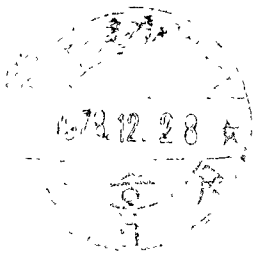
NAL REPORT
ECEMBER 1978

EVALUATION STUDY ON SMALL AND MEDIUM SCALE IRRIGATION PROJECT UNDER IBRD LOAN



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Evaluation Study on Small and Medium Scale Irrigation Project

Contents

I. Agricultural Development Policy and Irrigation Investment

1. Prior to 1945

Agricultural policy before 1945 was part of the Japanese colonial economic policy in the Japan's own interest. Two major objectives pursued in agricultural policy were increased production of food and raw materials to satisfy her growing demand.

In order to increase food production in Korea, a series of rice production plan were initiated. The first rice production plan was formulated, upon completion of the cadastral land survey, to cover the period 1918-26. Major target in this plan was to increase rice production by 1.3 million M/T. Measures were taken to improve and expand irrigation facilities and to convert irrigable upland into paddy land. Waste land and tideland conversion projects were implemented. Improved variety of crop seeds and chemical fertilizer were distributed. A total of 63 million yen was provided as direct subsidy and 75 million yen as credit loan to implement various projects.

As a result, many advanced agricultural practices were

adopted by farmers and the level of agricultural production was increased. However, compulsory measures used by the Japanese authorities created much resentment on the part of Korean farmers. Moreover, the class of land lord showed more interests in farmland speculation rather than in increased farm production, mainly because of high rental rate. Failure in meeting production target necessitated formulation of the second rice production plan.

The second rice production plan was launched beginning 1927 with a target of 1.2 million M/T increase in rice production. A total of 325 million was invested to expand and improve irrigation facilities for 350,000 na of paddy land. A nation-wide quasi government organization called the Korean Agricultural Association was organized in 1926 to undertake various agricultural programs throughout the country. But the second rice production plan was suspended midway in 1930 because of a sharp drop in rice prices in Japan due to the Great Depression. An increase rice production in Korea lost its relative importance. The third rice production increase plan was formulated in order to meet growing demand due to Japan's military expansion and successive involvement in World

War II. The Japanese colonial authorities in Korea enacted several control measures to secure adequate food supplies and to make possible continued exports of rice to Japan. The free market for grain was completely closed down with compulsory grain delivery quotas assigned to all farmers and all consumers were rationed. A series of these compulsory measures, especially low purchase prices paid to farmers, had a negative effect on rice production efforts and resulted in a shortage of rice in Korea. To fill this gap, cheap cereals, such as millet, corn, and sorghum, were imported from Manchuria.

Along with the efforts for increased food production, Japanese government emouraged farmers in the southern part of Korea to cultivate cotton under the "cotton production increase plan" in the interest of the cotton textile industry in Japan. With Japan's occupation of the production increase in Korea naturally received less attention. Sericultural production and livestock propagation, particularly propagation of Korea native cattle, were two other fields of development that were emphasized during the Japanese occupation.

While Japanese interests in developing Korean agriculture may have been based on selfish motives of colonial exploitation

- to produce as much food and industrial raw materials as possible so as to meet her own needs - it can not be denied that various measures such as introduction of improved crop varieties, improved cultivation methods, dissemination of chemical fertilizers and improvement of irrigation facilities made contribution to fostering the productivity of Korean agriculture.

2. During the 1945-61 Period

The U.S. military government replaced the Japanese colonial government in August 1945 and took over the colonial administrative system without modification. Amidst social confusion after the Liberation from Japanese rule, the U.S. military government was obliged to concentrate all its efforts on maintaining social order and the major emphasis in economic policy, if any, was directed toward reducing post-war inflationary spiral. There were no policy or program designed to expand farm production. It was mainly concerned with securing and adequate flow of food-grain supply for urban consumers out of current farm output or through importation of foreign grain. Government investments and loans to agriculture was severely limited by small budget. Maintenance of the existing irrigation facilities and

importation of a part of required fertilizer were about all the measures taken in the agricultural sector.

With the establishment of the Government of the Republic of Korea in 1948, considerable efforts were made to shift from colonial policy to a new agricultural policy. The most notable was land tenure reform carried out under the Land Reform Act enacted in June 1949. Under the land reform program the absentee land ownership was eliminated and land ownership was placed in the hands of operaters. This reform had a significant impact not only on agriculture but also on the overall economy. In 1950, the Grain Management Law was legislated to replace a compulsory rice collection system by a government purchase system at the government determined prices. The coercive methods of rural guidance practiced by Japanese authorities was abandoned to give way to a voluntary-oriented guidance methods.

Public investment and loans in agriculture started in 1949 when the government formulated the economic rehabilitation budget based on the counterpart funds generated by the U.S. aids delivered by the Economic Cooperation Administration (ECA). But the investment of these counterpart funds were withheld and a major part of it had to be spent on combatting runaway

inflation of those days. Under the economic stabilization program formulated in 1950, counterpart funds were again to be used as a source of government investment and loan projects. But the whole stabilization program was suspended due to the outbreak of Korean War in June, 1950.

Following the outbreak of Korean War, the general budget expenses almost tripled over that of the previous year, with a total of 235.6 million won. Government finance was shifted to a war time system and defense outlays totaled 132.4 million won or 56.2 percent of the total budget expenditures. Agricultural sector received only 6 million won or 2.5 percent. But the special account for grain management was settled at 113.1 million won and the special account for land reform at 12.8 million won, a sharp increase from the previous year. Securing of military grain and the distribution of relief grain to refugees emerged as one of the priority issues at the time. The annual quantity of rice needed for government distribution was estimated as about 600,000-700,000 M/T. Due to the enormous wartime budgetary requirement, resulting monetary inflation and upward spiraling of grain prices, the government was obliged to discointinue the direct purchases of rice from farmers.

Instead, an attempt was made to secure rice by means of farmland reimbursement for farmland distributed to tenants at the time of land reform. These two special accounts continuously increased with an expansion of wartime budget scale and agricul tural investment and loan programs had relied for financing sources chiefly on these two special accounts during the 1950-53 period.

With the armistice agreement signed in July 1953, policy emphasis was shifted from wartime efforts to recovering from the war damages, building new plant facilities and alleviating the soaring in the general prices. Beginning from 1954, the Korean economy entered a phase of rehabilitation and various economic programs were actively launched under the U.S. aid policy. The emphasis in the U.S. aid policy to Korea changed from aid relief purposes to economic development and financed the imports of raw materials and capital equipments. Major sources of public investments and loans were grant aids from the Foreign Operation Agency (FOA) and counterpart funds of the U.S. grants usable under the Korea-U.S. agreement on the Combined Economic Board (CEB) for Economic Rehabilitation and Financial Stabilization Program concluded in 1953 and the

special account for economic rehabilitation established in 1954

Beginning 1955 the overall economic policy was subjected to a drastic change with the signing of the U.S. Farm Surplus Importation Agreement. The U.S. farm products imported under this agreement were wheat, barley, raw cotton, corn, sorghum and tallow, of which wheat and barley accounted for about 50 to 60 percent of the total value of imports. The sale proceeds of these imported commodities in the domestic market were formed into the "Counterpart Funds," which enabled the Agriculture Bank to establish an agricultural production loan fund amounting to 39 million won and also a rice lien program.1/

In 1958, the Agriculture Bank was established and entrusted with financing from enterprises and farmers as the sole credit

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1/ The rice-lien program is analogous in principle to the non-recourse price-support loans made by the Commodity Credit Corporation in the United States. The government is authorized to provide nonrecourse loans and is required to buy rice used as security for the loans whenever the borrowers wish. This program was initiated as one of the measures to prevent a sharp decline in the price of rice at the harvest season. The loan rate ranged from 65 to 90 percent of the government purchase prices.
The program was considered quite successful in that it enabled farmers to borrow money on rice after harvest and redeem or sell later when the price was seasonally higher. Because of the increasing difficulties of securing loan funds from the Central Bank, the program was discontinued in 1968.

institution in rural areas. The office of Agricultural Extension was organized to assume the responsibilities for the development of improved farm technology. The five-year food production plan was formulated to be carried out for the period 1958 through 1962. Subsidies and loans were provided to farmers for increased food production. Irrigation and land improvement systems were readjusted so as to alleviate farmers' conplaints by reducing water fee.

The student uprising in April 1960 put the country into political and economic confusion, and the implementation the five-year food production plan had to be suspended. After the government of the Second Republic was born in late 1960, the five-year food production program was resumed with a major emphasis upon expansion of irrigation facilities.

Despite various efforts made for farm development programs, farm policies during the fifteen-year period from 1945 to 1960 did not bring forth any distinctive improvement in the rural sector. As the government put higher priority in the rehabilitation of industrial sector and general economic stability, imbalance between rural and urban sector had even widened during this period.

3. During the First Five-year Economic Plan Period (1962-66)

A shift in the economic policy was made under the First Five-year plan (FFYP) formulated shortly after the military revolution in May 1961. Emphasis was shifted from rehabilitation and stability to expansion and this had a direct effect upon agricultural development.

The basic goal of the plan was to eliminate the vicious circle inherent in the underdeveloped economy and to build an foundation to attain self-sustaining economy. The agricultural policy geared to such economic goal included:

(1) development of viable farm units through regional farm development; (2) expansion of abrable land and pastures; (3) maintenance of the prices of farm products at reasonable level; (4) promotion of livestock industry; (5) development of forestry resources; and (6) fostering of farm organizations of various levels.

In actual implementation, however, the above policies were not fully put into effect due to various constraints. The creation of optimum farming units with adaptable farming pattern was stalled entirely because such a comprehensive program could not be undertaken with an average farm holding of less than one

hectare. Subsistence farming and incefficient use of land were the primary restraints. The idea of abolishing the ownership ceiling of three hectores was intermittently suggested with a view to expanding farming scale, but this was never realized. The policy of supporting the prices of farm products at the reasonable level could not be implemented due to funding difficulties, and contrary to the original intention, emphasis was rather shifted to maintaining farm prices, particularly rice prices, at low level in favor of urban consumers. Specific policy action was not taken to develop large scale commercial livestock farms. Major constraints were limitted feed resources and lack of transportation, processing and marketing facilities However, the various measures for institutional reform undertaken by the military government in the early 1960's deserve high mark in the history of agricultural development.

The most noticiable is a program to liquidate the usurious debts of rural areas to relieve farmers and fishermen of heavy debt burden. The Law on Settlement of Usurious debts of Farm

and Fishing Communities was enacted in 1961,[2/] and new Agricultural Cooperatives Law was promulgated to merge the Agriculture Bank into the National Agricultural Cooperatives Federation and integrated cooperative marketing and agricultural credit services. The Office of Agricultural Extension and the Bureau of Community Development were merged to create the Office of Rural Development under the Ministry of Agriculture and Forestry.

In addition to reforming various centeral machinery, the government launched various programs to boost agricultural production, including expansion of irrigation facilities, slope land reclamation by bench terracing methods, increased supply of fertilizer and pesticides, and strengthening of agricultural researches and extension services.

A total of 10.0 billion or 22.2 percent of the total agricultural investment was allocated for expanding and improving irrigation facilities. A total of 53,000 ha of paddy land was

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2/ According to this law, all loans with interest rates exceeding 20 percent per annum should be reported to the authorities. A total of 4.8 billion won was reported in loans by the end of 1961, of which 2.5 billion won was declared as usurious. Credit debentures were issued to creditors by agricultural cooperatives for their receivable loans. The debtors were required to repay their debts to agricultural cooperatives on the installment basis.

brough under irrigation during the plan period. Planted rice area classified as fully irrigated increased from 682,000 ha in 1962 to 729,000 ha in 1966. Despite the government's efforts to expand irrigated paddy fields, poor quality of irrigation and drainage facilities were still major constraints to increasing yields and expanding the double cropped area.

Beginning 1964 paddy consolidation projects assumed increasing importance. These projects involve consolidation of small irregularly shaped paddies into single, larger units of uniform shape. They include improvement of irrigation and drainage ditches, installation of on-farm water control structures and construction of feeder roads to provide better access to fields.3/ In 1965, the government invested 85 million won to consolidate 18,000 ha of the existing paddy land and in 1966 the investment outlay was increased to 188 million won to carry out the project on 19,500 ha of paddy land.

Tideland development and slopeland development projects

3/ The first trial projects were carried out in Kyongsang-Puk Do (province) in 1963 on approximately 6,000 ha of the existing paddy land under the financing of local government. Having received favorable reactions from farmers, the government decided to expand the project on the national scale providing direct subsidy.

were also intensively carried out during 1962-66. A total of 2.6 billion won or roughly 8 percent of the total investment in the agricultural sector was allocated in order to convert 6,000 ha of tide flat land into paddy. Due to high cost of construction combined with technical difficulties, however, many of the projects were stalled on the way and left uncompleted to await later undertaking.

(Table 1-1) Total Investment and Loan During the First Five-Year Plan Period (1962-66)

Unit: Million Won

	Amount	Component Ratio
Total Government Investment and Loan	170,347	
Agriculture, Forestry & Fisheries	45,185	100.0
Agriculture	33,637	74.4
Improvement of Production Basis	14,600	32.3
Irrigation Facilities	10,035	22.2
Land Consolidation	273	0.6
Slope Land Reclamation	1,726	3.8
Tidal Land Reclamation	2,566	5.7
Agricultural Production Increase a/	7,616	16.9
Cash Crops	609	1.3
Sericulture	1,404	3.1
Livestock	1,971	4.4
Agricultural Experiment & Extension	1,970	4.4
Agricultural Mechanization	765	1.7
Others	5,467	12.1
Forestry	4,633	10.3
Fisheries	6,555	14.5

a/ Includes development of new varieties supply of fertilizer, lime pesticides, farm machineries and other production materials.

Source: Ministry of Finance, Summary of Financial Implementation for FY 1962-66.

(Table 1-2) Total Investment and Loan During 1964-66.

Unit: Million Won

	Investment		Loan		Total	
	Amount	Component Ratio (%)	Amount	Component Ratio (%)	Amount	Component Ratio (%)
Total Government Investment and Loan	95,872		19,982		115,864	
Agriculture, Forestry & Fisheries	23,011	100.0	7,708	100.0	30,719	100.0
Agriculture	16,895	73.4	5,978	77.6	22,873	74.5
Improvement of Production Basis	8,961	38.9	1,699	22.0	10,660	34.7
Irrigation Facilities	5,936	25.8	774	10.0	6,710	21.8
Land Consolidation	273	1.2	-	-	273	0.9
Slope Land Reclamation	329	1.4	925	12.0	1,254	4.0
Tidal Land Reclamation	2,423	10.5	-	-	2,423	7.9
Agricultural Production Increase[a/]	1,933	8.4	1,736	22.5	3,669	11.9
Cash Crops	236	1.0	92	1.2	328	1.1
Sericulture	911	4.0	203	2.6	1,114	3.6
Livestock	367	1.6	270	3.5	637	2.0
Agricultural Experiment & Extension	1,356	5.9	-	-	1,356	4.4
Agricultural Mechanization	757	3.3	8	0.1	765	2.5
Others	2,374	10.3	1,970	25.6	4,344	14.1
Forestry	2,752	12.0	360	4.6	3,112	10.1
Fisheries	3,364	14.6	1,370	17.8	4,734	15.4

a/ Includes development of new varieties supply of fertilizer, lime pesticides, farm machineries and other production materials.

Source: Ministry of Finance, Summary of Financial Implementation for FY 1962-66.

(Table 1-3) Fully Irrigated Paddy Area, 1962-66

Unit: 1,000 ha

Year	Annual by Developed Area	Accumulated Area (A)	Total Paddy Land (B)	Ratio (A/B)
	ha	ha	ha	%
1962	17.3	682.4	1,223.1	56
63	1.2	683.7	1,228.1	56
64	2.1	685.8	1,261.1	54
65	15.4	701.2	1,286.2	55
66	27.8	728.9	1,287.1	57

Source : Ministry of Agriculture & Fisheries

(Table 1-4) Paddy Consolidation Project

Unit: ha
Million Won

Year	Annual Development	Accumulated Area	Ratio to Total Paddy %	Investment & Loan
Before 1964	38.1	38.1	3.0	-
1964	6.0	44.1	3.5	-
1965	17.8	61.9	4.8	85
1966	19.5	81.3	6.3	188
Total '64-'66	43.2	-		273

Source : Ministry of Agriculture & Fisheries

4. During the Second Five-year Economic Plan Period (1967-71)

The First Five-year Economic Plan was followed by the Second Five-year Plan beginning 1967. The basic goals enunciated in the plan were 1) to modernize the industrial structure and 2) to accelerate the economic growth so as to attain the self-sustaining economy. The agricultural production was planned to grow at an annual rate of 5 per cent during the plan period. The major objectives in the agricultural sector were an adequate supply of food and enhancement of social and economic position of farmers.

Included in the development measures were; 1) Increased foodgrain production and attainment of self-sufficiency in staple food by 1971, 2) development of intensive farming areas under a principle of suitable-crop-for-suitable-area, 3) farm price support so as to provide greater incentives for increased production, 4) promotion of livestock industry through stable supply of feeds, and 5) Increased agricultural exports by promoting production of exportable farm products.

In order to strengthen the legal foundation in the implementation of various farm policies and programs, the government enacted the Basic Agricultural Law in 1967. Investment and

loans budget for the agricultural sector had been substantially expanded in its scale. During the plan period the total amount of investment and loans in agricultural sector was 199 billion or 26 percent of the overall government investment and loans outlays, which compares with 27 percent in the First Five-year Plan. In the agricultural sector, the highest priority was given to the land and water resource development projects. The called for a massive increase in investment in these projects. Of the total investment budgets allotted for the agricultural sector, land and water resource development projects received 46.2 billion won or 23 percent. Construction and improvement of small irrigation systems were by far the largest program, accounting for about 70-80 percent of the total investment and loans in the land and water resource development projects in most years during the plan period. Large scale development projects did not become important until 1971 and 1972 when large investments were initiated for the Pyongtack-Gumgang irrigation projects. Following severe droughts and water shortages in 1967 and 1968, the government embarked on tubewell construction in massive scale in 1969 and 1970. Some wells were successful in supplying water but most were not, because they were generally shallow and dependent upon surface water, but

both surfact and shallow underground sources were dry in many areas. Emphasis was also placed upon improvement and repairing of the existing irrigation facilities.

As a result of the intensive investment in irrigation projects. Planted acreage of rice paddy classified as irrigated increased from 731,000 ha, or 61 percent of the total paddy area in 1966, to 868,000 ha or 74 percent in 1971, the target year of the plan. Nevertheless, the total paddy has not increased significantly despite investment made to convert upland into paddy fields because of loss of paddy land to highways, urban and industrial plants.

Government financial support was also given to paddy consolidation, upland reclamation and tideland development projects. Original targets were to perform consolidation work on 200,000 ha of existing paddy fields, to develop 20,000 ha of tideland into paddy land, and to bring 126,000 ha of hillside land under cultivation by 1971. But actual performances in these projects has lagged much behind the original target in the plan. Major emphasis was placed upon on the expansion of irrigation facilities so as to free farmers from drought damages by providing stable water supply. A total of 95,000 ha of paddy land was

(Table 1-5) Total Investment and Loan During (1967-71) the Second Five-Year Plan Period

Unit: Million Won

	Investment		Loan		Total	
	Amount	Component Ratio(%)	Amount	Component Ratio(%)	Amount	Component Ratio(%)
Total Government Investment and Loan	627,076		142,727		769,803	
Agriculture, Forestry & Fisheries	138,824	100.0	59,944	100.0	198,768	100.0
Agriculture	106,893	77.0	45,708	76.3	152,601	76.8
Improvement of Production Basis	34,711	25.0	11,292	18.8	46,003	23.1
Irrigation Facilities	28,807	20.8	8,169	13.6	36,976	18.6
Land Consolidation	2,382	1.7	-	-	2,382	1.2
Slope Land Reclamation	130	0.1	3,073	5.1	3,203	1.6
Tidal Land Reclamation	3,552	2.6	50		3,602	1.8
Agricultural Production Increase[a/]	13,328	9.6	14,847	24.8	28,175	14.2
Cash Crops	932	0.7	2,475	4.1	3,407	1.7
Sericulture	3,260	2.3	2,900	4.8	6,160	3.1
Livestock	3,425	2.5	5,063	8.4	8,488	4.3
Agricultural Experiment & Extension Service	6,937	5.0	465	0.8	7,402	3.7
Agricultural Mechanization	4,708	3.4	4,107	6.9	8,815	4.4
Others	39,592	28.5	4,559	7.6	44,151	22.2
Forestry	15,472	11.1	892	1.5	16,364	8.2
Fishries	16,459	11.9	13,344	22.3	29,803	15.0

a/ Includes development of new varieties supply of fertilizer, lime pesticides, farm machineries and other production materials.

Source: Ministry of Finance, Summary of Financial Implementation for FY 1967-71.

(Table 1-6) Improvement of Production Basis

Unit: ha

Year	Irrigation	Land Consolidation	Slopeland Reclamation	Tidal Land Reclamation
1967	15,000	23,246	16,785	
1968	1,481	15,972	13,500	
1969	228,392	13,527	7,690	
1970	83,444	15,380	2,953	342
1971	14,000	26,907	1,137	846
Total	342,317	95,032	42,065	1,188

Source : Ministry of Agriculture and Fisheries

(Table 1-7) Irrigation Project

Unit: Area in ha
Cost in Million Won

Facilities	1968		1969		1970		1971		Total	
	Area	Cost	Area	Cost	Area	Cost	Area	Cost	Area	Cost
Tube well	1,411	99	97,744	3,403	27,522	981	-	-	126,677	4,483
Infiltration Gallery	13	2	58,205	4,253	24,111	2,130	1,855	392	84,184	6,777
Pumping Station	-	-	18,149	2,579	39,111	2,181	4,399	1,623	26,459	6,383
Feed Canal	-	-	8,438	422	1,355	102	1,458	178	11,251	702
Weir	-	-	7,515	502	3,107	494	1,420	361	12,042	1,357
Reservoir	37	6	15,098	3,057	10,333	4,125	6,203	3,497	31,671	10,685
Sub-Total	1,461	107	205,149	14,216	70,339	10,013	15,335	6,051	292,284	30,387
Supplementary Irrigation & Drainage (Reclaimed Tideland)	20	2	23,243	2,347	13,105	1,338	4,865	2,062	41,233	37,564
Total	1,481	109	228,392	16,563	83,444	11,351	20,200	8,113	333,517	5,749

rearranged, a total of 42,000 ha of hillside land reclaimed and 1,200 ha of tideland was developed into paddy land during the plan period.

Effects were also directed toward introduction and diffusion of improved varieties of major crops, such as rice, barley and soybean, in the farm area. A seed improvement program was expanded and carried out intensively during the plan period. Agricultural research and extension services were continuously expanded to improve farming technology. Increased and efficient application of fertilizer and pesticides were disseminated through agricultural extension services.

5. During the Third Five-year Economic Plan Period (1972-76)

During the 1960's, the agricultural sector grew at an annual average of 4.5 percent. This growth was mainly attributable to the increased production of food crops as well as to the development of livestock and fisheries. In spite of the increased food production, the supply failed to keep pace with rising demand. Imports of foodgrains rose from 500,000-600,000 M/T level in the early 1960's to the 2,000,000 M/T level in 1975. Imports of food and feed grains increased from

57 million U.S. dollars in 1961 to 736 million U.S. dollars in 1975, resulting in heavy pressure on the nation's balance of payment position. The growing deficit in food grains was among the most noteworthy changes in Korea's trade in the 1970's. The government became also concerned with growing income disparity between rural and urban households. The growing food deficits and income disparity were two major developments which caused government to put much more emphasis on agricultural development in the Third Five-year Plan for 1972-76.

The annual growth rate envisaged under the plan was 4.5 percent, and the following objectives of development strategies were laid down within the framework of broad objective of balanced development between agricultural and urban industrial sector;

(1) To achieve more equitable income distribution and improve rural infrastructure through rural electrification, farm road construction and housing improvement.

(2) To accelerate expansion of foodgrain production and in particular to achieve self-sufficiency in rice;

(3) To develop land and water resource in order to achieve all weather farming in the future;

(4) To accelerate farm modernization through increased mechanization:

(5) To improve marketing, storing and processing facilities to provide adequate services needed by commercialized agriculture.

The original plan called for investment in the agricultural sector of 470 billion won, nearly 2.5 times as large as during the second plan (1967-71) and eight times as large as during the first plan (1962-66). During the 1972-75 period, a total of 340 billion was invested in the agriculture, fisheries and forestry from the public sector, which accounted for 23.2 percent of the total government investment and loans. Of the total government investments and loans in agricultural sector, land and water development projects received the largest share, amounting to about 94 billion won or 27.5 percent. The development of agricultural water resources has been one of projects most intensively carried out since the Second Five-year Plan started. During the second plan, the government had rather emphasized on small scale irrigation projects, such as construction of weirs, pumping stations and tubewell irrigation. But an emphasis has been shifted to larger scale development

projects for 1972-76, the third five-year plan period.

The integrated plan for Four Major River Basins development was set out in 1971 in order to construct 13 dams and power plants. In addition, afforestation, erosion control projects on watershed areas of the Han, Geum, Nakdong and Yongsan Rivers were also planned. The government planned to invest 560 billion won for these projects during 1971-81, of which 165 billion won was earmarked for agricultural projects on areas of 215,000 ha. The projects for developing multipurpose large-scale farming areas were undertaken in the Geum River and Pyongtack areas, where reservoirs, tidal dikes, water pumping and draining plants and water canals are under construction at a cost of 48 billion won by 1976. The two tidal dikes completed at Asan and Namyang Bays in 1974 are the biggest projects in Korean history of water resource development. The completion of these projects brought 11,000 ha of new-land under cultivation and irrigated 16,000 ha of existing farmlands. Table 15 shows the actual investment outlays for the integrated farming areas development projects for the period 1969-75. During 1972-75, the area of irrigated paddy fields was expanded from 1,030,000 ha in 1971 to 1,078,000 in 1975, covering about 85 percent of the total paddy area.

(Table 1-8) Total Investment and Loan During 1972-1975

Unit: Million Won

	Investment		Loan		Total	
	Amount	Component Ratio (%)	Amount	Component Ratio (%)	Amount	Component Ratio (%)
Total Government Investment and Loan	1,334,813		128,095		1,462,908	
Agriculture, Forestry & Fisheries	280,442	100.0	59,686	100.0	340,128	100.0
Agriculture	244,277	87.1	54,097	90.6	298,374	87.7
Improvement of Production Basis	83,251	29.7	10,376	17.4	93,627	27.5
Agricultural Production Increase	26,428	9.4	-	-	26,428	7.8
Cash Crops	2,782	1.0	2,424	4.1	5,206	1.5
Sericulture	2,832	1.0	673	1.1	3,505	1.0
Livestocks	4,889	1.7	879	1.5	5,768	1.7
Agricultural Experiment & Extension Services	6,943	2.5	-	-	6,943	2.0
Agricultural Mechanization	44	0.0	14,982	25.1	15,026	4.4
Improvement of Rural Environment	51,083	18.2	23,553	39.5	74,636	21.9
Others	66,025	23.5	1,210	2.0	67,235	19.8
Forestry	23,020	8.2	450	0.8	23,470	6.9
Fisheries	13,145	4.7	5,139	8.6	18,284	5.4

Source: Ministry of Finance, Summary of Financial Implementation for FY 1972-1975.

Paddy consolidation projects continued to be promoted to facilitate farm mechanization and increase farming efficiency. A total of 28.2 billion won was invested by the government to consolidata 102,000 ha during 1972-75. The total area of paddy fields rearranged under this program amounted to 251,000 ha by 1975.

In order to minimize the transfer of arable land for purposes other than farming, the government enacted the Farmland Expansion Promotion Law in 1974. All the farmlands were classified into two categories; "absolute farmland" and "relative farmland". The law strictly prohibits the use of farmland classified as "absolute category" for other purposes. This measure was inevitable because a significant area of the existing farmland were being lost to urban and industrial plants. Total area of farmland lost to other uses, such as urbanization and industrialization during 1972-75 was estimated roughly as 37,000 ha.

The most noticiable expansion in the field of rural development during 1972-75 was envisaged in the New Community Movement (Saemaul Movement). The scope of participation has expanded to become virtually a national movement in 1973.

(Table 1-9) Government Investment in Large Scale Agricultural Comprehensive Development Project

Unit: Million Won

Year	Domestic Funds	Foreign Loan[a/]	Total
1969	10		10
1970	326	321 (1,018)	647
1971	1,484	1,237 (3,236)	2,721
1972	5,031	3,395 (8,729)	8,426
1973	8,103	7,121 (17,798)	15,224
1974	10,982	6,836 (16,320)	17,818
1975	13,255	8,044 (16,586)	21,299
Total	39,191	26,954 (63,687)	66,145

a/ Figures in Parenthesis are in U.S. Thousand Dollars

Source: Ministry of Agriculture and Fisheries

Emphasis in this movement was shifted from basic projects for improving living environment to income generating projects based on cooperative works among villagers. Farmers were encouraged to carry out productive projects including cultivation of cash crops, raising livestock, repairing river dikes, etc. The government supplier technical and financial assistance to rural communities for improving facilities for education, health, housing, roads, electrification, communication and various other projects to improve rural living conditions.

During 1972-75, the government investment and loans under the category of improvement of rural living environment marked a remarkable increase up to 75 billion won, constituting approximately 22 percent of the total agricultural investment. Of the total amount, 51 billion won or 68 percent was expended as government subsidy and 24 billion or 32 percent as credit loan. Through the implementation of these projects, a total of 41,500 kilometers of farm roads were constructed, the number of rural households benefited from electrification increased to 1,643,000 which means about 65 percent of the total farm households in Korea were supplied with electricity by 1975. In addition, the number of Ris and Dongs (administrative unit comprising averagely

3-4 natural villages) installed with communication net works reached more than 10.000 and 1,595,000 rural households or 77 percent of the total in Korea had improved roofs in 1975.

Farm mechanization received ever increasing attention in the Third Five-year Plan. Rising rural wage rates and labor shortages during peak demand season motivated the government to put increased emphasis on farm mechanization programs. Total employment in agriculture decreased about 5 percent and real wage rates for hired farm workers doubled from 1965 to 1971. Although there were still much under-employment in the rural area during much of the year, labor shortages during peak labor periods were becoming more acute.

II. Responsible Organization for Irrigation System

1. Role of Farmland Improvement Association

As of the end of 1976, the number of farmland improvement associations stood at 127, and the area of irrigated paddy under control of the farmland improvement association covered 380,000 hectares, or 31.3 percent of the total area of paddy fields in Korea. Under the control of the farmland Improvement Associations are 1,055 pumping stations, 1,813 reservoirs and 2,750 weirs. There are also 95 waterways, 354 underground water channels, and 2,517 wells.

The organization, apparatus and operation of the farmland improvement association are not much different from those of the irrigation association during the era of Japanese occupation, and the Land Development Association of the 1960s. As a central body, the association has a Federation of Associations, but this organization functions only nominally, and does not play an active role as in the case of the Union of Land Development Associations of the 1960s.

The Rural Community Modernization Expedition Law, enacted in 1970, recognizes the farmland improvement association as an

independent unit, but actual operation is under the control of the government. The Ministry of Agriculture and Fisheries, the supervisory organization, has delegated part of its supervisory authority to local governments. As prescribed in Article 37 of the Rural Modernization Expedition Law, Article 37 of the farmland Improvement Association regulation, functions assigned to the farmland Improvement Association include irrigation in the regions under its supervision, construction of drainage systems, water control, maintenance and operation of facilities, land consolidation, and auxiliary projects, development of paddy fields and upland fields, and improvement of farming methods. In addition, the Land Improvement Association is responsible for the conservation of farmland, rehabilitation of damaged facilities, and other projects required to help fulfill the objectives of the association. When it is deemed necessary, the Association may commission the Agricultural Development Corporation to carry out some of the project.

Among these one of the most important function for the Association is the maintenance and management of facilities under its control. The maintenance and management of facilities require accurate assessment of the actual conditions of the

facilities, repair and improvement of obsolete or damaged facilities so as to ensure the maximum possible durability and thus full display of their original capacity. Also, maintenance and management concerns modification, improvement and streamlining of the facilities.

In the past member farmers benefitted by the irrigation facilities had been entirely responsible for the funding of the repair and improvement of facilities. However, under the 1972 five-year plan on the improvement and repair of facilities, the government has been financing large-scale projects to repair and improve facilities.

It is virtually impossible to determine accurately the status of obsolescence and operation of the existing facilities. In general, however, the facilities installed after World War II are believed to be well done, but are considerably obsolescent due to lack of repair in scores of years, impeding their function of irrigation and drainage. There are many facilities requiring replacement or completely new work.

During the 1940-45 period, since the Japanese colonial government gave top priority to increased food production to meet wartime needs, the country witnessed the construction of

irrigation and drainage systems far more in number than at any other time. But most of the irrigation projects done during that period were poor due to the wartime lack of materials and capital pinch, thus requiring repair and reconstruction. In particular, most of the motor-powered pumps require complete replacement, since they have outlived their durability.

During the 1950s following the liberation of the country from Japanese colonial rule. much investment was poured into irrigation projects, but political intervention in the selection of projects, coupled with lack of technology on the part of undertakers caused many of the irrigation projects to be poorer in quality than those constructed during the period of World War II. In order to extend the durability of the existing facilities and ensure full function, the government worked out a long-term plan in 1972 to maintain and repair the facilities, but simple projects are done by the members of the Association as part of the Saemaul (new community) movement.

2. Some Problems Relating to Operation

1) Short-term loans

The farmland improvement association requires

operational funds to finance the maintenance and repair of facilities and cover the cost of its own operation all year round. But the membership dues, whichaare the main source of income, can only be collected after harvest, that is, the fourth quarter. In this situation, the association is compelled to obtain short-term loans to meet capital requirements.

In most cases, the short-term loans come from the National Agricultural Cooperatives Federation, and the money is provided in the form of rediscount by the Bank of Korea. The interest rate is the same as on other general loans.

Since 1970 the government has made the grain procurement fund available in advance to the Association, thereby helping reduce the burden of interest rates on the loans. Still, the Association has to bear a considerable burden on payment of interest every year. The debt-servicing burden is reflected in the membership dues, and thus eventually passed on to the member farmers.

Government assistance is required to help the Association stand on its own feet financially without depending on outside funds so as to ensure healthy operation and especially the timely repair and improvement of the facilities.

(Table 2-1) Short-term Loans and Repayment (1970-74)

(Unit: in ₩ million)

Year	No. of Associations	Loans	Amount of Repayment	Interest Rate (%)
1970	237	2,369	2,218	26.0
1971	230	2,656	2,546	24.0
1972	240	3,899	3,958	15.0
1973	121	3,777	3,797	15.0
1974	123	4,732	4,722	15.5

Source: Agricultural Development Corporation

2) Repayment of long-term loans

The finance of the farmland Improvement Association is made up largely of the appropriation of funds for the construction, maintenance and repair of facilities. The fund sources for the outlays for the construction of facilities consist of government subsidies and long-term loans. The money required to pay back the long-term loans and expenditures for the maintenance and repair of the facilities is supplied from membership dues. In case the farmland Improvement Association undertakes the construction of facilities with long-term loans, the farmers who are the members have to bear an additional financial burden

to pay the interest on the loans, in addition to their regular membership dues.

In general, the debt-servicing burden for the long-term loans constitutes the chief cause of the insolvent operation of the association, and this situation is especially acute for small-scale associations. Since the reimbursement involves the equal repayment of principal, the debt-servicing burden is heavy in the initial year of reimbursement, and thus the amount of reimbursement gets smaller with every passing year. However, in the present economic situation involving inevitable price rises, the equal installment repayment including both principal and interest every year will help reduce the burden of the farmers, although the amount of interest as a whole may be greater.

3) Independent accounting system

Under the existing system, differing sub-districts are under the control of the same association, but an independent accounting system allowed for each region. This clogs the channel for interflow of capital within the identicial association.

There is no dispute about such a system, in the sense

that such an independent accounting system is compatible with the principle of giving the burden to the beneficiaries. But there are instances in which one specific sub-district under the control of the same association encounters an unforeseen disaster and is in dire need of funds for emergency repair of facilities, but the repair work is postponed due to difficulty in securing the needed money.

In this light, delegating discretionary power to the competent chief of the association to borrow temporarily the deposits of other sub-districts to prepare for such emergencies will be very efficient in ensuring the timely maintenance and management of facilities as well as smooth operation of unit associations.

III. Economic Evaluation of IBRD - Funded Irrigation Investment

1. General Status of Sample Project District

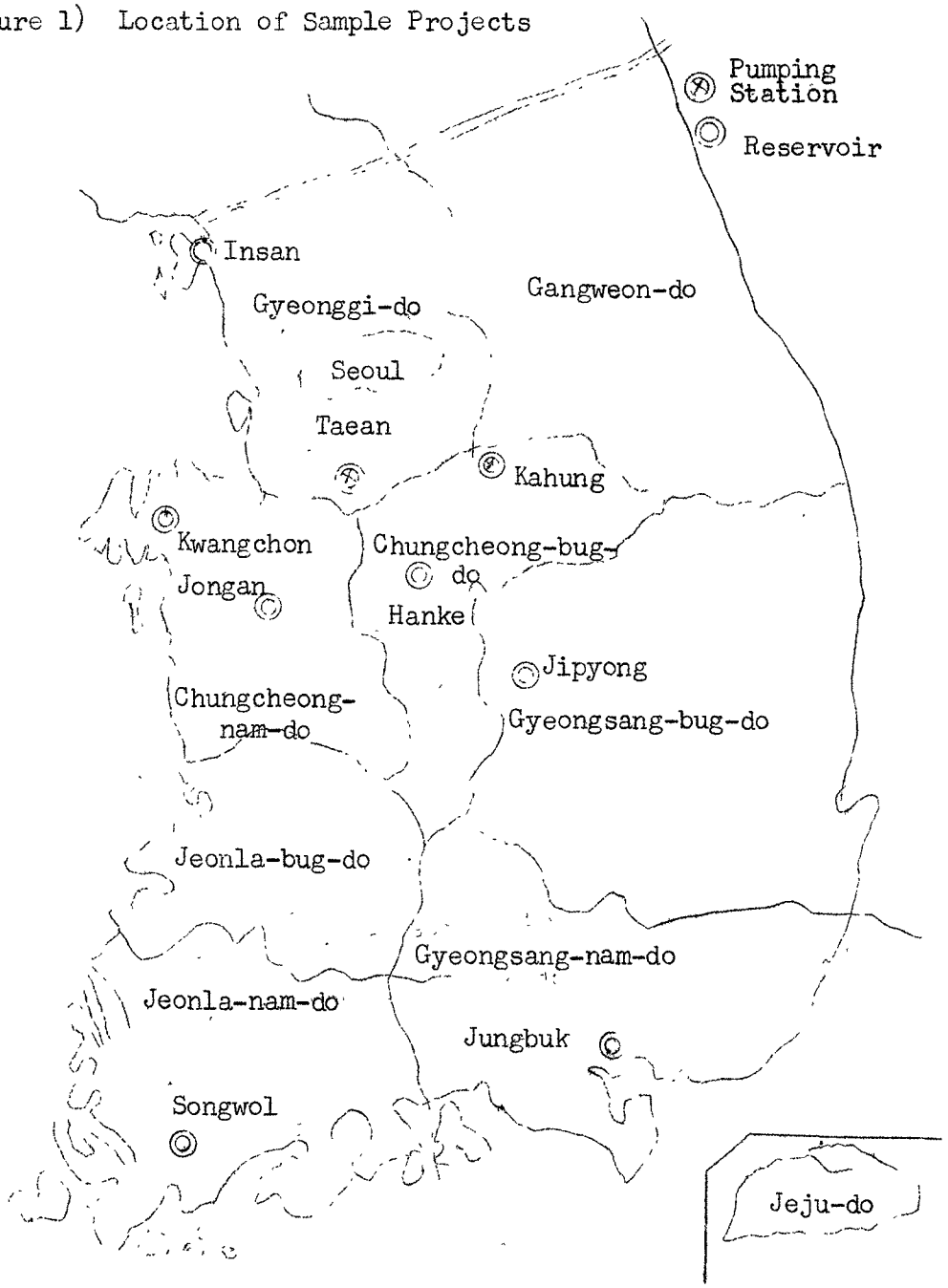
Of the total 61 districts where the IBRD-funded irrigation project was launched, only three areas saw operation of the irrigation facilities in the rice transplanting season of 1977. They are the Taean district in Ansong-gun, Kyonggi-do, the Kahung district in Chungwon-gun, Chungchong-Bukdo, and the Jipyong district in Sanju -gun, Kyongsang-Bukto. In the Interims report submitted in 1977, the effect of the irrigation facilities could not be determined for these three project districts. Therefore, the survey included three additional areas, where the AID-funded irrigation projects similar in nature to the IBRD-funded projects had been completed, in order to obtain benchmark data to analyze the effects of irrigation facilities on the IBRD-funded projects. The three AID-funded project districts are the Jongan district in Kongju-gun, Chungchong-Namdo, the Songwol district in Kangjin-gun, Cholla-Namdo, and the Jungbuk district in Changwon-gun, Kyongsang-Namdo.

But when the second survey was conducted in the summer of 1978, the relevant data regarding 1977 performance with project were available for the above three IBRD-funded projects. In addition, the three IBRD-funded project which come into operation in the summer of 1978 were added in the second survey, though the post-project data were not available. They are the Insan district in Kyonggi-do, the Hanke district in Chungchong-Bukdo, the Kwangchon district in Chungchong-Namdo.

Data on construction progress and project costs were obtained from the Farmland Bureau of the Ministry of Agriculture and Fisheries and from the Farmland Improvement Associations in the project areas. Farm budget data were obtained from 20 farming families selected in each area which surveyers visited for interviews.

The general status of each district are as follows:

(Figure 1) Location of Sample Projects



1) IBRD loan projects

(1) Taean district

This area is located to the north of Ansong, a town on Taedok-myon, Ansong-gun, Kyonggi-do. In other words, it is in the middle farming zone of Kyonggi Province. The area is under the responsibility of the Kiho Farmland Improvement Association. Under the original plan, the irrigation project in this district was to start with an IBRD fund in June 1976 and to be completed by December 1977. But water supply started in the early 1977 thanks to the earlier completion of the pumping station than planned. At present, the irrigat area comes to a total of 430.0 hectares in this district.

In 1976, that is, before the irrigation improvement, there were 100.5 hectares of rice paddies and 329.5 hectares of dry fields, and most rice paddies were not irrigated. There is a total of 357 farming families in this district, and the average size of farm is 1.20 hectares -- 0.28 hectares for rice cultivation and 0.92 hectares for upland crops, which is slightly larger than the national average of 0.94 hectares. The farming population in this district is 2,472, average size of farily being 6.7 persons which is larger than the national average.

According the results of survey, 52.4 percent of the total number of farming families in this district own farmland ranging from 0.5 to 1.0 hectares and the total area of land they cultivate account for 32.9 percent of the total area of land under cultivation in this district. Farmilies possessing land ranging from 1.0 to 2.0 hectares accounted for 40.5 percent of the total number of farming families and the total area of land they cultivate represent 51.5 percent of the total area of land under cultivation, while families owning 2.0 hectares or more are only 7.1 percent of the total number of farming families. This means that families owning less than 2.0 hectares account for 92.9 percent of the total number of farming families in this district.

Rice paddies in this district having been mostly unirrigated, farmers had cultivated varieties of rice requiring relatively little water until the irrigation facilities came into existence. For example, the conventional varieties of rice accounted for 69.8 percent of the total paddy and the Tongil variety 30.2 percent.

The appropriate time for rice transplanting in the Taean area, which is in the central part of the country, is

the period June 21 - 30. The cropping ratio on rice paddies was low at 114.1 percent chiefly because of the farmers' unwillingness to plant the second crop on unirrigated rice paddies.

The yield per hectare is 3390 kilograms in conventional varieties of rice, 4250 kilograms in the Tongil variety and 1930 kilograms in barley, slightly higher than those in other surveyed districts. The irrigation project in this area was scheduled to be completed in two years, at a total cost of ₩475,665,000, of which ₩228,242,000 was invested in 1976 and the rest in 1977. Major products in this area are rice and barley, white beans, cabbage, radishes, potatoes, red pepper and sesame are produced in small quantities.

In 1977, after the irrigation improvement, there were 430 hectares of inigated rice paddies which were dry fields and insufficient irrigated paddies before the project. The average size of farm per household increased from 1.20 hectares to 1.23 hectares, that is, 0.03 hectares increased, because of decreasing of farm households from 357 to 350.

The total farm population decreased from 2,422 persons to 2,318 persons. But population per household were remained unchangedly. Farm households and farm land distribution by the

size of farm land were unchanged through the project. But the planted area of Tongil variety in rice paddies increased remarkably. The conventional varieties of rice accounted for 25 percent of the total paddy and Tongil variety 75 percent with the project, compared with the planted ratio of conventional varieties of rice of 70 percent and Tongil variety of 30 percent before the project. The rate of land utilization decreased because of converting from upland to rice paddy.

The appropriate time for rice transplanting advanced by about 10 days to June 11 - 20. The per hectare yield also increased 3,870 kilograms for conventional varieties of rice, 4,790 kilograms of the Tongil variety. But per hectare yield of barley decreased to 1,270 kilograms because of the severe cold in January in 1977.

(2) Kahung district

The Kahung district is located in the middle farming zone of Chungchong-Pukto and is under the responsibility of the Chungwon Farmland Improvement Association. The water source in this area is the upper stream of the South Han River to the northwest of Chungju and a total of 210.9 hectares was developed into irrigated paddy.

Before the irrigation project was launched in 1976, there were 126.0 hectares of rice paddies and 84.9 hectares of dry fields in the area. Of the 126.0 hectares of rice paddies, 16.4 hectares were irrigated and 109.6 hectares were unirrigated. The average size of farm per farming family was 1.37 hectares -- 0.28 hectares of dry fields and 0.92 hectares of rice paddies, largest of the six surveyed districts. There is a total of 153 farming families with a total farming population of 875, averaging 5.7 persons per family.

Rice is a major crop on paddy though tobacco was grown as a second crop on a few of these paddies. Double cropping ratio on paddy was low at 121.8 percent. Conventional rice varieties accounted for 64.2 percent of the total area of rice paddies and the Tongil variety was only 35.8 percent.

The rice transplanting season in this area lasts 10 days from June 11 to 20. Because of the not very fertile soil and poor irrigation facilities, the yield per hectare was low -- 3050 kilograms for conventional rice varieties, 3950 kilograms for Tongil variety and 2050 kilograms for barley. Dry field crops before the irrigation project were barley, sweet potatoes, sesame, potatoes, radishes, red pepper and

tobacco. The total investment in the irrigation project was ₩230,176,000 -- ₩139,526,000 in 1976 and ₩90,649,000 in 1977.

Of total cost, IBRD-funished materials was ₩21,548,000. The area of irrigated paddy in this project comes to a total of 210.9 hectares which were 126.0 hectares of uncompleted irrigated rice paddy and 84.9 hectares of upland before the project. The area of land under cultivation per farm household was 1.40 hectares. Total farm households and farm population decreased and per household population decreased too. The average per household population were 5.5 persons.

The distribution of farm households and cultivated land by the size of farm was not changed. The planted area of Tongil variety of rice increased remarkably, while the planted area of the conventional varieties of rice in this district decreased as the other districts did. The rice transplanting season in this area advanced about 10 days to June 1- 10, because of the sufficient water supply.

The rate of land utilization decreased to 110.0 percent. The yield per hectare was 3,540 kilograms for conventional rice varieties, 4,540 kilograms for Tongil variety which increased by 15-16 percent, compared with the yield per hectare before

the project. These were slightly lower than those of other surveyed districts. The yield per hectare for barley decreased from 2,050 kilograms to 1,180 kilograms because of the servre cold in winter of 1977.

(3) Jipyong district

The Jipyong area is part of the Kyongbuk Plains located in Hamchang-myon, Sangju-gun, Kyongsang-Pukto. There are no dry fields but rice paddies only in the area. The area is under the responsibility of the Sangju Farm Improvement Association, which operates Jipyong Reservoir for the irrigation of rice paddies in the area. But this reservoir was not sufficient to irrigate all rice paddies in the area and accordingly most rice paddies remained insufficiently irrigated Under the circumstances, it was first planned to expand the reservoir but this plan was later revoked because of many technical problems involved. As a result, a weir was constructed, instead.

The area of irrigated land in this area comes to a total of 105.0 hectares, and the area of land under cultivation per farming family is 0.93 hectares. There is a total of 112 farming families with a population of 782, averaging 6.98 persons per family.

Although this area is located near Sangju, there were no non-farming families and no families in other agricultural lines.

Although rice paddies in the area were not sufficiently irrigated, they were still under the influence of Jipyong Reservoir, and this caused the government to encourage owners of these paddies to grow Tongil variety of rice, which accounted for 72.0 percent of the total area of rice paddies in the district, and the conventional varieties of rice only 28.0 percent. No second crop is grown on rice paddies, and the rice transplanting season in this area is the period of May 21 - 30. The yield per hectare is 3360 kilograms for conventional rice varieties, 4150 kilograms for Tongil variety and 2200 kilograms for barley, slightly lower than those of other surveyed districts.

The irrigation project in this area was to be carried out in two years, 1976 and 1977, and a total of ₩58,068,000 was invested in the project, ₩500,000 in 1976 and ₩57,568,000 in 1977, much lower than the costs in other surveyed areas.

After the inigation project, there was no significant change in total area of rice paddies. Insufficient irrigated paddies were converted into fully irrigated paddies.

The average size of farm land per household increased slightly by 0.95 hectares with the result of decreasing of total farm households in this surveyed district. Farm population with farm households decreased and population per household dropped to 6.7 persons. The ratio of farm households belonged to the size of 0.5-1.0 hectares and 1.0-2.0 hectares increased, and under 0.5 hectares and over 2.0 hectares decreased.

After the project, a significant change was found in the cultivation of Tongil variety, which accounts for 90.0 percent of the total of rice paddies, compared with 10.0 percent of conventional varieties of rice. The rice transplanting season advanced by about 10 days to may 11-20. The rate of land utilization increased as a result of enhanced rate of double cropping system in the rice paddies irrigated. The rate of land utilization was 120 percent. The per hectare yield also increased to 3,690 kilograms for conventional varieties of rice, 4,870 kilograms of the Tongil variety and 1,400 kilograms for barley.

(4) Insan district

This area is located on the small island of Gwang Hwa Gun, Kyonggi-do, the northest district of IBRD project surveyed

areas. Therefore, some special prosperities were seen in this area, compared with other surveyed areas. The main water source in this area is a reservoir and water supply started in the season of rice transplanting in 1978.

Before the project, that was in 1977, there were 100.13 hectares of insufficient paddies. There was a total of 234 farm households. Farm population was 1,036 in this district, average size of family being 4.4 persons which is smaller than the other surveyed areas.

The average size of farm is 0.43 hectares which were consisted of only rice paddies. There was no upland in this area. 45.7 percent of the total number of farm households in this district owned farm land under average size of less than 0.5 hectares, 32.9 percent of farm households possessed the land ranged from 0.5-1.0 hectares, the farm households owned the land between 1.0-2.0 hectares accounted for 15.4 percent, while farm households had 2.0 hectares or more were only 0.4 percent of the total number of farm households.

Rice paddies in this area having been mostly unirrigated, farmers had cultivated varieties of rice requiring relatively little water before the project. Therefore the

planted area of the conventional varieties of rice accounted for 88 percent of the total paddy and the Tongil variety was only 12 percent.

The appropriate time for rice transplanting in Insan area, which is in the central part of the Korea, was the period of June 1-10. There was no double cropping in paddy land in this area. The rate of land utilization was 100 percent.

The average yield per hectare for conventional varieties of rice was 4,200 kilograms and 4,800 kilograms for Tongil variety in 1977. There was no barley cultivation.

The irrigation project in this area was to be performed in three years, 1976, 1977, and 1978, and a total of ₩435,815,000 was invested in this project, ₩215,487,000 in 1976, ₩180,564,000 in 1977, and ₩39,764,000 in 1978. Of total investment, IBRD-funished materials standed for ₩22,559,000.

(5) Hanke District

The Hanke district is located on Gaduk-myon, Cheongwon-gun, Chungchong-Pukdo. The water source is a reservoir and the area of farm land under the influence of this reservoir comes to a total of 202 hectares. The irrigation project in this area was originally undertaken started in 1976 and

completed in the season of rice transplanting in 1978. The total investment cost was ₩395,564,000, of this IBRD-funished materials amounted to ₩26,328,000.

Before the project, there were 131.9 hectares of insufficient irrigated rice paddies, 46.1 hectares of upland and 24.5 hectares of others. The average size of farm land per farm household was 0.37 hectares, that was, 0.09 hectares of upland, and 0.28 hectares of paddy land, smallest of the surveyed districts. There was a total of 479 farm households with a total farm population of 2,824, averaging 5.9 persons per household.

The farm households owning land less than 0.5 hectares accounted for 46.1 percent of the total farm households in this area, and they tilled to 37.0 percent of the total area. 35.1 percent for farm households owning land of 0.5 to 1.0 hectares, accounting for 32.6 percent of the total area, 1.7 percent for farm households owning land more than 2.0 hectares, accounting for 5.2 percent of total land area. Tongil variety of rice accounted for 96 percent and conventional variety of rice accounted for only 4 percent.

The rice transplanting season in this area is the

period of June 1-10, the rate of land utilization was 155.2 percent. The yield per hectare was 3,600 kilograms for conventional rice, 5,000 kilograms for Tongil variety, and 1,100 kilograms for barley.

Major crops for upland in this area were soybean, radishes, potatoes, sweet potatoes, red pepper, tobaco leaves, cabbage, and sesame.

(6) Kwang Chon district

Kwangchon district is located on Gwangchon-myon, Hongseong-gun, Chungchon-Namdo and is under the responsibility of the Hongsong Farmland Improvement Association. The water source in this area is a reservoir and a total of 258 hectares was developed into irrigated paddy.

Before the irrigation project in 1977, there were 233.4 hectares of rice paddies, 23.0 hectares of dry fields and 1.6 hectares of forestry land. Most of the rice field was unirrigated.

The average size of farm per household was 0.66 hectares, that was, 0.06 hectares of upland, 0.6 hectares of paddy land, less than the national average size. There was a total

of 391 farm households with a total farm population of 2,304, averaging 5.9 persons per household. According the results of survey, 40.4 percent of the total number of farm households in this district owned farm land less than 0.5 hectares and the total area of land they tilled accounted for 24.8 percent of the total area of land under cultivation. Farm households possessing land ranging from 0.5 to 1.0 hectares accounted for 43.2 percent of the total number of farm households and the total area of land they cultivated represented 46.5 percent of the total land.

Therefore, this means that 83.6 percent of the total number of farm households in this district owned farm land less than 1.0 hectare and the total area of land they cultivated accounted for 71.3 percent, representing small scale of farm size. Farmers had cultivated Tongil variety of rice mostly in this district as the farmers did in Hanke district in Chung-cheongpuck-do in rice paddies.

The planted area of the Tongil variety of rice accounted for 78.0 percent of the total paddy, and the conventional varieties of rice accounted for 22.0 percent.

Because Gwang Chon district is located in the

middle farming zone of Chungcheong-Namdo, the rice transplanting season in this area lasted 10 days from June 1-10.

Because of the very fertile soil, the yield per hectare was 4,020 kilograms for conventional rice varieties, 4,900 kilograms for Tongil variety, similar to the national average.

Before the project, there was only barley crop which was 1,800 kilograms per hectare in the upland in this area, slightly larger than other surveyed districts.

The total investment in the irrigration project was ₩799,112,000, of this, IBRD-funished materials represented ₩37,436,000. In 1976 ₩361,631,000 was invested, ₩394,442,000 in 1977 and ₩43,039,000 in 1978.

2) AID loan projects

(1) Jongan district

Located in Jongan-myon, Kongju-gun, Chungchong-Namdo, this district is under the responsibility of the Kongju Farmland Improvement Association. Total area of rice paddy receiving water from the reservoir constructed by AID financing is 256.7 hectares. The irrigation project was first initiated by the Kongju Farmland Improvement Association with its own funds in

1968, and the project was completed in 1975 with an AID fund.

Before the project, there were 220 hectares of rice paddies and 25 hectares of dry fields, totaling 245 hectares of land under cultivation. In addition, there were 11.7 hectares of grassland.

The area of land under cultivation per farming family in the area is 0.469 hectares -- 0.42 hectares of rice paddies and 0.048 hectares of dry fields, thus being the lowest of the six surveyed districts because this is a mountainous area.

There are 522 farming families with a total population of 4,278, averaging 8.2 persons per family, the highest of the six surveyed districts. In addition, there also are non-farming families of civil servants, daily laborers and others, which account for 15.1 percent of the total number of families. Moreover, families engaged both in agriculture and other lines represent 1.1 percent of the total number of families.

Conventional varieties of rice accounted for 75.9 percent of the total area of rice paddies in the area and the Tongil variety 24.1 percent. Growning on dry fields were barley, beans, sweet potatoes, sesame, radishes, potatoes and

red pepper. The use rate of farmland was 129.3 percent. The rice transplanting season is the period of June 11 - 20.

The yield per hectare is 3,430 kilograms for conventional varieties of rice, 4,210 kilograms for Tongil variety, 1,940 kilograms for barley and 1,310 kilograms for soybean, lower than those of the other surveyed districts chiefly because this is a mountainous area.

Investments in the project totaled ₩133,045,000 and an AID fund equivalent to ₩111,223,000 was invested in 1974 and 1975, thus totaling ₩244,268,000. In 1975 and 1976, the land improvement cooperative invested ₩106,346,000 in rezoning 190 hectares of the 256.7 hectares under the influence of irrigation facilities.

The irrigation project, along with the rezoning work, brought about significant changes in the area's agricultural situation. For instance, the 25.0 hectares of dry fields and 11.7 hectares of grassland were converted into rice paddies, with the result that the area of land under cultivation per family increased from 0.47 hectares to 0.49 hectares. This was because of an expanded area of land under cultivation and a reduced number of farming families from 522 to 515, a 1.3-percent

decrease. As a result, the farming population dropped to 4,168 and per family population dropped to 8.09. Moreover, farming families account for 86.9 percent of the total number of families in the area, showing a drop of 13.1 percent from that before the project.

No significant change is seen in the breakdown of farming families by area of land under cultivation. But the area of rice paddies cultivating the Tongil rice sharply increased to 85.8 percent of the total area of paddies from 24.1 percent before the project. As a result, paddies cultivating conventional varieties of rice declined to 14.2 percent from 75.9 percent before the project.

With the increased account crop system, the use rate of rice paddies rose to 134.1 percent, a 4.8-percentage point increase from that before the project. The rice transplanting season advanced by about 10 days to June 1 - 10 because of the irrigation facilities, and the yield per hectare rose to 3,940 kilograms of conventional rice varieties, 4,850 kilograms for the Tongil variety and 2,050 kilograms for barley.

(2) Songwol district

The Songwol area is in Songjon-myon, Kangjin-gun,

Cholla-Namdo and under the responsibility of the Kangjin Farmland Improvement Assaciation. The irrigation project in this area was originally undertaken started by the farmland improvement association in 1972 and completed in 1975. The water source is a reservoir and the area of farmland under the influence of this reservoir comes to a total of 70.0 hectares. Like other AID-funded projects, this district first started the irrigation project with its own funds and later received an AID fund to complete the project in 1975, as in the two other AID-funded projects.

The investment up to 1973 totaled ₩15,919,000, and an AID fund equivalent to ₩78,196,000 was additionally invested -- ₩70,938,000 in 1974 and ₩15,919,000 in 1975. In addition to the irrigation project, a total of ₩50,206,000 was invested in paddy rearrangement in the period November 1974 through May 1975.

Before the project, there were 70.0 hectares of rice paddies, with the area of rice paddies per family standing at 0.50 hectares which is almost equal to that in the Jongan. Farming families numbered 140, with a total farming population of 756, averaging 5.4 persons per family. The 140 farming

families accounted for 90.2 percent of the total number of families, and non-farming families of merchants, daily laborers and civil servants 9.4 percent. Families engaged in both agriculture and other lines were 4.3 percent.

Before the irrigation project, conventional varieties of rice accounted for 81.1 percent of the total area of rice paddies and the Tongil variety only 18.9 percent. With the increased second crop system, the use rate of rice paddies rose to 157.7 percent. The rice transplanting season in this area is June 21 - 30. The yield per hectare of conventional varieties of rice was 3,380 kilograms, the Tongil variety 3,660 kilograms and 1,890 kilograms for naked barley lower than those in other surveyed districts.

After the project, there was no significant change in the total area of land under cultivation and in the distribution of farmland among crops. There was no change, either, in the number of farming families, but the farming population per family rose by 7.4 percent to 5.77 persons, with an increase of the total farming population to 808. Meanwhile, the number of non-farming families rose to 11.5 percent of the total number of families in the area.

A significant change was found in the cultivation of the Tongil variety which now accounts for 73.6 percent of the total area of rice paddies, compared with 18.9 percent before the project. On the other hand, conventional varieties of rice now represent only 26.4 percent, sharply down from 81.1 percent before the project. The second crop system also shows an increase, bringing the use rate of rice paddies up to 161.0 percent. In addition, the rice transplanting season advanced by about 10 days to June 11 - 20. The per hectare yield also increased to 3,890 kilograms for conventional varieties of rice. 4,280 kilograms of the Tongil variety and 2,140 kilograms for naked barley.

(3) Jungbuk district

The Jungbuk area is in Jinbuk-myon, Changwon-gun, Kyongsang-Namdo and under the responsibility of the Changwon Farmland Improvement Association. The association initiated the irrigation project in October 1971 and completed it in 1975. The total cost was ₩418,160,000, of which ₩46,878,000 was invested up to 1973, and an AID fund of ₩371,282,000 was additionally invested -- ₩46,897,000 in 1974 and ₩324,385,000 in 1975.

The water source is a reservoir and a total of 189 hectares is benefitted by this reservoir. In 1976 and 1977, a total of ₩294,387,000 was invested in rezoning 150 hectares of rice paddies for better irrigation. Before the irrigation project, there were all rice paddies in this district, as in Songwol, though they were not irrigated. The area of land under cultivation per farming family was 0.44 hectares, lowest of the six surveyed districts. There were 431 farming families and no non-farming families. The farming population was 1,994, averaging 4.63 persons per farmily.

The farming families broke down by area of land they till to 49.7 percent for families owning land less than 0.5 hectares, accounting for 18.7 percent of the total area of land under cultivation in this area; 41.3 percent for families owning land of 0.5 to 1.0 hectares, accounting for 49.8 percent; 7.4 percent for families owning land of 1.0 to 2.0 hectares; and 1.6 percent for families owning land more than 2.0 hectares.

Conventional varieties of rice accounted for 56.3 percent of the total area of rice paddies and the Tongil variety 43.7 percent. The use rate of rice paddies was 141.1 percent, with nearly half of the rice paddies being used for the second crop system. The rice transplanting season was June

21 - 30. The yield per tanbo was 421 kilograms of the Tongil variety and 301 kilograms of conventional varieties of rice.

After the irrigation project, the number of farming families slightly dropped to 424, but no significant change was seen in the total area of rice paddies. Thus the area of rice paddies per farming family slightly rose to 0.45 hectares. On the other hand, the farming population per family dropped to 4.50 persons.

Also, there was no change in the distribution of farming families by area of land they till, but the area of rice paddies cultivating conventional varieties dropped, while the area of paddies cultivating the Tongil variety climbed. After the project, conventional varieties of rice accounted for 25.5 percent of the total area of paddies and the Tongil variety 74.5 percent. The second crop system also increased to raise the use of rate of rice paddies to 157.9 percent. In addition, the rice transplanting season advanced by about 10 days to June 11 - 20. The yield per hectare after the project also increased to 3,470 kilograms for conventional varieties of rice, 4,840 kilograms for the Tongil variety and 2,430 kilograms for naked barley.

(Table 3-1) General Status of Sample Project Districts

Project District	Location	Responsible Farmland Improvement Association	Type of Irrigation Facility	Benefitted Area	Total Investment	Interest Paid
				ha	1,000Won	1,000Won
Taean	Taeduk Hyun, Anseong Kun, Gyeonggi-do.	Giho	Pumping Plant	430.0	475,664	5,483
Kahung	Kakum Myun, Jungwon Kun, Chungcheong-bug-do.	Jung Won	"	210.9	230,175	2,180 "
Jipyong	Hamchang Myun, Sangju Kun, Gyeong-sang-bug-do	Sang Ju	Reservoir (Weir)	105.0	58,068	15 "
Jongan	Jongan Myun, Gongju Kun, Chungcheong-nam-do.	Gong Ju	Reservoir	256.7	244,268	10,757 "
Songwol	Songjeon Myun, Kang Kangjin Kun, Jeonla-nam-do.	Kang Jin	"	70.0	94,114	198 "
Jungbuk	Jinbuk Myun, Changwon Kun, Gyeongsang-nam-do.	Chang Won	"	189.0	418,160	3,956 "

(Table 3-1) Con't

Project District	Location	Responsible Farmland Improvement Association	Type of Irrigation Facility	Benefitted Area	Total Investment	Interest Paid
Insan	Yangdo Myun, Gwang Hwa Gun, Gyeonggi do	Gwang Hwa	Reservoir	100.0	435,815	4,053
Hanke	Gaduk Myun, Cheongwon-Gun Chungchong-Pukdo	Cheong Won	"	202.0	395,564	8,657
Kwang Chon	Gwang Cheon Myun, Hongseong-Gun Chungcheong-namdo	Hongseong	"	258	799,112	14,093

(Table 3-2) Cultivated Land, Farmhouseholds & Farm Population

District	With & without project	Cultivated Land						Farm household	Farm Population	
		Total Area			Per household average				Total	Per household average
		Upland	Paddy	Total	Upland	Paddy	Total			
		ha	ha	ha	ha	ha	ha	household	person	person
Taean	Without project	100.5	329.5	430.0	0.28	0.92	1.20	357	2,422	6.7
Kahung	Without project	84.9	126.0	210.9	0.55	0.82	1.37	153	875	5.7
Jipyong	Without project	-	105.0	105.0	-	0.93	0.93	112	782	7.0
Jongan	Without project	25.0	220.0	245.0	0.05	0.42	0.47	522	4,278	8.2
	with project	-	256.7	256.7	-	0.49	0.49	515	4,168	8.1
Songwol	Without project	-	70.0	70.0	-	0.50	0.50	140	756	5.4
	with project	-	-	70.0	70.0	-	0.50	0.50	140	808	5.8

(Table 3-2) Con't

District	With & without project	Cultivated Land						Farm household	Farm Population	
		Total Area			Per household average				Total	Per household average
		Upland	Paddy	Total	Upland	Paddy	Total			
		ha	ha	ha	ha	ha	ha	household	person	person
Jungbuk	Without project	-	189.0	189.0	-	0.44	0.44	431	1,994	4.6
	with project	-	189.0	189.0	-	0.45	0.45	424	1,908	4.5
Insan	Without project	-	100.0	100.0	-	0.43	0.43	234	1,036	4.4
Hanke	Without project	46.1	131.9	178.0	0.09	0.28	0.37	479	2,824	5.9
Kwong Chon	Without project	23.0	233.4	256.4	0.06	0.60	0.66	391	2,304	5.9

(Table 3-3) Farm household & cultivated land by size of farm (Unit: %)

District	With & without project	Farm household by size of farm					Cultivated land by size of farm			
		Others	Less than 0.5	0.5 -1.0	1.0 -2.0	More than 2.0	Less than 0.5	0.5 -1.0	1.0 -2.0	More than 2.0
Tuean	Without project	-	-	52.4	40.5	7.1	-	32.8	51.5	15.7
Kahung	Without project	-	5.9	32.8	50.1	11.2	0.7	16.0	58.0	25.3
Jipyong	Without project	-	16.5	69.4	12.4	1.7	12.7	68.1	15.3	3.9
Jongan	Without project	-	67.8	16.5	14.0	1.7	51.1	24.2	19.3	5.4
	with project	-	67.8	16.3	14.2	1.7	50.0	22.4	21.8	5.8
Songwol	Without project	10.0	63.3	17.0	7.8	1.9	46.9	24.2	20.9	8.0
	with project	11.5	59.0	18.0	9.6	1.9	38.5	29.2	23.6	8.7
Jungbuk	Without project	-	49.7	41.3	7.4	1.6	18.7	49.8	21.9	9.6
	with project	-	49.0	41.6	8.0	1.4	21.5	47.5	23.3	7.7
Insan	Without project	5.6	45.7	32.9	15.4	0.4	17.1	42.3	38.5	2.1
Hanke	Without project	-	46.1	35.1	17.1	1.7	37.0	32.6	25.2	5.2
Kwang Chon	Without project	3.3	40.4	43.2	9.3	3.8	24.8	46.5	16.3	12.4

(Table 3-4) Planted Area by rice varity, optimum period of transplant, land utilization ratio & yield per 10 a by crop.

District	With & without project	Planted area by rice varity		Optimum period of transplant	Land utilization ratio	Yield per 10a by crop.		
		Conventional rice	Tongil rice			Conventional rice	Tongil rice	Barley
		%	%		%	Kg	Kg	Kg
Taean	Without project	69.8	30.2	June 21 - 30	114.1	339.3	425.4	193.0
Kahung	Without project	64.2	35.8	June 11 - 20	121.8	305.0	395.0	205.0
Jipyong	Without project	28.0	72.0	May 21 - 30	100.0	336.0	415.0	220.0
Jongan	Without project	75.9	24.1	June 11 - 20	129.3	343.0	421.0	194.0
	with project	14.2	85.8	June 1 - 10	134.1	394.0	485.0	206.0
Songwol	Without project	81.1	18.9	June 21 - 30	157.7	338.4	366.0	188.6
	with project	26.4	73.6	June 11 - 20	161.0	389.2	428.0	214.0
Jungbuk	Without project	56.3	43.7	June 21 - 30	141.0	301.0	421.0	229.0
	with project	25.5	74.5	June 11 - 20	157.1	347.0	484.0	234.0
Insan	Without project	87.6	12.4	June 1 - 10	100.0	420.0	480.0	
Hanke	Without project	4.0	96.0	June 1 - 10	155.2	360.0	500.0	110.0
Kwang Chon	Without project	22.0	78.2	June 1 - 10	109.5	402.0	490.0	180.0

2. The Effect of Irrigation Investments

The direct effect of investment in irrigation is increased output of farm products through the development of farmland base, increased yields, and the elevation of utilization of farmland. Other effects are increased profitability and stable farm management, agricultural labor input, expedition of mechanization, and improvement of cultivation and farming methods.

Of the total 9 sample projects, it was possible to analyze the effects of irrigation for 6 projects (3 IBRD and 3 AID-funded projects) since relevant data were available through actual survey with and without the implementation of the projects. In the case of 3 IBRD projects districts (Taean, Kahung and Jipyong) the farm budget survey was conducted for 1976 and 1977, and in the case of 3 AID project districts (Jongan, Songwol and Jungbuk) data for 3 years (1975-77) were obtained through actual survey.

However, as for the 3 IBRD-financed projects (Insan, Hanke and Kwangchon, a survey was made only of the effects relating to the development of farmland base, cultivation system, and utilization status of farmland, as there are no post-implementation data concerning the effects on output, the reduction

of labor force, or the increase in profitability. Therefore, we cannot but omit review of the effects in these fields. The effects of mechanization were minimal, mainly because the AID-financed projects were implemented mostly in semi-mountainous and mountainous regions, and it is only a few years since the irrigation facilities came into operation. The effect of farming methods, as has been pointed out, was that the transplanting time moved foreward by about 10 days on average as the acreage planted to the high-yielding Tongil rice has been expanded.

1) Development of Farmland base

The primary objective of irrigation investment is to increase rice production by expanding paddy fields through the development of upland fields, forest land and other areas where productivity is low, and by turning drought-prone areas into drought-free farmland through the improvement of irrigation and drainage systems.

The development area of the six IBRD-financed project districts covers 746.3 hectares, including 430.5 ha in the Taean, 210.9 ha in the Kahung, 104.9 ha in the Jipyong, Insan 100.0 ha

Hanke 202.0 ha and Kwangchon 258.0 ha. The development area involving the AID-financed projects totals 515.7 ha, including 256.7 ha in the Jongan district, 70.0 ha in the Songwol district, and 189.0 ha in the Jungbuk district. In the Taean region, 101.0 ha of upland fields, 23.5 percent of the total development area, was turned into drought-free paddy fields through the implementation of the project. In the Kahung district, 84.9 of upland fields, 40.3 percent of the total development area, was turned into drought-free paddy fields. In the Jipyong district, 104.9 ha of paddy fields prone to drought has been turned into fully irrigated paddy fields.

In the case of Insan district, a total of 100.0 ha of partially irrigated paddy field was upgraded to fully irrigated paddy. In the Hanke district, 46.1 ha of dry land 131.9 ha of drought-prone paddy were converted into drought-free paddy-field. In the Kwangchon district, 245.0 ha of drought-prone paddy, or 95.0% of the total development area was turned into fully irrigated paddy.

As for the AID-financed project, 25.0 ha of the total development area covering 256.7 ha in the Jongan district was upland fields before the implementation of the project, and

11.7 ha was land for miscellaneous crops. In the Songwol and Jungbuk district, the existing drought-prone land has been turned into drought-free land.

As has been explained, the three AID-financed project district are different from the IBRD-financed project districts, in that the AID-financed project for irrigation and drainage was carried out in parallel with a land consolidation projects financed by the local governments.

(Table 3-5) Changes in Land Utilization with Project by District

Unit: ha

Land Classification	Taean		Kahong		Jipyong		Jongan		Songwol		Jungbuk		Insan		Hanke		Kwangchon	
	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project	Without project	With project
Paddy Land	329.5	430.5	126.0	210.9	104.9	104.9	220.0	256.7	70.0	70.0	189.0	189.0	100.1	100.1	131.9	202.5	233.4	258.0
Upland	101.0		84.9				25.0								46.1		23.0	
Forest land																		
Others							11.7								24.5		1.6	
Total	430.5	430.5	210.9	210.9	104.9	104.9	256.7	256.7	70.0	70.0	189.0	189.0	100.1	100.1	202.5	202.5	258.0	258.0

Source: Actual Survey Data

2) Increase in yield

Table 3-6 shows the rice and barley yields per hectare for the first two years immediately with and without the projects.

In Taean district, the yield of conventional rice per hectare rose from 3,390 kg in 1976 (without project) to 3,870 kg in 1976 (with project), or 14.2 percent increase, and Tongil rice yield increased 12.7 percent. In Kahung district, conventional rice yield marked 16.1 percent and Tongil 14.9 percent. In Jipyong district, conventional rice yield rose by 9.3 percent and Tongil rice yield by 10.1 per cent.

In the case of barley, the yield per ha in 1977 declined 35-42 percent from those in 1976 irrespective of the newly established irrigation system. This drastic deline in yield of barley crop is mainly due to the severe coldness that swept the whole nation in January and February of 1977.

As for the AID-funded projects, rice yield per hectare in Jongan district rose from 3,430 kg to 3,940 kg with the implementation of projects, approximately 14.9 percent increase. Tongil rice yield also increased by 15.2 percent, and barley output rose by 6.2 percent. In the Songwol and Jungbuk

districts, the yield increase for conventional rice varieties and Tongil rice ranged from 15 to 17 percent, not much different from those in the Jongan district. The Songwol district, however, slightly led other districts in the output of naked barley, recording a 10.6-percent increase. When compared with nationwide average yield during the same period, the AID-financed project districts, as shown in Table, generally stand high in yield increase rates.

Although weather conditions may account for such differences among different districts, but it is evident that the effect of irrigation is prominent where irrigation projects have been implemented.

What should be noted in connection with the irrigation system is the fact that the new irrigation system does not generate an immediate effect of improving soil quality. The effect of the irrigation and drainage systems comes after the lapse of considerable time. Regarding this matter, we will discuss later in connection with the computation of IRR.

(Table 3-6) Rice and Barley Yields Without and With Project in IBRD Loan Project District (Polished)

(Unit: Kg/ha)

Classification	Taean	Kahung	Jipyong	National Average
Conventional Rice				
Without project[a/]	3,390	3,050	3,360	3,960
With project	3,870	3,540	3,690	4,230
Rate of increase(%)	14.2	16.1	9.8	6.8
Tongil Rice				
Without project[a/]	4,250	3,950	4,150	4,790
With project	4,790	4,540	4,570	5,530
Rate of increase(%)	12.7	14.9	10.1	15.4
Common Barley				
Without project[a/]	1,960	2,050	2,250	2,270
With project	1,270	1,180	1,400	1,460
Rate of increase	(-)35.2	(-)42.4	(-)37.8	(-)35.7

a/ Those without project are 1976 yields and those with project are 1977 yields.

(Table 3-7) Rice and Barley Yields Without and With Project in AID Loan Project Districts (Polished)

(Unit: Kg/ha)

Classification	Jongan	Songwol	Jungbuk	National Average
Conventional Rice				
Without project[a]	3,430	3,380	3,010	3,830
With project	3,940	3,890	3,470	3,960
Rate of increase(%)	14.9	15.1	15.3	3.3
Tongil Rice				
Without project[a]	4,210	3,660	4,210	5,030
With project	4,850	4,280	4,840	4,790
Rate of increase(%)	15.2	16.9	15.9	(-)4.8
Common Barley				
Without project[a]	1,940	-	-	2,160
With project	2,060	-	-	2,170
Rate of increase(%)	6.2	-	-	5.1
Naked Barley				
Without project[a]	-	1,880	2,290	2,580
With project	-	2,080	2,430	2,640
Rate of increase(%)	-	10.6	6.1	2.3

a/ Those without project are 1975 yields and those with project are 1976 yields for Jongan and Jungbuk districts and national average. Those without project are 1974 yields and those with project are 1975 yields for Songwol district.

Source: Actual Survey Data.

3) Changes in cropping pattern and land utilization

The expansion of the irrigation and drainage systems has caused a change in cropping pattern in all districts surveyed, and an increase in double cropping on paddy fields.

As for the change in cropping pattern, there was no measurable change in paddy field cultivation before and after the implementation of the project, with the second crops mostly confined to barley and naked barley. Upland field cultivation, however, shows some change in each district. Before the implementation of the projects, the cultivation of barley and wheat came first, and then the cultivation of soybeans, sweet potatoes, sesame, cabbage and turnips followed. These crops, however, almost vanished following the convension of upland into paddy field. Barley and naked barley have become the mainstay for cultivation after rice harvest.

Regarding the change in the utilization of land, the Taean district, which had no two-crop farming before the implementation of the project, witnessed a 10.0-percent rise in the use rate of paddy fields after the implementation. In the Taean district, the double cropping ratio in upland fields was 167.3 percent, but after the implementation of the project

barley became the only second crop after rice in paddy fields. This resulted in the overall decline in double cropping ratio from 115.8 percent to 110.0 percent. In the Kahung district, the situation was not much different, with the overall ratio of double cropping falling from 122.9 to 110.0 percent. In the Jipyong district, two crops were totally unavailable on the same land before the implementation of the project, but the use rate rose to 120.0 percent after the implementation. In the Insan district, no double cropping is observed. In the Hanke district, the land utilization rate rose from 143.1 percent to 160.0 percent after the project is implemented. In the Kwangchon district, utilization rate did not change after the project implementation, remaining about 110 percent.

In the AID-financed project districts, the use rate of arable land edged up only slightly. In the Jongan district, it increased from 128.3 to 134.1 percent, and in the Songwol it rose from 157.7 to 160 percent. In the Jungbuk district, the crop cultivation rate after rice harvest increased from 141.1 to 157.1 percent.

In general, the two-cropping rate in paddy fields has increased in all regions, mainly because the expansion of

irrigation and drainage systems resulted in expansion of the acreage planted to the high-yielding Tongil rice variety, and moved the rice transplanting period about 10 days foreward, thus bringing about an early harvest, and removing the overlapping of labor input during the period of barley planting.

Regarding the change in the planting composition of conventional rice and Tongil rice varieties, the cultivation ratio for Tongil rice has been measurably on the rise, as shown in Table 3-10. The expansion of the cultivation area for high-yield rice varities represents the most spectacular effect of agricultural water development.

(Table 3-8) Cropping Pattern Without and with Project

	Cropping pattern		Taean				Kahung				Jipyong				Insan			
			Without project		With project		Without project		With project		Without project		With project		Without project		With project	
	1st crop.	2nd crop.	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio
	Conventional Rice	-	223.0	69.8	107.6	25.0	80.9	64.2	63.3	30.0	29.4	28.0	110.5	10.0	87.6	87.6	45.0	45.0
	Conventional Rice	Common Barley							21.1	10.0								
Paddy	Conventional Rice	Naked Barley																
	Tongil Rice	-	99.5	30.2	279.8	65.0	45.1	35.8	126.5	60.0	75.5	72.0	73.4	70.0	12.4	12.4	55.0	55.0
	Tongil Rice	Common Barley			43.1	10.0							21.0	20.0				
	Tongil Rice	Naked Barley																
	Total		329.5	100.0	430.5	100.0	126.0	100.0	210.9	100.0	104.9	100.0	104.9	100.0	100.0	100.0	100.0	100.0
	Common Barley	Soybeans	29.2	28.9			30.4	35.8						14.2				
	Common Barley	Sweet Potatoes					5.3	6.3						2.8				
	Common Barley	Sesame					7.2	6.1						1.3				
	Common Barley	Chinese Cabbage	30.0	29.7														
	Naked Barley	Soybean																
Upland	Naked Barley	Sweet Patatoes																
	Naked Barley	Red Pepper																
	Naked Barley	Sesame																
	White Potatoes	Radish	8.8	8.6				4.2	5.0									
	Red Pepper	-	24.0	23.8				35.3	41.6									
	Sesame	-	9.0	8.9														
	Leaf Tobaco	-						3.6	4.1									
	Total		101.0	100.0				84.9	100.0									

Source: Actual survey data.

(Table 3-8) Con't

Hanke				Kwangchon				Jongan				Songwol				Jungbuk			
Without project		With project		Without project		With project		Without project		With project		Without project		With project		Without project		With project	
Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio	Area	Ratio
2.5	1.9	0	0	52.4	20.3	30.0	11.6	132.7	60.3	9.5	3.7	26.0	37.2	9.2	13.2	64.3	34.0	24.0	12.7
2.8	2.1			4.4	1.7	0	0	34.3	15.6	27.0	10.5								
												30.7	43.9	9.2	13.2	42.1	22.3	24.2	12.8
72.5	55.0	80.8	40.0	181.1	70.2	200.0	77.5	35.9	16.3	159.6	62.2	3.6	5.1	18.1	25.8	47.1	24.9	57.1	30.2
54.0	41.0	121.2	60.0	20.1	7.8	28.0	10.9	17.1	7.8	60.6	23.6								
												9.7	13.8	33.5	47.8	35.5	18.8	83.7	44.3
131.8	100.0	202.2	100.0	258.0	100.0	258.0	100.0	220.0	100.0	256.7	100.0	70.0	100.0	70.0	100.0	189.0	100.0	189.0	100.0
23.5	51.1							56.6											
10.0	21.7							11.4											
2.5	5.4							5.0											
5.5	12.0																		
								2.2	8.8										
3.5	7.6							4.5	18.2										
1.0	2.2																		
46.0	100.0							25.0	100.0										

(Table 3-9) Utilization Rates of Cultivated Land

District	Classification	Without project			With project		
		Area of cultivated land	Cropped Area	(B/A)	Area of cultivated land	Cropped Area	(B/A)
		(A)	(B)	%	(A)	(B)	%
Taean	Total	430.5	498.5	115.8	430.5	473.6	110.0
	Upland	101.0	169.0	167.3	-	-	-
	Paddy	329.5	329.5	100.0	430.5	473.6	110.0
Kahung	Total	210.9	259.1	122.9	210.9	232.0	110.0
	Upland	84.9	133.1	156.8	-	-	-
	Paddy	126.0	126.0	100.0	210.9	232.0	110.0
Jipyong	Total	104.9	104.9	100.0	104.9	125.9	120.0
	Upland	-	-	-	-	-	-
	Paddy	104.9	104.9	100.0	104.9	125.9	120.0
Jongan	Total	245.0	316.9	129.3	256.7	344.3	134.1
	Upland	25.0	45.5	182.0	-	-	-
	Paddy	220.0	271.4	123.4	256.7	344.3	134.1
Songwol	Total	70.0	110.4	157.7	70.0	112.7	160.0
	Upland	-	-	-	-	-	-
	Paddy	70.0	110.4	157.7	70.0	112.7	160.0
Jungbuk	Total	189.0	266.6	141.1	189.0	296.9	157.1
	Upland	-	-	-	-	-	-
	Paddy	189.0	266.6	141.1	189.0	296.9	157.1

Note: 1) The base year without project for Taean, Kahung and Jipyong district is 1976, and the year with project is 1977.
2) The base year without project in Jongan and Jungpuk district is 1975 and the year with project is 1976.
3) The base year without project in Songwol is 1974 and the year with project is 1975.

Source: Actual Survey Data

(Table 3-9) Con't

District	Classification	Without project			With project		
		Area of cultivated land	Cropped Area	(B/A)	Area of cultivated land	Cropped Area	(B/A)
		(A)	(B)	%	(A)	(B)	%
Insan	Total	100.0	100.0	100.0	100.0	100.0	100.0
	Upland	-	-	-	-	-	-
	Paddy	100.0	100.0	100.0	100.0	100.0	100.0
Hanke	Total	177.8	276.1	155.3	202.0	323.2	160.0
	Upland	46.0	87.5	190.2	-	-	-
	Paddy	131.8	188.6	143.1	202.0	323.2	160.0
Kwangchon	Total	258.0	282.5	109.5	258.0	286.0	110.9
	Upland	-	-	-	-	-	-
	Paddy	258.0	282.5	109.5	258.0	286.0	110.9

Note: The base year without project is 1976, and the year with project is 1977.

Source: Actual Survey Data

(Table 3-10) Cultivated Ratios of conventional rice and Tong Il Rice

Classification \ District	Daean	Kahung	Jipyong	Jongan	Songwol	Jungpuk	Insan	Hanke	Kwangchon
	%	%	%	%	%	%	%	%	%
Without Project									
Conventional Rice	70	64	28	76	37	34	88	4	22
Tong Il Rice	30	36	72	24	63	66	12	96	78
With Project									
Conventional Rice	35	40	10	14	13	13	45	0	12
Tongil Rice	65	60	90	86	87	87	55	100	88

Source: Actual Survey Data

4) Labor saving and increase in labor productivity

The development of farming techniques and the push for farm mechanization reduce the per unit labor input required in every stage of agricultural production.

In rice cultivation, in particular, the expansion of irrigation and drainage system helps ensure the rational water, management, thus reducing the labor input and the composition of the labor input by type of work.

Table 3-11 shows the change in the number of days of labor input per hectare by type of work in rice and barley cultivation due to the implementation of projects in the three IBRD-financed project districts where the irrigation facilities came into operation for 1977 crop. The table shows that the work days dropped in both rice and barley cultivation after the irrigation improvements.

The composition of labor input by type of work varies slightly according to district. In general, however, while there was no measurable change in the frequency of labor input for such work as tilling, land preparation and development of seed beds for both rice and barley cultivation due to the implementation of the project, the number of days of labor

input for irrigation and drainage works dropped, and the number of days of labor put into harvesting, transportation, threshing and pest control increased after the implementation of the projects.

The reduction of the number of days of labor required for irrigation and drainage works in rice cultivation may be related to good weather conditions and the sufficient rainfall, but may well be regarded as the natural consequence of the easy control of water resulting from the expansion of the irrigation and drainage systems. The fact that the number of days of labor required for harvesting and threshing increased after the implementation of the project is chiefly due to the increase in output. In the case of the rice and barley cultivation, the number of days of labor put into weeding has been on the decline, a phenomenon which is related to the wide use of herbicides.

In rice cultivation, the increase in unit output and the reduction of labor input after the implementation of the project led to an increase in labor productivity.

Table 3-12 shows the level of labor productivity as expressed in terms of output per day of labor input before and after the implementation of project in the three AID-financed

project regions. The table indicates that labor productivity has risen measurably following the implementation of the project.

In the Taean district, labor productivity rose by 43.7 percent as compared with that before the implementation of the project. The Kahung district saw an increase of 39.6 percent, and the Jipyong district 26.3 percent.

When labor productivity is compared with the national average based on the cost of production data for major farm products, the level of output per unit of labor input is much lower, but the rate of increases are much higher than that of the national average labor productivity increase rate of 11.2 percent.

(Table 3-11) Labor input by type of work per ha

(Unit: man/day)

Type of work \ District	Taean			Kahung			Jipyong			Average		
Crop.	Rice			Rice			Rice			Rice		
	Ordinary rice	Tong-il rice	Barley	Ordinary rice	Tong-il rice	Barley	Ordinary rice	Tong-il rice	Barley	Ordinary rice	Tong-il rice	Barley
Without the project (A) (1976)												
Plowing	6.0	6.0	5.7	6.8	6.9	5.7	5.8	5.9	5.4	6.2	6.3	5.6
Seed bed preparation & seeding	6.6	11.2		7.6	12.7		6.5	10.9		6.9	11.6	
Transplanting	17.3	20.1	14.9	19.8	22.9	15.0	16.9	19.6	14.0	18.0	20.9	14.6
Irrigation	26.4	30.2		30.1	34.4		25.8	29.5		27.4	31.4	
Weeding	8.6	8.5	32.4	9.8	9.8	32.4	8.4	8.4	30.3	8.9	8.9	31.7
Pest Control	8.1	7.2	0.5	9.3	8.2	0.5	8.0	7.1	0.4	8.5	7.5	0.5
Harvesting & Transportation	35.5	34.5	34.8	40.5	39.4	34.9	34.7	33.7	32.5	36.9	35.9	34.1
Others	13.1	9.5	24.2	15.0	10.9	24.3	12.8	9.3	22.7	13.6	9.9	23.7
Total	121.6	127.2	112.5	138.9	145.2	112.8	118.9	124.4	105.3	126.4	132.2	110.2

(Table 3-11) Con't

District / Crop. / Type of work	Taean			Kahung			Jipyong			Average		
	Rice			Rice			Rice			Rice		
	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley
With the project (B) (1977)												
Plowing	5.2	5.7	5.1	6.3	6.8	5.4	5.7	5.6	5.0	5.7	6.0	5.2
Seed bed preparation & seeding	6.0	10.4		7.3	12.4		6.6	10.4		6.6	11.1	
Transplanting	16.7	18.6	14.1	19.1	20.6	14.8	17.2	18.5	13.6	17.7	19.2	14.2
Irrigation	12.1	12.2		13.5	16.1		12.1	12.2		12.6	13.5	
Weeding	7.6	7.5	28.1	9.2	9.2	29.7	8.3	7.2	27.2	8.4	8.0	28.3
Pest control	8.1	7.9	0.9	9.7	9.2	1.0	8.9	8.2	0.9	8.9	8.4	0.9
Harvesting & transportation	37.8	42.4	37.6	45.9	50.6	39.6	41.4	42.1	36.4	41.7	45.0	37.9
Others	9.7	6.8	19.0	11.8	8.1	20.1	10.5	6.8	18.4	10.7	7.2	19.2
Total	103.2	111.5	104.8	122.8	133.0	110.6	110.7	111.0	101.5	112.2	118.5	105.6

(Table 3-11) Con't.

Type of work \ District / Crop.	Taean			Kahung			Jipyong			Average		
	Rice			Rice			Rice			Rice		
	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley	Conventional rice	Tongil rice	Barley
(B-A)												
Plowing	-0.8	-0.3	-0.6	-0.5	-0.1	-0.3	-0.1	-0.3	-0.4	-0.5	-0.2	-0.4
Seed bed preparation & seeding	-0.6	-0.8	-	-0.3	-0.3	-	0.1	-0.5	-	-0.3	-0.5	-
Transplanting	-0.6	-1.5	-0.8	-0.7	-2.3	-0.2	-0.3	-1.1	-0.4	-0.3	-1.6	-0.3
Irrigation	-14.3	-18.0	-	-16.6	-18.3	-	-13.7	-17.3	-	-14.9	-17.9	-
Weeding	-1.0	-1.0	-4.3	-0.6	-0.6	-2.7	-0.1	-1.2	-3.1	-0.6	-0.9	-3.4
Pest control	0.0	0.7	0.4	0.4	1.0	0.5	0.9	1.1	0.5	0.4	0.9	0.5
Harvesting & transportation	2.3	7.9	2.8	5.4	11.2	4.7	6.7	8.4	3.9	4.6	9.2	3.8
Others 4)	-3.4	-2.7	-5.2	-3.2	-2.8	-4.2	-2.3	-2.5	-4.3	-3.0	-2.7	-4.6
Total	-18.4	-15.7	-7.7	-16.1	-12.2	-2.2	-8.2	-13.4	-3.8	-14.2	-13.7	-4.6

Source: Actual Survey Data

(Table 3-12) Increase in labor productivity with project in the 3 IBRD loan project districts a/

Classification	Taean	Kohung	Jipyong	National average
Without project (1976)				
Yield per ha(kg)(A)	3,660	3,370	3,930	4,872
Labor input per ha (days) (B)	12.48	140.5	122.7	103.7
Output per man-day(kg) (A/B)	29.3	24.0	32.0	47.0
With project (1977)				
Yield per ha(kg)(A)	4,570	4,120	4,480	5,360
Labor input per ha (days)(B)	108.7	122.9	110.9	101.5
Output per man-day (kg) (A/B)	42.1	33.5	40.4	52.8
Rate of increase	43.7	39.6	26.3	11.2

a/ Average yields weighted by planted acrease of conventional rice and Tongil rice.

Source: Actual survey data for project districts, and cost of production survey for major agricultural products for national average.

5) Increase in net return per unit acreage

Table 3-13 shows an increase in net return per hectare from the cultivation of conventional rice and high-yield Tongil rice due to the implementation of the irrigation projects in the three IBRD-financed project districts.

In all districts, the cost of production per ha tend to rise after the project implementation, but the increases in gross return due to the rise in the yields per ha are greater than the rise in cost of production, resulting in greater net return.

In the Taean district the net return per hectare from the cultivation of crops rose by 41.1 percent from ₩549,000 to ₩775,000. In the Kahung district, the amount rose by 39.7 percent from ₩468,000 to ₩654,000, and in the Jipyong district, it increased by 14.8 percent from ₩715,000 to ₩821,000.

The increase in profits is attributed to the fact that the expansion of irrigation and drainage systems provided a shift in cultivation from relatively unprofitable upland crops to comparatively profitable paddy rice, and that the secure supply of agricultural water expanded the acreage of high-yield Tongil rice cultivation.

(Table 3-13) Additional net return per ha due to project

(Unit: 1,000 Won)

Crops.	Classification	Taean	Kohung	Jipyong
Ordinary rice	Without project (A) (1976)			
	Gross revenue	1,025	910	1,028
	Production cost	345	384	337
	Net return	680	526	691
	With project (B) (1977)			
	Gross revenue	1,169	1,056	1,129
	Production cost	332	377	341
	Net return	837	679	788
	Net increasement B- A	157	153	97
	(B/A) x 100 (%)	123.1	129.1	114.0
Tong Il rice	Without project (A) (1976)			
	Gross revenue	1,115	1,029	1,096
	Production cost	380	424	372
	Net return	735	605	724
	With project (B) (1977)			
	Gross revenue	1,257	1,183	1,207
	Production cost	373	419	368
	Net return	884	764	839

(Table 3-13) Con't

Crops.	Classification	Taean	Kahung	Jipyong
	Net increasement			
	B - A	149	159	115
	(B-A) x 100 (%)	120.3		115.9
All crops.	Without project (A) (1976)			
	Gross revenue	912	893	1,077
	Production cost	363	425	362
	Net return	549	468	715
	With project (1977)			
	Gross revenue	1,128	1,045	1,158
	Production cost	353	391	337
	Net return	775	654	821
	Net increasement			
	B - A	226	186	106
	(B-A) x 100 (%)	141.1	139.7	114.8

Source: Computed from the Actual Survey Data

3. Analysis of Investment Efficiency

1) Indicators of investment efficiency

Three indicators of investment efficiency are generally used as yardstick to measure the relative advantage of investment: they are (1) benefit-cost ratio, (2) net present worth, and (3) the internal rate of return. Each of these indicators has merits and demerits depending on the purpose of its application and the nature of the investment to which it is applied.

(1) Benefit-cost ratio (B/C ratio)

The benefit-cost ratio of an investment project is the ratio which is obtained when the total present worth of the benefit to be generated by the project is divided by the total present worth of the cost of the project. The higher the ratio is, the more favorable the effect of the investment will be and, therefore, the higher the priority of the investment. To compute the benefit-cost ratio of an investment project, the following formula is used:

$$\frac{B}{C} \quad \sum_{i=0}^{n} \frac{b_i}{(1+r)^i} = b_0 + \frac{b_1}{(1+r)} + \frac{b_2}{(1+r)^2} + \cdots + \frac{b_n}{(1+r)^n}$$

$$\sum_{i=0}^{n} \frac{C_i}{(1+r)^i} \quad C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_n}{(1+r)^n}$$

Where; B = Sum of the present value of benefit stream due to project.

C = Sum of the present value of cost stream due to project

bi = Benefit (revenue) in the ith year

ci = Cost in the ith year

r = Opportunity cost of capital or discount rate

n = Length of project life

In applying a benefit-cost ratio as a measuring rod of the effect of an investment project, however, two things have to be considered. One is the problem involved in setting an appropriate rate of discount, and the other is the problem concerning the validity of the benefit-cost ratio per se in practical terms.

Factors that affect the social rate of discount include the social opportunity cost of capital, the rate of interest in the capital market, and the social rate of time preference. Theoretically, in an economy where a perfectly competitive capital market exists in the public and private sector, the social opportunity cost and the social rate of time preference would be equal to the market rate of interest. Therefore, the current market rate of interest could well be applied as

the adequate rate of discount.

But, in reality, such a perfectly competitive capital market does not exist, nor is it likely to come into existence. Furthermore, the rate of interest on the loans of financial institutions, which is directly controlled by the government or through the central bank's rediscount policy, tends to differ considerably from the private rate of interest (the rate of interest in the private money market). This difference causes the difficulty of determining the appropriate social rate of discount.

Since the benefit-cost ratio of an investment project is computed on the basis of the present worth of the cost and benefit of that project, the sooner an investment project yields returns, the more advantageous the project is considered to be. Conversely, an investment project that produces return slowly over time is regarded as being of less significance, even if it is an absolutely essential project to the long-term interest of the nation.

(2) The Net present worth

Net present worth is the most straightforward indicator of investment efficiency. It is the net value

obtained by subtracting the present worth of outlays on an investment project from that of the benefits of the project. If the sum thus calculated is positive, the project is considered worthy of implementation at the social opportunity cost of the social rate of discount applied in the calculation. If it turns out to be negative, then the project is regarded as unworthy of investment.

This indicator has an advantage in that the calculation is simple. However, in using this indicator, there arises the problem of how to determine the appropriate social rate of discount to be applied, as is the case with the cost-benefit ratio. The net present worth (NPW) is calculated as shown below:

$$NPW = B-C = \sum_{i=0}^{n} \frac{b_i}{(1+r)^i} - \sum_{i=0}^{n} \frac{C_i}{(1+r)^i}$$

$$= \left\{ b_0 + \frac{b_1}{(1+r)} + \frac{b_2}{(1+r)^2} + \cdots\cdots + \frac{b_n}{(1+r)^n} \right\}$$

$$- \left\{ C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots\cdots + \frac{C_n}{(1+r)^n} \right\}$$

$$= (b_0 - C_0) + \frac{(b_1 - C_1)}{(1+r)} + \frac{(b_2 - C_2)}{(1+r)^2} + \cdots\cdots + \frac{(b_n - C_n)}{(1+r)^n}$$

Lacking a basis for comparison, the net present worth indicator has a drawback--it may cause confusion in setting

investment priority between two or more optional projects. For example, it may happen that an investment project which has a relatively high rate of return but is small in scale is taken as being less favorable than a project which has a lower rate of return but is larger in scale and, therefore, shows a greater absolute net present worth. Hence the likelihood that the bigger the scale of a project is, the higher investment priority it may claim. When an investment project has an internal rate of return (to be explained later) which is equal to that of another project, the one that yields a greater net present worth would contribute more to the economy of the nation and would therefore be considered more favorable.

(3) The internal rate of return

The internal rate of return is the rate of discount which makes the total present worth of the benefits equal to the total present worth of the costs, or makes the ratio between the two values unity. Alternately, it represents the earning power of capital which produces returns while the principal can be recollected over the lifetime of project concerned. When the earning power of capital of a project is higher than the society's average opportunity cost, investment in the project

is rated as worthwhile. The calculation generally used to obtain the internal rate of return is as follows:

$$B = \sum_{t=0}^{n} \frac{b_t}{(1+R)^t} = b_0 + \frac{b_1}{(1+R)} + \frac{b_2}{(1+R)^2} + \cdots\cdots + \frac{b_n}{(1+R)^n}$$

$$C = \sum_{t=0}^{n} \frac{C_t}{(1+R)^t} = C_0 + \frac{C_1}{(1+R)} + \frac{C_2}{(1+R)^2} + \cdots\cdots + \frac{C_n}{(1+R)^n}$$

Where R, the rate of discount which makes B/C = 1 or B = C, is the internal rate of return.

The internal rate of return may be expressed in two ways depending on the point of view taken in analyzing it. One is the economic internal rate of return, which takes into account the national economy as a whole. The other is the financial internal rate of return, which takes into consideration the standpoint of the investor (the farmland improvement association in this study) or of farmers. Thus, the difference between the two types of internal rate of return is that which arises between economic and financial analysis of the rate. The economic internal rate of return will be examined in this chapter. The financial internal rate of return will be dealt with later.

The use of the internal rate of return as the basis of measuring the effect of an investment project has been criticized in several ways. Two typical cases of such criticism are noted here.

The nth degree equation in variable R, the internal rate of return, may produce n number of solutions including negative or imaginary roots. This raises the question as to which of the multiple solutions represents the true internal rate of return. However, the possibility of multiple solutions is but an algebraic problem, which arises only when the value gained by subtracting the total present worth of costs from that of benefits is negative due to relatively large outlays: such as those required for replacement of facilities made during the length of project life. Such a problem seldom occurs in actual investment projects in the agricultural sector and may therefore be considered of little concern.

The internal rate of return (is a) function of the size of the cost of investment, the year of investment, the year in which the investment begins to yield returns, and the durability of the investment project. Therefore, in comparing two or more investment options, the one which has a shorter period of durability tends to appear capable of producing more

return. An investment project which has a long gestation period or requires a relatively lengthy period of time before it begins to yield benefits is likely to be regarded as less favorable than a project which produces benefits in the early stage of implementation. Moreover, in an investment project the same outlay would seem to generate a higher internal rate of return when invested later in the period of economic durability of the project than invested earlier. Critics assert that public investments--such as the development of water resources for agriculture--are highly long-term national projects and should be undertaken with a view to improving the welfare of not only the present generation but also that of the future generation. Therefore, it would be myopic to judge public investments merely on the basis of the internal rate of return from the standpoint of the present generation.

In spite of its apparent shortcomings in certain contexts, the internal rate of return, which does not require prior setting of the social rate of discount, is in fact widely accepted as one of the most useful criteria for investment determination ever developed. For this reason, the internal rate of return is used as the chief indicator of investment efficiency in this analysis.

2) Valuation of benefits and costs

Prerequisite to the economic analysis of an investment project is the evaluation of the cost and benefit to be generated by the project in money terms. However, depending on the nature of investment projects, certain aspects of costs and benefits cannot easily be quantified in market prices. For example, tourism, recreational opportunities and other associated effects that may be created by the development of water resources cannot be adequately measured in terms of market prices.

In the case of the small and medium-scale irrigation projects which are the subjects of this analysis, however, the possible additional effects such as tourism and scenic and recreational benefits would be marginal. Even if such concomitant effects prove to be of some significance in some areas, it would be difficult to quantify them in terms of market prices. In this analysis, therefore, such unquantifiable effects of the projects are excluded and only whose cost and benefit items which can be calculated in terms of money are dealt with.

(1) Problems concerning the application of current prices

Most of the quantifiable costs and benefits may develop market prices through commercial transactions. Even so, there have always been controversies over whether current market prices correspond to the true social values in measuring the effects of public investments. According to established economic theory, current market prices cannot be applied as a yardstick of true social values, under the following three conditions:

-- When the market is functioning imperfectly because of monopolistic, oligopolistic and other factors that render competition in the market imperfect;

-- When there is a continuous rise in prices; that is, when inflation is chronic; and

-- When project implementation drastically increases the supply of certain products or causes a major change in the demand for certain inputs, and thus affects the structure of market prices (relative prices).

The problem of rising prices should not pose a serious predicament since it is possible to compute real-term prices by deflating nominal prices by the appropriate price index. The only question that matters then, is how to select the

appropriate price index. For consistency, this analysis used 1976 constant prices throughout the project lifetimes by deflating all the costs and benefits by the 1976 wholesale price index (WPI).

The problem with regard to the effect of changes in the supply of and demand for certain products on their relative prices may well be ignored in this analysis, since such effects would be negligible in the case of the implementation of the small and medium-scale irrigation projects under study. However, the possible changes in the terms of trade for agricultural products will be dealt with later in the separate section on sensitivity analysis.

As to the problem of distortions of the market price structure caused by imperfections in the operation of the competitive market, it is generally agreed that the disparity between market prices and true social values occurs due to the following three reasons:

a. Prices of goods and services, instead of being formed by free competition in the market, are influenced by the administered pricing of a handful of monopolistic and oligopolistic firms or the government's protectionist policies (especially for agricultural products) or by the price control

measures.

b. Due to imperfections of the factor market, especially of the labor market, some labor may be idle in a certain sector.

c. Because of environmental pollution and other external diseconomies, private marginal costs differ from social marginal costs.

Many scholars often advocate the use of shadow prices (also called accounting prices) in order to minimize the disparity between deserved market prices in a real economy and true social values. However, it is not easy to compute shadow prices. Therefore, the use of international prices, instead of shadow prices, is widely advocated. The chief reason is that international prices, in spite of imperfections such as those caused by export support policies, protectionist tariffs, import restrictions, and dumping, are relatively closer to perfectly competitive prices than domestic market prices, and therefore can serve as "the second best prices" to shadow prices.

The question then is whether domestic market prices are entirely ineffective as a basis for analysis of economic efficiency.

In Korea, as elsewhere, the government purchases staple foodgrains from farmers and sells them to consumers at fixed prices under its grain price policy. This policy has largely influenced the formation of the domestic market prices of agricultural products; so much so in fact that it often seems as though price levels for agricultural products are determined unilaterally and arbitrarily by the government. However, in the course of setting its purchase and release prices of staple foodgrains, the government substantially takes into account the existing market prices, whether on the basis of the production cost or on a parity basis. Moreover, self-sufficiency in staple foodgrains under the country's resource structure has long been pursued as one of the Korea's primary policy goals. Therefore, it may be that the government purchase and release prices of staple foodgrains squarely represent the social values which Korea's national economy places on these products.

In view of the severe fluctuations of international prices that followed the international resource crisis in 1973, it is obvious that there is little or no difference between domestic prices and international prices in that they are both formed through imperfect competition. In this analysis,

therefore, investment efficiency is computed in two ways--one based on the evaluation of benefits and costs in terms of international prices and the other based on the evaluation in terms of domestic prices (taking the government financial support into consideration).

The wage problem that arises in the case of a steep decrease in employment opportunities will be dealt with later in a separate sector. However, the problem of possible price distortions caused by external diseconomies will not be taken up in this analysis.

(2) Effective rate of foreign exchange

Due to the existence of various export subsidies and import taxes, the current official exchange rate (₩484=US$1) understates the value of the foreign exchange used in valuing the internationally traded commodities. A study made by the Korea Development Institute estimates the effective exchange rate (the one that would prevail in the absence of trade barriers) as ₩560=US$1, approximately 15 percent higher than the official rate accordingly, this rate was used wherever the international prices were applied in this study.

(Table 3-14) Estimation of Effective Exchange Rate, 1970-76.

Unit: Won

Classification	'70	'71	'72	'73	'74	'75	'76
Nominal Official Rate	311.1	350.8	394.0	398.3	406.0	454.0	484.0
Subsidy Per $ Export							
Interest Subsidy	13.6	16.0	10.1	5.8	5.9	9.0	8.7
Direct Tax Exemption	3.6	5.1	2.0	1.4	-	-	-
Indirect Tax "	28.5	34.1	27.2	21.3	22.8	33.3	33.6
Custom Duties "	42.6	50.9	68.5	65.4	55.8	33.8	33.4
Discount on Electricity	0.1	0.1	0.1	-	-	0.1	0.1
Sub-total	88.4	106.2	107.9	93.9	84.5	76.2	75.8
Nominal Effective Rate	399.5	457.0	501.9	492.2	490.5	560.2	559.8

Source: Korea Development Institute

(3) Product prices

In the case of applying domestic prices for rice and barley, 1976 farm gate prices were used after taking into consideration the price subsidy (deficit in the Grain Management Fund) due to two price system for rice and barley. For Tongil rice, 90% of the price of the conventional rice was applied because of its lower quality. For other agricultural products, the annual average farm gate prices in 1976, weighted at the monthly transaction volumes, were applied.

(Table 3-15) 1976 Domestic perices of farm products (Adjusted to price subsidies)

Unit: Won/Kg

Commodity	Price	Remarks
Rice	276.63[a/]	Adjusted to price subsidies
Common Barley	122.95[b/]	"
Naked Barley	115.28[b/]	"
Soybean	237.79	Farm gate price
Roddish	36.53	"
Chinese Cabbage	38.13	"
Sweet Potato	62.13	"
White Potato	69.33	"
Red Pepper	1,116.67	

(Table 3-15) con't

Commodity	Price	Remarks
Tobacco	590.00	Farm gate price
Sesame	968.06	"
Green Onion	80.27	"

a/ Computation basis for rice price

1975 rice production	4,669,000 M/T
Gov't (GMSA) deficit due to price subsidy	19.7 billion won
Price subsidy per kg	₩4.22
1976 farm gate price per kg	₩280.85
280.85 - 4.22	= ₩276.63

b/ Computation basis for prices of common barley and naked barley:

1976 total barley production	1,759,000 M/T
Gov't (GMSA) deficit due to price subsidy	280 billion won
Price subsidy per kg	₩15.91
1976 farm gate price per kg	
Common barley	₩138.86
Naked barley	₩131.19
138.86 - 15.91 =	₩122.95
131.19 - 15.91 =	₩115.28

Source : NACF, Agricultural Statistics Yearbook, MAF 1975-1976.

The international prices were applied only in the case of rice, barley and soybean. In the case of rice, the applied price was the 1976 U.S. export price of Californian Pearl, quality of which is similar to the Korean rice, plus the ocean freight and stevedoring costs. The price was $427 per metric ton. As compared with the price for Thai rice (5% broken) of $271 per metric ton, the price is 57.6 percent higher. In the case of barley, the price of $138.13 per metric ton in 1976 plus ocean freight and stevedoring costs was applied.

(Table 3-16) 1976 international market prices of rice, barley and soybean per M/T.

Classification	Rice	Barley	Soybean
FOB price ($)	410.00[a/]	121.13	224.75
Ocean freight ($)	15.00	15.00	15.00
Stevedoring ($)	2.00	2.00	2.00
Total	427.00	138.13	241.75
Coverted to Won (Won)	239,120[b/]	77,352	135,380
Per Kg	239.12	77.35	135.38

a/ 1976 price of USA Californian Pearl

b/ Applied ₩560 per $.

Source : Food Bureau, Ministry of Agriculture and Fisheries.

(4) Input factor prices

Rural wages

In the subsistance type of farming which is highly dependent on family labor, the valuation of family labor cost raises quite a few problems. The cost of production factors used in production refers to the value of that part consumed in the course of production. In the case of family labor, theoretically it may be considered to be the value of living necessities based on the cost of needed for the reproduction of labor forces. In practice, however, the actual computation is almost impossible.

One conceivable method is to estimate potential wages taking into account the employment opportunities in rural areas in light of the concept of opportunity cost. Since there still remains seasonal unemployment. In the rural areas of the nation this method refers to one under which the potential wages are estimated by applying an annual cost rate.

With the rapid development of industry, the non-agricultural employment opportunity has been growing. Not only that, quite a few rural population has migrated into the urban industrial areas. Even in the future, the large segment

of the rural population is anticipated to move to the urban areas. Accordingly, the attempted evaluation under the concept of opportunity cost, with the application of the seasonal unemployment rate, can hardly escape its imperfectness at this moment.

In this study, therefore, the estimation of rural wages in consideration of the seasonal unemployment rate was taken only as a reference. For the computation of actual wages, the daily average rural wage rate of ₩1,903 in 1976 was applied for the hired farm labor. For family labor, an amount of ₩1,308 remaining after the deduction of food cost of ₩595, which is no cash expenditure, from the wages for employed farm hands, was applied.1/

During the past several years, the real wages in rural areas have been rising continuously. The real wages are expected to continue to rise. The real wages (at the 1976

1/ Shadow wages in consideration of the seasonal unemployment rate are estimated as follows.

According to the result of farmhousehold economy survey conducted by the Ministry of Agriculture and Forestry, an annually average number of work days during the 1973-75 period was 192 days. Assuming that the number of full employed days in a year is 260 days, the average rural employment rate is calculated at 75.8 percent. When this rate is applied to rural wages, the shadow wage is ₩1,442 daily, which is ₩134 higher than ₩1,308 applied in this study.

constant market prices) during the three-year period (1977-79) after the implementation of the project were projected on the basis of the past trends for the application in the computation of the internal rate of return. Table 3-17 shows the results of the projections.

(Table 3-17) Projection of Rural Wages, 1974-1979[a/]

Unit: Won per day

Year	Index	Family labor	Hired labor
1974	87.3	1,142	1,661
75	88.0	1,163	1,692
76	100.0	1,308	1,903
77	104.9	1,372	1,996
78	109.8	1,436	2.089
79	114.7	1,500	2,183

a/ Those for 1974-76 based on NACF survey. Those for 1977-79 based on projection.

Source: NACF, Agricultural Statistics Yearbook, 1974-76.

Fertilizer Price

When domestic prices were applied for rice and in the calculation of IRR, the domestic prices for fertilizer were also applied for fertilizer input. In the event of applying international prices, the world market prices were also applied for fertilizer.

It must be noted that up to 1974 the government had compensated for deficit in its fertilizer account in setting the fertilizer sales prices to farmers. But the provision of government subsidy for fertilizer prices has been virtually suspended since 1975. Accordingly, it will be reasonable to apply the NACF's fertilizer selling prices to farmers without modification. For compost, the price of ₩5 per metric ton was applied according to the evaluation made by the Agricultural Development Corporation.

Table 3-18 shows the domestic prices and world market prices of fertilizer. The world market prices are calculated on the basis of IBRD, Price Prospects for Major Primary Commodities, Report No. 8/4/77, June 1977.

(Table 3-18) 1976 Fertilizer Prices

Unit: Won per kg of plant nutrient

Type	Domestic Price	International Price
N	265.74	137.60
P_2O_5	184.00	110.80
K_2O	70.11	51.30

Source : NACF, Agricultural Statistics Yearbook, 1976.
IBRD, Price Prospects for Major Primary Commodities, Report No. 814/77, June 1977.

Seed Prices

In the case of conventional rice, Tongil rice varieties, barley and naked barley, the 1975 government purchase prices for the unhulled Grade-1 products were applied. For soybean the 1976 government purchase price was applied, for seed potatoes, raddish, cabbage and red pepper, the prices paid by farmers in the planting season were applied. And for sesame, the price received by farmers was used.

(Table 3-19) Seed and Seedling Prices

Crop	Unit	Price Won	Remarks
Cerdinary Rice	Kg	183.89	1975 gov't purchase price
Tongil Rice	"	211.48	"
Common Barley	"	103.04	"
Naked Barley	"	110.97	"
Soybean	L	207.81	1976 gov't purchase price
Whitepotato	Kg	86.40	1976 prices paid by farmers
Sweetpotato	"	77.67	"
Raddish	L	1,515.00	"
Chinese Cabbage	"	1,685.00	"
Red Pepper	dL	225.00	"
Sesame	L	660.22	"

Source : NACF, Agricultural, Statistics Yearbook, 1975-76.

3) Cost estimate

(1) Investment costs

Investment costs consist of net construction cost, material cost, land purchase and compensation cost, survey and design cost, work supervision cost, work management cost, interest on long-term loans, miscellaneous cost, and repairing and maintenance cost. In the case of AID loan projects, the cost incurred for paddy rearrangement is additionally required. Of those investment costs, interest on long-term loans has been excluded from the computation of IRR. Land Purchase and compensation cost includes the land purchasing cost for the inundated land, for opening canals, for construction of a reservoir and the compensation money paid to resettlers.

Prior to the implementation of this project, farm crops were cultivated on the whole or part of the land. It might be reasonable, in principle, to exclude the land purchasing cost from the investment cost items, in return for taking into consideration the return of farm crops prior to the implementation of the project in the computation of IRR. Theoretically, however, the land price itself reflects the total amount of investment return in the future, and is sacrificed by the

implementation of the project. Accordingly, the land purchasing cost has been included in the investment cost for the computation of IRR.

Appendix Table I shows investment costs by project district at the current market prices.

(2) Operation and maintenance cost

In the case of the AID loan projects, the irrigation facilities were put into operation in 1976, the first year after the completion of the project. Accordingly, the data provided by the competent farmland improvement associations (cooperatives) were used. In the case of the IBRD loan projects, the national average operation and maintenance cost per hectare projected by the Agricultural Development Corporation (ADC) was applied over the service life period of each project since no irrigation has been made available by 1976.

(Table 3-20) Operation and maintenance cost per ha by scale of benefited area.

Unit: Won/Ha

Scale	Reservoir	Pumping Station
Less than 300ha	40,000	55,600
300 - 1,000ha	39,000	54,210
1,000 - 2,000ha	33,000	45,870
More than 2,000ha	24,000	33,360

Source : Agricultural Development Corporation

3) Replacement cost

In the cost estimate, the assumption was made that in the reservoir areas there will be no replacement of facilities during the service life period. Even when there is an investment for partial replacement, such cost was considered to be incorporated in the operation and maintenance cost since it is of the nature of maintenance.

In the case of a pumping station, the durability of basic structure is different from that of pumping equipments. Accordingly, it is imperative to take a replacement investment into account. In the case of the Taean and Kahung pumping stations, it was assumed that the water pumps and motors be

replaced in every 20 years. Table 3-21 shows the replacement costs on facilities.

(Table 3-21) Replacement costs by equipment for pumping station

District	Equipment	Standard	Number of equipment	1977 Price
			ea	Won/ea
Taean	Pump	500mm	2	4,824,000
	Motor pumping capacity	200HPx6Px3.3KV 0.880m^3/sec	2	2,394,000
Kahung	Pump	350mm		2,706,000
	Motor pumping capacity	225HPx6Px3.3KV 0.482m^3/sec		2,890,000

Source: Kiho Farmland Improvement Association for Taean District.
Chungwon Farmland Improvement Association for Kahung District.

(4) Project life and residual values

The project service life was set at 60 years in the case of reservoirs and at 40 years in the case of pumping stations. The residual value of facilities was projected at 20 percent of the total investment for reservoirs and 25 percent for pumping stations.

(Table 3-22) Durability and residual value by facility

Facility	Durability	Residual Value
Reservoir	60 years	20% of construction costs
Pumping station	40 "	25% of construction costs

Source : Agricultural Development Corporation

4) Farming cost estimates

Farming cost has been projected on the basis of the data made available by conducting a crop-by-crop budget survey for 20 benefitted farm households selected in each project district. For the AID loan projects, the survey has been conducted on farm budgets for two years, 1975, the year immediately preceding to the implementation of the project, 1976, the year following the implementation of the project. For the IBRD loan projects, only the farm budgets for 1976, the year immediately preceding to the implementation of the project, was surveyed. The farm budget for 1977 was projected on the basis of the data made available by the survey conducted in the AID loan project districts.

In addition, the farming costs by crop have been

projected up to the year of 1979 on the basis of the past trends for each item, assuming that such major component items as labor input and fertilizer and pesticide input will change along with the improvement of farming methods. For the years following 1979, the identical levels of cost were applied.

The farming cost items surveyed include seed cost, fertilizer cost (N, P, K and compost manure), plant disease and blight prevention cost, labor cost (family labor and hired), and other costs. The project methods are explained in this Chapter only on fertilizer, plant disease and blight prevention cost, and labor cost.

(1) Fertilizer

On rice crop, an annual average increased input per hectare was projected on the basis of the national average use per hectare during the 1971-75 period. The projected increase in use was added to the surveyed values by district in 1976 for the projection of the fertilizer cost up to 1979. The fertilizer input in the following years was assumed to be at the identical level.

In plant nutrient basis, the increase in input for rice has been projected at 12 kilograms per hectare on annual

averages in the case of nitrogen, 7.7 kilograms of phosphates, and 6.0 kilograms of potash, respectively.

Table 3-23 shows the national average fertilizer input by nutrient per hectare and the annual average increase in input during the 1971-75 period.

(Table 3-23) National average fertilizer application for rice and barley, 1971-75.

Unit: Kg/Ha in plant nutrient

Year	Rice			Common Barley			Naked Barley		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1971	141	18	7	152	13	2	227	16	6
72	180	34	9	234	30	4	202	38	4
73	142	41	10	165	13	5	189	41	5
74	168	41	21	250	37	2	194	35	6
75	207	53	31	193	56	7	238	89	23
Annual Rate of Increase	12.0	7.7	6.0	4.0	2.0	2.0	4.0	2.0	2.0

Source: Cost of production survey for major agricultural products, 1971-75, Ministry of Agriculture and Fisheries.

(2) Pesticides

Plant disease and blight prevention cost for the years up 1979 has been projected under the trend equation based on the national average actual cost per hectare during the 1965-75 period (at constant 1976 market prices); and for the succeeding years, the same level of cost was assumed. The national average actual input cost per hectare during the 1965-75 period and the projected trend equation are as follows.

(Table 3-24) National average pesticides application for rice, 1965-75.

Unit : Won/Ha

Year	Amount of pesticides	Year	Amount of pesticides
1965	870	1971	2,280
66	860	72	3,020
67	1,110	73	2,770
68	1,360	74	2,230
69	1,610	75	4,480
70	2,400		

Trend Equation: Est = 317.3 +- 293.5 (t=4.83)

Source : Cost of production survey for major agricultural products 1965-75, Ministry of Agriculture and Fisheries.

(3) Labor

Labor cost refers to that calculated by multiplying wages by the number of man days. With a progress being made in farm mechanization, the cultivation of farm crops shows a trend of decrease in manual labor. Anticipating that labor input will continue to decrease in the future, the trend equation was estimated by classifing labor into "family labor and hired labor" on the basis of the national average number of labor input days per hectare during the 1967-76 period. From this, the number of labor input days per hectare up to 1979 was projected, assuming that the years from 1979 it will be maintained at the same level.

The following shows the number of labor input days per hectare by crop and the estimately trend equation.

(Table 3-25) National average labor input per ha for rice and barley

Unit: Day/Ha

Year	Rice		Common barley		Naked barley	
	Family	Hired	Family	Hired	Family	Hired
1967	-	-	83.0	18.1	78.9	27.8
68	88.7	48.0	78.3	16.8	74.6	24.7
69	88.8	44.2	72.4	12.5	65.6	23.1
70	86.1	42.1	78.3	10.9	70.2	18.7
71	91.5	36.9	71.9	11.5	83.7	18.3
72	87.9	34.4	77.4	9.4	85.9	15.2
73	91.1	32.4	78.8	10.6	77.7	19.1
74	83.6	31.8	70.9	10.2	76.6	16.1
75	75.8	37.8	63.7	11.1	66.9	20.0
76	69.9	47.7	56.2	11.9	51.3	20.4

Trend Equation:

(1) Rice
Family labor RLF = 94.8 - 1.99 T (t=2.94)
Hired labor RLH = 43.3 - .76 T (.93)

(2) Common barley
Family labor CLF = 84.6 - 2.08 T (3.57)
Hired labor CLH = 16.0 - .67 T (2.82)

(3) Naked barley
Family labor NLF = 80.6 - 1.35 T (1.25)
Hired labor NLH = 24.9 - .83 T (2.39)

5) Revenue estimates

A gross return from irrigation investment refers to the income from crop cultivation and income from by-products. Farm crop income is calculated by multiplying the output by the price. Since the applicable prices for farm crops were already discussed, discussions in this section will be made on an increase in crop yield and by-product income.

(1) Increase in crop yield

Agricultural water resources development projects, in general, are designed to develop unirrigated paddy fields, rain-fed paddies, upland fields or forest land into fully irrigated paddy fields. In the early days of the project implementation, the increasing speed of crop yield per unit area is bound to be slow. Since time goes by and soil fertility increases, the effect of irrigation water will appear fully only after it adapts to changes in the crop planting structure.

In this analysis, therefore, the ratio to full production level was projected at 80 percent in the first year after the completion of the project, at 90 percent in the second year and at 100 percent in the third year, in the event of converting the upland field, forest land or miscellaneous land, which have

latively low productivity, into paddy fields.

In addition to the enhancement of soil capacity through irrigation, the crop yield increases on account of other factors, such as an improvement of the farming method. To reflect this point, the trend of increase was projected by means of trend equation estimated on the basis of the national average yield in the past; and on that basis, the crop yield per hectare was forecast for three years after the completion of the project (1977-79).

More specifically, the methods for projection of crop yield per hectare are as follows:

First, in the case of the three IBRD project districts-Taean, Kahung and Jipyong districts, the yields per hectare for 1978 and 1979 following the completion of the project were projected by applying the annual average increase trend value obtained from the foregoing annual ratio to full pro-duction level and the trend equation. And the same level of yield is assumed for the following years up to the project life.

Second, for the rest of the three IBRD projects-Insan, Hanke and Kwangchon districts-the crop yield survey was conducted only for 1977, the year immediately preceding to the project

implementation. Accordingly, it was impossible to compare the yield before and after the project implementation. The comparative study was made on the basis of the survey data that were available for the three IBRD and AID projects, where the actual measurement of crop yields were possible with and without the project implementation.

Third. in the case of the three AID project districts, since the paddy rearrangement projects were implemented together with the irrigation and drainage projects, the yield was projected by adding 7 percent of the yield in the base year as the possible effects of those projects. Table 3-26 shows the trend equation for yield per hectare projected by utilizing yield data of the 1965-76 period, as a result of the projection of annual yield per hectare by district.

(Table 3-26) Projection of yield per ha by crop by district

Unit : Kg / ha

Crop.	Taean				Kahung				Jipyong				Insan				Hanke				Kwangchon			
	1976	1977	1978	1979	1976	1977	1978	1979	1976	1977	1978	1979	1977	1978	1979	1980	1977	1978	1979	1980	1977	1978	1979	1980
Conventional Rice	3,390	3,870	4,050	4,170	3,050	3,540	3,630	3,750	3,360	3,690	3,820	3,945	4,200	4,790	4,920	5,040	3,600	4,180	4,410	4,530	4,020	4,620	4,740	4,860
Tongil Rice	4,250	4,770	5,180	5,180	3,950	4,540	4,810	4,930	4,150	4,570	4,690	4,810	4,800	5,420	5,540	5,660	5,000	5,750	5,820	5,990	4,900	5,650	5,770	5,870
Barley	1,960	1,270	2,080	2,080	2,050	1,180	2,150	2,200	2,250	1,400	2,350	2,400	-	-	-	-	1,100	2,150	2,200	2,250	1,800	2,100	2,160	2,210
Soybean	1,250				910												1,070							
Raddish	15,630				12,990												14,500							
Chinese Cabbage	15,090																13,500							
Sweetpotato	-				15,600												18,800							
Whitepotato	12,500				14,600												9,500							
Redpepper	1,710				1,780												1,780							
Tobacco					2,120												2,150							
Sesame	610				720												750							
Green Onion	13,000																-							

(Table 3-26) con'd

Crop.	Jongan				Songwol				Jungbuk			
	1975	1976	1977	1978	1974	1975	1976	1977	1975	1976	1977	1978
Conventional Rice	3,430	3,940	4,280	4,510	3,380	3,890	4,010	4,290	3,010	3,470	3,710	3,970
Tongil Rice	4,210	4,850	5,750	5,070	3,660	4,280	4,400	4,910	4,210	4,840	5,980	5,290
Barley	1,940	2,060	1,610	2,220	1,880	2,080	2,210	1,460	2,290	2,430	1,090	2,640
Soybean	1,310				1,090							
Raddish	21,070											
Chinese Cabbage	22,620											
Sweetpotato	18,850				17,620							
Redpepper	1,520											

Trend equations based on 11 years field data (1965-75) for rice:

1) National average

$$AR = \underset{(20.19)}{2,988.4} + \underset{(5.56)}{121.2}\ T \quad (R^2 = 0.774)$$

2) Partially irrigated paddy

$$PIR = \underset{(17.29)}{2,772.7} + \underset{(4.77)}{112.7\ T} \quad (R^2 = 0.716)$$

3) Fully irrigated paddy

$$FIR = \underset{(23.41)}{3,145.5} + \underset{(5.92)}{117.3\ T} \quad (R^2) = 0.796)$$

Source : Agricultural statistics yearbook, 1965-75, Ministry of Agriculture and Fisheries.

(2) Byproducts

For the calculation of income from agricultural byproducts, we employed the byproduct ratio to the income from agricultural producd in the surveyed districts or their vicinities, which appears in the analysis report on "standard profitability of agricultural and livestock products" by area surveyed and projected by the National Agricultural Economic Research Institute.

The following table shows the ratio of byproduct income by district and by crop.

(Table 3-27) Ratio of the value of byproducts to that of main products.

Crop.	Taean %	Kahung %	Jipyong %	Jongan %	Songwol %	Jugbuk %
Conventional	6.2	7.6	8.9	6.9	9.4	7.2
Tongil Rice	3.1	3.8	4.5	3.5	4.8	4.0
Common Barley	5.3	5.3	5.3	5.3	-	-
Naked Barley	-	-	-	-	5.6	5.6
Soybean	9.2	9.0	-	9.7	-	-
Whitepotato	0.6	0.6	-	0.6	-	-
Sweetpotato	-	13.8	-	13.8	-	-
Radish	0	0	-	0	-	-
Chinese Cabbage	0	-	-	-	-	-
Red Pepper	1.2	1.3	-	1.2	-	-
Sesame	1.3	1.5	-	1.4	-	-
Tobacco	-	1.2	-	-	-	-

Source: National Agricultural Economic Research Institute

6) Calculation of internal rate of return

(1) Formula used for actual calculation

Regarding the actual computation of internal rate of investment, three formula are available depending on how the operation and maintenance cost, and farming costs are treated.

In one formula the difference in gross revenue without and with the implementation of the project is treated as revenue, while the difference in farming cost without and with the implementation of the project is included in the project cost, together with the operation and maintenance costs.

To explain more especifically by formula,

$$\frac{B}{C} = \frac{\sum_{i=0}^{n} \frac{bi}{(1+R)^i}}{\sum_{i=0}^{n} \frac{Ci}{(1+R)^i}} = 1$$

In this formula, only the difference in gross agricultural income is included in to numerator , and the sum of the investment cost, the operation and maintenance and the difference in farming cost is included in the denominator

In another formula, the added net return after subtracting the balance of farming cost from the balance of gross

agricultural income is included in the numerator, while denominator covers both the project cost and the operation and maintenance cost.

In the third formula, the amount after subtracting both the balance of the farming cost and the operation and maintenance cost from the balance of gross agricultural revenue is included in the numerator bi , while the denominator ci concerns only the investment cost. There is no measurable difference in the results of computations using the three formulas, but the meaning of each formula becomes different depending on what items are treated as investment, since IRR means, in concept, the earning power of capital invested.

The first formula concerns the efficiency of capital as seen from the standpoint of the national economy, in the sense that farming cost funded by farmers or the cost operation and maintenance funded by responsible associations can be regarded as the investment of capital to contribute to the formation of social capital, like facility investments. The second formula concerns the efficiency of capital as measured from the standpoint of farmland improvement associations since farming cost is regarded as liquid cost involving farmers who are the units in

agricultural management, while the cost of maintenance and management is treated as the investment of capital by those who undertake and manage the project. The third formula concerns the efficiency of capital as measured from the standpoint of the government, which is the principle source of funds to finance the investment.

In this report, the second formula, widely used in other countries and recommended by the IBRD, is used to compute the internal rate of return.

(2) The result of calculation

As for the three AID-financed projects, and three IBRD progects currently in operation the estimated revenue and cost are computed on the basis of data spanning one or two year; before and after the implementation of the project, and then based on that estimate the investment rate of return is computed. Thus the result is, in part, a postproject evaluation. In a strict sense, however, the result should be regarded as a prior evaluation, since the revenue and and cost for the first threee years following the implementation of the project are based on estimates.

But for the three IBRD-financed projects, not in

operation for 1977 crop, the profit and cost during the post-project period of 1978-80 are estimated on the basis of data obtained in 1977 before the completion of the irrigation project, and then based on that estimate the internal rate of returns are computed. In this light, the result of the computation is in nature of advance evaluation, i.e., feasibility study.

Table 3-28 presents the internal rate of return as computed by applying domestic prices and international prices. The table shows that the internal rate of returns for the IBRD-financed projects are much higher than those for the AID-financed projects.

The main reason for such a difference lies in the fact that while the investment period covered only tow years for new projects in the case of the IBRD-financed project, the AID-financed projects not new ones but involved new funding for unfinished projects funded by domestic capital years ago, and, therefore, there is a possibility of double investment due to the reconstruction of some parts of the facilities that had been damaged or lost after the initial implementation started years ago. In addition, the AID-financed projects required a long period of investment, four to seven years, and, for this

reason, the cost of investment is greatly overevaluated in the course of converting to the prevent value in the IRR computation.

Among the IBRD-financed projects, the rate of return is especially high in the Jipyong district, mainly because the unit project cost per hectare was only half the amount required in other district as the Jipyong project was within the sphere of irrigation before the implementation of project, and weirs have been developed as a supplementary project.

Table 2-29 concerns the effect of increased output per hectare, plus several factors influencing IRR. The unit project cost and the period of projects apparently have great bearings on the size of IRR.

7) Sensitivity tests

In order to examine the influence on project feasibility of different price conditions for major products and higher rate of increase in rural wages, six sensitivity analyses were performed as shown in the following table.

(Table 3-30) The results of sensitivity analysis of IRR.

Test	Taean	Kahung	Jipyong	Insan	Hanke
Test No,1	16.4	14.9	18.9	3.1	16.3
Test No,2	17.1	15.5	20.4	3.2	21.6
Test No,3	18.2	16.1	19.8	4.2	15.0
Test No,4	35.2	37.7	37.8	6.7	32.2
Test No,5	18.7	17.5	23.2	5.1	23.5
Test No,6	37.1	39.3	40.0	7.4	33.8

Test	Kwangchon	Jongan	Songwol	Jungbuk
Test No,1	5.8	13.1	9.7	6.4
Test No,2	6.0	12.7	9.4	6.6
Test No,3	7.2	13.0	10.9	6.2
Test No,4	9.4	17.9	16.5	10.6
Test No,5	7.2	13.0	7.8	7.2
Test No,6	10.4	18.2	14.8	11.1

(Table 3-28) Computed IRR by project district

District	I B R D Project district							A I D Project district				Totol
Prices	Taean	Kahung	Zipyong	Insan	Hanke	Kwangchon	Average	Jongan	Songwol	Jungbuk	Average	IBRD+AID
Applying a/ domestic price	18.0	16.9	21.7	3.9	18.3	7.0	12.0	13.4	9.7	6.8	10.3	11.1
Applying World b/ market price	19.7	16.8	22.4	4.9	17.1	7.2	12.3	13.4	10.9	6.7	10.4	11.3

a/ Applied 1976 farm gate prices adjusted for the GMF deficit.
b/ Applied 1976 world market price for rice (USA Californian pearl).

(Table 3-29) Major factors affecting IRR

Factors	I B R D Project						A I D Project		
	Taean	Kahung	Jipyong	Insan	Hanke	Kwangchon	Jongan	Songwol	Jungbuk
Yield increase per ha (Kg)	910	750	550	620	750	600	1110	670	860
Investment per ha (1,000Won) a/	1.029	1.032	558	4,072	1,812	2,875	2,329	2,820	3,773
Construction period (year)	2	2	2	2	2	2	7	4	5
Paddy conversion (%)	25	40	0	0	35	10	13	0	10

a/ 1976 constant prices.

Source : Actual Survey Data.

Note: 1. Test No.1 Applied 1976 farm gate prices adjusted to the GMF deficit and assumed the annual rate of increase in rural wage at 10%.

2. Test No.2 Applied 1976 farm gate prices (not adjusted) and assumed the annual rate of increase in rural wage at 10%

3. Test No.3 Applied 1976 world market price projected by IBRD and assumed the annual rate of increase in rural wage at 10%.

4. Test No.4 Applied 1985 world market prices (1976 constant prices) projected by IBRD and assumed the annual rate of increase in rural wage at 10%.

5. Test No.5 Applied 1976 farm gate prices (not adjusted) and assumed the annual rate of increase in rural wage at 5%.

6. Test No.6 Applied 1985 world market prices (1976 constant market price) projected by IBRD and assumed the annual rate of increase in rural wage at 5%.

IV. Conclusion and policy Recommendations

1. Conclusion

In evaluating benefits and costs arising in the irrigation investment projects, this study was conducted on small and medium scale irrigation projects. Accordingly, secondary effects, such as the development of tourism, scenic and recreational areas, were considered very low. Even when such effects may take place depending on project area, it is extremely difficult to measure. Moreover, there are no market prices for such, the correlation effects were excluded from the objects of analysis.

Only those items which can be measured and valued at currency units were included in benefits and costs. In addition, internal rate of return (IRR's) now most extensively used as an indicator of investment efficiency were calculated.

IRR's were computed by applying the domestic prices and international prices for each sample project. For the domestic prices, the 1976 farm gate prices were applied in consideration of the deficit in the Grain Management Fund resulting from the payment of price subsidies. For international prices, the 1976 FOB price ($410/MT) for Californian Pearl was applied in the

case of rice.

According to the result of this calculation, the IRR's in the case of applying domestic prices were projected at 12.0 percent for all IBRD loan projects and at 10.3 percent for all AID loan projects. In the event of applying international prices, the IRR's were 12.3 percent for all IBRD projects and 10.4 percent for all AID projects.

The IRR's loan projects were higher than those of AID loan projects. This is ascribable chiefly to the fact that the construction period for the IBRD projects was two years, while in the case of AID projects as residual projects, it has already taken four to seven years before completion. Accordingly, in the calculation of IRR's, the investment cost has been evaluated high in the case of the AID projects.

According to the preliminary feasibility study conducted by the IBRD team on the IBRD loan projects, the IRR was 12.6 percent using international prices, which is slightly higher than 10.4 percent computed in the present study.

For direct effects of agricultural irrigation investment, the following examples may be cited; the development of farmland base, increase in the yield per hectare, changes in cropping

patterns, economization of labor, increase in labor productivity and increase in profitability per hectare.

First, 988.5 hectares of unirrigated paddies and 280.0 hectares of upland were irrigated, in the case of the three IBRD loan projects selected as sample. Second, when the paddies reach their full production level three years after the project, the rice yield per hectare is expected to increase by 15 to 20 percent from 1976.

Third, in cropping patterns, there was not particular change before and after the project implementation in the case of rice paddy, barley being cultivated as a second crop in most cases. In the case of upland farming, the crop items vary by area. Before the project implementation, barley was cultivated as first crop and soybeans, sweet potatoes, sesame, cabbages and radish as second crops. With the development of paddies, such crop items have disappeared. Instead, barley and naked barley became the major second crop items.

In rice cultivation, the double crop ratio has been evidently rising chiefly for the following reasons:

With the expansion of irrigation facilities, the cultivated area of high-yielding Tongil rice variety expanded remarkably:

the harvesting period could be advanced with the rice transplanting generally 10 days ahead on the average; and accordingly, it was possible to avoid the duplicate employment of labor forces during the barley sowing period.

Fourth, for the expansion of irrigation and drainage facilities, the number of work days required for the irrigation and drainage work could be reduced through the reasonable water management. An increase in yield per hectare and a reduction of labor input through the implementation of the projects, resulted in increasing the labor productivity by 26 to 44 percent in paddy rice farming.

Fifth, with the expansion of irrigation facilities, it was possible to convert the low-productive upland crop farming to the paddy crop farming, which is relatively superior in terms of yield. A steady supply of water has led to an increase in the planted area of Tongil rice variety. As a result, the net benefit per hectare has grown 15 to 40 percent, as compared with that before the implementation of the projects.

2. Policy Recommendation

1). Although it is difficult to make an accurate assessment of the actual conditions of the facilities, considerable portion

of the existing irrigation and drainage systems seems to be in obsolescent or near-obsolescent status due to lack of repairs in scores of years, impeding their normal function. It is necessary that the government conducts a nation-wide survey on the operation status of the existing facilities and launch large-scale repairing projects so as to ensure the full display of their original capacity.

2). Government has placed a major emphasis on farm mechanization since early 1970's, with a view to alleviating the rural labor shortages. But the small size of field plot and irregularity of foot path and partition has been main obstacle for mechanization. As of 1978, only 24 percent of the total paddy area has been consolidated. Expansion in paddy consolidation project is a precondition for farm mechanization. Enlargement and improved partition of farm lot, and expansion of farm roads will not only upgrade the efficiency of the mechanized works such as plowing, carrying of products and input materials, pest control, etc., but also promote the expanded cultivation of cash crops through improvement of irrigation and drainage.

3). In Korea, the capital formation capability of farmers themselves is very weak. It is a desirable policy direction

that the government plays a leading role in water resource development projects with government financing. However, since the ultimate goal of the projects is to improve the farmers' living, no agricultural policy will bear its effect if the government should interfere too in detail in the implementation and management of the projects against the free will of the farmers themselves. The existing farmland improvment associations should be developed in the self-supporting direction, so as to operate the associations on the basis of the farmers' own consciousness of ownership. In this respect, the govern-ment's interference should be minimized as far as possible.

4). Despite that the primary functions of the farmland improvement association are construction of irrigation and drainage systems, water control operation and maintenance of facilities, paddy consolidation, and other auxiliary activities related to farmland improvement, the amount of work assignments related to extension services has substially increased in recent years. This increase in workload other than primary function tends to disperse the work efficiency of limited manpower and weaken the original function of the association. It is desirable that the association concentrates its resources and efforts on the

performance of its primary assignments.

5). Because of the hasty attempt to achieve the numerical goals only, they tend to start the projects without fully conducting preliminary research and review. In many cases, therefore, the projects often resulted in a waste of government funds, without an achievement of any fruitful result.

For instance, as part of the 1969-70 drought countering measures, tube well projects were implemented on a nationwide scale with the investment of an enormous amount of budget funds. Part of the tube wells were successful in supplying water. But in most cases, the depth of the wells was not sufficient, with the catchment of water dependent only on ground surface water. In many areas, therefore, the projects ended up as being insolvent. In order to prevent loss from such trials and errors, it will be necessary to conduct the engineering and economic feasibility studies in advance.

6). For securing the operating funds needed throughout the year, the farmland improvement associations have been dependent on high-interest, short-term borrowings which are repayable within the year. Accordingly, the associations bear a considerably large sum of interest burden. Such an amount of interest

burden is reflected in the assessment of association membership dues and shifted to the beneficiary farmers.

For the sound operation of the associations, particularly for the timely implementation of the repair and maintenance projects, it is necessary for the associations to get the government financial support so that they may endeavor to realize their financial self-sufficiency without depending on borrowed capital.

7). The excessive repayment burden on long-term borrowings used by farmland improvement associations for establishment of their facilities was the major cause of insolvent operation of the associations.

Under the present equal installment repayment system of principal, the amount of both principal and interest repayable in the early part of the repayment period is large, while the repayable amount of principal and interest is smaller in latter years. In view of the economic situations in which the inflation is anticipated tocontinue for a considerable period of time in the future, it will be virtually to reduce the actual financial burden on farmers to set the annual, equal repayment system of principal and interest of such loans.

8). As of 1978, the total of approximately 10 billion was accumulated by individual farmland improvement associations as reserve funds. Under the present system, these funds are deposited in the agricultural coops and operated on individual basis by each association. It is desirable that these funds w which are deposited in separate account be pooled together into one account and the mutual credit system be established in the federation of the associations and operated on a nation-wide scale. Such system vill ensure a flexible use of funds by needy associations as well as a rapid accumulation of funds.

9). When an emergency repair and maintenance is required due to an accident occurred in specific area under the jurisdiction of the same farmland improvement association, it is necessary to finance the expenses speedily and effectively. To make this possible, it is recommended that the head of the competent land improvement association be given a discretionary right to temporarily use reserve funds of other district. Such an action is considered efficient for ensuring the speedy maintenance and management of the facilities and smooth operation of the associations.

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A p p e n d i x

I. Investment By District

I-1. Investment by District

Unit: 1,000Won

Districts	Taean District			Kahung District		
Cost Items	1976	1977	Total	1976	1977	Total
Civil Work	117,831	180,729	298,560	90,749	62,214	152,963
Materials	19,117	25,876	44,993	13,024	10,776	23,810
IBRD Materials	19,117	25,876	44,993	11,386	10,163	21,548
Other Materials	-	-	-	1,639	623	2,262
Land Acquisition	70,081	6,192	76,273	24,580	957	25,537
Survey & Design	1,063	-	1,063	2,730	-	2,730
Supervision	11,935	18,967	30,902	7,304	6,396	13,699
Management	2,932	2,908	5,840	879	1,566	2,444
Interest of Long-term Credit	32	5,452	5,484	248	1,933	2,181
Others	30	7,300	7,329	13	3,295	3,308
Repair & Rehabilitation	-	-	-	-	3,503	3,503
ADC Design	5,221	-	-	-	-	-
Total	228,242	247,423	475,665	139,526	90,549	230,176

I-2. Investment

Districts / Cost Items	Jipyong District					
	1975	1976	Total	1968	1969	1970
Civil Work		38,587	38,587			15,659
Materials	12,553	1,383	13,936			2,129
IBRD Materials						
Other Materials						
Land Acquisition						47
Survey & Design		5; 5,252	5,252			1,778
Management		278	278			302
Interest of Long-term Credit		16	16			362
Others						
Repair & Rehabilitation						
Total	12,553	45,515	58,068	20,045		20,276

by District

Unit: 1,000Won

Jongan District							
1971	1972	1973	Sub-total	1974	1975	Sub-total	Total
25,937	42,816	26,189	83,400	38,674	31,134	69,808	153,208
	4,992	1,384	8,505	8,549	589	9,139	17,644
2,002	725	1,010	20,170	20,307	4,169	16,138	36,308
6,028	1,268	1,126	12,356	3,214	3,172	6,386	18,742
1,287	85	208	2,386	957	746	1,703	4,089
746	1,691	2,021	5,021	2,200	3,537	5,737	10,758
	167	140	1,207	57	1,117	1,175	2,381
36,000	49,301	32,078	133,045	73,958	37,265	111,223	244,268

I-3. Investment

Districts	Songwol District						
Cost Items	1972	1973	Sub-total	1974	1975	Sub-total	Total
Civil Work	4,431	9,581	14,012	51,729	5,246	56,975	70,897
Material	-	-	-	7,941	1,475	9,416	9,416
Land Acquisition	120	500	620	3,311	-	3,311	3,931
Survey & Design, Supervision	443	-	443	6,924	537	7,461	7,904
Management	396	331	727	637	-	637	1,363
Interest of Long-term Credit	29	88	117	81	-	81	198
Others	-	-	-	315	-	315	-
	-	-	-	-	-	-	-
Repair & Rehabilitation	-	-	-	-	-	-	-
Total	5,419	10,500	15,919	70,938	7,258	78,196	94,114

by District

Unit: 1,000Won

Jungbuk District

1971	1972	1973	Sub-total	1974	1975	Sub-total	Total
5,500	14,555	1,049	21,104	30,056	245,504	275,570	296,674
	2,628		2,628	435	27,165	27,600	30,227
3,301	11,690	2,570	17,561	11,820	20,002	31,819	49,380
550	1,607	110	2,267	3,156	26,868	30,024	32,291
371	883	588	1,841	426	1,711	2,137	3,978
49	280	699	1,028	812	2,116	2,929	3,956
50	305	95	450	184	1,019	1,203	1,653
9,821	31,947	5,110	46,878	46,897	324,358	371,282	418,160

I-4. Investment by District

Unit: 1,000Won

	Insan District				Hanke District				Gwang Chon District			
	1976	1977	1978	Total	1976	1977	1978	Total	1976	1977	1978	Total
Civil Work	30,340	106,100	26,266	162,706	59,959	120,860	12,575	193,394	47,091	264,798	23,269	335,158
Materials	2,512	19,049	998	22,559	3,865	25,073	-	28,938	6,869	29,872	4,863	41,604
IBRD Materials	2,512	19,049	998	22,559	3,505	22,823	-	26,328	6,319	26,913	4,204	37,436
Other Materials	-	-	-	-	360	2,250	-	2,610	550	2,959	659	4,168
Land Acquisition	175,003	29,742	9,014	213,759	122,170	8,056	-	130,226	298,070	55,401	-	353,551
Suvey and Design	438	-	-	438	-	-	-	-	-	-	-	-
Supewision	3,310	12,514	2,701	18,525	6,381	14,592	1,259	22,232	4,709	30,154	2,813	37,676
Management	867	1,572	786	3,225	2,158	2,445	1,184	5,787	3,287	4,584	553	8,424
Interest of long-tem credit	316	3,737	-	4,053	226	3,432	4,999	8,657	727	7,525	5,841	14,093
Others	260	1,550	-	1,810	53	1,272	937	2,262	879	2,028	2,240	5,147
Repair and Rebabilitation	-	6,300	-	6,300	-	-	-	-	-	-	3,460	3,460
A D C Design	2,441	-	-	2,441	4,069	-	-	4,069	-	-	-	-
Total	215,487	180,564	39,764	435,815	198,881	175,729	20,954	395,564	361,631	394,442	43,039	799,112

II. Net Return and Total Investment By Year

빈 면

II-I Using 1976 Domestic Prices
(GMSA deficit considered)

1976 Domestic Price (GMSA deficit considered)

(Taean District)

Unit: 1,000Won

	Year	Project net return	Total Cost: Construction cost	Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-1	1976	0	228,206				228,206	228,206
0	77	62,232	241,971				241,971	214,334
1	78	88,455				23,334	23,334	20,650
2	79	98,339				23,334	23,334	20,650
19								20,650
20				7,218				28,807
21								20,650
39		98,339				23,334	23,334	20,650
40		186,847				23,334	23,334	20,650

1976 Domestic Price (GMSA deficit considered)

(Kahung District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-1	1976	0	139,279				139,279	139,279
0	77	30,854	88,716				88,716	78,510
1	778	41,757				11,724	11,724	10,376
2	79	46,862				11,724	11,724	10,376
19								10,376
20				6,323				16,699
21								10,376
39		46,862				11,724	11,724	10,376
40		90,420				11,724	11,724	10,376

1976 Domestic Price (GMSA deficit considered)

(Jipyong District)

Unit: 1,000Won

	Year	Project net return	Total cost					
			Construction cost	Replacement cost	Land consolidation cost	OO& M cost	Total cost	1976 constant price
-2	1975	0	500				500	561
-1	76	0	58,068				58,068	58,068
0	77	10,503				4,195	4,195	3,712
1	78	15,583				4,195	4,195	3,712
2	79	18,217				4,195	4,195	3,712
59		18,217				4,195	4,195	3,712
60		32,874				4,195	4,195	3,712

1976 Domestic Price (GMSA deficit considered)

(Jongan District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-7	1969	0	20,045				20,045	58,442
-6	70	0	19,914				19,914	53,105
-5	71	0	35,254				35,254	86,620
-4	72	0	47,610				47,610	102,607
-3	73	0	30,057				30,057	60,599
-2	74	0	71,758				71,758	101,641
-1	75	0	33,728				33,728	37,811
0	76	68,425			22,654	10,268	32,922	32,922
1	77	115,404			83,592	10,268	93,860	83,062
2	78	128,666				10,268	10,268	9,087
59		128,666				10,268	10,268	9,087
60		278,325				10,268	10,268	9,087

1976 Domestic Price (GMSA deficit considered)

(Songwol District)

unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-7	1969	0	20,045				20,045	58,442
-6	70	0	19,914				19,914	53,105
-5	71	0	35,254				35,254	86,620
-4	72	0	47,610				47,610	102,607
-3	73	0	30,057				30,057	60,599
-2	74	0	71,758				71,758	101,641
-1	75	0	33,728				33,728	37,811
0	76	68,425			22,654	10,268	32,922	32,922
1	77	115,404			83,592	10,268	93,860	83,062
2	78	128,666				10,268	10,268	9,087
59		128,666				10,268	10,268	9,087
60		278,325				10,268	10,268	9,087

1976 Domestic Price (GMSA deficit considered)

(Songwol District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-4	1972	0	5,390				5,390	11,616
-3	73	0	10,412				10,412	20,991
-2	74	0	70,857				70,857	100,363
-1	75	0	7,258		50,206		57,464	64,423
0	76	6,185				2,800	2,800	3,164
1	77	8,305				2,800	2,800	3,164
2	78	16,833				2,800	2,800	3,164
3	79	21,400				2,800	2,800	3,164
59		21,400				2,800	2,800	3,164
60		56,677				2,800	2,800	3,164

1976 Domestic price (GLSA deficit considered)

(Insan District)

Unit: 1,000Won

	Year	Project net return	Total cost: Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1976	0	215,171				215,171	215,171
-1	77	0	176,827				176,827	160,606
0	78	15,598	39,764				39,764	31,404
1	79	18,023				4,005	4,005	2,775
2	80	20,553				4,005	4,005	2,775
59		20,553				4,005	4,005	2,775
60		102,732				4,005	4,005	2,775

1976 Domestic Price (GMSA deficit considered)

(Hangye District)

Unit: 1,000Won)

-	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-2	1976	0	198,655				198,655	198,655
-1	77	0	172,297				172,297	156,491
0	78	71,498	15,955				15,955	12,601
1	79	73,720				8,100	8,100	5,611
2	80	80,912				8,100	8,100	5,611
59		80,912				8,100	8,100	5,611
60		155,920				8,100	8,100	5,611

1976 Domestic Price (GTSA deficit considered)

(Gwang cheon District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1976	0	360,904				360,904	360,904
-1	77	0	386,917				386,917	351,423
0	78	52,923	37,198				37,198	29,378
1	79	58,605				10,320	10,320	7,149
2	80	64,517				10,320	10,320	7,149
59		64,517				10,320	10,320	7,149
60		215,293				10,320	10,320	7,149

1976 Domestic Price (GNSA deficit considered)

(Jungbuk District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total Cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-5	1971	0	9,772				9,772	24,009
-4	72	0	31,667				31,667	68,248
-3	73	0	4,411				4,411	8,894
-2	74	0	46,085				46,085	65,276
-1	75	0	322,269				322,269	361,288
0	76	36,205			31,491	7,560	39,051	39,051
1	77	28,482			172,896	7,560	180,456	159,696
2	78	59,972				7,560	7,560	6,690
59		59,972				7,560	7,560	6,690
60		326,108				7,560	7,560	6,690

II-2 Using 1976 World Market Prices

1976 World Market Price

(Taean District)

Unit: 1,000Won

Year		Project net return	Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-1	1976	0	228,206				228,206	228,206
0	77	71,625	241,971				241,971	214,334
1	78	95,217				23,334	23,334	20,650
2	79	104,343				23,334	23,334	20,650
								20,650
20				7,218				28,807
								20,650
39		104,343				23,334	23,334	20,650
40		192,851				23,334	23,334	20,650

1976 World Market Price

(Kahung District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-1	1976	0	139,279				139,279	139,279
0	77	31,969	88,716				88,716	78,510
1	78	41,587				11,724	11,724	10,376
2	79	46,184				11,724	11,724	10,376
								10,376
20				6,323				16,699
								10,376
39		46,184				11,724	11,724	10,376
40		89,742				11,724	11,724	10,376

1976 World Market Price

(Jipyong District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1975	0	500				500	561
-1	76	0	58,068				58,068	58,068
0	77	11.874				4,195	4,195	3,712
1	78	15,883				4,195	4,195	3,712
2	79	18,422				4,195	4,195	3,712
						4,195		
59		18,422				4,195	4,195	3,712
60		33,079				4,195	4,195	3,712

1976 World Market Price

(Jongan District)

Unit: 1,000Won

	Year	Project net return	Total cost: Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-7	1969	0	20,045				20,045	58,442
-6	70	0	19,914				19,914	53,105
-5	71	0	35,254				35,254	86,620
-4	72	0	47,610				47,610	102,607
-3	73	0	30,057				30,057	60,599
-2	74	0	71,758				71,758	101,641
-1	75	0	33,728				33,728	37,811
0	76	69,067			22,054	10,268	32,922	32,922
1	77	117,196			83,592	10,268	93,860	83,062
2	78	127,712				10,268	10,268	9,087
59		127,712				10,268	10,268	9,087
60		277,371				10,268	10,268	9,087

1976 World Market Price

(Songwol District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-4	1972	0	5,390				5,390	11,616
-3	73	0	10,412				10,412	20,991
-2	74	0	70,857				70,857	100,363
-1	75	0	7,258		50,206		57,464	64,423
0	76	10,906				2,800	2,800	3,164
1	77	11,436				2,800	2,800	3,164
2	78	20,439				2,800	2,800	3,164
3	79	23,343				2,800	2,800	3,164
59		23,434				2,800	2,800	3,164
60		58,620				2,800	2,800	3,164

1976 World Market Price

(Insan District)

Unit: 1,000Won

	Year	Project net return	Total cost: Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1976	0	215,171				215,171	215,171
-1	77	0	176,827				176,827	160,606
0	78	19,548	39,764				39,764	31,404
1	79	22,058				4,005	4,005	2,775
2	80	24,403				4,005	4,005	2,775
59		24,403				4,005	4,005	2,775
60		106,582				4,005	4,005	2,775

1976 World Market Price

(Hangye District)

Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1976	0	198,655				198,655	198,655
-1	77	0	172,297				172,297	156,491
0	78	66,548	15,955				15,955	12,601
1	79	68,729				8,100	8,100	5,611
2	80	75,476				8,100	8,100	5,611
59		75,476				8,100	8,100	5,611
60		150,484				8,100	8,100	5,611

1976 World Market Price

(Gwang Chon District)

Unit: 1,000Won

	Year	Project net return	Total cost: Construction cost	Total cost: Replacement cost	Total cost: Land consolidation cost	Total cost: O & M cost	Total cost: Total cost	1976 constant price
-2	1976	0	360,904				360,904	360,904
-1	77	0	386,917				386,917	351,423
0	78	54,446	37,198				37,198	29,378
1	79	59,952				10,320	10,320	7,149
2	80	65,688				10,320	10,320	7,149
59		65,688				10,320	10,320	7,149
60		216,464				10,320	10,320	7,149

1976 World Market Price

(Jungbuk District) Unit: 1,000Won

	Year	Project net return	Construction cost	Total cost: Replacement cost	Land consolidation cost	O & M cost	Total cost	1976 constant price
-5	1971	0	9,772				9,772	24,009
-4	72	0	31,667				31,667	68,248
-3	73	0	4,411				4,411	8,894
-2	74	0	46,085				46,085	65,276
-1	75	0	322,269				322,269	361,288
0	76	34,013			31,491	7,560	39,051	39,051
1	77	36,806			172,896	7,560	180,456	159,696
2	78	58,071				7,560	7,560	6,690
59		58,071				7,560	7,560	6,690
60		324,206				7,560	7,569	6,690