A POST-PROJECT ECONOMIC EVALUATION OF SELECTED SMALL AND MEDIUM SCALE LAND AND WATER DEVELOPMENT PROJECTS FUNDED BY USAID IN KOREA

DECEMBER, 1976

THE MINISTRY OF AGRICULTURE AND FISHERIES
THE AGRICULTURAL DEVELOPMENT CORPORATION
AND THE KOREAN AGRICULTURAL PLANNING PROJECT

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Summary of the Post-Project Economic Evaluation of Selected Small and Medium Scale Land and Water Development Projects Funded by USAID in Korea, 1974

The objectives of this study were to measure the changes which have occurred following the completion of 11 of 66 small and medium land and water development projects funded by the United States Agency for International Development in 1974 and to compare the Internal Rates of Return (IRR's) associated with these changes with those calculated prior to project implementation. Eleven projects were selected from 16 projects which were completed in 1974. In all 220 farm households were randomly selected and interviewed to ascertain what changes had occurred in agricultural production due to the projects.

In general, all of the projects were designed to increase and/or improve paddy acreage. The sample projects resulted in per household increase in paddy area of .07 hectares and an improvement in the ratio of fully irrigated to total paddy of 56.6 points. These changes led to shifts in croping patterns, production inputs and yields. A summary of the overall changes which occurred in the sampled areas is as

follows:

1. The double cropping ratio increased from 135.6 to 148.5 percent.
2. The area devoted to the production of new high yielding varieties increased 21.8 percent while the area devoted to native rice production declined 28.3 percent.
3. The total demand for labor employed in the cultivation of rice increased 2.1 percent for Tongil and 3.7 percent for native varieties while labor inputs used in barley production declined 1.1 percent. Increases in labor used in Tongil cultivation resulted from a substancial increase in labor required for harvesting and transportation activities.
4. The transplanting date for rice was advanced from 9 to 15 days due to the more wide spread cultivation of the new high yielding varieties.
5. The quantity of chemical fertilizer used per 10 Are and the number of times agricultural chemicals were applied per year increased on the sample farms 16.4 percent and 2.6 times respectively.

6. Pure yield increases associated with the projects tended to be higher for rice and lower for barley than anticipated. The yields associated with Tongil rice increased 17.4 percent, with native rice 35.0 percent, with common barley 7.5 percent and with naked barley 9.9 percent. White potato yields also increased 11.7.

The above changes in the production base and the agricultural input structure in the sample areas while favorable, may percipient future problems. The movement of the rice cropping season forward, which resulted from the introduction of vinyl seed beds recommended for Tongil rice production, should increase the time available for barley preparation and planting at the close of the rice season. However increases in rice yields which necessitate an increase in labor inputs during the rice harvest period, may nullify any advantages to double cropping which occur due to earlier harvesting. The study did indicate that improvement in drainage decreased the labor required in preparing paddy for the winter barley crop. If labor constraints do develop during this rice harvesting-barley planting period improved drainage may be a method of

lessening the constraint.

The increased use of chemical fertilizers, production chemicals and machinery, all indicate the need for increases in the supplies of these inputs at times when they are required. In addition, an increase in the flow of information is needed to inform farmers how to use the inputs. With respect to the new rice varieties, the study did suggest that in areas where these varieties have been extensively grown in the past such information flows tend to exist between farmers. In other areas where the new varieties have not been extensively cultivated, the lack of information and production inputs may be constraining the adoption of the new varieties. This was especially true in the northern provinces of the country.

As indicated, the projects effected rice yields significantly. Of particular importance to future efforts to diversify crop production is the yield response associated with white potatoes. Yields, even when adjusted to account for natural increases experienced in the sample areas rose 7.1 percent. With barley production reaching self-sufficiency

this crop would seem to be aviable substitute for winter barley.

Comparing the yield responses estimated in the study with those appearing in the initial planning documents indicated that barley yields were 23.6 percent lower while rice yields were 21.8 percent higher than those planned in the sampled area. The excellent yield responses associated with rice production more than compensated for sluggish increases in barley. For example, assuming that the 1975 yields were to remain constant during the planned life of the projects, the IRR's associated with the resulting income streams (value at 1975 international prices) ranged from 8.56% to 19.39%. When construction costs incurred prior to the provision of AID loan funds were excluded from the calculations, the IRR's rose; ranging from 13.33 to 50.00 plus percent.

In the initial planning documents, project evaluation was carried out using 1973 domestic prices. When these evaluations were updated using 1975 domestic prices and compared with those developed in this study, it became apparent that the initial IRR's had been understimated in 9 of the 11 project areas.

In the remaining 2 areas the rates were slightly lower than initially planned due to unforseen construction problems. In each of the areas, however, the new rates were well above the acceptable level. In all 11 projects the new rates ranged from 13.21 to 29.48 percent. Again when only AID investment funds were considered, 10 out of the 11 project areas exhibited IRR's greater than those previously calculated. In this latter case, rates ranged from 18.06 over 50.00 percent.

In summary, even though the study did indicate that there may be some problems with input supply in the future, the internal rate of return associated with the sampled areas are likely to be higher than originally planned.

PART I

INTRODUCTION

Background

In May, 1974 USAID granted AID Loan No. 489-T-090 to the Republic of Korea to help finance the completion of 66 land and water development projects throughout the country. These 66 projects are small and medium scale projects designed to benefit 52,288 hectares of land.

Under the terms of the loan, the Ministry of Agriculture and Fisheries (MAF) agreed to conduct a series of studies to evaluate the effects of the projects before and after the completion of the improvements. The purpose of these studies was to determine the actual effects of the projects and to compare these realized effects with those that were planned in the initial project evaluation. It is anticipated that the study results will assist planners in developing more accurate estimates of the effects of similar projects in the future.

Three types of studies were planned, The first, conducted in 1975 was designed to collect base line data before the projects began. The second, an interim study, was to examine effects of the projects one year after their completion. The third, a follow-up study based on the first was to be conducted 2 or 3 years after the projects were completed. This report presents the findings of the second or interim study.

Objectives of the Analysis

The economic analysis of any public investment project provides project analysts with a method of measuring the economic benefits generated by the project. This is turn provides policy makers with a portion of the information they need to select those projects which maximize benefits per unit of investment. For example, the economic evaluation of projects:

(1) Prevents the selection of low profit bearing projects beforehand, thus avoiding the waste of scarce investment funds on less profitable projects;

(2) Provides a measure of project effects, which can be used

to select the implementation order within a number of projects given available funds;

(3) Serves as a useful instrument to assist public agencies in allocating investment funds, in determining investment priorities and in inducing foreign loans;

(4) Provides the basic guidelines and supporting evidence for making and setting pertinent changes in the level of public utility charges; and

(5) Provides information which allows planners to isolate unprofitable projects which may, after modification, be converted to profitable projects in the future.

Prior to the implementation of the 66 land and water development projects an economic feasibility study was conducted. 1/

This feasibility study provided planners with information and supporting material they needed to select the

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1/ MAF & ADC, AID Loan Application for Expansion of Irrigation Facilities Project and AID Loan Application "Supplementary" as Requested by AID. (Seoul: The Ministry of Agriculture and Fisheries and the Agricultural Development Corporation, Dec. 1973)

sub-project areas to be included for improvement. However, since the initiation of the projects, there has been little information as to the effects of the investments on farm incomes and expenses.

The economic analysis contained in this report measures the changes which have occurred in selected project areas after completion of the projects and compares the IRR's associated with these changes to those calculated prior to project implementation. It is hoped that the information found in this report will assist planners in formulating plans for similar projects in the future and increase the credibility of economic analysis as a planning tool.

Progress of the Evaluation

Two complementary but distinct types of studies are being conducted in the process of the evaluation. The first, included a base line survey conducted by Dr. Richard D. Duvick in 1975 and a follow up survey to be conducted during the Fall of 1978.

The purpose of this first survey was to determine the economic and physical conditions which existed on selected farms before project implementation. The items surveyed land utilization rates, labor inputs and a variety of other physical factors associated with farm production.

This initial base line survey chose 38 sub-project areas from the original 66 as a sample frams. These were stratified by size, type of facility and location and a random sample of 16 projects selected. In these project areas, interviews were conducted with 5 farmers in each of 60 villages for a total of 300 interviews.

At present, an analysis of the survey results are being conducted and a summary will be available early in 1977. An interim report was published in April, 1976 and is presently available 2/. This report presented a list of the 16 project areas surveyed, estimates of cultivated area per farm household, yields by crop, cropping patterns and the area of irrigated paddy per sample household. A second survey which

2/ Richard D. Duvick, "Interim Report of Economic Evaluation of 66 Small and Medium Scale Irrigation Projects in Korea, "KAPP Working Paper No.13 (Seoul: Korean Agricultural Planning Project, Michigan State University and the Ministry of Agricultures and Fisheries, April, 1976).

will re-examine the same projects and households is planned for the Fall of 1978.

A second type of survey, conducted in 1976, has also been carried out by the Agricultural Development Corporation (ADC). Dr. Martin E. Hanratty, the Program and Project Evaluation Analyst, Korean Agricultural Planning Project, assisted the ADC staff in the development of this survey and the subsequent analysis. Additional advice was provided by Dr. Moon, Pal Yong, Professor of Economics, Keun Guk University and Mr. Ryu, Byung Seo, Professor of Economics, Chung Buk University.

This second survey, the results of which are presented in this report, examined the agricultural production conditions on farms in project areas excluded from the 1975 base line survey because construction had already been completed at the time when that survey was conducted. The results of this survey and the resulting economic analysis are presented in the remaining portion of the report.

Outline of the Report

For purpose of clarity the following report has been

subdevided into four sections. The first, Part II explains the metholology used in the study. Part III presents an evaluatirn of the physical and monetary effects of project investments, while Part IV examines the Internal Rates of Return (IRR) associated with each project. The study concludes with a list of conclusions drawn from the analysis.

PART II

THE METHODS USED TO EVALUATE THE EFFECTS OF LAND AND WATER DEVELOPMENT INVESTMENTS

The Viewpoint of Economic Analysis

The evaluation of projects may be performed from two different but consistant vantage points; the national and the private economy. In each type of evaluation slightly different information is required and a slightly different type of analysis performed.

Theoritically, in evaluating projects from the point of view of the national economy the analyst attempts to quantify and measure the impact that project investment will have on nationally defined development goals, Traditional, analysts have limited their activities to measuring changes which accure in the level of goods and services consumed in the country. In recent years, this single objective has been expanded to include others such as; the more equitable distribution of regional and per capita income, the decline in unemplayment/ underemployment and the alleviation of balance-of-payments

problems. Under this multiple objective formate the total effect of project investments becomes the weighted sum of the value of the effects of investments on each of the defined objectives.

While theoretically appealing this method of evaluation has encountered a number of practical problems. In both developing and developed countries, policies makes have been reluctant to articulate and appropriate set of weights necessary to aggregate project effects. In addition the reliance of the method on more sophisticated data has precluded or limited to use in a number of developing countries. In these countries, where appropriate data is not available at the present time, analysts have been forced to retain their emphysis on evaluating projects with respect to the single national aggregate consumption objective.

Within the context of this approach analysis measure increase or decrease in net income generated by project investments as an indicator of changes in aggregate consumption. Only new income which is generated is considered. Items such as taxes, government subsidies and interest are excluded from

the analysis since they constitute inter-sectoral or inter-personal transfers of income not new income.

Such an approach may or may not make use of prevailing market prices. If the analyst feels that the prices of inputs or outputs generated by or used in the project are not representative of the value of the items to the economy, because of natural or institutional market imperfections, he may develop and use shadow prices in place of real market prices.

In analyzing projects from the point of view of the private economy, the financial incomes generated by project investments that would accrue to the target groups associated with a project are the point of interest. In this type of evaluation, the analyst attempts to estimate what individuals will gain or loose financially as a result of project investments. Unlike the former analysis, the analyst must consider all income that flows into and out of individual households or firms. As such, transfer payments, subsidies, the distribution of costs and benefits, the solvency of liabilities and the sources and cost of financing the project all need to be considered.

Financial analysis although a useful tool in accessing the effects of projects on individual or group incomes, does not provide the basic information required to calculate the overall worth of a project to the nation as a whole. This limitation when combined with the economic significance of rice production in the Korean economy, led to the use of economic rather than financial analysis techniques in the study.

The Effect of Investments in Land & Water Development

The effects of investments in land and water development are generally broken down into two categories; direct or primary effects and indirect or secondary effects. The former are directly linked to the project investment and are relatively easy to define and measure. The latter are more difficult to access and are often physically removed from the project site.

In general land and water development projects tend to generate direct increases in net farm income in a variety of ways. Such projects;

1. Increase the area used for paddy rice production via land reclamation.
2. Improve rice yields by supplying more water under more controlled conditions.
3. Improve the potential for double cropping via the improvement of drainage facilities, and,
4. Decrease production costs per unit of output by increasing plot size, making the land easier to cultivate and increasing cropping intensity.

Considering only the direct effect of land and water development projects on per hectare rice yields, these tend to increase for two reasons. The projects increase the supply of water per hectare of paddy eliminating periods of low supply which adverly effect yeilds. Also, the improvement of irrigation structures allow farmers to control the level of supply much more efficiently. This in turn allows them to shift production from traditional rice varieties to the newer high yielding varieties such as Tongil and Yushin.

The secondary or indirect effects generated by such projects are more difficult to articulate and measure.

The effect of such items as increased tourism, improved health resulting from better diets and improved living conditions while most likely present cannot at this time be measured accurately.

While this study recognizes the presences of both secondary benefits and costs, measurement problems have preclude their inclusion in the calculation of the net income streams associated with the projects. As such, the net benefits flowing from investments in land and water development only include the direct benefits and costs.

The Survey Method

As indicated, the sample frame for the survey consisted of 21 AID assisted projects which were completed in 1974. Of these 11 were selected for inclusion in this survey. Their selection was done in such a way to insure that the project were evenly distributed with respect to size, type of facility and location. The distribution of the sample project areas by region and type is persented in Table 2.1, while their location is presented in Figure 2.1.

TABLE 2.1

The Number, Type and Location of Project Area Selected for The Interim Survey, 1976

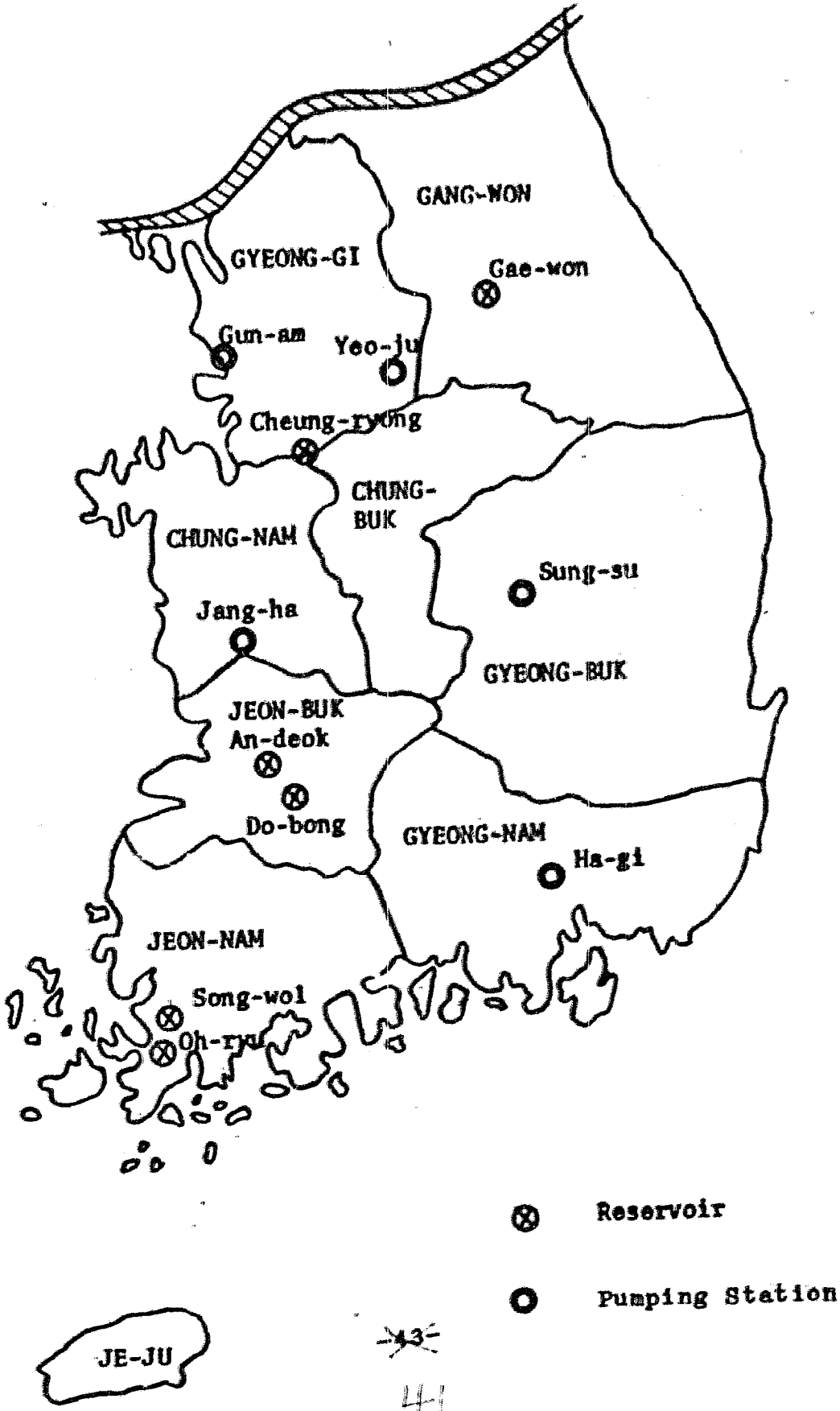
Region 1/	Reservoir	Pumping Station	Total
I	2	2	4
II	2	2	4
III	2	1	3
Total	6	5	11

1/ Region I: Gyeong-gi province and Gang-won province

Region II; Chung-nam & Chung-buk province, Jeon-buk and Gyeong-buk province

Region III; Jeon-nam and Gyeong-nam province

Figure 2.1 The Location of Sub-Project Areas Selected for Inclusion In the Interim Survey, 1976.



In each project area 4 villages were selected. In the process of selection, both the location of the village and the population distribution within the project areas were considered. Five household, whose members were considered to be full time farmers were randomly selected from each village. Representatives of each household were interviewed and responses recorded to questions concerning the area cultivated by the household; the cropping pattern followed, their use of production inputs such as labor, fertilizer and chemicals; the quality of irrigation facilities used, and the yield levels they achieved by crop in 1974 and 1975. Answers to questions concerning the 1974 cropping season constituted the "before" project case, while answers to questions concerning 1975 were taken to be the "after" project responses. In all 220 farm households were interviewed with data being collected for the period from January 1974 to December 1975.

In addition to the information requested from each farm household, certain data was collected from the sample vallages. This included; the number of farm households in the village by size of cultivated area, the village's land use and cropping patterns, estimates of the village's labor supply and demand by month, the type of farm machinery used in the village and average yields achieved by crop variety and year. Responses were requested for both 1974 and 1975.

The Evaluation of Project Benefits and Costs

Basic Benefit Cost Formulation Used in the Analysis

The basic measure of project effectiveness used in the analysis was the internal rate of return associated with investments in each of the project areas. The development of these rates of return relied on information generated in the above survey and on data provided by the Ministry of Agriculture and Fisheries describing project investment levels and maintenance costs. The basic formulation used in developing these measures of project effectiveness was as follows:

$$\text{Internal rate of return} = \text{That discount rate such that}$$

$$\left\{\begin{array}{l}\text{Present worth of net}\\ \text{direct agricultural}\\ \text{benefits}\end{array}\right\} = \left\{\begin{array}{l}\text{Present worth of}\\ \text{investment plus oper-}\\ \text{ating and maintenance}\\ \text{costs}\end{array}\right\}$$

The year in which the above benefit and cost streams began tended to vary by project from 1970 to 1974. During the initial years of the period, investments which were from domestic sources were relatively small and never enough to complete the necessary improvements. The loan funds, provided by USAID in 1974, were used to complete the planned improvements and constituted the final installment in these investment streams.

In calculating the internal rates of return for the project areas, certain assumptions concerning the benefit-cost streams were made. For example it was assumed that increases in agricultural production which resulted from project investments prior to 1974 were negligible. Whatever benefits did result were assumed to be offset by discruptions in the production process which occurred during construction and additional operating and maintenance costs expended to maintain

the new facilities. As such investment streams were measured for each year during the projects life, starting in 1975. All benefits and costs occurring during the life of the projects were expressed in 1975 won and discounted back to the first year in which capital investments occurred. In keeping with government regulations, it was assumed that the economic life of projects developed around reservoirs was 60 years while those projects developed in conjunction with pumping stations had an economic life of 40 years.[1/]

At the close of the economic life of specific projects there remains a salvage value which should be included in the calculation of project benefits. In the case of reservoir projects, this value was assumed to be 35 percent of gross project investment costs. In areas where pumping stations were constructed, a salvage value of 25 percent was assumed. In land reclamation areas, where the economic life is extremely long, 75 percent of the 1975 value of the land involved was assumed to remain at the close of the life of the project

1/ Government regulations goverining the methods used by Farmland Improvement Associations (FLIA) specify the economic life of any given facility. A listing of these by facility is presented in Appendix. IV.

calculated using the above assumptions, was added to the project benefits in the final year of the project.

The Computation of Direct Project Net Benefits

In strictly physical terms, the gross benefits associated with the projects were assumed to equal the increases in yields in crops grown in the project areas over and above yields which would have occurred without the project. These additional yields, when converted into monetary term and reduced to account for net production costs, represent the value of the income streams associated with project investments.

In the computations of these benefits a variety of relationships needed to be considered. These relationship are shows in mathematical form below and explained in following sections.

$$NB = NVAP_{w} - NVAP_{wo}$$

$$NVAP = GVAP - TC$$

$$GVAP = \sum_{i=1}^{n} GVAP_i$$

$$GVAP_i = P_i \ (Y_i \times H_i)$$

$$TC = \sum_{i=1}^{n} TC_i - TP$$

Where:

NB	=	Net benefits
NVAP	=	Net value of agricultural production
w	=	With the project
w_o	=	Without the project
GVAP	=	Gross value of agricultural production
TC	=	Total costs of production
$GVAP_i$	=	Gross value of crop i
P_i	=	Price of crop i
Y_i	=	Yield of crop i
H_i	=	Hectares cultivated in crop i
TC	=	Total cost of producing crop i
TP^i	=	Transfer payments

Calculation of Agricultural Production With and Without the Projects

Increases in crop yield formed the basic for estimating the benefits associated with the project. In each project area, estimates of physical crop production were developed

by multiplying 1974 crop yields realizied on the sample farms by the area devoted to their production. Both yield and the area estimates were developed from information solicited in the survey. Similar estimates of 1975 production levels were also developed. In indepth discussion of these estimates is presented in Part III of this report.

In interpreting these production levels, certain caveates are in order. The yields experienced on the sample farms are not in all probability the optimal yields which will be experienced by farmers in the future. There are a number of reasons for this. For example, in all of the sample areas construction activities were not limited to improvements in the irrigation system. In some, land reclamation activities were undertaken to convert upland and forest areas to paddy production. In other, land consolidation activities which combine small dispersed paddy plots into larger ones were carried out. Both activities normally have a short-term detrimental effect on soil fertility and textures. Under normal conditions 2 to 3 years are required to build soils back up to their optimal production capacity. As such, yields do not tend to reach their optimal level until the third

production year after completion of the projects. Also, increases in average rice yields, which are heavily effected by the adoption of the new higher yielding varieties, are not likely to reach their maximum following the completion of an improved irrigation system. Farmers generally tend to be slow in adopting these newer varieties due to informational and input constraints. As such, it take 2 to 3 years for paddy which can support the production of these varieties, to be actually cultivated for that purpose.

As a consequence of the above, the production estimates used in the evaluation, which are vased on production responses which resulteds after only one year of production, will tend to underestimate the long term production effects associated with the projects. To the extend that this is true the net benefits accruing to the project are underestimated.

In accessing the effect of the project on agricultural production, it was necessary to net out yield effects generated by factors which would have been present even if project improvements had not been implemented. Increases in crop yields not only rely on improvements in irrigation and drainage but

also on increases in the area and intensity of cultivation and on the timely and adequate application of inputs. In formulating the effects of the projects, it was assumed that a certain level of improvements would have occured even without the projects. The effect of these improvements on production during the 1975 growing season were assumed to be equal to the average yearly increase in yields per hectare by crop and project area during the period from 1969-1974. By subtracting these yield increases from those generated in the survey, estimates of the yield effects directly associated with project implementation were developed. These "pure" yield effects, in addition to the cropping patterns and land utilization rates estimated from survey data, were assumed to remain constant throughout the life of the projects.

The Level of Produotion Inputs With and Without the Projects

To calculate the net value of the benefits associated with increases in production, it is necessary to netout the costs of production. In accessing production cost levels the following classification scheme was used;

Figure 2.2

Schematic Classification of Production Inputs Used in the Analysis

(1) Management Inputs
- (a) Intermediate goods
  - Seed
  - Non-organic fertilizer
  - Organic fertilizer
  - Production chemicals
  - Other materials
  - Farm tools & machinery structure and facilities
  - Rents
- (b) Hired labor
- (c) Hired animal

(2) Self-supplied labor inputs

(3) Self-supplied draft animal inputs

Estimates of the input levels for each of the above items were solicited from sample farms in both 1974 and 1975. Input items such as interest on fixed and variable capital assets were not collected since they represented simple transfer payments from the viewpoint of the national economy.

In they, units of additional inputs employed in production should tend to decrease per unit of output as yield increases. No attempt was made in the analysis to estimate the increase in input productivity which would have occurred

naturally from that which was due to the implementation of the projects. Whatever declines in inputs levels which occurred between 1974 and 1975 where assumed to be a direct result of the projects themselves. While this may tend to over estimate the effect which the projects have had on the level of inputs used, the error introduced was assumed to be relatively minor and acceptable, given the likely underestimation of potential production.

Prices Used In Assessing
the Monetary Value of
Agricultural Inputs and Outputs

A variety of both market and shadow prices were used to convert the increases in agricultural outputs and inputs associated with the project into monetary values. Shadow prices were substituted for market prices in those cases where market distortions had generated prices which did not represent the true value of the item to the society as a whole.

In general, all prices were assumed to be those paid for commodities of medium quality during 1975. Inflation was assumed to effect the prices of inputs and outputs equally.

As such, constant 1975 prices were assumed to exist during the period covered by the analysis.

In the case of rice and barley, CIF prices were used rather than normal market prices since these are heavily influenced by government support programs. The valuation of all other commodities was done using the average price paid to farmers during 1975. In cases where the marketing of specific commodities was highly concentrated during a set period during the year, as is the case with red pepper and chinese cabbage, the average monthly price paid to farmers during the period was used. A breakdown of the methods used in calculating these prices is presented below.

The Shadow Price for Rice. Because of the relatively strong rice price support program traditionally carried out by the Korean government, a shadow price for rice was developed. This price was based on the 1985 projected price of rice at Bangkok, Thailand as calculated by the International Bank for Reconstruction and Development (IBRD)[2/]. In constant 1975

2/ IBRD, "Official Memorandum on Long Term Price Projections" (Washington; IBRD, December, 1974).

US dollars, the price was estimated at $302.40 per M/T. To this was added transportation costs of $30 per M/T, an allowance for damage of 5 percent of the CIF price and a $25 per M/T premium to account for the higher quality of Korean rice. The computations of the price took the following form;

$$\frac{\$302.40 + \$30.00}{.95} + \$25.00 = \$374.89$$

<u>The Shadow Price of Barley</u>. The shadow price for barley was based on estimates made by Dr. Richard D. Duvick, Korean Agricultural Planning Project, and expressed in constant 1975 US dollars. In estimating this price, Dr. Duvick assumed that U.S. barley used for feed grain was comparable to Korean barley which is used for human consumption. Examining U.S. prices, he found that the price of second grade U.S. barley was approximately equal to the FOB price (Portland, Oregon) of second grade U.S. corn. This relationship was strengthened by the fact that the price of corn and barley imported by Korea from 1972 to 1974 had been essentially the same (Table 2.2).

TABLE 2.2

Price Per Metric Ton of Barley and Corn Imports, Korea, 1972-1974

Unit: US$/MT

Year	Barley		
	Hulled	Unhulled	Corn
1972	90	60	60
1973	152	100	103
1974	240	166	155

Taking the above relationships into consideration, he assumed that IBRD's 1985 estimate for second grade US corn deflated to constant 1975 US dollars and adjusted for milling, damage and transportation cost, would be the appropriate shadow price for Korean barley. The 1985 projected corn price, in 1975 constant dollars, was $104.16 per M/T. Assuming a transportation charge of $40 per M/T, milling costs of 3 percent of the CIF price and a 75 percent milling rate, the cost per M/T of polished barley was calculated at $197.98.

$$\frac{(\$104.16 + \$40)}{.75} = \$197.98$$

This price was for common barley. The price for polished naked barley, grown in the southern part of Korea, has in the past been approximately 95 percent that of common barley. This relation led to the adoption of, a shadow price of $188.00 per M/T for this crop.

The Price of Seed Grains. In estimating the price of seed grain for rice, barley and soybeans, the 1975 official government purchase price for these grains was used. For all other grains, average 1975 prices surveyed by the National Agricultural Cooperatives Federation (NACF) were applied.

The Price of Other Farm Products. Prices of other farm commodities tended to flucturate quite widely during 1975. Because of this, the average 1975 farm gate prices as reported by NACF were used. In all probability, shadow prices for each commodity should have been developed because of the wide seasonal swings in price which occured and because of the governments involvement in the marketing of many of the commodities considered. However, in view of the lack of international prices for many of the commodities and the fact that they constituted an insignificant contribution to the internal late of return, the average

1975 farm gate prices were assumed to be adequate.

The Price of Farm By-Products. The value of commodity by-products was also included in the calculation of gross farm income. In the computation of these values, a percentage of the value per metric ton of each commodity was assumed to be a proxy for the value of the by-product. The percentages by commodity used are provided below;

TABLE 2.3

Percentages Used to Calculate the Value of By-Products

Item	Percent	Item	Percent
Common rice	10.3	Red pepper	12.4
Tongil variety of rice	7.4	Peanuts	4.6
Common barley	10.3	Sweet Potato	6.9
Naked barley	8.3	Corn	25.7
Soybean	7.0	Sesame	1.2
White potato	0.6		

The Price of Fertilizer. During the early 1970's, Korea, like many developing countries, experienced a shortage of fertilizer. Since that time heavy investments in fertilizer production facilities have boosted production to a level where demand has been met and in some instances exceeded. For this reason the 1975 farm gate prices for fertilizer, set by NACF, have been used to represent fertilizer prices in 1985. The prices used were as follows;

TABLE 2.4

Prices of Fertilizer Used in the Analysis

Item	1975 Farm gate price 1/	
	W/M.T.	$/M.T.
Urea (46%)	64,300	134.00
Ammonium phosphate	36,040	75.08
Fused phosphate (20%)	22,870	47.65
Potassium choloride (60%)	26,400	55.00

1/ W 480 = $1.00

The Price of Farm Chemicals. Prior to 1975, the price of farm chemicals such as insecticides and herbicides were heavily subsidized by the government. In 1975, subsidies were discountinued and farmers began paying the prevailing market price.

With the rapid growth in demand for these chemicals in the past, demand has tended to exceed supply and prices have been high. By 1978 it is anticipated that demand will be met by indiginous and foreign supplies and prices will decline. Examining both the present and future supply situation, it was assumed that the most appropriate price for farm chemicals to use in the analysis was the 1975 farm gate price. A complete listing of these prices appears in Appendix I.

The Shadow Price for Farm Labor. Due to season flucuations in the demand for farm labor, a shadow price for labor representing its average annual value was developed. During the period from April to October, the 1975 farm labor wage was approximately W2,000 per man-day. This wage dropped during the off-farm season when farm labor was engaged in less productive activities to W500-600 per man day.

Data from the Yearbook of Agricultural and Forestry Statistics published by the Ministry of Agriculture and Fisheries (MAF), during the 1971 to 1974 period, indicated that the average annual work days per farm household were 250 man days per year. During this period each farm household averaged 2.8 laborers. Therefore, each laborer worked on the average 89 man days per year. This suggests a labor utilization rate of 39 percent during any given year. When this utilization rate is multiplied by the full employment wage rate which existed in 1975 (₩2,000) a shadow price for farm labor of ₩720 resulted. This wage rate was used in the analysis as an indicator of the average daily productivity of unskilled labor. Skilled labor, on the other hand, was valued at its average annual wage rate.

The Calculation of Project Investments and Operating and Maintenance Costs

Investment Costs

In developing estimates of the capital investment cost associated with each project, a variety of expenditure items were considered. These included the cost of the construction

and paddy formation works including the costs for materials, supervision, and design and modification; post-project management costs; estimate of the costs for the repair and rehabilitation of project structures and other miscellaneous expenses. The cost of land purchased for the projects, in addition to compensation paid to individuals who lost homes, farm structures and forest stumpage were also included in the estimates if such costs occured outside the project's benefited area.

Under normal circumstances the valuation of input items, used in the construction of a given project, is done using shadow prices. These prices attempt to excluded the effects that internal government support programs and fluctuations in the unskilled labor market have on the price of construction materials and labor used in a project. Such detailed pricing of inputs has been excluded in this study. In its place it was assumed that 10 percent of the construction costs, 5 percent of the management costs and all of the interest which would accrue to capital tied up in construction were deducted from the total capital investment.

Due to the fact that the Korean government provides

various subsidies and barriers that protect domestic industries, a shadow price on foreign exchange was developed and used in the analysis, This was necessary to take account of the true cost of imported goods used in the projects, which tend to be distorted because of tariff barriers, export subsidies and the nonconvertability of Korean currency.

Updating the work done by Mr. Koo Bon Ho at the Korea Development Institute, a 15 percent increase above the normal rate of exchange seemed appropriate as a shadow price on foreign exchange. This shadow price was used to evaluate that portion of the projects costs which were used to purchase imported items or services used in the construction of the projects.

Operating and Maintenance Costs

Under normal circumstances operating and maintenance costs tend to vary from project to project for a number of reasons. These might include the type of facilities involved, the size of the irrigated area, the duration of the irrigation season, natural features in the area an so on. In the study, no attempt was made to measure the actual annual O and M costs that would

be expended in each of the sample project areas. As a proxy for these yearly expenditures, estimates of the O and M costs per hectare and type of facility based on sample survey data collected by the Farmland Bureau, MAF were used [3/]. These estimates constituted the average yearly O and M costs expended within FLIA areas in 1975. In reservoir areas these costs averaged W28,782 per hectare of benefited area and in pumping station projects they were W49,770 per hectare.

The Calculation of Internal Rates of Return and the Comparison of Survey and Pre-Project Evaluation Results

The Calculation of Internal Rates of Return

Using the above price and input-output estimates an internal rate of return (IRR) was calculated for each of the sampled project areas. In estimating these rates of return, a three step procedure was use. First, a set of benefit-cost ratios based on discounting rates from 3.5 to 30.0 percent were developed for each of the projects. The results of these

3/ MAF and ADC, "Analysis of Water Charge Structure" (Seoul, The Agricultural Development Corporation, December, 1976).

calculations, which are presented in Appendix II, provided a rough estimate of the IRR associated with investments in each project area. From this cost-benefit data, estimates of the net income streams associated with each project were developed. Using these income streams the actual IRR for each project was developed by an interative approach. First, the discount rate suggested in the benefit cost analysis was used to discount the net income stream to the present. This procedure was repeated, using different discount rates, until the present net value of the income stream associated with a given project was approximately zero. This is the point where project net benefits are equal to project costs.

Four sets of IRR's were developed for each project area by varying the prices used to evaluate project benefits and costs and the cost of investment. In two sets, international market prices were assumed and used to evaluate project net benefits and investment costs. For the remaining two sets, the same procedures were followed but 1975 market prices were substituted for international prices. These procedures were followed for two reasons; 1) to determine the actual rate of return associated with the USAID loan funds; and 2)

to determine the effect of international verses market prices on the IRR's.

In addition to the calculation of the above IRR's estimates of the secondary benefits associated with the projects were developed. These included; estimates of the savings generated by the projects in foreign exchange and the effect of the projects on employment.

Comparison of Survey and Pre-Project Evaluation Results

In the analysis of the data, estimates of certain variables were selected for comparison with estimates appearing in the 1973 pre-project evaluation report. These included land utilization ratios, affected acreage, commodity yields and project IRR's. These comparisons were made to determine if gross discrepencies existed between the actual and planned estimates, and if adjustments in estimating procedures would be appropriate to make future studies more realistic.

PART III

THE EFFECT OF PROJECT INVESTMENTS ON AGRICULTURAL PRODUCTION AND INCOME

The following section examines the physical and monetary effects which investments have had in the selected project areas. When appropriate, comparisons have been made between the estimates of key variables presented in the 1973 pre-project evaluation and estimates developed in the present survey. The section begins with a discussion of the capital investment levels expended in each project area and then proceeds to the physical and monetary effects which these investments have had.

Project Investment Levels

In total, slightly less than 3 billion won was invested in the 11 project areas (Table 3.1). Of this approximately half was invested prior to 1974 and came from government sources with the remainder coming from AID loan funds invested in 1974.

Investment cost per hectare, calculated using domestic prices, tended to vary from 3.523 million won in Gae-won to 542

million won in Sung-su. In the former project area the construction of a long earth filled dam helped to generate the high per hectare costs. These costs tended to inflate the average cost per hectare in the region to 1.641 million won, the highest recorded. The average cost per hectare of the projects in Region III also tended to be high because of the extensive drainage facilities which were constructed in conjunction with the irrigation works. In this region the cost per hectare ranged from 1.83 to 1.23 million won while averaging 1.64 million won. The lowest per hectare costs were associated with sample projects in the middle provinces of Region II, where costs averaged 1.02 million won per hectare.

As would be expected the costs per hectare, calculated using shadow prices, tended to be less than those above. This was due to the exclusion of a portion of certain cost items which were assumed to be inflated because of export subsidies, tarriff barriers and foreign exchange considerations[1/]. The use of shadow prices, while not changing the order of the projects, did drop the overall average costs 9.3 percent to 1.28 million won per hectare.

Examining these costs with respect to the major type of facility constructed, unit costs associated with reservoir projects tended to be almost twice as large as those associated with pumping station

1/For a more detailed explanation of the adjustments made in construction costs the reader is referred to pp. 28-30.

TABLE

Investment levels and Per hectare
and Water Development Projects,

Region	Type of Project 2/	Benefited Area (Ha)	Investment (Domestic 1973 & before
Region I			
Gae-won	R	115	258,618
Cheung-ryong	R	277	110,836
Yeo-ju	PS	187	5,396
Gun-am	PS	288	237,147
Sub-Total		867	611,997
Region II			
Do-bong	R	7	25,800
An-deok	R	201	118,944
Jang-ha	PS	235	64,794
Sung-su	PS	631	121,385
Sub-Total		1,142	330,923
Region III			
Song-wol	R	70	29,369
Oh-ruy	R	150	140,128
Ha-gi	PS	393	310,806
Sub-Total		613	480,303
Total		2,622	1,423,223

1/ All costs are in thousand, 1975 won
2/ R= Reservoir PS = Pump station
3/ USAID funds
4/ In developing cost estimates using shadow cost and 100 percent of interest payments are deducted
5/ Average cost per hectare

3.1

Investment Costs in 11 Sampled Land
Korea 1/

Cost Prices)		Cost per Hectare	
1974 2/	Total	Domestic Price	Shadow Prices 4/
146,566	405,184	3,523	3,133
161,820	272,656	984	902
156,550	161,946	866	782
106,383	343,530	1,193	1,676
571,319	1,183,316	1,641.5 5/	1,473.3 5/
82,094	107,894	1,439	1,319
142,721	261,665	1,302	1,189
119,000	183,794	782	715
220,684	342,069	542	490
564,499	895,422	1,016.3 5/	928.3 5/
98,856	128,225	1,832	1,670
136,689	276,817	1,845	1,696
172,675	483,481	1,230	1,084
408,220	888,523	1,635.7 5/	1,483.3 5/
1,544,038	2,967,261	1,412.6 5/	1,277.8 5/

prices 10 percent of construction cost, 5 percent of management from table costs.

Table

Project Name Location,
Patterns Prior to

Project Name & Region 1/	Type of Project	Paddy
Region I		
Gae-won	Reservoir	49.9
Cheung-ryong	Reservoir	227.9
Yeo-ju	Pumping Station	88.2
Gun-am	Pumping Station	68.0
Sub-Total		434.0
		(50.0)
Region II		
Do-bong	Reservoir	56.5
An-deok	Reservoir	131.0
Jang-ha	Pumping Station	190.0
Sung-su	Pumping Station	631.0
Sub-Total		1,008.5
		(88.6)
Region III		
Song-wol	Reservoir	70.0
Oh-ryu	Reservoir	148.1
Ha-gi	Pumping Station	393.9
Sub-Total		612.0
		(99.7)
Grand-Total		2,054.5
		(78.4)

1/ Region I consists of the two northern provinces, provinces, Chung-buk, Chungnam, Gyeong-buk and Jeon-buk Jeon-nam and Gyeong-nam provinces.

2/ Numbers appearing in parenthesis represent of

3.2

Type and Land Use
Construction

Land Area by Use (Hectares)			
Upland	Forest	Other	Total
47.4	-	18.0	115.3
-	49.1	-	277.0
-	99.3	-	187.5
-	-	220.0	288.0
47.4	148.4	238.0	867.8
(5.5)	(17.1)	(27.4)	(100.0)
18.5	-	-	75.0
47.4	22.6	-	201.0
41.0	-	-	231.0
-	-	-	631.0
106.9	22.6		1,138.0
(9.4)	(2.0)		(100.0)
-	-	-	70.0
1.9	-	-	150.0
-	-	-	393.9
1.9	-	-	613.9
(0.3)			(100.0)
156.2	171.0	238.0	2,619.7
(6.0)	(6.5)	(9.0)	(100.0)

Gyeong-gi and Gang-won; Region II consists of the four middle provinces; and, Region III of the two southern provinces,

the total project area in a given land use.

projects. The average cost per hectare for the former was 1.65 million won while the cost for the latter was .83 million won. Excluding the cost per hectare of construction in the Gae-won project area, which tended to be abnormally high, reservoir projects still tended to be 63.4 percent more expensive per hectare than pumping station projects.

The Physical Effects of Land and Water Investments

Whenever land and water development projects such as those examined in this study are undertaken, a number of physical changes occur in the project areas. These not only include changes in the agricultural land base but changes in cropping patterns and intensity, cultivation practices and yields. The following section examines the changes which occurred in each of these components in the 11 sample project areas.

Changes in Land Base and Irrigated Acreage

In all, slightly over 2,600 hectares of land,867.8 hectares in Region I, 1,138 hectares in Region II and 613.9 hectares in Region III, were effected by the projects. The total land area involved by project and land use prior to the initiation of construction is provided in Table 3.2.

As the data indicates, the majority of land in the sampled areas, 78.4 percent, was already used for rice cultivation. This tended to vary from region to region with paddy acreage composing 50.0 percent of the total project area in Region I, 88.6 percent in Region II and 99.3 percent in Region III. Upland cropping areas were of relatively minor importance composing on the average only 6.0 percent of the total project area or 5.5 percent in Region I, 9.4 percent in Region II and .3 percent in Region III. The remainder of the land in these areas, 15.6 percent, was utilized in forest production or other uses.

Following the completion of the projects all land in the project areas, with the exception of Yeo-ju, was converted to paddy production. This resulted in an increase in paddy area of 465.9 hectares or 22.7 percent. In Yeo-ju, no new paddy acreage was developed but 99.3 ha of land, formally used in forest production, was reclaimed for upland crop production. This addition, when combined with the lossess in upland associated with the creation of new paddy acreage, produced a net decline in upland acreage of 56.9 hectares or 36.2 percent.

These changes in land base and use were accompanied by improvements in the area of fully irrigated paddy land. The effect of these improvements per farm household is presented in Table 3.3. Prior to the projects, each farm household surveyed cultivated on the average .85 hectares of paddy. This was 60 percent higher than the 1974 national average of .54 hectares per household.

TABLE 3.3

Irrigated Paddy by Type With and Without the Project 1/

Item	Region I	Region II	Region III	Average
Without the project				
Fully irrigated paddy 2/	.29	.22	.17	.23
Partially irrigated paddy 3/	.55	.55	.77	.62
Total	.84	.77	.94	.85
Irrigation ratio	34.5	28.6	18.1	27.1
With the project				
Fully irrigated paddy	.86	.66	.80	.77
Partially irrigated paddy	.16	.18	.11	.15
Total	1.02	.84	.91	.92
Irrigation ratio	84.3	78.6	87.9	83.7
Change				
Total paddy area	.18	.07	-.03	.07
Irrigation ratio	49.8	50.0	69.8	56.6

1/ Estimates for fully, partially and total irrigated paddy are in hectares per farm household, while irrigation ratios are in percent.

2/ Paddy land in Korea is classified according to the level of irrigation water supply. Fully irrigated paddy has a water supply sufficient to withstand 10 year drought conditions while partially irrigated paddy does not. Rainfed paddy receives no irrigation water but relies totally on rainfall.

3/ Includes both partially irrigated and rainfed paddy.

Even though the sample households tended to cultivate more paddy than the national average the irrigation facilities which serviced this paddy were significantly poorer. For example, the ratio of fully irrigated to partially irrigated paddy on the sample farms was 27.1 percent, almost 55.9 points less than the national ratio of 83.0. This fact alone was sufficient to indicate a substantial need for the irrigation improvements subsequently carried out in the project areas.

The examination of the irrigation ratios associated with the sample projects in each region pointed out an interesting trend. Moving from the northern provinces of Region I, to the southern provinces of Region III, the presence of partially irrigated paddy prior to the projects tended to increase. This would seem to be resonable given the rainfall distribution pattern in Korea[2/]. In the southern provinces, where seasonal rainfall is higher, there was a heavier reliance on partially irrigated and rainfed paddy. In the northern provinces where rainfall is less and cropping conditions more severe there was a higher reliance an fully irrigated paddy.

Following the completion of the projects both the area of paddy cultivated per farm household and the area of fully irrigated paddy

2/ In 1974 the average monthly precipitation during the rice growing season (March-September) was; Region I - 167.5mm, Region II - 244.6mm and Region III - 325.3mm.

tended to increase. In Region I and II increases in paddy acreage were the result of upland and forest land reclamation activities. In the former region, 334.5 hectares were reclaimed. This resulted in an increase in per household paddy acreage of .18 hectares. In Region II similar increases occurred. Here 129.5 hectares of upland and forest land were reclaimed resulting in an .07 hectare increase in paddy area per household. In Region III, where only 1.9 hectares of upland were converted to paddy, there was an overall decline in per household paddy acreage. Project activities in this area generally centered around land consolidation not reclamation. It is normal, in such projects that a certain amount of paddy be taken out of cultivation to provide land for farm roads, bunds, risers and so on.

As would be excepted, the projects generated a substantial increase in the area of fully irrigated paddy and a decline in the area of partially irrigated paddy per farm household. On the average, fully irrigated paddy rose from .23 to .77 hectares per household, while partially irrigated paddy declined from .62 to .15 hectares. This resulted in a significant increase in the irrigation ratio from 27.1 to 83.7. By 1975, the ratio was slightly higher than the 1974 national average of 83.0 3/.

Regionally, the most significant change occurred in the southern region where the irrigation ratio increased slightly less than 70 points.

3/ MAF & ADC, 1975 Yearbook of Land and Water Development Statistics (Seoul: Sung Moon Publishing Co., 1976), p. 19

This rise can be linked to the rather low ratio present before the projects and to the emphasis placed on irrigation development in land consolidation activities. Increase in the other two regions tended to range on or very close to 50 points.

The movement of land from upland and forest production to paddy cultivation and the improvements in irrigation facilities associated with the projects generated changes in cropping patterns and intensity, cultivation practices and yields. These changes are examined below.

Change in Agriculture Production

Change in Land Utilization Ratios and Cropping Patterns

Even prior to the projects the area of cropland operated by sample farmers tended to be slightly larger than the national average (Table 3.4). This was especially true in Region III where farmers cultivated..4 hectares more land than the national average.

When broken down into paddy and upland components, per household paddy acreage tended to be significantly higher than the national average while upland acreage was quite similar to its national counterpart. The double cropping ratio for all sample farms prior to the projects was 135.6, 11.4 points lower than the national average. As expected, the ratio was the lowest in the northern provinces of Region I

TABLE 3.4

Area of Land Cultivated Per Farm Household and Double Cropping Ratio by Region for 220 Sample Farm Households, Korea, 1974-1975 1/

Item	Sample Farms				National Average 2/
	Region I	Region II	Region III	Average	
Without the project					
Paddy	.84	.77	.95	.85	.53
Upland	.43	.33	.39	.38	.41
All Cropland	1.27	1.10	1.34	1.23	.94
Other	.40	.19	.31	.30	-
Total	1.67	1.29	1.65	1.53	-
With the project					
Paddy	1.02	.84	.91	.92	.53
Upland	.51	.26	.39	.39	.41
All Cropland	1.53	1.10	1.30	1.31	.94
Other	.11	.19	.31	.20	-
Total	1.64	1.29	1.61	1.51	-
Double cropping ratio-Paddy 3/					
Without the project	103.0	152.2	151.5	135.6	
With the project	111.7	163.7	170.2	148.5	
Increase or decrease	8.7	11.5	18.7	12.9	

1/ All estimates are in hectares per farm household.

2/ MAF, 1975 Yearbook of Agriculture and Forestry Statistics (Seoul: Sung Moon Publishing Co., 1976), p. 21.

3/ Double cropping ratios are calculated for paddy acreage only. In all sub-project areas, except Yeo-ju, no upland cropping areas remained within project boundaries after the projects were completed. In addition, the ratios apply to paddy physically within the project areas. Paddy cultivated by sample farm households outside the project area was excluded from consideration.

and highest in the southern provinces of Regions II and III.

Following the completion of the projects, the area of paddy per sample household and the rate of double-cropping on paddy increased. Examining all the sample farms, total agricultural acreage per household increased .08 hectares, with paddy increasing .07 and upland .01 hectares. In addition, the double cropping ratio on paddy also rose to 148.5. Increases in the double cropping ratio tended to be more prominent in the middle and southern provinces of Region II and III. In each of these regions, the ratio rose 11.5 and 18.7 points respectively. In the northern provinces of Region I, where climate is a limiting factor, the double cropping ratio rose only 8.7 points.

Improvements in the water supply and increases in paddy acreage generated by the projects combined to alter the cropping patterns in the sample areas (Table 3.5). Prior to the projects 9.4 percent of the paddy acreage cultivated by the sample farms was employed in the production of Tongil rice, 64.4 percent in native rice, 7.8 percent in common barley, 18.2 percent in naked barley and 0.2 percent in white potatoes. Following the completion of the projects, this pattern changed with the cultivation of Tongil rice, common and naked barley and potatoes becoming more prominent and native rice cultivation declining. The area devoted to Tongil production increased 21.8 percent, that used for native rice production declined 28.3 percent and that used for common barley, naked barley

TABLE 3.5

Change in Cropping Patterns on Paddy Acreage With and Without Irrigation Improvements, 220 Sample Farm Households, Korea, 1974-1975 1/

Type of cropping patterns	Sample Farms			
	Region I	Region II	Region III	Average
Without irrigation improvements				
Rice - Tongil	4.3	6.8	15.5	9.4
- Native	92.8	58.9	50.5	64.4
Barley - Common	2.9	7.7	11.4	7.8
- Naked	-	26.1	22.6	18.2
White potatoes	-	0.5	-	0.2
Total	100.0	100.0	100.0	100.0
With irrigation improvements				
Rice - Tongil	23.5	34.0	33.8	31.2
- Native	66.0	27.1	25.0	36.1
Barley - Common	10.5	8.5	12.9	10.7
- Naked	-	28.6	28.3	21.4
White potatoes	-	1.8	-	0.6
Total	100.0	100.0	100.0	100.0
Change (in percent)				
Rice - Tongil	19.2	27.2	18.3	21.8
- Native	-26.8	-31.8	-25.5	-28.3
Barley - Common	7.6	.8	1.5	2.9
- Naked	-	2.5	5.7	3.2
White potatoes	-	1.3	-	0.4

1/ All estimates are in percent of the total paddy area utilized for crop production.

and white potato production increased 2.9, 3.2 and 0.4 percent respectively. Since these latter three crops are double cropped with rice, increases in the area devoted to their production resulted in direct increases in the double-cropping ratio.

It is of particular interest to examine the rise in the paddy area allocated to the production of Tongil rice. With improved irrigation sample farms tended to replace native varieties with Tongil. The largest increase occurred in the middle provinces of Region II, where Tongil acreage increased 27.2 percent after the completion of the projects. This was followed by increases of 19.2 percent in the northern provinces of Region I and 18.3 percent in the southern provinces of Region III.

As previously indicated, the area devoted to the production of winter crops tended to increase after the completion of the projects. These increases were smallest in the northern provinces of Region I, where 7.6 percent more paddy was devoted to common barley production. Climatic conditions seemed to be a constrant in this region, with increases being relatively modest and centered around the much heartier variety of barley. In the middle provinces of Region II, increases in acreage planted centered around naked barley, the less hearty variety. On the average 2.5 percent more land was devoted to its production following the projects. The acreage planted

in common barley showed only a slight increase .8 percent while white potato acreage increased 1.3 percent. In the southern provinces, of Region III where climate is least constraining, increases in the area devoted to naked barley production rose 5.7 percent, while common barley acreage rose 1.5 percent.

The conversion of upland to paddy in ten of the eleven sample projects precluded the growth of upland crops following construction. In the only area where upland remained, Yeo-ju, only minor shifts in the upland cropping pattern were experienced.

Changes in Cultivation Practices and Inputs

On the sample farms, improvements in paddy acreage led to changes both in the level of factor inputs and the cultivation practices employed by farmers in the production of rice and barley. In all three regions, there was a general tendency for sample farmers to move the rice transplanting date forward (Table 3.6).

As indicated, sample farmers tended to transplant rice from 9 to 15 days earlier after the projects were completed. While the causal linkage between improved irrigation and earlier transplanting is difficult to isolate, the following may provide an acceptable

TABLE 3.6

Change in Rice Transplanting Dates Associated with Irrigation Improvements on 220 Sample Korean Farms by Region, 1974-1975

Item	Earliest and latest transplanting dated		
	Region I	Region II	Region III
Without Improvements	6/1-6/25	6/5-6/30	6/21-7/5
With Improvements	5/21-6/10	5/25-6/20	6/11-6/25
Change (In Days)	11-15	10	9-10

explanation for the trend. Improved irrigation facilities generally allow farmers to shift rice production from native to the higher yielding varieties. The recommended cultivation practices associated with these varieties includes the use of vinyl seed beds. Covered beds allow the farmer to plant earlier by decreasing the probability of frost damage. Thus, as the area planted in Tongil increased as was the case in the project areas (Table 3.5), there is a tendency for farmers to prepare their seed beds earlier and to advance the rice transplanting date.

In the northern provinces of Region I, where double cropping of rice and barley is constrained by climatic conditions, this may prove

to be a significant shift. In this region, under present cropping practices, there is a relatively short period at the close of the rice production season to harvest rice and to prepare thoe plant barley. Movement of the rice transplanting date forward should provided farmers more time during this critical rice harvest - barley planting period, thus increasing the potential for double cropping.

Sample farms not only tended to move the rice transplanting date forward but also to use less labor during the precultivation and cultivation periods (Table 3.7). With respect to Tongil rice, farmers tended to use the same amount of labor in preparing for production but less in actual cultivation. The labor required for both these activities for native rice and barley was less with the projects.

These reductions were offset by increases in labor requirements at the close of the production season for harvesting and transportation activities. Increases at this time were in all probability caused by increases in yield. Overall, the labor required for these activities increased on the sample farms 10.1 percent for Tongil rice and 22.0 percent for native rice. Requirements for barley, whose yield did not increase as sharply as rice, were 2.8 percent higher with the projects than without.

The increased demand for labor during the harvest season tended to counter - balance reductions earlier in the season. As a result, positive increases in labor demand for both Tongil and native rice production were experienced on the sample farms. In barley production modest increases in labor at harvest time were not sufficient to offset reduction earlier in the growing season. As a result, overall labor requirements for this crop declined 1.1 percent.

Examining these trends more closely, using data from Appendix III the following relationships between project implementation and shifts in labor requirements are indicated;

1. <u>Improvements in the condition and size of paddy acreage allowed farmers to spend less time on plowing.</u>

   On the average, sample farmers employed 1.1 and 1.8 Hours less labor per 10 Are in the preparation of Tongil and native rice production areas and .8 hours less in the preparation of barley acreage.

2. <u>Improvements in drainage may play a key role in the reduction of labour required for plowing prior to barley seeding.</u>

   In Region III where drainage improvements were a major objective, labor requirements for this activity declined 12.0 percent or an average of 1.4 hours per 10 Are from pre-project levels.

TABLE

Change in Labor Inputs by
Korea Farms With the Without

Item	Region I			Region
	Rice		2/	Rice
	Tongil	Native	Barley	Tongil
Without the project				
Precultivation activities 3/	59.0	52.8	20.5	53.6
Cultivation	46.4	62.5	48.5	43.3
Harvestir g & transportation	61.0	38.5	44.5	54.7
Total	166.4	153.8	113.5	151.6
With the project				
Precultivation activities 3/	56.1	49.0	20.5	55.2
Cultivation	43.1	59.3	47.0	44.5
Harvesting & transportation	63.0	52.0	45.5	65.0
Total	162.2	160.3	113.0	164.7
Change (percent)				
Precultivation activities 3/	-4.9	-7.2	-	3.0
Cultivation	-7.1	-5.1	-3.1	2.8
Harvesting & transportation	3.3	35.1	2.2	18.8
Total	-2.5	4.2	-0.4	8.6

1/ Estimates are in man hours per 10 Are, while changes

2/ Includes both naked and common barley.

3/ Precultivation activities for rice include; plowing, activities include; irrigation, weeding and pest control. plowing and seeding, while cultivation activities include; breakdown of labor inputs can be found in Appendix III.

3.7

Type and Region on 220 sample
Irrigation Improvements, 1974-1975 1/

II		Region III			Average		
	2/	Rice		2/	Rice		2/
Native	Barley	Tongil	Native	Barley	Tongil	Native	Barley
53.1	22.0	54.7	45.6	22.7	55.8	50.5	21.7
46.6	36.5	51.0	51.1	54.0	46.9	53.4	46.3
47.3	46.3	51.3	43.7	36.7	55.7	43.2	42.5
147.0	104.8	157.0	140.4	113.4	158.4	147.1	110.5
50.3	22.0	55.9	44.7	20.3	55.7	48.0	20.9
48.3	35.8	46.7	48.3	51.4	44.8	51.9	44.7
53.0	46.5	56.0	53.0	39.0	61.3	52.7	43.7
151.6	104.3	158.6	146.0	110.7	161.8	152.6	109.3
-5.3	-	2.2	-2.0	-10.6	-0.2	-5.0	-3.7
3.6	-1.9	-8.4	-5.5	-4.8	-4.5	-2.8	-3.5
12.1	0.4	9.2	21.3	6.3	10.1	22.0	2.8
3.1	-0.5	1.0	4.0	-2.4	2.1	3.7	-1.1

are in percent.

seed bed cultivation and transplanting while cultivation
In barley production, precultivation activities include;
weeding and pest and herbicide control. A more detailed

3. Improvements in irrigation, which allow farmers to cultivate the new higher yielding varieties, increase labor requirements for seed bed preparation and transplanting.

In the production of Tongil rice, sample farmers experienced an increase in the demand for seed bed labor of 3.9 percent and in transplanting labor of 2.3 percent.

4. Improvements in irrigation structures allowed farmers to spend less time on water management activities during the rice cultivation season.

On the average, sample farmers devoted 2.8 hours less labor per 10 Are to water management in the production of Tongil and native rice. This represented a decline in irrigation labor requirements of 15.8 and 13.3 percent respectively.

5. Increases in yields and area planted with the new varieties increased the demand for labor at the end of the production season for both rice and barley.

On the average, labor used for harvesting and transportation increased on the sample farms 5.6 hours per 10 Are for Tongil and 9.5 hours per 10 Are for native rice. Increased labor requirements at this time, while partially offset by moving the growing season forward (Table 3.6), may still result in labor shortages between

the rice harvest - barley planting period in October. One way of partially avoiding this potential bottle-neck is to increase drainage improvement activities in future projects. As indicated in two, such improvements tend to decrease the labor required to prepare and plant barley on double cropped paddy.

While changes in the general level of labor inputs tended to vary with and without the projects by activity and region, overall labor productivity, indicated by a decline in labor output ratios, increased (Table 3.8).[4] On all farms surveyed, substantial increases in native rice yields accompanied by modest increases in labor inputs led to an 23.0 percent increase in labor productivity. More modest increases were experienced in labor productivity associated with Tongil rice and barley production. In the former case productivity increased 13.0 percent while in the latter it rose 8.5 percent.

The prominence of native rice varieties in the context of increasing labor productivity seems to be due to two factors. Prior to the projects native varieties were generally grown in partially irrigated paddy. With the provision of full irrigation, yields which in absolute terms were relatively low tended to rise much more rapidly than labor inputs. On the other hand, Tongil rice cultivation, which is much more dependent on adequate water supply, was grown prior to

4/ In this case labor productivity is measured in man hours per kilogram of yield per 10 Are of paddy.

Table

Change in Labor Output Ratios
Korea Farms With and Without
1974 - 1975 1/

Item	Region I			Region	
	Rice		Barley 2/	Rice	
	Tongil	Native		Tongil	Native
Without the project					
Precultivation activities 3/	0.131	0.197	0.112	0.127	0.166
Cultivation	0.103	0.234	0.264	0.103	0.145
Harvesting & transportation	0.135	0.144	0.242	0.130	0.148
Total	0.369	0.575	0.618	0.360	0.459
With the project					
Precultivation activities 3/	0.112	0.124	0.108	0.110	0.122
Cultivation	0.086	0.150	0.247	0.088	0.117
Harvesting & transportation	0.126	0.131	0.239	0.129	0.128
Total	0.324	0.405	0.594	0.327	0.367
Change					
Precultivation activities 3/	-14.5	-37.1	- 3.6	-13.4	-26.5
Cultivation	-16.5	-35.9	- 6.4	-24.6	-19.3
Harvesting and transportation	-6.7	- 9.0	- 1.2	- 8.0	-13.5
Total	-12.2	-29.6	- 3.9	- 9.2	-20.0

1/ Estimates are in man hours of labor per kilogram of .

2/ Includes both naked and common barley.

3/ Precultivation activities for rice include; plowing activities include; irrigation, weeding and pest control. In plowing and seeding, while cultivation activities include weeding of labor inputs can be found in Appendix III.

3.8

by Type and Region on 220 Sample
Irrigation Improvements,

II	Region III			Average		
Barley 2/	Rice		Barley 2/	Rice		Barley 2/
	Tongil	Native		Tongil	Native	
0.117	0.131	0.144	0.121	0.130	0.169	0.116
0.194	0.122	0.162	0.287	0.109	0.179	0.247
0.246	0.123	0.138	0.195	0.129	0.144	0.227
0.557	0.376	0.444	0.603	0.368	0.492	0.590
0.109	0.109	0.111	0.098	0.110	0.119	0.104
0.177	0.091	0.120	0.248	0.089	0.129	0.221
0.230	0.109	0.132	0.188	0.121	0.131	0.215
0.516	0.309	0.363	0.534	0.320	0.379	0.540
- 6.8	-16.8	-22.9	-19.0	-15.4	-29.6	-10.3
- 8.8	-25.4	-25.9	-13.6	-18.3	-27.9	-10.5
- 6.5	-11.4	- 0.4	-3.6	-6.2	-9.0	- 5.3
- 7.4	-17.8	-18.2	-11.4	-13.0	-23.0	- 8.5

output, while changes are in percent.

seed bed cultivation and transporting while cultivation
barley production precultivation activities include;
and pest and herbicide control. A more detailed breakdown

the projects on fully irrigated paddy. Improvements in the irrigation system associated with the projects expanded the paddy area available for Tongil production and increased Tongil yields. These yield increases, however, were not as significant as those experienced in native rice because of their relatively high initial levels. As such, labor productivity did not tend to increase as much in the case of the latter as it did in the former. The actual increases in yields associated with the sub-projects are discussed in a later section.

A word of caution is in order when interperting these productivity estimates. There is some indication that the increases experienced may have been generated not only by project related improvements but also by increases in the use of farm machines to supplement human labor (Table 3.9). In the villages where the sample farmers resided, the use of power machinery tended to increase substantially during the year while manual machines and animal power declined or remained relatively stable. A substitution of machine power for human and animal labor was evident during the precultivation period with the number of power tillers owned by farmers increasing in absolute terms 222.1 percent during 1974. During the same period draft animals increased only 7.7 percent.

A similar trend was evident at the close of the harvest season.

Here, the number of power rice threshers and barley threshers tended to increase 159.2 and 164.6 percent respectively while the number

TABLE 3.9

Absolute Percentage Increase in Farm Machinery Owned by Farmers in Sample Korea Villages, 1974-1975

Type of Farm Machinery	Absolute Percentage Increase			
	Region I	Region II	Region III	Average
Draft cattle	5.4	18.1	-4.8	7.7
Ox carts	5.1	6.7	-	5.8
Motor tillers	123.9	339.3	235.0	222.1
Rear carts	37.9	143.8	84.4	73.6
Rice threshers (manual)	-19.8	-46.2	-20.9	-31.8
Rice threshers (power)	96.[illegible]	172.0	181.3	159.2
Barley threshers	64.5	189.9	153.3	164.6
Power pumps	8[illegible].3	41.0	111.8	63.6

of manual rice threshers declined 31.8 percent. The greatest concentration of growth in machinery use was in Region II and III. This might suggest that the excess demand for labor which would normally occur at the beginning and end of the rice production season has been partially overcome by substituting machine for human power in both these regions. This may provide a partial explanation for the ability of farmers to maintain the relatively high double cropping ratios present in the regions (Table 3.4).

TABLE

Change in Fertilizer Application Rates and
on 220 Sample Korean Farms With and Without

Item	Region I			Region
	Rice		2/	Rice
	Tongil	Native	Barley	Tongil
Without the project				
Chemical fertilizer 3/	35.8	35.7	38.3	37.8
Compost	878	786	728	905
Production chemicals 4/	5.7	5.0	-	6.0
With the project				
Chemical fertilizer 3/	42.0	43.0	42.2	45.8
Compost	911	789	751	794
Production chemicals 4/	5.5	7.0	-	10.0
Change (percent)				
Chemical fertilizer 3/	17.3	20.4	10.2	21.2
Compost	3.8	0.4	3.2	-12.3
Production chemicals 4/	-0.2	2.0	-	4.0

1/ Estimates of chemical fertilizer and compost with and production chemicals are in terms of the number of application are in terms of percent while production chemicals are the

2/ Includes both naked and common barley.

3/ Chemical fertilizers include N.P. and K. A finer break is presented in Appendix IV.

4/ Production chemicals include, insecticides, pesticides ponents by type and region can be found in Appendix IV.

3.10

Number of Applications of Production Chemicals
Irrigation Improvements by Region, 1974-1975 1/

II		Region III			Average		
	2/	Rice		2/	Rice		2/
Native	Barley	Tongil	Native	Barley	Tongil	Native	Barley
34.9	35.4	35.2	29.7	31.4	36.3	33.4	35.0
935 6.9	1,054 -	720 7.0	655 7.7	597 -	834 6.2	792 6.5	793 -
39.4	40.0	42.1	34.2	37.0	43.3	38.9	39.7
933 10.7	1,056 -	771 9.7	745 10.7	734 -	825 8.4	822 9.5	847 -
12.9	13.0	19.6	15.2	17.8	19.3	16.5	13.4
-0.2 3.8	0.2 -	7.1 2.7	13.7 3.0	22.9 -	-1.1 2.2	3.8 3.0	6.8 -

without the projects, are in kilograms per 10 Are, while
per year. The change in chemical fertilizer and compost
change in the number of applications.

down of each of these components by type and the region

and herbicides. Application rates for each of these com-

Increases in paddy acreage and improvements in irrigation facilities also led to changes in factor inputs other than labor and machinery. For example, sample farms increased chemical fertilizer applications 19.3 percent on Tongil rice, 16.5 percent on native rice and 13.4 percent on barley (Table 3.10). On a regional basis, increases in fertilizer use tended to be highest in the middle and southern regions with respect to Tongil rice production and least in the northern region. This would agree with the more intensive cropping of Tongil rice in these former regions following completion of the projects (See Table 3.4).

In general, increases in the rate of compost application by sample farmers tended to be rather stable in the northern region, decline in the middle region and increase in the southern region. Increases in the use of compost in this latter region most likely resulted from farmers attempting to improve the composition of paddy soils following the extensive paddy rearrangement activities which occurred in the project areas. In the middle region, declines in compost application with respect to paddy used in Tongil production were offset by a sharp increase in the application rate of chemical fertilizers.

With respect to the use of production chemicals, such as pesticides, insecticides and herbicides, sample farmers tended to apply

these chemicals more often following the projects. Increases in the number of applications tended to be more prominent in the production of native varieties than Tongil in all region except the middle region. Here, approximately four more applications were recorded on the sample farms for both varieties following project completion. The reason for such an increase cannot be determined from the survey data and requires further study.

Changes in Agricultural Yields

Increases in paddy crop yields are one of the most important effects generated by irrigation improvements. On all sample farms, the average 1974 rice yields tended to be lower than the national average of 371 kilograms per 10 Are. Comparing the weighted average yields of rice per hectare in the project areas with the national average, project yields tended to be 15.6 percent (313.2)Kg. per 10a) lower than the nation's.

In the first year of crop production after completion of the projects, average yields from all of the sample farms increased (Table 3.11). Major increases occurred in native rice, 104.7 kilograms per 10 Are or 35.0 percent, in Tongil rice, 74.9 kilograms or 17.4 percent and in white potatoes, 151.5 kilograms or 11.7 percent. With respect to rice, these increases resulted in yields above those

TABLE 3. 11

The Absolute Increase in Paddy Crop Yields With Improvements in Irrigation, 220 Sample Korean Farms, 1975 1/

Paddy Crops	Region I		Region II		Region III		Average	
	Yield	% increase	Yield	% increase	Yield	% increase	Yield	% increase
Without the project-1974								
Rice - Tongil	451.4	100.0	421.1	100.0	418.0	100.0	430.2	100.0
Native	267.4	100.0	313.2	100.0	315.7	100.0	298.8	100.0
Average Yield	275.5	100.0	324.4	100.0	339.7	100.0	313.2	100.0
Barley - Common	183.8	100.0	187.3	100.0	186.3	100.0	185.8	100.0
Naked	-	-	184.2	100.0	189.9	100.0	187.1	100.0
White Potatoes	-	-	1,291.0	100.0	-	-	1,291.0	100.0
With the project - 1975								
Rice - Tongil	498.9	110.5	503.6	119.6	512.8	122.7	505.1	117.4
Native	395.6	147.9	412.8	131.8	402.2	127.4	403.5	135.0
Average Yield	422.7	153.4	463.3	142.8	465.8	137.1	450.6	143.9
Barley - Common	190.6	103.7	201.7	107.7	206.8	111.0	199.7	107.9
Naked	-	-	203.0	110.2	208.3	109.7	205.7	109.9
White Potatoes	-	-	1,442.5	111.7	-	-	1,442.5	111.7
Change - 1974 to 1975								
Rice - Tongil	47.5	10.5	82.5	19.6	94.8	22.7	74.9	17.4
Native	128.2	47.9	99.6	31.8	86.5	27.4	104.7	35.0
Average Yield	147.2	53.4	138.9	42.8	126.1	37.1	137.1	43.9
Barley - Common	6.8	3.7	14.4	7.7	20.5	11.0	13.9	7.9
Naked	-	-	18.8	10.2	18.4	9.7	18.6	9.9
White Potatoes	-	-	151.5	11.7	-	-	151.5	11.7

1/ All yield estimates are in kilograms of polished grain per 10 Are.

experienced at the national level in 1974.

As would be expected, there was an inverse relationship between the growth in Tongil and native rice yields. The farther south the project area the greater were the yield increases associated with Tongil rice, while the farther north the greater the increase in native yields. For example, in the northern provinces of Region I, Tongil yields increased 47.5 kilograms while native rice yields increased 128.2 kilograms per 10 Are. In the southern provinces of Region III, the opposite was true with Tongil yields increasing 94.8 kilograms and native rice yields increasing 86.5 kilograms.

These rather low increases in Tongil production in the northern region may suggest the presence of additional constraints other than irrigation which are limiting production. Because of the tendency for the yields to increase the further south you go, climatic conditions are indicated as a constraining factor. In addition to this, however farmers in the southern provinces of region III have been growing the new vaireties longer and over a wider area. It would seem logical to assume that the information and inputs needed to cultivate the new varieties would be more available in these areas. In the northern provinces where the area planted in Tongil has been small, information and inputs required for cultivation may be lacking and thus presenting an additional constraint on the growth in yields.

Table

The Absolute Increase,
Caused by Irrigation
Region, 220 Sample Korean

By Crops	Region I				Region
	Absolute Increase	Natural Increase	Net Change	Absolute Increase	National Increase
Rice-Tongil	10.5	4.2	6.3	19.6	5.0
Native	47.9		43.7	31.8	
Barley-Common	3.7	4.1	-0.4	7.7	1.3
Naked	-	-	-	10.2	1.8
White Potatoes	-	-	-	11.7	4.6

1/ All estimates are in percent.

3.12

Natural Increase and Yield Increase Improvements by Crop Variety and Farms, 1975 1/

II	Region III			Average		
Net Change	Absolute Increase	Natural Increase	Net Change	Absolute Increase	Natural Increase	Net Change
14.6	22.7	2.3	20.4	17.4	3.8	13.6
26.8	27.4		25.1	35.0		31.2
6.4	11.0	0.3	10.7	7.5	5.6	1.9
8.4	9.7	2.4	9.3	9.9	7.0	2.9
7.1	-	-	-	11.7	4.6	7.1

This hypothesis is strengthened by the fact that in the northern provinces of Region I yields of native rice, which presumably are not constrained by the level of information or inputs, rose quite sharply with improvements in the water supply. Whatever the reason for these differences more information is need to isolate the cause or causes.

The yield increases shown in Table 3.11 do not result exclusively from improvements in irrigation facilities but contain a certain natural growth component which would have occurred even without the projects. To determine the actual or net increase in yields which can be attributed to the projects, these natural yield increase have to be subtracted from the total increase experienced in the project areas. Due to the absence of yield data from control farms, composit estimates of the average yearly increase or decrease in yields experienced in the Gun (county) where the projects were located were developed using 1969-1975 time series data. These estimates were assumed to equal the natural increases in yields which would have occurred even without the projects. When aggregated to the regional level and subtracted from the overall increases (Table 3.11), the "pure" yield effects associated with the projects were isolated (Table 3.12).

Examining the "pure" yield effects experianced on all sample farms, native rice still retained the number one position, increasing

31.2 percent during the first year of production. This is followed by increases in Tongil yields of 13.6 percent and increases in potato yields of 7.1 percent. One might argue that because of the relatively strong yields response associated with white potato production that this crop should play a more dominent role in the planning of future cropping patterns to be promoted in small scale irrigation projects.

The relationship between Tongil and native rice increases, previously discussed, also tended to show up in the calculation of the "pure" yield effects. In the province in the northern region, Tongil yields increased only 6.3 percent while the yields of native varieties increased 43.7 percent. In the provinces in the southern region the growth in Tongil yields rose to 20.4 percent while the growth in yields associated with native rice production declined to 25.1 percent.

Common barley yields also tended to follow the basic trend associated with Tongil yields. In the northern provinces of Region I sample farmers registered declines of -0.4 percent in yields while farmers in the southern provinces of Region III experienced a 10.7 percent increase. In the former region, the decline in barley yields might be associated with increases in native rice production. Increases in labor required during the rice harvesting season may

have caused delays in the planting of barley thus generating the lower yields. In the middle and southern provinces, where the climate is milder, reasonable delays of this nature would not have as great an impact on yields as in the northern provinces. Also in these latter two region, the substitution of machinery power for human labor during the harvest period was significant and may have eased any labor supply problems which may have arisen.

The reader is cautioned in reviewing these yield increases to remember that they constitute the yield responses which have occurred during the first year of paddy production. In the future, they are likely to rise, even more significantly, as farmers become more accustomed to the new facilities and as soil textures improve. These future increases depend heavily on the type of development plans individual farmers have for the future. These plans are discussed belev.

Farmer's Attitudes Toward
Future Development

In conjunction with the questions asked concerning land use and production changes during the survey, additional questions concern farmers plans for future development and the constraints which they saw limiting this development were asked. When asked if they had specific plans for future improvements 45.0 percent responded affirmatively, while 55 percent replied that they had no future plans

(Table 3.13). Examining the responses of all sample farmers, the greatest emphasis for future development is to be placed on the introduction of new high yielding varieties of rice. On the average 20.0 percent of those questioned said that they plan to introduce these varieties in the near future. Responses on a regional basis tended to be inversely proportional to increases in the area planted in Tongil presented in Table 3.5. For example, the highest response rate occurred in the northern provinces of Region I where the increase in area planted in Tongil was the least. In the southern provinces of the Region III just the opposite was true.

The second largest affirmative response, 6.9 percent, was for the introduction of communal fertilizer and pesticide application. This response tended to be heavily weighted by a strong interest of farmers in the middle provinces of region II. Here, 12.0 percent of all farmers surveyed answered that they wished to organize such activities. As indicated previously, this was the only region which showed positive increases in labor inputs during rice cultivation (Table 3.7). When combined with the above response rate, this may indicate the presence of a labor shortage during the cultivation season. This conclusion however, must be tempered with the realization that local government units in the region have recently put on a campaign to promote the introduction of communal farming practices.

TABLE 3.13

Percent of Farmers Having Positive Development Plans by Type of Development and Region, 220 Sample Farms, Korea, 1975

Type of development	Region I	Region II	Region III	Average
Introduction of new high yielding varieties - rice	27.3	20.1	12.4	20.0
Increase in the double cropping ratio	6.0	2.3	6.2	4.8
Increase in farm machanization	5.4	4.9	2.5	4.3
Communal fertilizer and pesticide application	3.8	12.0	4.9	6.9
Soil improvement	2.6	6.3	2.5	3.8
Introduction of cash crops	2.7	2.6	8.6	4.6
Other	1.7	-	-	0.6
Sub-Total	49.6	48.6	37.1	45.0
No planned improvements	50.5	51.7	62.9	55.0
Total	100.0	100.0	100.0	100.0

Two development issues, the introduction of cash crops and increases in the double cropping ratio registered third amongst the most common postitive responses. With respect to the latter activity, 5.0 percent of all farmers interviewed rank this as their major development goal. Affirmative responses tended to be strongest in the southern provinces of Region III where climateic conditions are most favorable for the production of such crops. On the issue of increased double cropping, a similar number of farmers, 5.0 percent, responded affirmatively. The strongest responses, 6.0 and 6.2 percent, seemed to occure in the northern provinces of Region I and the southern provinces of Region III. In the former region, the double cropping ratio increased the least of all three regions following the projects. In the latter region, where the ratio increased 18.3 points, the emphasis placed on drainage improvement may have created conditions for even greater improvements.

Because of the importance placed on the improvement of the double-cropping ratio in project plans, a second question concerning the constraints which farmers felt in their attempts to improve this ratio was also asked. In general, 56.8 percent of the sample farmers responded that they were constrained in improving their double-cropping ratio (Table 3.14). The remaining 43.2 percent felt they had no problems.

TABLE 3.14

Percent of Farmers Who Felt Some Constraints on Improving Their Double-Cropping Ratios by Type of Constraint and Region, 220 Sample Korean Farms, 1975

Type of constraint	Region I	Region II	Region III	Average
Poor drainage	29.9	33.2	39.6	35.8
Labor shortage	2.5	3.5	6.2	5.1
Capital shortage	*	*	13.3	4.8
Weather	26.5	*	*	7.5
Others	2.1	4.3	1.0	3.6
Sub-Total	67.1	40.9	62.4	56.8
No constraints	32.9	51.1	37.6	43.2
Total	100.0	100.0	100.0	100.0

*Less than 1 percent

In all three regions, responses seemed to be dominated by poor drainage. Of all farmers asked this question, 35.18 percent responsed in this manner. Responses tended to become stranger moving from the northern provinces of Region I to the southern provinces of Region III. It is interesting to note that even in this latter region where drainage improvements were emphasized, the responses of sample farmers indicated that drainage was still a problem. This was also true, but to a lesser extent in the northern provinces of Region I and the middle provinced of Region II, where 29.9 and 33.2 percent of the sample farmer felt that drainage was a problem.

Other constraints tended to vary by region. As would be expected, weather was considered by farmers in the northern provinces of Region I to be the greatest constraining factor on double cropping. In the southern provinces of Region III, capital was the second most mentioned constraint. Given the relatively high double-cropping ratio already practiced by farmers in this region and their desire for further intensification, the level of this response would seem reasonable. Increases in the capital supply available to the sample farmers in the region would in all probability be used for mechanization to relieve labor shortages. Slightly more than 6 percent of the farmers in the region indicated this as a constraint to increased double cropping.

A Comprison Between the Physical Effects of the Investment and the Planned Effects

In the 1973 preinvestment analysis, a variety of assumptions were made concerning the effect of the investments on the size of benefited area, changes in cropping patterns and yields. After one year of production, it would seem reasonable to hypothesize that the realized benefited area should equal the planned area and that the actual changes in cropping patterns and yields should be lower than those anticipated. This latter point is based on the premise that it normally takes farmers 2 or 3 years because of soil, technological and input constraints, to reach anticipated production levels.

Examining the planned and realized benefited area associated with the eleven sampled projects, the first hypothesis above seems to be partially substantiated (Table 3.15). In only one sub-project area, Ha-gi, was there a substantial change between the planned and realized area. Here, the realized area was only 71.2 percent that of the planned area. In all other areas the planned and realized area were approximately the same.

TABLE 3.15

Planned and Realized Benefited Area Associated With 11 Land and Water Development Project Areas, Korea, 1974-1975 1/

Project and Region	Planned Area	Realized Area	%
	---------Ha---------		
Region I			
Gae-won	115.0	115.3	100.3
Cheung-ryong	277.0	277.0	100.0
Yeo-ju	180.0	187.5	104.2
Gun-am	288.0	288.0	100.0
Sub-total	860.0	867.8	100.9
Region II			
Do-bong	78.1	75.0	96.0
An-deok	201.0	201.0	100.0
Jang-ha	231.0	231.0	100.0
Sung-su	631.0	631.0	100.0
Sub-total	1,141.1	1,138.0	99.7
Region III			
Song-wol	70.0	70.0	100.0
Oh-ryu	150.0	150.0	100.0
Ha-gi	553.0	393.9	71.2
Sub-total	773.0	613.9	79.4
TOTAL	2,774.1	2,619.7	94.4

1/ Planned estimates are taken from MAF, AID Loan Application "Supplementary" As Requested by AID (The Government of the Republic of Korea, December, 1973), pp.29-30, while realized area is calculated from the 1976 sample survey.

Unlike the estimates of project area, a comparison of the double cropping ratios which appeared in the initial plans and those developed from the survey data did show some variability (Table 3.16). Divergence between the two series occurred in both the with and without project estimates. In the without project estimates, the initial plans overestimated the ratios in northern provinces of Region I and underestimated the ratios in the middle and southern provinces of Region II and III. In the with project estimates, the planned ratios underestimated the double cropping ratio. in Region I and II and overestimated it in Region III. It should be remembered that the survey ratios only estimate the double cropping ratios after one year of production. In all probability, as the intensity of cultivation increases after 1975 (Table 3.13) the differences between the planned and realized ratios will lessen.

To examine this likelihood target ratios were developed by adding the 1974 double cropping ratios developed from survey data to the planned changes which appeared in the initial documents. These target ratios where then compared

TABLE 3.16

Change in the Planned and Realized Double Cropping Ratios Based on Rice Barley Paddy Area in 11 Land and Water Development Project Areas, Korea[1]

Sub-Project and Region	Without Project		With Project		Change	
	Planned	Realized	Planned	Realized	Planned	Realized
Region I						
Gae-won	100.6	100.0	113.9	100.0	13.3	-
Cheung-ryong	105.7	111.9	109.7	130.7	4.0	18.8
Yeo-ju	104.5	100.0	110.0	111.1	5.5	11.1
Gun-am	120.6	100.0	109.7	104.9	-10.9	4.9
Average	107.8	106.2	110.3	114.2	2.5	8.0
Region II						
Do-bong	129.5	139.0	150.0	150.1	21.5	11.1
An-deok	114.5	178.9	124.9	184.7	10.5	5.8
Jang-ha	112.1	141.1	110.8	152.8	-1.3	11.7
Sung-su	139.9	150.4	184.9	168.2	50.0	17.8
Average	132.7	151.7	157.0	166.8	24.3	15.1
Region III						
Song-wol	140.0	157.2	180.0	191.4	40.0	34.2
Oh-ryu	140.1	146.0	179.5	167.9	39.6	21.9
Ha-gi	140.0	151.8	185.0	165.9	45.0	14.1
Average	140.1	151.0	183.6	169.3	43.5	18.3

1/ Planned estimates are from MAF, AID Loan Application "Supplementary" As Requested by AID, pp.32-34, while realized estimates are calculated from the 1976 sample survey.

with the after project ratios developed from the survey data to determine if the initial planned changes seemed reasonable. This comprarison indicated that the target ratios will most likely be exceeded in the northern and middle provinces of Region I and II and fall short in the southern provinces of Region III. In Region I the target ratio was 107.8 while the survey ratio was 114.2 or 6,4 points higher. In Region II the target was 157.0 where as the present ratio is 166.8. In Region III, the hypothetical target was 183.6, while the survey ratio was 169.3, a difference of 18.3 points. It may be difficult to reach this latter tharget level even after the two to three year period following the completion of the projects.

As Table 3.17 indicates, the rice yields which were thought to exist in the project areas in 1974 when compared to the survey yields tended to be slightly high in Region I and low in Region II and III. In all regions, the planned yield responses tended to be lower than these actually realized. The survey results indicate that rice yields were 3.2, 17.3 and 21.8 percent high during the first year of production than those planned in Region I through III respectively.

TABLE 3.17

A Comparison Between Rice and Barley Yield Planned and Realized After One Year's Production in 11 Land and Water Development Project Area, Korea[1/]

Sub-Project Area and Region	1975 Survey Yields as a percent of 1973 Planned Yields			
	Rice		Barley	
	Before	After	Before	After
Region I				
Gae-won	77.1	103.6	94.7	87.9
Cheung-ryong	113.8	110.6	-	-
Yeo-ju	105.9	106.6	-	84.4
Gun-am	92.3	91.8	-	84.8
Average	97.3	103.2	94.7	85.7
Region II				
Do-bong	93.7	111.1	72.4	69.6
An-deok	100.0	125.1	76.6	73.7
Jang-ha	119.5	119.3	97.5	97.7
Sung-su	108.6	113.5	81.1	74.2
Average	105.5	117.3	76.9	73.8
Region III				
Song-wol	97.0	119.1	78.5	75.5
Oh-ryu	125.9	120.8	77.2	76.9
Ha-gi	108.7	125.5	76.6	76.8
Average	109.5	121.8	77.4	76.4

1/ Planned yields are taken from MAF, AID Loan Application for Expansion of Irrigation Facilities Project (Republic of Korea, December, 1973), pp. 29-30, while the realized yields are from the 1976 survey.

These substantial increases most likely resulted from a much more rapid introduction of the higher yielding varieties in the project areas. Apparently, such variety changes were not considered in the initial yield estimates.

The planned barley yields tended to be overestimated in all regions both before and after project completion. In the northern provinces, the planned estimates tended to be 5 percent overestimated before the project and 14 percent after. In the middle and southern provinces of Region II and Region III, berley yields were overestimated by about 24 percent both before and after the projects. Errors in these estimates may have been caused by problems which existed in Korea's barley statistics reporting system during the period. These problem have recently be reduced by a complete readjustment of the statistics.

The unplanned yield increase in rice mentioned above tended to over shadow the rather week barley responses. This shows up in the calculation of the net income streams and the IRR's associated with each project. These are discussed in Part IV below.

PART IV

THE NET INCOME STREAMS AND IRR'S ASSOCIATED WITH THE SAMPLE PROJECT AREAS

The rather substantial increases in rice yields, discussed in Part III, led to increases in the net agricultural income generated in each of the sampled project. These increases and the IRR's associated with them are discussed in this section.

The section opens with an examination of the net income streams associated with each project. This is followed by an discussion of the various IRR's developed in the study. The section closes with an evaluation of the indirect benefits generated by the projects which were not used in the calculation of the IRR's.

Changes in Net Agricultural Income

In each of the sampled project areas, a positive increase in net agricultural income was evident. Examining all eleven project, this amounted to slightly more than 547 million won

per year, ranging from 12.5 million won in the Do-bong sub-project area to 90.9 million won in the Gun-am project area (Table 4.1).

This overall increase resulted from a rather substantial increase in gross agricultural receipts and only modest increases in production costs. From 1974 to 1975, the former increased 777.2 million won or 46.0 percent, while the later increased only 230.1 million won or 27.9 percent. When viewed in terms of the ratio of gross income to production costs, this rose from 2.05 won in 1974 to 2.34 won in 1975. This meant that farmers in the project areas tended to receive 14.1 percent more gross income per won invested in production inputs in 1975 than in 1974.

On a per hectare basis, the investment in land and water development tended to generate an increase in net income of 163 thousand won per hectare (Table 4.2). The lowest average per hectare increase, 159.8 thousand won per hectare, was recorded in the northern provinces of Region I, while the largest increase 214.2 thousand won per hectare, was in the southern provinces of Region III.

These increases when combined with the capital investment and yearly operating and maintenance costs from the basic income streams required to calculate the IRR's associated with each project. These are examined below.

TABLE 4.1

Net Increase In Agricultural Incomes Resulting From Land and Water Development Investments in 11 Sample Project Areas, Korea, 1976 1/

Sub-Project area & region	Without Project			With Project			Net increase 2/
	Gross income	Production cost	Net income	Gross income	Production cost	Net income	
Region I							
Gae-won	44,928	28,455	16,473	88,728	35,757	52,971	36,498
Cheung-ryong	149,965	77,937	72,028	244,840	102,652	142,188	67,160
Yeo-ju	59,367	23,725	35,642	115,981	54,266	61,715	26,073
Gun-am	39,884	20,838	19,046	201,266	91,335	109,931	90,885
Sub-Total	294,144	150,955	143,189	650,815	284,010	366,805	220,616
Region II							
Do-bong	55,254	31,479	25,179	68,712	31,052	37,660	12,481
An-deok	141,839	78,158	63,681	219,837	95,689	124,148	60,467
Jang-ha	181,023	90,528	90,495	228,933	103,925	125,008	34,513
Sung-su	523,401	231,223	292,178	651,147	270,784	380,363	88,185
Sub-Total	901,517	431,388	471,533	1,168,629	501,450	667,179	195,646
Region III							
Song-wol	50,554	28,397	22,157	72,515	31,836	40,690	18,533
Oh-ruy	110,444	57,062	53,382	154,854	66,290	88,564	35,182
Ha-gi	329,538	156,147	173,391	420,975	170,488	250,487	77,096
Sub-Total	490,536	241,606	248,930	648,355	268,614	379,741	130,811
TOTAL	1,690,601	823,949	866,652	2,467,799	1,054,074	1,413,725	547,073

1/ All monetary estimates are in thousand 1975 won, calculated using shadow prices where appropriate.

2/ A more detailed breakdown of these increases are found in Appendix IV.

TABLE 4.2

Increase in Net Agricultural Income Per Hectare of Paddy Resulting from Land and Water Development Investments in 11 Sample Project Areas, Korea, 1976[1/]

	Without Project			With Project			Increase Per Ha
	Planted Area (Ha)	Total Net Project Income	Net Income Per Ha	Planted Area (Ha)	Total Net Project Income	Net Income Per Ha	
Region I							
Gae-won	97.5	16,473	169.0	115.3	52,971	459.4	290.4
Cheung-ryong	227.9	72,028	316.0	277.0	142,188	513,3	197.3
Yeo-ju	88.2	35,642	404.1	88.2	46,125	523.0	118.0
Gun-am	68.2	19,046	279.3	288.0	109,931	381.7	102.4
Sub-total	481.8	143,189	297.2	768.5	351,215	457.0	159.8
Region II							
Do-bong	75.0	25,179	335.7	75.0	32,660	502.1	166.4
An-deok	178.4	63,681	357.0	201.0	124,148	617.7	260.7
Jang-ha	231.0	90,495	391.8	231.0	125,008	541.2	149.4
Sung-su	631.0	292.178	463.0	631.0	580,363	602.8	139.8
Sub-total	1,115.4	471,533	422.8	1,138.0	667,179	586.3	163.6
Region III							
Song-wol	70.0	22,157	316.5	70.0	40,690	581.3	264.8
Oh-ryu	151.7	53,383	351.9	150.0	88,564	590.4	238.5
Ha-gi	393.9	173,391	440.2	393.9	250,487	635.9	195.7
Sub-total	615.6	248,931	404.4	613.9	379,741	618.6	214.2
TOTAL	2,212.8	866.652	391.7	2,520.4	1,398,135	554.7	163.0

1/ All monetary estimates are in thousand 1975 won, calculated using shadow prices were appropriate.

IRR's Associated with the Sampled Projects

The internal rate of return associated with total project investments were calculated for each project area using shadow and domestic prices. The results of these calculations are presented in Table 4.3.

Assuming international prices these rates tended to vary from 8.56 in tbe Gae-won project area to 19.39 in Cheung-ryong. The low rate of return in Gae-won was a direct result of relatively high construction costs. In this area the presence of unfavorable soil conditions inflated investment costs to 3.1 million won per hectare.[1/] In Do-bong project area, investment costs were relatively reasonable averaging 1.3 million won per hectare, the per hectare net income generated by the project was the lowest recorded amongest the eleven projects. In Oh-ryu project area, relative high investment costs of 1.7 million won per hectare resulted in a rather modest IRR of 10.69.

An examination of the IRR's with respect to the type of major facility constructed, did not provide a clear indication of the productivity of reservoir facilities over pumping stations or vice versa. On a regional basis, projects in the sourthern provinces of Region III did seem to be slightly less productive than those in the other two

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1/ The presence of large amounts of sand and gravel in the area hampered the construction of the reservoir and required that irrigation canals be lines in some areas and that reclaimed and consolidated paddy soils be strengthened with clay.

TABLE 4.3

The IRR's Associated with Land and Water Development Investments In 11 Sample Project Area, Korea, 1976[1/]

Region	International Price		Domestic Prices			
			Total Investment		AID Investment	
	Total Investment	AID Investment	Planned	Realized	Planned	Realized
Region I						
Gae-won	8.56	25.56	8.22	13.21	21.08	40.64
Cheung-ryong	19.39	39.91	15.01	27.92	33.33	50.00 +
Yeo-ju	12.86	13.33	22.14	17.39	29.05	18.06
Gun-am	19.04	50.00 +	13.20	23.74	31.23	50.00 +
Region II						
Do-bong	9.81	13.97	8.72	19.52	9.99	27.53
An-deok	18.64	42.05	18.68	29.48	40.65	50.00 +
Jang-ha	13.55	23.12	23.32	23.41	41.67	43.61
Sung-su	18.42	31.42	28.44	27.05	50.00 +	50.00 +
Region III						
Song-wol	13.66	18.61	7.97	17.94	9.39	24.39
Oh-ryu	10.69	24.63	14.64	16.68	29.85	37.92
Ha-gi	12.59	40.15	50.00 +	18.06	50.00 +	50.00 +

1/ Planned estimates are taken from MAF, AID Loan Application "Supplementary" As Requested By AID (Seoul, The Government of the Republic of Korea, December, 1973), pp. 52-53. Realized estimates are from the sample survey.

regions. This might be attributed to the slow increase in the double cropping ratio and modest increases in the yield of native rice which occurred in this region. These causes, however, represent only tentative conclusions and should be examined more closely.

An attempt was made to examine the rate of return associated with only the AID investment. These rates of return have very little meaning and were calculated to facilitate a comparison with those calculated in the preinvestment analysis. Because of the complex nature of the construction process and the investment streams associated with it, it was assuumed the AID loan funds constituted project investments expended during 1974. This assumption most likely over estimates AID's portion of the investments since some funds from MAF were used during the year. These latter investments, however, were rather small when compared to the AID portion.

When these investments were combined with the total net benefits and operating and maintenance costs associated with each project area, substantially improvements in project IRR's occurred. This was a direct result of the methodology used. In project area such as Yeo-ju, where AID funds constituted almost 97 percent of total investment the increases were rather small. In other areas such as Gun-am, where AID funds constituted only 31 percent of total investments the changes were relative large. In this latter area project benefits which were generated by

domestic investments were assumed to accrue only to the AID investments.

Increases in the initial IRR's were also experienced when the benefit streams associated with the projects were valued at domestic prices. Using these values, IRR's tended to range from 13.21 percent in the Gae-won project area to 29.48 percent in the An-deok area. A major portion of this increase can be attributed to the rice price subsidies maintained by the Korean government in 1975. During this year, government prices were $502.58 per metric ton, $127.69 above the international price used in the analysis.

In the initial analysis conducted in 1973 prior to the AID loan, domestic prices were used to estimate the IRR's associated with each of the project areas. When these planned IRR's were compared with those developed using the survey data, a general increase in the rates was indicated. The only project areas where this did not occure was in Seo-ju and Ha-gi. In the former area, the basic development plan was changed to include the reclamation of 99.3 hectares of irrigated upland rather than the area to 29.48 percent in the An-deok area. A major portion of this increase can be attributed to the rice price subsidies maintained by the Korean government in 1975. During this year, government prices were $502.58 per metric ton, $127.69 above the international price used in the analysis.

In the initial analysis, conducted in 1973 prior to the AID loan,

domestic prices were used to estimate the IRR's associated with each of the project areas. When these planned IRR's were compared with those developed using the survey data, a general increase in the rates was indicated. The only project areas where this did not occure was in Yeo-ju and Ha-gi. In the former area, the basic development plan was changed to include the reclamation of 999 hectares of irrigated upland, rather than the paddy area originally planned. This tended to depress the IRR for two reasons; 1) under the present price support structure upland crops tend to be less profitable than paddy crops, and 2) there have been a number of problems were encountered in the area due to its relatively innovative nature[2/]. In Ha-gi project area, similar changes in the IRR's have occurred. Here, the total benefited area was decreased because of technical problems (Table 3.15).

The Effect of the Sampled Projects on Employment and Foreign Exchange Savings

Of particular importance to Korea policy makers is the effect of the projects on employment and foreign exchange savings. During the construction of the projects, slightly over .9 million man-days of employment were generated (Table 4.4). In the long-run, the new

2/ Korean farmers and land developed have relatively little experience with upland irrigation. This area was one of the first developed for that purpose in the country.

Table 2.1.

The Effect of the Sampled Projects on Employment and Foreign exchange Savings

Region	Employment Opportunities		Savings in foreign exchange
	Construction Period	After Project Completion (per year)	
	----------man/days----------		1,000 $
Region I			
Gae-won	128,332	-	117
Cheung-ryong	74,669	1,285	177
Too-fu	56,485	1,538	30
Gun-an	57,172	2,809	301
Region II			
Do-bong	30,787	1,137	60
An-dook	77,244	7,496	210
Jang-he	53,925	2,115	166
Sung-su	110,882	1,310	42
Region III			
Song-wol	41,083	1,971	42
Oh-ryu	73,111	4,396	73
Ha-gi	155,023	6,655	211
TOTAL	902,664	31,722	1,429

facilities will generate slightly over 30 thousand additional man days of labor per year. The majority of this labor will be used in the operation and maintenance of the new facilities.

Assuming that the net increases in rice and barley production associated with the project where used to displace agricultural imports which have occurred in the past, this would result in a savings in foreign exchange of approximated 1.43 million U.S. dollars per year, valued at 1975 domestic prices.

PART V

CONCLUSIONS

The above report has suggested a variety of general and specific conclusions which may be of significance to future land and water development projects. A set of general conclusions are presented in outline form below. These are followed a set of more specific conclusions dealing with such items as; labor inputs, cropping patterns and so on. The general conclusions are as follows;

1. The IRR's associated with the sample sub-projects, calculated using data from the survey and domestic prices where appropriate, tended to be higher than those calculated in the preproject evaluation. In general, this was due to the presence of a much higher rate of adoption of the higher yielding rice varieties than anticipated in the earlier evaluation. These yield responses suggest that;

   A. In future evaluations, the two to three year lag in rice production is not an appropriate estimate in areas where the newer varieties can be grown following the completion of projects. Barley yields, on the other hand, did tend to lag behind targets indicating that estimates of production responses should be lagged.

   B. The rice and barley yields used in assessing the economic

effects of projects in the future should be modified, with expected rice yields being increased and barley yields constant.

2. The adoption rate associated with the newer high yielding varieties of rice varied from region to region, being lowest in the northern provinces of Region I and highest in the southern provinces of Region III. This suggests the presence of constraints other than adequate irrigation facilities which are interferring with the adoption of these newer varieties. Since these varieties have not been grown in the past on a large scale in this former region the lack of adequate information or inputs may be the constraining factor.

3. A breief examination of the per hectare investment costs associated with the sample projects indicates an inverse relationship between investment costs and IRR's. Further analysis is necessary to isolate the key variables involved and to quantify this relationship. This analysis might provide a sample decision rule which could be used by policy makers in the future to exclude highly unprofitable projects.

4. The analysis did not indicate any significant difference between the productivity of investments in reservoir as opposed to pumping station projects. On a Regional basis, projects in southern provinces of Region III tended to be slightly less productive

than projects in the other two regions. The research indicated that this might be attributed to the slow increase in the yields of native rice which occurred in the region. These causes are, however, only tentative conclusions and should be examined more closely.

A number of specific conclusions dealing with components in the production system of sample farms were also revealed in the study. These are as follows;

1. As a result of the project both the area cultivated and the area of fully irrigated paddy per household increased. The former area, which grew from 1.23 to 1.31 hectares, was the direct result of land reclamation. The latter, which expanded from .17 to .80 hectares, was most pronounced in the southern provinces of Region III, where rainfed paddy was most prevalent.
2. On the sampled farms, there was a tendency to move the rice transplanting date from 9 to 15 days forward. This may have been the direct result of improved irrigation facilities. Improved irrigation allows farmers to cultivates the new high yielding varieties which are started in vinyle seed beds. Covered bed decrease the probability of frost damage so farmers

tend to plant earlier. Thus, as the planted area in Tongil increases there is a tendency for farmers to prepare seed beds earlier and to advance the rice transplanting date.

3. The movement of the rice cultivation season forward does theoretically provide a longer period at the close of the rice cultivation season to prepare and plant barley. This should increase the potential for double cropping. However, increases in labor required at the close of the season for harvesting the larger yields and at the beginning, for advanced seed bed preparation may interfer with double cropping. These constraints should be most restrictive in the northern provinces of Region I where climatic conditions are most servere.

4. The study did suggest a number of affects with respect to the allocation farm labor. These are;

   A. Improvements in the condition and size of paddy acrease allowed farmers to spend less time on plowing.

   B. Improvements in drainage may play a key role in the reduction of labor required for plowing prior to barley seeding.

   C. Improvements in irrigation, which allow farmers to cultivate the new higher yielding varieties, increased labor requirements for seed bed preparation and transplanting.

   D. Improvements in irrigation structures allowed farmers to spend less time on water management activities during the rice cultivation season.

E. Increase in yields resulted in the increased demand for labor during the rice and barley harvesting season.

All of these shifts in labor, especially these at the beginning and end of the rice cultivating season may have adverse effects on double cropping. As such they should be examined in more detail.

5. Yield increases in potatoes, as a winter crop, were significant enough to suggest that they be given a more prominent place in the double cropping pattern planned for future projects. There inclusion, however, will be dependent on the presence of adequate drainage. If the double cropping ratio in future project areas is to be significantly effective, drainage improvements must be an important component.

6. Following the completion of the projects farmers tended to employ power machinery, and chemical fertilizer and to use production chemicals more intensity than before. Demand responses for this inputs need to be determined in the initial project plans and steps take to insure that adequate supplies are available to meet demand.

The above findings represent only an initial investigation into the effects of land and water development. Further work is required to determine such items as; the substritution rate between human and machine power, the effect of increases and temporal shifts in labor demand on double cropping, and the constraints, other than water,

which limit the adoption of new high yielding varieties in project areas. It would seem appropriate that these questions could be addressed in the analysis of the follow up survey in 1978.

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APPENDIX I

Price List of Farm Chemicals, 1975

Price List of Farm Chemicals, 1975

Name of farm chemicals	Form	Unit	Price 1/
Pesticide			
Grace	Liquid	100cc	139
Gaugamin	Liquid	100cc	153
Gaugamin	Powder	3kg	247
Lilagin	Liquid	100cc	218
Lilagin	Powder	3kg	327
Kocarsogin	Liquid	100cc	126
Insecticide			
Diogenon	Liquid	100cc	214
Hoshol	Liquid	100cc	250
Bass	Powder	3kg	371
Saitiron	Liquid	100cc	323
Saitiron	Powder	3kg	386
Elsan	Liquid	100cc	593
Sabin	Liquid	500g	624
Herbicide			
Nasbit	Granular	3kg	629
2.4 - D	Liquid	700cc	194
Tarro	Granular	3kg	627

1/ Average Price paid by Farmers in 1975.

APPENDIX II

Benefit Cost Ratios Calculated
Using International and Domestic
Prices Associated with
11 Land and Water Development
Projects, Korea, 1976

Benefit Cost Ratios Calculated Using International and Domestic Prices
Associated with 11 Land and Water Development Projects,
Korea, 1976

a. Using Total Cost

Price Interest rate Region (%)	International Price					Domestic Price				
	3.5	10	15	20	30	3.5	10	15	20	30
Region I										
Gan=wan	2.01	0.85	0.55	0.40	0.25	3.09	1.30	0.85	0.62	0.38
Cheung=ryong	3.67	1.88	1.30	0.97	0.60	5.56	2.85	1.97	1.46	0.92
Yeo=ju	1.61	1.15	0.87	0.62	0.50	2.21	1.45	1.10	0.88	0.63
Gun=am	3.38	1.86	1.28	0.94	0.57	5.45	3.00	2.07	1.51	0.91
Region II										
Do=bong	2.00	0.99	0.70	0.53	0.36	3.65	1.81	1.27	0.97	0.65
An=dong	3.85	1.86	1.26	0.92	0.57	6.34	3.06	2.07	1.52	0.94
Jang=ha	1.96	1.23	0.90	0.82	0.46	3.24	2.02	1.55	1.07	0.77
Sung=su	2.19	1.49	1.15	0.93	0.65	3.02	2.06	1.60	1.23	0.90
Region III										
Song=wol	2.75	1.32	0.91	0.69	0.46	3.55	1.69	1.17	0.89	0.59
Oh=ryu	2.17	1.07	0.71	0.51	0.31	3.40	1.67	1.11	0.80	0.49
Ha=gi	2.11	1.18	0.83	0.62	0.39	3.05	1.71	1.20	0.90	0.56

b. Using Remaining Cost

Price / Interest rate / Region (%)	International Price					Domestic Price				
	3.5	10	15	20	30	3.5	10	15	20	30
Region I										
Gae-won	4.29	2.23	1.60	1.24	0.86	6.61	3.43	2.48	1.91	1.32
Cheung-ryong	4.84	2.94	2.22	1.78	1.28	7.32	4.45	3.36	2.70	1.94
Yeo-ju	1.84	1.18	0.89	0.85	0.52	2.31	1.49	1.13	0.91	0.66
Gun-am	5.61	4.22	3.47	2.94	2.24	9.07	6.82	5.61	4.74	3.62
Region II										
Do-bong	2.42	1.29	0.93	0.73	0.50	5.15	2.34	1.69	1.32	0.92
An-deok	5.50	3.21	1.39	1.90	1.35	9.06	5.27	3.93	3.12	2.22
Jang-ha	2.36	1.67	1.33	1.28	0.82	3.70	2.75	2.19	1.82	1.35
Sung-su	2.52	1.91	1.58	1.34	1.03	3.49	2.65	2.19	1.86	1.43
Region III										
Song-wol	3.31	1.69	1.19	0.93	0.63	4.26	2.16	1.54	1.19	0.82
Uh-ryu	3.31	2.08	1.52	1.19	0.84	5.18	3.25	2.38	1.87	1.31
Ha-gi	3.34	2.46	1.98	1.66	1.25	4.83	3.53	2.87	2.40	1.81

APPENDIX III

Labor Inputs Used in the Production
of Rice and Barley in 11 Project
Areas With and Without
Land and Water Development
Investments in Korea, 1976

Change in Labor Inputs in the Production of Rice and Barley by Activity In 11 Sample Sub-Project Areas With and Without Land and Water Development Investments in Korea, 1976 1/

	Region I			Region II			Region III			Average		
	Rice		2/	Rice		2/	Rice		2/	Rice		2/
	Tongil	Native	Barley	Tongil	Native	Barley	Tongil	Native	Barley	Tongil	Native	Barley
Without the Project												
Plowing	21.0	20.5	12.0	18.3	17.3	8.5	17.7	17.3	11.7	19.0	18.4	10.7
Seed bed preparation or seeding	16.3	11.3	8.5	14.3	9.3	13.5	15.0	12.3	11.0	15.2	11.0	11.0
Transplanting	21.7	21.0	-	21.0	26.5	-	22.0	16.0	-	21.6	21.2	-
Irrigation	15.7	19.5	-	16.3	19.8	-	21.0	23.7	-	17.7	21.0	-
Weeding	20.0	33.7	43.5	17.3	15.0	30.5	22.0	18.7	50.3	19.8	22.5	41.4
Pest Control	10.7	9.3	5.0	9.7	11.8	6.0	8.0	8.7	3.7	9.5	9.9	4.9
Harvesting & Transportation	51.0	38.5	44.5	54.7	47.3	46.3	51.3	43.7	36.7	55.7	43.2	42.5
TOTAL	166.4	153.8	113.5	151.6	147.0	104.8	157.0	140.4	113.4	158.5	147.2	110.5
With the Project												
Plowing	19.3	17.5	11.0	16.0	16.5	8.3	18.3	15.7	10.3	17.9	16.6	9.9
Seed bed preparation of seeding	16.3	11.0	9.5	14.7	10.3	13.7	16.3	12.7	10.0	15.8	11.3	11.1
Transplanting	20.5	20.5	-	24.5	23.5	-	21.3	16.3	-	22.1	20.1	-
Irrigation	12.3	16.5	-	15.7	18.0	-	16.7	20.0	-	14.9	18.2	-
Weeding	18.3	29.8	42.0	15.0	14.5	30.0	20.0	17.0	47.7	17.8	20.4	39.9
Pest Control	12.5	13.0	5.0	13.8	15.8	5.8	10.0	11.3	3.7	12.1	13.4	4.8
Harvesting & Transportation	63.0	52.0	45.5	65.0	53.0	46.5	56.0	53.0	39.0	61.3	52.7	43.6
TOTAL	162.2	160.3	113.0	164.7	151.6	104.3	158.6	146.0	110.7	161.9	152.7	109.3
Absolute Change												
Plowing	-1.7	-5.0	-1.0	-2.3	-0.8	-0.2	0.6	-1.6	-1.4	-1.1	-1.8	-0.8
Seed bed preparation or seeding	-	-0.3	1.0	0.4	1.0	0.2	1.3	0.4	-1.0	0.6	0.3	0.1
Transplanting	-1.2	-0.5	-	3.5	-3.0	-	-0.7	0.3	-	0.5	-1.1	-
Irrigation	-3.4	-3.0	-	-0.6	-1.8	-	-4.3	-3.7	-	-2.8	-2.8	-
Weeding	-1.7	-3.9	-1.5	-2.3	-0.5	-0.5	-2.0	-1.7	-2.6	-2.0	-2.1	-1.5
Pest Control	1.8	3.7	-	4.1	4.0	-0.2	2.0	2.6	-	2.6	3.5	-0.1
Harvesting & transportation	2.0	13.5	1.0	10.3	5.7	0.2	4.7	9.3	2.3	5.6	9.5	1.1
TOTAL	-4.2	6.5	-0.5	13.1	4.6	-0.5	1.6	5.6	-2.7	3.4	5.5	-1.2

1/ Estimates of labor inputs are in hours per 10 Are.

2/ Includes both common and naked barley.

APPENDIX IV

Fertilizer Application Rates and the
Number of Applications of Production Chemicals
in the Production of Rice and Barley
in 11 Project Areas With and
Without land and Water Development
Investment in Korea, 1975

Changes in the Number of Times Production Chemicals Were Applied to Rice on 220 Korean Farms With and Without Irrigation Improvements by Region and Rice Variety, 1974-1975

Item	Region I		Region II		Region III		Average	
	Rice		Rice		Rice		Rice	
	Tongil	Native	Tongil	Native	Tongil	Native	Tongil	Native
Without the Projects								
Production Chemicals	5.7	5.0	6.0	6.9	7.0	7.7	6.2	6.1
Insecticides	3.7	2.5	3.7	3.5	4.3	3.7	3.9	3.2
Pesticides	1.0	1.5	1.3	2.8	1.7	3.0	1.3	2.0
Herbicides	1.0	1.0	1.0	0.6	1.0	1.0	1.0	0.9
With the Projects								
Production Chemicals	5.5	7.0	10.0	10.7	9.7	10.7	8.4	9.5
Insecticides	3.0	3.3	6.0	5.7	5.7	5.7	4.9	4.9
Pesticides	1.5	2.7	3.0	4.0	3.0	4.0	2.5	3.6
Herbicides	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Changes								
Production Chemicals	-0.2	2.0	4.0	3.0	2.7	3.0	2.2	3.4
Insecticides	-0.7	0.8	2.3	2.4	1.4	2.0	1.0	1.7
Pesticides	0.5	1.2	1.7	1.2	1.3	1.0	1.2	1.6
Herbicides	-	-	-	0.2	-	-	-	0.1

Changes in Fertilizer Application
Farms With And Without Irrigation
1974 - 1975 1/

Item	Region I			Region
	Rice		2/	Rice
	Tongil	Native	Barley	Tongil
Without the Projects				
Chemical fertilizers				
Nitrogen	16.4	16.4	18.1	17.7
Phosphoris	8.5	8.4	9.1	9.3
Potassium	10.9	10.9	11.1	10.8
Compost	878	786	728	905
With the Projects				
Chemical fertilizers				
Nitrogen	19.2	19.6	17.6	21.5
Phosphoris	11.1	9.7	11.9	11.0
Potassium	11.7	13.7	12.7	13.3
Compost	911	798	751	794
Change				
Chemical fertilizers				
Nitrogen	17.1	19.5	-2.8	21.5
Phosphoris	30.6	15.5	30.8	18.3
Potassium	7.3	25.7	14.4	23.1
Compost	3.8	0.4	3.2	-12.3

1/ Estimates are in kilograms per 10 Are, while the

2/ Includes both common and naked barley

Rates on 220 Sample Korean
Improvements by Region,

II		Region III			Average		
	2/	Rice		2/	Rice		2/
Native	Barley	Tongil	Native	Barley	Tongil	Native	Barley
15.8	15.6	15.8	13.7	14.4	16.6	15.3	16.0
8.6	10.5	9.9	8.3	9.0	9.2	8.4	9.5
10.5	9.3	9.5	7.7	8.0	10.4	9.7	9.5
935	1054	720	655	597	834	792	793
18.2	18.1	19.3	16.6	17.5	20.0	18.2	17.7
9.4	12.5	12.0	8.7	9.0	11.4	9.3	11.1
11.8	9.4	10.8	8.9	10.5	11.9	11.5	10.9
933	1056	771	745	734	825	822	847
15.8	16.0	22.2	21.2	21.5	20.5	19.0	10.6
9.3	19.0	21.2	4.8	-	23.9	10.7	16.8
12.4	1.1	13.7	15.6	31.3	14.4	18.6	14.7
-0.2	0.2	7.1	13.7	22.9	-1.1	3.8	6.8

change is in percent

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II. 1960~1970年間의 日本穀物 生産에 對한 論考

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1960~1970年의 日本 穀物生産에 對한 論考

本 論考는 農水産部 綜合企劃担当官의 要求에 依해 作成한 것으로서 日本에서 60年代에 惹起되었던 農業分野의 諸動向과 이의 日本農業構造変化와의 関聯을 把握함을 目的으로 한바 本 論考가 農水産部의 当局者들에게 祖国의 未来農業政策方向을 設定하는데 有利하게 使用될 수 있기를 바란다.

本 論考와 韓国의 未来의 農業用水 開発事業에 直接的인 関聯은 없다. 그러나 現在의 韓国에서의 米価支持政策과 過去 日本에 있어서의 米価支持政策과는 비슷함을 說明하고 있다.

한편 日本에서 経験했던 여러 問題点의 反覆을 避하기 為한 政策変化는 現在 韓国의 土地 및 農業用水 開発政策의 変化에 直接的인 影響을 줄 것이다.

本 論考는 두国家間의 諸与件을 比較하려는 것이 아니고 日本에서의 傾向을 提示하려는 것이다.

本 記述에 있어서 国家的 側面에서는 全穀物의 自給状況, 1人当 穀物消費 및 米価支持政策에 対하여 記述하였고 農家水準에서는 営農規模 農家戸数 및 農業機械化等의 変化에 局限하여 記述하였다.

全国的인 傾向

1960年代에 있어서 日本의 穀物自給状況은 一般的으로 悪化状態에 있었다. 図1에서 보는 바와 같이 日本의 米穀生産은 거의 自給水準에 있었다[1].

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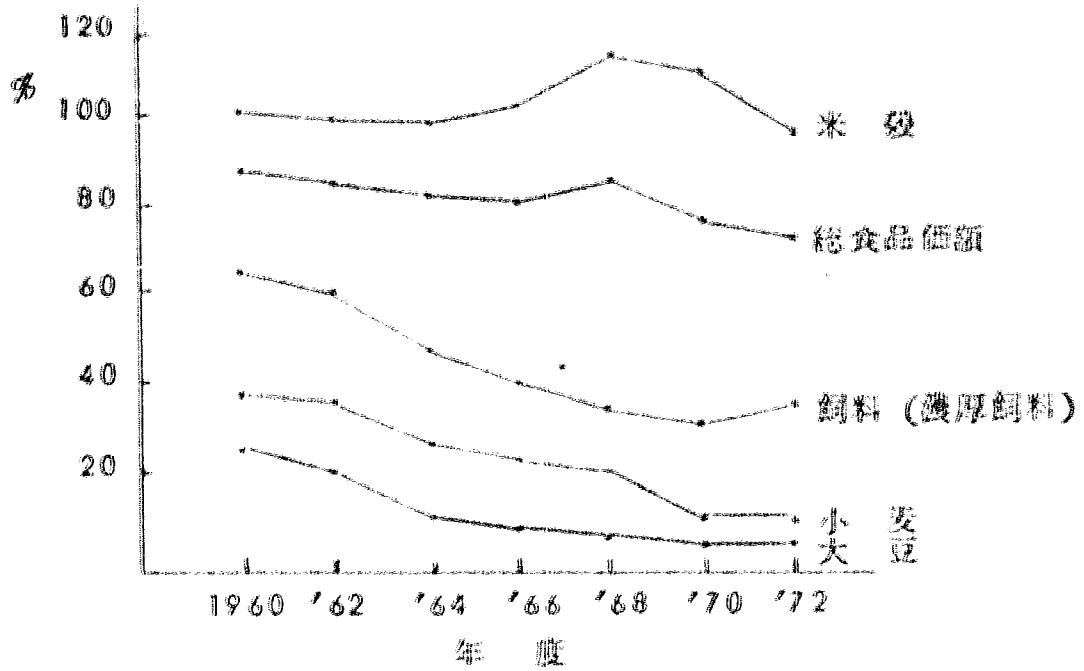
1) 図1에 関한 細部的 係数는 〈表2〉 参照

〈図1〉 日本의 主要食糧 및 国内飼料供給率(1960～1971)



그러나 其他 穀類의 自給水準은 顯著히 떨어져 있었다. 例를 들어 밀의 供給率은 34 %에서 9 %까지 떨어져 있고 콩은 28 %에서 4 %로 濃厚飼料는 (옥수수·수수) 1960年에 67 %에서 1970年에 33 %가지 떨어져 있었다.

国内消費를 充足시키는데 充分한 水準에서 穀物生産을 維持하기 위한 日本政府의 努力은 米穀보다도 다른 穀物의 輸入을 実質的으로 增加시켜왔다.

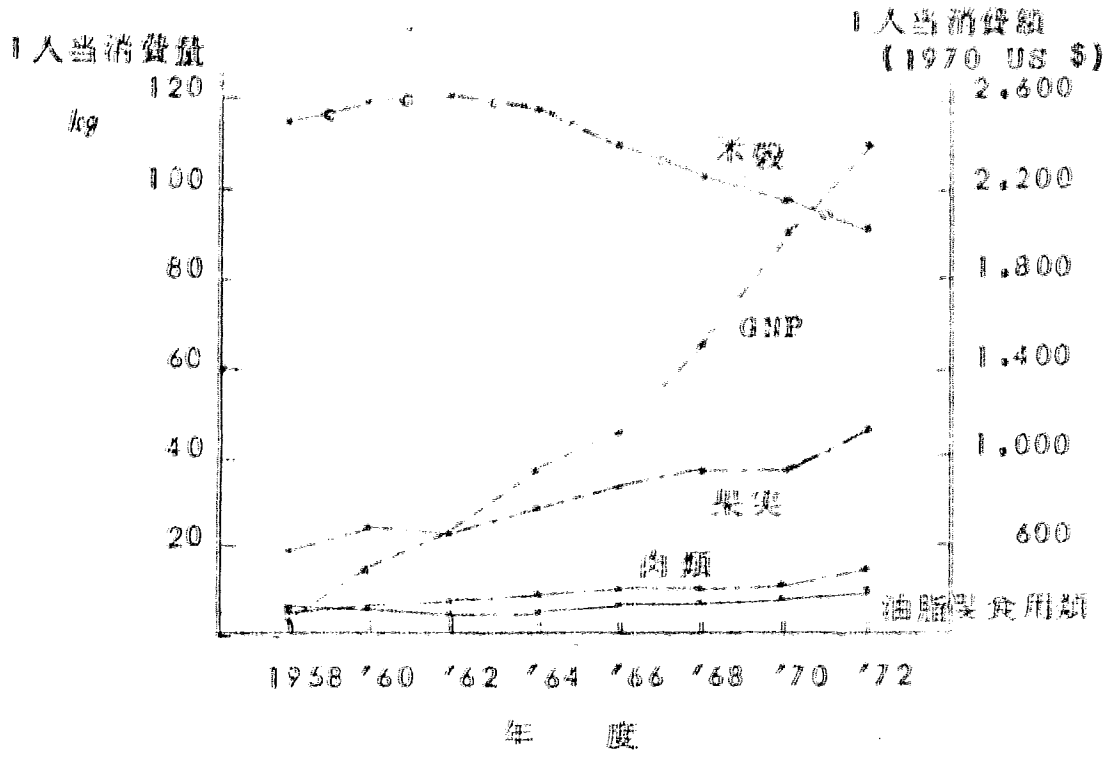
1960年代에 있어 日本의 食品供給 総評価額(経常市場価格)의 90 %는 国内食品生産에서 나머지 10 %는 輸入에서 充当되었다. 1971年의 自給率은 72 %로 減少되었고 輸入은 28 %로 增加되는 現象을 보여주었다. 1975年에는 食品総価額의 50 %가 輸入에 依存되었다. 이 期間中에 米穀이 比較的 安定된 두가지 理由는 消費者 価格의 引上과 1人当所得 增加에 따른 消費量의 減少 및 많은 農家들이 二毛作体系에서 一毛作体系로 転換한데 基因한다.

米穀의 消費量에 있어서 価格 및 所得効果는 아래와 같고 農家立場에서

는 生産量 變化는 그다음에 言及되어 있다.

過去 10年間의 日本의 1人当 國民所得은 1970年度 不變價格으로 1960年에는 .524 $ 1970年에는 1.908 $로 거의 4배 가량 增加되었다. 이러한 所得의 急上昇은 1人当 米穀消費量을 減少시켰고 果実, 肉類, 油脂, 食用油 등의 消費量을 增加시키는 特徵을 갖이왔다.

〈図2〉 日本의 1人当 消費量 및 GNP (1958-1972)



1人当 米穀消費量이 減少하고 밀의 自給이 減少하는 状況을 聯關시켜 検討해 볼때 〈図1〉 日本의 食生活이 밀에 의한 쌀의 代替을 示唆해 주고 있었다.

또한 日本国内의 飼料 生産不足은 다음 節에서 意味하는것과 같이 家畜生産을 위한 相対的인 価格引上을 뜻하는 것이다. 만약에 이런것이 事実이라면 1人当 適正肉類 消費의 增加에 対해서 說明할 必要가 있다.

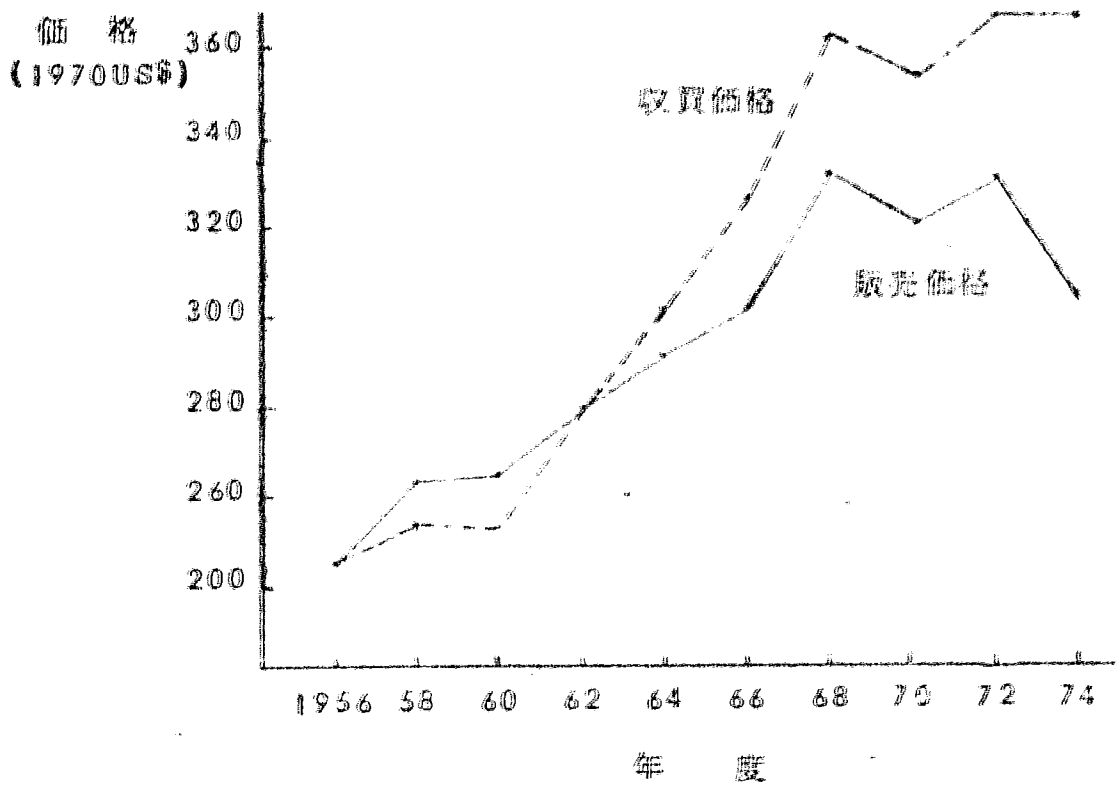
肉類의 1人当 消費量은 1958年의 4.5kg에서 1972年의 15.4kg으로

增加되었다.

1人当 米穀消費量의 低下 傾向은 이 期間중만의 政府販売価格의 引上強化에 따른 所得 增大에 起因되었다.

日本에서 生産된 모든 米穀은 政府가 統制하는 市場 流通経路를 通하여 販売되고 있다. <図3>에서 보는 바와 같이 1961年 以前의 米価는 1970年 不変 달러 価格으로 評価해 볼때 米穀M/T当 価格은 1957年의 218$에서 1962年의 225$로 上昇하였고 1962年에서 1972年 사이에는 61%가 올라 M/T当 363$에 到達하였다.

<図3> 日本의 米穀収買 및 販売価格(1956~1974)



한편 米穀의 販売価格은 政府収買 価格의 水準을 따르게 된다.
1961年 以前에는 日本政府가 価格形成方式을 채택함으로서 即 収買価格에 市場 流通費(倉庫費, 操作費)를 包含시켜 収買価格과 販売価格이 같게 하였다.

1962年初부터 米穀收買 補助計劃이 施行되었으며 이로부터 10年 동안은 政府收買価格이 政府販売価格보다 平均 10%정도 높았다.

米穀 生産者에게 所得을 移転시킨 本 価格政策은 米穀生産에 有利한 効果를 갖어왔다.

<図1>에서 보듯이 米穀의 国内供給率은 1962年의 98%에서 1968年에는 112%로 增加되었으며 1970年에는 107%로 낮어졌다.

相対的으로 有利한 本 米穀価格은 非農業分野의 雇傭機会의 增大와 더불어 農業構造에 많은 変化를 갖어왔다. 이러한 変化는 다음에서 検討코저 한다.

日本農業의 経営構造変化

위에서 言及한 政府收買価格의 急速한 上昇은 農家所得의 增大를 갖어왔다. 農家所得을 1970年度의 不変 달라価格으로 測定해 볼때 1960年度의 1291$에서 1970年度의 3.870$로 300%가 되었다(表1). 이 期間동안 農家所得中 農業所得이 차지하는 比率은 낮어지고 있는바 農業所得은 1960年의 710$에서 1970年에는 1.412$로 約 200%로 增加되었다.

이 增加의 相対的인 比重은 1970年度 不変 달라価格으로서의 非農業所得이 1960年의 581$에서 1970年의 2.459$로 약 5倍가 된것에 比하면 相対的으로 減少되었음을 나타내고 있다. 그리하여 1970年에는 農家所得의 64%가 非農業分野에서 依存되었다.

米価上昇에 対한 非農業所得의 增加는 日本의 農業構造에 두가지의 重要한 変化를 일으켰다. 첫째로 農民들이 耕地는 같은 面積을 保有하면서 專業農業에서 兼業農業으로 転換되는 뚜렷한 傾向을 보였다. 1965年의 平均耕作面積은 1.03 ha이었고 1970年에는 平均 耕地面積이 1.06 ha로 增加되어 거의 같은 状態이면서도 專業農業에 従事하는 農家戸数比率은 1960年의

34.3%에서 1972年에는 14.4%로 떨어졌다〈圖4〉.

〈表1〉 年度別 農家戶当 農業所得 및 非農業所得[a])

年	農家所得	農業所得	非農業所得	非農業所得率
1960	1,291	710	581	45.0
1965	2,351	1,123	1,222	52.0
1970	3,870	1,412	2,459	63.5

a) 都売物価指数 (1970 = 100) 로 대프레이트 시켄것임 1 $ = 360 ¥

한편 兼業農家는 1960年의 65.7%에서 1972年의 85.6%로 增加되었다. 兼業農業類型中에서 耕作者가 主로 營農에 從事하고 있는 第一種 兼業農家는 1960年의 33.7%에서 1965年의 36.7%로 增加되었으나 1972年에는 27.1%로 減少되었다[2].

兼業農業에 從事하면서 그들의 大部分의 所得을 此農業部門의 就業으로부터 얻고 있는 農家戶數는 계속 增加趨勢를 보였다. 그리하여 1960年에 32%이었던 二種兼業農家가 1972年에는 全農家의 58.5%로 增加되었다.

專業農業에서 兼業農業으로 轉換되는 것은 穀物生産과 關聯시켜 볼때 第二次的으로 重要한 傾向인 것이다.

非農業部門의 雇傭機会가 增加함에 따라 農業生産에 從事하고 있는 勞動力에 非農業分野의 雇傭, 即 工業·세비스 分野로 轉出되었다.

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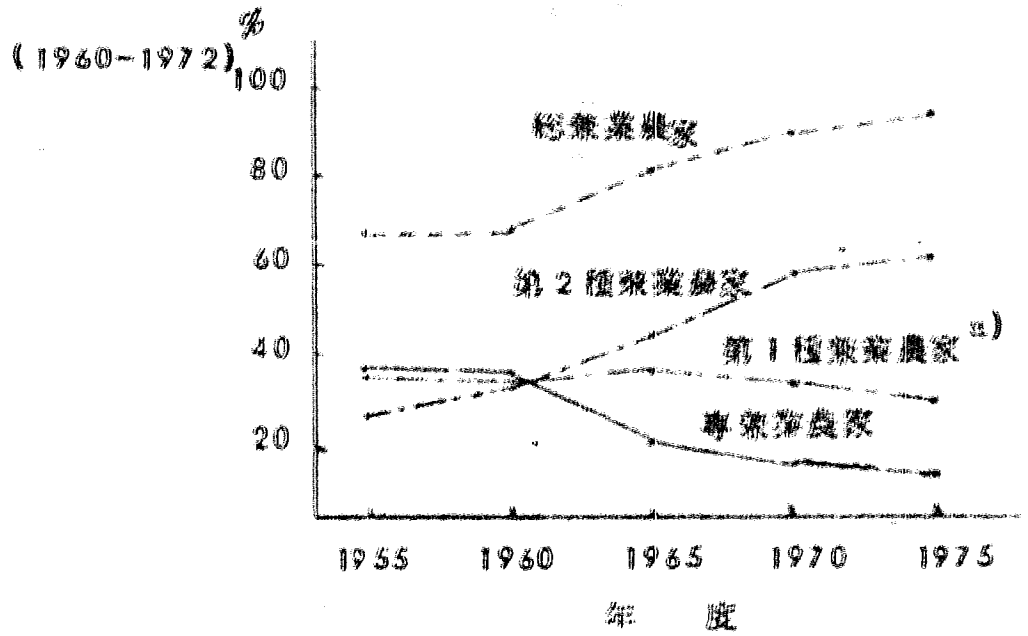
2) 日本에서는 兼業農家를 2가지 類型으로 区分하고 있으며 第一種 兼業農家는 農業所得이 農業外所得보다 많은 農家를 지칭하고 第二種 兼業農家는 이와 反対의 農家로 말함.

《圖4》 日本의 專業農家 및 兼業農家變動趨勢



a) 兼業農家……第一種은 50% 以上의 所得을 農業所得에서, 第二種은 50% 以下의 所得을 農業所得에서 얻는 農民을 말한다.

후쿠다教授는 이러한 動向에 対하여 다음과 같이 말하고 있다. 1950年代의 日本은 工業化를 通하여 그들의 経済発展을 試圖하였으며 그後 農業労賃은 모든 生産要素中에서 가장 높은 上昇率로 引上되었고 農村의 젊은 青年들은 都市로 流出되어 農業労動力의 深刻한 不足을 갖어왔다[3].

이러한 農業労動力의 転出을 完全하게 計量化할 수 없는 理由를 요리氏는 不完全 労動市場의 存在와 未熟練農業 労動力의 낮은 就業機会라고 믿었다[4].

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3) Minoru Fukuda. "Economic Conditions for Fram Mechanization" in Economic Approaches to Japanese Agriculture ed. by Masanobu Kuwahara (Tokyo:Fuji Publishing Co., Ltd. 1969). p.34.

4) Taira Yori. "Characteristics of the Family Farm in Japan." in Economic Approaches. op. cit.. p.99.

이러한 変遷은 미나미教授가 1950年代 7末에 1960年代初까지의 期間동안에 日本経済가 Lowie-typo의 段階 即 伝統的 経済(原始経済)의 特徵인 労動의 無制限的 供給段階로부터 制限된 供給段階로 転換된다는 結論을 내림에 充分한 根拠가 되는 것이다[5]. 이러한 労動流出의 大部分은 20세~29세까지의 年齡層이라는 것이다(図5).

1960年에서 1970年까지의 期間동안에 이러한 年齡層의 農業労動者들은 全農業 労動者의 41.5%에서 21.3%로 줄어 들었다. 이러한 農業労動力의 大量流出은 農村의 老年層과 婦女子의 雇傭과 農業機械의 需要를 增加시켰다.

60才 以上의 農業従事者数는 1960年의 18%에서 1970年의 33.1%로 增加되었다. 이와 함께 婦女子 特히 老年層의 役割이 보다 顯著하게 되었다. 1970年頃에는 全農業 労動者의 40%가 40代의 婦女子로 構成되어 있었다. 総労動力의 減少에 따른 農業労賃의 上昇은 日本 農業을 土地節約的인 労動集約的 農業에서 資本集約的農業 即 機械化 農業으로 転換시켜 놓았다.

価格維持에 따른 収益性 提高 및 米穀增産에 關한 日本政府의 主要施策과 더불어 主要農機械開発 및 供給은 耕耘機, 移秧機 및 収穫機 等의 分野에서 이룩 되었다.

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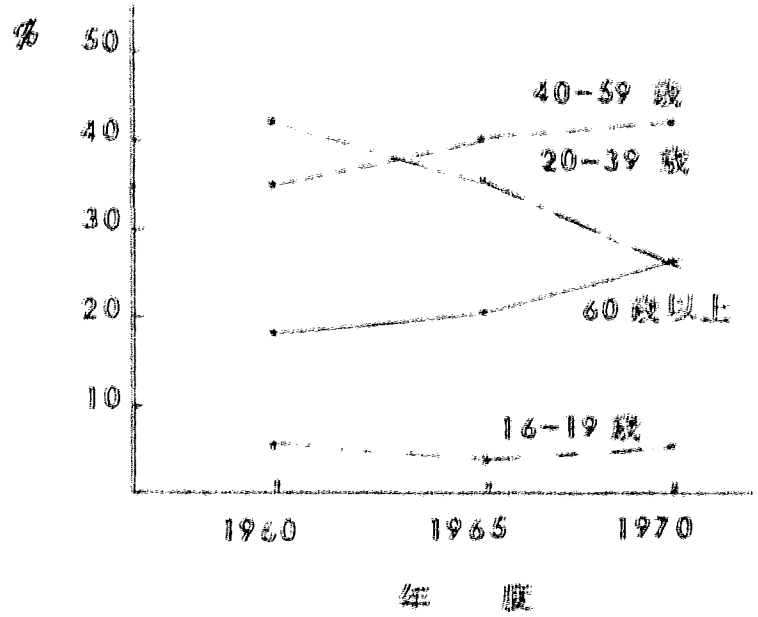
5) Ryoshin Minami, "The Turning Point in Economic Development: Japan's Experience. "Economic Research Series No. 14 (Tokyo: The Institute for Economic Research, Hitotsubashi University. 1973). p.172.

<(図5> 農業労動의 年齡別 構成図(1960-1970)



모든 農機械는 小規模 農家를 위해서 만들어졌고 労動이 不足한 農業部門에서 크게 所要되었다.

<(図6>에서 보듯이 耕耘機는 470%가 增加되었고 動力噴霧機는 500%나 增加되었다. 1970年에 처음으로 紹介된 米穀收穫機의 保有臺数는 2年사이에 100,000臺가 넘었고 水稻移秧機의 保有臺数는 正確히 알려져 있지는 않지만 1973年에 全面積의 32%가 移秧機로 移秧하고 있었다[6].

経営規模의 変動은 없었지만 労動集約的 構造로 転換되는 農業機械化는 다소 粗放的인 耕作을 가져왔다. 이러한 結果로서 2毛作率이 顕著하게 줄어 들었고 労動이 적게드는 水稻一毛作에 專念하는 傾向이 있었다. 即, 冬作物인 밀, 보리等의 生産은 継続 下向勢를 보였다.

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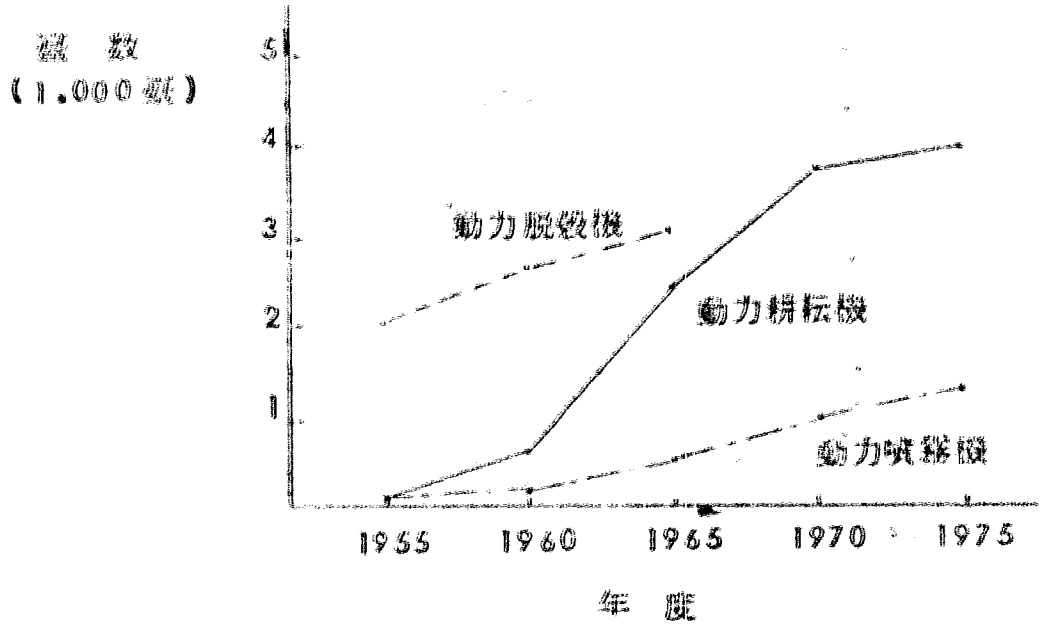
6) Dr. Motosuke Kaihara. "The Changing Structure of Agriculture in Janpa; Effects on Rice Farming." (Madison: The Land Tenure Center, University of Wisconsin, 1976), p.19.

〈圖 6〉 主要 農機械 保有現況(1955-1972)



밀의 生産은 1961年의 3백8십만M/T에서 1970年의 1백만M/T으로 減産되었고 보리, 옥수수, 두류, 도(圖1)에서 보듯이 줄어들었다.

要約 및 結論

1960年代의 米穀에 対한 重点支援策과 非農業部門의 発達로 因한 農業労動의 減少는 日本의 農業을 機械化 農業으로 転換시켰다.

우리가 보아온 바와같이 日本의 機械化는 集約的 農業形態에서 이루어 진 것이 아니고 土地利用率의 低下와 単作農業의 再現에 依해서 이루어진 것이다.

많은 경우에 있어서 밀, 옥수수, 수수 및 大豆는 그自給率이 低下되는 状況에서 冬季作物인 밀의 生産이 減少되었다. 그리하여 1960年代의 日本農業은 米穀 生産部門으로 専門化되었다.

〈表2〉 日本의 主要穀物需要에 対한 供給率(1960-1970)

穀物名	1960	1962	1964	1966	1968	1970	1972
米	101	98	95	101	112	107	92
小麦	39	38	28	22	21	9	8
大豆	28	21	12	8	7	4	5
飼料	67	61	49	40	36	33	30
(総食品価額)	90	87	82	80	84	77	70

資 料: Dr. Motosuke Kaihara. "The Changing Structure of Agriculture in Japan: Effects on Rice Farming." (Madison: The Land Tenure Center, University of Wisconsin, 1976). p.3.

〈表3〉 日本の 1人当 食品 消費量

年度	1人当国民所得 (1970＝US$)[1]	1人当 消費量 (kg／人／年)[2]					
		穀類			肉類	油脂類 食用油	果実
		農村	都市	総計			
1953	253	155.5	93.4	100.4	2.6	1.8	15.0
1954	267	154.8	91.3	99.3	2.8	2.0	11.5
1955	320	156.6	93.4	110.2	3.0	2.3	12.3
1956	299	158.0	99.3	117.7	3.4	3.0	17.4
1957	371	157.0	98.2	116.4	3.9	3.2	18.6
1958	413	156.6	97.5	113.5	4.5	3.4	19.2
1959	468	157.3	97.1	113.5	4.8	3.8	20.5
1960	524	156.2	98.9	115.0	4.3	4.3	22.3
1961	635	150.4	94.9	117.5	6.2	4.7	23.3
1962	712	155.5	90.5	118.3	7.7	5.3	23.8
1963	796	158.8	89.1	116.8	7.7	6.1	25.7
1964	928	150.7	85.8	115.7	8.4	6.5	28.3
1965	1,003	152.6	83.2	111.7	8.9	6.7	28.5
1966	1,124	150.0	78.1	105.9	9.7	7.6	32.1
1967	1,292	147.5	75.9	103.3	10.3	8.1	33.0
1968	1,507	144.5	72.3	100.0	10.3	8.6	38.1
1969	1,698	138.0	67.5	97.1	11.6	9.1	36.6
1970	1,908	136.1	65.3	95.3	12.6	9.4	38.2
1971	2,104	135.8	63.5	93.1	14.4	9.8	38.0
1972	2,338	129.9	59.5	91.6	15.4	10.7	44.2
1973	2,457	129.6	56.2	91.3	16.3	11.1	43.7
1974	2,191	128.1	56.6	89.8	16.2	11.4	41.4
1975			52.2	88.0	16.8	11.4	42.9

1) Per capita GNP estimates were developed by deflating current Japanese GNP estimates by wholesale price index (base year = 1970) and then multiplying the deflated values by the 1970 exchange rate. 360¥ = US$1.00.

2) Japanese per capita consumption estimates were provided by the Agricultural Attache, US. Embassy, Tokyo.

〈表4〉 日本의 米穀價格

가격/MT

年度	日本의 都매 物價指數 (1970 = 100)	政府價格 1) 收買價格 經常市場價格 (1000円)	收買價格 不變價格 2) (1000円)	收買價格 US$ 3)	販賣價格 經常市場價格 (1000円)	販賣價格 不變價格 (1000円)	販賣價格 US$ 3)
1953	88.1	71.2	80.8	224	67.2	76.3	212
1954	87.2	66.7	76.5	213	67.1	76.9	214
1955	86.3	67.7	78.4	218	67.7	78.4	218
1956	89.8	67.1	74.7	208	66.6	74.7	206
1957	92.5	68.8	74.4	207	72.6	74.4	218
1958	86.3	68.8	79.1	221	72.6	84.1	234
1959	87.3	68.9	79.0	219	72.6	83.3	231
1960	88.1	69.4	78.8	219	72.5	82.3	229
1961	89.0	73.7	82.8	230	72.1	81.0	225
1962	87.2	81.1	93.0	258	81.3	93.2	259
1963	89.0	87.8	98.7	274	80.3	90.2	251
1964	89.1	99.7	111.9	311	93.9	105.4	293
1965	89.9	109.0	121.3	337	101.8	113.2	314
1966	92.0	119.0	129.3	359	101.1	109.9	305
1967	93.8	130.0	138.6	385	116.5	124.2	345
1968	94.5	137.6	145.6	404	125.8	133.1	370
1969	96.5	137.6	142.6	396	124.9	129.4	359
1970	100.0	137.9	137.9	383	124.0	124.0	344
1971	99.2	142.0	143.0	398	122.9	123.9	344
1972	100.0	149.2	149.2	414	130.8	130.8	363
1973	115.9	171.7	148.1	411	130.1	112.3	312
1974	152.2	226.9	149.1	414	170.9	112.3	312
1975		259.5			203.4		

1) Unlike Korea, all rice grown in Japan flows through a government rice purchase and sale program

2) Current yen was deflated to constant yet by dividing by the wholesale price index

3) Converted to U.S. dollars using the 1970 yen/U.S. dollar exchange rate(¥ 360.0 = U.S. $1)

〈表5〉 農家雇傭程度에 따른 農家戶數

年度	總計	專業農家	兼業農家		
			總計	第一種兼業農家	第二種兼業農家
(a) 農家戶數(單位:千)					
1955	6.043	2.106	3.937	2.174	1.663
1960	6.057	2.078	3.978	2.036	1.942
1965	5.665	1.219	4.446	2.081	2.365
1970	5.342	831	4.510	1.802	2.709
1971	5.261	798	4.463	1.567	2.896
1972	5.170	743	4.427	1.404	3.023
(b) 農家率(單位:%)					
1955	100.0	34.8	65.2	37.7	27.5
1960	100.0	34.3	65.7	33.7	32.0
1965	100.0	21.5	78.5	36.7	41.8
1970	100.0	15.6	84.4	33.7	50.7
1971	100.0	15.2	84.8	29.8	55.0
1972	100.0	14.4	85.6	27.1	58.5

〈表6〉 專業農家 및 兼業農家의 農家戶數 1000/(%)

年度	總農家戶數	專業農家戶數	兼業農家戶數	兼業農家戶數	
				第一種	第二種
1950	6.176	3.086	3.090	1.753	1.337
	(100)	(50.0)	(50.0)	(28.4)	(21.6)
1955	6.043	2.106	3.937	2.274	1.663
	(100)	(34.9)	(65.1)	(37.6)	(27.5)
1960	6.057	2.078	3.979	2.036	1.942
	(100)	(34.3)	(65.7)	(33.6)	(32.1)
1965	5.665	1.219	4.446	2.081	2.365
	(100)	(21.5)	(78.5)	(36.7)	(41.8)

〈表7〉 年齢 別 性別 労働人口

年齢別	1960	1965	1970	1970 男	1970 女
16 − 19	752	406	570	318	252
	(5.4)	(3.7)	(5.6)	(8.0)	(4.8)
20 − 29	2,787	1,398	1,000	345	655
	(20.0)	(12.7)	(9.8)	(8.7)	(10.4)
30 − 39	2,996	2,470	1,795	573	1,222
	(21.5)	(22.4)	(17.5)	(14.4)	(19.5)
40 − 49	2,466	2,194	2,198	746	1,451
	(17.7)	(19.9)	(21.4)	(18.8)	(23.1)
50 − 59	2,424	2,099	1,920	675	1,245
	(17.4)	(19.0)	(18.7)	(17.0)	(19.8)
60 才以上	225,008	2,471	2,770	1,316	1,454
	(18.0)	(22.4)	(27.0)	(33.1)	(23.2)
計	13,933	11,039	10,252	3,973	6,279
	(100)	(100)	(100)	(100)	(100)

資 料： The Interim Report of the Census of Agriculture in 1960, 1965 and 1970(Ministry of Agriculture and Forestry, Japan).

〈表8〉 主要農機械保有台数

年	動力脱穀機	耕 耘 機	動力噴霧機	収 穫 機
1945	352	8	6	−
1951	972	16	20	−
1955	2,038	89	87	−
1960	2,476	746	232	−
1965	3,048	2,509	494	−
1970	−	3,448	958	45
1972	−	3,529	1,162	117

資 料： Farm Machinery Yearbook, 1967, and data from the and Survey Division, Ministry of Agriculture and Forestry, Japan.

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Martin Hanratty

KOREAN AGRICULTURAL PLANNING PROJECT
A JOINT PROJECT OF THE REPUBLIC OF KOREA
AND MICHIGAN STATE UNIVERSITY

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SOME NOTES ON GRAIN PRODUCTION IN JAPAN WITH SPECIFIC REFERENCE TO RICE, 1960-1970

Martin Hanratty*

The following short essay has been developed in response to a request made by the Director General for Planning and Management and the Office of Overall Planning, Ministry of Agriculture and Fisheries. Its purpose is to draw a picture of the various trends which occurred in Japanese agriculture during the 60's and to relate these trends to changes which occurred in Japanese farm structure. It is hoped that such a scenario will provide planners in the Ministry with useful insights into the Japanese experience which can be used to plan the direction of Korea's future agricultural policies.

While the essay doesn't have a direct relationship with future Korean land and water development, it does describe a rather close parallel between present Korean and past Japanese rice support policies. Changes in Korean policies to avoid the problem created in the Japanese case will, however, have a direct effect in altering present Korean land and water development policies.

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* Program and Project Evaluation Analyst, Korean Agricultural Planning Project Michigan State University and the Ministry of Agriculture and Fisheries.

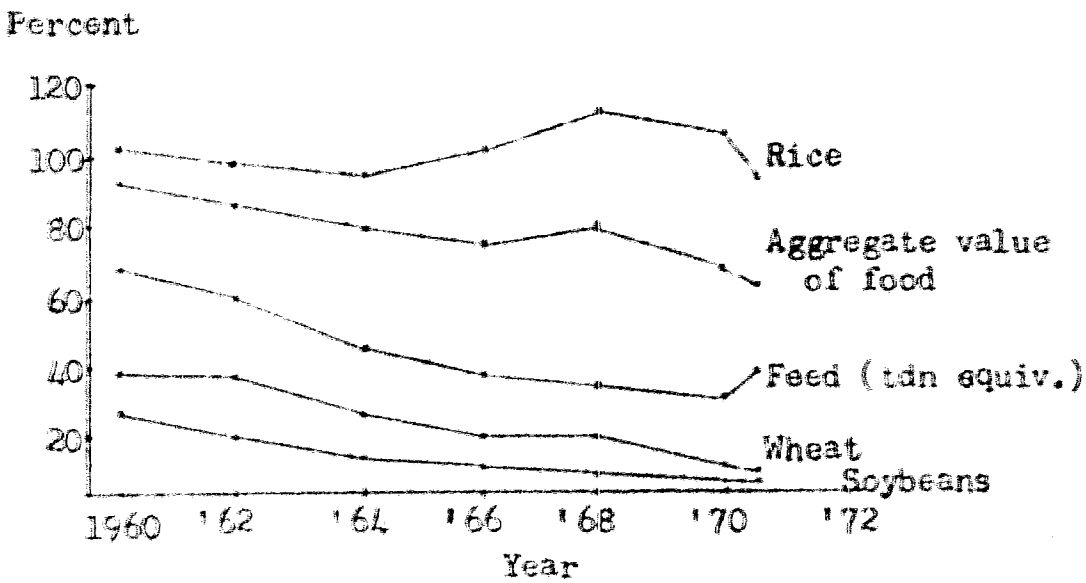
The essay does not attempt to draw a comparison between conditions in the two countries, but only to present the trends in Japan. At the national level, the overall grain self-sufficiency situation, per capita consumption and rice price support structure are reviewed. At the farm level the discussion is restricted to changes in farm size, farm households and mechanization.

National Trends

During the 1960's Japan experienced a general deterioration in its grain self-sufficiency situation. As Chart 1 indicates, rice production tended to fluctuate on or around the self-sufficiency level throughout the period 1/.

Chart 1

DOMESTIC SUPPLY AS A PERCENT OF TOTAL SUPPLY FOR SELECTED COMMODITIES IN JAPAN, 1960-71



1/ Data for the charts appear at the end of the essay.

However, the self-sufficiency level of other grains declined markedly. For example, the domestic supply of wheat as a percent of total supply declined from 39 to 9 percent. Soybeans dropped from 28 to 4 percent and feed grains (mostly corn and sorghum) calculated in total digestible nutrients declined from 67 percent in 1960 to 33 percent in 1970.

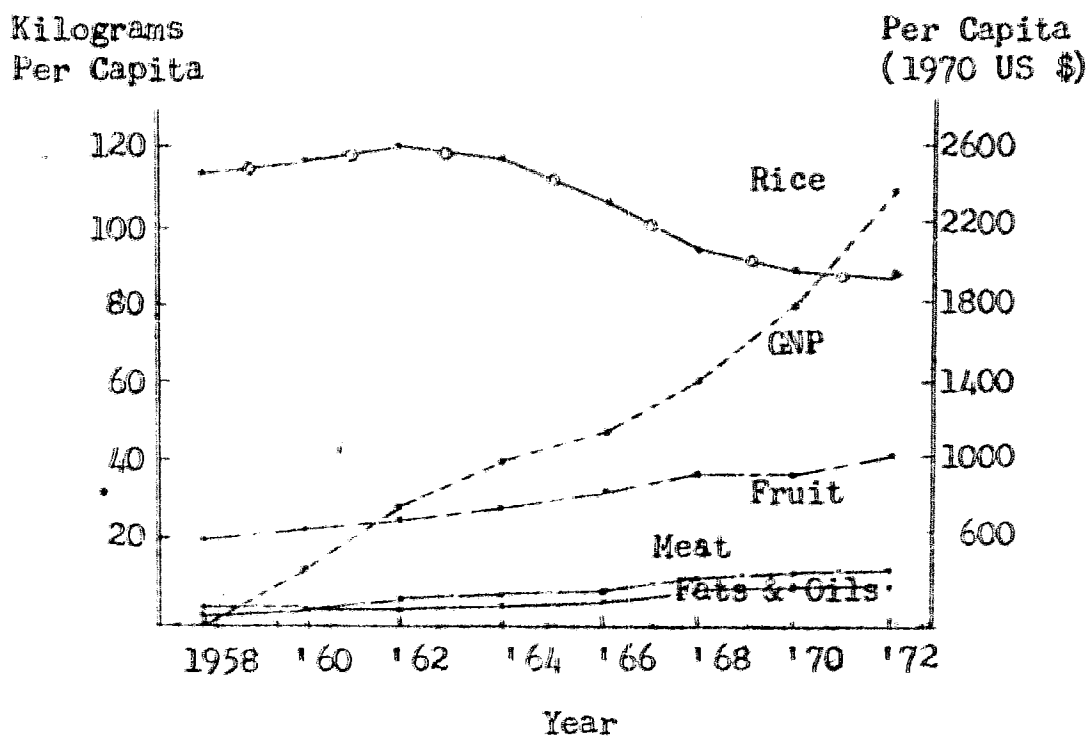
The inability of Japan to maintain grain production at levels sufficient to meet domestic consumption led to a rather substantial increase in imports of grains other than rice. In 1960, 90 percent of the aggregate value at current market prices of all food supplied in Japan was derived from domestic production and only 10 percent from imports. By 1971 the share of domestic production had declined to 72 percent with the share of imports increasing to 28 percent. During 1975, it was estimated that food imports constituted 50 percent of the nation's food supply in terms of food value.

The relatively stable position of rice during the period can be traced to two factors; a decline in per capita consumption generated by increasing consumer prices and per capita incomes and the movement away from a multiple cropping to a single cropping pattern on many Japanese farms. The effect of price and income on rice consumption is examined below, while changes in production which resulted from changes in resource allocation at the farm level are dealt with in a latter section.

During the ten year period, Japanese per capita GNP valued in constant 1970 dollars almost quadrupled, increasing from $524 in 1960 to $1,908 in 1970. This rapid increase in income led to shifts in individual consumption trends characterized by a decline in per capita rice consumption and general increases in the consumption of fruits, meats and fats and oils.

Chart 2

JAPANESE PER CAPITA FOOD CONSUMPTION AND GNP, 1958-72



This decline in per capita rice consumption when combined with a drop in wheat self-sufficiency (Chart 1) would indicate the replacement of rice by wheat in the Japanese diet. Also, the

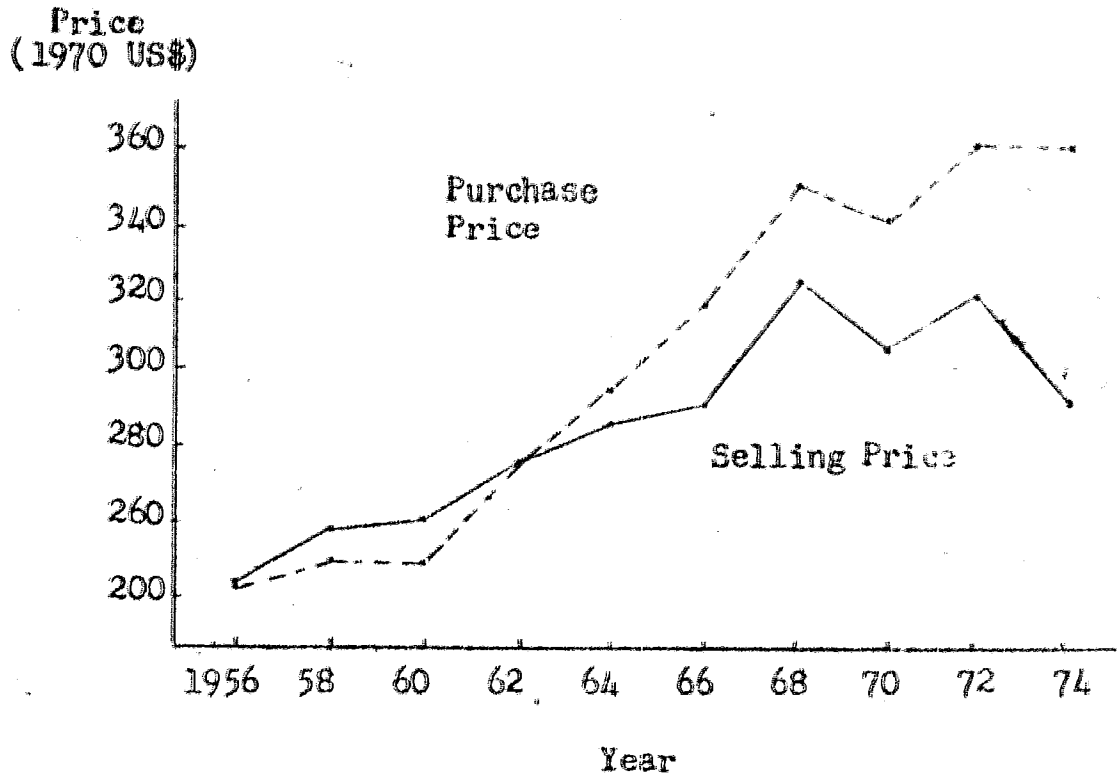
shortage of domestically produced feed grains implied in this latter chart suggests a relatively high price for livestock products. If true this would provide an explanation for the relatively modest rate of growth in per capita meat consumption. Consumption of this commodity rose from 4.5 kilograms per person in 1958 to 15.4 kilograms in 1972.

The downward trend in per capita rice consumption generated by increasing income tended to be strengthened by increases in the government selling price of rice during the period. In Japan all rice produced flows through government controlled marketing channels. As Chart 3 indicates, prior to 1961 the consumer price for rice valued in constant 1970 US dollars remained rather stable, ranging from $218 per M/T in 1957 to $225 per M/T in 1962. Between 1962 and 1972 however, the price increased 61 percent reaching $363 by the end of the period.

The rapid rise in selling price however, did not keep pace with the official purchase price. Prior to 1961 the Japanese government maintained a pricing structure so that the purchase price plus marketing margin, presumably to cover storage and handling costs equaled the selling price. Starting in 1962 a subsidized rice purchase program was initiated. During the ten year period commencing in 1962 purchase prices tended to be on the average 10 percent greater than government selling prices.

Chart 3

JAPANESE RICE PURCHASE AND SELLING PRICES, 1956-74



This price policy, which transferred income to rice farmers, did have a beneficial effect on rice production. As Chart 1 indicates, domestic supply rose from 98 percent in 1962, reached a peak of 112 percent in 1968, and declined to 107 percent in 1970.

However, this relatively favorable rice price situation, when combined with an increase in off-farm employment opportunities, also led to some major shifts in farm structure. These changes are examined below.

Changes in Japanese Farm Structure

The rapid increase in the purchase price mentioned above helped to generate increases in farm household income. Overall farm household income, measured in constant 1970 US dollars grew 300 percent from $1,291 in 1960 to $3,870 in 1970 (Table 1). During the period the proportion of this income generated from farm sources declined. Farm source income rose slightly less than 200 percent, from $710 in 1960 to $1,412 in 1970. The relative importance of this rise was overshadowed by a five-fold increase in off-farm income, from $581 in 1960 to $2,459 in 1970. By 1970, approximately 64 percent of all farm household income was generated from nonfarm sources.

The growth in nonfarm income sources in light of a rising rice price led to two major changes in the structure of Japanese farms. First, there was a distinct tendency for farmers while retaining the same production area to switch from full-time to part-time farming. In 1965, the average area cultivated by farm households was 1.03 ha. While this area remained rather stable, rising to 1.06 ha by 1970, the percent of farm households engaged in full-time farming declined from 34.3 percent in 1960 to 14.4 percent in 1972 (Chart 4). On the other hand, part-time farm operations increased from 65.7 percent in 1960 to 85.6 percent in 1972. In this latter category part-time farmers engaged mainly in farming (Type I)

TABLE 1

Annual Farm and Off-farm Income
Per Farm Household in Selected Years a/

Year	Total Farm Household Income	Farm Income	Off-farm Income	Share of Off-farm Income(%)
1960	1,291	710	581	45.0
1965	2,351	1,128	1,222	52.0
1970	3,870	1,412	2,459	63.5

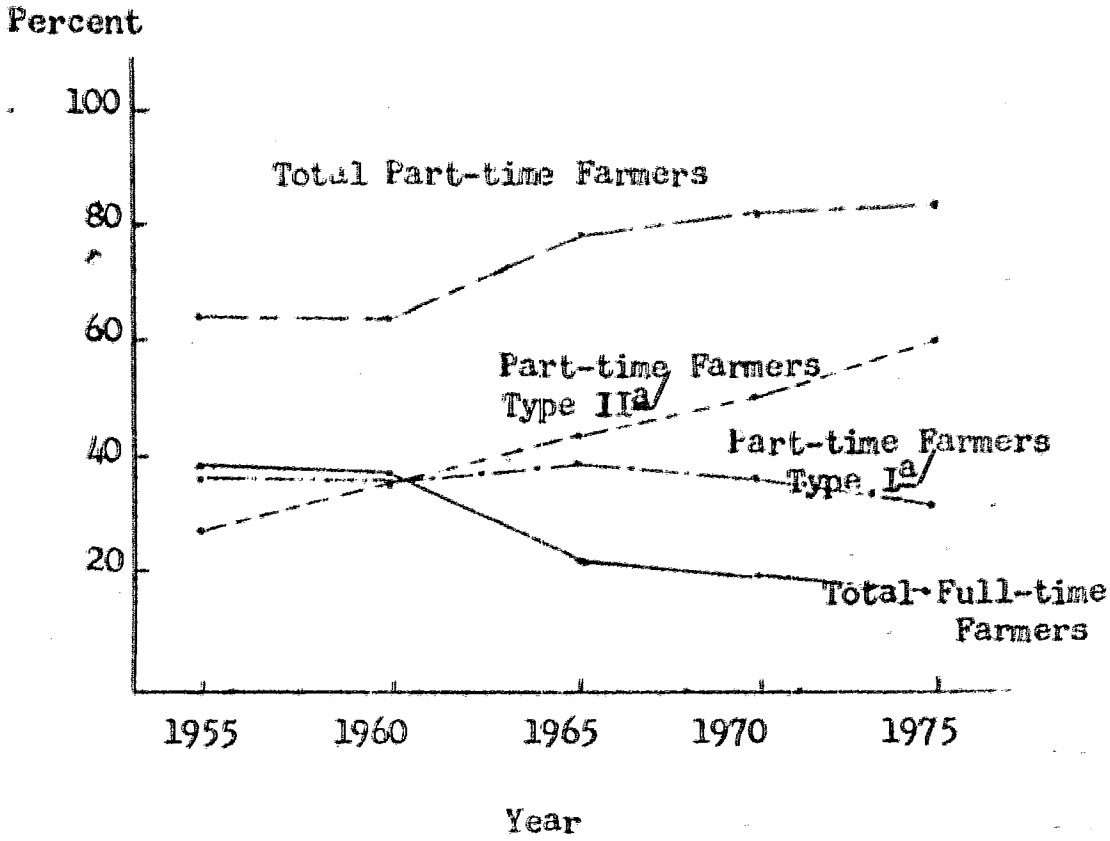
a/ Deflated from current yen using the Japanese wholesale price index (1970 = 100) and converted to 1970 US dollars using the 1970 exchange rate $1 = 360 ¥.

first tended to rise from 33.7 percent of all farm households in 1960 to 36.7 in 1965. By 1972 they had declined, comprising only 27.1 percent of all farm households 2/. The number of farm households engaged in part-time farming but with a major portion of their income coming from off-farm employment (Type II) showed a steady tendency to increase. In 1960 these households constituted 32.0 percent of all farm households. By 1972 they had increased to 58.5 percent of all farm households.

2/ Part-time farm households are divided by Japanese statisticians into two categories: Type I, households in which farm income exceeds off farm earnings; Type II, households in which the reverse is true.

Chart 4

TRENDS IN FULL AND PART-TIME
FARMING IN JAPAN, 1960-72



a/ Part-time farmers - Type I are farmers who earn more than 50 percent of their income from farming while Type II farmers earn less than 50 percent.

Associated with the shift from full to part-time farming, a second and possibly more important trend with respect to grain production also occurred. As the portential for nonfarm employment increased, labor which was normally used in farm production shifted to nonagricultural employment in the industrial service sectors.

Professor Fukuda describes these changes in the following words:

> Since the 1950's when Japan was challenged to expand her economy through industrialization, the economic conditions surrounding agriculture ... wages rose at the highest rate among all the factors of production, bring a rapid exodus of rural youth and even of farm operators themselves, and seriously resulted in a shortage of labor for farming ...[3]

Yori believed that the only reason that this shift didn't amount to a complete exodus was the presence of an imperfect labor market which provided only unstable, low wage opportunities for unskilled farm labor[4]. This shift was substantial enough to lead Minami to the conclusion that during the late 1950's or early 1960's Japan passed from a phase of Lewis-type "unlimited supplies of labor" in the traditional (primarily agricultural) sector of the economy to a phase of "limited supplies "[5].

3/ Minoru Fukuda, "Economic Conditions for Farm Mechanization" in Economic Approaches to Japanese Agriculture ed. by Masanobu Kuwahara (Tokyo: Fuji Publishing Co., Ltd. 1969), p. 34.

4/ Taira Yori, "Characteristics of the Family Farm in Japan," in Economic Approaches, op. cit., p. 99.

5/ Ryoshin Minami, "The Turning Point in Economic Development: Japan's Experience." Economic Research Series No. 14 (Tokyo: The Institute for Economic Research, Hitotsubashi University, 1973), p. 172.

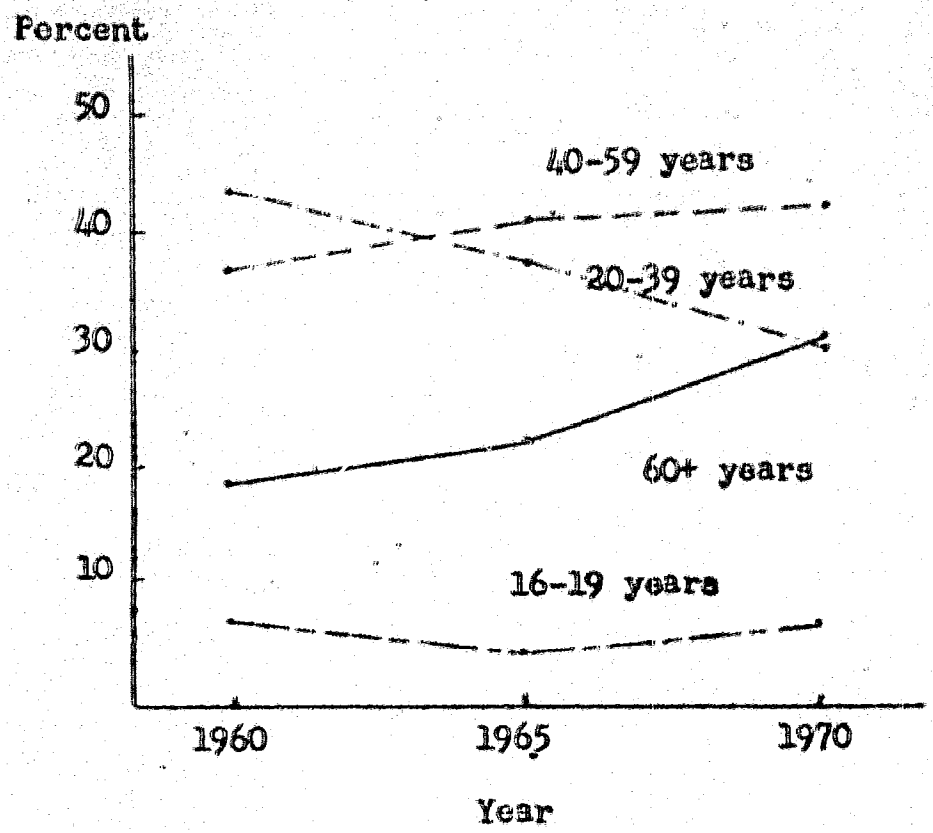
The major share of this labor outflow was in the 20 to 39 year age range (Chart 5). During the period from 1960 to 1970, this age group dropped from 41.5 percent of the total agricultural labor force to 27.3 percent. This exodus resulted in the increased employment of women and elderly as agricultural laborers and an increase in the demand for farm machinery. The number of persons over 60 employed in agriculture also increased from 18.0 percent in 1960 to 33.1 percent in 1970. In addition, women especially in the older age groups began to take a more prominent role. By 1970, 40 percent of the total farm labor force was made up of women over the age of 40.

The increase in farm wages associated with the decline in total labor force moved Japanese agriculture away from a land-saving labor intensive technology to a more capital-intensive, machine using technology. With the government's emphasis on rice production and its enhanced profitability due to the price support structure, major machinery development and introduction occurred in the area of rice cultivating, planting and harvesting equipment.

All equipment was developed for small holdings and was in high demand in the labor scarce agricultural sector. As Chart 6 indicates, power tillers increased 470 percent while the number of power sprayers rose 500 percent. The number of rice combines which were first introduced in 1970, grew in a two year period to over 100,000

Chart 5

SELECTED AGE GROUPS AS A PERCENTAGE
OF THE TOTAL AGRICULTURAL LABOR FORCE, 1960-70



units. While the number of rice planters is not known, it is known that 32 percent of the paddy field area was planted in this way by 1973 6/.

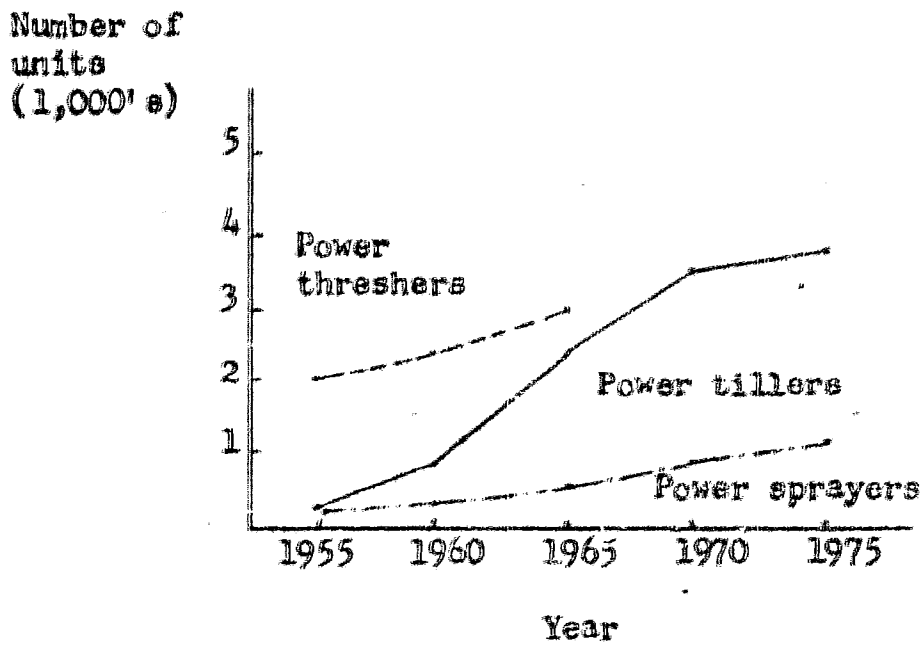
Given rather stable farm size, the movement toward a more mechanized type of agriculture away from the traditional labor intensive

6/ Dr. Motosuke Kaihara, "The Changing Structure of Agriculture in Japan: Effects on Rice Farming," (Madison: The Land Tenure Center, University of Wisconsin, 1976), p. 19.

structure has led to less intensive cultivation. As a result there has been marked decline in the double-cropping ratio and a tendency to engage in the specialized single-cropping of rice which requires less labor. The typical winter crops of wheat and barley have continued to decline. Wheat production fell from 3.8 million tons in 1961 to 1 million in 1970. Barley, corn and soybean production, as indicated in Chart 1, also tended to decline.

Chart 6

MAJOR EQUIPMENT ON JAPANESE FARMS, 1955-1972



Summary and Conclusions

The heavy support which rice received during the 60's and the decline in the agricultural labor force caused by growth in the

nonagricultural sector moved Japanesd agriculture toward mechanization. This mechanization, as we have seen, has not led to a more intensive form of agriculture but to a decrease in cropping intensity and the rebirth of single-cropping agriculture. Winter crops in many instances were abandoned with a resultant decline in the self-sufficiency rate of wheat, corn, sorghum and soybeans. Thus, Japanese agriculture became, during the 60's, more and more specialized in rice production.

Table 2

DOMESTIC SUPPLY AS A PERCENTAGE OF
TOTAL SUPPLY FOR SELECTED CROPS IN JAPAN, 1960-70

Item	1960	1962	1964	1966	1968	1970	1971
Rice	101	98	95	101	112	107	92
Wheat	39	38	28	22	21	9	8
Soybeans	28	21	12	8	7	4	5
Feed	67	61	49	40	36	33	40
Aggregate Value of Food	90	87	82	80	84	77	70

Source: Dr. Motosuke Kaihara, "The Changing Structure of Agriculture in Japan: Effects on Rice Farming," (Madison: The Land Tenure Center, University of Wisconsin, 1976), p. 3.

Table 3

JAPANESE PER CAPITA CONSUMPTION

Year	Per Capita GNP (1970 US$) 1/	Per Capita Consumption (kg/person/yr) 2/					
		Rice				Fats &	
		Rural	Urban	Total	Meat	Oils	Fruit
1953	253	155.5	93.4	100.4	2.6	1.8	15.0
1954	267	154.8	91.3	99.3	2.8	2.0	11.5
1955	320	156.6	93.4	110.2	3.0	2.3	12.3
1956	299	158.0	99.3	117.7	3.4	3.0	17.4
1957	371	157.0	98.2	116.4	3.9	3.2	18.6
1958	413	156.6	97.5	113.5	4.5	3.4	19.2
1959	468	157.3	97.1	113.5	4.8	3.8	20.5
1960	524	156.2	98.9	115.0	4.3	4.3	22.3
1961	635	150.4	94.9	117.5	6.2	4.7	23.3
1962	712	155.5	90.5	118.3	7.7	5.3	23.8
1963	796	158.8	89.1	116.8	7.7	6.1	25.7
1964	928	150.7	85.8	115.7	8.4	6.5	28.3
1965	1,003	152.6	85.2	111.7	8.9	6.7	28.5
1966	1,124	150.0	78.1	105.9	9.7	7.6	32.1
1967	1,292	147.6	75.9	103.3	10.3	8.1	33.0
1968	1,507	144.6	72.3	100.0	10.3	8.6	38.1
1969	1,698	138.0	67.5	97.1	11.6	9.1	36.6
1970	1,908	136.1	65.3	95.3	12.6	9.4	38.2
1971	2,104	135.8	63.5	93.1	14.4	9.8	38.0
1972	2,338	129.9	59.5	91.6	15.4	10.7	44.2
1973	2,457	129.6	56.2	91.3	16.3	11.1	43.7
1974	2,191	128.1	56.2	89.8	16.2	11.4	41.4
1975	-	-	52.6	88.0	16.8	11.4	42.9

1/ Per capita GNP estimates were developed by deflating current Japanese GNP estimates by wholesale price index (base year = 1970) and then multiplying the deflated values by the 1970 exchange rate. 360¥= US$1.00.

2/ Japanese per capita consumption estimates were provided by the Agricultural Attache, US. Embassy, Tokyo.

Table 4

JAPANESE RICE PRICES

Price Per M/T

Year	Japanese Whole-Sale Price Index (1970=100)	GOVERNMENT PRICES 1/					
		PURCHASE			SELLING		
		Current Yen (1000's)	Constant Yen 2/ (1000's)	US$ 3/	Current Yen (1000's)	Constant Yen (1000's)	US$ 3/
1953	88.1	71.2	80.0	224	67.2	76.3	212
1954	87.2	66.7	76.5	213	67.1	76.9	214
1955	86.3	67.7	78.4	218	67.7	78.4	218
1956	89.8	67.1	74.7	208	66.6	74.7	206
1957	92.5	68.8	74.4	207	72.6	74.4	218
1958	86.5	68.8	79.1	221	72.6	84.1	234
1959	87.3	68.9	79.0	219	72.6	83.3	231
1960	88.1	69.4	78.8	219	72.5	82.3	229
1961	89.0	73.7	82.8	230	72.1	81.0	225
1962	87.2	81.1	93.0	258	81.3	93.2	259
1963	89.0	87.8	98.7	274	80.3	90.2	251
1964	89.1	99.7	111.9	311	93.9	105.4	293
1965	89.9	109.0	121.2	337	101.8	113.2	314
1966	92.0	119.0	129.3	359	101.1	109.9	305
1967	93.8	130.0	138.6	385	116.5	124.2	345
1968	94.5	137.6	145.6	404	125.8	133.1	370
1969	96.5	137.6	142.6	396	124.9	129.4	359
1970	100.0	137.9	137.9	383	124.0	124.0	344
1971	99.2	142.0	143.0	398	122.9	123.9	344
1972	100.0	149.2	149.2	414	130.8	130.8	363
1973	115.9	171.7	148.1	411	130.1	112.3	312
1974	152.2	226.9	149.1	414	170.9	112.3	312
1975		259.5			203.4		

1/ Unlike Korea, all rice grown in Japan flows through a government rice purchase and sale program.

2/ Current yen was deflated to constant yen by dividing by the wholesale price index.

3/ Converted to U.S. dollars using the 1970 yen/U.S. dollar exchange rate (¥60.0 = U.S.$ 1).

Table 5

NUMBER OF FARM-HOUSEHOLDS CLASSIFIED
BY DEGREE OF FARMING ENGAGEMENT

Year	Full-time Total	Full-time Farms	Part-time Farms Total	Part-time Farms Mainly Farming	Part-time Farms Mainly Other Jobs
(a) Number in thousands					
1955	6,043	2,106	3,937	2,274	1,663
1960	6,057	2,078	3,978	2,036	1,942
1965	5,665	1,219	4,446	2,081	2,365
1970	5,342	831	4,510	1,802	2,709
1971	5,261	798	4,463	1,567	2,896
1972	5,170	743	4,427	1,404	3,023
(b) Percentage					
1955	100.0	34.8	65.2	37.7	27.5
1960	100.0	34.3	65.7	33.7	32.0
1965	100.0	21.5	78.5	36.7	41.8
1970	100.0	15.6	84.4	33.7	50.7
1971	100.0	15.2	84.8	29.8	55.0
1972	100.0	14.4	85.6	27.1	58.5

Table 6

NUMBER OF FULL-AND PART-TIME FARM-HOUSEHOLDS

1,000/(%)

Year	Total No. of Farm-Households	No. of Full-time Farm-Households	No. of Total Part-time Farm-Households	of which Type I	of which Type II
1950	6,176	3,086	3,090	1,753	1,337
	(100)	(50.0)	(50.0)	(28.4)	(21.6)
1955	6,043	2,106	3,937	2,274	1,663
	(100)	(34.9)	(65.1)	(37.6)	(27.5)
1960	6,057	2,078	3,979	2,036	1,942
	(100)	(34.3)	(65.7)	(33.6)	(32.1)
1965	5,665	1,219	4,446	2,081	2,365
	(100)	(21.5)	(78.5)	(36.7)	(41.8)

Table 7

WORKING POPULATION IN AGRICULTURE BY AGE AND SEX

Age Group	1960	1965	1970	In 1970	
				Male	Female
16-19	752	406	570	318	252
	(5.4)	(3.7)	(5.6)	(8.0)	(4.0)
20.29	2,787	1,398	1,000	345	655
	(20.0)	(12.7)	(9.8)	(8.7)	(10.4)
30.39	2,996	2,470	1,795	573	1,222
	(21.5)	(22.4)	(17.5)	(14.4)	(19.5)
40.49	2,466	2,194	2,198	746	1,451
	(17.7)	(19.9)	(21.4)	(18.8)	(23.1)
50.59	2,424	2,099	1,920	675	1,245
	(17.4)	(19.0)	(18.7)	(17.0)	(19.8)
60 and over	2,220	2,471	2,770	1,316	1,454
	(18.0)	(22.4)	(27.0)	(33.1)	(23.2)
Total	13,933	11,039	10,252	3,973	6,279
	(100)	(100)	(100)	(100)	(100)

Source: The Interim Report of the Census of Agriculture in 1960, 1965 and 1970 (Ministry of Agriculture and Forestry, Japan).

Table 8

MAJOR EQUIPMENT OF FARMS

(1,000)

Year	Power Threshers	Power Tillers	Power Sprayers	Combines
1945	352	8	6	-
1951	972	16	20	-
1955	2,038	89	87	-
1960	2,476	746	232	-
1965	3,048	2,509	494	-
1970	-	3,448	958	45
1972	-	3,529	1,162	117

Source: Farm Machinery Yearbook, 1967, and data from the and Survey Division, Ministry of Agricult and Forestry, Japan.