequently flooded areas rather than pavement drainage. Considering this, the project was enforced in the 1970s through basic study and final design, and the project focused on Gyeongnam and Gyeongbook provinces around the Nakdong River with the first stage in 1975 and on frequently flooded area of Jeonnam and Jeonbook provinces in 1976, trying to remove surface water. However, there were difficulties with developing planning and designing techniques such as deciding removal volume, considering the depth of drain or fresh water delay time so that it can be connected with the underdrain network in the future. In the 1970s, the project was invested with 14 billio billion won for 5 years, to arrange a drainage system of 107 districts with 16,526ha of rice field.

Meanwhile, techniques for underground drainage were barely established even after the project was launched. As a part of the technology development, the UNDP provided technological support with a 5-year plan from 1975, as follows: With the support from UNDP, the government tried to select 3 complexes, each of 2,000-4,000ha, and establish a general plan for the drainage system as well as to launch pilot project of subdrains for 20-50ha. The pilot project was about developing underdrain type and construction methods for subdrains, introducing construction equipment, and training with foreign technology, and it was invested with 10.3 million won of domestic capital and 1.412 million dollars of foreign capital. The foreign investment was spent on the labor cost of foreign experts and trenchers (excavator to lay underdrain) and overseas training cost of domestic technicians.

At that time, technology or techniques for subdrains were not sufficient, so the support from UNDP significantly contributed to the development of subdrain theory and technology.

Chapter 6

Re-finding Development Target & Reinforcing Facility Management

Re-finding Development Target & Reinforcing Facility Management

1. Establishment of Farmland Fund and Reclamation Development

1.1. Establishment of Farmland Fund System and the Fund

A farmland fund is a fund required to establish farmland corresponding to the converted farmland from the person who uses his farmland for other purposes, according to "Law on Farmland Preservation & Usage"; farmland fund management is to manage and operate the fund. When the law was enacted (Dec. 18, 1972), peopled had to obtain approval to use farmland which is located in places other than urban planning areas or industrial complexes for other purposes, aiming to regulate conversion of existing farmland and increase the availability.

Afterwards, through special revision on Dec. 31, 1975, it has contributed to preserving farmland with operational enhancement and change such as designated classification of absolute farmland and relative farmland and regulations of making conversion payment. However, the receipt and operation of payment for establishing alternative farmland was supposed to be managed by the governors of cities and provinces so it was difficult to have an actual effect. So on Mar. 7, 1981, the 5th revision regulated Agricultural Development Corporation to operate and manage the fund (Clause 4, Article 6) and clearly classified the used into 1) Establishment of alternative farmland, 2) Production base arrangement to establish farmland, and 3) Fund management (Clause 5, Article 6).

As the corporation started to operate and manage the fund since 1981, it was able to conduct alternating farmland establishment projects including position study and design, as well as studies to preserve farmland.

Thus, the amount collected for alternating farmland establishment was 264.2 billion won, for 9 years from 1981 to the end of 1989, and farmland conversion was outstanding in capital area with 36% of the amount from Seoul, Incheon, and Gyeonggi. The annually-collected amount was under 10 billion won until 1983, but it increased sharply to reach 30 billion won in 1984 and even over 50 billion won in 1988. Most of the collected amount was used to cover reclamation development.

1.2. Alternating Farmland Establishment Project (Reclamation Development)

As mentioned earlier, the main source of the farmland fund was the Alternating Farmland Establishment cost collected from farmland converters, and the fund has been used for reclamation development such as developing unfinished reclamation and abandoned land and design & study costs for it since 1981. The reclamation with the fund was executed by Farmland Improvement Association and it spent 77% of 203.1 billion won of the fund by 1989: 190 billion won for reclamation, 9.8 billion won for study and design, 2.7 billion won for R&D, and 600 million won for fund management.

1.2.1. Need for Reclamation

Reclamation is needed for the following reasons:

First, external land expansion and superior agricultural development is necessary to secure resources, 1) to weaponize food and maintain a stable supply of food for Unification (loss of farmland securing supplementary resources), 2) because farmland decreased by 40,000ha annually due to industrialization, 3) because of land expansion and paper industry composition. Second, it is needed in order to take advantage of multi-purpose industrial sea wall freshwater lake by securing abundant water resources infrastructure through: A) Development Zone, since floods are not an all-weather farming Tues improvement and ever drought during 1994 raised through land reclamation project in freshwater lake in water catchment areas for agriculture at all, do not have a shortage of water and a good harvest MCP), ② the flood prevention (of course, the cities and the rural household water and coastal areas, there is no industrial water resource provision), ③ facilitates multipurpose water supply, ④, ⑤ regional Development. authority contrast to the composition provides a rich industrial freshwater lakes inland development and fisheries development. Third, to promote the balanced development of rural areas and rural restructuring ① facilitate rural environment and agricultural advancement, ② agricultural competitiveness and economic gap reduction, ③, ④ increase the farmers income and rural environment improvement mechanized farming agricultural productivity enhancing and, fourth, to the dimension of the coast. completion effects ① fifth, flood prevention and control function ②, ③ farmland protection environmental

protection, and transportation improvement hearth shoreline ① Insular improve the living environment and production costs, ② Land Transport Transportation Improvement reduce logistics costs and save time, ③ coastline to the reduced defense budget reductions, promote regional development and strengthen the defense system, the sixth national tourist Yeongeon composition as tourism industrialization expectations and local promotion of economic and cultural development, improve logistics and distribution

1.2.2. Effectiveness of Reclamation

With respect to economic, social and cultural development interests and development, the effect is favorable reassessment of the expected effects of business development with the passage of time, along with the development of local industries rapidly growing and is in Effects of direct development reclamation land expand and enhance the utilization of the land, based on the loss of farmland supplement composition (stable food supply), the paper industry providing and promoting regional development, transportation improvements, and logistics costs, transportation network improvements (Land Transport *danchul*), future industrial development features, and the economic effects of infrastructure sites Reclaimed-weather farming mechanization, increased rural incomes, enable marginalized Reclaimed Land area of rural development, and agricultural center of the idle land resources 4.9 times 1.7 times in the development of fisheries, comprehensive development during effects of the development. Conscious reform, effects of marine environmental change environmental conservation Coastal Development, the new tidal flat reclamation projects performed after outside the dyke being created as fast (Ganghwa Island, Asan Bay, gyehwado, etc.), with the lapse of time after sea wall construction marine formatting environment business performed before and has been little or no recovery, the marine environment, such as new fishing grounds diversify the composition changes are being made outside the dyke, fishermen consciousness to effect change, the urban rural gap in income and living conditions decrease (improve rural living environment and income increase), mechanized farming improvements and agricultural productivity raising, farming operation the commercialization of agriculture, and rural restructuring, agricultural distribution system improvements.

1.2.3. Problems with Reclamation Project to Date

Current problems of reclamation projects to the business plan and future development plans (land use plan) in conjunction with the development before and after in-depth analysis Review insufficient, lack of systematic management development after post-TURF (neglect) development effectiveness and environmental impact assessment, compensation schemes, Reclaimed Land reclamation landfill projects lack of planning, lack of national management system, lack of development of management direction and development management system, in-depth development of long-term national. regions favorable few

select development from first selected reclamation projects, including the main coastal fishery conditions, good enforcement loss or lack of enough considering the development plans fishermen livelihoods comment, a thorough environmental impact assessment pre- and post-reclamation project due to business by promoting the event of a disaster, and civil causes, natural ecosystems, and marine environmental degradation term restoration and long-term disturbances, and environmental facilities lack of water pollution, such as sewage inflow is induced. In addition, reclamation of large-scale, widely common as far, has shown its limitedness in failing to curb conversion of existing lands into that of other purpose and preserve rice planting land while showing shortages of countermeasures against serious freshwater lake pollutant of inflow of wasted water such as livestock wastewater, domestic wastewater, sewage inflow, long-term delay in construction after public notice that caused undesirable delay in regional development, aggravating water pollution with little improvement measures. The pursuit of large-scaled reclamation has left several needs to ensure adequate river resources, preserve areas neighboring rivers, construction of 4 dams at Youngsan River, structuring waterways, recycling irritation waters and strengthening supplementary water pumping facility, refurnishing water system of jeoksung Dam around Sumjin River with waters and reinforced measures against water quality and for environment.

1.2.4. Directions for the Future

Future tidal flat reclamation project in the loss of fisheries resources and to minimize environmental damage in the direction of balanced development of the country and the development of the national economy, considering to sustainable development promoted by establishing a systematic business requires long-term planning, and coastal pollution than worth less and Fisheries Fishery conservation reclamation developed into the center of a large area, and develop effective environmental impact assessment of the construction period and after completion of 5 years post-environmental impact assessment conducted and evaluation be carried out. Also avoided, and simple agricultural development and project implementation plan during development effectiveness and environmental impact, water conservation, and follow-up management and in-depth analysis necessary to review and transition to the development of a comprehensive, multi-purpose, and the encroachment of existing cropland, marginal farmland Hugh respond to hardening optimal scale of farmland that can efforts to secure business conducted hearings comments professional, technical, and social convergence and the opinion of stakeholder and governments converge sufficiently objective, national, long-term development plan, review, and how to develop an individual post complementary enforcement management system is needed.

2. Issue & Policy for Irrigation Facility Management

2.1. Actual Condition of Irrigation Facility Maintenance & Point of View

Development of irrigation facilities had been extended until the 1980s, but the maintenance for the existing facilities was the responsibility of the managing agents. But the agent was not able to maintain them, which required a lot of cost and labor force. Originally, the maintenance was supposed to be conducted as part of general facility management by managing agent (Farmland Improvement Association), and when it is difficult for them to cover, government-provided support (subsidies or long-term bond) but it was not enough at all. Since the maintenance which was almost all reinforcement work coming close to construction, and was conducted under the name of improvement work in the 1950s (40% subsidies and 60% long-term bond), there had been small support (long-term bond) by the beginning of the 1980s. The support size in the 1950s was 12% of large & small district construction working expenses of the fund, but it was only 5% since the 1960s. The irrigation policy of that time focused only on development and there was no political consideration for maintenance. But the damage to irrigation facilities increased very year. For 5 years in the beginning of the 1980s, flood damage amounted to 23% of construction expenses. So we can say that there was unbearable vulnerability in the maintenance of irrigation facilities. This was because there was an institutional limit on the investment due to the B/C principle applied to construction of irrigation facilities until the 1980s and were vulnerabilities in the construction and maintenance. The vulnerabilities were deterioration or underuse of facilities; insufficient capabilities below design standards during construction; crude and defective construction; and defects due to poor maintenance. Considering that the regulations for the design standards for flood or rainfall were changed almost every 10 years, old facilities had many vulnerabilities to flood management capabilities and it was not realistic to reinforce the facilities as a part of managing maintenance.

2.2. Policy for Reasonable Maintenance of Irrigation Facilities - Cancellation of Long-term Bonds & Consolidation of Farmland Improvement Associations

As the managing agent of irrigation facilities, the Farmland Improvement Associations' work was very seasonal, so it was difficult to standardize the working amount as general businesses and the level of difficulty of varied due to differences in quality of maintenance facilities. The level was related to management labor force, and labor costs increased over whole industry due to high-degree economical growth in the 1970s, resulting in a higher

ratio of labor cost in the expenses of the associations, which was burdensome. For instance, labor costs were less than 20% of the estimated expenditures in 1979 but increased to 24% in 1987 and maintenance expenses decreased from more than 20% to less than 10%, so it was impossible to expect self-regulating maintenance. To solve the burden of budget operation, cancellation of long-term bonds and consolidation of farmland improvement associations were conducted. With the Special Law on Growing Farmland Improvement Association enacted on Jan. 12, 1971, the long-term bond of 5.1 billion won was canceled in December and 266 associations were consolidated into 127 associations to reduce the operation cost and burden of the members. With the consolidation, employees decreased from 5,557 to 5,190, significantly reducing the burden for labor cost. As the long-term bond of 40 billion won was canceled in Jan. 1982, the 123 associations were consolidated into 103 associations and employees were decreased from 4,390 to 3,808, for reducing the burden of members and streamlining the operation. Seemingly, the managing labor force was adjusted from 104ha/person in 1982 to 124ha/person and it was thought to be 'appropriate' size. The cancellation of long-term bonds and personnel reduction through the consolidation temporarily reduced the burden due to labor cost, but it was not enough to find space to reinforce & repair the defects of irrigation facilities accumulated so far.

2.3. Policy to induce Self-regulated and Reinforced Management - Building Maintenance Cooperative Credit & Operation Credit

With no support expected from the government, regulations on maintenance cooperative credit of Farmland Improvement Associations (Instruction No. 544 of Ministry of Agriculture and Fishing) and operation credit (Instruction No. 543 of Ministry of Agriculture and Fishing) were enacted in April 1983, as a policy to solve the problem with self-regulated or cooperative efforts among the agents.

The maintenance cooperative credit was built in the Federation of Farmland Improvement Associations to finance with installment among the associations and extend & conduct the project, to maintain the functions of irrigation facilities. According to it, the credit is financed with government subsidies, long-term low-interest loans, installment of members, and surplus of final accounts; the management is the responsibility of the chairman of the federation. Also, there was a managing committee to establish or report project plans, to report final accounts, to organize associations, to set dues of working expenses, and open & close operation regulations of the credit.

For organization of associations, 5 associations composed 1 unit group based on the required working expenses of each association for maintenance and the maintenance was

funded by government subsidies or long-term low-interest loans (45%), installment of the federation (45%), and self-regulated expenditure (10%).

According to the system, 95 associations participated in the project from the first year, 1983, composing 35 groups. It was enforced with 31 associations with the investment of 10.67 billion won (4.857 billion won in long-term loans, 4.860 billion won in installments, and 1.043 billion won in self-regulated expenditures) for 550 facilities in 319 districts.

When the first projects were successful beyond expectation, the government established the second project plan (5 years, from 1987) in which 100 associations composed 109 groups. In 1987, the project was conducted with 5.223 billion won for 252 facilities. However, it was politically proposed to cancel the debt of farming and fishing villages and the associations requested cancellation of long-term loan and union dues. While the request was accepted, maintenance expenses relied on government subsidies so the cooperative credit project finished in 1988. Meanwhile, operation credit was to finance between the associations using the saved money held by associations. Traditionally, the associations spent first and covered it with income later so it was planned to cover the insufficient operational capital with saved money, income with disposal of unused assets, and income from using the irrigation facilities out of the purpose.

Associations deposited the saved money and extra capital to operation credit, and the credit lent the money to small associations for operational capital or working expenses with lower interest rates and simpler procedures than general banks, to supply funds to each association easily; to invest the rest in national bonds with high profitability and stability for more income; to provide high-interest income to depositors; to reduce the burden of interest for borrowers; and to enhance management and develop with fair balance. The credit was managed by the chairman and there was a general meeting to discuss opening & closing of operational regulations, establishment & change of the operational plan, and reporting final account and managing committee to discuss establishment & change of capital utilization plan and utilization plan for extra assets.

In 1983, credit deposits totaled 6.746 billion won from 48 associations. This increased 4-fold to 25.567 billion won from 103 associations in 1988. In addition, lent capital for operational cost or maintenance was 2.726 billion won for 32 associations in 1983, but increased to 13.272 billion won for 46 associations in 1988.

3. Extension of Large-scale General Development Project

3.1. Completion of 1970s' Projects

Among 13 large-scale project which were launched in the 1970s, 8 districts (Sapgyocheon, Changnyeong, Mihochoen, Imjin, Namg River, Yeongsan River, Nakdong River, and Nonsan) finished the projects in the 1980s. Among the 8 districts, the Yeongsan River's estuary dam, which was conducted as a Stage 2 Project, was the 6th freshwater lake following Lake Asan and Lake Sapgyocheon.

The stage 2 project, launched in 1976, was a huge project developing 20,700ha for 1 city and 4 *Guns* by establishing a freshwater lake with an estuary dam 6km upstream from Mokpo, developing agricultural water source with it, improving flood control and drainage for the hinterland, and extending farmland with reclamation.

The district was frequently hit with drought and flood damage due to unstable rainfall. It experienced 8 big droughts from 1942 to 1968 and it was flooded in Aug. 1974 with once-in-a-century heavy rain resulting in damage to crop and residents. In addition, 3-4 typhoons pass by or affect the area between summer and early autumn damaging it with storm and flood. And the development target of 20,700ha was a mostly flat area with a slope of 2% so drainage was poor, and 1,780ha of Yeongam *Gun* and 245ha of Mooan *Gun* were frequently flooded areas. There were only 60 small or medium reservoirs to irrigate 5,200ha but they didn't function properly due to deterioration.

It was the Stage 2 Yeongsan River project's goal to change the area into a stabilized faring base expecting the freshwater lake that would be established with estuary dam to be the water source. Lake Yeongsan, which would be established with the estuary dam and store 253 Mill tons of water to be supplied to the 20,700ha, Mokpo city and surrounding as residential and industrial water, and others which will be developed in Stage 3-5 projects as agricultural water. The huge estuary dam, which was built for 4.35km between Okam-ri, Samhyang-myeon, Mooan *Gun*, Jeonnam and Sanho-ri, Samho-myeon, Yeongam Gun across the sea, cost 42.6 billion won with height of 19.5m, width (max. floor surface) of 225m, and volume of 2,914 thousand m^3. Upstream, a 10m-wide paved road was constructed, and the area of full water was 3,460ha with a pondage of 253 Mill tons. The drainage floodgate which was installed in the left bank of the estuary dam was composed of eight 13.6m-high and 30m-wide gates weighing 467tons in total. The max flood prevention capability of the gate was 56 Mill ton/sec, which worked to prevent flood and control water level. In addition, the first miter gate was installed so that ships could access the lake. The lock chamber was 6m wide and 30m-long so 30ton-class ships could freely enter and exit without considering the inside and outside water level difference.

3.2. Large-scale Projects launched in the 1980s

3.2.1 Daeho District

This district was located in Taean peninsula in the central-west part of Korea, and the project was supposed to develop 7,700ha including Seonsan-eup, Seosan Gun; 6 Myeon such as Haemi, Eumam, Seongyeon, Jigok, and Daesan; and 4 *Myeon* of Dangjin Gun (Jeongmi, Godae, Daehoji, and Seokmoon). It included the Daeho breakwater, 7 pumping & draining stations, and a 258km irrigation channel. Using the facilities, it was planned to rearrange land of 1,140ha, improve irrigation of 1,760ha, reclaim farmland of 3,700ha, and reclaim paddy fields of 1,100ha. This project had been prepared since 1971. Zone 1 construction of the breakwater and drainage floodgate was started on Apr. 16, 1981 and final trench construction for breakwater No. 2 was finished on Apr. 16, 1982. In addition, on Jan 23, 1983, final trench construction for breakwater No. 1 was successfully completed, which was the most difficult one in the Daeho district. The breakwater construction was completed in Nov. 1984. As the project, which cost 162 billion won in total, finished, a new food base was established for 31,133tons of rice and 3,700ha of reclaimed farmland. Daeho breakwater, which was the main construction, was the longest breakwater in Korea, connecting Hwagok-ri, Daesan-myeon, Seosan *Gun* with Gyoro-ri, Seokmoon-myeon, Dangjin *Gun* through 7,807m. Additionally, the breakwater is valued because it was built purely with the technology of engineers from Agricultural Development Corporation based on the experiences with Lake Asan, Lake Namyang, Lake Sapgyo, and Lake Yeongsan.

757m^3 of soil/earth and stone/rock was used to build the breakwater with a max height of 30.5m and max floor width of 255m, and 950,000 workers and 89,000 pieces of land and marine equipment were used. During construction, there was 10.3m of tidal range and strong flow velocity of 7.2m/s with the tidal amount of 230 Mill tons at the final trench construction section, and the max water depth was 27m making it one of the most difficult reclamation constructions. To overcome the unfavorable conditions, defects of connections were reduced by extending laying area of each mattress and synthetic fiber filter was used instead of sand between rubble mounds and banking materials to prevent the banking materials to be washed away from the rubble mounds due to water-flow velocity and to fix the dam body.

3.2.2. Keum River Estuary Dam

The construction of the district called “Keum River Stage 1 Project” was to build a huge freshwater lake by blocking the estuary of Keum River, which is one of the 4 big rivers of Korea, with an estuary dam providing agricultural water to 43,000ha of farmland. Building breakwater for 1,814m from Seongdeok-ri, Seongsan-myeon, Okgoo Gun, Jeonbook

province to Dosamm-ri, Maseo-myeon, Sechon Gun, Chungnam province to build an artificial freshwater lake, it was planned to supply the water as agricultural water to 43,000ha composed of 2 provinces, 3 cities, 6 Gun, and 50 eup and myeon including Secheon and Booyeo Gun of Chungnam province, Jeonjoo citi, Iri city, Okgoo, Iksan, Wanjoo, and Kimje of Jeonbook province. Farmland downstream of the Keum, Mankyeong, and Dongjin Rivers was granary with well-established irrigation system, but the existing facilities were old, causing serious water shortage; additionally, the gentle slope, hills with fine soil quality, rain-fed paddy fields, and forest land were left underdeveloped. So it was a basic plan to secure massive water resources by building the freshwater lake with the estuary dam and develop the neglected land resources by rearranging over water supply system. The estuary dam, which cost 101 billion won, created a freshwater lake that can store 139 Mill tons of water (3,650ha of full-water area). The max floor width was 240m and height was 16.6m. A double-track line was planned to be placed on top of the dam for 49.5m with 4-lane roads and sidewalks on both sides, to provide land transportation system instead of existing ships, contributing to the industrial development of agriculture, industry, and commerce and living conditions of the west coast area. Furthermore, it was planned to install a 10m-wide and 31m-long miter gate and Korea's first fish way (9m wide and 78m long) to preserve the ecosystem, at the estuary dam. Meanwhile, after completion of the estuary dam as Stage 1 (Oct. 1990), Stage 2 project would follow to supply water to 43,000ha; to rearrange 10,140ha of land; to improve drainage for 13,470ha; and to reclaim 7,290ha of paddies. With the projects, 3,280ha of new farmland will be established, contributing to increased annual food production of 113,700tons. In the plain, 3 weirs, 270km of irrigation channel, and 9 pumping stations supply water from the fresh water.

The biggest problem of the estuary dam construction was the final construction. 4 years and 2 months after the commencement of work in Aug. 1983, Gunsan, Jeonbook and Janghan, Chungnam were connected with a land route on Jan. 27, 1988. Preparatory construction for final closing was launched in 1987, and only a 400m section was left after completing 727m out of 1,127m. Final closing was planned for February when entering and exiting of seawater is lowest; tidal gate construction was completed in Sept. 1987; the last 400m section was finished with day and night marine work and land work using 50 pieces of heavy equipment including 29 15-ton dump trucks, 9 backhoes, and two 700-ton barges for 10 days (Jan. 25, 1988 to Feb. 3, 1989).

For the final closing, 16,230 gabions (1.6 ton per each) and 65,000tons of stopper stones -enough to fill 9,000 15-ton trucks – were added. On the profile of breakwater, sea sand that was deposited on the floor or Keum River was used instead of land soil, using a 4,000-hp dredge. This method helped to reduce the cost as well as preserve nature.

4. Rural Water Management Informatization Business

4.1. Republic of Korea Water Management Informatization Current Status

Korea has seen production and management of its water related information being carried out separately by government agencies of water management business. Investigation occurs for both water quantity (meteorological water gates, level flow, dam operations, flood warnings, irrigation facilities, sewer facilities, water use, ground water status), and water quality (water quality by lakes, contaminant distribution and pollutant loads in the water), and environmental infrastructure surveys. The Ministry of Agriculture and KARICO are investigate agricultural irrigation facilities, rural water use status, low water storage capacity. <Table 6-1> shows basic data in survey and status on related agencies.

In addition, in order for water management informatization projects to be efficiently promoted, the water quality improvement planning task force is in charge of organizing the Water Quality Improvement Planning Council whose functions are to evaluate performance of execution, establish policies on water management informatization management, and deliberating institutional water management informatization practice plans. The Water Quality Improvement Planning Council consists of 20 or less, but the chairman of the Water Quality Improvement Task Force works as Deputy Commissioner, and commissioners are divided into incumbent ex officio members and appointees. The ex officio members include the Ministry of Environment, the Ministry of Construction and Transportation, the Ministry of Government Administration and Home Affairs, the Ministry of Information and Communication, Ministry of Agriculture and Forestry, the Ministry of Maritime Affairs and Fisheries, the Ministry of Commerce, Industry and Energy, the Ministry of Planning and Budget, the Japan Meteorological Agency director, and less than 10 appointed civilian experts. Especially an ex officio member of each department who is appointed to the Chief Information Officer (CIO) whose responsibility ensures seamless business information consultation, sharing of knowledge and experience on water management.

Table 6-1 | Basic Data in Survey by related Agencies

Survey details		Relate Agency
Water Quantity	Watershed, Humanities and Social Survey	Ministry of Land, Transport, Ministry of Public Administration and Security, Statistics Korea, K-water , KARICO
	Meteorological, Hydrological Investigation	Ministry of Land, Transport, Ministry of Public Administration and Security, KMA, K-water, KARICO, KEPCO
	Level/ Flow surveys	Ministry of Land, Transport, K-water, KARICO, KEPCO
	Dam Operations Research	K-water, KEPCO, KARICO
	Flood precaution	Ministry of Land, Transport, K-water
	Irrigation Facility Survey	Ministry of Land, Transport, K-water, KARICO, KEPCO
	Groundwater investigation	Ministry of Land, Transport, Local Governments, K-water, KARICO
	Water Usage Survey	Ministry of Land, Transport, Ministry of Environment, K-water, KARICO, Local Governments
Water Quality	Water Quality Survey	Environmental Management Office, Local Governments, K-water, KARICO
	Contamination Source Investigation	Ministry of Environment, Local Governments, K-water
	Environmental Infrastructure Survey	Ministry of Environment, K-water, Local Governments
Agricultural Water	For rural water basic data	Ministry of Agriculture, Ministry of Land, Transport, Ministry of Environment, K-water, Local Governments, KMA

The Ministry of Construction and Transportation is in charge of organizing "Water Management Information Standardization Working Group," drawing plans and measures of standardization and legal and regulatory framework. "Water Management Information Standardization Working Group," which is comprised of members of 30 persons, and its chairman leadership is taken by Chief of the Water Resources Policy Division, Ministry of Construction and Transportation, while the ex-officio members include those responsible for water management of each constituent institution and computational personnel (agency officer grade 2), and appointees consisting of 10 civilian experts. <Table 6-2> showing systematic progress with responsibility for Water Management Informatization by Government Agency and for water management informatization.

Table 6-2 | Responsibility for Water Management Informatization by Government Agency

Government Agency	Chief Information Officer	Responsible organization	Functions
Office for Government Policy Coordination	Head of Planning Dept.	Planning Dept.	Water management information council Water information management planning and coordination
Ministry of Environment	Chief of Water Quality Division	Water Quality Policy Division Water Supply and Sewerage Policy Division	Promotion of competent work on informatization Water quality division of Standardization Integrated system in water sector Legal and regulatory framework plan prepared
Ministry of Land Infrastructure and Transport	Chief of Water Resources Division	Water Resources Policy Division River Planning Division	Competent work on Informatization Promotion Quantity sector standardization Quantity integrated systems by sector Legal and regulatory framework plan prepared
Ministry for Food, Agriculture, Forestry and Fisheries	Chief of Agricultural Development Division	Development Policy Division	Competent work on Informatization Promotion
Ministry of Land, Transport and Maritime Affairs Ministry of Knowledge Economy .Ministry of Knowledge Economy	Chief of Marine Policy Division / Director of Electricity Committee Executive Office/ Chief of Forecasting Division	Marine Environment Division Market Management Division Forecasting Management Division	Promotion of competent work on informatization
Ministry of Government Administration and Home Affairs	Director of Computation Information Management	Information Flow Division	Information and communication support among inter agencies
Ministry of Information and Communication	Members of information deliberation council	Informatization Promotion Division	Water management, information technology and human resource development support Water management informatization investment support

Government Agency	Chief Information Officer	Responsible organization	Functions
Ministry of Planning and Budget	Chief of Budget Division for Governments	Budget Division for Construction and Transportation Budget Division for Governments Budget Division for Food, Agriculture, Forestry and Fisheries	Water management informatization investment support

4.2. System Establishment Status of Water Information by Government Agency

Systematic establishment of 24 items of water information by 10 government agencies including the Ministry of Environment, Ministry of Land, Transport and Maritime Affairs, Ministry of Agriculture, KARICO, K-water.

4.2.1. Ministry of Land Infrastructure and Transport

Five informatization projects by the Ministry of Land Infrastructure and Transport are underway: the Comprehensive National Water Resources Management Information System (WAMIS), groundwater information management system, waterworks comprehensive management system, rivers GIS system, and integrated flood warning system. They are divided into stages of the data management system, an early stage includes data management system to start with to the next step of the data analysis system, or business management system in place. In particular, the main system of the Ministry of Construction and Transportation, "WAMIS" is driven separately into "basic data management system", "analysis system " and "policy support system", three fields that are pursued in 3 staged plans such as short-term, medium-term and long-term plans.

4.2.2. Ministry of Environment

Through its own information informatization in 1999, the Ministry of Environment, which began basic environmental data collection, supplemented the existing DB for a "comprehensive environmental information system (water policy support, water and sanitation management systems, etc.)", and launched a public service in 2000 on the Internet. It is a system that adds GIS functionality to an existing system, securing location coordinates

(TM) of approximately 15 million facilities with about 500 million pieces of basic data that were scattered across the country, materializing the secure digital map (1:25,000), and the Ministry of Environment and frontline municipalities (*si*/*do* and *si*/*gun*/*gu* in administrative districts) connected as the network, making it capable to send and receive data in real-time. In addition. it provides Environmental Geography (Remote Sensing Information, land *pibokdo*, satellite photos, aerial photos, digital elevation data, ground control point), and Natural Environment Information (status of the natural environment, natural *siksaengdo*, greenery, species, landscapes, etc.) through the Internet.

4.2.3. Ministry for Food, Agriculture, Forestry and Fisheries

Related to rural water and looking at the trends of the construction of the water information system, over the last 10 years in the field of Agricultural Engineers according to the Rural Water Use Rationalization Plan (Ministry of Agriculture and Forestry, Agricultural and KARICO, 1989), a total of 464 rural water related material and information *giseol* facilities, and a new development plan for the systematic management and efficient use of the survey was divided into sections. In December 1999, a rural water resources management "system" was established. In addition, since 1994, "rural geographic information system (RGIS)" development projects undertaken by the various characters and shapes on the use and management of farmland information management system that systematically (also the subject of a total of 20 species) has been developed recently, rural water development of long-term planning of the Third rural water 10-year survey was constructed. This survey can be retrieved from an Internet operating system, 10-year rural water in 2002, according to the national water information Management business "for rural water information various rural water development plans and agricultural production-based maintenance plan to support the development of the system (RAWRIS)" has been actively used in the business. Likewise, in the field of Agricultural Engineers during the basic shapes for the efficient management of rural water can deploy and manage, and the character of the information and analysis for steady effort came.

4.3. Problems

The following are problems with the Agricultural Water Management Informatization Project under the current government. First, due to lack of scientific analysis of basic data on water management in terms of production and management, its stability and credibility have declined. Second, even with establishment of the Water Management Information Standardization Basic Plan (2002.12.), there is still difficulty in establishing a system that can share data on both water quantity and quality at the same time, considering data sharing system to build water quantity is difficult for agriculture, such as the different goals of

each system is difficult to adjust points. Third, the overall budget gap due to the ongoing secured lack of water management informatization budgets and interagency National Water Information Management System is being delayed. Fourth, for general users of water management (superior-level data, such as real-time water information, etc.) through the Internet, providing increased material provided by management of the subject, or making the level of data formats, and secondary processing of data publicly available.

4.4. Reforms

4.4.1. Expansion and Modernization of Water Management Basic Data

Expansion of rainfall water level gauging station observation and gradual modernization of facilities toward unmanned automatic observatory should be pursued in order to obtain efficient management of water resources and the reliability of the data. Of rainfall observations, the National Weather Service AWS (Automatic Weather System: Automatic ground observation device) and a KARICO observatory should be in conjunction with the expansion, and even for winter precipitation and measuring the equipment should be supplemented to make rainfall and water level measurements possible.

Water usage in order to understand the ongoing investigations nationwide, long-term water usage for quantity surveys, the rivers keep the water crystal, regression, etc., should promote research. Targets should include greater reliability in order to improve the accuracy of hydrologic data, systematic hydrological observations Task Force responsible for the installation and improve the system using satellites to measure the sending and receiving of data, development of ultrasonic flow meter, and tachometer for accurate rainfall forecast, radar, rain gauges, such as the introduction via modernize the facilities and techniques for hydrological observations.

4.4.2. Promotion of Water Management Information Standardization

To ensure continuity and reliability of the water management materials, regulate water balance analysis, predictive modeling water quality, the amount of pollutants, such as water quantity for Rural Integrated Management of Water Resources “standardization of water management information” in order to lay the foundation should be promoted.

Water management in order to standardize should be promoted, as well as a standardized framework “organized by the Ministry of Construction and Transportation Standards basin also separated rural water quantity water information”. On the basis of standard basin also separated from the Ministry of Construction and Transportation Quantity sector, the Ministry of Environment, Water Quality Division, Ministry of Agriculture and Forestry,

standardized information on water management of the rural water sector and come up with ways research unit (watershed), the survey items, survey points, survey period, survey planning, water management, basic materials production, consistent with information provided and the operating system should be established. And each central government ministries, agencies and local governments, the Ministry of Environment, the Ministry of Construction and Transportation, the Ministry of Agriculture and Forestry in accordance with standardized measures of water management material production and the operating system must be built. Water management since 2000 in promoting the standardization of the target business information and <Table 6-3>.

4.4.3. Continued Investment in R&D Sector

Continuous investment must be carried out in short- and mid-term planning of water resources basic research, research technology development, and information management sector for rational development of water resources, use and management of water resources. First, in the short-term, reliable water supply model development, and water reservoir analysis model, drought assessment techniques development, areas with expected water shortages and water allocation during unusual drought are all needed in order to enhance efficiency of water use by supplying waters in a stable way and minimizing water waste. In the long-term, forecasting simulation model development for regions without rainfall observatory, research on operation linkage among water resources and on proper flood control capacity set for rational water resources utilization should be considered.

4.4.4. System Establishment allowing for Efficient Information Management and Systematic Information Exchange

In order to develop, use and conserve water resources, the long-term data acquisition with analysis is required and by doing so, it will be possible to analyze and use data through efficiently managing various hydrological database as well as development of real-time water information system, Water Resources Information Management System and Rural Water Resources Information Systems. Long-term measures should be established including internet-based Water Resources Information Management System, all of the Water Resources Information Sharing through high-speed information communication networks and the supportive systems in development for non-professional use of materials.

Table 6-3 | Classification of Water Management Information Standardization

Classification	Contents
Work Standardization	Water-related work systems and standardization of investigative work
Data Standardization	To maintain consistency of water-related data, homogeneity, uniqueness for data and how to collect, location of collection and collection time on standardization
Code Standardization	Water-related DB structure and standardized code system to work according to the system Search for data retrieval with standardized key value
Information Provision Standardization	Acquisition and retention of water-related information, provide the spatial (location), temporal (time) information and with standardized form (form)
Operation System Standardization	Communication protocols, and operating system standardization by institution

4.5. Agricultural Water Management Informatization Project

4.5.1. Background

Most of the information on water is natural phenomena-related and relies on data obtained through continuous observation and investigation. With the development of information and communication technologies, it has been recently possible for those who need to obtain a variety of real-time hydrologic data and it's a country that is responsible for technical support with which this information can be easily obtained like developing "Water Management Information systems" to meet these obligations. However, currently-available water-related information systems or those under construction are limited to provision of some information, instead of providing comprehensive information on waters, leaving it far short of being a standardized system itself and finding it uncomfortable to use and the quality declined. Deemed the "Basic Plan for Water Information Management" in December 1999 at water management policy coordination committee of the Office of the Prime Minister, the Ministry of the Environment became responsible for "water quality", the Ministry of Construction and Transportation for "water quantity", and Ministry of Agriculture and KARICO for "rural water management informatization project" for the purposes of systematic development and efficient use management.

4.5.2. Purpose

The purpose of this project is to establish "rural water resource information systems (RAWRIS) " under the Ministry of Agriculture and Forestry for smoothly pushing ahead with the "Basic Plan for National Water Information Management (December 1999)," of the Prime Minister's Office of Water Quality Improvement Task Force jointly participated by Ministry of Construction, Ministry of Environment, Ministry of Agriculture and Forestry ministries, and for building a scientific and systematic water management for the rational development and utilization of rural water in preparation for the 21st century: the era of water shortages. In addition, drawing 464 water deficit areas of agriculture, animal husbandry, industry, environment, water with rural water demand and usage forecasts and following development plans by a numerical analysis system translating the numbers into a conventional paper map. It also included system development that can provide regional water supply plans, including public water resources such as reservoirs, pumping stations, areas at risk of regional drought, efficient water management methods after considering related conditions of water districts to those including government agencies and farmers via the Internet.

4.5.3. Contents

Rural Water Management Informatization, linked to the "Basic Plan for Water Information Management (1999.12)" by the water quality improvement task force of Office of the Prime Minister, and the " Information Strategy Planning (ISP)" of KARICO included promoting a "long-term master plan" and informatization based on various water-related data and information by which "agricultural rural water comprehensive use plan" and "agricultural production-based comprehensive plan" for the existing regional facilities and new projects, respectively, are in conjunction to form a system. For the integrated management of rural water and groundwater, water quality information, "comprehensive rural water system" was also included. Policy direction for a systematic and standardized basis of the information relates to: (1) Rural water management master plan, (2) measures for rural water resource information standardization, (3) Rural Water collection, analysis, management, and co-use of DB building system, (4) rural water and production based information DB technology integration operation for mutual systematic and organized comprehensive information systems, (5) Corporation-built RGIS system with linking operational measures, (6) improvement plan on other legislations and systems.

4.5.4. Performance

Code standardization work for 68 thousand agricultural irrigation facilities nationwide in was completed in 2001, providing the basic framework for informatization and establishing

the "Water Management Informatization Master Plan (basic plan)" 2002, to efficiently and systematically promote the project.

An internet-based, real-time reservoir automatic water level measurement program was developed and tested, and in order to enhance utilization through avoiding redundant investment, search program for common basin waters, the facility status within water areas, a production base alignment plan (rural water, arable land, clean up, drainage improvements, etc.) was also developed.

Table 6-4 | Basic Direction and Contents

Basic Direction	Contents
Systematic development of the rural water and efficient use and management of irrigation facilities	Demand for rural water supply calculation and development planning Basic data management, agricultural irrigation facilities, rural water DB built storage capacity, such as reservoir water level, reservoir level information
Disaster preparedness reliable water supply system establishment	When drought threatens, regional drought prediction Prediction of drought duration; suggesting countermeasures Material presented for drought response policy
Rural water-related information sharing And distribution system establishment	Standardize information system allowing interagency information sharing on rural water Distribution systems prepared of rural water related information Building a public service system of rural water-related information

4.5.5. Project Plan

The 2002-2011's rural water management informatization project plans to develop rural water related analysis system which is divided into 3 areas: (1) Rural Water Resources Management System (water basic data survey, DB and GIS for Standardization), (2) rural water analysis system (for water resources and hydrologic analysis, drought plans to develop a system of forecasting and analysis techniques developed), (3) rural water utilization system (rural water basis, the sharing of data analysis, search, and output program development). Therefore, rural water management informatization is to be set as the final goal of the year 2011, and separated from be set up by the mid-term, long-term or ultimate plans, but the mid-term plan for 2002-2006 and long-term plan for 2007-2011 to execute under the plan.

a. Mid-term Plan (2002-2006)

When one needs to understand rural areas of water quantity and water use situation in a quantitative way and provide water related information to agencies that need it, introduction of management system that allows for provision of decision support information such as rural water usage management system, rural water informatization infrastructure, rural water district water development plan, irrigation management, drought management and in which rural water use status can be analyzed in real-time. Provision of various types of information via the Internet on the rural water and implementation of a Clearing House (data store), which provides functionality for information retrieval on rural water district in the GIS form, and provision of necessary information outlined in the basic Plan for national water information Management to other agencies are included.

b. Long-term Plan (2007-2011)

Establishment of "Comprehensive Rural Water Information System" linked with agricultural water, groundwater system information, RGIS and interagency integration in operation and system security, maintenance, etc.

Chapter 7

New Change - From Development to Maintenance Management

New Change - From Development to Maintenance Management

1. Big Change to Irrigation Facility Management System

1.1. Motivation to Integrate 3 Organizations

The irrigation-related system was largely changed when the government was changed. During the military government (launched with a military coup on May 16, 1961), irrigation associations were dramatically integrated and the Farmland Improvement Project Law (a basic law related to irrigation) was enacted for the first time after independence. In 1994, the Kim Yeong Sam administration enacted the Farming & Fishing Village Arrangement Law was enacted as a national task, and the Kim Dae Joong administration initially integrated 3 irrigation-related organizations as a big task. For the subsidies of working expenses or maintenance expenses for irrigation facilities, the Noh Tae Woo administration dramatically decreased them and fully subsidized to reduce farmers' burdens for purely political reasons, without considering or reviewing the capabilities of flood-damaged farmers. These large changes were forced without official procedure.

Since Jan. 1, 2000, the Korea Rural Community Corporation (KRCC), Farmland Improvement Association (FIA), and Federation of Farmland Improvement Associations (FFIA), which were related to production base arrangement, were integrated into a single organization. It also was an aspect of the aforementioned large changes.

Meanwhile, these organizations were granted unique necessities and liabilities as time went by. FIA was established with the name of Irrigation Association in 1908 according to the 1906 Irrigation Association Ordinance, and it built irrigation facilities such as irrigation and drainage and maintained them for 92 years until the name changed to the Farmland Improvement Association. For the KRCC, the Federation of Irrigation Associations was

the parent institution which was established according to revision of the Chosun Irrigation Association Order in 1940, and it provided technical support mainly for production base arrangement while changing its name from Federation of Farmland Improvement Associations in 1961 (Farmland Improvement Project Law) to Agricultural Development Corporate in 1970 (Farming Village Modernization Acceleration Law) to KRCC in 1990 (Korea Rural Community Corporation & Farmland Management Fund Law). For FFIA, as it was integrated to the Agricultural Development Corporation (FFIA+Underground Water development Corporation) in 1970, the relation with FIA was cut (through the central federation with association members), but it came back as an organization to seek or represent the mutual benefit of FIA.

Starting in 1978, these 3 organizations maintained cooperative relations for about 20 years leading production base arrangement, but sometimes they competed with each other. For FIA projects (large/medium-scale agricultural water development or land rearrangement), KRCC and FFIA sometimes competed for service provision options such as study, design, or supervision, and there were many conflicts while FIA was taking over large-scale general development projects enforced by KRCC. Especially, it was encouraged to fully open technical work from the end of the 1990s so the technical work for production base arrangement couldn't exclusively taken by KRCC and FFIA resulting in weakened their roles as technical agencies. In this situation, before launching a new administration in Feb. 1998, the presidential transition team selected 100 national tasks including integration of KRCC and FFIA in the name of increasing efficiency of agriculture/forestry/fishing-related organizations by reducing or restructuring them so that they can become a professional organization to support agriculture restructuring & to provide technical support for Rural-area production base. The integration was suggested only for KRCC and FFIA, but the 3 organizations including FIA were eventually integrated during realization of the plan.

This was because unification between FIAs became an urgent problem with the insolvency despite 50% of the operation cost of FIA had been subsidized by government since 1989. The direction cause was that some tasks of KRCC and FFIA overlapped (study, design, and supervision) and the government provided both organizations (study and design for land rearrangement project) with finance (union due subsidies) resulting in decreased efficiency.

However, there was considerable resistance while trying to draw agreement from the target organizations and to building consensus among the beneficiaries. Because there were some conflicting interests while integrating the different two organization into one. General reasons for resistance were 1) insufficient understanding of the integration; 2) concerns and psychological burden for a new order (severance of existing social relations); 3) damage to stability and pride of existing organizations; 4) individual damage (reduced salary, layoff, and demotion of position); and 5) doubts for the necessity and outcome. Meanwhile, during

the integration, the beneficiaries requested to abolish union dues; there were legal conflicts for comprehensive succession of property rights of the dissolved FIAs; there were problems with interest of elected head of FIA and shortage of severance pay for employees among small FIAs. Some FIAs suggested self-regulated restructuring plans together.

Under the principle to accept these problems with legal measures in terms of restructuring reformation, the government took legislative actions with the following reasons for integration: First, the labor force would be fully operational and complementary irrigation projects would be available by integrating the 3 organizations into one organization; Second, it could solve the issue of competition or overlapped tasks between KRCC and FFIA; Third, operational cost would be reduced and labor force utilization would be facilitated by integrating headquarters and local branches of KRCC and FFIA. With strong will for integration, the government promised to fully subsidize the maintenance cost without any union dues of 5kg/10a (about 6,000 won/kg) from the 950,000 members from 1999. There were some learned men who argued that poor operation of FIA was not just because of itself but also because of insufficient subsidies by the government for the maintenance (union due subsidies) since 1989, but their arguments vanished behind the wave of reformation. There was no FIA member who would raise objections to the fact that they didn't have to pay for the agricultural water.

Table 7-1 | Domestic and Foreign Agriculture Environment Changes and History of Agency Authorities

Name of authority	Period	Foreign agriculture environment	Domestic projects	History
Water authority Vessel repair association Korea agriculture land development	1906-45	-	Increase grain production 1st: 1918-26 2nd: 1926-33 3rd: 1940-45	• Water authority rule declaration: 1906 • Okgu west (formerly Junbuk farm) Mil yang magupyong repair association: 1908.2 • Korea land improvement (land improvement association annulled): 1940.7 • Korea farm land development established: 1942.12

Name of authority	Period	Foreign agriculture environment	Domestic projects	History
Land improvement Association Land improvement league Underground well development authority	1945-70	GATT launched 1948.1	Agriculture output increase 3-year plan: 1949-51 Agriculture output increase 5-year plan: 1st: 1953-57 2nd: 1968-62 3rd: 1962-66 Land reform: 1950-68	• Korea land development function revived: 1945.10 • Korea water association function revived: 1945.12 • Korea water authority (formerly-Korea water association): 1949.6 • Korea land development merged with Korea water association: 1950.6 • Rules for water authority merger legislated: 1961.8 • Land improvement plan rule established: 1961.12 • Land improvement association: 1961.12 • Land improvement association: 1962.1
Farm land association Farm land improvement association Farm authority	1970-90	UR launched 1986.1	• Water supply development 10-year plan: 1982-91 • Farm and fishing comprehensive plan: 1986.3 Farm & fishing debt relief: 1987.12 • Farm & fishing economic plan: 1987.12 • Farm and fishing • comprehensive plan: 1989.4 • Farm and fishing debt relief: 1989.12	• Farm modernization law established: 1970.1 • Farm land improvement authority: 1970.1 • Agriculture authority: 1970.2 • Farm land association: 1971.9 • Land improvement association: 1973.9 • Land improvement association: 1978.4
Land improvement Land improvement association Farm authority	1990-99	WTO launched 1995.1	Farm and fishing improvement plan: 1991.7	• Farm improvement law: 1990.4 • Farm authority established: 1990.7

Name of authority	Period	Foreign agriculture environment	Domestic projects	History
Farm base authority	2000-06	•DDA launched: 2001.11 •Korea-Chile FTA effective: 2004.4 •DDA rice negotiation law: 2006.11	Agriculture, farm comprehensive plan: 2004.2 Farm land law revised: 2005.7 Farm land bank: 2005.10	• Farm base authority fund: 1999.2 • Farm base authority: 2000.1

Table 7-2 | Main Projects and their Changes per Period and Organizations

Period	Authority	Projects
1970-90	Farm land improvement association Farm land improvement association united Farm and fishing authority	(farm land improvement association) • Maintenance of farm land facility • dividing farming blocks project • Rice paddy and cropland • land improvement • Farm land preservation and repair of its facilities • Other projects (farm land improvement association united) • Research and instruction to members • welfare and health care for members • Assist in operation & assessment • Testing and hiring members • Technical assistance to maintenance and restoring natural damages • Election process training • members training • Revoked land project • farm land block project (reclamation, irrigation, land section control) • Land improvement maintenance • other projects (Farm and fishing authority) • Large scale farm development program • farm land project (reclamation, irrigation, land section control)

Period	Authority	Projects
1970-90		• Mid-scale farm water development program • underground well development • Reclamation on west coast • service contract for overseas • Farming program • maintenance program • Farm construction, training, electro computation # Farm land improvement and Farm land improvement united have many overlapping common programs
1990-99	Farm land improvement association Farm land improvement association united Farm and fishing authority	(farm and fishing authority) • Farm structure improvement project (farm land optimization, trainings for farmer and fishermen, overseas training) • Farm and fishing community development • farm and fishing comprehensive development (farm and industrial areas) • Designated for farm and fishing special zone • service contract for overseas program • Large-scale development project • reclamation (Saemangum) • Water monitoring system • Farm production base project (mid-scale water supply development, irrigation pipes, sections evaluation) • Underground well development •computer database, research, training
2000-06	Farm base authority	• Farm production & sections: water supply development, farm water, well water investigation and development, maintenance, west coast reclamation, irrigation upgrade, drainages, modern farm facility, cropland arrangement • Farm base facility management project: farm water supply management, irrigation upgrade, monitor facility and automation • Farming database project: re-arrangement of farms, direct payment, farm land database, water supply to farm and database • Local community development: farm development, retirement homes, nursing home, theme cluster model development, exchange program with cities, ground waters, land environment investigation, farm and fishing village resort, environment friendly pilot programs, infrastructure for environment

Period	Authority	Projects
2000-06	Farm base authority	• International cooperation and service contract • Alternate energy development, waste dump investigation, environment-friendly farm land • Training, environment-friendly research
2006-	Korea farm authority	-

1.2. Water Management after Integration

1.2.1. Reinforcement and Modernization of Irrigation Facility

Only 881,000ha (76.9%) of domestic rice paddies is irrigated, however, only 430,000ha (37.5%) of those would be able to withstand a 10-year repeat-cycle periodic drought while 254,000ha (23%) is farmed depending solely on natural precipitation. About 48% of such limited irrigation facilities were built more than 30 years ago. Among reservoirs that irrigate 59% of rice paddies, 9,648 reservoirs were built before 1945 and 15,856 reservoirs (88.7%) were built more than 30 years ago. Increasing the volume of such aged reservoirs could be achieved by dredging silted sand deposit, and to prevent losses due to water leaks by repairing old dams and water intake systems. Furthermore, reinforcement developments or even reconstructions of water resources should be considered in some cases. Since these repairs require a sizable budget, yearly phased-in planning should be established and adhered to accordingly. If water resources are in short supply while corresponding with said planning, construction of auxiliary water resources should be given a new review. Combining small-scale pumping/draining stations could curtail the maintenance labor and cost. The improvement of irrigation channels, from earth ditches (70,215Km, 63%) to piped channels, should be planned in phases. Irrigation channels near a village should be upgraded in an environmentally friendly manner to maximize their usage while minimizing their losses.

1.2.2. Greater Regional Water Management Structure

Based upon the division of rural areas into 464 water supply districts and the earlier establishment of the Water Supply Plan for the rural agricultural region by the Government, water supply systems should be restructured per each district and per each water supply area. Existing facilities lack the interfaces due to localized water supply developments undertaken by each water supply regions on a small scale. Water supplies scattered through a wide area should be combined into main and auxiliary water supplies to improve water supply utilization. Connection of water channels should be upgraded to better fit into new

development. Insufficient water supply systems should be declared obsolete, discarded and replaced with more efficient water management. The water resources should be devised to secure water supply not only to farming irrigation systems but also for living, industries, and streams. It is also necessary to restructure the water management system into a multi-purpose water supply system where it is possible to supply waters to piped water channels and to upland crops.

1.2.3. Conservation of Water via increased Efficiency of Water Management system

Based on a continuously-updated database of water managing records, water supply schedules can be predicted according to the demand of crop growing rate per season. Re-utilization of drainage waters and reuse of water can be maximized by irrigating at upper streams. Through a strictly enforced simple irrigation and circulating irrigation system, water-saving irrigation must be observed. As a countermeasure against unexpected drought, an emergency water supply plan should be in place in advance, and water can be conserved considerably by measuring water flows with installed measuring devises.

1.2.4. Specialized and Elite Water Managing Personnel

Since conventional water management is no longer valid as the modernization and automation of irrigation facilities progress, the new operation manuals adequate for each facility should be prepared and distributed to water managing personnel. The large-scale pumping/draining station operators or major facility supervisors especially should be staffed with knowledgeable technicians, and furthermore, they must be continuously and repeatedly educated, in order to maintain the system with specialized and elite water managing personnel.

1.2.5. Farmer Participation in Water Management and Co-op System

It is not feasible for the national government to manage all the water supply systems since irrigating facilities are too numerous, spread thinly nationwide. Currently they are operated by local governments and by the farm base authority, however, water systems are mismanaged and wasted by lack of skilled personnel and funds. It is necessary to institutionalize them to provide incentives to local farmers who will take part in managing water systems. Recently, the farming base authority has been running a pilot program where farmers are voluntarily participating in the water management systems which are producing a desirable result.

It is an international trend that strongly encourages farmers' participation in water management. International finance institutes such as the World Bank are proposing the

idea of participatory irrigation management where farmers take part voluntarily in the water supply management systems. The OECD has been discussing distributing the water resources based on the free market system where price fluctuates according to demand and usage. It will be impossible to revoke the policy of free-water which was instituted by a political consideration; however, the farmers' participation in the water supply systems must be realized. An effort must be given to inform the farmers about the water management system before irrigation begins, and bring out the interest amongst farmers about the issue by developing and announcing the irrigation forecast online.

1.2.6. Preventing Reservoir Pollution and Water Quality Improvement

Reservoirs dedicated for agricultural use generally have good-quality water; however, due to the increased use of fertilizers and related chemicals, livestock farms and sewage from urbanization, water quality has been gradually degraded. This has brought the attention to the fore after testing of water quality produced 400 reservoirs (23% of the total) in a 2000 survey and 85 reservoirs (17.3% of 492) in a 2001 survey conducted by the farm base authority with unacceptable level of COD levels. It is therefore important to promote environment-friendly agriculture at the upper stream with the assistance of an organized community participated in by farmers, local governments, the farm base authority and water quality management committee.

1.2.7. Water Management with Irrigation System Disaster Prevention

Water management has been primarily focused on drainage in the past, but the reservoirs and dams such as Jangsung (downstream) have increased their scale and size. There have been increases in cases where descript reservoirs, irrigation pipes, pumping and draining station have broken due to the concentrated rainfall caused by climate changes. It is now necessary to control the water pumping and draining systems of agricultural use. It is thereby necessary to maintain and repair the old descript facilities deemded unsafe by KOWACO in preparation. It must be also noted that the EAP (Emergency Action Plan) should be established to control the water per possible scenarios including the typhoon damages caused by Lusa from August last year.

1.3. Facility Management after Integration

On Feb. 5, 1999, the Agricultural Development Corporation & Farmland Management Fund Law was enacted and proclaimed for integration. According to the law, the newly-established Agricultural Development Corporation (ABC) took the functions of the KRCC and management of irrigation facilities from the FIA. The law put ABC in charge of several projects: various arrangement projects according to the Rural Area Arrangement

Law, maintenance of irrigation facilities, development/use/preservation of water for rural area & underground water resources, rationalization of farming size, and development of rural areas. Among them, the production base arrangement project (building & maintaining overall arrangement facilities) of FIA was integrated into other projects, and it had to compete with private corporate bodies for replotting (city & Gun projects) of FFIA which doesn't belong to the corporation automatically (replotting was open to private corporate bodies with revision of enforcement ordinance of Farming & Fishing Village Arrangement Law on Apr. 9, 1999). Especially for the former, government investors (national enterprises) came to handle whole process from enforcement to facility management. The expectations for the newly-launched ABC were: First, it would actively respond to facility modernization within the jurisdiction based on technical strength and enforce systematic facility modernization project in terms of national tempo comparison; Second, it would contribute to rationalization of agricultural water usage by reasonably combining existing water usage systems with newly-developed water resources through setting management zones for agricultural water and continuous management; Third, it would conduct safety management, function extension, and reinforcement & maintenance for existing facilities with certain plans. Especially, it was expected to distribute or enforce the budget efficiently by adjusting the tempo of the maintenance which was previously done by individual FIAs so far; Fourth, because ABC had national control capability it would be able to understand operations of each branch and cope with it flexibly, reducing the time needed for procedures of supervising organization; and Fifth, it would create various base arrangement techniques expecting the changes through systematic study for new technology development as well as creating information network.

ABC was launched with these expectations but suffered from the deficits of the irrigation facility arrangement from the beginning. Since 2000, the government budget item was changed from union due subsidies to support fund for maintaining irrigation facilities. The budget was set in 1999 when there were many arguments around integration, so it was only 63.4 billion won compared to the average 90 billion won in union dues subsidies in the 1990s. So they invested 189.4 billion won including 116.7 billion won dedicated to maintenance in the first year. After integration, support for maintenance costs of irrigation facilities were increased to an annual 129 billion won for 5 years from 2001 to 2005, but it was only 63% of the amount required; the remaining 37% was continuously covered with its incomes (new city development, compensation for the flooded facilities, sale of unused assets).

With the integration, the ownership for irrigation facilities or the attached land was transferred to the government; the maintenance cost was subsidized by the government; and the shortage was covered by the corporation, so it actually became a national management system.

Thus, water-right disputes around water management were solved for some areas, and upgraded facility management was possible by securing professional of facility construction, maintenance, and water management based on the experiences of the FIA and accumulated technology for design and supervision of facilities from the corporation. However, the branch (former FIA) which actually managed facilities was operated under a budget or guidelines from the headquarters so it was difficult to reflect the local characteristics and to avoid negative effects such as standardized development & management which is not suitable for local conditions. Especially, the flood-damaged people didn't participate well, so a larger labor force was needed resulting in financial pressure for the corporation.

Argument for reduction of farmers' burden in 1989 and elimination of flood-damaged people's burden in 1999 finally caused a national management system, but measures need to be prepared in case of accumulated deficit when the responsible corporation has to cover the insufficient finances.

2. Goal of Production Base Arrangement & Goal Accessibility

2.1. Arrangement Goal of Major Projects & Middle/Long-term Plan

There are 5 traditional food crops in Korea: rice, barley, beans, root and tuber crops, and miscellaneous cereals. Among them, rice and barley (which are main crops) were cultivated in rice fields, and cultivation patterns were diversified for the rest. In the rice paddies which can be filled with water during summer, rice was grown, and it was typical to do double-cropping with barley in the South. Rice growing required a lot of water, so irrigation facilities to supply water artificially were essential. Water sources for irrigation can be reservoirs, pumping & draining stations, weirs, and underground water depending on geographical conditions, stream development, and location of irrigation target. Water storage facilities were main water sources for irrigation in Korea.

Meanwhile, irrigation facilities were main factors to assess rice fields, and there were well-irrigated paddies, partially irrigated paddies, and rainfed paddiesin the 1970s but they were simplified into irrigated paddies and non-irrigated paddies from 1981. Development of irrigation facilities or agricultural water facilities means establishing irrigated paddies, and the potential area became the goal of agricultural water development. Regardless of project type, development goals depend on social & economical background and agricultural policy, and the goal is frequently changed during enforcement. Here is how the development goal and mid/long-term plan has changed for agricultural water development land rearrangement, and drainage improvement (the main projects for production base arrangement).

2.1.1. Agricultural Water Development Project

In June 1965, the initial development goal was set for the agricultural water development project. It was to develop all-weather agricultural water sources for 357 thousand ha out of 547 thousand ha - all 1,239 thousand ha of rice fields excluding the 692 thousand ha of well-irrigated paddies. It was the new-development target area with the goal to establish irrigated paddies for 85% of total rice field. Based on the evaluation & study of irrigation capabilities of overall irrigation facilities in 1980, it became a goal to establish irrigated paddies for 90% of total rice fields (1,385 thousand ha) in 1991, which was the target year of the 10-year agricultural water development plan (Stage 1, 1982-1991), established in 1981 so they tried to newly develop 334 thousand ha as well as 65 thousand ha with insufficient irrigation capability and 156 thousand ha for supplementary underground-water development for drought targeting 555 thousand ha in total.

The 10-year plan subdivided the development types of unit projects according to water sources, which was changed with all-weather plan in 1965. In other words, surface water or underground water development was added to complement insufficient irrigation capability of existing irrigated paddies in addition to the new development and there was tube-well development to use underground water during drought.

In 1994, a 10-year agricultural water development plan (Stage 2, 1995-2004) was established again, and the goal was to establish irrigated paddies for 88% (967 thousand ha) of the estimated 1,100 thousand ha in 2004 but it was reduced to 82% (907 thousand ha) in 2000. According to the changed irrigated-paddy goal, the development area was planned to be 191.4 thousand ha including 52.3 thousand ha with large-scale general development and 21.3 thousand ha of reclamation in the southwest coastal area. The second 10-year plan didn't set a general development goal but only target area of the plan.

a. Plan

The second 10-year agriculture water development plan (1995-2004) was drafted to find a permanent solution for drought as happened in Youngnam and Honam provinces in the years 1994 and 1995. The plan, with budget of 14.42 Trillion won, is to increase irrigated paddies to 88% from 74% and the well-irrigated paddy rate to 60% from 32% from 1995 to 2004.

Table 7-3 | 2nd 10-year Plan Status

Programs	Development areas (thousand ha)				Program cost (billion W)	remarks
	total	new	reinforce	streams		
Total	296	96	150	50	144,200	
Mid/large-scale water development	90	50	40	-	41,500	
Small scale water development	6	4	2	-	3,000	
Reinforcement water development	70	-	70	-	14,000	
Underground well development and drought plan	30	12	18	-	3,600	
Water system Repair	14,000	-	-	-	28,000	
Large-scale comprehensive development	100	30	20	50	42,500	
Fishing & farming water supply development	5,000	-	-	-	11,600	

The big point of the second 10-year plan is that reinforcement and repair projects have been expanded in addition to the new project-focused plans of the past. As shown in Table 1, more than half (150,000ha) of total development areas (296,000ha) were reinforcement projects and it was first the reinforcement budget exceeded that of new projects. It emphasized the reinforcement of the existing descript system against disasters.

b. Results

According to the second 10-year plan, it was planned to invest 66,530 billion won over 6 years (1995-2000) and develop 150,000ha, but only 52,287 billion won were spent and developed 102ha. Per ration of developed land, a lowest result was from reinforcement and repair projects followed by mid/large scale projects and only 66% of budget was spent on the development of water supplies, however, achieved a 100% development result.

c. Evaluation and Forecast

First, the evaluation result of the second 10-year plan shows <Table 7-4> that execution of budget achieved 86% and areas of development 69%. However, the rate of irrigated paddies has increased to 77% from 74% and a well-irrigated paddy to 37% from 32% and it have contributed the steady supply of staple grain. As a reference, the first 10-year plan (1982-1991), which was drafted in 1981, intended to develop 555,000ha but achieved only 309,000ha (56%) and executed a budget of 18,033 billion won (34%) out of the total budget (53,242 billion won).

Table 7-4 | Project Status per Plan

(unit: billion won, thousand ha)

Project		plan	'95-'00			'01			'02-'04
			plan	result	%	plan	result	%	
Total	Program cost	144,200	66,530	57,287	86	16,821	10,304	61	76,709
	Developed area	296	150	102	68	34	12	35	182
Mid/large scale	Program cost	41,500	19,227	18,265	95	4,750	3,099	65	20,136
	Developed area	900	49	26	53	10	4	40	60
Small scale	Program cost	3,000	1,294	590	46	380	-	-	2,410
	Developed area	6	3	4	133	1	-	-	2
Large scale	Program cost	42,500	21,658	15,873	73	5,036	2,479	49	24,148
	Developed area	100	47	45	96	12	6	50	49
reinforcement	Program cost	14,000	4,067	1,704	42	1,930	323	17	11,973
	Developed area	70	33	14	42	8	1	13	55
Underground water	Program cost	3,600	1,624	2,312	142	400	275	69	1,013
	Developed area	30	18	13	72	3	1	33	16
Repair/ reinforcement	Program cost	28,000	11,760	14,018	119	3,200	3,312	104	10,670
	Developed area	14,000	6,042	2,079	45	2,108	301	14	10,990
Home water	Program cost	11,600	6,900	4,525	60	1,125	816	73	6,259
	Developed area	5,000	2,817	2,819	100	530	480	91	1,701

Second, upland crop farming is on the rise. However, a systemic development or aggressive assistance is difficult, as those are not reflected in the current 10-year plan. As of late 2000, there are only 42,000ha (6%) out of the total cropland (740,000ha) with a reliable supply of irrigated water and the rest (698,000ha, 94%) relies only on rain-fed irrigation systems unable to cope in time of droughts.

Third, the emphasis has been on the hardware - as in projects for new reservoirs, dams, tubular wells and the repairs of existing facilities - and neglected the development of software for maintenance and preservation of water resources. Fourth, the magnitude of disasters as droughts and floods in comparison to the past have intensified and become unpredictable due to global warming, destruction of the ozone layer, El Nino, etc.

Additionally, population growth, expansion of urban areas, increases in standards-of-living, and increases in home water supplies have all depleted the limited water resources,

causing degradation of water qualities. This has awakened the importance of water resource development. As the demand for water supply rises as farming has increased the areas of diverse plants and vegetations, there have been increasing pleas for environmental protection as the heavy demand for water has caused fog, dry streams and tributaries. The outlook for the environment protection is not good, since the budget for those project increases dramatically due to land price increases. The U.N has indicated that Korea will become the only nation in Asia that lacks water by the year 2011 unless it establishes a plan for water management. This needs to be addressed and the long term adequately prepared for; it is critical at this juncture.

In addition, the second plan made it the goal to arrange upland base. During the two 10-year agricultural water development plans, there was a 4-year gap between them. Losing continuity, they have maintained the goal to establish irrigated paddies. However, in 2000, the goal was changed into a new 10-year goal including agricultural water development, drainage improvement, land rearrangement, large-scale general development, reclamation, and irrigation facility maintenance under the name of middle/long-term plan of production base arrangement project. The plan for 2002-2011 was changed in 2004 so the period was changed to 2004-2013, resulting in changed goals of each project. At the time, the target area was 116 thousand ha but the new 2013 goal was set at 174 thousand ha including large-scale general development and southwest reclamation.

2.1.2. Land Rearrangement Project

Since 1965, land rearrangement was planned by the government, but the standards and target areas were set in 1969. The target was 588 thousand ha, or about 50% of the 1.176 million ha of targeted irrigated-paddy area. It was not the result of a national study but just the complexes or 10ha or more in which rice fields were relatively clustered; average gradient was 1/100 or less; and it was well-irrigated paddy field, among 1,301 thousand ha of rice field. (1/50,000 ballast) Local distribution of the target area collected from each province according to the standard (ratio against well-irrigated paddy field) showed some provincial differences but relatively-evenly distributed (Kangwon - 25%, Jeonbook - 53%, Jeonnam - 48%, and Gyeongbook - 45%).

With the target area, labor-force shortage was severe and mechanized farming was urgently needed, so the target was adjusted for irrigated paddies with 10ha of grouping size, 1/50 or less average gradient, and agricultural water secured. The target was 706 thousand ha, or 54% of the total 1.316 million ha of rice fields. As working expenses were subsidized (80% from government and 20% from the local government), eliminating farmers' burden with the goal of to rearranging land for development areas when agricultural development areas were designated at the end of 1992, project needs rapidly increased. The target was

902 thousand ha including the farmland with grouping size of 10ha and average gradient of 1/50 or less but also including farmland with 2ha of grouping size and 1/15 or less of gradient, which it was located outside of the agricultural development area but continuous faring was available thanks to the conditions.

This target from the early 1990s was changed to 1.1 million ha (902 thousand ha of rice field and 180 thousand ha of facility horticulture) of rice fields (in 2004) through a national study in 1997 and general measures for the rice industry's development in June 1996, and it was changed to about 800,000ha (799,785ha) after a complementary national study for the target area of land rearrangement in 1997. Eventually, the final target became 800,000ha, about 70% of 1.16 Mill ha of total rice fields. In addition, 83% of it was inside the development area and the remaining 17% was outside of it.

Because the drainage improvement project adopted in 1975 aimed to extend double cropping, the target area included surface drainage and subdrain. There were many influencing factors for the target, so it was difficult to understand them without any study. Initially, a study was conducted for frequently-flooded areas in 1975-1976, focusing on the removal of surface water, resulting in target area of about 110 thousand ha (107,832ha) in total.

The target area was increased to 207 thousand ha after administrative study through province, city, and *Gun* governments and the FIA by dividing the target into surface drainage and subdrain in 1983-1984. The target area almost doubled in 1975, and there was no big difference in surface drainage comparing to the one of 1975 study but differences between areas were considerable.

However, as flood damage to farmland increased with frequent and localized heavy rain due to weather anomalies at the end of the 1980s, the target of surface drainage was increased for preventing disaster. From July 1997 to June 1998, it was ordered that city and *Gun* governments and the FIA survey the target of drainage improvement considering the local conditions such as rainfall frequency and stream arrangement status. Based on the survey results, the target area was set to be 235 thousand ha in 1998 and 180 thousand ha was the target of surface drainage.

The goal of drainage improvement and target area has changed over time; demand for food crops (double cropping) was reduced; and strength or frequency of localized heavy rain increased, focusing on surface drainage to prevent flood damage. In the old days, subdrain was planned for about 40% of the target area to extend the double-cropping area, but the underdrainage disappeared after the initial pilot project for 4-5years (1976-1979) during the process. Afterwards, there were some arguments for the necessity of the underdrainage project, but it was ignored because of new investment to production base arrangement and investment needs control.

Table 7-5 | Table of Change in Financing Assistance of Readjustment of Arable Farmland

	60's	-80's	1981-1982	1983-1986	1987	1988	1989-1993	1993-
National fund	80 PL-480 II grain	50	50	60	60	70	70	80
Local government		30	30	20	20	20	20	20
-State		18	18	18	12	12	10	10
-Regional		12	12	2	8	8	10	10
Individual		20	20	20	20	10	10	-
-Cash		20	6.7	6.7	10	-	-	-
-Loan		-	13.3	13.3	10	10	10	-

2.1.3. The Four-river Restoration Project for Agriculture

a. Raising Reservoir Dike Elevation

Korea's terrain is about 65% hills and mountains, and the rainwater reaches the streams quickly due to the terrain's steep inclines. Starting in June and continuing through September, during which 2/3 of annual rain and typhoons are concentrated, there are many small- and large-scale deluges followed by droughts when the rainy season ends. The climate and terrain are very disadvantageous to control. Korea has put a high priority on water supply for agriculture and flood prevention since the old days, and has built numerous reservoirs in order to cope with the non-conducive climate and terrains and to control the water supplies. As of the year 2007, there were 17,649 agricultural reservoirs and those contribute water to 474,000ha of land and improve water quality, and control floods and ecosystems. 14,233 of those reservoirs are managed by local governments and 3,326 are managed by the Agriculture and Fishery Development Corporation (AFDC). Those agricultural reservoirs are too small and too decrepit. They are too numerous to maintain due to budgetary constraints, though they are continuously upgraded and maintained. There are increasing demands in rural areas for ample supply of water for high-yield, high-quality agricultural product cultivation, living environment upgrades, for homes and industry, and regional water needs. The raised dike is a very effective means to meet those challenges faced in limited areas to avoid dams, submerged villages and environmental concerns.

a) Advantages

The purpose of the dike raising program is to prevent natural disasters and enhance the ability to control floods with a combination of upgrading the decrepit water systems and increasing th volume of reservoir waters. First of all, it is possible to contain water which

was used to drain to ocean before. This additional water is now contribute to improving the sulfur content in streams and rivers, and ecosystems by preventing dry rivers beds. This will also ensure stable agriculture from drought damage by having ample water supplies. As for the second advantage, the decrepit water supply systems will become secure by having upgraded systems and water overflow prevention structures. The increased annual rainfall due to climate change and the increase of paved surfaces from urbanized areas have both contributed to the spillages. Straightened stream lines over the years and the increase of drainage processing stations have contributed to overwhelming flow of water while the decrepit drainage systems and shallow reservoirs from the old days remain inadequately equipped to handle the excess water. Additionally, reservoirs which are capable of controlling the water levels within can contribute to reducing flood water damage. As for the third advantage, the raised dike and development of increased water surface expanse will contribute to providing rest areas and tourist destinations. This development will provide eco-parks, walkways, and rest areas which will help develop the region's attraction for tourists and its residents. Lastly, the embankment development will provide income opportunities by enabling locals to sell local produce and operate businesses for local cuisine and specialties to tourists. The program, therefore, will be able to prevent floods and droughts and enable agriculture to thrive, provide rest areas and facilitate the regional economies by increasing locals' incomes.

b) Program Status of raising Dikes

Programs to increase the height of dikes are under way for those that needs repairs and suffer from lack of water supplies: 94 reservoirs around the 4 largest rivers and 17 reservoirs from other rivers. As of this time, 108 projects have been launched and an additional 20 areas will commence by the year's end. 94 reservoirs from the 4-rivers area will be completed by the end of next year and the rest of the reservoirs will be completed by 2015.

b. Agriculture Land Remodeling Program

There is much agriculture land in Korea that is situated at a lower elevation than water's. It will therefore inevitably suffer damage from floods. The agriculture land remodeling program was begun to prevent such damage. This remodeling program is to raise the level of land by 3m from the dirt out of dredges. The original agricultural surface dirt is removed so that dirt from dredge can be laid over and have the original dirt spread back over it. Another point for this program is to provide the ground whereupon additional income can be created for locals by introduction of upgraded irrigation ditches, roads and other agricultural infrastructure for easier farming. It is expected to result in increases in income for local farms by utilizing farmland such as from upland crops and horticulture, moving away from rice farming. The remodeling program is underway in 140 regions from the

4-rivers areas from 2010 through 2011 with a budget of 1 trillion 387.2 billion won. As of now, 140 regional remodeling programs are scheduled to be completed in 2011. It used to take about 200mm of rainfall to flood 60-70ha of agricultural lands before the remodeling was completed in October 2010 in the Osang area (Jukam-ri, Sangju, Kyungbuk province), but it has sustained no damage this summer even from over 300mm rains. Those local farmers of low-lying areas were not able to sleep from worries of flood damage during summer. This program is a gift from the government to farmers. This program is popular and demand for it is strong among farmers, however, it is regretful that government and its agencies cannot meet the demand due to a shortage of dredge.

c. The Search for a New Development Paradigm of Agriculture Infrastructure

The 4-rivers program has put forth a new development model for a multi-purpose and multi-function water management system over the previous paradigm of developing the reservoirs, irrigation systems and agriculture infrastructures for increased productivity only.

a) Expand Embankment Program Nationwide

It is needed now more than ever before to embark on the expansion of programs for raising embankments nationwide not only to control and manage the demand of water supplies, but to relieve the people from flood damage and to give back the environment around water conducive to people. The program needs to expanded into streams and tributaries nationwide to increase the capacity to hold water and to repair and upgrade the decrepit water systems well enough to withstand floods and earthquakes. In order to undertake the embankment program more effectively, it is recommended to combine similar development programs so time won't be wasted in securing funding from a newly-enacted government budget codes. However, those programs are funded 70% by the central government and 30% by local governments, and are hit by delays and scale-downs due to budget restrictions. Therefore, it will be conducive if the programs commence in conjunction with other related agriculture programs to tackle the water issues fundamentally.

b) Repair Agriculture Infrastructure

1) Restructuring Sea Dike Sluice as Multi-function

Increases in rainfall due to climate change and spillage due to urbanization, sea dike sluice and regulating gates are no longer able to control the floods. It has become critical to expand and upgrade the structures and capacities for sea dike sluice and regulating gates.

2) Landscaping Pumping and Drainage Stations

The Ministry of Land and Maritime Affairs is directly undertaking building and reinforcing the pumping & drainage stations that are affected by the 4-rivers programs as the water level and topology change. There are 256 pumping and drainage stations near the

4 rivers that are affected and include 128 facilities that are managed by the Ministry. There are potential conflicts between the facility management and constructing parties who are conducting building and reinforcing work. It is best to put those in managing the facility to undertake the building and reinforcing works. There have been cases previously where agricultural infrastructure has damaged the environment and surrounding landscape from having non-existent landscape plans, but now it needs change. A landscape plan should be established to afford rest areas and observatory points to the locals and visitors alike. The plan should incorporate the plan for its diverse local resources to express its identity and provide an open access and for local community to mingle with visitors. It is anticipated that in the process of building and reinforcing the infrastructure, the old and decrepit infrastructures are replaced with new ones and thereby rendering easier operations for new agricultural infrastructure and helping promote the 4-rivers project by replacing the eyesore structures of old with newly-landscaped infrastructure.

3) Multiple Usage of Reservoirs

What is the common ground between water's-edge parts of Bodensee, Germany and Isanomura, Japan? These cities have become famous tourist destinations by developing the water's-edge parks despite the fact that they are located in remote areas. There are numerous such cases overseas where lakes and lakeshore developments have greatly contributed to the local economies and development. There are also many cases where local governments have undertaken such similar water's-edge development projects in cities to provide rest areas, such as Ilsan lake park, Yuldong park in Bundang, and Hoam park in Chungju. The possibilities are limitless for reservoirs spread throughout the nation as tourist attractions. However, the reservoir construction was only focused in its main purpose of water supplies for agriculture and its safety and functionality, not allowing focus on the potential in developing landscapes, water-friendly activities, tourism and local communities. Recently, there has been a strong movement arising to develop and utilize reservoirs and their surroundings with environmentally-friendly ways while maintaining its main functional purposes. This is due to the role of reservoirs developing rural areas in a sustainable process. As mentioned earlier, the waterside program originally began as part of the raising embankment program, and it contains many issues. First, the reservoir water's-edge development program needs to have differentiated programs from similar developments as tributary developments. In other words, it needs branding of its own reservoir development programs. Secondly, after the reservoir development is completed, it needs to secure the funds, local management capabilities and rules for users to have sustainable management and facility operation. Facility management teams, local governments, locals and local historians need to gather to come up with plans unique to a locality to take initiative for development.

4) New Water Management Process

The existing water supply system has been changed due to the 4-rivers programs. The agriculture water supply systems need new reasonable and scientific systems, rules and regulations instead of old ways where they have been managed from field experience and customs. The Korea Water Resources Corporation and Ministry of Land and Marine Affairs need to set up a water flow control system to monitor water flow for agriculture purposes and tributaries. The raising embankment program therefore needs to set up the control tower for a reasonable and effective water flow management system and the flood management per the 4-rivers project. A task force team should be able to meet the demands for water management and maintenance and establish its role in a streamlined process which flows from headquarters – regional offices – branch offices. The task force team is expected to expand its role as the top water control center for agricultural water supplies.

The task force team will need to set up a legal and institutional system in place as "Rules for dam and reservoir joint operation" in order to operate in connection with the water supply systems of the Ministry of Land and Marine Affairs. The operation rules should set up a reasonable and scientific operational system to supply water and improve environments in waters downstream, while giving considerable care to each reservoir. Water management goals and monthly and seasonal water control levels, actual water management water flow-ins and supplies to reservoir are necessary in order to evaluate and to reflect its results back in planning the next phase of the water management plan. It also needs to establish the organization and hire adequate staff, and to set up information systems as the water supply system and authority undergo changes. It also needs to pay attention to the consensus of the site personnel in conjunction with a new water management system and standards. The AFDC has set up the "Agriculture section control center for the 4 rivers" that monitors and controls the program status and water systems. This opportunity should be utilized to enhance and develop this control system to further refinement to determine and reflect the results ("smart") from monitoring. The AFDC should reinforce its status on the agricultural water supply authority by having the ability to control all information necessary to determine outcomes of water control and natural disasters. It should also operate the control tower that links headquarters and regional offices via mobile application devices.

2.2. Accessibility of Arrangement Goal

As mentioned above, the target of the production base arrangement has been changed every 10 years for the past 60 years approaching the goal. Now arrangement & development are in final stages, excluding maintenance of the facilities. It is estimated for the remaining projects of major projects to be completed by about 10 years after 2008. In other words, if the remaining working expenses are maintained at the same rate of investment as 2007,

agricultural water, drainage improvement, and general development will be completed in 5-6 years, and land rearrangement including large sections, upland arrangement, and farm road pavement will be completed in 15 years. To wit, the 20th-century production base arrangement will have been finished by around 2020.

However, management and maintenance will remain as tasks to be continuously taken care of as long as farming is continued. The maintenance is mainly composed of maintenance cost support for irrigation facilities and recovery costs for disasters, and the working expenses increased considerably as the view of investment changed in 2000. This is because society has started to see irrigation facilities as a form of disaster prevention for social overhead capital, and the need for maintenance has rapidly increased due to the deterioration of the facilities themselves. The principle of development first is being changed to one of preservation and management as the development is finished.

Table 7-6 | Major Program Results (1946-2007)

Programs	Projects	Area (ha)	Investment (unit: million \)	In 2007 money (unit: million \)	Ratio
Total		2,371,298	42,506,852	56,090,744	100
Irrigation Drain	Total	1,229,371	15,853,199	22,222,367	39.6
	Agriculture	939,764	7,270,552	10,736,108	19.1
	Water				
	- Mid-size	416,196	5,580,660	8,259,961	14.1
	- Small size				
	- Reinforce development	512,909	1,123,377	1,874,721	
	- Drought plan	-	403,165	426,092	6.2
	Drainage improvement	10,659	163,350	175,334	
	Total development	126,367 163,340	2,893,750 5,688,897	3,457,317 8,028,942	14.3
Expansion of Agriculture Land	Total	216,567	2,533,720	3,577,077	6.4
	Reclamation	188,040	102,501	345,070	
	Reclaimed land	28,527	2,431,219	3,227,007	
Upland Development	Total	925,360	13,333,973	17,186,345	30.6
	- General	742,421	6,875,225	9,756,681	17.4
	- Great block	105,401	2,720,822	3,197,310	5.7
	Upland development	77,538	1,804,189	2,056,822	
	Agricultural roads	(18,850)	1,933,737	2,175,432	

Programs	Projects	Area (ha)	Investment (unit: million \)	In 2007 money (unit: million \)	Ratio
Disaster Restoration	Total - Disaster restroation Flood restoration	- - -	3,658,001 51 3,657,949	4,683,245 4,514 4,678,731	8.3
Facility Management	Total - Management fee support - Repair and restoration - Reservoir build - Water management - Others		7,057,275 2,010,954 4,786,887 188,000 45,095 26,339	8,351,925 2,456,144 5,580,455 227,206 47,802 66,657	14.9 4.4 10.0
Technology Development			70,684	74,843	

3. New Change to Production Base Arrangement

3.1. Big Change to Basis of Agricultural Administration

Internationally, the WTO negotiation on rice was finished in 2004 and full opening of the market was postponed for 10 years, but mandatory imports increased from 4% to 8%. There has been pressure to open from many places such as reduction of subsidies for agricultural protection and continuous reduction of customs tariffs. Domestically, rice has been produced excessively and the government announced general measures for the rice industry in April 2002, and in November of that year, the 'Law on Building, Operating, and Managing Rice Income Preservation Fund' was enacted, taking measures such as compensation for non-cropping and difference conservation (85% conservation of difference between target price and producing-district price). In March 2004, the 'Special Law regarding Enhancing Quality of Life for Farmers & Fishermen and Farming/Mountain/Fishing Village Development Acceleration' was enacted; there have been new policies for better welfare of rural areas, improved educational conditions, local development, and systematic plans for boosting complex industry.

In this situation, the new direction of agricultural administration set focus on Korean agricultural products in the globe and maintaining & developing farming villages, and the points are as follows: First, policy targets include not only agriculture but also food

and farming villages; Second, differential support by farm-family type instead of whole farm-family support or average support; Third, investment & loan focusing on income, welfare, and local development instead of SOC such as production base; Fourth, income conservation instead of price support of produce and livestock products for stabilized income; Fifth, customer safety & quality-centric policy instead of production-centric policy; and Sixth, setting the arrangement scope and goal so that farming villages can be a space for production, settlement, and rest. They largely changed the view on farming villages and the support method.

Agriculture, the target of changed policy for agricultural administration paradigm. Agriculture, food, and farming village support method Whole farming family, Average support Policy differential for farm-family type Investment & loan direction SOC such as production base. Income, welfare, and local development means for income stabilization. Point of income conservation policy production-centric. Consumer safety, quality-centric Role of farming village Space for agricultural production. Space for production, settlement, and rest.

Now, agricultural administration is changing based on the three policies for agriculture, income, and farming villages. With agricultural policy, it is focusing on market-oriented structural reorganization, eco-friendly & high-quality agriculture, and expansion of growth-friendly power. Income policy is focusing on extended direct payment, reinforced safety measures for management, and increased nonfarm income. Farming village policy is focusing on boosting local development of farming/mountain/fishing villages (farming village development), reinforcing the social safety net, and expanding educational & welfare infrastructure.

Among them, the tasks of farming-village development sought with the farming-village policy are as follows: 1) General development of farming villages such as growing small towns which have core functions, 2) General improvement of basic living conditions, 3) Promotion of investment & talent inflow to farming villages with boosted farming-village tourism, 4) Growing local industry with agricultural & industrial complex, 5) Promotion of culture & art for farming villages and expansion of welfare facilities, and 6) Promotion of informatization for farming villages.

<Core Policy Theme for Local Development of Rural Areas>

1) Growing small towns that have core functions for general development of rural areas; Investment of 10 billion won for 3 years, growing 20 towns every year until 2013, and general development for rural community grouping 3-5 back village as 1 unit; Investment of 7 billion won for 3 years developing 1,000 units in 10 years

2) General improvement of basic living conditions

3) Investment to rural areas, promotion of talent inflow (5 Urban day & 2 Rural day); Living in urban area for 5 days and rural area for 2 days; Boosting tourism of rural areas

4) Growing local businesses; Local intellectual property excavation; Growing agricultural & industrial complex as a local business; Growing local agricultural culture

5) Promotion of culture and art of rural areas & Expansion of welfare facilities

6) Promotion of informatization for rural areas

3.2. New Tasks of Production Base Arrangement

With the big change to agricultural administration basis, the production base arrangement has barely received attention. This is because the social view on agriculture or agricultural environments have largely changed. For changes to the production base arrangement since the middle of 1990s, large-block land arrangement & upland base arrangement project were adopted in 1994; a project for expanding and paving agricultural roads was adopted in 1995; a project for automation of agricultural water management was adopted in 2001; other projects such as water-quality improvement projects for reservoir or freshwater lakes, water management informatization projects, and reorganization of farming-village water usage systems were also adopted as new tasks for preservation & management of farming-village water, counteracting quickly to the conditions of agriculture & farming villages.

At the final stage of the traditional production base arrangement, the current administration is focusing on the following factors for future projects, based on the assumption that farming villages will be built as complex industrial spaces for futuristic agriculture: 1) Creation of production base for new futuristic agriculture, 2) Expansion of the base to maintain & develop the rice industry, and 3) Disaster prevention & eco-friendly arrangements for sustainable agriculture & farming villages.

For 1), they will consider how to create the base for creating various agricultural incomes from stockbreeding, horticulture, and fruit growing, and to create pilot complexes for futuristic agriculture using large-scale reclaimed land and will extend the upland base arrangement according to the increased needs for upland crops. For 2), they will improve usage management system of farming-village water to distribute already-developed water resources efficiently and use it for agricultural, residential, and environmental water. For 3), they will repair & reinforce reservoirs and pumping & drainage stations to enhance the disaster prevention capabilities of irrigation facilities; will finish drainage improvement earlier to consolidate disaster-handling capability for frequently-flooded farmland; will

arrange reservoirs' waterside areas along with farming-village tourism & local development plans; and will control water quality to supply clean water. New projects to be conducted under these assumptions will be studied through resource surveys for related matters before the current one is finished.

Chapter 8

Outcome of Development & Future Tasks

Outcome of Development & Future Tasks

1. Outcome of Development

In the 60 years since independence in 1945, Korea has invested 42.5 trillion won to arrange a production base for a total area of 2,371 thousand ha based on irrigation facility construction (agricultural water development. The investment amount can be converted to about 56.09 trillion won based on 2007 prices. The different sectors are irrigation & drainage including agricultural water, drainage improvement, and general development; farmland extension including cultivation and reclamation; land arrangement including general land rearrangement, large-block arrangement, upland arrangement, and paving agricultural roads; disaster recovery including war damage recovery or flood-damage recovery; and facility management & maintenance including management cost support for irrigation facilities, maintenance of irrigation facilities and breakwaters, dredging work for reservoirs, and safety management. Among them, irrigation & drainage, farmland extension, and land rearrangement are calculated as development or arrangement areas.

For the area of development & arrangement, land rearrangement has the biggest share of 848 thousand ha, including a large block being followed by mid-sized agricultural water development of 416 thousand ha. For investment performance of working expenses, mid-sized agricultural water development, large-scale general development, and facility management take about 14% each. Land rearrangement takes the biggest share at 23%, including large block. This is because there have been concentrated arrangement to cope with the UR since the middle of the 1990s. Among the various unit projects, the land rearrangement project was finished for the 1st time because the goal was almost achieved.

Arrangement & development of production base has been divided into many types of projects as social & economic conditions or farming methods have been changed.

For irrigation improvement projects conducted by the Irrigation Association under the name "Irrigation" in 1908, the enforcing agent's name had been changed from the Land Improvement Association to the Farmland Improvement Association, but it had taken care of irrigation facility management consistently until 1999. From 2000, the management system was largely changed - for instance, a government investment organization called the "Agricultural Development Corporation" (changed to "Korea Rural Community Corporation" in 2006) took the responsibility. In addition, the traditional principle of beneficiaries' burden was eliminated from 2000 and it became a government management system in which all the cost for facility management is covered with government subsidies and the corporation's income.

After independence, irrigation projects were conducted for 10 years and a cultivation project with government subsidies was adopted for the first time in 1957. In 1965, the land rearrangement project was adopted as government-subsidized project after 20 years of independence. When the land rearrangement was started, there was no need for it because of a rich labor force in farming villages; they tried to avoid or resist it. After 3 years, farmers started to feel the need for it and the demand skyrocketed from the beginning of the 1970s. Government-oriented projects eventually became projects favored by farmers.

In 1970, the goal was set and the cost was estimated for agricultural water development project established due to extreme drought in the Yeongnam & Honam areas from 1967 to 1968, and it was decided that the massive development cost couldn't be covered by a domestic fund, so they tried to obtain a foreign loan. It was achieved in 1969, and a large-scale development project (the "Large-scale Agricultural General Development Project") was launched in the form of general development including agricultural water, reclamation, cultivation, and land rearrangement. This project caused big changes in the system in which only a unit project was conducted for single purpose. In 1975, extensive development was conducted ("Hill Development Project") by changing stair-wise cultivation from the existing dot development method into large-scale complex development, to cope with global food crisis. It was followed by adopting drainage improvement projects as the first fully-government-supported project ever in the history of base arrangement project, to increase food production by extending double cropping. It was a means to secure a food base via hill development to extend absolute farmland, and drainage improvement to extend farmland utilization for increasing food production.

The aforementioned 5 kinds of unit projects lasted for a long time (until the 1980s). In 1994, they adopted a large-block land rearrangement project (initially referred to as land re-rearrangement) to build an efficient farming base using large agricultural machinery by extending the block size from 2-40a to 50-300a whereat the rearrangement was already finished and upland base arrangement project to develop water for upland crops and arrange

agricultural roads. In 1995, the agricultural road extension and pavement project was adopted to extend the width of agricultural roads to 3-5m and pave them for already-rearranged rice fields. In addition to those 9 projects, irrigation facility (including breakwater) maintenance was led by associations using an institutional credit fund (government-guaranteed long-term bond) supported from 1949 but the budget was not fully supported. However, with the aggressive policy to reduce farm families' burdens from 1986, maintenance of the irrigation facilities managed by associations was supported with government subsidies of 70% and a long-term bond of 30% in 1987. It was fully subsidized by the government starting in 1989, and the investment has grown since. It was a political consideration as irrigation facilities were recognized as social overhead capital.

It was not easy to draw results from major unit projects. For instance, mid-/large-scale agricultural water development projects (irrigation projects) that were main projects for production base were resumed in 1946 and slowly progressed until the beginning of the 1950s. There were given a boost with assistance funds from the USA (ICA assistance) from 1953, but it was at a standstill in the 1960s as the support was reduced. However, it was revived with underground water, pumping station, weir, and reservoir development when Korea's property claims against Japan became a new source of finance along with all-weather agricultural water-source development plan in 1965. With the drought in the Yeongnam & Honam areas in 1967-68, people overestimated underground water while looking coldly upon reservoir development projects. So projects focusing on pumping stations, weirs, and underground water lasted for about 10 years while reservoir construction was very limited. However, the reservoir construction was revived as loans from AIR, IBRD, and OECF were introduced to agricultural water development project in 1975, which became a huge opportunity to extend agricultural water. At the time, there was another opportunity in 1981 to develop through the 10-year agricultural water development plan established based on the survey for anti-drought capability of irrigation facilities. The development trend continued until the beginning of the 1990s and they met another chance when the Rural Area Structure Improvement Plan was established in 1991. It was an investment plan for rural area putting 4.2 trillion won for 10 years, until 2001. The plan included 144.41 trillion won (annual average of 1.444 trillion won) of investment for production base arrangement & extension, which is corresponding to the double of investment of 758 billion won in 1991. In other words, production base arrangement was the main focus to enhance the competitiveness of agriculture by improving the structure, before opening up to imports. For the investment plan, as the UR produce negotiation was settled in a lump sum in Dec. 1993 and the WTO system was launched in 1994, it was changed in July 1994 to invest 4.2 trillion won by 1998, which was 3 years earlier than before, and the Special Tax Law for Rural Area was enacted to arrange 1.5 trillion won of finances for the next 10 years, which would be invested to rural areas as the countermeasure to the UR. It was rich year of support fund for rural area.

As a part of the countermeasure for the UR, the investment was concentrated on agricultural water, drainage improvement, large-scale general development, land rearrangement, and maintenance of irrigation facilities since 1995.

As a result of the production base arranged for 60 years, irrigated paddies (which were only 34% in 1955) are now approaching the goal with 78%, and general rice-field rearrangement was finished in 2004, fully achieving the goal. Especially, storing and pumping facilities have been enlarged and even estuary dams were built to store and use the water that escapes to the sea, securing water source for the southwest coastal area. It is 224,946ha of 52 main irrigation facilities built after independence (corresponding to 54% of 416,196ha which is the total irrigation area of mid-sized agricultural water development). Meanwhile, it will take 4-7 year from 2008 for the remaining projects of agricultural water development (medium), large-scale general development, and reclamation that are continuous projects (estimation based on the investment size in 2007) and the area developed will increase by 170,000ha.

2. Performance of Large-scale General Development Project

2.1. Agricultural Production Base

From 1968, foreign loan capital was introduced for large-scale agriculture general development project so the IBRD loan project was launched for the Keum River & Pyeongtaek districts from 1970 until now.

By 1977, 30,567ha of in the Keumg River & Pyeongtaek districts were turned into all-weather farmland; from 1979, 38,107ha in District 1 of the Yeongsan River, Gyeongjoo, and Geyhwado districts were turned into all-weather farmland; and by 1989, 18,806ha in the Changnyeong, Imjin, Nam River, and Nakdong River districts were turned into all-weather farmland, resulting in self-sufficiency of main crops at 1983.

For this project, 14 districts were completed by 1998 securing 1,437 Mill m^3 by constructing reservoirs and freshwater lakes in the upstream and supplying residential, industrial, environmental, and tourism water to the neighboring areas. It was a good condition in which to establish all-weather farmland and to build large industrial complexes such as the National Daebool Industrial Complex. Especially, tourist attractions such as the Gyeongjoo Bomoon tourism complex were built around the large lakes, encouraging the local economy.

It was typical to secure water resources by constructing reservoirs upstream, but this project built estuary dams at the estuaries of large rivers such the Keum River and Yeongsan River establishing freshwater lakes storing about 1 Bill m^3 of water resources. When currently undergoing District II & III of Yeogsan River, Hongbo district, and Saemangeum districts are completed, about 3.2 Bill m^3 of water resources will annually be secured, contributing to community development as well as national development. Meanwhile, with reclamation of public waters, land was extended for 97 thousand ha: 63 thousand ha can be cultivated into outstanding farmland to produce 2.2 Mill bags of rice and the increased water amount expected from 21 districts will be 809 thousand M/T. By improving the agricultural base with 74 thousand ha of land rearrangement and 37 thousand ha of drainage improvement, farming will be easier and farmland will be universal, so 267 thousand ha of all-weather farmland will be established. In addition, thanks to the employment in construction and farming, annually 145.6 Mill job openings will be provided, to increase farm-family income and promote local economy.

2.2. Economy & Society

Agricultural water came to be supplied at the right time reducing the effort for pumping, water collection, and stored-water management to secure agricultural water; production costs were reduced thank to mechanized farming and new agricultural road and land rearrangement, so labor charges were reduced for growing, seeding, farming, rice planting, pest control, harvest, and transportation, and relative savings from hired labor; it is expected for the 14 districts to have annually-increased income of 350.1 billion won in total. As the large-scale agriculture general development project built multi-purpose reservoirs, breakwaters, and estuary weirs, agricultural water as well as residential and industrial water was provided to homes and factories in Gyeongjoo, Pyeongtaek, Sapgyocheon, Yengsan River I, Daeho, and Keum River I districts (1.08 Mill m^3/day). By building access road in addition to estuary weirs, breakwaters, and reservoirs, transportation systems and networks were improved for the target districts as well as the surroundings, resulting in a huge impact on the national economy and local & economical development. The improvement of transportation and the effects are as follows:

With reclamation project for public waters, 97 thousand ha was extended, which is 1.0% of total territory. This is a huge contribution that will be remembered forever. With many ongoing wars between neighboring countries and races to secure every single inch of land, extension of the territory and production land by developing natural resources had more value to the investment elevating the economical impact.

Wages paid to skilled and non-skilled workers had a big impact on the community economy, and it was very helpful to solve national unemployment by using surplus labor

forces from rural areas and solving the problem of seasonal unemployment in rural areas in the process of conversion from an agrarian society to an industrial society. In addition, the impact of the labor-intensive construction method of overall civil-engineering work was higher with the increased employment. The increased employment of large-unit project districts will contribute to increased direct employment of 143.53 Mill people including 89.49 Mill people of 14 already-completed districts and 54.04 Mill people of the districts under construction.

In terms of environmental preservation of rice fields, it was possible to elevate 100% of the effects of environmental preservation of rice fields with conversion of reclamation, upland, and hills to paddy fields and by supplying irrigation water to partially irrigated paddies and rain-fed paddy fields. Typically, a flood season follows a drought season so agricultural reservoirs can store water against floods because the stored water was already used for rice planting in May - July contributing to prevention of flood damage. Against floods, when the 141 thousand ha of already-completed districts are filled with water to a depth of 20cm, 282 Mill m^3 of water can be stored without causing flood damage. The water from the reservoirs and freshwater lakes are used for agricultural, residential, and industrial purposes and the empty space can be used to prevent floods. 45% of water in the rice field passes through the ground (Institute of Agricultural Technology, 1993) contributing to the underground water, which prevents ground subsidence as well as seawater infiltration in the coastal area. The water which is irrigated to rice fields contains fertilizer, agricultural pesticides, heavy metal, synthetic detergent, and organic matter; it is purified while it is staying in the rice field. And it is said that the crops absorb heat and the water evaporation controls the temperature.

Before the project for Anseongcheon of Pyeongtaek, Balancheon, Sapgyocheon, Daeho, and District II of Yeongsan River among the project districts, high tide caused the water to flow backward so farmland or residential areas were flooded, but the effective control of tidal gates after constructing breakwaters and estuary weirs prevented floods for 21,889ha of farmland. By distributing 0.5-3.0ha of farmland per household in Pyeongtaek, Gyehwado, Sapgyocheon, Daeho, and District II of Yeongsan River, they provide the base of farming to 15,935 households. In addition, they provided a new base of living for those who had to leave their hometown because of the project. Relief recipients (1,163 households in Namyang and 1,992 in Gyehwado) reclaimed land.

It is possible to measure visible figures in terms of economics when evaluating the effects of the agriculture general development project, but it is difficult to measure the indirect effects which are bigger and have more restrictions. However, the Asia Development Bank recently tried to measure social and economical effects such as enhanced quality-of-life of community residents using the demographic view which shows who the beneficiaries are

through Project Benefit Monitoring and Evaluation (PBME); economical effect focusing on the benefit; and participation activity or system which is helpful for farmers. With this method, we can see that there are very satisfactory effects of large-scale agriculture general development.

2.3. Culture & Tourism

As reservoirs, breakwaters, and estuary weirs were built, access roads were well connected so that they were able to provide the local residents with water sources, youth centers, recreational and resting spaces for citizens, weekend rural villas, meeting places, water-skiing facilities, boat yards, and fishing spots. Deokdong Dam of Gyeongjoo supplied tourism and residential water to the Bomoon tourism complex, boosting the tourism business.

2.4. Environment

Large-scale agriculture development projects change some natural environments into artificial environments. In other words, natural mud flats or streams are turned into artificial freshwater lakes and agricultural environments cause big changes in the ecosystem, sedimentation, sea, agriculture, and transportation.

2.4.1. Building Agricultural Environment

With large-scale agriculture general development, mud flats and river areas which were low value were changed into freshwater lakes and farmland contributing to stable farming production with fine agricultural environment and vast farmland to which mechanized farming can be applied and securing water resources such as agricultural, industrial, and residential water. In addition, there was drought damage due to insufficient water sources, flood damage with backflowing seawater because of high tide or elevated sea level due to typhoon or tsunamis, resulting in salt damage to crops and facilities, but the reclamation solves those problems, providing safe and comfortable living spaces. Meanwhile, the newly-built freshwater lakes or agricultural ecosystems have contributed to the preservation of natural ecosystems with purification functions for air and water, wetland, underground water, air temperature control, flood control, and providing food and habitat for wild animals.

2.4.2. Creation of New Mud Flat

After the construction of breakwater, there were many changes for the velocity of tidal current and seawater movement affecting the sedimentation environment resulting in the change of coastline. Kimje, Mangyeong, Gimpo, and Kimhae plains, which are granaries,

were mud flats in the very old days but have now turned into farmland; new mud flats were created toward the southwest as time goes by. In addition, there are some cases in which new mud flats were created outside of the breakwaters and so were developed for new reclamation, too. For instance, Kanghwado Island was composed of two islands long time ago but small reclamation has been conducted from 700 years ago, resulting in one island after repeated reclamation and creation of mud flats. For Asan breakwater, Sapgyo breakwater, Keum River estuary weir, and Dongjin River breakwater, wide new mud flats toward the seaside can be found by comparing the maps before/after the construction. In the new mud flat which was created after building Asan & Sapgyo breakwaters, Pyeongtaek port is being constructed. Around Asan bay and Kwanghwado Island, new mud flats have been created, which is very healthy in terms of ecology and sedimentology and can be consistently developed. In addition, new mud flats are being rapidly created out of the Keum River estuary weir, especially around Seocheon. The mud flat on which Saemangeum breakwater is being constructed was newly created after Donjing River breakwater was built about 30 years ago.

2.4.3. Improved Transportation Environment

Estuary areas that are the target of reclamation have unfavorable geographical conditions so the transportation environment is not good, resulting in falling behind and inconvenient lives for the residents. But, with the newly-built breakwater, land transportation environment was considerably improved, providing the base with community development and convenient transportation to the residents. The 1998 survey of traffic for 5 breakwaters including Asan, Sapgyo, Keum River, Yeongsan River, and Yeongam breakwaters showed that the breakwaters provided transportation benefit for 165.4 billion won per year.

2.4.4. Arrival of Migratory Birds & Rare Beasts

After developing reclaimed land, it is very common for the habitat of snipes and coursers, which eat the animals living in mud flat, to be reduced, so they leave.

However, the surroundings of freshwater lakes, farmland, and breakwaters which are built with reclamation provide migratory birds with space; are used by other birds as habitats; and become a space for a new ecosystem for birds in a macroscopic view. In winter, dabbling ducks visit freshwater lakes including Lake Keumgang at the estuary of Keum River, Lake Yeongsan at the estuary of Yeongsan River, Lake Yeongam, Lake Keumho, and Lake Ganwol and Boonam of Cheonsoo bay; egrets and herons visit there in the summer, making it an important habitat for them. In addition, such areas are inhabited by 25 kinds of birds such as little ringed plovers, long-billed ring plovers, wagtails, crakes, common kingfishers, little grebes, and parrotbills.

With many birds arriving and living, the freshwater lake and its surroundings will look beautiful enough to be used as tourism resources. Meanwhile, snipe-coursers started to visit the newly-created mud flat around Asan bay after constructing Asan & Sapgyo breakwater in 1988 and sometimes they number more than 200,000. In Seosan A and B districts, there is the globally biggest habitat for spectacled teal so it was decided to designate it as a habitat for migratory birds. The fact that the stork, which is natural monument No. 199, is living in a main freshwater lake is the result of habitats for rare birds that were established thanks to reclamation.

The outside slope of breakwater a is used as an important habitat for sea otters, according to research in 1993-1995, as in the gap between riprap protections outside of breakwater of Yaksan & Wando districts of Jeonnam Wando. The fact that sea otters, which used to live in the shore cliff, are living in the tideland proves that new ecosystem is being established in the tideland.

2.4.5. Creation of New Fishing Ground

Reclamation removes all the fishing grounds or farms inside the breakwater, but the fishing outside the breakwater is the same or even better than before. For the reclamation of Wando and Yaksan districts of Jeonnam, traditional fishing facilities were gone after the development, but more farms were created in the nearby sea and the production was higher than before. New fishing grounds are being created in the new mud flat which was created after constructing the Keumgang estuary weir, and there is a vast fishing ground outside of Asan and Gyehwado reclaimed lands.

3. Homework for the Future

3.1. Arranging Production Base and Environmental Problems

Since the 1970s, global population has grown rapidly and human activity has spread vastly, affecting changes to the global environment. Resources started to run low, the natural environment started to be damaged, and artificial materials started to pollute nature in the process of production and consumption. Especially, carbon dioxide due to fossil fuel use has contributed to global warming, and it is expected that we will experience an elevated sea level, a rapidly-changing climate, and reduced food production if the situation continues. It is a predominant view that the global warming and water problem will be the biggest issues.

It is said that global warming, reduction of tropical forests, and desertification are the main factors for climate change. Temperature elevation due to greenhouse gas such as carbon dioxide coming from using fossil fuel; decreased carbon dioxide absorption;

deterioration of soil due to excess pasture, farming, and logging; and desertification due to climate change are being found everywhere. Meanwhile, as concerns had been raised since the 1980s in the USA or advanced European countries about the environmental load from farming, the USA reinforced environmental protection regulations such as water resources preservation plans, wetland recovery and preservation plans, and a long-term noncropping program to preserve soil in 1985 & 1990 and claimed sustainable agriculture (reduced usage of fertilizer and agricultural pesticides), and European countries tried to enforce low-input sustainable agriculture and to find measures to coexist with the environment, under the Cooperative Agricultural Policy (CAP) led by EU countries.

The biggest problem for the USA or EU countries focusing on upland farming is the water pollution due to agricultural pesticides or chemical fertilizers, and it is estimated that about 50 Mill people (20% of total population of 248 Mill) in the USA are drinking polluted water. For EU countries, most countries excluding the UK rely on underground water for drinking (70%), and it is known that pollution is caused by excess scattering of stock excreta.

In Korea, the environment was barely valued. Increased and efficient production was the only focus, with the policy to increase production. As the result, scientific principles and mechanization of farming and building chief producing districts with single items were axes for agricultural modernization. However, the environmental problem is being raised. In other words, 1) During the modernization of agricultural technology, safety of produce was damaged and there was excess load for environment (eutrophication of lakes and ground-water level) because of agricultural plastic, massive disposal of plastic, spread of chemical fertilizers and agricultural pesticides, spread of weedkillers, and dioxins from incinerating wastes; 2) During the agricultural base arrangement, block rearrangement caused turning and moving of ridges between rice paddies, small waterways, and soil, and organisms were damaged by electricity from large machinery; 3) Farmland ecosystems have been simplified; resistance against disease and pest injury was decreased; and fertility of soil was consumed due to creating chief producing; 4) Use of oil and synthetic detergents has contributed to water pollution; there was no plan for environmental preservation; water pollution; and waste. These environmental problems across farming villages and agriculture are connected with production base arrangement. If production base arrangement is not conducted because it has a side effect to the environment as mentioned in 2) above, there will be higher damage due to discontinued agricultural activities. This will cause productive damage but also environmental damage. Production base arrangement is the basic means to guarantee agricultural activities and furthermore it guarantees the sustainability and preservation of agriculture and farming villages contributing to the society.

Agriculture & farming villages contribute to preservation of national land and environment: 1) Flood control, 2) Developing water resources, 3) Preventing soil erosion, 4) Preventing landslide, 5) Air purification, 6) Preserving biota; and 7) Health & resting. Recently, these functions have been economically calculated. For Japan, the evaluated amount by General Agriculture Lab of Ministry of Agriculture, Forestry, and Fishing was 6,878.8 Bill Yen/year, corresponding to 65% of agricultural production.

3.2. Direction of Base Arrangement Considering Environment

For the past 60 years, production base arrangement aimed to guarantee water supplies and drainage and to build a mechanized farming base, to enhance agricultural productivity. The only beneficiaries were farmers. Based on agricultural water or land rearrangement, they aimed for a plain area with good conditions and focused on extending the project quantitatively, and 20-30% of working expenses were paid by the farmers; beneficiaries had to pay for the maintenance. However, it is necessary to establish a new arrangement policy while preserving the arrangement of good farmland and general arrangement of unfavorable areas for sustainable agriculture, for production base arrangement. With these 2 factors, it is necessary to find a supporting policy while integrating or re-classifying the projects so far. For instance, if projects belong to medium mountainous areas such as agricultural water, drought measures, land rearrangement, upland base arrangement, and agricultural roads, the projects can be integrated, or the standard or supporting policy can be differentiated. For maintenance of good farmland, modernization of management facilities, re-arrangement of the plan, or an integrated management plan can be considered.

Especially, the farmland of medium mountainous areas has low productivity and requires excessive investment for the arrangement, but appropriate arrangement is essential for preservation of national land or environment. Considering the preservation policy of Europe for mountain agriculture or boosting medium mountainous area of Japan, we need to set certain policies. It is important to find various arrangement plans focusing on the public function of agriculture, not on standardized rules or economic feasibility.

Without especially political consideration for the unfavorable areas, agricultural & farming village arrangement of a medium mountainous area will be limited in terms of economic feasibility or efficiency. There can be various plans for the unfavorable areas by country; recent trend shows that supporting plan is established in terms of environment preservation. However, it is important to focus on Japan, whose supporting plan for medium mountainous area is focusing on base arrangement despite that the degree of food self-support is 30%, and 30% or more of rice fields are upland cropping. Our future plan will need to separate the agricultural & farming village plan for unfavorable areas and add various details seeking new project system. For instance, the ‘Special arrangement project

for unfavorable areas' can include 1) General arrangement project for production base, 2) Farmland preservation project for paddy rice fields, and 3) Farmland arrangement project. Therefore, advanced research will be essential in terms of system and technology. Based on this, a pilot project will be launched and extended as a main project.

3.3. Agriculture Water Utilization System Restructuring Plan

Instead of embarking on new developments based on rain-fed rice paddies, agriculture water supplies should more effectively provide waters to the below-average regions of 197,000ha and the rain-fed rice paddies within the agriculture promotion region from the already-developed water resources. The water supply systems for various purposes including upland crops, horticulture, livestock, living, environments and water supplies for tourisms should be provided in response to the changing demands of various income-producing industries in addition to rice-dependent farming. The Ministry of Agriculture has declared 464 water supply regions nationwide to systematically develop agriculture water supplies, to effectively distribute and set up a system to preserve and maintain farm environments in 1991. The water supply region's typical area is on average about 19,500ha; too vast to undertake the program per region. Therefore, it is necessary to restructure the water utilization systems per units suitable for water supply and drainage system as 500ha, per TM/TC and according to mid or large scales, except for small-sized water supply regions.

Table 8-1 | Agriculture Water Utilization Control Systems Restructure Concept and its Characteristics

Items	Existing water development programs	Authority reshuffle programs
Development means	Development per small- / mid-scale regions or unit programs • Water supply areas expansion-focused development → rain-fed paddy-focused water supply development	Development per unit or region Multi-purpose water development per water supply region units → well irrigated paddy-focused development in promotion regions
Water utilization	• Water utilization per unit structures • rice paddy-focused water supply system → water supply distribution per facility and reserve utilization	Water utilization per region Multi-purpose water supply utilization → effective use of water, distribution and ease of reserve utilization
Maintenance	Maintenance per unit facility → management staff, increase of cost and difficulty in disaster response	KOWACO and assistant KOWACO interfaces and merge small water facilities → reduction of maintenance costs and enhanced capability in disaster response
Program cost	Small-/mid-size reservoir: 1M won/ha	Small-/mid-size reservoir: less than 1/2

There are risks in maintaining both small- and mid-sized water systems spread over farming areas nationwide during the times of frost and flood damages. This needs to be combined and restructured via remodeling the existing small-sized water supply systems and achieve effective water utilization, maintenance, cost reduction and resolve disaster risks.

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