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EVALUATION STUDY ON RURAL INFRASTRUCTURE DEVELOPMENT PROJECTS UNDER IBRD LOAN

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Evaluation Study on Rural Infrastructure Development Project

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I. Introduction

1. Purpose of the Study

The purpose of this study is the post evaluation of the rural infrastructure projects including minor irrigation, upland reclamation, fuelwood plantation, roads and bridges, water supplies and rural electrification. At the request of the Government of Republic of Korea, IBRD provided a financial assistance for those multi-sectoral nationwide projects.

The detail purposes are:

A. Assessment of socio-economic effects of rural infrastructure development projects: (a) benefit-cost analysis; (b) optimal contribution by the beneficiaries; (c) attitude changes in project beneficiaries; and (d) the economic and social impact of the projects on rural society.

B. Analysis of the effectiveness of administrative procedures and the role of governmental supporting units.

C. Future directions in rural infrastructure development policy.

D. Developing an institutional assessment of investment projects for rural Saemaul Movement under the responsibity of the governmental organizations.

2. Method

A. Rural Electrification

Most of aggregate data related to the rural electrification was obtained from the Korean Electric Company (KECO) and was supplemented with field surveys. No availabilitly of systematic studies on effects of rural electrification requires some detail survey on rural households electrified. The sample survey was conducted to interview 200 rural households, of which half of those was electrified during 1976-77 and the other half, during 1970-1975, and 40 village leaders. The sample households and villages were randomly selected from 40 sub-project units in 4 regions, which are mountaineous, in-between, plain, suburban, and coastal regions. The number of sample of 1977 survey was 50 households in 10 sub-project units which were resurveyed in 1978 and the rest of the sample was surveyed in 1978. In addition, mail survey was conducted for KECO branch offices to find out technical and operational problems for implementation of the project. Answers from 13 branch offices out of total 17 were collected and analyzed.

B. Roads and Bridges

Throughout the 2-year's evaluation study period starting

from 1977, about 19 feeder roads and 17 bridge subprojects in the field has been surveyed. The survey has not been confined only to the IBRD project, for the impacts of road development on rural economy would appear for a prolonged time-period. For the first year of study 8 road segments and 8 bridges in 5 Guns with 100 farm households were sampled from the MOHA Saemaul Comprehensive Evaluation Survey Areas in an attempt to develop adequate evaluation parameters and methodology for the road and bridge program. Out of each 8 samples, the IBRD-loaned were three roads and two bridges. Thus, the 1st year survey had included interviews with 5 Gun Saemaul officers, 19 village representatives, and 100 farmer-residents for road and bridge segments. In the 2nd year survey, eleven roads and nine bridges have been sample-surveyed, which included 7 roads and 6 bridges financially sponsored by the World Bank. For this 2nd year survey a total of 20 Gun Saemaul officers, 51 village representatives and 136 farmer-residents were interviewed. Some of the parmeters that had been developed in the 1st year study have been applied to the 2nd year study.

A typical sample road segment in the 1978 survey had the following characteristics: 3.4 kilometers long, 5.4 beneficiary

villages with 361 rural households and about 1,980 heads in population served, 238 hectares of cultivable farmland affected. Nine bridges surveyed in 1978 had characteristics of 37.3 meters long, on the average, 3.9 villages with 1,012 residents served, and 133 hectares of farm land. The reason why the above characteristics of the 2nd year samples is that more IBRD projects have been included in 1978 than 1977.

C. Upland Reclamation

The study employed the methods of B/C Analysis on the reclamation investment projects and the financial analysis of the farms in order to successfully meet the above objectives. The research collected original data through field surveys and related secondary data.

The study covered 12 individual reclamation investment projects out of 147 upland reclamation projects that have been so far implemented since 1972. Four projects out of fourteen 77 IBRD projects were sampled together with eight non-IBRD projects out of 93. The number of farms covered in this research were 249 in all.

D. Fuelwood Plantation

To obtain the data necessary to grasp general pictures of fuelwood plantation projects and their performances, 36 sample villages from eight provinces except Cheju province were selected for the 1978 research year. From each village five to seven beneficiary households and 2 nonbeneficiary households if possible were selected, and amounted to 177 benficiary households and 27 nonbeneficiary households. The sample villages which form bases of the study were chosen to reflect geographical characteristics such as mountain, plain, intermediate, and suburban fishing areas. Country Forestry Association Union, Village Forestry Association (VFA) Chiefs, and households were interviewed to fill out the survey forms. About 50 percent of the sample villages have IBRD financed plantations during 1976 and 1977 years. The interviews were carried out in July and August, 1978.

E. Water Supply

In 1977, the first year of this study, efforts were concentrated on comprehending the general situation of the rural water supply program. Thus, study was limited to simple water-

works in 10 sample and the number of beneficiary families surveyed were limited to a total of 50, or five from each of the 10 villages. In 1978, the second year of the study, 18 villages were purposefully chosen from among those which had installed piped water systems financed with the help of the IBRD loan, in consideration of topographical features of the village areas--such as mountainous, semi-plain and plain areas, as well as the types of water supply systems used. And 10 households in each of the sample villages were surveyed.

For field studies, questionaires were prepared in advance for use in discussions with managers of water supply systems. Information obtained from them included, among other things, construction and maintenance costs. Also, housewives were interviewed to obtain their opinions.

In analyzing the effects of the water supply projects, attempts have been made to measure the rates of return on investment based on the concept of benefit and cost. In addition, data provided by the Ministry of Health and Social Affairs and the county administrations concerned have been used in studying the overall pictures of the rural water supply program and the construction and management of facilities under the program.

F. Minor Irrigation

Of the total 61 IBRD-funded projects, six projects-Taean, Kahung Jipyong, Insan, Hanke and Kwangchon - were selected for survey as there were the only districts completed and benefitted by newly constructed irrigation facilities for 1977 crop. In addition, 3 AID-funded project districts - Jongan, Songwol and Jungbuk - which had been completed in 1975 and had been in operation since 1976 were also selected for survey for the purpose of using as benchmark data or for comparisons. From each area 20 farmhouseholds were sampled for budget survey, totaling to 180 households.

II. Back grounds of Rural Infrastructure Development

A. Rural Electrification

Electricity consumption in Korea has been growing at more than 18% per annum over the last decade and reached 19,620 KWh in 1976. By the end of 1976, about 95% of total households have electricity supply and the whole households have been electrified by the end of 1978, except about 79,000 households in the remote area and small islands which will remain unelectrified. About 12.5% of total consumption in 1976 was accounted for by residential users. This is equilvalent to a household use of 600 KWh. The growth rate of total electricity consumption is expected to be about 12-15% per annum through the early 1980's. On the other hand, the corresponding supply of electricity is expected to increase by about 12-16% per annum. The capacity of generation facilities will be also increased form 4,629 MW in 1977 to 15,985 MW in 1980, so that about 20% of excess capacity is expected to exist through early 1980's.

Rural electrification in Korea started in the early 1960's and accelerated by the Law of Rural Electrication in 1965. It has now reached a final stage. The Law specifies that funds

required for rural electrification be provided by a combination of government loan, KECO's own investment and customer's contribution. Government loan financed 80% of total investment during 1965-1978 and are made to customers through the Korean Development Bank (KDB) with conditions of 5 year gestation and 30 year repayment periods and 7.5% of interest rate per annum. KECO is responsible for collecting loan repayments from customers, together with the electricity bill. The customers have no way to pay the bill without loan repayment, due to local government influence and pressure. During 1965-1978, some 1,727,300 households in rural area were electrified, 236,000 households have had electricity supply under loans from IBRD and OECF in 1976, and 120,000 will in 1977 and 58,600 in 1978. This will virtually complete the electrification of the country, as the remaining some 79,000 households without electricity which are located in remote mountain areas and on small islands. The government is doing its best to supply electricity to those households.

B. Roads and Bridges

As A.T. Mosher adequately points out, a good rural access road poses one of six basic elements essential to building a

progressive rural structure. The road development brings about a wide range of economic and social benefits for rural residents. Such benefits include: Smoothening of traffic flows, transportation time-savings, reduction in freights, enhancement of farm prices and terms of trade, accelerating transformation of traditional cropping patterns into commercial one, facilitating farm mechanization and labor productivity increase, new farmland reclamation induced by easy access and land value increase, and broadening off-farm job opportunities for rural residents affected. Non-economic effects include expansion of social, cultural and political services into then-unexplored areas, upgrading the social prestige of villagers, facilitating communication between urbanites and villagers, and closer ties and cooperation among villages toward rural modernization.

An inventory survey of Korea's rural feeder roads and bridges made by MOHA revealed that at the end of 1977 there existed about 42,140 Km of such roads in the country, of which about 76 percent had been built by villagers as part of the Saemaul Movement since 1971. MOHA determined that about 7,270 Km of 8,812 units have to be further developed in the near future. At the end of 1977, there were also 44,499 rural feeder bridges

with total length of 377,542 meters, of which about 90 percent in length has been built as a Saemaul Movement project since 1971. MOHA estimated that a total of 94,108 meters of bridges would be further developed to give adequate access to all Korea's villages.

According to MOHA census survey, as of the end of 1976 rural feeder roads may be categorized as follows: 13.9% located within the boundary of village; 47.6% connecting farm to village; 18.1% connecting farm to farm; 18.0% connecting village to village; and the remaining 2.4% connecting village to industrial or express highways. Re-classified by road classes, about 31% of the existing feeder roads are less than 3 meter wide, good for only carts and pick-ups; other 31.1% are for which truck can go in, but not turn around because of relatively narrow width of 3 to 4 meters; and 37.9% are more than 4 meter wide, so that truck can go in and turn around. Among 41,895 feeder bridges in 1976, approximately 36.3% are 3 meter wide; 34.5% for 4 meter wide; and remaining 29.2% are 5 meter wide or more. On the average, a typical feeder road in the country was estimated at 0.95 kilometer in length and a bridge was about 8.23 meters long.

C. Upland Reclamation

Upland reclamation projects were originally initiated by the government in an attempt to settle the refugees during the Korean War after 1957. In 1962, the projects were undertaken based on foreign assistance under the Law of Reclamation Promotion. During the period of 1965-1966, the projects were financed through PL 480. After having some adjustments over the period of 1967-1971, the projects have been actively undertaken by the government since 1972.

The development policies by period can be briefly summarized as follows;

Stages	Year	Major Contents
Trial and Initiation Period	1957	Initiated by government.
	7/1960	Pilot Projects were sponsored by UN Special Funds by UNKUP
	8/1961	24 projects for resettlement
Enforcement Period	2/1962	Law of Reclamation Promotion was enacted
	1965/1966	Law of Reclamation Promotion was substituted by Law of Farm Land Construction
Adjustment Period	1967/1971	Government subsdies were replaced by PL 480 funds

Stages	Year	Major Contents
Large Unit Development Period	1972- Present	Law of Farm Land Construction was replaced by Farmland Enlargement and Development Promotion in 1975. Active government subsidies started again

The actual results of the upland reclamation projects that have been implemented under the initiation by the government, subsidizing the projects since 1972. Total number of individual projects was 147, and of which 109 projects were implemented by the Agricultural Development Corporation and 38 projects by respective Dos (provinces). The total area developed reached to 15,960 hectares and the total amount of construction costs was 8,169,273 won.

D. Fuelwood Plantation

It has not been possible to have self-sufficiency in fuelwood and lumber supplies despite the fact that 67% of Korea's land is classified as forest. Although Korea has many laws and measures to protect the forest, it was impossible to enforce the laws due to the political turmoils and weak economic bases. Significant forest denudations have been followed

after political disruptions such as the annexation of Korea to Japan, World War II, and Korean War.

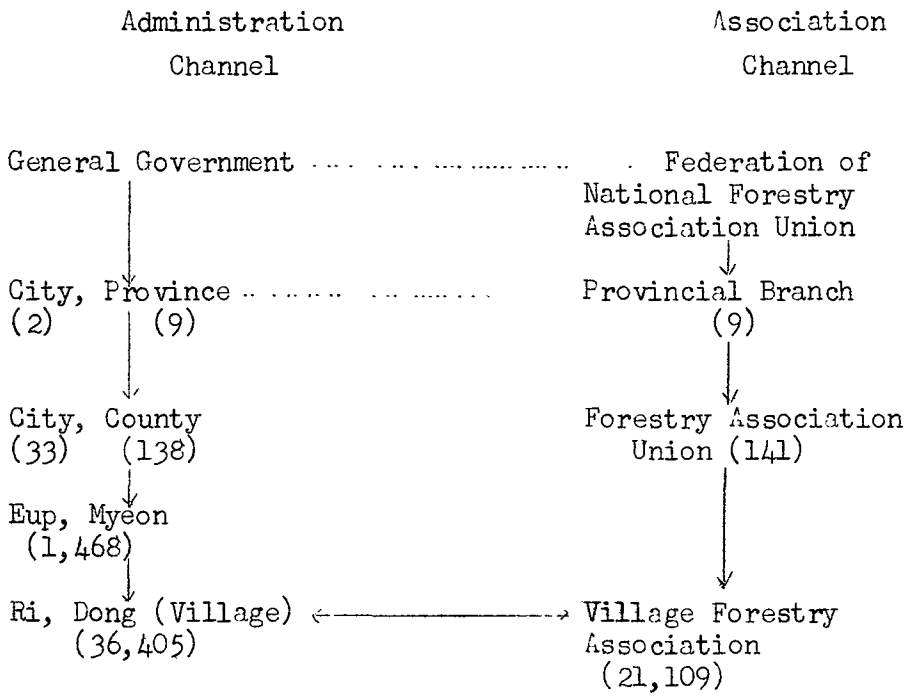
One of the most direct reasons of forest devastation was indiscriminative cutting of woods for fuel except some of the remote mountain forest. Korea's winter is very cold with three month duration of freezing temperature. This unfavorate climate condition has led to develop "ondol" heating system in which the flues from the kitchen cooking stoves are led beneath the floors of the living rooms of the house and thence to chymneys on the other side of the house. This under-floor heating system consumes large quantities of fuel.

The Korean Government has put massive effort to protect and reforest the mountains since her independence in 1945. Without adequate alternative means of fuel supplies, however, farmers and firewood dealers could not help stop illegal cutting of the forest woods. Recognizing the necessity of alternative ways of fuel supplies the Government started to establish 850 thousands hectars of fuelwood plantations in 1959 with an aim to arrange farm fuels through the establishment of fuel forests, contributing to the prevention of forest demages. The program was accomplished in 1977, totalling 643 thousand hectars planted

in terms of area which is less than as planned by 207 thousand hectare, after many years of trial and errors. Of 643 thousand hectare of the fuelwood establishment, 50 thousand hectars were carried out in 1976, and 127 thousand hectare in 1977 respectively. Part of the necessary funds for the project was provided by IBRD loaning during 1976 and 1977 years. Shape of forest is visibly improving in recent years.

The present status of the Village Forestry association system as of the end of October, 1977 is that a total mambers of the VFA are amounted to 2,250,000. There are more 21,109 VFA and there associations organize 141 City and County Forestry Association Unions, these organizations resemble the administrative organization system and become to have cooperation and connection with administrative system.

Connections between Governmental
Administration system and Village Forestry Association



If there were no counter-measures arranged for fuel needed by households much demages to forests would be inevitable through the indiscriminative cutting of woods and collection of forest by-products for fuel. Therefore, as one of measures to solve not only significant fuel problem in rural and fishing area but also to contribute to the prevention of forest, the fuelwood plantation which has been started by the Government

from 1959 and ended by the end of 1977 will be a total of 643 thousand hectare lanted, averaging 30.5 hectare per village Forestry Association. Of 643 hectare the IBRD loan covered 50 thousand hectare in 1976 and 77 thousand hectare in 1977.

For the establishment of fuelwood plantations the City, County and Forest Association Union make survey to find out fuel requirement by the unit of village, and then necessary area for plantation is selected by the FAU and reported to the City and County. Finally, the City and County decide it as the fuelwood reforestation area after their confirmation. In accordance with the law City or County order forest owner to carry out plantation on the selected area. When the ordered forest owner does not carry out plantation. Village Forest Association is of ordered to carry out proxy execution reforestation with materials of seedlings and fertilizers provided by the Government and also the technical support of the Forest Association Union. When the proxy execution is over, the forest owner is ordered to reimburse expences of the plantation. If the forest owner cannot reimburse the expenses a profit sharing contract has been made between VFA and forest owners on the condition to distribute forest products at the ratio of nine to VFA and one to the forest owner.

Recognizing the necessity of forest fuels required by villagians the members of VFA are called out and plant under the guidance of reforestation guides with no wages. All fuel forest were planted by the Village Forestry Association members through their cooperative operation with seedlings and fertilizers provided by the Government.

The Village Forestry Associations are supposed to do the following businesses in accordance with the Forest Law and the Charter of the Village Foresty Association.

1) autonomous forest protection, reforestation, and silvicultural management.
2) businesses designated by Forest Law and joint projects according to forest management plan.
3) works entrusted by members of the Village Forestry Association
4) projects for the promotion of common profits of members of Village Forestry Association
5) Other matters regarding to forest

E. Water Supply

As of the end of 1977, a total of 15,677 simple piped water supply systems were installed across the country, providing

clean water to 5,191,000 persons, or about 47% of the total rural population of 11,149,000.

During the Fourth Five-Year Economic Development Plan, the government plans to have simple waterworks installed in all the 37,574 rural villages consisting of 20 or more households (where piped water supply is considered feasible), with the aim of supplying 100% of the eligible households with running water.

Previously, simple piped water supply projects had been promoted by a number of agencies, such as the Office of Rural Development, the fisheries cooperatives, the UNICEF, and the Ministry of Home Affairs. Since 1972, however, such projects have been carried out under the centralized control of the Ministry of Health and Social Affairs.

Simple piped water supply systems built under the administrative jurisdiction of the Ministry of Health and Social Affairs currently number 9,177, or 55% of the total.

F. Minor Irrigation

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 II-2 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.

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 consolidate 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. 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 supplies 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.

III. Implementation of IBRD Projects and Sample Situations

A. Rural Electrification

The proposed project would help finance the government program for 1976, which aims to electrify 305,000 households. The estimated construction cost of the proposed program was total of 17,258 million wons (35,583 thousand dollars), not including cost for house wiring. This is equivalent to Won 56,500 per household. The original program was revised. Total construction cost had been increased by 30% and reached Won 22,200 million, due to increase in domestic material cost by 26% and labor charge by 63%. In addition, delay in purchase of materials by international bid and in payment of customer's contribution requires to revise the original program which aims to electrify 305,000 household in 1976 so that 206,860 households were completed to supply electricity and remaining 98,140 households will be, in 1977. The final completed program included that total construction costs were increased by 57% and amount to ₩27,133 million ($55,944 thousand), due to increase in domestic material costs by 93% and labor charges by 76%. It also included that total of 306,497 households was electrified in the 3,579 sub-project areas in all provinces in Korea, with an

average of 86 households per sub-project.

Total of 136,294 households completed to supply electricity, 140,257 households in 1977 and 29,315 households in 1978. Average households per sub-project number 128, 80 and 39 in 1976, 77 and 78 respectively. The average construction cost per household was Won 88,525, of which the loan took 77%, customer's contribution, 12% and KECO's own investment, 11%. There were great differences in the construction cost per household by region. For example, total cost per household was Won 71,365 in Cheonnam Province and Won 178,852 is Jeju Province. The proportions of customer's contribution per household was 0.3% of total in Cheonnam, 21.4% in Chungbuk, and 42.2% in Jeju. These difference in the construction cost would result from difference in grographical conditions, customer's financial situation and number of households per sub-project, and equal share of government loan by provinces.

The sample villages were located average of 1,500 meters from existing electricity supply, ranged from 200 meters to 5,000 meters. The distance was a main source of increase in loan and/or customer's contribution because of constant proportional KECO's own investment (10-11% of total cost).

The sample households were typical households in Korea which had average of 7 families and 3 laborers, owned 1.0 hectares of farm land and several kinds of engine power equipments. They earned average won 1,300 thousand of which 22% accounts for non-agricultural income. The house wiring took average 6.8 days, ranged from 3 days to 9 days. Electricity supply after house wiring took average of 62 days (range 30-365 days). Average 3.1 electricity bulbs per household were initially installed and they extend extra 2 bulbs.

Survey and design: Most of KECO's own investment was used for survey and design. The survey and design had been made for every individual sub-project over time. Therefore, there is a possibility of low voltage and imbalance of power for transmission and distribution. The design should be done considering the balance of transimission and distribution of electricity ever whole rural area and the maximum demand for electricity power use. The design standards followed generally accepted such standards for rural electrification as Construction Standard for Distribution Line, Technical Standard for Electricity Facilities, and Cost Standard.

Operational problems: The election of pole and stringing ·

were done by small contractors under KECO's supervision. The small contractors were mostly selected by competitive bid for construction and house wiring. KECO's branch offices answered the following operational problem: (1) Construction was delayed because of large and deferred contribution of customers in relatively remote area, (2) rearrangement of loan to customers according to connecting initially unelectrified households in subproject area where is already electrified, (3) losses in design cost due to cancel out electrification of some villages after design being made, (4) selection of some villages not to be based on economic criteria, (5) some objection of land lord where pole is elected, (6) difficulties of construction works during crop growing season.

Technical Problems: A typical village was supplied by extending from an existing 22.9 Kv or 6.6 Kv primary feeder, a 3 wire single phase or a 2 wire single phase branch on concrete poles to a pole-mounted 5 or 10 KVA transformer. The secondary system within the village was 220V, single phase 2 wire. Contract power is less than 4 Kw. This kind of distribution system is for only domestic use, mainly lightening use. The 3 phase motor can not be utilized for small power use.

The single phase motor can be used, for threshing, pumping and other agricultural use within village transformer capacity. But practically a small capacity of transformer is suitable for only lightening use. The development of Korean agriculture and growing economy needs more and more small or large power in rural area in the future. At that time, distribution lines for power use should be restringed. Other technical problems are: (1) disordered distribution system because of regional base design, (2) difficulty of distribution of tele-cable, (3) too long distribution line with single phase from transmission, (4) high risk of electricity accidence with 220V, (5) difficulty of main tenance and repairment due to long distribution line with poor condition for transportation.

B. Roads and Bridges

The IBRD Rural Infrastructure Project includes construction of 317 road subprojects (858.6 Kilometers) and 211 bridges (6,826.8 meters) with total budgets of approximately 6.5 billion won during 1976 to 1977. In its first implementation year, 197 roads and the whole bridges were constructed, and the remaining 120 roads (373 Km) have been completed by the end of 1977.

This component has been asserted to benefit a total of 2,283 villages with 856 thousand residents and 84 thousand hectares of agricultural land. Road segments averaged about 2.7 kilometers in length and 5 or more meters in width. The average length of bridges was about 32 meters with more than 4 meters wide. Villagers provided about 44% of road construction costs and 16.4% of bridge segments in the form of land contribution and communal labor. The balance was provided by the government with cement, reinforcing steel, tools and equipment, and skilled labor plus professional services.

The construction cost of an IBRD road construction was computed at 13.6 million won as of 1976 and 21.5 million won on 1977 prices. In other words, the construction cost of 1 km of road averaged to 5.5 million won (US$ 11,340 equivalent) in 1976 and 6.9 million won (US$ 14,250 equivalent) in 1977, far-exceeding the level of IBRD estimation of US$7,575/km by the Loan Appraisal Mission in 1974. The cost of bridge construction averaged about 5.7 million won (US$ 11,832 equivalent) for a bridge of 30 m long, comparable with US$ 10,000 originally estimated by the IBRD Mission.

C. Upland Reclamation

The total number of individual projects covered by IBRD loans during 1977. The 77 IBRD Saemaul projects are heavily concentrated in Gyonggi Do Province and Chonbuk Do Province, having 5 and 4 projects, respectively, whereas rest of the Dos induced only two projects or none, depending upon their natural environments.

The 14 projects covered 1514.3 hectare in all and the total costs invested reached about 1,211,523 thousand won.

The terms of loan by financial institutions were as follows; 1) 60 per cent of the total investment shall be subsidized by the government; 2) 40 per cent shall be borrowed from the banks at the interest rate of 10.5 per cent per annum for 5 years with 3 year grace period; and 3) the repayment shall be made from the fourth year on after the projects are implemented.

There are a lot of variations in the number of natural villages per 100 hectare in the 12 reclamation project areas. The number of natural villages in the surveyed area varied from 2.2 villages in 1972 to 8.1 villages in 1976. The table also shows that there is a great gap in number of the natural

villages among the project areas, showing 1.9 villages in Icheon and 9.5 villages in Ochang.

The density of the farm households per 100 hectare of the reclaimed areas also tremendously vary from 34.1 farms in Dukjol (77 IBRD project area) to 207.1 farms in Ochang, showing 62.2 farms on the average throughout the whole surveyed areas. This situation can be interpreted as implying that these gaps could arise from the differences in natural environments of the different areas.

The changes in the size of farms before and after the reclamation projects were implemented by project year. In 1972 reclaimed areas, the number of farms smaller than 1,500 pyongs occupied 20 per cent of the total number of farms. After the project was undertaken, the percentage was significantly reduced, that is, to 10.7 per cent. On the opposite, per cent of the farms with size greater than 1,000 pyongs was increased to 35.7 per cent from 8 per cent after the project was undertaken. Similar trends occurred in the 77 reclamation areas; that is, the composition of the farms with less than 1,500 pyongs was originally 22.2 per cent, and yet it was decreased to only 6 per cent after project was implemented. On the average, the

composition of the farms with size less than 1,500 pyongs before the project was 21.1 per cent and that after the project 6.8 per cent. On the contrary, before the project the percentage of the farms with size greater than 6,000 pyongs was 13.2 per cent, while it increased to 36.9 per cent after the project was undertaken.

It is very interesting to note that, on the average, smaller farms with the size of less than 1,500 pyongs become even smaller after the project, whereas the larger farms with the sizes of above 6,000 pyongs become greater after the project is implemented. This can be interpreted as implying that the average farm size in the reclamation areas has been tremendously increased due to the projects themselves and that the farms in the reclaimed areas have a trend to become larger farms.

D. Fuelwood Plantation

The total number of households of the 36 sample Villages was 4,085. Average number of households per village was 113. Average family number per household was 5.7 person which was very high. Of the total households 3,624 households were farm households and the rest nonfarm households. This comprises the ratio of 89 percent for the farm households and 11 percent for the

non-farm households. Relatively high ratio of the farm households indicates that rural households in Korea are heavily dependent upon farming. Members of Village Forestry Association were 3,839 which amount to 93 percent of the total household surveyed. Of the total VFA member households, 916 households were forest land owners and 2,741 households did not possess their own forest land.

A total land area of the sample Villages was 19,789,871 hectare consisting of 4,323 hectare of cultivation land 2,936 hectare of upland, and 10,807 hectare of forest land. An average land area per Village was about 300 hectare.

Of 10,807 hectare of the forest land the share of fuelwood plantation was 2,962 hactare which amounts to 27.4 percent of the total forest land of the sample villages. Of the total plantation area 1,877 hectare which amounts to 63.4 percent was established before 1976 and 1,084 hectare which is 36.6 persent was planted since 1973. 611.6 hectare which amounts to 20.6 percent of the total fuelwood plantation was established during 1976 and 1977 with IBRD loans. Amout 20 percent of the fuelwood plantation area which was established before 1973 was disused and considered to result in a great waste of resources.

Varieties of the fuelwood species are regidar pine, acasia, alter, acasia-alter mixed forest, and bush clover. The most preferable species among VFA members was rigidar pine due to its strong adaptability to environment and fast growth. Looking at the fuelwood plantation area established before 1973 by fuelwood species acasia amounted to 38.4 percent rigidar pine 50.7 percent, alder 6 percent, and other 41.8 percent. Of 190 hectares planted in 1974 acasia amounted to 33 percent, rigidar pine 36 percent, alder 17 percent, and bush clover 5 percent. Of 204 hectare established in 1975 acasia was 36 percent, rigitar pine 21 percent, alder 34.7 percent, and bush clover 7.8 percent. Of 290 hectare planted in 1976 acasia amounted to 23.3 percent, rigidar pine 40.4 percent, alder 26.9 percent, bush clover 2.8 percent, and other 6.5 percent. Of 374 hectare planted 1977 acasia amounted to 22.4 percent, rigidar pine 41.8 percent, alder 15.7 percent, bush clover 15.2 percent, and other 4.9 percent. According to the figures the rigidar pine has the largest planted area except 1975. On the basis of the percentage of the plantation area the rankings among fuelwood species are the rigidar pine, alder, acasia, and bush clover.

Ninetynine percent of fuelwood plantation in terms of hectare nearby mountains from villages and other along roads and the edge of streams. The ownership of the site planted by fuelwood species is mostly private owned which amounts to 90 percent The owners of the plantation site have to render their tenure rights to VFA to establish fuelwood plantation by law if the County office designate the site for fuelwood plantation. The fuelwood plantation is established and managed by VFA with voluntary labor of VFA members. The harvested products will be shared by VFA and the site owners with 9:1 ratio.

The servival rates of planted tree ranged from 75 percent to 95 percent and the reforestration of nearby forest is closely visible fuelwood raising status varied widely depending upon soil, light, location, and management of the plantation site. Application of fertilizer, particularly, seems to be very important to raise fuelwood in good condition. Among the 36 sample Villages 30 Villages have applied fertilizers after the establishment of the fuelwood plantations. After the plantation of fuelwood aftercares such as weedings, tendings, fertilizations are carried out for 2-3 years by the members of VFA, voluntarily, with no wages paid except fertilizers subsidied

the Government. For autonomus fuelwood plantation protection a patrol team is organized by the VFA members. The inturn patrol team consisting of two VFA members makes intensive patrols during the season of fall through the spring of the following year which forest damages are heabily expected. These patrols have served for the prevention of collecting illegally forest products, control of destructive actions against forest facilities, prevention of forest fire, prevention of illegal hunting, etc. There were no villages hired full time patrolmen among the 36 sample villages. All chiefs of the VFA surveyed were serving without pay. It takes generally 4-5 years to harvest fuelwood after planting the seedlings. weeding is taking place every year until the havest time comes, and the remains are not collected for fuel. They are spreaded and left around the tree for fertilizer.

Fuel production from the fuelwood plantation has been considerably low compared to what has been expected. The survey reveals that the average amount of fuel harvest out of the fuelwood plantation was 1.71 M/T per hectare. Expected or planned fuel production was fire M/T per hectare. The highest production turned out to be 10 M/T per hectare while the lowest 0.1M/T

per hectare. Most of the sample villages produced less then average. But all village shown higher productivity then average have applied organic fertilizers or chemical fertilizers after the establishment of the plantations.

E. Water Supply

1. IBRD Financed Water Supply Projects

The government obtained 2,570 million won (US$5.35 million) out of the proceeds of the IBRD loan for Saemaul projects to finance the construction of simple piped water supply systems. Together with the government's own cash contributions to the water supply projects, the IBRD money was used to build 4,073 piped water systems during the two years of 1976 and 1977, thereby benefiting about 1.5 million persons with running water supply.

The ultimate supervisory agency for simple piped water supply projects is the Ministry of Health and Social Affairs. The Ministry allocates the necessary budgets to city and county administrations, which select villages in which water supply projects are to be carried out. To be more specific, local governments consider applications for water supply

projects submitted by Saemaul Committees in villages, and establish an order of priority among applying villages. Water supply systems are designed by the Construction Sections of city and county administrations in accordance with guidelines issued by the Ministry of Health and Social Affairs. Materials financed by IBRD funds are purchased on the basis of international biddings. Villagers who are to benefit from the projects become the project sponsors, and the projects are carried out as part of the Saemaul rural development program. The villagers contribute labor and some funds toward the projects.

In a rural piped water supply system, a simple water collecting device, to which a chlorinator is attached, is installed at a water source in the vicinity of the village (such as an artesian spring, ground water, an infiltrated gallery, or surface water). The chlorinated water is distributed through PVC pipes, by gravity or by pumping, to water taps at individual households.

Simple rural waterworks can be classified into three types: (1) a gravity system which, taking advantage of the difference in the elevations of the water source and the village, distributes water without using power; (2) a pumping

plus gravity system, in which water is pumped upward into an elevated reservior from which it is distributed by gravity; and (3) a pressurized system in which water is pumped into a pressurized tank for distribution.

It usually takes five to six months to complete simple piped water supply systems. Upon completion, the systems are inspected by the Construction Section of the city or county administration concerned to determine whether they are properly constructed. The following criteria are applied in determining the order of priority among villages to receive water supply project assistance from the government:

(1) Areas that have been, or are likely to be, afflicted by water-borne diseases.

(2) Areas with poor-quality water.

(3) Backward areas, best-performing Saemaul villages, or remote areas such as islands.

(4) These villages which are capable of bearing one-third or more of the total construction cost.

According to the general guideline issued by the Ministry of Health and Social Affairs, each village is required to organize a maintenance committee upon completion of construction.

The committee will consist of the following members:

(1) Chairman- 1 person

(2) Facilities manager - 1 person

(3) Maintenance manager - 1 person

(4) Facilities guard - 1 person

(5) Others

The committee is responsible for (1) Sanitation (2) Reparing and enlargement (3) Water quality control (4) Emergency cut-off of water supply (5) Protection of facilities and (6) Provision of repairing and maintenance expenses, etc.

2. Current Status of Simple Piped Water Projects

a. Diffusion Status of Piped Water Supply

The 28 villages covered by this study (10 surveyed in 1977 and 18 studied in 1978) had a combined population of 20,457, constituting 3,820 households. Beneficiaries of piped water supply numbered 14,490, representing 70.8% of the total population. The number of households receiving piped water supply stood at 2,503, corresponding to only 65.5% of all families in the villages surveyed. If only the eligible households are

taken into account, nearly 100% are benefitted by the simple water systems.

Water was for household use. The remaining 5.0% was used for stand pipes, restaurants, Saemaul assembly-halls, barber shops, etc. The number of water taps per household stood at 1.11. About 78% of household water taps were installed in house yards, with only 22% of them placed in kitchens. The number of kitchen taps is expected to increase steadily as the village remodeling program makes head way.

Of the 28 villages surveyed, 11 had attained 100% water supply diffusion rates. The lowest diffusion rate was shown by the village of Miwon Igu, located in Miwon-myon, Chongwon-gun, Chungchong-pukto: only 45.1% of households in this village were receiving piped water supply.

b. Types of Waterworks Installed and Conditions of Water Sources

Ten villages had established gravity-fed systems in which water in reservoirs set up on elevated spots was distributed by means of gravity without using any electric power. Waterworks built in 13 villages were pumping plus gravity

systems in which ground water was pumped upward into elevated reservoirs from which water was distributed by means of gravity. Pressurized systems in which pumps installed at the water sources send water under pressure directly to consumers were constructed in five villages.

Of the 28 villages surveyed, 15 were collecting ground water from tube wells--the most frequently used type of water source. Nine villages were using culverts to collect water from infiltrated galleries underneath river beds. Nine villages were using hillside streams as their water sources. Artesian spings were serving as water sources for three villages. One village was drawing on surface water for its water supply.

Most villages studied had adequate water sources and had little difficulty in securing their water supply. But two villages dependent on hillside streams--namely, Wonsaekchang Maul in Wanju-gun, Cholla-pukto, and Yuchon Maul in Yongi-gun, Chungchong-namdo--were found to experience water shortages during droughts.

c. Water Supply Situation

The guidelines for designing simple waterworks issued by the Ministry of Health and Social Affairs provide that the

maximum daily per capita water supply should be 150 liters. In actuality, however, the scales of waterworks in individual v villages often differ to some extent from the Ministry-set standards. The water supply capacities in the villages studied ranged from a low of 80 liters per head per day to a high of 160 liters. There were 14 villages that had daily water supply capacities of 100 liters or less, while another 14 had capacities of over 100 liters. Thus the average capacity of the 28 villages worked out at a little over 110 liters.

Depending on the conditions of the water sources, water supply shortages sometimes develop during summer, the peak demand season. In most instances, however, water shortages result from droughts, which occur mostly in late spring. In such cases, most villages limit their water supply to three to four times a day in order to ensure fair distribution of scarce water among consumers. Such rationing is carried out without which difficulty. At times, the use of piped water for laundering and bathing is prohibited.

Villagers are at times unable to receive water supply owing to breakdowns in their house connections, due mostly to freezing during winter. Such trouble had occurred most frequently

in Hoam-ni, Nangsan-myon, Iksan-gun, where 33% of all households connected to the village water supply system had experienced temporary water supply stoppages due to their own fault.

The liability of house connections and individual taps to freeze during winter contsitutes the grestest weakenss of many rural waterworks, for which remedies must be found urgently.

d. Repair and Maintenance

If the water supply facility within the boundary of a household goes out of order, the affected beneficiary must repair it at his own exense. When such common facilities as the water storage tank or transmission pipes develop the kind of trouble that can be corrected by simple manual labor, the usual practice is to mobilize one person from each beneficiary household to fix it. When a professional repairman is needed, attempts are made to bring one in from a nearby town. In case a professional repairman can not be found, villagers themselves often try to repair the water supply system. But such amateurish repair efforts tend to shorten the life of motors, pumps and other equipment, often leading to greater troubles.

Only one system was employing a skilled workman on a full-time basis to maintain its equipment. It is the water-

works in the seven-village Yangmok Cooperative Sphere, which serves 600 households. In all other villages, when their water systems break down, either a repairman is brought in from some other place or villagers themselves do the repair, depending on prevailing circumstances.

e. Village Organization for Management

As a general rule, a water supply management committee is established in the village when a simple piped water system is installed in it. According to this survey, however, the ri chiefs in 21 villages were serving as defacto managers of their village water supply systems. In four other villages the Saemaul leaders were working also as water supply managers. In one village, the heads of beneficiary households took turns to take charge of the village waterworks. Only two villages were employing full-time managers for their water supplies.

The water supply managers are responsible for sanitation of the piped water systems, inspection of water quality and the raising of funds for the repair, maintenance and expansion of the village waterworks. They are not paid for their work, with the exception of the full-time managers employed by

Miwon Igu (in Miwon-myon, Chongwon-gun) and the Yangmok Cooperative Sphere Villages (in Chilgok-gun).

f. Operating Expenses and Water Charges

Of the 28 villages surveyed, only 17 were regularly collecting each month operating expenses or water charges from the beneficiaries. In the other villages, the villagers either share in the payment of expenses for repair only when their water supply systems break down, or have the Saemaul Funds finance such repair.

Collection or non-collection of water charges depends on the types of water supply systems involved. Villages having pumping or pressurized systems collect water charges regularly in order to meet the costs of electric power used for their waterworks. But villages with gravity systems, which do not use electricity at all, do not collect water charges.

Water bills for individual households in the 17 villages covered by this study which collect water charges, ranged from 300 won to 900 won per month on the average. Monthly water charges in the Yangmok Villages in Chilgok-gun, where water meters are installed at individual households,

ranged from 900 won to 1,200 won per month. The village of Miwon Igu (in Miwon-myon, Chongwon-gun, Chungchong-pukto) was levying an average monthly water charge of 800 won on such large consumers as restaurants, inns and barber shops, while collecting 300 won to 500 won from ordinary households according to their living standards.

g. Depreciation Funds

None of the 28 villages studied was providing for a depreciation fund. Most of them were planning to meet replacement costs by drawing on reserve funds of their Saemaul banks.

F. Minor Irrigation

(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, Cheong-won-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 Association. 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 family.

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.

IV. Benefit/Cost Analysis and Financial Viability

A. Rural electrification

1. Economic costs and benefits per household are measured based on 1976-77 average domestic prices and converted into total costs and benefits of the project. Analysis of project feasibility and internal rate of return of the project carried out by two alternatives; one was that economic benefit was measured by material savings for lightening and warming, time savings, productivity gain from labor, time and material saving. The other was that economic benefit was measured by "Willingness to pay" which included actual payment and consumer surplus.

Alternatives of measurement of project revenue would alter the division of benefit and cost items. Therefore, basic figures of costs and benefit were explained as follows and then the analysis of project feasibility was made.

2. Demand for electricity:

Consumption of electricity can be the basic data to estimate the project cost and benefit. The sample household consumed average of 297 KWh per annum. That was 422KWh in

suburlban region, 330KWh in plain region, 279 in in-between region, 258KWh in coastal region and 196 in mountaineous region.

The electricity consumption per household was increased according to lapse of time after electrification. Average consumption of electricity per household was 243KWh per annum in the first year after electrification, 334KWh in the fourth year and 371KWh in the sixth years.

Using annual consumption data, the trend equation of electricity demand was estimated as

$$Y = \underset{(16.88)}{229.99} + \underset{(3.77)}{20.22}\ X$$

$$R^2 = .8516$$

where Y represents average annuall consumption of electricity per household and X as the lapse of years after electrification. The estimation has a difficulty to represent consumption data of the same population over time because of hetrogeneous population in the same year, which might partially reflect electricity consumption response to change in income. The equation estimated was used to predict the future demand for electricity of a household in the national and regional average (Table 1). In the 35th year after electrification,

national average consumption of electricity per household per annum will be 936KWh, and 1062KWh in suburban and 837 in coastal region,.

3. Cost of Project: The following costs were included in the analysis.

a. Direct cost: All costs incurred by the stage of consumption of electricity were included in the direct cost.

(1) Investment: Total cost of construction of distribution line for rural electification was devided by total number of households, 306,497, to get a investment cost per households It included the Government loan of Won 67,810, KECO's own investment of Won 9,384 and customer's contribution of Won 11,331, which totaled Won 88,525 per household.

(2) Energy supply cost: Supply cost of electricity was estimated by KECO every year. The average supply cost in 1977 was utilized to estimate energy cost in 35 years in the furture under assumption that cost and price would be increased by the same rate. The energy cost per KWh of sales divided into two components; generation cost and operation cost. The generation cost per KWh sales included generation cost of Won 13,221 and cost for losses of transmission and distribution of

Won 1.352. The operation cost of Won 3,176 per KWh of sales included transmission cost, distribution cost, service cost for customer and selling cost. The energy cost was composed of material cost, labor cost, depreciation, and maintenance cost for generation and operation. But such costs as non-operation cost, corperate tax, surtax, were excluded from energy supply cost because these costs can be regarded as social benefit from electricity supply. The energy cost per KWh of sales mutiplied by electricity consumption per household made the energy cost per househod.

(3) Customer's costs for house wiring and maintenance: The customer's costs for house wiring in 1976 was estimated as average of Won 9,712 per household. The cost for expansion and maintenance amounted to Won 1,795 per household per annum. Other customer's costs included preparation and negotiation cost for village electrification and reached Won 8,451 per household.

b. Indirect costs: Rural electrification plays a role to create a market for electric appliances, TV and other electric tools. The production and selling costs of these electric tools were regarded as indirect cost. In addition, cost incurred from electric supply should be included to

Table 1. Projected demand for electricity by year and region average per household

(KWh/Year)

Year after electrification	Plain	In-between	Mountainous	Suburban	Coastal	National average
1	285	234	150	375	213	250
2	305	254	170	395	233	270
3	325	274	190	415	253	291
4	346	295	211	436	274	311
5	366	315	231	456	294	331
6	386	335	251	476	314	351
7	406	355	271	496	334	372
8	426	375	291	516	354	392
9	447	396	312	537	375	412
10	467	416	332	557	395	432
11	487	436	352	577	415	452
12	507	456	372	597	435	473
13	527	476	392	617	455	493
14	548	497	413	638	475	512
15	568	517	433	658	496	532
16	588	537	453	678	516	552
17	608	557	473	698	536	573
18	628	577	493	718	556	593
19	649	598	514	739	577	613
20	669	618	534	759	597	633
21	689	638	554	779	618	653
22	709	658	574	799	637	674
23	729	678	594	819	657	694
24	750	699	615	840	678	714
25	770	719	635	860	698	734
26	790	739	655	880	718	754
27	810	759	675	900	738	775
28	830	779	695	920	758	795
29	851	800	716	941	779	815
30	871	820	736	961	799	835
31	891	840	756	981	819	856
32	911	860	776	1,001	839	876
33	931	880	796	1,021	859	896
34	952	901	817	1,041	880	916
35	972	921	837	1,062	900	936

cost incurred from electric supply should be included to estimate indirect benefit of the project providing electricity market.

c. Social costs: The rural electrification project would not causes any significant environmental problems and would have no effect on air and water quality. The low voltage used would not require an exclusive right of way for the distribution lines. Therefore, it was not necessary to estimate any social costs.

4. Economic benefit: Electricity can be used for residential and productive purposes. The residential use include lightening and uses for electric appliances. The benefit from residential uses of electricity would be estimated as benefit from material savings for lightening and warming, time savings, life and market informations and good conditions for life and working. Those benefits of consumptive uses of electricity are regarded to equal to "willingness to pay" which includes actual payment and consumes surplus. Revenue of productive use of electricity can be measured as productivity gain including labor, time and material savings. These kinds of measurement of project revenue would alter the division of benefit and cost items.

In addition, rural electrification mainly aims to domesti• uses of electricity and small power uses were counted by the same meter. Moreover, power use of electricity for agricultural production needs other electrification project including restringing of distribution lines.

a. Material savings and productivity gains

It is possible with some limitation to measure the revenue from material savings and productivity gains from electricity use.

The material savings amount to Won 3,068 per annum per household at average price of 1976 and 1977. Time-savings from threshing time extending over night, cooking and water supply by small automatic pumping machine are calculated as 6.43, 14.67 and 162 hours per annum per household respectively. Total value of time saving amounts annually Won 25,465 per household.

Productivity gains from threshing and pump for irrigation are valued at won 21,894 (Won 91.4 from threshing and Won 20,980 from pumping) per household per annum. Table 2 shows the detail of culculation.

Table 11. Materials Savings and Increase in Productivity by Electrification, 1977

Item	Amount(Won)	Remarks	
Material Savings	3,068		
Extension and Saving of Working time			
Threshing	965	Save 6.3 hours per year	
Cooking	2,200	Save 14.6 hours per year	
Waterworks	24,300	Save 40.5 hours per year and Save 4 men per hour	
Increase in productivity		Using time per year	labor saving per hour
Threshing	914	0.87	7.0
Pumping	20,980	14.6	9.6
Cutting	-	0.00	7.6
Dry	-	0.00	2.0

Note: During 76-77, farm wages (in cash) is ₩1,500/day man, and work 10 hours per day in rural area, so farm wages per hour is ₩150. This is equal to 8 working hours per day devided by Index number of out of peaktime 0.8.

b. Electric bill: Electricity tariffs for domestic use in 1976-77 was used to estimate future payment by customers.[1)]

Revenues from sales of electricity were derived by multiplying the estimated average annual consumption per household by the current KECO tariffs for domestic use.

c. Consumer's surplus: The sample survey could not provide enough data to estimate the demand function of electricity for domestic use. Therefore, the demand function of electricity for domestic use, estimated by the Korean Development Institute (KDI), was ulitized to compute the consumer's surplus from electricity consumption. It was assumed that area under demand curve and above the

1. Table of rate schedule (Monthly bill)

Tariff 1. General service A.

Applicable to general service of less than 4KW of contracted demand, including residential service.

a. Demand charge: W 234 per household

b. Energy charge:

W 22.12 per KWh for the first 50KWh of total energy used

W 30.50 per KWh for the Second 50KWh of total energy used

W 44.18 per KWh for the Third 50KWh of total energy used

W 44.18 per KWh for the Fourth 350KWh of total energy used

(Less than W 10 of total bill goes up to W 10)

Sources: Electricity Supply Regulation of KECO, 1977

equilibrium price would measure the consumer's surplus and that aggregation or disaggregation of demands function could be measures of aggregation or disaggregation of the consumer's surplus. If the demand function is a linear with respect to price, the consumer's surplus could be computed with relation of $S = (\frac{1}{2})Q_e^2 b$, where S is the consumer surplus Q_e' actual use of electricity, and b, the slope of demand function / $\frac{P}{Q}$ /. If the demand function is non-linear or constant price elastic, the consumer's surplus computed by $S = (\frac{1}{2})Q_e^2 b$ would underestimate actual consumer's surplus. The demand function which was utilized to estimate the consumer's surplus was constant price elastic.[2] Therefore, the computed surplus was a minimum of the actual surplus.

d. Loan repayment by customers: The Government made loan to customers through KDB under conditions of repayment with annual interest rate of 7.5% within 30 years after 5 year

gestation period. The annual payment ratios of total amount with interest were fixed KECO Loan Repayment Regulation. Annual amount of loan repayment was computed by multiplying amount of loan per household by these ratios.

2) Demand function of electricity for comestic use:

$$\underset{}{\text{Ln } Q} = \underset{(-2.06)}{-4.57} + \underset{(1.70)}{0.284}\ \text{Ln } Q\text{-}1 - \underset{(-2.26)}{0.47}\ \text{Ln } P + \underset{(1.82)}{0.679}\ \text{Ln PCE}$$

$$+\underset{(2.84)}{0.451}\text{Ln HH} + \underset{(1.83)}{0.445}\ \text{DVD}, \qquad R^2 = .9959, \quad DW = 1.36$$

Q = Quarterly consumption of domestic electricity (MKWh)

Q-1 = Electricity consumption in the previous quarter (MKWh)

P = Quartely average price at 190 constant price (W/KWh)

PCE = Private consumption at 1970 price (W 100 million)

HH = Number of households

DVM = Dummy variable (0 for limit to supply, 1 for no limit to supply)

Figures in ( ) are t-- values.

Source: KDI, Analysis of Demand for and Price of Electricity in Korea 1977

5. Indirect benefit: Rural electrification has created new market for electric appliances. Therefore, extra sales of those were regarded as indirect benefit. The extra sales

of electric appliances over time was computed at 1976-77 constant price. The indirect net benefit was computed by multiplying the extra sales by rate of operating profit to net sales[3] Net profit of KECO by supply of electricity to rural area is measured as indirect net benefit. It was assumed that rural electrification for only domestic use will not creat new opportunity of employment in industries in the rural area, which use electricity power which was not available by rural electrification project.

3) Rate of operation profit to net sales, 1976

Radio, television and communication appratus	9.2%
Electric appliances and housewares	8.8%
Electric wire of cable	9.3%
Electric bulb	6.8%

Source: The Bank of Korea, Financial Statements Analysis for 1976.

6. Social effects

a. Improvement in quality of rural life and change in rural attitude to the project: The descriptive survey about improvement in quality of rural life and change in rural attitude to the project was made. All of the customers

heartly welcomed the rural electrification project. They also answered that the rural electrification improved rural living conditions to be easy to live, clean environment, and cooperative atmosphere. The access to such amenities as radio and television provides informations about urban life and rational way of activities. They try to be economical in ceremonial occasions and are anxious for children to have higher education. It was found that they are satisfying rural life after electrification.

b. Redistributive effects: The rural electrification provides market informations in time and eccelerates technology diffusion so that the relative income level in rural area is increased. There was no evidence that rural electrification itself was able to stem out migration from rural areas. But rural electrification gradually creates opportunity of employment of rural labor in rural industries. It was shown that rural electrification had redistributional effect within rural sector. The customers in the higher income class consumed the more electricity. Consumption of electricity could be regarded as the project revenue. Therefore, the project revenue was distributed more to the higher income classes. Furthermore, electricity demand for agricultural production and processing

would be increased more for the larger size of farm.

7. Impacts on rural development

a. Rationalization of rural life by electrification would provides a momentum to encourage economic activity in rural area.

b. Rural electrification would create willingness to develop rural economy becuse it provide the same living conditions in rural areas as in urban areas.

c. Village common facilities such as watering, public bath etc, were established by rural electrification, which increases rural welfare.

d. Development of rural industries by rural electrification would provide an opportunity to employ idle resources in rural area, if any, and to increase rural income level.

e. Security effects of remote rural and coastal areas was very great by rural electrification.

8. Financial flow of KECO: The Government loan was made to customers through KCB and nothing to do with KECO. But the loan actually converted into KECO's facilities investment Therefore it is more practical that the loan is regarded as KECO's cash cost and loan repayment as KECO's cash receipts.

The customers contribution of investment cost has both characteristics of cost and revenue and was excluded from financial flow chart. As a results cash costs included KECO's own investment, energy cost and sales tax. This energy cost is somewhat different from the energy cost in the direct cost by including corporate tax, surtax and non-operational costs. The KECO's financial flow chart was shown in Table 3.

9. Streams of direct costs and benefits:

Alternative I; Material savings and productivity gains from electricity use Direct costs of the project include the construction cost, electric bill, house wiring and maintenance cost, and purchasing cost of electric motors (Table 5). Direct revenue is total of material savings, time saving and productivity gains. Material saving and time saving from electricity use is assumed to be constant over time but productivity gain is expected to be increased at the same rate of increase in number of electric motor purchased per household (Table 4). Regional direct, cost and revenue under alternative I. lack of adequate data.

Alternative II: "Willingness to pay" approach Direct costs include construction costs, house wiring and

maintenance costs and energy supply costs the direct revenue is total of electric bill, loan repayment by customer and consumer's surplus (Table 5).

10. Stream of indirect costs and benefits:

Only net profits of electric appliances manufacturers and KECO are calculated to arrive indirect economic net revenue. The indirect costs and revenue stream can be derived from indirect net revenue concept and shown in Tables 4 and 5.

11. Rate of return of the project:

Internal rate of return (from direct cost and revenue) is 44.26% for alternative I and associated rate of return (from direct and indirect cost and benefit) is 48.5% for alternative I.

In alternative II, national IRR is 14.2% and ARR, 18.6%. IRR in suburban is 16.2%, 14.6% in plain region, 13.9% in in-between region, 13.5% in coastal region and 11.7% in mountainous region

Table 3. Financial Flow Chart of KECO, Per Household

Unit: Won

Year	Electricity Sales	Loan Payment	Total Cash Receipts	Investment	Energy Cost	Sales Tax	Total Cost	Net Cash Receipts	PV of Net Cash Receipts 10%	12%	15%
0				78,428			78,428	-78,428	-78,428	-78,428	-78,428
1	8,820	5,086	13,906		4,901	441	5,342	8,564	7,785	7,646	7,447
2	9,330	5,086	14,416		5,293	467	5,760	8,564	7,149	6,901	6,545
3	9,710	5,086	14,796		5,705	486	6,191	8,605	6,462	6,125	5,658
4	10,210	5,086	15,296		6,097	511	6,608	8,688	5,934	5,521	4,907
5	10,710	5,086	15,796		6,489	536	7,025	8,771	5,447	4,977	4,361
6	11,220	7,283	18,503		6,881	561	7,442	11,061	6,238	5,604	4,782
7	11,600	7,113	18,713		7,293	580	7,873	10,840	5,561	4,903	4,075
8	12,100	6,943	19,043		7,685	605	8,290	10,753	5,022	4,343	3,515
9	12,600	6,774	19,374		8,077	630	8,707	10,667	4,523	3,847	3,032
10	12,980	6,604	19,584		8,469	649	9,118	10,466	4,040	3,370	2,587
11	13,490	6,435	19,925		8,861	675	9,536	10,389	3,636	2,987	2,233
12	13,990	6,265	20,255		9,273	700	9,973	10,282	3,280	2,639	1,922
13	14,490	6,096	20,586		9,665	725	10,390	10,196	2,957	2,337	11,657
14	14,870	5,926	20,796		10,038	744	10,782	10,014	2,634	2,049	1,415
15	15,380	5,757	21,137		10,429	769	11,198	9,939	2,375	1,816	1,221

Table 3. Financial Flow Chart of KECO, Per Household (2)

	Electricity Sales	Loan Payment	Total Cash Receipts	Invest-ment	Energy Cost	Sales Tax	Total Cost	Net Cash Receipt	PV of net Cash Receipts 10%	12%	15%
16	15,880	5,587	21,467		10,822	794	11,616	9,851	2,148	1,607	1,053
17	16,260	5,418	21,678		11,234	813	12,047	9,631	1,907	1,403	895
18	16,760	5,248	22,008		11,626	838	12,464	9,544	1,718	1,241	771
19	17,270	5,079	22,349		12,018	864	12,882	9,467	1,553	1,099	665
20	18,020	4,909	22,929		12,409	901	13,310	9,619	1,433	997	588
21	18,590	4,740	23,330		12,802	930	13,732	9,598	1,296	888	510
22	19,240	4,576	23,810		13,214	962	14,176	9,634	1,185	796	445
23	19,890	4,401	24,291		13,606	995	14,601	9,690	1,085	715	389
24	20,510	4,231	24,741		13,998	1,026	15,024	9,717	991	640	339
25	21,180	4,602	25,782		14,390	1,059	15,449	10,333	951	608	314
26	21,830	3,892	25,722		14,782	1,092	15,874	9,848	827	517	260
27	22,480	3,723	26,203		15,194	1,124	16,318	9,885	751	464	227
28	23,120	3,553	26,673		15,586	1,156	16,742	9,931	685	416	198
29	23,770	3,383	27,153		15,978	1,189	17,167	9,986	629	373	173
30	24,420	3,248	27,668		16,370	1,221	17,591	10,077	574	336	152
31	25,070	3,044	28,114		16,782	1,254	18,036	10,078	525	300	132
32	25,720	2,875	28,595		17,174	1,286	18,460	10,135	478	270	116
33	26,350	2,705	29,055		17,566	1,318	18,884	10,171	438	242	101
34	27,010	2,536	29,546		17,958	1,351	19,309	10,237	401	217	88
35	27,660	2,366	30,026		18,350	1,383	19,733	10,293	371	195	77
Total	612,530		783,266		407,015		516,078	267,188	14,561	- 40	-15,514

IRR = 11.99

Economic Rates of Return of Rural Electrification Project

	Financial flow (FRR)	Direct benefit and cost (IRR)		Total benefit and cost (ARR)	
		Alternative I	Alternative II	Alternative I	Alternative II
Whole country	11.99	44.26	14.20	48.47	18.60
Mountainous			11.74		
In-between			13.91		
Plain			14.57		
Suburban			16.17		
Coastal					

B. Roads and Bridges

The economic cost of road construction actually incurred to the 1st year's 8 sample subprojects was calculated to be 4,440 thousand won per Kilometer or US 9,155 dollars/km, using an exchange rate of US$ 1.00 to ₩ 485. Since five non-IBRD road segments were constructed prior to 1976, the original costs were re-computed on the 1976 prices. Three IBRD-sponsored road constructions costed 5,508 thousand won or US$ 11,356 per Kilometer on 1976 prices. The average construction cost of the 2nd years 11 roads was estimated as 5,768 thousand won ((US$ 11,893) per Km on 1977 prices. The seven IBRD road development costed 6,045 thousand won (US$ 12,463). The above values certainly far exceeded the original IBRD estimates of the per Kilometer road construction cost of US$ 7,575. This is due to sharp price increases during 1974-1977 and to most IBRD project areas being more difficult to open the road. Villagers contributed more than 70% of total construction costs for non-IBRD Saemauel roads and about 50% of IBRD road construction costs, in terms of land donation and unskilled labor services.

A typical bridge construction of 30 meters long was simulated to cost 6,210 thousand won or US$ 12,804 equivalent on

Table 4. Direct, Indirect Costs and Benefits Flow (Alternative I) Whole Country, Won Per Household

Table 4. Direct, Indirect Costs and Benefits Flow (Alternative I) Whole Country; Won Per Household

Year	Meterial Savings	Time Savings	Productivity Gains	Direct Revenue	Invest-ment	Electric bill	Customer's Cost House-wiring	Others	Expansion & Maintenous Cost	Purchasing Cost of Electric moters	Direct Cost
0					88,525		9,712	845			99,082
1	3,068	27,465	3,899	34,432		8,820			2,014	1,117	11,951
2	3,068	27,465	24,293	54,826		9,330			2,014	5,841	17,185
3	3,068	27,465	35,689	66,222		9,710			2,014	3,264	11,988
4	3,068	27,485	42,288	72,821		10,210			2,014	1,889	14,113
5	3,068	27,465	46,187	76,720		10,710			2,014	1,117	13,841
6	3,068	27,465	48,217	78,750		11,220			2,014	601	13,835
7	3,068	27,465	48,217	78,750		11,600			2,014	601	14,215
8	3,068	27,465	48,217	78,750		12,100			2,014	601	14,715
9	3,068	27,465	48,217	78,750		12,600			2,014	601	15,215
10	3,068	27,465	48,217	78,750		12,980			2,014	601	15,595
11	3,068	27,465	48,217	78,750		13,490			2,014	601	16,105
12	3,068	27,465	48,217	78,750		13,990			2,014	601	16,605
13	3,068	27,465	48,217	78,750		14,490			2,014	601	17,105
14	3,068	27,465	48,217	78,750		14,870			2,014	601	17,485
15	3,068	27,465	48,217	78,750		15,380			2,014	601	17,995
16	3,068	27,465	48,217	78,750		15,880			2,014	601	18,495
17	3,068	27,465	48,217	78,750		16,260			2,014	601	18,875
18	3,068	27,465	48,217	78,750		16,760			2,014	601	19,375
19	3,068	27,465	48,217	78,750		17,270			2,014	601	19,885
20	3,068	47,465	48,217	78,750		18,020			2,014	601	20,635
21	3,068	27,465	48,217	78,750		18,590			2,014	601	21,205
22	3,068	27,465	48,217	78,750		19,240			2,014	601	21,855

Direct Net Benefit	P.V. of Direct Net Benefit		Indirect Costs		Total Costs	Indirect Revenue		Total Revenue	Total Net Benefit	P.V. of Total Net Benefit	
	40%	50%	Costs of KECO	Costs of Electric Appliances Manufactures		Benefits of KECO Excluding Tax	Benefits of Electric Appliances Manufactures			40%	50%
-99,082	-99,082	-99,082			99,082				-99,082	-99,082	-99,082
22,481	16,058	14,987	4,901	17,866	34,718	8,400	19,633	62,465	27,747	18,819	18,498
37,641	19,205	16,729	5,293	33,842	56,320	8,886	37,189	100,900	44,581	22,745	19,814
51,234	18,671	15,180	5,705	21,982	42,675	9,248	24,156	99,625	56,951	20,755	16,874
58,708	15,282	11,597	6,097	9,049	29,259	9,724	9,944	92,489	63,230	16,459	12,490
62,879	11,691	8,280	6,489	7,533	27,863	10,200	8,278	95,198	67,335	12,519	8,867
64,915	8,621	5,699	6,881	6,097	26,813	10,686	6,700	96,136	69,323	9,208	6,086
64,535	6,122	3,777	7,293	6,097	27,605	11,048	6,700	96,498	68,893	6,535	4,032
64,035	6,339	2,499	7,685	6,097	28,497	11,524	6,700	96,974	68,477	4,640	2,672
63,535	30,175	1,653	8,077	6,097	29,389	12,000	6,700	97,450	68,061	3,294	1,770
63,155	2,183	1,095	8,469	6,097	30,161	12,362	6,700	97,812	67,651	2,339	1,103
62,645	1,547	724	8,861	6,097	31,063	12,848	6,700	98,298	67,235	1,660	773
62,145	1,096	479	9,273	6,097	31,975	13,324	6,700	98,774	66,799	1,178	515
61,645	777	317	9,665	6,097	32,867	13,800	6,700	99,250	66,383	836	341
61,265	551	210	10,038	6,097	33,620	14,162	6,700	99,612	65,992	594	226
60,755	391	139	10,429	6,097	34,521	14,648	6,700	100,098	65,577	422	150
60,255	277	92	10,822	6,097	35,414	15,124	6,700	100,574	65,160	299	99
59,875	196	61	11,234	6,097	36,206	15,486	6,700	100,936	64,730	212	66
59,375	139	40	11,626	6,097	37,098	15,962	6,700	101,412	64,314	151	44
58,865	98	27	12,018	6,097	38,000	16,448	6,700	101,898	63,898	107	29
58,115	69	17	12,409	6,097	39,141	17,162	6,700	102,612	63,471	76	19
57,545	49	12	12,802	6,097	40,104	17,705	6,700	103,155	63,051	54	13
56,895	35	8	13,214	6,097	41,166	18,324	6,700	103,774	62,608	38	8

	Materials Savings	Time Savings	Productivity gains	Direct Revenue	Investment	Electric bill	Customer's Cost House-wiring	Customer's Cost Others	Expansion & Maintenous Cost	Purchasing Cost of Electric Meters	Direct Costs
23	3,068	27,465	48,217	78,750		19,890			2,014	601	22,505
24	3,068	27,465	48,217	78,750		20,510			2,014	601	23,125
25	3,068	27,465	48,217	78,750		21,180			2,014	601	23,795
26	3,068	27,465	48,217	78,750		21,830			2,014	601	24,445
27	3,068	27,465	48,217	78,750		22,480			2,014	601	25,095
28	3,068	27,465	48,217	78,750		23,120			2,014	601	25,735
29	3,068	27,465	48,217	78,750		23,770			2,014	601	26,385
30	3,068	27,465	48,217	78,750		24,420			2,014	601	26,385
31	3,068	27,465	48,217	78,750		25,070			2,014	601	27,035
32	3,068	27,465	48,217	78,750		25,720			2,014	601	28,965
33	3,068	27,465	48,217	78,750		26,350			2,014	601	28,965
34	3,068	27,465	48,217	78,750		27,010			2,014	601	29,625
35	3,068	27,465	48,217	78,750		27,660			2,014	601	30,275
	107,380	961,275				612,530			70,490	31,258	813,360

Direct Net Benefit	P.V. of direct Net Benefit 40%	50%	Indirect Costs: Costs of KECO	Costs of Electric Appliances Manufactures	Total Costs	Indirect Revenue: Benefits of KECO Excluding Tax	Benefits of Electric Appliances Manufacturers	Total Revenue	Total Net Benefit	P.V. of Total Net Benefit 40%	50%
56,245	24	5	13,606	6,097	42,208	18,943	6,700	104,393	62,185	27	6
55,625	17	3	13,998	6,097	43,220	19,533	6,700	104,983	61,763	19	4
54,955	12	2	14,390	6,097	44,282	20,171	6,700	105,621	61,339	14	2
54,305	9	1	14,782	6,097	45,324	20,790	6,700	106,240	60,916	10	2
53,655	6	1	15,194	6,097	46,386	21,409	6,700	106,860	60,473	7	1
53,015	4	1	15,586	6,097	47,418	22,019	6,700	107,469	60,051	5	1
52,365	3	0	15,978	6,097	48,460	22,638	6,700	108,088	59,628	3	0
51,715	2	0	16,370	6,097	49,502	23,257	6,700	108,707	59,205	2	0
51,065	2	0	16,782	6,097	50,564	23,876	6,700	109,326	58,762	1	0
50,415	1	0	17,174	6,097	51,606	24,495	6,700	109,945	58,339	1	0
49,785	1	0	17,566	6,097	52,628	25,095	6,700	110,545	57,917	1	0
49,125	1	0	17,958	6,097	53,680	25,724	6,700	111,174	57,494	1	0
48,475	0	0	18,350	6,097	54,722	26,343	6,700	111,793	57,071	0	0
	11,474	15,446			1,493,557				2,057,526	24,951	-4,503

TRR = 48.47

Table 5. Direct, Indirect Costs and Benefit Flow (alternative II) Whole Country, Won Per Household

Year	Electricity Sales	Consumers Surplus	Loan payment	Diect revenue	Investment	Energy Cost		Customers Cost		Maintenance Cost	Direct Cost
						Operational Cost	Generization Cost	House Wiring	Other		
o					88,525			9,712	845		99,082
1	8,820	3,250	5,086	17,156		794	3,643			2,014	6,451
2	9,330	3,510	5,086	17,926		858	3,935			2,014	6,807
3	9,710	3,784	5,086	18,579		924	4,241			2,014	7,179
4	10,210	4,043	5,086	19,339		988	4,532			2,014	7,534
5	10,710	4,304	5,086	20,099		1,051	4,824			2,014	7,889
6	11,220	4,563	7,283	23,066		1,115	5,115			2,014	8,244
7	11,600	4,836	7,113	23,549		1,181	5,421			2,014	8,616
8	12,100	5,096	6,943	24,139		1,245	5,713			2,014	8,902
9	12,600	5,356	6,774	24,730		1,309	6,004			2,014	9,327
10	12,980	5,616	6,604	25,200		1,369	6,281			2,014	9,634
11	13,490	5,876	6,435	25,801		1,436	6,587			2,014	10,037
12	13,990	6,149	6,265	26,404		1,499	6,878			2,014	10,391
13	14,490	6,409	6,096	26,995		1,563	7,170			2,014	10,747
14	14,870	6,656	5,926	27,452		1,626	7,461			2,014	11,101
15	15,380	6,916	5,757	28,053		1,690	7,753			2,014	11,457
16	15,880	7,176	5,587	28,643		1,756	8,059			2,014	11,829
17	16,260	7,449	5,418	29,127		1,817	8,350			2,014	12,161
18	16,760	7,709	5,248	29,717		1,883	8,642			2,014	12,539
19	17,270	7,969	5,079	30,318		1,947	8,933			2,014	12,894
20	18,020	8,229	4,909	31,158		2,010	9,255			2,014	13,279
21	18,590	8,489	4,740	31,819		2,077	9,531			2,014	13,622
22	19,240	8,762	4,570	32,572		2,141	9,822			2,014	13,977

Directnet benefit	P.V of Direct net benefit		Indirect revence		Total revenue	Indirect costs		Total Costs	Total net benefit	P.V of Total net benefit	
	12%	15%	Benefits of KECD excluding tax	Benefits of electric appliance manufacture		Costs of KECO	Costs of electric appliance manufacture			18%	20%
-99,082	-99,082	-99,082						-99,082	-99,082	-99,082	-99,082
10,705	9,558	9,309	8,400	19,633	45,189	4,901	21,419	29,218	15,971	13,535	13,309
11,119	8,864	8,408	8,886	37,189	64,001	5,293	40,573	45,942	18,059	12,969	12,541
11,400	8,114	7,496	9,248	24,156	51,982	5,705	26,354	34,866	17,117	10,418	9,905
11,805	7,502	6,750	9,724	9,944	39,007	6,097	10,849	22,680	16,327	8,421	7,874
12,210	6,928	6,071	10,200	8,278	38,577	6,489	9,031	21,911	16,666	7,285	6,598
14,822	7,509	6,408	10,686	6,700	40,452	6,881	7,309	21,222	19,230	7,123	6,440
14,933	6,755	5,614	11,048	6,700	41,297	7,293	7,309	22,006	19,291	6,056	5,384
15,167	6,126	4,958	11,524	6,700	42,363	7,685	7,309	22,754	19,609	5,217	4,560
15,423	5,554	4,378	12,000	6,700	43,430	8,077	7,309	23,501	19,929	4,493	3,862
15,536	5,002	3,840	12,362	6,700	44,262	8,469	7,309	24,230	20,032	3,827	3,235
15,764	4,532	3,388	12,848	6,700	45,349	8,861	7,309	24,995	20,354	3,296	2,739
16,013	4,110	2,993	13,324	6,700	46,428	9,273	7,309	25,761	20,667	2,836	2,318
16,248	3,724	2,641	13,800	6,700	47,495	9,665	7,309	26,509	20,986	2,440	1,961
16,351	3,346	2,311	14,162	6,700	48,314	10,038	7,309	27,236	21,078	2,077	1,642
16,596	3,032	2,040	14,648	6,700	49,401	10,429	7,309	27,983	21,418	1,789	1,390
16,814	2,743	1,797	15,124	6,700	50,467	10,822	7,309	28,748	21,719	1,537	1,175
16,946	2,468	1,575	15,486	6,700	51,313	11,234	7,309	29,512	21,801	1,308	983
17,178	2,234	1,388	15,962	6,700	52,379	11,626	7,309	30,262	22,117	1,124	831
17,424	2,023	1,224	16,448	6,700	53,466	12,018	7,309	31,009	22,457	967	703
17,879	1,853	1,092	17,162	6,700	55,020	12,409	7,309	31,785	23,235	848	606
18,197	1,684	967	17,705	6,700	56,214	12,802	7,309	32,521	23,703	733	515
18,595	1,537	895	18,324	6,700	57,596	13,214	7,309	33,288	24,308	637	376

Year	Electricity Sales	Consumers Surplus	Loan Payment	Direct revenue	Investment	Energy Cost		Customers Cost		Maintenance Cost	Direct Cost
						Operational Cost	Generization Cost	House Wiring	Other		
23	19,890	9,022	4,401	33,313		2,204	10,114			2,014	14,332
24	20,510	9,282	4,231	34,023		2,268	10,405			2,014	14,687
25	21,180	9,542	4,602	35,324		2,331	10,697			2,014	15,042
26	21,830	9,802	3,892	35,524		2,398	11,003			2,014	15,415
27	22,480	10,075	3,723	36,278		2,461	11,294			2,014	15,769
28	23,120	10,335	3,553	37,008		2,525	11,586			2,014	16,125
29	23,770	10,595	3,383	37,748		2,588	11,877			2,014	16,479
30	24,420	10,855	3,248	38,523		2,652	12,168			2,014	16,834
31	25,070	11,128	3,044	39,242		2,719	12,474			2,014	17,207
32	25,720	11,388	2,875	39,983		2,782	12,766			2,014	17,562
33	26,350	11,648	2,705	40,703		2,846	13,057			2,014	17,917
34	27,010	11,908	2,536	41,454		2,909	13,349			2,014	18,272
35	27,660	12,168	2,366	42,194		2,973	13,540			2,014	18,627
					1,053,159						538,087

IRR = 14.209

Direct net benefit	P.V of Direct net benefit 12%	P.V of Direct net benefit 15%	Indirect revence: Benefits of KECD excluding tax	Indirect revence: Benefits of electric appliance manufacture	Total revenue	Indirect costs: Costs of KECO	Indirect costs: Costs of electric appliance manufacture	Total Costs	Total net benefit	P.V of Total net benefit 18%	P.V of Total net benefit 20%
18,981	1,401	763	18,943	6,700	58,956	13,606	7,309	34,035	24,921	554	376
19,336	1,274	675	19,533	6,700	60,256	13,998	7,309	34,782	25,474	480	320
20,282	1,193	416	20,171	6,700	62,195	14,390	7,309	35,529	26,666	426	279
20,109	1,056	531	20,790	6,700	63,014	14,782	7,309	36,294	26,720	361	233
20,509	962	471	21,409	6,700	64,388	15,194	7,309	37,060	27,328	313	199
20,883	874	417	22,019	6,700	65,727	15,586	7,309	37,808	27,919	271	169
21,269	795	369	22,638	6,700	67,086	15,978	7,309	38,554	28,632	235	144
21,689	724	328	23,357	6,700	68,480	16,370	7,309	39,301	29,179	204	123
22,035	657	289	23,876	6,700	69,818	16,782	7,309	40,086	29,732	176	104
22,421	597	256	24,495	6,700	71,178	17,174	7,309	40,833	30,345	152	89
22,786	541	226	25,095	6,700	72,498	17,556	7,309	41,580	30,918	131	75
23,182	492	200	25,724	6,700	73,878	17,958	7,309	42,327	31,551	114	64
23,567	446	177	26,343	6,700	75,237	18,350	7,309	43,074	32,163	98	54
515,072	17,128	-8,257	1,216,284		1,935,721	407,015		1,218,284	718,436	3,369	-7,738

IRR + 14.209 TRR = 18.6%

1977 prices, which, however, far exceeded the MOHA standard cost of 4,428 thousand won per bridge on the 1976 prices. In the meanwhile, IBRD-loaned bridges were constructed at the cost of 6,560 thousand won or US$ 13,526 equivalent for a 30 meter long bridge. Elsewhere in the surveys, cost estimates made by MOHA or IBRD were found very low against the actual costs incurred. The villagers' share of total construction costs of bridges was about 25% for non-IBRD segment about 22% for IBRD-loaned bridges.

Maintenance for road and bridge has been primarily assumed by villagers. The annual cost for Km maintenance was calculated as 1,070 thousand won (US$ 2,206), using the shadow wage rate of 1,500 won per man/day on the 1977 prices. A typical 30 m long bridge costed 86.3 thousand won (US$ 178) a year for maintenance.

Most of beneficiaries of the sample roads, and bridges have been surveyed in order to quantify some of the main benefits attached to the characteristics of the road and bridge components. Direct benefits quantified in this report are time savings in traffics and a reduction in transportation costs of agricultural products and inputs. Also surveyed are

such indirect benefits as increased farm income owing to a shift from low-value crops to high-value perishable produce, increased land value, a general increase in agricultural production, increased land value, better access to off-farm employment and social services, and upgraded quality and prestige of rural life in general. Due to the limitations of sample characteristics, off-farm employment effects were hardly quantifiable from the survey data available. A deliberate attempt to select industrially-oriented project areas has been failed, for a road opening alone does not bring off-farm job opportunities to villagers.

Time Savings in Traffic

In regards to time savings in traffic, all the sample roads and bridges were investigated into their average daily traffic flows by different transportation modes. And hours of time saved by different modes after the new road was multified by relevant traffics in order to obtain money values of time savings of rural residents travelling on the road. Rural resident's time was valued as 187 won per hour in 1977 (150 won in 1976), using the shadow wage rate agreed among our IBRD Evaluation Study Team. As shown in the text, the average annual

traffic time savings of a kilometer new road in 1977 were calculated as 2,260 thousand won with the largest amounts observed in the roads where mass transportation services like bus have been introduced following the new road operation. Out of the 19 sample roads, bus services were available on eight project areas. Likewise, a typical 30 meter bridge construction was found to bring traffic time savings of 1,211 thousand won worth a year, with more savings resulted in the aftermath bus-serving areas.

Reduction in Transportation Costs

An empirical calculation was attempted to estimate a reduction in transportation costs attributable to road and brdidge development in rural areas. Before the project, the agricultural inputs and outputs were generally transported by an A-frame 'Jige' on man's back or by animal-draft cart. Economically a ton of carload per kilometer costed 250 won in 1977, whereas the same (t/Km) would cost 935 won by 'Jige' and 560 won by cart. With the project, the cost savings of transportation of 1 ton-km carload would be 685 won when Jige was replaced by truck, and 310 won when cart was substituted by truck on 1977 prices. By multiplying the relevant cost-

saving bases by the annual carload tonnage transported and the effective road length, an annual reduction in transportation costs on 1km road was calculated as 301 thousand won.

Income Increases Resulting from Changes in Cropping Pattern

Throughout the survey areas it was observed that the cropping pattern has largely shifted from low-value crops (puleses in summer) to high-value vegetables and fruits. On the average, a rural road of 2.34 km development resulted in an increase of 10.08 ha for vegetables grown and 6.7 ha for fruits in 1976. Yet the acreage was expected to increase more and more with the years elapsed after the construction. The social net value increase of production per hectare was estimated as 156 thousand won for the pulses-vegetables whift case and 1,595-1,266 thousand won for the pears or grapes growing in the previously uncultivated slope lands, after deducting, in both cases, an additional transport cost of the increased production from gross benefits. The benefit buildup rate of vegetables was assumed to be 30% in Year 1, 65% in Year 2 and 100% in Year 3. That of pear was 35%, 65%, 85% and 100% from the 4th to 7th years and that of grapes was 30%, 65% and 100% from the 3rd to fith years. The social net value increases in the production

shifts per km road or 30 m bridge were considerable as the text.

Other Benefits

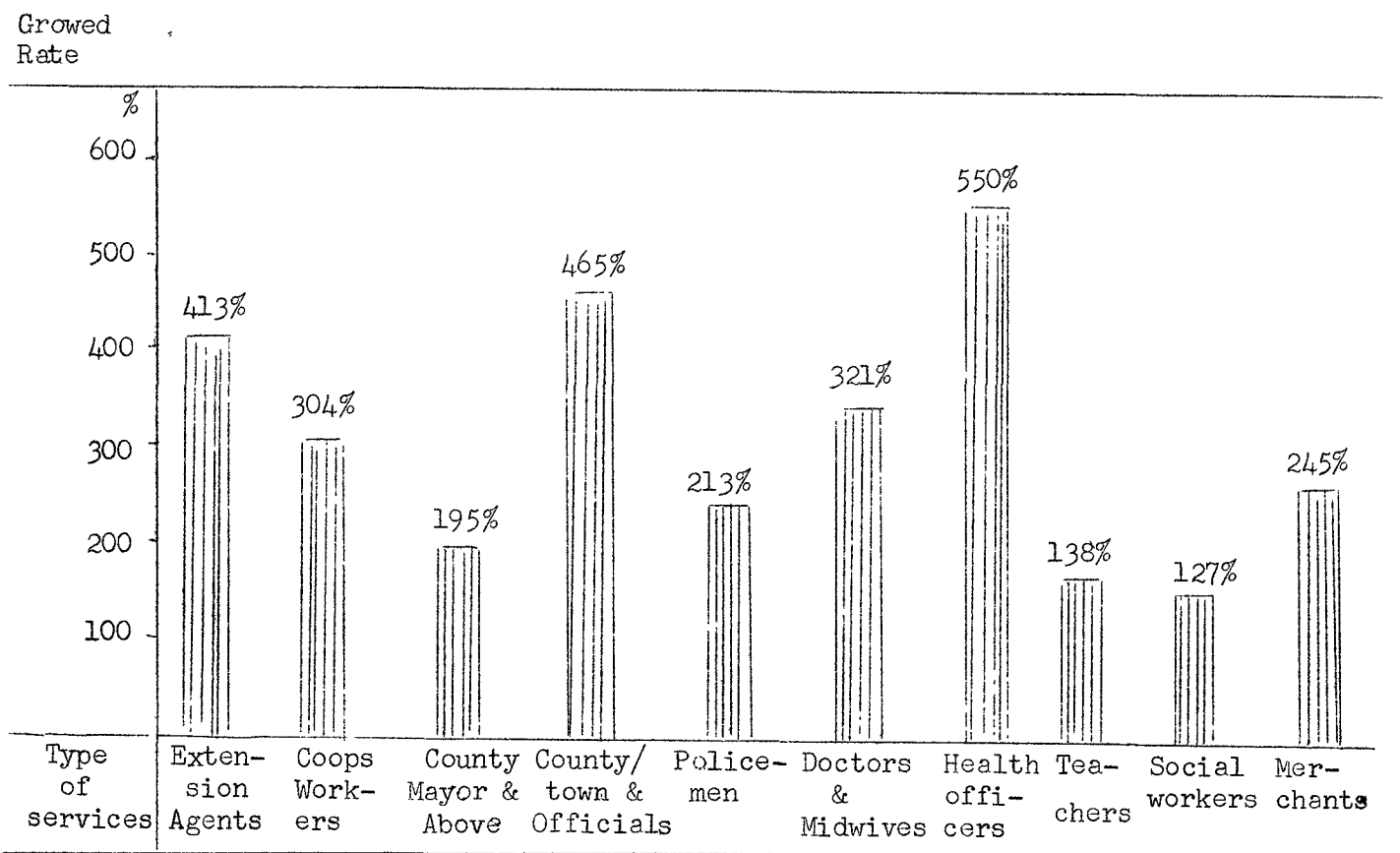
Firstly, the average rate of agricultural land utilization has increased from 115% to 134% after the road construction. Secondly, farmers' marketing methods and prices received by them have been considerably improved along with the accessibility improvements by about 5-10% in price receipts. Thirdly, the inflow of such social services as health, extension, administrative (public) and commercial services into the beneficiary villages has been trippled following the road construction. Lastly, number of commuting students and workers from their home in the villages have been steadily increasing as the accessibility to the village from the outside became easy.

Economic Analysis

Based on the per km cost/benefit survey data, an analysis was made of the economic viability of various road and bridge projects as shown below. In order to estimate IRR, only direct benefits such as traffic time savings and transportation cost savings were counted, whereas farm income increases

resulting from changes in cropping pattern were counted as for the associate rate of return on investments (ARR). Thus the internal economic rate of returns from a typical road was found to be about 19-22% with its ARR as 19-25%. IRR and ARR of a 30 m long bridge were estimated as 13.7%-28% and 26-30%) respectively. The results of the post-evaluation on sample projects indicate that number of people affected, introduction of mass-transport modes (bus), and high-value cropping system are important factors to raise the economic viability of the project.

Growth Indices of Social Services After Improvements in Rural Accessibility, 1978



Computerized Results of Economic Viability Analysis of Rural Roads and Bridges, 1977: 1st Year's Survey Roads & Bridges

Classification	IRR (Direct) Effect)	ARR (Indirect)	Remarks
All Roads	18.9%	25.43%	Direct Effects B/C : 1.5 (10% D.R) " : 1.2 (15% D.R)
Road (01)	24.7	28.60	Bus Services + Cash Crops
" (02)	19.3	27.21	Cash Crops
" (03)	17.5	17.05	Cash Crops
" (04)	15.4	6.24	-
" (05)	26.7	3.30	Bus Services
" (06)	17.0	-1.52	-
" (07)	21.1	7.95	Largest Population Served
" (08)	19.5	5.90	-
All Bridges	13.7	26.6	Direct Effect B/C : 1.2 (10% D.R) " : 0.9 (15% D.R)

Computerized Results of Economic Viability Analysis of Rural Roads and Bridges, 1978: 2nd Year's Survey Roads & Bridges

	IRR (Direct Effect)	ARR (Indirect)	Remarks
All Roads	21.8%	19.2%	Direct Effects B/C : 1.8 (10% D.R) " : 1.4 (15% D.R)
Road (001)	7.4	10.5	Small village with relatively small number of people affected
" ((002)	23.5	15.4	Lots of traffics
" (003)	29.3	24.9	Bus services available + cash crops
" (004)	28.2	16.8	Bus services available
" (005)	23.7	13.8	Bus services available
" (006)	26.5	10.1	Bus services available
" (007)	29.7	33.5	Bus services + Cash crops + traffic center
" (008)	20.6	26.2	Multi-purpose road + cash crops
" (009)	10.2	16.6	Expensive construction costs
" (010)	11.9	12.3	Small number of people served
" (011)	17.6	20.5	Larger No.of people served + Cash crops
All Bridges	28.1	30.3	Direct Effect B/C : 2.1 (10% D.R) " : 1.5 (15% D.R)

C. Upland Reclamation

1. Construction Costs

The upland reclamation construction costs per hectare of net upland reclaimed area were measured in an attempt to compute the costs of the investment projects and thus computing the IRRs and B/C ratios.

The construction costs per hectare of net farmland developed by project year. The construction costs per hectare of net farmland developed vary with a large range from 460.7 thousand won in Taean to 1,388.4 thousand won in Ochang. However, the average construction cost per hectare for four 77 IBRD projects reached to 982.9 thousand won. It appears that such variations in the construction costs between those of the individual projects are caused not only from the differences in the engineering techniques but also from differences in costs occurred from the different scales of projects. On the contrary, it appears that the construction costs for farmland developed were estimated lower than that for net farmland developed, varying from 460.7 thousand won for Taean to 1,388.4 thousand won in Ochang, whereas the average cost was estimated 982.9 thousand won for the all four IBRD projects surveyed.

2. Productivity

Annual yields by crop per 19 areas of 72 reclaimed land area were measured. On the average, barley production in the reclaimed areas reached to 107 Kg/10 ares in the first year of operation after the reclamation, achieving only 45.1 per cent of the averge unit yield from the existing upland. In its 4th year, it achieved the highest yield showing 182 Kg/10 areas, showing only 76.8 per cent of the average umit yield from the existing upland. These percentages, however, dropped to below 50 per cent during its 5th and 6th years due to severe drought in the early springs of the respective year. Soybean production reached the highest yield with 95 Kg/10 areas in its 5th year of operation, achieving only 93.1 per cent of the average unit yield from the existing upland. Sesame production also showed relatively low production yield only with 45 Kg/10 areas, achieving only 85 per cent of the average unit yield from the existing upland in its 4th year of farm operation, and yet from that year on the yield has been sharply dropped as time passess. However, sweet potato and red pepper reached the level of average unit yields from the existing upland in their 5th and 2nd years of operations,

respectively. Except for these two crops, all other crops showed sharp drops in yields in the years of 1976 and 1977 due to severe drought. From the above survey results, it is apparent that the 6 major crops started with low productivities in 1972 and achieved the level of average unit yield from the existing upland in 1977. Furthermore, yields of sweet potato and red pepper exceeded the level of average unit yield from the existing upland in 1977, achieving 104.3 per cent and 108.7 per cent, respectively.

The above situations imply that the major crops in the upland reclaimed areas are able to achieve their productivities similar to that of the upland existing lands in their 5th to 7th years of operations after the reclamation projects were implemented. This is because the farmers in the reclaimed area must have devoted more efforts to improve the soil conditions than they or the other farmers would do for the existing lands. However, it is also necessary to note the fact that the crops from the reclaimed areas were more susceptible and sensitive to droughts than the crops from the existing upland areas.

3. Farm Incomes and Net Returns from Reclaimed Areas

There have been a lot of variations in farm incomes by year among the crops. It was found that the farm incomes from 10 areas of 72 reclaimed areas was realized highest in its 5th years of operation, that is, in 1976. Red pepper brought in the highest income with 63,392 won, achieving 113.4 per cent of the average farm income of the existing upland. Sweet potato was next to red pepper in bringing in farm incomes, showing 50,681 won achieving 117.3 per cent of the average farm income of the existing upland. It is interesting to note that income from red pepper exceeded that from the existing upland area in farmer's third year of operation, showing 125.9 per cent of the average farm income of the existing upland, whereas sweet potato and upland rice in their fourth year. On the contrary, however, soybean barley and sesame achieved 84.7 per cent, 58.4 per cent and 76.3 per cent of the average farm income of the existing upland in 1976 when these crops showed the highest incomes.

One of the ways of deriving net incomes or net returns is to subtract the production costs from total revenues by crop in respective year.

Soybean showed loss in almost every year, except for 1976, bringing in losses of 1,657 won in 1974 and 4,111 won in 1977. Barley also brought in losses of 2,769 won in 1973 and of 22,826 won in 1977, while red pepper in loss of 16,428 in 1977 only because of severe drought in that year. However, rest of the crops brought in positive net incomes in almost every year. Particulary red pepper achieved 146.9 per cent of the net farm incomes of the existing upland rice achieved the similar level of net incomes from existing upland areas in 1975, respectively.

Looking from the above situations, it is very useful to note that the net incomes vary among the crops, depending upon whether conditions, unit yields per unit land area, and prices of crops that the farmers receive from their sales of crops in that particular year.

4. Investment Validity Analysis

a. Assumptions

i) Every measures for costs and incomes were applied to one hectare of reclaimed areas that were developed during the period of 1972-1977.

ii.) It is assumed that the cropping patterns for 1977 will continue over the 50 years in the surveyed reclamation areas.

iii) Various crop yields were estimated for 8 years by apolying the yield measures[4] than the Agricultural Development Corporation has filed as can be seen in the Table.

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4) Regression Coefficients of Various Crop yields for the 1972-1977 projects.

Crops	Regression Coefficients	R^2
Barley	Y= 43.80 + 8.25 X	0.93
Soybean	Y= 56.63 + 7.69 X	0.99
Sweet Potato	Y= 68.90 + 5.76 X	0.85
Upland rice	Y= 57.80 +12.79 X	0.90
Red-pepper	Y= 67.49 +11.89 X	0.73
Sesame	Y= 59.85 + 6.58 X	0.88
Tobacco	Y= 70.30 +11.10 X	0.40

Estimated Yields by Crop From 10 areas of
72 Reclaimed Land Areas

Crop \ Year	1st	2nd	3rd	4th	5th	6th	7th	8th	Existing land
Soybean	65 (64.3)	73 (72.0)	80 (79.7)	88 (87.4)	96 (95.1)	101 (100.0)	101 (100.0)		101
Barley		114 (52.1)	132 (60.3)	150 (68.6)	168 (76.8)	186 (85.1)	204 (93.3)	219 (100.0)	219
S. Potato	1,052 (74.7)	1,133 (80.4)	1,215 (86.2)	1,295 (91.9)	1,377 (97.7)	1,409 (100.0)	1,409 (100.0)		1,409
Red Pepper	77 (79.4)	89 (91.3)	97 (100.0)	97 (100)					97
Sesame	31 (66.4)	34 (72.3)	37 (78.7)	41 (86.2)	44 (92.8)	47 (100.0)	47 (100.0)		47
Peanuts	64 (70)	73 (88)	91 (100)	812 (100)					91
Oilseed	119 (70)	186 (88)	170 (100)	170 (100)					170
Radish	1,850 (80)	2,312 (100)	2,312 (100)						2,312
Water Melon	1,600 (80)	2,000 (100)	2,000 (100)						2,000
Upland rice	102 (66.4)	112 (73.0)	122 (79.6)	132 (86.2)	142 (92.8)	153 (100.3)			153
Apple									2,764
Tobacco	105 (46.0)	166 (72.8)	211 (92.5)	218 (95.6)	228 (100.0)				228

1) Figures in parentheses are the estimated yields

The annual measures of yields for other crops not included in this survey such as radish, oilseed, watermelon and fruits were provided by Agricultural Development Corporation, Korea, for the projection purposes.

b. Gross Revenues

Gross Revenues from one hectare of reclaimed land areasby individual project were obtained by multiplying the yield measures by crop by the 77 farm prices received. Gross revenues by crop were also employed to estimate the gross revenues from one hectare of land areas by multiplying the crop patterns by crop acreages.

c. Costs

Production costs and management costs per hectare of reclaimed land of each individual project were estimated on the basis of the above data, and the estimated production costs by crop and management costs by crop were also applied to estimate the costs per one hectare of reclaimed area.

d. Farm Incomes and Net Revenues

Farm incomes and net revenues per hectare of reclaimed land areas for each individual project were also estimated on the basis of the above data.

e. Investment Costs

Investment costs were also employed to measure the present values of the past investment costs, by reflecting the annual price increases.

5. The Results of B/C Analysis

The results of B/C analysis are summarized in the following table According to the Table, the average Internal Rate of Return for 12 projects is found to be 22.6 per cent and its B/C [5] ratio to be 3.56. IRR for 77 IBRD projects is found to be 22.3 per cent and its B/C ratio is found to be 2.63, and thus showing the fact that the projects, on the average, are showing their economic validity with relatively great percentages of IRRs and B/C ratios.

It is also interesting to note that the lowest B/C ratio among the 12 B/C ratios for 12 projects is 1.2, and thus proving that all investment projects are economically valid. However, IRRs and B/C ratios are in a great variation, having

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5) B/C ratios were computed by discounting the streams of costs and benefits over 50 years, discounted at discount rate of 10.5 per cent. This is because the interest rate for loan was 10.5 per cent.

Hyungyong with 29.9 per cent of IRR, Songcheon with 29.1 per cent, Shinbuk with 26.4 per cent, Hakdong with 25.0 per cent, Gochang with 23.3 per cent and Ochang with 20.5 per cent, respectively. Most of them showed relatively high IRRs, showing IRRs greater than the average.

On the contrary, Songam and Taean located in west cost of Chungcheongnam Do showed relatively low IRRs with 12.1 per cent and 12.8 per cent.

IRR and B/C Ratio by Project

	Project	IRR	Net Reclaimed Area	B/C Ratio	Remarks
PY72	Taean	12,8	104	1,38	Located in west coast of Chungnam Do. Poor soil capabilities. Barley and soybeans are the major crops
	Shinbuk	26,4	133	3,55	Located in the suburban area of Kwangju City. Watermelon and Radish are the major crops and the cropping rates are very high. Good Water supply.
PY74	Icheon	17,8	271,89	2,53	Fruits are major crops, Planting acreage rates are very low. Relatively high rate of outmigration causes the shortages of farm labor.
	Gochang	23,3	325,2	4,29	Largest reclamation area and thus generates large scale economies of the project. Watermelon and radish are the major cash crops.
PY75	Samsung	20,0	259	3,86	Remote farming in Chungbuk Do, Tobacco and Red pepper are the major cash crops. Use of green houses are well developed.
	Hyungyong	29,9	150	3,98	Located in Chungnam Do. Sweet potato is the major crop.
PY76	Ochang	20,5	38,05	2,59	Located in Chungju suburban area with such cash crops as Tobacco and peanuts..
	Hakdong	25,0	73,58	3,02	Located nearby Shinbuk, Chongnam Do. Watermelon and Radish are the major cash crops. Very good soil capabilities.
PY77	Dukjol	19,3	110,51	2,10	Ratio of Idle land is relatively high due to the close access to Suwon city and Seoul.

	Project	IRR	Net Reclaimed Area	B/C Ratio	Remarks
PY77	Songam	12.1	130,48	1,20	Located nearby Taean. Similar natural conditions to that of Taean. Idleland ratio was 15 per cent in 1977 due to severe drought.
	Oju	24,2	8,385	24,67	Good soil capabilities. Fruits are cash crops.
	Songcebn	29,1	183,24	4,32	Located in the Southern Part of Chonnam Do. Good soil capabilities. Watermelon and Radish
77	Average	22,3	-	2,63	
	Overall average	22,6	-	3,56	

1). 10.5 per cent of discount interest rate was applied to derive the B/C ratio. for the loan was made for 10.5 per cent of interest rate.

6, Farmer's Repayment Capacity

Farmer's repayment capacity was measured based on the data collected from the four 77 IBRD projects reclaimed in 1977.

Farm incomes per hectare of the 77 IBRD reclaimed areas were computed on the basis of total revenues and production costs by crop from one hectare of reclaimed land areas, and on the estimated construction costs per hectare of reclaimed area.

A farm had the farm income of 308 thousand won from the farm operation on one hectare of 77 IBRD reclaimed land in its first year of operation. Farm incomes have gradually increased and finally increased to 630 thousand won in its 7th year of farm operations.

It is found that farms have a repayment capacity both with and withought its family living expenditures subtracted. In their first year of farming, the farms had repayment capacity, showing income balances of 72.6 thousandnd won, 82.6 thousand won and 92.6 thousand won, respectively, in the cases of 40 per cent, 30 per cent and 20 per cent loans of the total construction costs.[6)]

6) In the case of the IBRD project, farmer are granted a loan amounting to 40 per cent of total construction costs at 10.5 per cent annum for 5 years with 3 year grace period.

This contrasts to the results that the Interim Report of NAERI" Economic Evaluation of Upland Reclamation Project" showed in 1977 with a statement that the farms were only able to repay the debt from the 4th year even when the percentage of cost sharing (loan) was 20 per cent of the total costs.

The reasons why the 77 IBRD project farms will have such a successful repayment capacity on both 40 per cent, 30 per cent and 20 per cent loan of total construction costs are found to be as follows;

1) Farmers on the 77 IBRD project areas have been fully knowledged with how to have their best crop patterns based on the experiences from the other farmers who have experience somewhere elss, and

2) Farmers on the 77 IBRD project areas had favorable financial assitances particularly in their loans with favorable terms as were stated in the early pages of this text.

7. Since the upland reclamation areas are usually located in the maountaineous and hilly areas of the county, there are a lot of reclaimed land areas that are owned by absentee landlords, large farm, and clans. A lot of owners do not operate farms and thus renting high percentages of the total reclaimed areas to the tenants.

About 30.7 per cent of the total reclamation area was leased to the tenants, whereas only 10.2 per cent of the total existing upland and 10.4 per cent total existing paddy were rented. It is found that the percentages of acreage rented were small as the size of farms increased, and vice versa.

In the case of existing lands, the percentage of land areas leased for the farms with the size less than 1,500 pyongs was 22.3 per cent, while that for the farms with the size that falls between 4,501 pyongs and 6,000 pyongs was only 6.3 per cent.

On the contrary, the reclaimed land areas showed much higher percentages of land areas leased. The farms with the size that fall in between 1,501 pyongs and 3,000 pyongs showed 48,2 per cent of reclaimed land areas leased, whereas the farms with size of 4,500 pyongs showed 40 per cent of land areas leased. In contrast, the farms with the sizes of greater than 4,500 pyongs showed only 10 per cent of reclaimed land leased.

The survey results also indicate that the per cent land areas leased per farm were also relatively large, compared to that of existing farms. Table 16 shows that the proportion of existing upland area leased per farm was 2.9 per cent, whereas that of reclaimed area leased per farm was 5.4 per cent.

The opinion survey results also indicate that about 86.8 per cent of the total farmers in the reclaimed land areas showed their strong favors for the continuation of the upland reclamation projects. 92.2 per cent of the farmers in the 72 reclaimed areas showed their wishes for the continuation of the projects, whereas about 72 per cent of the total farmers in the 77 IBRD project areas expressed their wishes for the project continuation.

One of the interesting things regarding the farmers' opinions on whether the projects should be continued is that the percentages of the a farmers who showed favor increase as the time passes after the reclamation projects were implemented. This can be interpreted as implying that most of the farmers are enjoying favorable farm incomes from farm operations on the reclaimed land areas with ever increasing soil capacities as the time passes.

Farmers are facing problems with farm operations depending on their individual situations.

Survey results indicate that, on the average, 90.7 per cent of the farms are experiencing difficulties with their farm operations. 31.3 per cent of the problems that the farmers are facing is the shortage of farm labor, whereas 15.4 per cent is

the shortage of farm operation funds. The second highest percentage (24.4 per cent) of the problems arise out of poor soil capabilities. However, the problem of soil capabilities appears to be less problematic as the time passes after the farm is open.

About 88.6 per cent of small farms express that they have operational problems, whereas 90.8 per cent of the large farms are experiencing the problems.

It is very interesting to note that the small farms are experiencing far greater problem of shortage of operation funds with 23.7 per cent, than the larger farms with only 7.8 per cent. In contrast, 16.7 per cent of small farms are experiencing the shortage of farm labor, while 46.1 per cent of large farms are experiencing it.

Although problems caused by poor soil capacity occupy somewhat greater than 20 percent, their degree do not vary a great deal among the different farm sizes, showing 26.3 per cent, 24.5 per cent, and 22.7 per cent, respectively.

The results indicate that, on the average, the smaller the farm sizes are, the greater problems with operation funds, they have and vice versa. On the contrary, the larger the

farm sizes are, the greater the problems with labor shortage is. These situations can be interpreted as implying that small farms have greater problems with operation funds than the large farms have, while having smaller problems with labor shortages than the large farms experience, This can be interpreted as implying that the recent problems that the farms are experiencing shift from problems of fund shortages to that of labor shortages.

D. Fuelwood Plantation

The principal benefits of the fuelwood project would be:

(a) production of forest fuel which would replace illegal cutting and gathering of timber and other forest products.

(b) labor saving in collecting fuel.

(c) creation of permanent timber producing forests as a secondary purpose of the fuelwood plantation projects, and consequent reduction of soil errosion and flood protection.

(d) increase inseedling farmer's income and creation of employment opportunities for the labor intensive seedling farms.

(e) beautification of mountains and villages, and institutional building at village level leading to self reliance.

Quantitative measurement of direct benefits a, and b is attempted. There are no explicit markets for fuewood in rural area any more. However fuelwood, more specifically trimmed tree branches sometimes are bought and sold among the residents in a village. Price of the fuel wood is around 1,000 Won per 60kg, a loadful of "gike" (A-frame). It is assumed that full yield would be reached in eighth year and would equal 5 tons/ha. Yields would build up 0.5 ton in fouth year, 1 tons in fifth year, 2 tons in sixth year, 4 tons in seventh year and there-after 5 tons/ha until 20th year. There will be no production until fourth year. During years 1 to 3, there would be a certain amount of grass and weeds produced but usually it is left on the site for fertilizer and value of this would be merely equal to the opportunity cost of labor maintaining the fuelwood plantation.

When there were no fuelwood plantations, a household had to spent average 41 days per annum to stock up 1 year fuel requirement during mostly winter time. With fuelwood plantation, a rural household spends about 7 days for a year to serve

fuelwood plantation including forest product harvest. Value of time saving may be evaluated as an opportunity costs of labor. 75% of annual average wage rate for man and woman in 1977 was 1,500 Won/day. Labor saving value per ha of fuelwood plantation was estimated to be about 16 days when substracting the effect of 45% composition rate of briquette and agricultural residuals in fuel consumption. Savings of coal resources and agricultural residues did not occur in the survey as country to expected.

The cost per ha of plantation establishment is estimated to be around 112,216 Won. Materials, transport and overhead are evaluated at their financial costs. Supervision costs are valued at 4,233 Won/day which is skilled laborer's wage rate in 1977. Village volunteer labor which comprises 57% of total cash valued establishment cost has been valued at 1,500 Won/day which is 75% of annual average farm wage rate in 1976. The volunteer labor cost is 63,214 Won/ha.

The maintenance costs of fuelwood plantation is composed of weeding brushing for the first 4 years and plantation patrol costs. This is valued at 3,047 Won. Production costs may be divided into labor cost for harvest and fertilizer costs. Labor cost is estimated at 2,417 Won per ha and fertilizer cost

is 1,303 Won/ha. Therefore, the total production costs for fuel is 3,786 Won/ha.

For cost and benefit streams, the rate of return is estimated to be 18,8%. The benefit cost ratio was 2,29 and 1,81 when 12% and 15% discount rates were used respectively. When the fuel production was valued at opportunity cost of labor, 1,500 Won/day, IRR is estimated to be 19,78%. It was assumed that one man can harvest and carry (by A-frame) 180 kg/day. The transport distance was assumed to be 1 km.

E. Water Supply

1. Cost Analysis

a. Fixed Investment Cost

The fixed investment costs of simple piped water systems vary depending on the types of system, the capacities for water supply, the distances between water sources or reservoirs and beneficiary households, etc. The average investment cost of the waterworks in the 28 villages surveyed is estimated at 4,189,000 won per system. The system that required the largest sum of investment was the one at the Yangmok Cooperative Sphere, which serves 3,600 beneficiaries in 568 households. This system cost 29,200,000 won to build. The least expensive one was the water

supply system for the village of Hoam Oedon, in Nangsan-myon, Iksan-gun, in which only 589,000 won was invested.

Fixed investment per beneficiary household worked out at 46,864 won on the average. As for variations according to the types of system, the gravity system, which does not require any pump or motor, cost an average of 46,494 won per household. The per household cost of pumping plus gravity systems averaged 48,323 won, and the comparable figure for pressurized systems stood at 41,282 won. The pressurized system costs least per household, partly because, unlike the gravity system, it does not require a reservoir, and partly because relatively small quantities of transmission and distribution pipes are usually needed. The reason for the latter is that whenever a suitable underground water source is available, the pumping facility can be installed at the heart of the village or in its close vicinity.

In the case of the gravity system, economies of scale become increasingly evident as the number of households receiving water supply increases, with the investment cost per household showing a definitive trend to decline. But in the case of systems using pumps and motors, economies of scale come into play to a certain extent with increases in the number of beneficiaries,

depending on the horse power of pumps installed. So the cost per household also decreases to a certain level. But when the number of beneficiaries rises above the 600-person level, both the pump and the motor need to be replaced with larger ones, causing the per household investment cost to go up, instead of down.

b. Operating And Maintenance Costs

Operating and maintenance costs include personnel expenses, repair expenses and such miscellaneous expenses as the cost of chemicals for sanitary control. The term personnel expenses as used here refers to remuneration for the water supply manager. But, as noted earlier, in 25 of the 28 villages surveyed, Ri chiefs, Saemaul leaders, or the chairmen of the village womens associations take charge of the village waterworks without receiving any pay. So no personnel expenses are actually disbursed in such villages. When the concept of opportunity cost is applied, however, the annual opportunity personnel expense per village is estimated at about 108,000 won, on the assumption that one-fourth of the daily working hours of an unpaid manager is devoted to running the village supply system.1/

1/ The cash value of the unpaid labor is estimated at 1,200 won per day, or about 75% of the average daily wage of 1,630 for men and women that prevailed in 1976.
(₩1,630 x .75 x $\frac{1}{4}$ 30 days) x 12 months = ₩108,00

The full-time manager employed by the Yangmok Cooperative Sphere Project in Chilgok is paid 50,000 won a month, and Miwon Igu (in Chongwon-gun) pays a monthly wage of 600,000 to its full-time manager. The village of Aninjin Iri, Myongju-gun, gives three sacks of rice to the village electrician to have him fix the motor whenever it goes out of order.

The cost of repairing individual households' own running water facilities are met by the beneficiaries themselves. When such common facilities as pumps, power systems, reservoirs and transmission pipes are in need of repair, the Ri chief orders manpower mobilization to work on them. Depending on circumstances, the cost of each repair may be apportioned to the beneficiary households.

Overall, maintenance and operating expenses came to an average of 5,684 won per household per year. But the sums of expenses required differ considerably depending on the types of water supply system. The cost of maintaining and operating gravity-fed systems (which do not consume any electricity) is estimated at 3,333 won per household per year--the lowest level. The comparable figure for pumping plus gravity systems (the mixed type) was 6,400 won, while that for pressurized systems, which depend

solely on the pump and the motor for water distribution, stood at 6,693--the highest level and double the cost of operating gravity-fed systems.

2. Analysis of Benefits

a. Direct Benefits

i) Increased Consumption of Water:

A survey of 230 sample households in the 28 villages covered by this study (50 households in 10 villages studied in 1977 and 180 households in 18 villages studied in 1978) with regard to their sources of water prior to the installstion of simple piped water supply systems revealed as follows: 75% of the sample households obtained water from public wells or open-air springs located outside of their house yards, and the remaining 25% secured water from their private wells or hand pumps in their own yards.

Before piped water became available, daily water consumption per household stood at about 210 liters in summer and at about 140 liters in winter, for an average of 170 liters throughout the year. Per capita consumption averaged 30 liters per day. Following the installation of piped water systems, daily water consumption per household increased to 650 liters, with per

capita consumption reaching 110 liters per day. These represented threefold increases over the pre-system days. Such big increases have resulted in part from rises in drinking water consumption. But the major cause of increase is the fact that although the family wash was usually done at nearby brooks or rivulets before the introduction of piped water supply, it is now done mostly in the house yards or kitchens using piped water.

For the purpose of measuring the effectiveness of investment in rural water supply projects, one cubic meter of water has been valued at 30 won in estimating the cash value of increases in water rates in Seoul, which charge 230 won for one cubic meter supplied to ordinary households.) When it is assumed that each household continuously receives water supply for 350 days per year, the value of increases in water consumption in the villages studied in 1978 is estimated at 5,080 won per year.

ii) Time-Saving Effect:

In the first year of the study (1977), a survey of 50 sample households in 10 villages indicated that 50% of the households drew water from public wells, springs or public

pumps located oustside their house yards. The average distance between the kitchens and these water sources was 29 meters and each day 44 minutes were spend per household on trips to obtain water. Assuming that all that time has been saved after the piped water systems were installed, it is estimated that time saved by the 50 households surveyed comes to 22 minutes per household per day.

A survey conducted in the second year of the study (1978) produced slightly different findings: some 75% of the 180 households surveyed in 18 villages depended on public water sources prior to the construction of village waterworks. The average distance to water sources was 32.2 meters. On the average, 5.3 daily trips were made per household to obtain water, with an average of 6.2 minutes spent on each trip. Thus, it is estimated that an average of 32.9 munitues was spent on fetching water by each household per day. When an weighted average is calculated for all households covered by the survey, the amount of time saved per household following the introduction of piped water supply comes to an estimated 24.7 minutes.

In evaluating the labor thus saved in terms of

opportunity coat, a daily rate of 1,066 won--corresponding to 75% of the average daily wage for women in rural areas obtained in 1976--has been applied. Such calculation shows that the value of labor saved in the villages surveyed in the first year amounted to 15,000 won per household, and that the comparable figure for the villages surveyed in the second year stood at 15,280 won.

iii) Effects of Promoting Health and Sanitation:

Public health experts are convineed that rural piped water supply makes definitive contributions to preventing water-borne and other deseases, thereby reducing medical expenses while promoting labor productivity. They are also convinced that piped water supply helps to improve and purify the rural living environment, leading to accelerated modernization of the consciouness of farmers. But the decrease in water-borne diseases is attributable not only to piped water supply, but also to the combination of such other factors as: the hightened sanitation-consciousness among rural residents due chiefly to rising standards of education; vaccination and other epidemic control programs; expansion of health and sanitation facilities; and various forms of administrative support of the government.

Accordingly, it is in fact impossible to isolate the health-promoting effects of piped water supply and quantify them.

Statistics by the Ministry of Health and Social Affairs show that 2,098 typhoid fever cases were reported in rural areas in 1970. But the incidence of typhoid fever has been steadily decreasing since, with only 270 cases reported in 1976. This downward trend is expected to continue. In 1970, 206 persons contracted cholera. But no cholera cases have been reported after that.

b. Indirect Effects

i) Improvement of Kitchens and Sewerage:

When a piped water facility is installed in the house yard or in the kitchen, improvement of the kitchen and the sewerage is also called for. Some 30% of the households surveyed have already remodeled or reworked their kitchens or sewer systems. The remaining families are also planning to improve their kitchens in the near future.

ii) Fire Prevention Effect:

Since water taps have been installed in the house yards or kitchens, it will now be easier to prevent fire.

iii) Increased Production of Materials Needed:

Increased demand for pumps, motors, pipes and other materials leads to increased employment and greater production by industries manufacturing such equipment and materials.

iv) Elimination of Feeling of Urban-Rural Disparity:

Together with rural electrification and expansion of rural communication and transportation facilities, the diffusion of piped water supply is a principal element in modernizing the rural living environment. The rural water supply program contributes toward eleminating the feeling of urban-rural disparity, thus enhancing the morale of rural residents.

3. FEASIBLITY ANALYSIS

In calculating internal rates of return (IRR) to be ussd as the yardstick in evaluating the feasibility of rural water supply projects, increases in water consumption and savings in time spent by women on fetching water were regarded as the return. On the other hand, maintenance and operating costs. (including personnel expenses on the manager, electricity bills, repair cost, and miscellaneous expenses) were taken as the cost. The life of simple piped water systems will vary depending on their types. For convenience's sake, however, the system life has been uniformly estimated at 15 years, with the residual

value assumed to be 20% of the cost of fixed investment.

The first-year (1977) survey showed that the internal rate of return in the 10 villages studied as a whole came to an estimated 35.8%, indicating a very high economic justifiabilty.

In the 18 villages studied in the second year (1978), the overall rate of return has been estimated at 26.1%, lower than the comparable figure for the villages surveyed in the first year. By type of system, gravity-fed systems (in six villages) showed and IRR of 25.8%; pumping plus gravity systems (in eight villages) indicated 24.4%; and pressurized systems (in four villages) registered the higest IRR, at 30.5%.

In light of the problem of accuracy involved in measuring increases in water consumption and savings in the labor of village women, as well as various problems relating to their valuation into monetary values, doubts can be raised as to whether the rural water supply projects can properly be made a subject of economic evaluation. But they are essentially technical problems of quantification and value estimation unique to the rural water supply program.

This program is highly appreciated by all concerned for its aspects transcending simple economic justifiability, such

as improvement in environmental sanitation, prevention of deseases, and enhancement of the consciousness of rural populaces. Accordingly, the program should be expanded to a maximum possible extent.

Internal Rates of Return by Type of Rural Water Supply System

Type of System	IRR
Gravity-fed systems (6 villages)	25.8
Pumping plus gravity systems (8 villages)	24.4
Pressurized systems (4 villages)	30.5

F. Minor Irrigation

1. Cost estimate

a. 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 bas been

Computed IRR by Surveyed Village

Village						
Province	County	Myon	Ri	Village	IRR	
Kyonggi-do	Pochon	Pochon	Kyodong	3-ri	22.9	%
Chung chong puk-do	ChongWon	Namil	Hwadang	Hwadang	27.7	
Chung chong puk-do	Chong Won	Miwon	Miwon	Miwon	22.0	
Chungchong nam-do	Yonki	Choneui	Yoochon	Yoochon	23.9	
Chungchone nam-do	Yonki	Choneui	Undang	Undqng	10.0	
Chonlapuk-do	Wanju	Yongjin	yongheung	Rokdong	18.2	
Chonlapuk-do	Wanju	Sangkwon	Saekjang	Won sook jang	35.4	
Chonlapuk-do	Wanju	Yongjin	Kueok	Hai	27.8	
Chonlapuk-do	Kimje	Mankyung	Mankyung	Daemoonnae	49.1	
Chonlapuk-do	Kimje	Bongnan	Daesong	Jopju	28.5	

Village					IRR
Province	County	Myon	Ri	Village	%
Chonlapuk-do	Kimje	Chongha	Donggisan	Sanjang	16.7
Kyong sang Puk-do	Kumreung	Bongsan	Yeji	Yeji	30.2
Kyong sang puk-do	Kumreung	Aeo mo	Danam	Dongsan	27.4
Kyong sang puk-do	Kumreung	Dachang	Deąkjeon	Deoksan	20.8
Kyong sang puk-do	Kumreung	Gaeryong	Kwanchon	Batnal	31.5
Kyong sang puk-do	Kumreung	Gammoon	Taechon	Wan dong	23.6
Kyong sang puk-do	Kumreung	Bong san	sindong	Sindong	43.6
Kyong sang puk-do	Kumreung	Daehang	Doeryong	Yongbok	16.9
Average					26.1
1977 Survey					35.8

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.

Table IV-15 shows investment costs by project district at the current market prices.

b. 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.

Operation and maintenance cost per ha by scale of benefited

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

c. 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. The following table shows the replacement costs on facilities.

Replacement costs by equipment for pumping station

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

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

d. 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.

Durability and residual value by facility

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

Source: Agricultural Development Corporation

2. 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 items, 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 composite manure), plant disease and blight prevention cost, labor cost (family labor and hired), and other costs.

a. 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.

The following table shows the national average fertilizer input by nutrient per hectare and the annual average increase in input during the 1971-75 period.

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.

b. 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.

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.

c. Labor

Labor cost refers to that caluclated 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 1976-76 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.

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)

3. 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.

a. 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. As 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 relatively 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 ha 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 production 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 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 shows the trend equation for yield per hectare projected by utilizing yield data of the 1965-75 period, as a result of the projection of annual yield per hectare by district.

Projection of yield per ha by crop by district

Unit: Kg/Ha

	Taean				Kahung				Jipyong				Insan			
Crop	1976	1977	1978	1979	1976	1977	1978	1979	1976	1977	1978	1979	1977	1978	1979	1980
Conventional Rice	3,390	3,870	4,050	4,170	3,050	3,540	3,630	3,750	3,360	3,630	3,820	3,960	4,200	4,790	4,920	5,040
Tongil Rice	4,250	4,790	5,060	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
Barley	1,960	1,270	2,040	2,080	2,050	1,180	2,150	2,200	2,250	1,400	2,350	2,400				
Soybean	1,250				910											
Raddish	15,630				12,990											
Chinese Cabbage	15,090															
Sweetpotato	-				15,600											
Whitepotato	12,500				14,600											
Redpepper	1,710				1,780											
Tobacco	-				2,120											
Sesame	610				720											
Green Onion	13,000				-											

Hanke				Kwangchon			
1977	1978	1979	1980	1977	1978	1979	1980
3,600	4,180	4,410	4,530	4,020	4,620	4,740	4,860
5,000	5,750	5,820	5,990	4,900	5,650	5,770	5,890
1,100	2,150	2,200	2,250	1,800	2,100	2,160	2,210
1,070							
14,500							
18,800							
9,500							
1,780							
3,150							
750							
13,500							

Cont'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	5,870	3,660	4,280	4,400	4,910	4,210	4,840	5,080	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
$$PR = 2,988.4 + 121.2\ T \quad (R^2 = 0.774)$$
$$(20.19) \quad (5.56)$$

2) Partially irrigated paddy
$$PIR = 2,772.7 + 112.7\ T \quad (R^2 = 0.716)$$
$$(17.29) \quad (4.77)$$

3) Fully irrigated paddy
$$FIR = 3,145.5 + 117.3\ T \quad (R^2 = 0.796)$$
$$(23.41) \quad (5.92)$$

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

b. Byproducts

For the calculation of income from agricultural by-products, we employed the byproduct ratio to the income from agricultural produced 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.

Ratio of the value of byproducts to that of main productions

Crop.	Taean %	Kahung %	Jipyong %	Jongan %	Songwol %	Jungbuk %
Ordinary Rice	6.2	7.6	8.9	6.9	9.4	7.9
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	-	-
Raddish	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

As for the three AID-financed projects, and three IBRD projects 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 post-project evaluation. In a strict sense, however, the result should be regarded as a prior evaluation, since the revenue and cost for the first three years following the implementation of the project are based on estimates.

4. Calculation of IRR

But for the three IBRD-financed projects, not in operation for 1977 crop, the profit and cost during the post-project period of 1977-79 are estimated on the basis of data obtained in 1976 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.

The following table 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 two 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 implementatioh of project, and weirs

Computed IRR by project district

District / Prices	I B R D project district							A I D project district				Total
	Taean	Kahung	Jipyong	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	10.7	6.7	10.4	11.3

a/ Applied 1976 farm gat a prices adjusted for the GMF defivit

b/ Applied 1976 world market price for rice (USA Califoruian pearl).

have been developed as a supplementary project.

The following table conserns 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.

Major factors affecting IRR

I B R D Prozest

Factors	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	0

a/ 1976 constant prices.

Source : Actual Survey Data.

V. Concluding Remarks:

1. Extension of distribution line and expansion of supply area of electricity for domestic and power uses are welcomed by customers and could be done small encourgements such as the Government loan. The main problem seems to be how to meet rapidly increasing demand with reasonable price, expecially in Korea where resources for electricity generation are relatively scarce. Rural electrification contributes to improve rural environment and to enhance living standard. It also solves national and regional security problems but street lightening is very poor. Attention should focus on alternatives to electrify households remaining unelectrified in the remote area and small islands.

2. Major complaints rehearsed in the survey are relatively low construction costs, no bus-line services after the project, poor maintenance system and budget, and unfair share-donations of rights of way for road development. It is, therefore, recommended that the budget for the construction cost should be realized, since most of the remaining projects are located in construction-difficult areas; that city county government do every efforts to extend mass-transport system services into the newly connected road; that the road maintenance responsibility should not soly

rely on villagers, for it sometimes requires a heavy financial burden for which farmers cannot solve by themselves, that agricultural extension services should be reinforced in the project area in order to facilitate a smooth and speedy transformation of traditional farm economy into a commercialized farming; that a fair cost-sharing device in regards to land contribution may be studied alongwith the increased land value; and that the government should prepare a road redevelopment plan such as broadening and asphaltizing of the existing rural roads in the near future.

3. Looking from the analyses so far, it can be said the upland reclamation projects in Korea have been relatively successful. Particularly it has to be pointed that high profitabilities are usually guaranteed if the farmers have favorable planting patterns with cash crops as they wish.

It was found, thanks to the reclamation projects, that the farmers happen to have larger farm sizes than the national average, that the farmers in the reclaimed areas enjoy far greater incomes than the other farmers might, and that the socio-economic status of the farmers in the upland development areas

has been tremendously improved. As a result they would like to continue the reclamation project or least they would like to recommend the others to participate in the projects.

However, there are a few comments and recommendations to be considered so that the policy makers might have find some avenues in which the future upland reclamation projects can be more effectively implemented.

1) There needs a sound mechanism and institution through which knowledges and technologies are always available for the farmers to maintain and protect the soil capability after the reclamation project is implemented.

2) High percentages of land lease and idle lands represent the dissatisfaction of the farmers against their current land uses. Therefore, there needs an institutional measure to let the farmers easily change their uses of land into whatever directions they would like to and operate their farms with the crop patterns they would like to have.

3) As was seen, the pressure from the shortages of labor gradually becomes a heavy burden on farmer's shoulder without mechanizations. Therefore there needs assistances to the farmers so that they might mechanize their farm operations.

4) In the selection of reclamation areas in the future, soil capabilities, possibilities of having favorable cash crop combinations and the scales of the projects should be considered with relatively high priorities, for they affect farm incomes the most.

5) In the selection of reclamation areas in the future, the choice has to be made in such a way that the projects do not harm the natural environments, for there rapidly grows a great demand for recreational areas and open spaces.

4. The fuelwood plantation project has two important purposes which are to solve rural fuel problem and to accomplish reforestation. Even if fuel harvest from the 643 hectars of fuelwood plantation begins from 1982 as planned, this would meet only 29 percent of total required fuel supply for 2.7 million farm households. According to the First Ten Year Forest Development Plan the deficit of fuel supply will be solved through the substitution of briquettes, oil and electricity for forest products, an increase in utilization of agricultural by-products, and fuel consumption saving.

Since the annual average amount of fuel per household which is 4.2 M/T was set under the assumption that a household's

annual fuel requirement would be enough with 910 pieces of briquttes, it considered to be underestimated compared to 6.89 M/T estimated by the study.

Furthermore, the increase of rural wage rate and the relative decrease of briquette price is significantly promoting the substitution of briqutte for other fuel resources in rural areas. But the fuel problem of the rural areas is expected to be more serious due to the limited amount of fuel resources and the rapid increase of prices of briquette and oil.

Therefore, it is recommended to take the following measures in order to ease the fuel problem of the rural areas with the fuelwood plantations which were already established.

1) The Government should take special measures which are urgently needed to increase fuelwood productivity such as continuous application of fertilizer and fuelwood breeding researches. It is also required to replace acasia with rigidar pine when supplementary plantations take place.

2) As fuelwood forestland is heavily reforestated is required for the Government to permit frequent trimmings and prunnings to Village Forestry Association so as to supplement the shortage of fuelwood production of fuelwood plantations.

3) Since lack of understanding future benefits of fuelwood plantation makes farmers who are called out for weedings and trimmings of the fuelwood plantations without payment not only lose their interest but also lower the efficiency of labor due to the jummping of rural wage rate a positive enlightening movement on real benefits of the fuelwood plantations should be conducted.

4) As the economic value of forestland gradually increases owners of private forestland of which fuelwood plantations are established are in advantageous position. Thus, it is urgently needed to supplement present law regarding to fuelwood plantations so as to cope with the negative attitude of the owners of the private forestland at the stage of regular harvest against the distribution rate of forest products.

5) Since the manpower and mobility of imfraorganization look dissatisfied to manage all fuelwood plantations, the supplement of the personnel and provision of more motor cycles to Forestry Association Unions should be achieved. It is also recommended that pick-up trucks being with the County Forestry Department, which were purchased for the fuelwood plantation project, should be returned to the County Forestry Association

Union so as to promote mobility.

6) In order to increase the socio-economic efficiency of fuelwood plantations and reforestation projects which have been established by the tremendous amount of financial support so far more positive financial supporting measures should be worked out so that the present Forestry Association Union can accomplish administrative and financial position and establish self-sufficient base.

5. The current rural water supply program is centered on small facilities designed to serve individual rural villages in conjunction with the Saemaul rural development program. In the future, however, the program should be extended to cover small towns in farming areas, especially the seats of myon administrations, in view of the fact that water sources for such towns are being increasingly polluted because of relative concentration of population and growing industrial activities in such places.

Most rural water supply systems have been designed and constructed to serve only the existing village populations. Accordingly, some of them are failing to meet increasing water demand. Village warterworks should be designed and built on

the basis of water demand projections extending for at least 10 to 15 years ahead, taking into account not only expected population growth but also anticipated increases in per capita consumption due to the diffusion of modern amenities, including public and family baths.

To ensure sound operation of village piped water systems, it will be necessary to employ full-time water supply managers. They should be paid proper amounts of wages so that they could be fully responsible for the management of village waterworks. Such full-time managers should be trained in management practices, general knowledge of modern water supply systems, machinery operation, water purification, etc.

To ensure equitable levying of water charges under the principle of having beneficiaries bear the cost, water meters should be installed at individual households in villages with large-scale water supply systems. Such a meter installation plan could be implemented on a phased basis.

Procurement of equipment under the IBRD loan is required to be based on international tenders. This is not only a time-consuming procedure, but also can lead to procuring pumps and other equipment whose specifications are not compatible with

local conditions, thereby causing delays in project execution, as well as troubles in operation of water supply facilities. It is desirable, therefore, that domestic procurement be permitted under IBRD financing. Since it takes a long time (nine to 10 months) to procure equipment and materials needed, designing expenses for water supply projects scheduled for the next year should be earmarked in the budget for the current year so that assistance in procurement of equipment and materials can be extended according to designs completed in advance. It is suggested, therefore, that the budget authorities of the government make arrangements under which expenses for designing can be disbursed in the fiscal year preceding the project execution.

6. 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.

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.

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 improvement 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 government's interference should be minimized as far as possible.

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 substantially 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.

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.

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.

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 to continue 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.

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 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 will ensure a flexible use of funds by needy associations as well as a rapid accumulation of funds.

When an emergency repair and maintenance is required due to an accident occurred in a 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.