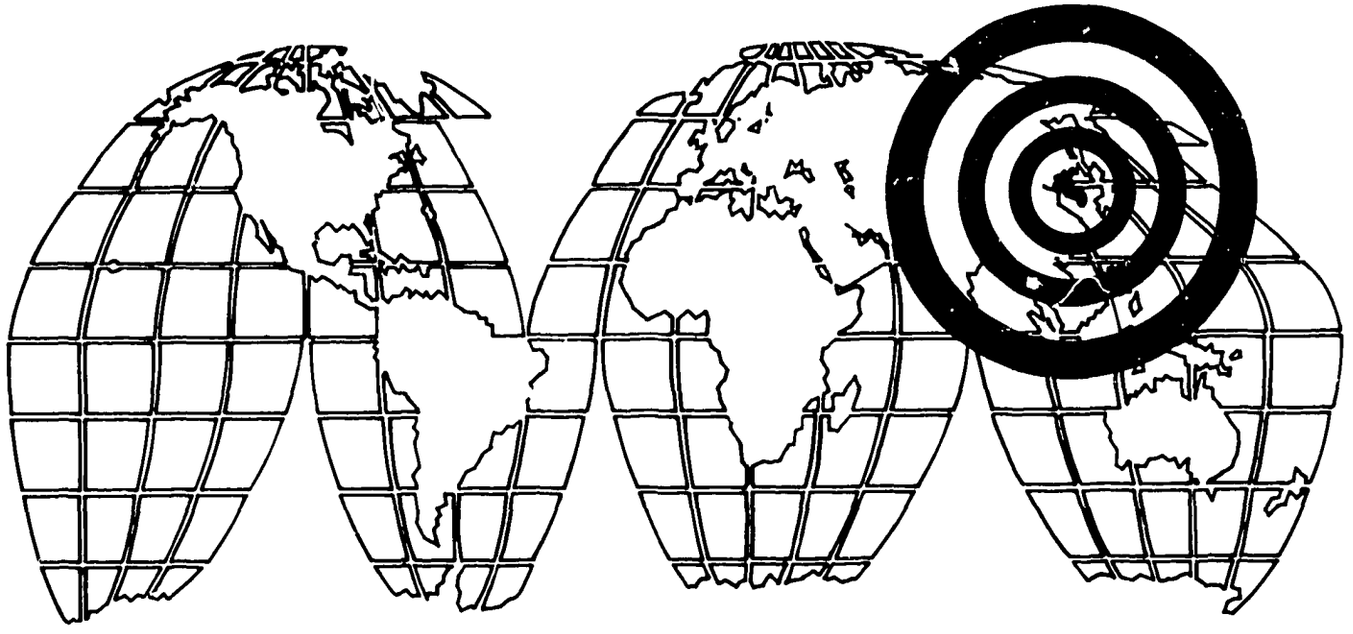
A.I.D. Project Impact Evaluation No. 27

Korean Agricultural Research: The Integration of Research and Extension



January 1982

U.S. Agency for International Development (AID)

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KOREAN AGRICULTURAL RESEARCH

THE INTEGRATION OF RESEARCH AND EXTENSION

PROJECT IMPACT EVALUATION NO. 27

by

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U.S. Agency for International Development

January 1982

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SUMMARY

A profound change occurred in the early 1970s that transformed the Korean Government's rural development strategy. From one emphasizing industrial exports, the costs of which were largely borne by the Korean farmers, the strategy evolved into one devoted to improving rural Korean life. The genesis of this approach was both political and economic: a hardening of PL 480 terms and the results of the 1971 election that amply demonstrated that government support had eroded in the countryside. The Korean government responded with a rice pricing policy advantageous to the farmers, the strengthening of the extension service, the formation of the Sae-maul ("New Village") Movement, and a rapid increase in rural infrastructure.

The origins of AID's support to agricultural research are found in the Korean Agricultural Sector Survey (1972) and succeeding documents that advocated a strengthening of research as a primary need. The project, proposed in 1973 and implemented in 1974, provided $5 million for a tripartite program to strengthen the capacity of the Office of Rural Development of the Ministry of Agriculture and Fisheries. It included training of Korean researchers overseas, equipment (including a computer and library materials), and both resident and short-term expatriate advisory services. At the close of the project in 1980, 21 Ph.D. students and 17 M.S. students were trained overseas, while an additional 94 received short-term training and 106 participated in observation tours.

Although there were problems with the English language competence of prospective students, the training aspects of the project were universally regarded as the most successful part of the program. Of notable, but secondary, importance was the provision of equipment and supplies, especially the computer and the library materials. Lagging far behind was the value of resident expatriate assistance, which was of marginal use to the project but was more significant in terms of relieving the AID Mission from continuous monitoring of the project than in providing help to the Koreans. Of greater importance was shorter-term foreign technical advice.

The inchoate goal, from a Korean perspective, was probably rice self-sufficiency--a strategic, political, and economic objective. The project purposes, however, were specified in considerable detail outlining exact yield increases on agricultural experimental stations over a ten-year period in the areas of rice, barley, wheat, and soybeans as well as generalized improvement in potato production and in the cropping systems. Specific increases were also proposed for farm fields for the same time. Since the decade of crop improvement is to end in 1984, this evaluation must be somewhat circumscribed.

The project paper suffered from spurious specificity regarding experimental station crop increases. Before the project began, experimental yields were higher than those indicated in the paper, often by considerable amounts. The research breakthroughs that the project

anticipated were generally made prior to the project. Farmer yields may well reach their objectives by 1984, but the AID project was only a beneficial increment to Korean agricultural research. It supplemented an existing, competent system, but offered little that was innovative.

The concentration on rice led to a lack of emphasis on other crops, an inattention caused by national concerns as well as social and economic factors the project ignored. Although there have been increases in crop yields, hectarage of the other crops has consistently been falling, even before the project began. Thus, national targets will not be met even if a relatively few farmers benefit. The choice of some of the crops covered by the project such as wheat, soybeans and potatoes seems questionable, as does the emphasis on increased fertilizer responsiveness.

Critical to a developmentally effective agricultural research program is the transference of experimental results to the farmers. Through a widespread extension service, a farmer training program that includes almost all families annually, demonstration plots, and the Sae-maul Movement, Korea has developed an authoritarian but effective means of disseminating research results.

Thus, beginning in 1972 the spread of the high-yielding varieties of rice was pushed with alacrity by the Korean bureaucracy in response to a national command structure. The effort was effective, making Korea self-sufficient in rice by 1975. Yet there were two inherent problems in this comprehensive effort: these varieties were sensitive to cold, and new races of the fungal disease called blast normally develop after a few years if large areas are planted to a single variety.

The crisis developed first in 1979 with a drop in production caused by blast followed by a disastrous 1980 crop due to cold temperatures. The rice crop fell by one-third, creating a crisis of confidence in the government and in the guidance service.

Ironically, the failures of 1979 and 1980 can be attributed to the strengths of the Korean guidance service. Thus its weakness is based on the omnipresent bureaucratic hierarchy that, in contrast to most developing societies, can transform research into production. In singleminded pursuit of its political goals, it neglected elemental precautions that might have avoided the problems of the last two years.

Agricultural research was an appropriate intervention for AID at the time. It assisted a well-established, agricultural research network, but did not materially transform it. It created no new institutions.

Agricultural research will continue in Korea but replication abroad will be difficult. Any successful adaptive agricultural research project will be dependent upon a positive pricing policy, an effective extension service, rural infrastructure, and continuous contact with international research centers, among other factors. Political will is required for its success, but too strong an emphasis on political objectives can undercut its effectiveness.

PREFACE

Although agricultural research has a long history in Korea, the recent introduction of the high-yielding varieties of rice and improved strains of other crops, combined with extensive attention to improved cultivation techniques, pervasive extension services, and better rural infrastructure have helped transform rural Korea within a decade. By any standard, this was a remarkable achievement.

The agricultural research project, for which the United States Government provided $5 million, was but a modest contribution to Korea's agricultural research capacity, and thus even a more modest contribution to its rural development. As this report demonstrates, agricultural research was one critical element in the change of rural Korea, but not the only causal factor.

The Korean agricultural research project was chosen for an impact evaluation because it seemed to provide lessons relevant for other nations, and because it was a blend of technical assistance, training, and equipment. The impact evaluation team was composed of three AID staff assisted by a Korean rural specialist. During the course of about one month in Korea, the team travelled some 2,700 kilometers and visited all provinces in the nation. No sampling technique for a project nationwide in scope can be scientific within the format of a rapid rural appraisal. The team, however, made a conscious effort to visit remote regions and poorer villages to determine whether the research results were reaching relatively isolated farmers. These site visits were spontaneously selected. Appendices A and B provide notes on the methodology and the team's itinerary.

The team wishes to thank the officials of the Office of Rural Development, both in its headquarters in Suwon and in the provinces, for their assistance and the sharing of their voluminous data. Our thanks also go to the farmers and their wives who often took time from their transplanting to talk with us. The team would also like to thank the U.S. Embassy for making available a vehicle and driver and for other logistical support.

PROJECT DATA SHEET

Project Title: Korea-Agricultural Research Project

AID Project Number: DLC/P-2014

AID Loan Number: 489-H-088

Borrower: The Government of the Republic of Korea. The project was implemented by the Office of Rural Development of the Ministry of Agriculture and Fisheries.

Loan Amount: Total $5.0 million

Korean Contribution $3.124 million in won
Total Project Costs: $8.124 million

Terms: Forty years repayment from the date of the first disbursement, including a 10-year grace period. Interest rate of 2 percent per annum for 10 years after the first disbursement and at a rate of 3 percent per annum thereafter.

Terminal Date for Request for Reimbursement and for Disbursement:

July 28, 1980

Purpose: To assist in a program of multidisciplinary research directed toward varietal improvement of certain basic food and feed crops and of cropping systems.

Accomplishments: Training of 38 scholars to the Ph.D. or M.S. degree level, 94 short-term trainees and 106 participants for observation and conferences; purchase and installation of 946 pieces of equipment and the provision of 10 long-term experts and 73 consultants.

Evaluation: An interim evaluation was conducted in June 1978.

Audit: An audit was conducted in May 1980.

GLOSSARY

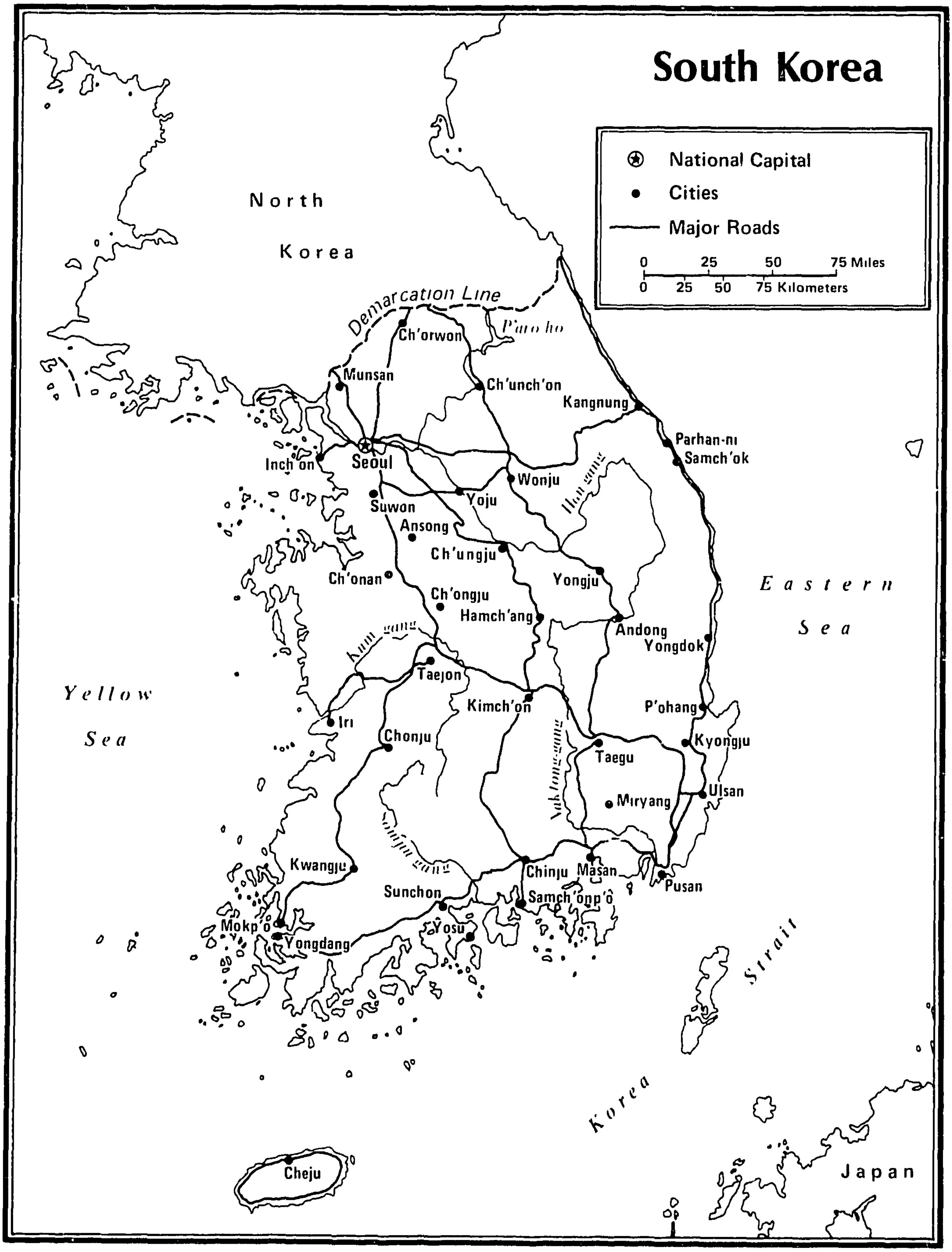
ADC	Agricultural Development Corporation, Ministry of Agriculture and Fisheries
AVRDC	Asian Vegetable Research and Development Center
chongbo	unit of measure, approximately equal to one hectare
CIMMYT	International Wheat and Maize Center, Mexico.
gama	a unit of volume, equal to 80 kg of milled rice or 54 kg of paddy.
gun	county: 140 throughout the country
gunsu	county chief, appointed by the Ministry of Home Affairs
hectare (ha)	2.45 acres
HPON	High Protein, High Lysine Observation Nursery
HYV	High-yielding varieties
IBWSN	International Bred Wheat Screening Nursery
INTSOY	International Soybean Institute
IRRI	International Rice Research Institute
IWSWSN	International Winter and Spring Wheat Screening Nursery
IWWPN	International Winter Wheat Performance Nursery
metric ton (MT)	2,205 pounds
MMT	million metric ton
myon	township, a part of a gun.
myonchang	township head; appointed on the authority of the governor.
NACF	National Agricultural Cooperative Federation
ORD	Office of Rural Development, Ministry of Agriculture and Fisheries

GLOSSARY (cont.)

paddy	unhusked rice; also, irrigated land on which rice is grown.
PORD	Provincial Office of Rural Development
pyong	unit of land measure; 36 sq. feet, 3,000 pyong equal one chongbo or hectare
R & E	research and extension
Sae-maul Movement	"New Village Movement," or "New Community Movement;" a government-controlled rural development activity.
sok	a unit of volume, equal to one gama

Exchange rates: In June 1981 - won 685 equalled U.S. $1.00

Note: Unless otherwise noted, all figures are for milled rice and pearled barley.


South Korea
National Capital
Cities
Major Roads
0 25 50 75 Miles
0 25 50 75 Kilometers
North Korea
Demarcation Line
Ch'orwon
Munsan
Ch'unch'on
Kangnung
Parhan-ni
Samch'ok
Inch'on
Seoul
Wonju
Suwon
Yoju
Ansong
Ch'ungju
Ch'onan
Yongju
Ch'ongju
Hamch'ang
Andong
Yongdok
Eastern Sea
Taejon
Yellow Sea
Kimch'on
P'ohang
Iri
Chonju
Kyongju
Taegu
Ulsan
Miryang
Kwangju
Chinju
Masan
Pusan
Sunchon
Samch'onp'o
Mokp'o
Yongdang
Yosu
Korea Strait
Cheju
Japan

I. PROJECT SETTING

The year 1980 was disastrous for Korean rice agriculture. An abnormally cold summer prevented the maturing of rice, the main staple grown ubiquitously on every available plot of even marginally irrigated land. The Korean economy went into shock as rural production and incomes suffered when rice production declined by one-third. Already beset with political turmoil after the assassination of President Park Chung-hee in 1979 and the Kwangju riots of May 1980, hit by a major slump in exports because of a worldwide recession, and suffering from heightened import requirements and inflation caused by oil price increases, there was a crisis of political legitimacy--for legitimacy for the past two decades in Korea was a product of continuous economic growth.

The economy as a whole declined in 1980. Real GNP was down by 5.7 percent, thus temporarily reversing the nation's spectacular advances that had pushed growth over 10 percent annually. Agriculture, however, was even more severely affected; rural income dropped by 24 percent. Much of the rural progress that had been a product of a deliberate change in national development strategy beginning in the early 1970s was in question. It was based on an incentive price support policy that provided Korean farmers with over two times the world market price for rice. Particularly adversely affected were the high-yielding rice varieties.

These rice varieties, known as Tongil ("unification"), were developed from a series of crosses between the indica varieties from Southeast Asia and the local and more traditional, but improved, japonica strains. From their introduction in the early 1970s and the release of the first variety to the farmers in 1972, they were known to be more susceptible to cold weather and temporarily more resistant to blast, a fungal disease. They promised, and delivered, substantially higher yields under greatly improved methods of cultivation, water control, increased fertilizer, pesticides, and herbicides.

As a result of the release of these new varieties and as a consequence of the vigorous encouragement by government of their cultivation, which in the early period of their expansion even included air freighting of seed from the Philippines, Korea became self-sufficient in rice in 1975. It was the first time since the Second World War that this long-sought objective had been reached. Rice self-sufficiency was an objective that was central to the Korean administration: it was strategic, for it furthered Korean autonomy and demonstrated to North Korea that South Korea was progressing; it was economic, for it saved almost $200 million annually in foreign exchange; and it was political, for it was dramatic evidence indicating that President Park, who had almost lost the 1971 election because of significant deterioration of his support in rural areas due to a

national policy of urban-based industrial exports and rural neglect, was rebuilding his rural base. Rice was a political hallmark of rural success.

Rice self-sufficiency was not a product of the new varieties alone. In place was an extensive irrigation system, an effective credit, procurement and pricing mechanism, improved rural transportation transforming local and regional markets into a national one, and a vigorous "guidance" system (extension service) that reached to the most remote areas. 1/ The story of the growth of rice production is one of both new seed strains generated by adaptive agricultural research coordinated with a guidance network and a farmer training program that reached almost every farm household and that markedly improved yields of even the traditional varieties of rice. How this change occurred is the subject of this report. The AID-supported agricultural research was designed to assist this growth, but the questions must be asked: how great was its contribution, and could a differently designed project or one operating in a less stringent political, and thus administrative, environment have prevented the failure of 1980?

II. THE PROJECT

The costs of the halting progress of Korean development in the 1950s and its acceleration in the 1960s were borne by the Korean farmer. For much of this period, the costs of production of both of the staples of the Korean diet, rice and barley, were above the government purchase prices. Korean agriculture was stifled by few incentives to produce beyond farmer needs. It could be characterized as a sophisticated but repressed sector that in some areas bordered on subsistence. Although infrastructure (such as irrigation) and adaptive research had begun under Japanese colonial rule, and even had a Korean guidance and credit system been in place, poor internal transportation and the disincentive of large amounts of PL 480 grain effectively retarded government interest in adjusting upward the rice prices. The potential political power of the urban consumer was greater than that of the rural population. In 1971, Korea was 82.5 percent and 91.8 percent self-sufficient in rice and barley respectively, and it only produced 10.7 percent of its wheat consumption. In 1971, rural household income was $1,150, less than $200 per capita.

The election of 1971, which dramatically demonstrated the erosion of government support in rural areas and a hardening of PL 480 terms,

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1/ See Appendix G, "Research and Extension: The Integration of Inquiry and Guidance," by David I. Steinberg; and Korea Irrigation, AID Project Impact Evaluation No. 12, 1980.

prompted a massive governmental effort to improve the rural-urban terms of trade. The Sae-maul (New Village) Movement was formed, and rice support prices increased. Rural infrastructure construction was hurried. Rural roads and national highways were built and paved, and irrigation expanded. 2/ Fertilizer consumption grew, rising from 308,494 metric tons (MT) in 1961 to 605,137 in 1971, and 886,206 MT in 1975. Mechanization increased. In 1961 there were 12 power tillers in Korea, but by 1971 there were 16,842, and in 1979, 239,909 were in operation.

It was in the context of this growing concern with the rural sector that AID began its support to agricultural research. The genesis of this project was the Korean Agricultural Sector Survey carried out by Michigan State University with AID support. As its highest priority, it recommended efforts to improve agricultural research in rice, barley, wheat, soybeans, and forages.

The study identified the problems facing Korea as a lack of concentration on key research priorities and a shortage of resources to meet these needs. It further characterized the national agricultural research system as relatively unfocused, poorly equipped, short of highly trained personnel, but relatively well-housed with sufficient land for research, well-balanced disciplinary skills, although suffering from a shortage of operating funds.

The study was followed by the publication in 1972 of "Investment Priorities in the Korean Agricultural Sector," also by Michigan State University. That study anticipated cumulative returns to agricultural research to reach 30 times an annual investment of $2 million by 1975, and 160 times its yearly costs by 1980. After a visit by an external specialist and negotiations with Korean authorities, an AID Intensive Review Request was cabled to Washington on July 13, 1973, outlining the project. A project paper proposing a $5 million loan was approved by AID's Development Loan Committee on December 5, 1973; authorized December 11 of the same year; and signed by the Korean Government on January 28, 1974. On February 21, Korean Presidential Ordinance #54 announced the agreement and authorized Korean funds ($3,125,000 in won) for the project. By September 8, 1974 the first expatriate Co-Director was appointed, and on November 14 a service contract was signed with the International Institute for Education covering support for the project and the funding of participants.

The objectives of the project focused on the five areas: rice, barley/wheat, soybeans. white potatoes, and cropping systems. Improvement in research was predicated on forming multidisciplinary teams that were to establish research priorities within each area of concern.

2/ For an extensive discussion of this phenomenon see Korea Irrigation, AID Project Impact Evaluation Report No. 12, 1980, especially Appendix F, "Korean Agricultural Pricing Policies" and Appendix G, "Change, Local Government, and Rural Participation in Korean Rural Development."

Very specific yield targets were established both for the experimental stations and the farms (See Table 1). Crop improvement goals were also stated in the project paper (See Appendices C & D).

The project was conceived as having three components: foreign advisory services, both long and short-term; short and long-term training, the latter including 19 M.S. and 13 Ph.D. trainees; and equipment, covering field, experimental, and library commodities including books and journals. About 46 percent of the $5.0 million loan was for technical assistance, 24 percent for training, and 30 percent for commodities.

The terminal date of disbursement was set for July 28, 1979, but was later extended to September 30, 1981. Seven trainees remained abroad after 1980 to complete their training.

Table I. Project Paper Baseline Data and Targets

Crop	Putative Yields 1972-73 Experiment Stations	Target Yields 1983 Experiment Stations	Putative Yields 1972-73 Farms	Target Yields 1983 Farms
Rice	4.79	6.0	3.25	4.5
Barley	2.79	3.6	2.04	3.5
Wheat	4.30	5.2	2.24	4.0
Soybeans	1.98	3.2	0.8	1.3
Potatoes	No yield targets specified.			

III. PROJECTS IMPACTS: FINDINGS AND ANALYSIS

A. The Project's Role in the Agricultural Research System

Korea has a long history of agricultural research. The earliest official agricultural demonstration station was established in 1906, and experimental improvements in rice were conducted throughout the Japanese colonial period. Critical to the development of an agricultural research system was the 1962 reorganization that established the Office of Rural Development (ORD) with AID support, and began the process of organizing branch offices in selected guns (counties). By 1975, ORD offices were in every county throughout the country. The guidance system thus had spread widely in rural areas before project implementation was initiated and was completed shortly after it was approved. The research establishment was effective, but limited in the scope of its activities, before the project began. The project did not alter or institutionally reform the existing structure, for it was already well organized.

The project, therefore, supplemented an established and effective research program. It provided, however, an impetus to an expanded program within a national policy framework that fostered the effective use of research. This project did not establish collaborative links between ORD and the Korean academic community; these had been inaugurated by presidential decree in 1971. The project did, however, begin the concept of multidisciplinary teams to work on the five priority areas of research. This was in part an innovation, although the teams have worked more to mobilize talent as needed rather than as a continuous, integrated multidisciplinary effort. The concept was not without problems, however, since in a hierarchical society such as Korea, rank and status control discussion and dissent, and position often seems more important than substance. The multidisciplinary teams became operational during the life of the project and although these early problems are now less acute, it is doubtful at this writing that the teams are as cohesive as they were at the time they were established.

There was universal agreement among Korean academicians and administrators and on the AID evaluation team that the most successful aspect of the project was the training component. Although Korea had a corps of skilled manpower, it was spread very thinly, and the project significantly enhanced the capacity of ORD to engage in research.

After approval of the project, the training component was expanded, and resident expatriate assistance truncated. In the end, 21 Ph.D. and 17 M.S. students were trained under the project, and an additional 94 received short-term training; a total of 106 participated in observation tours and conferences.

There were two major problems connected with the training and subsequent employment of trainees. The first was the adequacy of English language skills prior to overseas training. In spite of later Peace Corps assistance, the level of English caused delays in sending out trainees, thus requiring an extension of the terminal date of disbursement of the loan. ORD had responsibility for placing trainees at U.S. institutions, which created minor delays, while the International Institute of Education administered the participants' allowances.

Of more significance for the future are the changes in wage differentials between the ORD and the academic community. In the 1960s, academicians' salaries were low relative to those of civil servants. Partly in an effort to prevent student demonstrations, academic salaries were gradually raised and supplemented with research bonuses and other emoluments so that there is a highly relevant difference today between academic and ORD salaries. To retain trainees, a three-year commitment to ORD was required for each long-term participant, and to date one trainee has refunded the costs of the training to take an academic position. As the three-year commitment comes to an end, pressures to leave are building up and there may be an exodus of skilled manpower from ORD to the universities. Although those who leave may not be completely lost to ORD,

as joint appointments are possible, the enhanced social prestige of academicians--an important factor in Korea--as well as the hard work and overtime requirements of ORD together with the salary issue may cause problems for the future. The ORD hopes to obtain parastatal status like the Korea Development Institute, thus freeing them from civil service salary levels. If the salary issue is resolved and the staff retained, the team believes the training aspect of the program has overall been successful.

Of secondary importance in the view of both the team and the Koreans at ORD was the provision of commodities, including equipment, a computer, and library materials. All AID-provided commodities seem well housed and used. There have been major additions to the equipment, much of it of Japanese origin. At the time when the loan was given, there was much less equipment and there is agreement that it was an important component of the project. The Korean government has allocated funds for spare parts and replacement equipment and supplies.

The computer deserves special comment for it is the sole instrument of its type in ORD and was both a major expense ($247,000) and innovation. It is essential to sophisticated research and has been intensively used. The library facilities, especially the foreign journals, are a heavy capital expense relative to their use, since only the more senior researchers in Suwon can take advantage of their availability because of the limited English and Japanese language competence of the more junior staff. Journals were, however, a necessary component of the project. ORD should make more effort to acquaint the staff of the experimental stations outside Suwon with their contents, as there is now no system for doing so.

Lagging far behind in priority terms, in the unanimous opinions of the team and of the Koreans, was the value of expatriate technical assistance. Shorter-term, nonresident advisors were deemed an overall advantage, but long-term resident expatriates proved to be less useful. Some could not work in the fields of their specialization as priorities shifted; others could accomplish little in a two-year tour. None were well acquainted with Korea on their arrival. Language proved a problem at Korean meeings that the Americans attended. The inescapable conclusion is that although the resident foreigners probably provided some degree of generalized professional, administrative, and even emotional support to ORD's Bureau of Research, it was more necessary to the AID Mission than to the Koreans for it placed the continuous burden of monitoring on the expatriate staff, not on the Mission. The AID Mission did, however, supervise the project, and staff attended the important joint Korean-American steering committee meetings.

Overall, the project did increase the capacity of the Korean Government to conduct agricultural research by providing better trained staff and more equipment. It built no new institutions and provided only marginal innovations, but neither was considered an aspect of project purposes or goals. The project did enhance Korea's institutional capacity.

B. Experimental and Farm Results

The inchoate goal of the project from a Korean vantage point seems to have been rice self-sufficiency. The project purpose however, was confined to increasing the yields of specified crops both on the experimental stations and on farmers' fields and to improving the cropping system. These objectives were stated over a ten-year period--a period not due to end until 1984.3/ Yet there are now some definitive conclusions that can be drawn from the existing results.

The targets set for the project were often spurious and simplistic, as were the baseline data. Yield increases on experimental plots and on the farms were based on general averages, but these average yields from experiment station plots were practically meaningless. For each crop (rice and barley, for example) many, sometimes dozens, of selections, strains, or varieties were tested for yield performance. Thus, experiment station average yields did not do justice to the complexity of the problem. On the other hand, Korea's agricultural statistics, those garnered from the farmers, were complete and detailed These reliable data could be used to make valid judgments on farm productivity targets used in the project paper.

The project also took no note of pricing, labor and other requirements, other crops such as vegetables, or social attitudes toward consumption that affected production and productivity. More important, there were no project targets for national production nor for self-sufficiency in food, both of which were important aspects of national policy that affected what varieties would be stressed by the extension service.

Further, by the time the project started significant increases in yields had already been achieved. What was more important than yield breakthroughs (which did not occur although they were specifically called for in the project paper) was the need for continuous adaptive research on other issues, such as resistance to cold, lodging, diseases, and insects, as well as for a shortening of the growing period which would allow for more doublecropping throughout a larger area of the country. These other issues were mentioned, but more attention was paid to production increases with its obvious political impact.

Rice production was to climb from 4.79 to 6.0 metric tons per hectare (MT/ha) on experimental stations and from 3.25 to 4.5 MT/ha on farms from 1973 to 1983. Yet experimental station results of the new strains of rice (Tongil indica-japonica) already were 5.06 MT in 1970, three years before the project started.4/ On a national average, the new

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3/ The Project Paper was prepared in 1973, so the decade was supposed to end in 1983. Since the project began in 1974, the ten-year period should terminate in 1984.

4/ Office of Rural Development, The Effectiveness of Tongil Rice Diffusion in Korea, Suwon: 1975, p. 9.

varieties yields were 5.03 MT in 1975 (before the project could have had any impact), 5.53 MT in 1977 and 4.86 MT in 1978. At the Yeongnam Experimental Station, yields were 3.90 for the traditional varieties in 1968 and 4.68 in 1973. The high yielding varieties at the same station were were 4.69 MT in 1974 and 5.08 MT in 1975. At the Honam Station in 1980, Tongil yields were 5.43 and other new varieties 4.39 MT/ha while japonica production was 4.74 MT.

Over the same ten-year period, barley experimental yields were to rise from 2.79 to 3.6 MT/ha and farm yields from 2.04 to 3.5 MT/ha. Barley production, however, at the Yeongnam Station was already 3.3 MT in 1972 and 3.5 MT in 1979 and 1980. The station's goal is 4.0 MT in 1981. The Honam Experimental Station reported yields for 1979 and 1980 between 3.15 and 3.95 MT/ha.

Wheat yields were to rise from 4.30 to 5.2 MT/ha on experimental farms and farm yields from 2.24 to 4.0 MT. At the Yeongnam Station crop yields before the project were again higher. They were 4.8 MT in 1971 and 4.5 in both 1979 and 1980. Their goal for 1981 is 5.5 MT.

Soybean increases on experimental plots were to increase from 1.98 MT to 3.2 MT/ha over ten years; farm production was to grow from 0.8 to 1.3 MT over the same period. At Miryang, soybean production was already 2.4 MT in 1974 (before the project began), and 2.3 MT in 1979 and 1980. Their target for 1981 is 3.5 MT/ha.

Overall, for all crops for which specific targets were set, experimental crop yields were well above the project baseline yields before the project began or prior to the time the project could have had any effect. Staff at Miryang indicated that yields on all crops have essentially remained relatively constant, having achieved heightened production by the early 1970s before the project. Concentration after that date was placed on reducing the factor of risk including an earlier maturity date and more resistance to disease and lodging.

If the project were based on too low a data base for experimental stations, what has happened to farmers' yields during this period and what is the prognosis for attaining target levels of production? The question is critical, but the answers are complex, for there were climatic and other conditions that intervened.

The project erred by failing to take into account other elements that have affected total yields. Critical factors were the high support price for rice that increased farm income appreciably and the growing demand for winter vegetables that often proved more lucrative than rice. Important as well were the lower price support for barley relative to inflation, the government's reluctance to purchase more of it, a shortage of labor that has become more acute in recent years, and social factors that make consumption of barley and potatoes less desirable than rice if farm families have higher income.5/ One farmer said, "Why should we eat potatoes when we can afford to eat rice?"

5/ See Appendix E, "Profitability, Costs and Revenue of Five Crops" by Kwan S. Kim.

Over the past decade there has been a highly significant drop in hectarage under cultivation of the crops aforementioned. The area planted in barley declined from 730,000 ha in 1970 to 473,000 in 1979; area in wheat from 97,000 to 13,000 ha over the same period; the area in soybeans from 295,000 to 207,000 ha; and the area in potatoes from 54,111 to 34,000 ha. Thus, even with increases in yields per hectare, aggregate production, and consequently national objectives, are not being met. For example:

-- Barley production in the decade beginning in 1970 basically remained constant [1,591 million metric tons (MMT) in 1970, 1,508 MMT in 1979], although per hectare yields rose from 2.18 to 3.19 MT.

-- Wheat production dropped from 219,000 to 42,000 MT over the same decade, while yields increased one-third (from 2.26 to 3.21 MT/ha).

-- Soybean production rose slightly from 232,000 to 257,000 MT and yields rose from .79 to 1.3 MT/ha.

-- Potato production dropped from 605,000 to 356,000 MT but yields also dropped from 11.31 to 10.58 MT/ha between 1970 and 1979.

With good weather and a continuing research program, it is possible that the targets may be obtained on all crops ten years after the initiation of the project, if government policy were to emphasize all crops. This seems unlikely, however, in the case of wheat, potatoes, and soybeans. Even if per hectare targets are reached, it is unlikely that any aggregate increases can be expected. Thus, individual farmers may well benefit but the nation as a whole may find its goals unfulfilled.

Rice represents a special case. The modern technological package on which Tongil depends and the sophisticated management required in cultivation has had a salutary effect on the traditional varieties as well as the higher-yielding ones. Thus Tongil production per hectare increased from 3.86 MT in 1972 to 4.63 in 1979 but the traditional varieties also rose from 3.32 to 4.37 over the same period. Given the private market premium for the traditional varieties and their greater resistance to cold and blast now, it may be as economic to grow the improved japonica as the newer Tongil varieties.6/

Other questions must be asked of the project design, the most important of which is whether the choice of subjects for research was the most appropriate. Rice obviously was critical both from a national and farmer viewpoint. Barley seemed necessary even though trends indicated that although it was a government priority, it was unlikely to remain one of the farmers'. Wheat, at any time given land use in Korea, was highly questionable. Soybeans were of less importance and potatoes were unimportant in terms of national needs. Researchers at ORD indicate that

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6/ See Appendix E, "Profitability, Costs and Revenue of Five Crops" by Kwan S. Kim and Appendix C, "The Korean Experience in Increased Rice Production" by Robert I. Jackson. The figures are taken from Table C-2.

livestock mechanization, agricultural economics, and horticultural crops have precedence in research priorities. The exclusion of vegetables in production, nutritional, and equity terms was a shared error. The Asian Vegetable Research and Development Center (AVRDC) supported research on a very limited scale, both monetarily and as to the number of vegetable crops, during the life of the AID project. This, however, was no reason to exclude such an important field.

The goal of making grains more responsive to higher fertilizer usage is a curious one given the oil crisis of 1973, the increase in petroleum imports, and the higher prices of fertilizer. Thought should be given to increasing production with less fertilizer, rather than creating an ever-expanding demand for imported petroleum.

It has proven impossible to establish a clear and direct link between the research carried out under the project and improved yields. There was no breakthrough. No doubt the project assisted the research effort and indirectly contributed to improved strains and probably will continue to do so as the trainees return or become more effective. The overall judgment that must be made, however, at least at this time prior to the end of the decade of planned growth in 1984, is that the agricultural research project was a beneficial but not a critical component of the well-established Korean research system.

C. Guidance: The Link between Research and the Farm

The developmental success of agricultural research is dependent upon the effectiveness of the spread of appropriate research results to the farmer. The Korean example links the research system both at the center and the periphery to an ubiquitous extension service known in Korean as a guidance system. 7/

Both research and guidance fall within the purview of the Director General of the Office of Rural Development. Thus, there is coordination at the administrative center at the top of the bureaucratic structure. This coordination also extends to the rural areas. Each province and gun (county) has a branch office of rural development and guidance workers are located in the lowest administrative unit, the myon, which forms a subdivision of a county. In 1981, there are a total of 7,980 guidance workers in Korea, of whom 7,648 are deployed at the gun and myon levels, 226 at the provincial level, and only 106 at headquarters.

Each guidance officer (the vast majority is male) is responsible for monitoring the production and cultivation techniques of from 6 to 12 villages depending on the terrain and population. He is in constant contact with the villagers, sometimes, according to a few farmers, too often. In some areas during critical periods such as transplanting or during emergencies such as drought, his visits may be daily, advising

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7/ For a more detailed discussion, see Appendix G, "Research and Extension: The Integration of Inquiry and Guidance," by David I. Steinberg.

farmers and reporting to the government on conditions. Even in a most remote, mountainous village inhabited by former swidden (slash and burn) farmers, the guidance worker visited the area once a month. It is probably safe to say that only isolated farmhouses escape their attention.

These workers are graduates of agricultural high schools where, through joint appointments, provincial office of rural development staff and teachers have close communication and the curriculum is geared to the practical needs of the rural areas. These men are overworked, visiting farmers seven days a week without any respite during the growing season. There is an attrition rate of 2 percent because of relatively low pay ($176 per month starting salary) and hard work, but this is remarkably low considering the demands the state places on them.

The guidance system is supplemented by an effective and equally widespread training program, carried out annually during the winter months. It first trains the trainers who then train the farmers. No farm family remains untouched by the system. Training includes instruction in improved cultivation techniques, crop management and human nutritional programs. The effort is coordinated with the Sae-maul Movement, the administrative organization of which reaches to the gun but which is also active in virtually every village through village leaders.

Guidance and training are further augmented by a series of demonstration plots with emphasis placed on rice. There are two plots for rice in every village that graphically illustrate to the farmer the expected results from growing various varieties of rice with improved techniques. The farmers have been quick to make the transition to the new varieties once they realize their potential benefits. For example, in North Kyongsang Province planting of the Tongil varieties rose from 16.2 percent of hectarage in 1970 (for seed) to 69.6 percent in 1978. Due to blast disease in 1979, the percentage dropped to 62.4 percent in 1979 and to 48.4 percent in 1980. Because of the disastrous harvest due to cold weather that year, the farmers in 1981 will plant perhaps two-thirds of their crop with traditional varieties which are more resistant to cold and now blast as well. This illustrates that although the guidance officer may cajole and persuade, he cannot dictate.

It is rare in any nation to see such a comprehensive and complete system that has the institutional capacity to transform research into production. Without it, an agricultural research program could not be as effective so quickly. This transition from research to production was further assisted by the growth of a rural road network that allowed the guidance worker easy access to the villages and enabled the farmers to have wider exposure to the outside world and to become a part of a national food market.

If research was stressed and guidance spread the research results, then what happened on the farm? Aggregate data are not sufficient to explain the condition of the individual farmer whose unique situation is described below.

D. The Korean Farm

Effective land reforms after the Japanese occupation and in the early period of the Korean Republic were a salient factor in improving rural equity in Korea. Korean farmer households, decreasing as a percentage of the total population from 51.6 percent in 1968 to 28.9 percent in 1979, may not legally own more than three hectares of farm land (excluding upland orchards). Some 29.8 percent of farm families cultivate land under 0.5 ha, and 35.3 percent between one-half and one hectare, 25.7 percent between one and two hectares; and only 5.4 percent over two hectares. The consequences of relatively equitable land distribution are that agricultural research and rural development programs, if they reach the farm as they do in Korea, are important factors in rural equity.

The growth of electrification of rural areas greatly contributed both to improved production and increases in the standard of living. Except perhaps for small, isolated islands and a few scattered farmhouses, farm families have access to electricity (some 83 percent have television sets). Even in villages that were traditionally composed of swidden farmers, some could afford the 3,000 won monthly electric charges.

The pervasive use of plastic to retain moisture and retard weeds on upland crops such as peppers, to protect against cold on rice seedlings, and to grow winter vegetables in the extensive plastic greenhouses have destroyed the traditional aesthetic scene of the Korean landscape (creating a problem for those who paint in the traditional oriental style), but without question it has improved farm income and helped transform the rural economy.

The rural economic structure, however, is dependent on rice. It provides more than half of the farm household income. Although the area of irrigated paddy has generally remained constant, the area devoted to the higher yielding varieties of Tongil has risen nationally from 15.9 percent of the rice area in 1972 to a high of 76.2 percent in 1978. With this increase came a steady rise in production per hectare from 3.86 MT to a high of 5.53 MT in 1977

An increasing national market orientation by the farmer coupled with an intensive campaign by guidance workers prompted this shift. It was accompanied by improvements in cultivation techniques and technological innovations that also spurred the increased yields of the traditional varieties of rice. This remarkable shift was predicated on two factors beyond the farmers' control but at least in part within the purview of agricultural research: the Tongil varieties in their earlier years were resistant to blast disease and the normally warm weather prevented cold from undercutting production increases.

It is common that new varieties of rice are resistant to blast for a number of years, but it is equally apparent that new races of blast develop, especially when vast contiguous areas are planted to the same strain. This occurred in 1979, causing a drop both in

aggregate production of Tongil from 4,516/MMT in 1978 to 3,449/MMT in 1979 and with a per hectare production drop from 4.86 to 4.63 over the same time. The extreme cold of 1980 devastated the Tongil crop cutting production and yields by one-third, lowering farm income, and creating a crisis of credibility between the farmer and the guidance worker, as well as the government, which had advocated Tongil production. Thus in 1981, although figures are not yet firm, the proportion of traditional varieties of rice cultivated are likely to be about two-thirds to only one-third of Tongil. Because cultivation techniques have improved, traditional varietal yields are expected to be high.

Increasing farm income from rice has led to a decrease in other crops included in this project and an overall decline in the land utilization ratio--the land double-cropped. In 1970, it was 1.42, but in 1979 it was 1.30, indicating that farmers regard winter crops such as barley and wheat as uneconomic and that they would prefer, acting economically, to put a much smaller amount of land under winter cultivation in vegetables. "We only grow barley," as many farmers remarked, "because there is nothing else to do in winter." This lack of enthusiasm for barley, in spite of government policy pronouncements, is only balanced by the special production of two-row barley in the South under contract with brewing companies that use it for malt.

Increases in use of pesticides and herbicides, which annually now cost the farmer more than fertilizer, are reflective of the shortage of labor. Whatever their potential deleterious environmental effects, they contribute to a national short-term economic goal. Fertilizer use, however, declined considerably in 1980 (to 828,000 MT from a high of 916,000 MT in 1978), again reflecting increased costs in relation to returns.

The economic consequences of the improved varieties are apparent. Until 1977, real income had risen--due to a strong government price support, shift in favor of Tongil, and the improved technological package and cultivation techniques that have spilled over not only to traditional rice but to other crops as well. Farm income rose reducing the economic disparity between the urban industrial class and the farmer. The profitability of rice was correlated with size of area cultivated, increased productivity, and the purchase price of rice. Increases of income, although partially attributed to vegetable crops, were mostly a product of Tongil cultivation.

Since 1977, however, the margin of profitability of Tongil has declined rapidly. Yield differentials between Tongil and the traditional varieties were more than 30 percent in 1977, but only 15 percent in 1980. The higher market price for the traditional strains, and their better resistance to cold and blast made them equally profitable, at least in some areas. Because of the poor performance in 1980, many farmers will opt for risk aversion and thus grow the older, more reliable, varieties.

Wheat and barley provide a different perspective. If the value of farmers' unpaid labor and equipment are included, the costs of production

are above the market value. Considerable barley is still grown because the winter opportunity costs for farm labor in some areas are minimal.

White potatoes and soybeans, however, were marginally profitable in 1977, but demand has declined as they compete on the same land with vegetable crops such as red peppers, onions, green onions, and cucumbers, for which prices are higher.

The effects of improved agricultural technology on the farm have been important. The Tongil strains require 20 to 30 percent more labor. Thus there is an increased demand for labor at a time when there have been massive population flows, especially of the most productive men and women, to urban areas. Labor costs have increased for both sexes, although disparities between them exist, and in some areas farm labor is the least attractive alternative. For example, in a fishing and farming village, male workers could earn daily only 6,000 won for farm work, but 10,000 won on the fishing boats.

In sum, there has been a substitution of mechanization for labor. The mechanization hierarchy change is first to tillers (there were 289,000 in Korea in 1980) since the most expensive farm cost involves cattle and male workers (female tiller operators are being trained by ORD, a welcome change). The second change is to the mechanical transplanter, a less cost-effective measure as transplanting mainly involves females at lower wages. The shortage of transplanting labor was apparent during the evaluation, as even the military was mobilized to assist in this process. The last change is to binders and small combines. As the farm population moves to urban areas, there will be an increasing demand for mechanization, which will become ever more important and will require increasing attention.

Agricultural research has contributed positively to rural equity. It has provided far greater benefits for the farmers than for the urban population, and thus, in a sense, represents a subsidy of the rural population by the nation as a whole. 8/ It has helped both smaller and larger landholders. The government's interest in rural equity, both a political and an economic need, is expressed in rice purchase price subsidies that have improved the rural-urban terms of trade. In some regions, due to poor yields of the high-yielding varieties, price support alone was not adequate to raise rural income. Thus in Kwangwon Province, for example, rural incomes rose in the past three years in current terms. In real terms, however, accounting for inflation, they declined. The government has helped the small holders (those with less than one-half hectare of paddy) by giving them priority in rice purchases, especially in 1980. In 1981, because of a current drought, the central government allocated $20 million to subsidize farmers. It also provided mobile water pumps and planted additional, later seed beds of rice, the seedlings from which will be distributed free to small farmers if their current ones cannot be transplanted because of water shortages. The government's concern with equity as an economic good and a political necessity seems real and continuing.

8/ See Appendix E, "Profitability, Costs and Revenue of Five Crops," by Kwan S. Kim.

E. Social Factors in Korean Agricultural Development

The milieu of the Korean farm village is dualistic. It is marked by increasing rationalization of farming patterns while retaining time-honored consumption preferences. There is new physical mobility, but traditional hierarchical family relationships are still evident. Increased female employment in urban areas has not yet broken sex discrimination in farm labor wages. Modern education is perceived to be a positive goal, but much of what is taught is Confucian in content. The farmer is cajoled by the government to grow certain crops and to donate labor for village projects; but he may remain autonomous if he feels his interests are threatened. Some of these changes have occurred as a result of increased agricultural production, a byproduct, in part, of agricultural research.

There has been a major migration to urban areas, for the mecca of the city is not only a call to the possibility of greater income; it is also an escape from the monotony of village life and the stratification of both the family and the village age and power structure. This results in an aging of farmers. Farm families' sizes have also declined from an average of 6.17 in 1975 to 5.03 persons in 1979. The farm population under thirteen has declined by 1.3 million during this period. More important for current labor needs on the farm, is the drop in younger and middle-age workers between 1975 and 1979, the 14 to 19 year cohort declined from 1.9 million to 1.6 million and the 20 to 49 year group, from 4.2 million to 3.5 million, approximately equally among both men and women. Labor has become increasingly scarce. Among new Sae-maul-constructed houses, one can occasionally see a more traditional one abandoned, now perhaps used for storage or animals.

The implications of these changes are important. Government figures indicate about a 7 percent rate of tenancy; yet informal estimates indicate that it may be higher and indeed is growing. Informal tenancy or working for wages on land owned by those who have migrated, at least temporarily, to urban areas has placed pressure on mechanization and the use of herbicides, thus reducing labor demands for weeding. Since Tongil rice requires more labor, and as barley for food is not profitable under present circumstances but especially if cash is required to hire labor, there is tension between the demands of national policy for higher yields of staple grains and the national need for industrialized export production.

The increased demand for education, financed mainly by the consumer as the government has invested less in education than in most developing countries, has also contributed to mobility. The better educated the boy or girl, the greater the likelihood of migration, for that is the goal. In a Confucian society, education is not only an inherent good; it is the social security of the family and the opportunity to escape to the unrestricted anonymity of urban life. Increased education also reduces family farm labor as children remain in school longer. So effective research resulting in higher incomes increased off-farm migration.

The Sae-maul Movement has had a strong command element to its diffusion to the villages. The distinction between taxation and voluntary donations to Sae-maul projects, such as a village road or water system, and between corvee labor and voluntary work is indistinct at best. Yet out of this mandated structure has come greater village cooperation and perhaps as well a sense of village pride that might continue to some degree should the Sae-maul Movement end.

Perhaps most evident and of lasting importance is a shift in attitudes. Korea has become a nation of farmers, no longer one of peasants. The rural economy has been transformed from one of subsistance to market-oriented production. Barter has given way to cash and micro-regional labor markets have been turned into one national labor force. These changes are generally positive, but they represent a more complex environment in which the Korean Government will have a continuing and an even more pervasive role that it will have tomanage with increasing care.

F. Macroeconomic Implications of Improved Technology

Although the impact of agricultural research can mostly be measured at the farm level, its economy-wide effect is generally indirect in nature, and more difficult to evaluate.

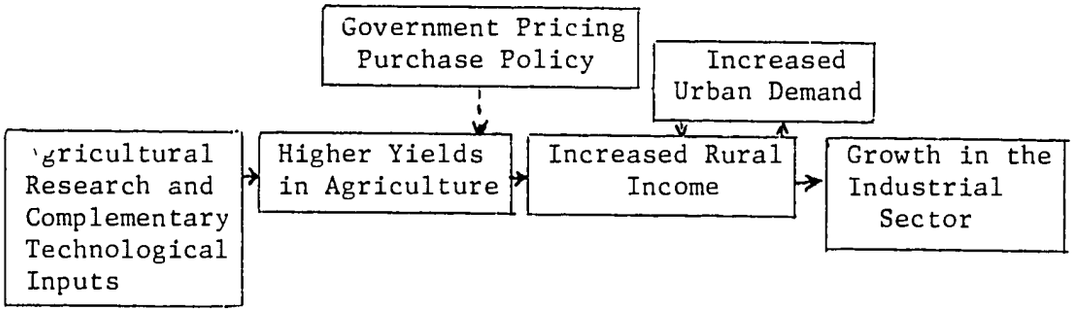
A readily measurable effect of the development of improved varieties of rice in Korea, excluding the past three successive years of extremely adverse weather, includes the government's saving of foreign exchange through the reduction in rice imports. Before 1975, the year Korea became self-sufficient in rice, imports of rice amounted to almost $200 million (in current dollars) per year.

The improved varietal development may also have important indirect effects on employment and growth in the economy. In Korea, the process leading to these indirect effects must be understood in conjunction with government pricing and purchase policy. Around the time of the adoption of the improved rice varieties in the early 1970s, the government instituted a package program of farm income support consisting of farm producer price and fertilizer subsidies, as well as of subsidies of other materials and supplies and procurement quotas for rice and barley. These new policies clearly differed from the agricultural policies in the 1950s and 1960s. In the 1960s, there was a deliberate attempt to keep grain purchase prices and wages low. The idea was to stimulate industrial expansion through enhanced profit margins. Thus, industrial expansion was brought about at the expense of the agricultural sector and at great cost to the farmers.

During the 1970s, the important role played by agricultural research, along with the development of agricultural infrastructure and the increased use of agricultural inputs, was to increase per hectare yields of rice. Together with new government pricing and purchase policies, it contributed to substantial increases in food production and farm income.

Growth in the rural sector can contribute to industrial output and employment growth. As real incomes in the farm sector increase, there will be greater demand for, and production of, industrial goods (farm machinery, farm inputs and consumer goods) and employment. This will lead to further expansion of industries supplying intermediate inputs required for the production in the initially expanded industries. This process can be seen to continue indefinitely in a diminishing and involuted sequence.

The magnitude of this indirect effect on output and employment growth depends on the structure of inter-industrial links within the economy. The Korean economy has a well-integrated inter-industrial structure. As such, the linkage effect on overall growth is substantial. These sequential impacts of new farm technology and government agricultural policy in a macroeconomic setting during the 1970s in Korea can be summarized in the diagram below:



Recently the government's agricultural income support policy has been increasingly subjected to criticism within the Korean Government and by donors. Apart from the argument of economic inefficiency resulting from the existing discrepancy between world market and farm support prices, there have been concerns about growing government deficits on account of the income support policy. According to the Economic Planning Board, in recent years the annual deficit amounted to as much as $150 million. The accumulated total deficit in the grain management account is expected to be $1.7 billion by the end of 1981, of which about 39 percent was caused by barley purchases.

Since these deficits have been drawn from the government general account in the form of increased currency supply, the effect of farm subsidy has obviously been inflationary. More importantly, during the last two successive years of economic stagnation the government was beginning to have increasing problems in financing the deficits, financing that runs counter to the government stabilization policy. Already there is some evidence that in recent years the terms of trade between farm products and purchased commodities have turned against the farmers.

An important lesson from the Korean case is that the Green Revolution could not have been successful without the vigorous enforcement of a government income support program. In the absence of the immediate prospects for a more favorable land-labor ratio or for the adoption of

highly mechanized farming methods, there is going to be the continued need for a government price support policy to attain self-sufficiency in rice and barley. Thus, this growing tension between attaining the goal of national self-sufficiency and that of economic efficiency will likely continue for many years.

G. Sustaining and Replicating Agricultural Research

Sustaining the agricultural research system in Korea will be subject to three basic stresses if economic conditions internally and abroad continue to cause concern to the Korean leadership. First, Government budgets are controlled by the Economic Planning Board (EPB) under the Deputy Prime Minister. A few economic rationalists in the EPB view rice and other grain production as uneconomic, for it is apparent Korea could import at least double the rice it produces for the same cost. More politically sophisticated views have prevailed and the rice support price, which politically would be difficult to lower, may keep rising, though more slowly than inflation, thus creating the illusion of support without its actuality. Agricultural research budgets, the second stress, as well as civil service research salaries (the third stress) may not rise fast enough to prevent some exodus to academia. There is little doubt, however, that in spite of these potential problems the agricultural research program is well-established and will continue. AID did not create it and AID did not dramatically affect it, but AID did assist its growth.

The agricultural research program does not need to be replicated in Korea. It already pervades the society. The question of replicability abroad poses different issues. Any agricultural research project should either be predicated upon, or have as components of the project, a variety of other elements without which it will either fail or prove to be an interesting, but essentially sterile, experiment. Most important is an effective extension service, but without pricing policies encouraging farmers, some rural infrastructure and communications, farm credit, and an overarching national policy encouraging agricultural research and its use, such a program is unlikely to succeed. It is fair to say that a similar project initiated in Korea in the mid-1950s probably would have failed. The Korean agricultural research model will be difficult to replicate in the Third World.

IV. CONCLUSIONS

The Office of Rural Development is the nexus of agricultural change in Korea. An efficient and pervasive governmental organization, it gains much of its effectiveness through its capacity to plan and execute agricultural research, its dissemination of experimental findings through a ubiquitous guidance (extension) system, training, cooperation with the Sae-maul Movement, and its links in both research and training to the academic community at all levels. Its organizational coordination of research and extension at the top of the bureaucracy gives it the capacity to guide rural change.

The agricultural research project ended in 1980. Its targets of increases in agricultural yields are to be achieved by 1984. Seven trainees sent abroad under the project are still overseas; those who have returned have done so only recently and cannot be expected to have made a major contribution at the time of this report. This evaluation is thus circumscribed by these factors.

Agricultural research was an appropriate intervention for AID. The project materially assisted in the development of the institutional infrastructure of the Office of Rural Development which was already well-established. It provided, however, only limited benefits. The most important benefits were: first, training; and secondly, equipment, including a computer and library materials. Resident expatriate technical assistance was of marginal utility, although short-term expert advice was more important. The project provided little that was innovative. The multidisciplinary research team concept was only a modest improvement on the existing structure. Assistance in fostering agricultural research could have resulted from a simple training and equipment project, with short-term advisory services as required.

If the project was more complex than necessary, the project paper was simplistic in its design and somewhat misleading in its data. In spite of a comparatively comprehensive data base, it underestimated existing yields in the experimental stations and the farms. It called for breakthroughs on research resulting in higher yields, but the major innovations occurred prior to the project. The reliance on average experimental yields was a convenient, but spurious, concept.

The areas of project concentration were rice, barley, wheat, soybeans, white potatoes, and cropping systems. Rice was a critical and appropriate concern, being paramount in national policy terms. In spite of inconsistencies in government grain support prices, barley was also important. Cropping systems were another critical area, but little was done in this field. Concentration on soybeans might have been useful, but here again little was accomplished. Potatoes and wheat research was minor, both because of extensive imports of wheat and the marginal value of potatoes in the Korean diet. Given already apparent trends in Korean migration, labor supply, and cropping patterns, attention should have focused on vegetable production and mechanization as well as rice, barley and cropping systems. Even in those priority areas, the contributions of this research project to Korean agricultural growth are necessarily blurred. The project was useful, indeed overall beneficial, but certainly not critical.

Trends showing a decline in barley, wheat, potato and soybean hectarage were apparent before the project began. Although project goals may be reached in some of these crops by 1984, statistically aggregate yields are likely to continue to drop. Thus, national goals will probably not be met although a relatively small number of individual farmers may benefit. Rice production may reach its targets by that date, but if this is accomplished it is likely that it will

be attained with only a modest contribution from the project itself. Project targets calling for heightened crop responsiveness to fertilizer consumption seem inappropriate in light of the petroleum crisis of 1973 and the increase in prices and Korean import requirements. Rather, increased yields with less fertilizer or attention to green manure crops might have been a more logical goal.

The responsiveness of the Office of Rural Development to national and thus political goals of heightened rice production was both its strength and weakness. It moved with alacrity against the advice of some researchers, to expand the Tongil varieties to satisfy bureaucratic requirements in the Korean hierarchical political culture. The choice of the name "Tongil" ("unification") is indicative of its political importance. It reacted too quickly, however, especially in light of the knowledge that cold weather can potentially damage Tongil rice and new races of blast fungus normally develop after a few years if a single strain is spread too extensively. It would have been more prudent to release Tongil gradually, supplementing it with other new and traditional varieties whose production also could be increased because of technological innovations and improved cultivation. This approach in the long-term might have been more successful, but the command system of the Korean Government demanding short-term gains and statistical manipulation to reach a political objective was given priority over longer-term research and production needs.

It might have been possible to avoid the decrease in rice production in 1979 due to blast and to mitigate the disastrous fall in rice yields in 1980 had the researchers been able to control dissemination and diversify production. Thus, the strengths of the Korean agricultural research and guidance system, its integration and political importance, proved also to be its elemental weakness.

V. LESSONS LEARNED

The Korean experience in rural development may be close to unique for there are few, if any, countries that are able to mobilize the variety and quality of resources that are required for the rural sector to prosper and agricultural research projects to succeed. Yet if Korea cannot be readily emulated and its agricultural research and rural development model exported, as are so many Korean manufactured products, there are generalizations that can be drawn from the Korean experience.

A. A successful agricultural research program requires a major national commitment.

This commitment not only takes the form of allocation of public resources for the support of the project; it also includes that indistinct quality that is sometimes referred to as political will. A successful adaptive research program requires an understanding that such research is a matter of high national policy. Thus it requires normally more than single-line support by a ministry of agriculture, but should involve other relevant cabinet level officials. The corollary to this lesson is:

B. Too great an emphasis on achievement of targets and too strong a command structure can lead to indiscriminate concentration on shorter term results.

This can, as in the Korean case, lead to discounting the long-term effects, such as pollution, too rapid dissemination of new varieties, or other major problems. Attempting indiscriminately to attain unrealistic targets can lead to inappropriate use of personnel and resources. It can result in manipulation of statistics. Thus the relationship between placing priority on agriculture and its adaptive research program must be carefully balanced with its longer range implications.

C. Agricultural pricing and procurement policies must provide sufficient motivation to the farmers for the incorporation of experimental research results onto farmers' fields.

A successful research and experimental program will not succeed if national pricing and procurement policies discourage farmers from reaping the benefits of higher yields or improved strains. The Korean experience has shown that even traditional farmers are often economically rational and are willing to adopt new technologies if they are assured of opportunities for increased incomes while minimizing risks.

D. An agricultural research program can only be effective if it is continuous.

Adaptive research requires a continuous testing, breeding and training program, without which short-term gains may dissolve. There are no single, one-shot, solutions to agricultural research, no matter how successful any single intervention may be.

E. There must be administrative integration of agricultural research and extension.

Separate administrative structures, even within the same ministry, will likely result in poor coordination between research and extension, thus obviating the usefulness of the project. The Korea case demonstrates the need for integration both at the top of the command structure and in rural areas.

F. Agricultural research, extension and agricultural education should be coordinated or integrated.

Too often agricultural education, which provides the basic training for extension staff and government personnel, has no formal administrative coordination at any level with the future employment of graduates. Responsibilities are often split between a ministry of agriculture and a ministry of education. In the Korea case, effective coordination exists between the Office of Rural Development at the center and the College of Agriculture, Seoul National University. Indeed it occurs at provincial agricultural high schools (training

future extension workers) and the provincial or gun agricultural extension and research workers, both in curriculum and staffing. It has proven effective.

G. The government must have the fiscal and administrative capacity to deliver services and commodities in support of the rural sector.

The Korean government spends some $20 million a year on extension service salaries alone, exclusive of administration and research. It also allocates considerable resources, through the National Agricultural Cooperative Federation and the Agricultural Development Corporation, for the delivery of commodities, subsidized credit, and the development of rural infrastructure. Agricultural research will not succeed unless there is a major national fiscal commitment coupled with administrative services and support.

H. PL 480 can be a deterrent to improved agricultural pricing policies and thus retard an effective agricultural research program.

Heavy emphasis on PL 480 commodity support, as in Korea in the 1950s and 1960s, can slow national reform of pricing and procurement policies, thus inhibiting an effective agricultural research effort. It also diminishes farmer incentives for increased production.

I. Training is a critical element of an agricultural research program.

In Korea, there was universal regard that training was the most critical element of the project. A training program built into an agricultural research project is a necessary component essential to the production of most agricultural research results. It must be complemented by a commitment to employ effectively those trained with adequate professional and personal incentives.

J. Adoption of the high-yielding varieties (HYV) leads to both positive and negative impacts on the economy.

The production of HYV is generally accompanied by increased costs of inputs and in some cases, soil impoverishment. The increases in production are generally associated with greater demands in soil nutrients. Resources must be directed not only toward improving yields but also to decreasing susceptibility to disease and insects. Potential adverse environmental conditions should also be anticipated and diminished.

K. Technical assistance should be carefully reviewed before it is included in the project.

Short-term, highly specialized technical assistance was regarded as useful in Korea, but long-term resident technical assistance proved less effective. In the Korean case, the institutional structure already

existed and long-term expatriates were not an essential component of the project. Careful consideration should be given to the need for such resident assistance on the basis of the institutional capacity of the local research system and the level of indigenous available trained personnel. Expatriate technicians should not automatically be included on agricultural research projects, no matter how much this may ease an internal AID administrative burden.

L. Continuing contacts are essential with the international agricultural research centers.

National adaptive research requires the interchange of plant materials and personnel with the international agricultural centers and foreign universities. Without such contacts, progress will be slowed.

M. The success of the Sino-centric societies in the field of agriculture and overall development should be studied to determine the possible causative effects of such a cultural milieu.

The remarkable achievements of Korea, Japan, Taiwan, and China in agriculture, their success in other economic areas (including Singapore and Hong Kong), the economic acumen of the overseas Chinese in Southeast Asia and the Chinese, Japanese and Korean communities in the United States may be a result of a particular cultural context that in some manner encourages economic development and farmer entrepreneurship. Although this conclusion may be regarded as speculative, the success of all of these cultures should prompt inquiry into the causes of such progress. If there are universalistic solutions to development problems, as donors predict, there may be culturally specific ones as well.

APPENDIX A

METHODOLOGY

The technique for the rapid rural appraisal of a nationally focused project must, by its nature, differ from one that is site-specific in scope. Given this approach, the problem of a statistically reliable sampling of a national project cannot be solved within the time and funds available. A number of site visits that differ by region, province, accessibility, climatic conditions, crop mix, and socioeconomic status of inhabitants, yield fascinating but anecdotal information; a valid sampling technique is not possible.

The problem is further complicated because sole focus on the project objectives raises more issues than it solves. The project suffered from spurious specificity: objectives of specific crop yields per hectare on experimental farms. This objective was inappropriate, because for all crops there is such diversity of testing of dozens or even hundreds of varieties that an "average" yield, however defined (and this was never done), is meaningless. In some cases (wheat and barley) the research objective on improved yields on these crops was not really paramount. It had basically been improved before the project began. What was more important was the breeding and testing of early maturing strains combined with resistance to lodging, wetness, and disease.

Whatever the project objectives in agricultural research, whether institution-building or yield improvement, the critical methodological, intellectual, and practical problems are in making the link between production in a research setting in the laboratory or on the experimental farm and that which is taking place in the farmers' fields. In Korea, the transformation of research results into practical farm production and increases in income is a product of the "guidance" system, the extension service. Both research and guidance are functions of the Office of Rural Development. Although the project only marginally mentioned average farm yields, the inescapable conclusion from early project information available in Washington was that this issue should be central to the evaluation, and therefore considerable time should be spent in determining the effectiveness of the guidance system.

The team thus determined that the evaluation should consist of gathering four levels of data recording the sequence from national policy to the farm level:

-- National information on crops, yields, incomes and expenditures together with relevant data on macroeconomic statistics related to agriculture; grain pricing and procurement policies, employment, imports and exports, etc.;

-- Experimental station crop and research results at the key stations throughout the country engaged in efforts related to the loan;

-- Provincial level agricultural data together with an analysis of the extension (guidance) service and its effectiveness in transforming experimental and demonstration results into farm yields; and,

-- Village and farm level data.

The team visited central research and experimental facilities at Suwon for several days collecting national data, interviewing trainees, and inspecting equipment purchased under the AID loan. Two short field trips were first arranged, and then a nationwide safari covering over 2,300 kilometers (km). A separate two-day trip was taken to review development on the island province of Cheju. The team covered some 2,700 km in total. All key crop experimental stations were visited: Chunchon, Kangwon Province for cold water tolerance rice research; The Honam Research Station, Iri, South Chungchon Province for rice, barley, and wheat; The Yeongnam Research Station, Miryang, South Kyongsang Province for the same crops; the Yeongduk Experimental Station in North Kyongsang Province for rice; and the Alpine Research Station in Chinbu, Kangwon Province (800 meters high) for cold air temperature tolerance for rice.

In addition, extensive discussions took place with Provincial Office of Rural Development staff in Kwangju, South Cholla Province; Taegu, North Kyongsang Province; Chunchon, Kangwon Province and Cheju City, Cheju Province. A visit to the gun (county) office in Heongsong, Kangwon Province, provided detailed information at that level. Officials were also interviewed at the myon (district) level, between the gun and village levels.

The selection of villages to be visited was arbitrary, but a reasonably representative sample was obtained based on province, cropping systems and employment, ostensible wealth and poverty, and remoteness. Only one village visit was suggested by gun officials, reportedly a wealthy village near Kyongju, North Kyongsang Province. A few villages were chosen because of their accessibility to main roads, but more were picked because they seemed poor and remote, often requiring tortuous travel along tracks far from the paved or major dirt roads.

The team was determined to find out whether the guidance service reached the most isolated villages. Toward this end, it spent one day in the remote mountain reaches of a sparsely inhabited region of Kangwon Province in an inaccessible area that barely allowed wheeled vehicular travel, on a track with precipitous drops of hundreds of feet without guard rails. Farmers who only fifteen years ago had been swidden cultivators were interviewed, some of whom now had television sets; even in this area the guidance officers visited once a month. In other villages they came almost too often--sometimes daily--according to some villagers.

In South Kyongsang Province, a remote valley was spontaneously selected by the team in an area that was obviously poor. Proceeding to a virtually inaccessible village isolated at the head of the valley, the last inhabitants in that area at the end of the dirt track, the team found two guidance workers, a man and a woman, working in the village. The latter was assisting in a day care

center for pre-school children. To all outward appearances this village was poor, but there was a higher level of income than might have been expected. Although rice production levels were low, due to the cultivation of persimmon and chestnut trees, incomes were quite good. Conversely, in some villages that gave the outward appearance of wealth based on improved and modernized Sae-maul housing, income did not seem as high. In all cases, the villages had some type of Sae-maul Movement activity along both productive and social lines (see Appendix G). The team talked with perhaps one hundred farmers and their wives, although greater attention was paid to the farmers as their wives were interviewed in more detail in the 1980 AID Impact Evaluation Report No. 12, Korea Irrigation (quod vide).

The team interviewed farmers who mainly grew rice, those who double-cropped with barley or other crops, some who grew tobacco or potatoes or soybeans, those small farmers who had less than one-half hectare of land and some who had up to three hectares, and a few villagers who both farmed and fished.

The team consisted of David I. Steinberg, AID team leader, with a long record of involvement in Korea studies; Dr. Robert Jackson, of the AID Development Support Bureau's Office of Agriculture and an agronomist; and Dr. Kwan S. Kim, Professor of Economics at Notre Dame University and an employee of AID. This group was ably assisted by Dr. Song Hae-kyun, an Agricultural Education Specialist of the College of Agriculture, Seoul National University, who is also a consultant to the Office of Rural Development. For short biographies see Appendix M, "Notes on the Authors."

Interviews were conducted in Korean, and extensive use was made of locally available Korean language sources (see Bibliography, Appendix K). No official of the guidance service accompanied the team nor did they suggest (with one exception noted above) site visits.

APPENDIX B

THE TEAM'S ITINERARY

May 21 evening: Arrival in Seoul.

May 22 morning: Visit to Embassy, arrange logistics for study.

afternoon: Courtesy call to the Office of Rural Development, Suwon, Kyonggi Province.

May 23 Field Visit to Kwangju gun, Kyonggi Province, to interview farmers.

May 24 Field Visit to Yangju gun, Kyonggi Province, to interview farmers.

May 25 Field Visit to Office of Rural Development, Suwon, Kyonggi Province.

May 26 " " " " " " " " " "

May 27 " " " " " " " " " "

May 28 Field Visit to Chunchon, Kangwon Province, Cold Water Tolerance Experimental Station; Provincial Office of Rural Development, Kangwon Province; Heong Song gun, Kangwon Province, to interview farmers.

May 29 Field Trip to Iri, North Cholla Province, Honam Crop Experimental Station, to interview farmers.

May 30 Provincial Office of Rural Development, Kwangju, South Cholla Province, and Mokpo, to interview farmers.

May 31 Chungmu, South Kyongsang Province, and Pusan, to interview farmers.

June 1 Miryang Crop Experimental Station, South Kyongsang Province, to interview farmers.

June 2 Taegu, North Kyongsang Province, Office of Rural Development, to Kyongju, North Kyongsang Province, to interview farmers.

June 3 Kyongju, North Kyongju, North Kyongsang Province, to interview farmers.

June 4 Yeongduk Crop Experimental Station, North Kyongsang Province, to interview farmers in mountainous areas.

June 5 Samchoek, Kangwon Province, to interview farmers in farming and fishing village.

June 6 Kangnung, and Chinbu Alpine Crop Experiment Station, Kangwon Province.

June 7 to 13 Seoul--Report Drafting

June 14 Cheju Province (by plane). Visit Provincial Office of Rural Development, and interview farmers.

June 15 Cheju Province, to interview farmers.

June 16 Debriefing, Office of Rural Development.

June 17 Debriefing, U.S. Embassy.

June 18 Departure from Korea.

APPENDIX C

THE KOREAN EXPERIENCE IN INCREASED RICE PRODUCTION

by

ROBERT I. JACKSON

Korea's shift from rice-importing to self-sufficiency in a relatively short time during the early 1970s is an exceptional achievement. It is unfortunate that cold weather and rice blast late in that decade have decreased rice production to a level where the country must again import rice. The story of this rapid increase in production is remarkable and could come about only in a country like Korea where the infrastructure is well established, and where there was a relatively vast amount of technical information available for increasing production. The recent decline in production is no doubt closely linked to the desire to increase rice production in the shortest possible time span.

A. Background

Korea's recent agriculture policy has been to become and remain self-sufficient in staple food production, particularly in rice. Self-sufficiency reduces the drain of foreign exchange for food imports and lessens the dependence on food coming from surplus-producing countries. As rice is the most important food in Korea, a greater effort has been given to this crop than to some of the other food crops, such as barley, wheat, soybeans and potatoes.

The apparent solution to the ever-increasing demand for food, coupled with the limited area of arable land, is increased productivity. One method of increasing productivity is through improved agricultural technology, the basis for which is research. It was agreed that an AID-financed loan to Korea to assist in financing training of scientists, purchase of equipment and supplies, and providing qualified foreign scientists would enhance the research system. The project identified five crops with which to work, of which rice was one.

More specifically, the project identified the following targets for rice:

-- Select and develop strains that will increase the present crop experiment station yield of 4.79 metric tons per hectare (MT/ha) to 6.0 by the end of 1983, and actual farm production yields from the present average (1972) of 3.25 MT/ha to an estimated 4.5 MT/ha within the same period.

-- Develop new strains which will possess the following characteristics:

  -- a growth and maturity period shorter by ten to 15 days, and at the same time be responsive to higher fertilization levels;

  -- improved grain quality standards, including higher protein and lower amylose content, and kernel shapes more acceptable to the consumers.

-- tolerance for cold temperatures, especially in the seedling stage and during the ripening period, and shorter maturing; and

-- resistance to blast disease, bacterial leaf blight, virus stripe disease, brown leaf hopper, green leaf hopper, rice stem borer and other insects and diseases.

Probably one of the most important dates in Korea's agricultural history was 1965, when the first cross was made leading to the release of the japonica-indica hybrid to farmers in 1972 to produce seed. The primary purpose for making this cross was to introduce genes resistant to rice blast from the indica rice and to retain the other desirable characteristics of the commonly grown japonicas. It was realized by rice breeders, however, that this wide cross could result in poor grain quality (taste), low seed set (fertility) and also low grain yield. Indica rice grew very tall, so it was susceptible to lodging, and it did not mature under natural conditions in Korea. During the selection process in the early generations, lines were selected for the earlier maturing and shorter plant height characteristics similar to the japonica type grown in Korea. After careful observations and selections for 12 generations, the variety Tongil was widely disseminated to farmers in 1974. Close cooperation and collaboration between the Office of Rural Development (ORD) and the International Rice Research Institute (IRRI) made it possible to grow two generations of rice each calendar year in the tropical IRRI climate.

The cultivation of the Tongil[1/] variety and subsequently released varieties proved that Korea could attain rice self-sufficiency for three or four years (see Table C-1, p. C-7). Due to unforeseen circumstances, these japonica-indica hybrids have been somewhat disappointing during the 1978-1980 seasons, as colder conditions than normal prevailed and the rice blast disease became much more severe.

Korea has been virtually unique in its rice program in that few, if any, countries have developed such a complete technical, informational and economic package to instruct and encourage farmers to change many of their traditional practices. The Korean experience is so different and so comprehensive that it is worthy of description. No facet was left uncovered in this comprehensive program.

The complete package associated with the introduction of Tongil rice changed the traditional farming technology. The expansion of Tongil rice intensified and speeded a comprehensive well-organized and effective agricultural extension service. Along with the concentrated expansion of the new rice strain, joint planning and encouragement of the farmers were attained through concentrated administrative support by the government. The resulting increased production of Tongil brought about several changes in the consumption patterns of farm households. Changes in farming technology and socioeconomic conditions were brought about with the relatively rapid increase in the areas cultivated with Tongil.

[1/] For the sake of brevity, Tongil is used throughout this paper to include it and all subsequently released japonica-indica varieties.

B. Improvements in Farming Technology

The most obvious benefit from the cultivation of Tongil was the increase in productivity for the three years after its introduction. The area planted to rice remained practically constant during these years, and the total production significantly increased by about one-third (See Table C-2, p. C-7).

Undoubtedly, the adoption of the new cultural practices was just as important, if not more so, in attaining self-sufficiency in rice as the planting of Tongil. This improved technology has been used more recently in the cultivation of the traditionally grown rice and has resulted in a very significant increase in productivity.

-- Farmers became aware of the advantage of high quality seed with the introduction of Tongil. This seed was produced by ORD, which took the necessary steps to ensure that the rice was purer and higher in germination than that usually planted by farmers. In addition to accelerating the selection program of growing alternate generations at IRRI and in Korea, seed was multiplied in the Philippines and flown to Korea for distribution to selected farmers. This seed multiplication program shortened the program by one year and Korea became self-sufficient in rice one year earlier. The Philippine seed was planted on farms throughout the country as demonstration trials. The extension workers were provided opportunities to observe the adaptability of Tongil under various local conditions and at the same time were able to hold training sessions on cultural practices at the demonstration sites. These trials were also used as multiplication plots and seed was harvested for the following year for distribution to an increased number of farmers.

-- Tongil requires earlier planting in the seed beds than the traditional varieties at times when the temperatures are lower. To protect it from the cold weather at sowing required the use of improved beds covered with plastic (See Tables C-3 and C-4, p. C-8).

-- Virgin soil, lime and silicate fertilizers were more frequently applied by farmers planting Tongil. They also did a better job of preparing their fields by plowing more times prior to transplanting the rice seedlings (See Table C-5, p. C-8).

-- An advantage of Tongil is its ability to withstand heavier rates of fertilizer application without lodging and thus be more productive. Tongil farmers' soils were tested and rates of fertilizer determined for optimum yields. The method of applying fertilizer was changed; in addition to the basal application at the time of transplanting, the number of applications of top dressing was increased from about two times with the traditional varieties to three times with Tongil. The fertilizers were applied with more systematic methods.

-- The Tongil farmers used larger quantities and more applications of agricultural chemicals to control diseases and insects than those planting the traditional varieties.

-- The total area of application of herbicides for weed control was increased and at the same time manual weed control decreased.

-- The farmers' methods of irrigation have been changed from the continuously flooded condition to that of intermittent irrigation.

-- Improvement in harvesting and drying was an important lesson for farmers to learn. Formerly, they stored the harvested grain without properly drying it in order to save time for barley planting. This method yielded lower quality and quantity of rice. Tongil shatters quite readily and must be threshed soon after harvesting. The farmers had to change their method and this shortened storage time in bundles reduced the shattering losses and increased the quality.

-- Farmers planting Tongil have shifted their dates of sowing, transplanting and harvesting, making them all earlier than those for the farmers growing traditional rice (See Table C-3). This makes it possible to increase barley production as more rice fields can be planted with barley as a second or winter crop. However, rather than increase the area planted to barley, the Tongil rice farmers have increased the area of land planted to cash crops such as vegetables because of the greater economic benefits from vegetables compared to barley.

C. The Role of the Extension Service

The Extension Service played a critical part in the rapid and broad dissemination of information regarding the Tongil variety and the necessary technical knowledge associated with its production. Farmers' meetings, radio broadcasts, and use of the village amplifier systems and TV sets were all important means of training farmers to shift to Tongil (See Table C-6, p. C-9).

Farmers were offered technical farm training sessions during the winter months so that they were able to improve their farm management techniques. These training programs were basic to bringing the national average productivity of Tongil to nearly that of the experimental plots.

The group farming or cooperative farming program made it easier for the extension workers to perform more efficiently and effectively through group contacts rather than through individuals. The group worked together, all using the improved variety and cultural techniques to attain higher yields.

D. Economic Benefits Associated with Tongil

The assets of those farmers planting Tongil increased more than those who continued planting traditional rice without any changes in technology. Their farm size, number of farm buildings, power tillers, power sprayers and mechanically driven threshers have all increased more rapidly than those of the non-cultivators of Tongil. Even their holdings of farm livestock have increased.

Prior to the introduction of Tongil, the government purchased a limited quantity of rice shortly after harvest for storage and to stabilize the price. Since the government's purchasing price was lower than that of the free market, farmers refused to sell their rice at the time of harvest. However, with the introduction of Tongil, the farmers sold their rice to the government soon after threshing and it was able to meet its goal.

E. Cooperation with IRRI

At the end of 1968, a cooperative agreement between IRRI and Korea (ORD) was signed. This provided for training Korean scientists at IRRI, five the first and subsequent few years. Koreans were to be trained in several of the agricultural disciplines, including breeding, soil chemistry, soil microbiology, weed control, disease and insect control, and rice quality. Along with training, it was agreed to continue the cooperative varietal improvement program. One of the targets of this program was to increase the number of generations of hybrids in the breeding program to two each year by growing a summer crop in Korea and the second one during the winter months in the Philippines at IRRI. This combination led to a cooperative training and research program.

In a similar manner to the varietal improvement program, seeds of any newly released varieties were increased in the Philippines during the Korean winter months. This enabled the ORD to accelerate its dissemination of new varieties to the farmers. From the release of Tongil to present, several hundred tons of rice seed have been multiplied at IRRI and air-freighted to Korea for distribution to farmers.

Much credit is given to IRRI for the strategy involving a three-way cross between indica and japonica types to produce high-yielding varieties (HYV). Tongil was the first HYV released in Korea.

In close collaboration with the Korean agricultural universities and IRRI, ORD made excellent use of their facilities and technical information in developing the new HYVs. This has had a very unifying effect between IRRI and Korea.

F. Project Targets

Average yields from rice grown on experiment station plots provide little, if any, meaningful data. There are many strains, selections and/or varieties cultivated under various conditions. Thus to make a valid comparison of the experimental yields at several stations, or even one

for that matter, is very nebulous. The project target to increase "experiment station yields of 4.79 MT/ha to 6.0 MT/ha by the end of 1983" is very misleading. It is interesting to note that ORD reported yields of Tongil at experiment stations of 6.24 MT/ha in 1970, higher than the initial figure and even greater than that projected for 1983.

On the other hand, to make a comparison of actual farm production yields with those stated in the project paper is much more valid, especially in Korea where massive agricultural statistics are readily available (See Table C-2). Before the loan was made to Korea, the improved variety, Tongil, yielded 3.86 MT/ha in 1972, about 0.6 MT/ha greater than that noted in the project for that year. Every year from 1972 through 1979, the national average or farm production yields have surpassed the project goal for 1983.

During the team's discussion and observations, only three characteristics other than yield, were found to be of much concern. Resistance to blast, tolerance to cold, and shorter maturity were all cited as major constraints still to be overcome, yet several others are noted in the original project. There is still a taste preference for the traditional or japonica rice.

Table C-1 - Rice Production and Imports

Year	Production (1000 MT)	Import (1000 MT)	Self Sufficiency Rate (Percent)
1970	4,090	541	93.1
1973	3,957	437	92.1
1974	4.211	206	90.8
1975	4,445	484	100.5
1976	5,215	157	102.9
1977	6,006	-	108.6
1978	5,797	-	103.8
1979	5,565	502	86.0
1980	3,550	580	88.8

Table C-2 - Area, Production and Productivity of Rice

Year	Area (1000 ha)		Production(1000 MT)		Productivity(MT/ha)		Percent Area Cultivated With Tongil
	Traditional	Tongil	Traditional	Tongil	Traditional	Tongil	
1970	1,203	-	3,939	-	3,37	-	-
1972	1,010	187	3,234	723	3,32	3,86	15.9
1974	1,023	181	3,589	856	3,69	4,73	15.2
1975	923	274	3,248	1,380	3,51	5,03	22.9
1976	663	533	2,626	2,553	3,96	4,79	43.9
1977	548	660	2,317	3,648	4,23	5,53	54.6
1978	290	929	1,263	4,516	4,35	4,86	76.2
1979	480	744	2,097	3,449	4,37	4,63	60.8

Source: Yearbook of Agriculture and Forestry Statistics, 1980

Table C-3 - Changes in Dates of Farm Operations

Operation	1970	1974
Rice sown in nursery	May 3	April 19
Rice transplanted	June 19	June 6
Rice harvested	October 21	October 8
Barley sown	October 28	October 18

Table C-4 - Adaption of Plastic Covered Seed Beds

Year	Plastic Covered Seed Beds (%)
1971	4
1973	27
1974	38
1975	56
1976	65
1977	81

Table C-5 - Application of Silicate Fertilizer

Year	Amount (1000 MT)
1970	13.1
1972	21.6
1974	80.0
1975	175.0
1976	267.0
1977	300.0

Table C-6 - Radio and TV Farm Programs

Year	Program	
	Radio	TV
1970	508	5
1973	1,341	58
1974	1,123	46
1975	1,103	77
1976	1,410	64
1977	1,186	82

APPENDIX D

RESEARCH ON SELECTED FOOD CROPS

by

ROBERT I. JACKSON

A. Purposes and Targets

One of the purposes of the AID-financed loan for agricultural research in Korea was to assist in varietal improvement of the five major food crops: rice, barley, wheat, soybeans and white potatoes. In addition to research on varietal improvement, the development of improved cropping systems was part of the project as well.

Specific targets were established for each of the crops, both for yield increases on the experiment station and on farmers' fields for the crops covered in the project with the exception of potatoes. Improved varieties of potatoes resistant to viruses, insect control measures, and methods of processing and marketing were stated as project targets. The targets for rice are presented in Appendix C.

Aims included the development of new varieties and strains of soybeans capable of increasing present (1973) yields from 1.98 MT/ha to a target level of 3.2 MT/ha, and increasing farmers' yields from 0.8 to 1.3 MT/ha by the end of 1983. These improved soybeans were to be more responsive to higher plant populations per unit area of land, resistant to lodging and at the same time responsive to higher rates of fertilizer, higher in protein and oil content, shorter in maturity, and resistant to the economically important pests. Research on cultural practices was also an item for consideration.

New strains of barley were to be selected and developed so that the experiment station yield of 2.79 MT/ha was to be increased to 3.6 MT/ha and farmers' yields increased from 2.04 MT/ha to 3.0 MT/ha within a ten-year period. A variety 10 to 15 days shorter in maturity, more resistant to cold temperatures, more responsive to higher rates of fertilizer without lodging, resistant to common barley insects and diseases, and tolerant to waterlogged paddy soils was to be developed.

Similar characteristics for wheat were stated in the project paper. Experiment station yields were to be increased from 4.3 MT/ha to 5.2 MT/ha, and on-farm yields from 2.24 to 4.0 MT/ha. The new varieties were to incorporate the following characteristics: growing period reduced from 20 to 15 days, improved milling qualities, higher protein, better baking quality, resistance to diseases and insects and tolerance to cold and more poorly drained paddy soils.

There were also five main targets for cropping systems, but as the team saw little evidence of any research results from this component of the project, no other comments will be made.

B. Rice

Research on rice has undoubtedly made the greatest contribution to the Korean agricultural economy through the development and release

of the japonica-indica (Tongil) hybrids and the technological package to accompany these hybrids. This package has also been applied to the cultivation of the traditional varieties and their productivity has increased to a level comparable with the hybrids (see Appendix C, Table 2).

C. Wheat

Wheat has probably received more than its share of research effort if wheat production and import statistics are used as a basis for judgment. Production and area cultivated has steadily declined over the past ten years but imports have increased; thus, overall the demand for wheat has waxed. This may be partly due to the shift in farm population to the urban centers and dietary changes. The productivity of wheat has increased and this can be largely attributed to the successful research program.

More specifically, the wheat scientists have been conducting research on the following characteristics:

-- Earliness
-- Erect plant types
-- Dwarfness
-- High yield
-- Good grain quality - plumpness and protein content
-- Drought tolerance
-- Resistance to sprouting in the head
-- Disease resistance including scab, powdery mildew, stem rust
-- Winter hardiness
-- Tolerance to wet paddy soils

It is clearly evident from this list of characteristics that the wheat research carried out is in conformity with that stated in the project paper.

One of the most commendable aspects of the wheat improvement program is the close cooperation between the International Wheat and Maize Center in Mexico (CIMMYT) and U.S. universities. AID financially supports the research on wheat at CIMMYT, Oregon State University and until recently the University of Nebraska.

Oregon State University has provided materials for the International Winter Spring Wheat Screening Nursery (IWSWSN) since 1973. Two nurseries have been sent by the University of Nebraska, the International Winter Wheat Performance Nursery (IWWPN) and the High Protein, High Lysine Observation Nursery (HPON). The IWWPN has been grown each year since 1968. CIMMYT has provided the International Bred Wheat Screening Nursery (IBWSN) since 1974.

D. Barley

The area cultivated with barley has steadily declined during the last decade. The production has remained relatively constant, with

the exception of 1977 when the crop was severely damaged by a typhoon. Most important, the productivity has significantly increased during this period and is due largely to the efforts and results of the barley research workers. It suffices to say that they are conducting similar research on barley to that on wheat to overcome the constraints related to barley production.

Nearly all of the farmers growing barley were unhappy with the Government's pricing policy. Should this be changed, undoubtedly barley production would increase markedly. Those farmers growing two-row barley for malting and under contract with the two Korean breweries expressed their interest and financial benefit in barley cultivation.

Cooperative international barley nurseries have been provided by CIMMYT and Montana State University.

E. Soybeans and White Potatoes

The area cultivated and production of soybeans and white potatoes have decreased during the past decade. Productivity of soybeans has increased and that for potatoes remained relatively static. The farmers interviewed expressed extremely little interest in either of these two crops.

The ORD has cooperated with CIP on potato research and the University of Illinois (INTSOY) on soybeans. All of these institutions receive financial support from AID.

F. Conclusions

If the project were to be redesigned at this writing, the inclusion of soybeans and white potatoes as crops to be developed by this project would be very questionable. There is a relatively strong research component on wheat, but the fact that the cultivated area has shrunk to such a great extent makes it difficult to justify support to research on wheat at this time. There is such an increase in the use of mechanically powered farm equipment, due to the improved cultivation methods and shortage of farm labor resulting from urban migration, that farm mechanization would receive a very high priority for inclusion. Farmers have learned that it is more economically advantageous for them to grow some of the vegetables under plastic during the winter months and in the open fields during the summer season than it is to cultivate wheat and barley. Research on vegetables should also receive high priority if the project were being designed at this time. It should be noted that the AVRDC cooperated with the ORD in research on a limited number of vegetables and provided only minimal financial support during the life of the AID project.

Table D-1. Area, Production and Productivity of Selected Crops

Year	Area (1000 ha)				Production (1000 MT)				Productivity (MT/ha)			
	Barley	Wheat	Soybeans	Potatoes	Barley	Wheat	Soybeans	Potatoes	Barley	Wheat	Soybeans	Potatoes
1970	730	97	295	54	1,591	219	232	605	2.18	2.26	.79	11.31
1972	710	63	282	43	1,600	149	224	459	2.25	2.38	.79	10.62
1974	704	36	286	41	1,388	74	319	447	1.97	2.03	1.11	10.86
1975	711	44	274	52	1,700	97	311	660	2.39	2.22	1.13	12.80
1976	711	37	247	49	1,759	82	295	569	2.47	2.22	1.19	11.76
1977	516	27	251	50	814*	45	319	558	1.58	1.68	1.27	11.30
1978	554	17	247	39	1,348	36	293	304	2.43	2.09	1.19	7.82
1979	473	13	207	34	1,508	42	257	356	3.19	3.21	1.24	10.58

Source: Yearbook of Agriculture and Forestry Statistics, 1980.

* Decrease due to excessive flooding from typhoon

APPENDIX E

PROFITABILITY, COSTS AND REVENUE OF FIVE CROPS

by

KWAN S. KIM

A. Introduction

After the adoption of the high-yielding varieties (HYV) of rice and other crops in the early 1970s, the switch from the traditional varieties (TV) to the HYV has been rapid. In the case of rice, the use of the HYV has in general resulted in higher yields of output, but this technological change has been accompanied by increasing use of fertilizers, chemicals, and implementation of government purchase and support prices of major crops. During the last two years, the cold weather conditions and blast diseases have severely affected yields in rice output, particularly those in the HYV. The fact that the HYV (Tongil) require heavier inputs, as compared with the TV, and that their yields were more susceptible to cold weather and blast disease is significant in determining the yearly relative profitability of the HYV over the TV and therefore the farmer incentive in crop selection. As a rule, the analysis of farm income accounts is essential to an understanding of the reason for the adoption of new technologies by farmers.

Profitability from crop production for a farm household depends on such factors as per hectare yield of output, per hectare use of inputs, consumer and government purchase prices of grains, and government subsidized prices of fertilizers and chemicals. The attached tables show calculations of the financial costs and returns for 1977 and 1980 from the production of the five crops funded by AID for agricultural research. The year 1977 recorded a highest yield per hectare in the production of the HYV of rice, and 1980 was a poor harvest year for the HYV because of the cold weather and diseases.

Figures in the tables are based on national sample surveys carried out by the Office of Rural Development. They refer to average farm household production costs and revenue. The term "economic profit" is defined as the residual of farm household income received from farming activities after subtracting all expenditures incurred for inputs including any unpaid return to family-owned resources (land, labor, or capital). "Operating profit" is calculated as the residual from the farm income after paying out all costs of inputs which exclude any unpaid return to family-provided resources. In several villages we visited, there were very few opportunities for farmers to engage in off-farm or alternative economic activities other than farming. Under these circumstances, the concept of "operating profit" provides a more appropriate measure of the incentive for production.

B. Summary: Salient Features of Farm Household Income

1. Profitability of HYV and TV

The high-yielding rice varieties used relatively more fertilizers, chemicals and labor input. They outyielded the TV by a greater margin. In 1977 economic profits from the HYV were 33 to 60 percent

higher, depending on whether rice was cultivated in a mono-culture or sequentially cropped system. The same profit margin declined, on average, to about 15 percent in 1980, which reflected the uneven incidence of cold weather and disease problems. Although the cultivation of the HYV has generally resulted in greater profits on both "operational and economic" accounts, there have been substantial variations in the profit margin from region to region.

The calculations in the tables assumed a uniform government purchase price for all varieties of rice. In interviews with several farmers we found that they could frequently obtain as much as 15 or 20 percent higher prices for the traditional varieties (japonica) on the free market: many consumers still seem to prefer japonica to Tongil rice in spite of the fact that there is virtually no difference in the taste, especially when rice is freshly cooked. Thus, if we assume that the price of the japonica was 15 percent higher in 1980, profitability can be shown as no higher for Tongil rice than for the TV. In other words, per hectare yield in the HYV had to be at least 15 percent higher in order to be economically profitable.

2. Effect of HYV on the Labor Market

The cultivation of the HYV was relatively more labor-intensive. This may be explained by the fact that Tongil varieties require more intensive cultural care and a longer gestation period. For 1980, output yield per man hour was about 3.3 kg per 10a (one-tenth of a hectare) in both varieties. As more of the rice area is cultivated with the HYV there will be a growing demand for labor in rural Korea. Effective labor is already in scarce supply in Korea. The dissemination of the high-yield farming technology is likely to accelerate the process of "tractorization" in Korean agriculture.

3. White Potatoes, Barley, Wheat, and Soybeans

Another crop that has continued to yield positive "economic profits" is white potatoes. Despite the profitability in potatoes, there has been a declining trend in the planted area and the total production since 1975. The profit rate from the cultivation of white potatoes is not only low relative to that from the more widely-demanded vegetables and fruits, but also many Koreans consider white potatoes as an "inferior" good. Their consumption increases only when other major staple food supplies decline. Also, since the consumption of potatoes is small relative to that of other foods, the potato market may be considered as volatile with prices highly sensitive to changes in demands for other foods.

For other crops, our calculations show that barley and wheat for both 1977 and 1980 incurred net losses in economic profit if unpaid returns to farm owners' resources are included in the production costs. However, "operating profits" become positive if only the actual paid-out costs are taken into account. In particular, barley is traditionally a second important staple food (next to rice) in the Korean diet.

Unlike the case of rice, however, there has been no adequate government price support for barley at least at a level that could ensure a comfortable profit margin to the farmers. For example, according to a recently announced pricing scheme for 1981, the margin between the government purchase price and the production cost of barley (excluding the implicit costs) was 2,531 won per bag. This implies an "operating profit" rate of some 9 percent in barley production. Consequently, barley has been grown only as a marginally important, winter-crop revenue source by farmers whose "opportunity" incomes during the idle season are insignificant. Like white potatoes, barley is an inferior good; as farmers' real incomes rise, its consumption tends to decrease as consumers substitute rice for barley. Thus, over the years, the Government of Korea has accumulated sizeable quantities of barley in storage. The barley-growers have generally been apprehensive of the possibility of sudden reductions in the government purchase of barley. The government's purchase decision is, as a rule, announced at the time of the harvest.

Soybeans yielded positive profits in 1977, but resulted in negative "economic profit" in 1980. Like white potatoes, the area planted in soybeans has somewhat declined since 1977.

4. Government Policies

It must be emphasized that in addition to per hectare yields and related production conditions, another major determinant of profitability in crop production is the government's pricing and purchase policies. The Korean Government instituted in 1969 a two-tier pricing system consisting of government purchase prices at the farm gate and selling prices to urban dwellers for rice and barley. The consumer price has since averaged twice that of imported rice. In an effort to subsidize farm producers, the government has also kept the purchase price of rice far above the consumer cost. As a result, in each year since 1968, the government has incurred deficits in the general account by issuing overdrafts on the central bank, which has of course added to the inflationary pressure in the economy. In the case of barley, the Government, in spite of relatively unattractive farm gate prices offered the farmers, has also provided a substantial subsidy to the growers by keeping consumer prices low. The economic implication of farm pricing policies in Korea is significant. If the social profitability of rice (and barley, of course) is to be calculated in terms of its accounting prices (international market prices), it would be unprofitable to grow rice and barley from the society's point of view. It is clear, however, that the farm price support policy in Korea seeks achievement of the political objective of self-sufficiency, and not that of achieving resource allocation efficiency.

A related issue concerning the farm support policy is the timing of the government's decisions for purchase quota and prices. The decisions are as a rule announced around the time of the grain harvest for the produce that has already been harvested or is going to be harvested. The uncertainty and risk caused by the government delay in action has additionally lowered the farmer incentives to grow barley as a winter crop.

Table E-1. Farm Household Account Per 10a Land for AID-Supported Crops - 1977

(Unit: Won/10 a)

Item	Gross Revenue	Operating Cost	Total Production Cost	Operating Profit		Economic Profit	
				Amount	Rate	Amount	Rate
1. HYV Rice (Single-cropping)	194,037	52,294	94,588	141,743	73.0	99,449	51.3
2. HYV Rice (Double-cropping)	180,213	50,308	91,874	129,905	72.1	88,339	49.0
3. TV Rice (Single-cropping)	155,454	47,410	89,388	108,044	69.5	66,066	42.5
4. TV Rice (Double-cropping)	139,183	44,742	85,729	94,441	67.9	53,454	38.4
5. Upland Rice (Double-cropping)	81,016	31,741	64,319	49,275	60.8	16,697	20.6
6. Upland Barley	56,455	29,096	68,867	27,359	48.5	- 12,412	-
7. Paddy Barley	58,247	28,241	78,220	30,006	51.5	- 19,973	-
8. Upland Naked Barley	57,455	30,448	70,040	27,007	47.0	- 12,585	-
9. Paddy Naked Barley	61,013	30,862	81,090	30,151	49.4	- 20,077	-
10. Upland Wheat	34,787	24,195	64,248	10,592	30.4	- 29,461	-
11. Paddy Wheat	34,128	23,701	73,061	10,427	30.6	- 38,933	-
12. Soybeans	50,876	12,662	47,196	38,214	75.1	3,680	7.2
13. White Potatoes (Upland)	147,290	35,702	70,990	111,588	75.8	76,300	51.8
14. White Potatoes (Paddy)	144,517	34,978	78,755	109,539	75.8	65,762	45.5

Source: Office of Rural Development

Table E-2. Average Rice Production Costs and Revenue Per 10a Land (1980)

(Value Unit: Won)

Item	HYV	TV	HYV	TV
Gross Revenue				
Output	446.4 kg	396.3 kg	255,564	226,882
Byproduct			14,588	18,098
Total			270,152	244,980
Expenses				
A. Operating Expenses (Materials)				
Seed	5 kg	4.9 kg	1,727	1,692
Organic Fertilizer	877 kg	833.5 kg	7,981	7,583
Inorganic Fertilizer			8,430	7,430
Chemicals			9,177	7,936
Milling	446.4 kg	396.3 kg	11,294	10,019
Others				
Total			71,058	66,665
(Labor)				
Hired Labor	36.8 hrs.	29.8 hrs.	21,094	16,810
Miscellaneous			657	822
Total for A			92,809	84,297
B. Implicit Expenses				
Own labor	98.4 hrs.	88.9 hrs.	57,402	51,424
Operating Capital Services			2,085	1,873
Fixed Capital Services			2,567	2,567
Rent			27,681	27,681
Miscellaneous			1,151	1,589
C. Total Expenses			183,695	169,431
Economic Profit			86,457	75,549
Operating Profit			177,343	160,683
Value Added			199,094	178,315
Profit Rate a/			32.0%	30.8%
Operating Profit Rate b/			65.6%	65.5%

Notes: a/ Economic Profit as a percent of gross revenue
b/ Operating Profit as a percent of gross revenue
Source: Office of Rural Development

Table E-3. Farm Household Income Account Per 10a Land for AID-Supported Crops - 1980

Item	Quantity (kg)	Crop Revenue	Operating[a] Cost	Production[b] Cost	Operating Profit Amount (Won)	Operating Profit Rate	Economic Profit Amount (Won)	Economic Profit Rate
Barley								
(Upland)	276.5	103,249	47,403	129,788	55,846	54.1	-26,539	
(Paddy)	291	109,607	52,352	139,889	57,255	52.2	-30,282	
Naked Barley								
(Upland)	312.9	114,205	55,205	129,735	59,000	51.7	-15,530	
(Paddy)	317	115,722	54,246	137,577	61,476	53.1	-21,855	
Wheat								
(Upland)	331.9	91,303	41,382	122,063	49,921	54.7	-30,760	
(Paddy)	333	91,638	46,218	129,235	45,420	49.6	-37,597	
Soybeans								
(Mono-culture)	144.5	82,445	26,636	96,794	55,809	67.7	-14,349	
(Double-cropping)	134.9	76,966	24,706	91,030	52,260	67.9	-14,064	
White (Spring)	1,188.3	254,060	97,611	182,289	156,449	61.6	71,771	28.2
Potatoes (Fall)	1,243.8	214,092	66,482	145,263	147,610	68.9	68,829	32.1

Notes:
a - All input expenditures excluding unpaid returns to family owned resources.
b - All expenditures including unpaid returns to family owned resources.

Source: Office of Rural Development

APPENDIX F

SOCIAL RETURNS TO AGRICULTURAL RESEARCH AND EXTENSION

by

KWAN S. KIM

I. Introduction

Scientific information generated by agricultural research is a public good once it is disseminated for application. No consumer can be excluded from benefiting from the application of research output, and there is no market pricing mechanism for the output. The absence of a pricing mechanism implies that private-sector firms tend to underinvest in agricultural research from society's point of view since the benefits of research cannot be entirely internalized by the firms. As a consequence, there is a need for public support of agricultural research. Since agricultural research would compete with alternative uses for public funds, it is important for decision makers to obtain information on the returns to agricultural investment.

This appendix reviews and provides a critique of the previous work on social returns to agricultural research and extension (R&E) in Korea. In an important study on Tongil rice, K. H. Park presented an analysis of socioeconomic returns on agricultural research and extension expenditures in Korea.1/ This work is significant because it deals with an ex post evaluation of agricultural research on Tongil rice. It provides the only estimate of social returns to Tongil rice development.

There was an earlier attempt in 1972 to evaluate returns on agricultural research expenditures in Korea using computer-simulation models by Michigan State University's Korean Agricultural Sector Study (KASS) team. Although actual expenditures on research for the improved varieties of rice (Tongil) were incurred starting as early as 1962, the expanded extension program to disseminate the research results began in 1972. The KASS Team's report provided an ex ante analysis of research project impact and, from the benefit of hindsight, was useful only as background information to a project feasibility analysis.

II. Park's Analysis

The main objective of this study was to estimate the ex post rate of return on the Korean Government's agricultural research and extension expenditures, utilizing the national, annual data series for the period 1962-1977 that were provided by the Office of Rural Development. The original data were expressed in current won and two types of data adjustments were made. First, the expenditure and revenue figures were adjusted for inflation. Second, as his calculations were to be derived from the vantage point of 1977, it was necessary to convert to present values as of 1977 all past and future streams of expenditures and

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1/ K. H. Park, "Analysis of Socioeconomic Consequences of the Green Revolution," Government of Korea Office of Rural Development, 1977.

incomes using an appropriate discount rate (0.05 in Park's study).

Briefly, the model used for estimating the rate of return was originally developed by Z. Griliches in which:

$$\text{Social Rate of Return} = \frac{\text{Perpetual flow of returns (PFR)}}{\text{Cumulated R\&E expenditures up to 1977 (CREE)}} =$$

$$\frac{\text{Interest income on cumulated past returns (ICPR)} + \text{Future annual return (FAR)}}{\text{Cumulated R\&E expenditures (CREE)}}$$ 2/

The term CREE represents a sum of past R&E annual expenditures, where each past year's real expenditures are converted to the present value of 1977.

In a similar manner, cumulated past returns can be calculated as a sum of previous annual returns from R&E investments. ICPR simply expresses future interest income on these cumulated past returns. FAR represents the projected yearly return in a perpetual stream of future returns from CREE. Under the assumption of perfect foresight, yearly future return is assumed as equal to the 1977 return. PFR thus consist of two sources, ICPR and FAR.

The annual returns from R&E expenditures for developing and disseminating Tongil rice were calculated by estimating hypothetical losses in income, which would occur had the new varieties not been introduced on the farm fields. For this, the author employed a supply and demand framework as shown in Figure 1. He then assumed perfect elasticities in rice supply, i.e., that rice can be produced in Korea at a constant cost at OP in the diagram. Introduction of the new technology could then be seen as a shifting downward of the supply schedule from SS to S'S'. Then the hypothetical losses in income without the introduction of the improved varieties can be shown equal to the net losses in the consumer surplus identified by the shaded area PBBP'. The consequences of dynamic changes in the proportion of the area cultivated for Tongil rice were carefully worked out in a formula used for calculating net losses in income. Based on an estimate given in the KASS study, he assumed a rice demand elasticity of -0.4 for Korea.3/

The economic (social) rate of return on R&E expenditures for Tongil rice was calculated by the author at 1200 percent. That is, from the vantage point of 1977, each one won worth of investment in Tongil rice development generated 12 won worth of return from the society's point of view. Although other studies show that the economic rate of return

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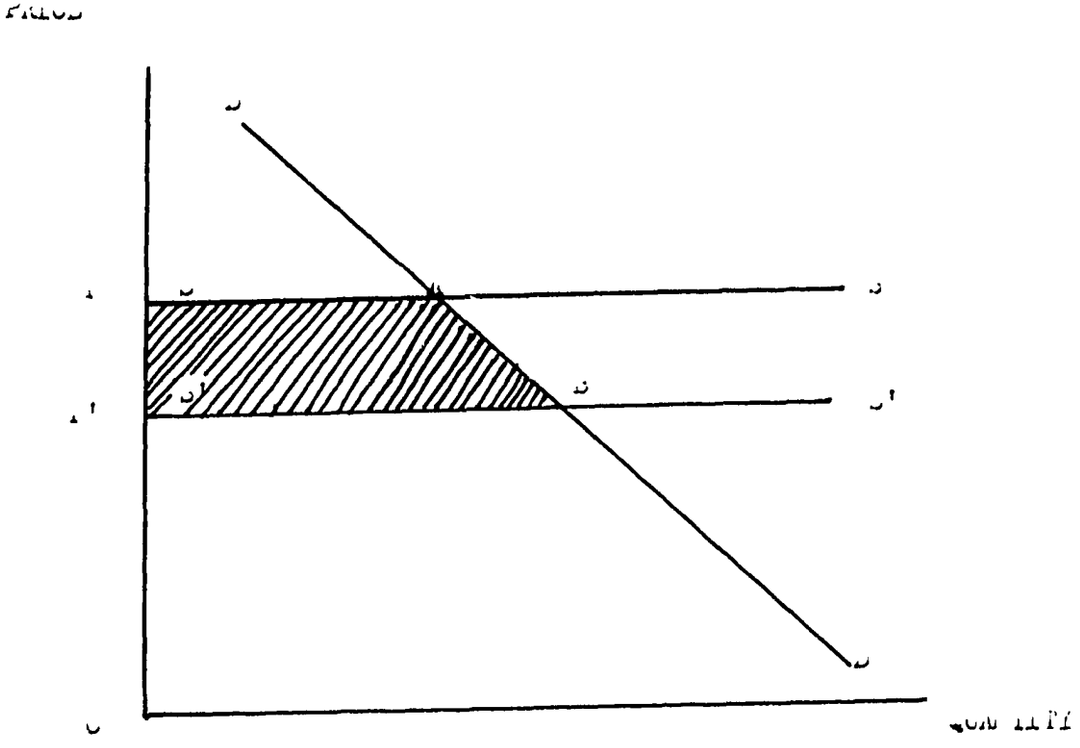
2/ Z. Griliches, "Research Costs and Social Returns: Hybrid Corn And Related Innovation," Journal of Political Economy, October 1958.

3/ See Park, K. H., ibid, pp 26-40.

Figure 1. The Rice Market in Korea (per H. Park)



from agricultural research is, as a rule, high for developed countries (1300 percent for the U.S.A. in Professor Griliches' estimation), Park's estimate comes as a surprise for a developing country like Korea.

III. Critique

The major deficiency in Park's analysis is that the estimate is based on a hypothetical model that employs a set of highly questionable assumptions. Among such assumptions are:

-- Perfect Supply Elasticity--In reality, rice cultivation in Korea can be expanded only with a heavy infrastructure investment. The constant cost assumption in rice production for Korea is utterly unrealistic.

-- Equal Input Requirements--As compared with the traditional varieties, the Tongil varieties require heavier inputs including labor hours. Operating expenses per hectare have been higher for the production of the HYV. Thus not only the difference in per hectare yields but also in per hectare input uses should have been taken into account in Park's analysis. Obviously, his results are overstated.

-- Closed Economy--There are no imports of rice in his model. Before Korea attained self-sufficiency in 1975, it had been importing 10 to 15 percent of its domestic demand for rice. As will be shown below, the introduction of rice imports drastically changes the model structure.

-- Uniform Pricing--The actual pricing mechanism for rice is far more complex than depicted in his analysis. This is examined in the following discussion.

IV. An Alternative Framework

The consumer-surplus approach in Park's analysis is too simplistic and unrealistic to be of much interest. In the following, an alternative framework is offered to describe the rice market situation in Korea.4/ In Figure 2 the demand and supply curves are shown by D and S. Point A represents market equilibrium in a closed economy situation. The effect of the improved varieties is displayed as causing a downward shift of the supply curve from S to S'. Distance OG represents an initial equilibrium price which for simplicity is assumed as equal to the government's selling price to consumers (In equilibrium the selling price should converge to a free market price). Government purchase price from farmers is indicated

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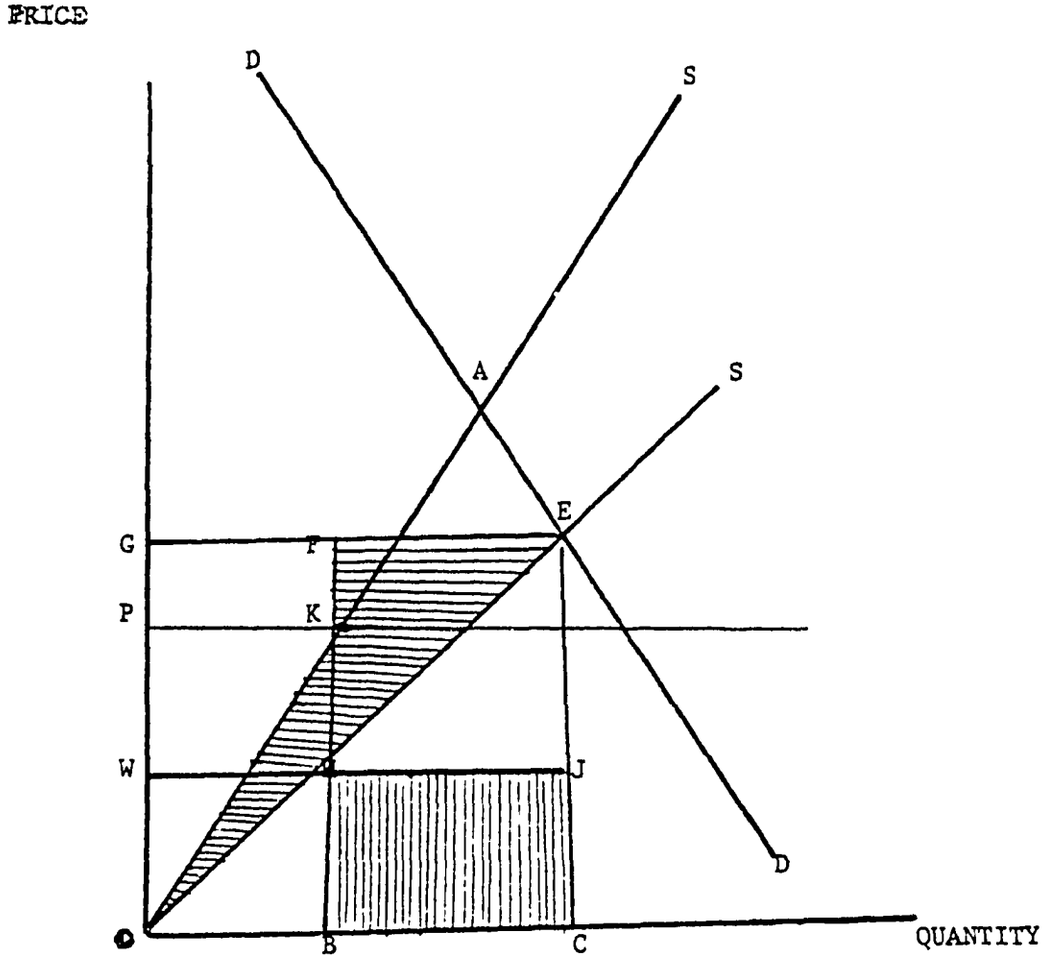
4/ This model is adapted from the Akino and Hayami model with appropriate modifications to reflect the Korean situation (M. Akino, and Y. Hayami, "Efficiency and Equity in Economic Development," American Journal of Agricultural Economics 57 (1975): 1-10)

Figure 2. The Rice Market in Korea (a suggested framework)



by OP, which is assumed lower than the selling price (The Government handling costs of rice storage and transaction are not included in this diagram. It is possible to show the situation of government deficits on rice accounts). Note that the world market price is OW, which is located below government purchase price OP.

In the initial situation covering the period before 1975, the year Korea reached self-sufficiency in rice, imports of rice are indicated by quantity BC with a foreign exchange cost equal to the area of BHJC; domestic production is shown by quantity OB. The effect of introducing Tongil rice, plus effecting changes in other agricultural production conditions can be seen as resulting in self-sufficiency in rice. The net effect of this is shown in the diagram. There is no change in consumer surplus and the increase in producer surplus equals the area OKFE. The incidence of research benefits is shown to fall more on producers than on consumers. This finding contrasts with Park's analysis in which the benefits exclusively fall on consumers. Indeed, the available data indicate that the market price of rice has risen at a rate faster than that of government purchase price. There is no evidence for a drastic decrease in the consumer rice price following increased domestic yields in rice.

More importantly, the real benefits of R&E expenditures did not lie so much in benefiting producers or consumers as in saving the cost of foreign exchange used for imports of rice. Our analysis clearly shows this. As a result of attaining self-sufficiency, the import saving is equal to BC in quantity and to the area BHJC in dollars.

To summarize, although our analysis is qualitative in nature, there are two important findings that emerge from it:

-- Producers (farmers), as compared with urban consumers, benefited more from the adoption of the improved agricultural technology. The critical factor contributing to this has been government pricing policy.

-- The previous estimate of economic returns from rice research is unreliable. It failed to recognize the gains in producer surplus, and overestimated consumer gains. Moreover, it totally overlooked, perhaps, a much larger benefit in foreign exchange savings. Because the previous study ignored the differences in input uses between the two varieties, the estimate of the economic return on rice research in Korea is likely overstated.

V. Further Suggestions

Among other things, one important caveat in the preceding model must be noted. That is, our analysis has failed to separate net effects of R&E investment from those of other factors that collectively or independently cause a shift downward of the supply curve (see Figure 1). Clearly, some factors such as fertilizer and chemicals are complementary in input

requirements. Others such as improved irrigation systems or mechanized farming methods may well be considered as substitutable. There is a need for a more rigorous analysis to understand the true effects of agricultural research. In this regard, the consumer-producer surplus approach is ill-equipped to deal with the complex agricultural production and marketing system in Korea. The results of an analysis using this approach would be sensitive to different specification of supply and demand functions and the nature of the supply function shifts. There are virtually no reliable estimates of agricultural demand and supply elasticities for Korea. It is suggested, therefore, that in the case of Korean agriculture the production function approach would be more appropriate for measuring the net benefits from agricultural research.5/ The clear advantage of this approach is that it provides a method of statistically isolating the influences of research programs from these other factors expected to affect observed yields. It also provides an estimate of the marginal return to research investment, which is a more useful indicator to decision-makers concerned with the merits of agricultural research projects.6/

5/ For a pioneering article on this topic, see Z. Griliches' "Research Expenditures, Education, and the Aggregate Agricultural Production Function." American Economic Review 54: 96-174, 1969. For a review of cited developments, see World Bank Staff Papers Nos. 360 and 361, 1979.

6/ The time-constraints prevented this team from delving into the calculations of rates of return to research investment. However, basic data required for an aggregate analysis on social returns seem available for Korea.

APPENDIX G

RESEARCH AND EXTENSION: THE INTEGRATION OF INQUIRY AND GUIDANCE

by

DAVID I. STEINBERG

A. Introduction

Critical to the development of a national research system is the continuous adaptation and creation of new plant strains suitable to a particular environment. Equally important is the capacity of a nation to translate research results into production, consumption, and income for the population. The Korean case represents a remarkably successful melding of research and extension. It is, however, based on a system so goal-oriented at every bureaucratic level that, not surprisingly, the attainment of targets becomes both a matter of pride and bureaucratic survival. Bureaucratic enthusiasm is sometimes transformed into involuted pressure to achieve--goals are created that the system itself cannot safely reach, each level striving to achieve targets that are sometimes unrealistic, resulting in costly errors at local and even national levels. It can lead to manipulation of statistics as the bureaucracy yields to the temptation of always indicating progress, higher yields, or larger exports. Only when dire, usually external, factors intervene can a decline be shown.

B. Administrative Centralism

Centralism is the hallmark of the Korean bureaucracy. The power of the Seoul administration is felt through an integrated system of regional and local pressure points having their nexus in the capital. The main bureaucratic mechanism of central control of the periphery is the Ministry of Home Affairs. It not only commands the police throughout the nation but, as there are no elected local officials, appoints the governors of the nine provinces, the 147 gun (county) chiefs and the more than 1,300 myon (district) heads. Its responsibility includes the Sae-maul Movement, which is ubiquitous. Real power throughout Korea rests with that Ministry; it is the central focus for the rural population in the gun. The gun capital, the primary market town of the area, is the head of both administration and market activity. The gun chief is the coordinator of all development programs (except education) and is held personally responsible for all activities within that area. This personalized power and responsibility is so pervasive that the under-achievement of targets within the gun or even the occurrance of a national disaster such as a forest fire (which he is supposed to prevent) can cause his summary expulsion. Someone personally must bear responsibility for error or failure in Korea; it is at the heart of the political and bureaucratic culture and profoundly affects policy and performance.

The gun chief coordinates the work of most agencies (except education, the military, and the judiciary) within his territory. He is thus in intimate contact with all other ministries with local programs in his gun. These other ministries have their own hierarchical command structures down to the myon in some cases, but at the gun level close cooperation with the

gunsu, or county chief, is a requirement.

C. The Ministry of Agriculture and Fisheries

Of primary importance in rural Korea is the Ministry of Agriculture and Fisheries (formerly the Ministry of Agricultural and Forestry). It has three main divisions that have impacts on the lives of farmers: the Office of Rural Development (ORD), the Agricultural Development Corporation (ADC), and the National Agricultural Cooperative Federation (NACF). The ADC is concerned with the development of irrigation systems, dams, and land reclamation. The National Agricultural Cooperative Federation is a governmental mechanism, misnamed a cooperative, for the provision of agricultural credit and other requirements such as seed, fertilizer, pesticides, and herbicides, as well as agricultural machinery. It is also the government arm for the purchase of crops at standard, centrally set prices and quantities. The NACF thus implements government policy on grain pricing and procurement but it is the Office of Rural Development (ORD) that encourages, trains, and provides the farmers with the means by which national targets can be achieved.

The Office of Rural Development has three major functions: basic and adaptive agricultural research designed to assist in achieving nationally set production targets for priority crops; training, a program of such magnitude that there is hardly a farm family left untouched annually by this effort; and "extension." In Korean, the term "extension" is more aptly translated as "guidance," which describes both the philosophy of the system and its actual operation.

The integration of research and guidance is perhaps not unique among developing countries, although it certainly is rare to the degree practiced in Korea. What may be unique, however, is an integration of both research and guidance with education.

Fifteen years ago, Seoul National University's College of Agriculture, under the Ministry of Education and the Office of Rural Development under the Ministry of Agriculture and Forestry had no working relationships, although located only a few hundred yards apart. Today, however, some staff at each institution hold joint appointments. The AID-supported agricultural research project did not initiate such relationships but did help strengthen them and bring into the research scene professors from other agricultural colleges.

As interesting and effective, but perhaps as rare, is the integration of the agricultural high school at the gun level into the agricultural guidance system. There, teachers also hold joint appointments at the gun rural development office and training classes in the high schools use the same materials and machinery as those used by the extension workers. These extension workers train farmers in the schools during vacation periods. Students from the agricultural high schools usually join the guidance service, thus completing the link where they may once again come under the supervision of their former teachers. This results in effective means

for overcoming the inherent rivalries of two ministries, as both strive to contribute to achieving national goals.

Borrowing from the Ministry of Home Affairs bureaucratic model, the Office of Rural Development, with its headquarters in Suwon, Kyonggi Province, has provincial Offices of Rural Development that report both to the governor of the province and centrally to the Director General of ORD, who has the rank of Vice Minister. At the gun level, the county office of rural development reports hierarchically to the provincial ORD and laterally to the gun chief. Below the gun at the myon, there are also offices of the rural development administration with primary responsibility for guidance at that level. Supplementing this system is a series of regional and crop or problem-specific research stations that were in part the subject of the AID loan and of this inquiry. They report to the ORD's Bureau of Research. The Office of Rural Development has three operational bureaus: research; guidance, including a farmers' training program at the national, provincial, and gun levels; and technical dissemination, involved in the production of literature, slides, radio and other mass communications materials in simple language that the farmers can understand. The use of complex Chinese characters, which are not introduced into the educational system until the seventh grade, is avoided.

Bureaucratic record keeping has traditionally been a major element of Confucian-oriented administrations. Korea is no exception; the Office of Rural Development illustrates the rule. Each year the government sets targets of national concern. Although formulated nationally, they take into account provincial and regional capabilities and potential. This year, for example, the major goal in agriculture is the production of 38 million sok of rice (5.4 million metric tons). This overall goal is translated into action plans to achieve targets that are specified in great detail, first at the provincial level, then at the gun, myon, and indeed at the village level as well.

D. The Provincial Level

The Provincial Office of Rural Development in each province prepares annually a detailed plan that specifies production targets by crop and by crop variety or strain, uses of fertilizer and other requirements, and the training that will be required of both trainers and farmers. The provincial office helps carry out those aspects of the Sae-maul Movement that are concerned with production and training. It helps organize the Sae-maul Youth Organization, which was formerly called 4-H Clubs but which has expanded its age cohort from 13 to 24 to a present maximum age level of 29 years. It specifies the number of times national, provincial, or gun radio programs (broadcast daily for 45 minutes) will exhort the farm population to plant, transplant, protect its crops from insects or diseases, as well as when to harvest. This is supplemented by an amplifier system located in every village that warns the population of weather changes that could effect production and how to take advantage, for example, of anticipated, unusually warm weather or how to protect crops from cold. The report specifies how many times pesticides or herbicides should be

applied based on crop and regional variations in altitude and climate. This document becomes the bible of provincial agricultural development for the year. It is normally from 70 to 80 pages in length and is remarkable for its comprehensiveness and thoroughness, taking into account each geographic and climatic variation within the province. Budgets are included for each category of activity. This material is annually supplemented by a provincial agricultural statistical yearbook and a separate report that provides complete data for the province as a whole and for each gun within the province. Within the province, each gun prepares a similar plan, outlining in even greater detail the potential and projected achievements of the county. These printed plans are usually about 70 pages in length, specifying down to the won the projected costs of lunch for those who will be trained.

E. The Village Level

The village does not prepare a printed plan, but in most villages the Sae-maul Movement develops a flip-chart version which is the equivalent of the provincial or gun program. It contains a listing of the number of households, population, and stratification by income, land holdings (paddy and upland), and farm animals. It contains statistics on water, sewage, telephones, tillers, mechanical transplanters, and other important production or social components of village life. The charts list past village improvement projects, and sets targets for new ones. It cajoles the population to improve the village in various ways, from keeping it clean to closing toilet lids. It sets labor requirements for the year for normal village maintenance as well as new projects. The charts estimate costs of projects, and the sources of such income, which has generally fallen more heavily on the villagers themselves. It is, in effect, an appointed village government that uses social pressure to achieve its impressive goals. Lacking a judicial base to tax and set corvee labor requirements, it nevertheless functions as the arm of central authority bringing the village into line with national priorities and acting to speed village change. The Movement is also used as a form of mass mobilization to urge the villages to vote as the government wants. It may not dictate, but its command of the purse strings gives it considerable power.

From the capital to the village, Korea is a nation of planning and flip charts. The importance of planning, however, should not detract from the pervasiveness of implementation. Even if the goals of planning sometimes cannot be met through difficulties such as poor weather or disease, the rigor of the implementation process is a strength that few societies, including socialist ones, have yet to equal. In Korea there is thus massive participation in the development process, however passive or controlled in nature. Alternative centers of power or programs and the questioning of national goals are never overtly or institutionally encouraged. Although farmers may and do grumble they recognize that, overall, their standard of living has generally improved over the past decade.

F. An Illustration : Kangwon Province

To place this abstracted version of provincial and gun planning and implementation in perspective, it is instructive to examine the detailed plans for a single province and gun within that province for 1981.

Kangwon Province is the mountainous area of northeast Korea, with three distinct climatic (and thus agricultural) zones. The slogan and goal of the province for 1981 is "to build the welfare of the rural areas through the green revolution." The policy for the province includes increasing rice yields and safeguarding production through dissemination of new agricultural techniques; spreading innovative cultivation techniques for upland crops; development of specialized production (sericulture, livestock, etc.), as well as cash crops; improving cooperative mechanized farming; expanding the Sae-maul Youth Movement; and making rural life more scientific.

The province is composed of 2,240 villages for which there are 664 rural guidance workers and 27 researchers. There are 119,167 farm households in the province, or 32 percent of the total provincial households, with a population of 614, 343. About 91,157 (63 percent) of farmland is in paddy, and 56,630 hectares in upland (non-irrigated). The majority of the budget for the Provincial Office of Rural Development is derived from the province itself (51 percent), with 46 percent from the national account and an additional 3 percent from the sale of crop production by the office itself Although rice hectarage has essentially remained constant since 1977, per hectare production has varied from 4.41 metric tons (MT) in 1977 to 4.16 MT in 1978, 3.65 MT in 1979, and a massive decrease in production to a low of 1.97 MT in 1980 because of cold weather. There is an anticipated production of 3.93 MT in 1981. The Tongil varieties of rice (high-yielding varieties) dropped from 40 percent of use to only 17 percent in 1981 because farmers fear the cold weather to which Tongil is susceptible.

The province recommends varieties of rice and other crops by region and altitude, as well as the density of planting and fertilizer requirements. It specifies that pesticides should be applied about eight times, depending on crop and variety. It promotes demonstration plots in addition to experimental research. There are two such plots for rice in every village, the government guaranteeing income to the farmer if the demonstration plot fails. In addition there are 40 demonstration plots for soybeans, ten for potatoes, and five for barley and wheat. These demonstration plots provide a continuing and accessible example to all farmers of what their production might be if they follow the recommendations of the guidance workers. This system clearly demonstrates the national priority attached to rice production as both an economic and political goal.

The plan also calls for the use of 4 million man days of farmer assistance through the military and youth organizations in order to assist in timely planting, transplanting, and harvesting. This is critical in a province plagued by rural labor shortages, and is also the impetus for increased mechanization, for in the colder climate double cropping is only

possible with a rapid turnaround of harvesting winter barley or vegetables and the transplanting of rice. A delay of even a few days could mean the failure of maturation of the critical rice crop.

The Kangwon Provincial Office of Rural Development is attempting to raise farm household income to 3.3 million won ($4,500) in 1981. It achieved its objectives of 1.9 million won in 1978 and 2.4 million won in 1979, but fell short of its goal, reaching only 2.5 million won in 1980. These figures in current prices indicate some progress, but in constant won, accounting for inflation, the standard of living has dropped over the past several years.

The training program is very widespread, and at least one member of every farm family receives training each year. Thus, during the non-productive winter months, 3,200 leaders are trained, who in turn train the farmers, most for three days. Stress is on production, but other subjects are also covered. For example, there are 3,676 women's clubs in the province, and about 20,000 women will be trained this year in increased use of barley in cooking (thus using up the barley production and saving rice), and 17,270 in home economics, including the use of home appliances and better clothing. There are 166 "nutrition improvement halls" that will help train wives to preserve 50,000 units of foodstuffs. Two mobile nutritional vans (supplied to each province by UNICEF) will visit 100 villages. There are 333 child care centers in the province and seven villages will be selected for new child nutritional programs. There are in addition 1,933 youth groups with 29,850 members and an additional 110 youth organizations for the 4,540 leader members of the Sae-maul Youth Movement.

The detail is exhaustive. In Heong Sung gun in Kangwon Province, their plan specifies in detail the socioeconomic status of the 10,101 agricultural households (69 percent of all households in the gun) in 587 natural villages (112 legal villages--an unusual ratio because of the mountainous terrain). Since 61 percent of the land in the gun is upland, this poses special problems of production. The relative poverty of the population is reflected in land holdings: 19 percent own less than 0.5 hectares; 31 percent between 0.5 and 1.0 hectares, and 25 percent between 1.0 and 1.5 hectares. Only 10 percent have over two hectares.

The plan specifies that radio will be used 48 times a year in improving agricultural production and that the 152 village amplifier systems will broadcast a total of 60[illegible]mes each month. Some 65,000 publications will also be distributed. There is a potential membership of 4,200 persons in the 13 to 29 age group eligible to join the Sae-maul program, of whom 1,293 are members. They plan to increase membership to 4,000 in 1981.

G. Summary

A successful agricultural research project is dependent on effective demonstration of research results. Three criteria for the successful integration of agricultural research and dissemination through extension thus exist in Korea:

-- Integration of research and guidance at the top of the hierarchy, thus allowing joint planning of research projects and dissemination of research results based on national needs;

-- High level concern for both research and extension at the subcabinet level; and

-- Effective coordination at the village through the county administration.

The integrative aspects of the Korean agricultural research and extension program can thus be considered a model developmental system fostering a remarkable level of implementation.

It is this strength, however, that leads to an elemental weakness in the Korean system. Although such a system could theoretically be considered potentially productive in any national bureaucracy, in the Korean context it has worked effectively because of the strong hierarchical nature of Korean society that drives compliance with objectives set from above. Thus each level of the bureaucracy responds with a virtual frenzy of activity to achieve the targets, and quite often they are successful. The drive for implementation, however, has demonstrably resulted in short-term effectiveness but with much less assurance of longer-range continued success. Massive spraying of pesticides and herbicides has dramatically increased yields, but the longer-range effects of pollution and disease are now being increasingly noted in the Korean press. It may be that such revelations have specified non-priority crops, such as fruits, either because they are more apparent or because they do not conflict with governmental priorities.

The introduction of the Tongil high yielding varieties of rice was massively encouraged throughout the country, and hundreds of tons of seed were airlifted to Korea from the Philippines for this purpose. Yet rice blast (fungus) has been known to be a problem with the new varieties of rice after a few years of cultivation, and early project documentation mentioned the susceptibility of Tongil to cold. In an effort to raise production these potential damages, if not overlooked, were not sufficiently anticipated by the bureaucracy, although key researchers warned against them. It was the overdependence on Tongil rice and its effective distribution through the guidance system that brought about both Korean self-sufficiency in rice and the highest per hectare rice yields in the world, as well as the crop disaster of 1980 due to cold weather. Better overall results might have been achieved had the government been less insistant on its political goal of rice self-sufficiency (Korea had the foreign exchange to import twice the amount grown with the same funds it paid to farmers), followed more prudent dissemination policies, and concerned itself with a continuing, effective, adaptive research program.

President Chun Doo-whan in May 1981 called for self-sufficiency in food production. This goal is a political objective that under present circumstances cannot be met. Even with self-sufficiency in rice and an

upturn in barley hectarage, wheat imports are still so enormous that this goal is impossible without massive, probably forced, changes in dietary patterns. At the same time President Chun called for the elimination of false statistics--those based on what the leadership wants to hear. But a bureaucracy that is predicated on a command system will have great difficulty in responding to both exhortations at the same time, for in the Korean context they are in conflict. It is likely that, as the political imperatives take precedence, agricultural research and guidance will be pushed to the utmost level to achieve targets and that statistics at the national level will be manipulated to prove compliance and success.

The Korean agricultural research system has thus been remarkably effective. It does contain an "Achilles Heel"--one that is not a product of its agricultural program, but rather of its political culture.

APPENDIX H

AGRICULTURE IN CHEJU PROVINCE

The isolated island of Cheju is slightly larger than Oahu in area, and located some 50 miles off the southern-most tip of the mainland. Volcanic in origin, Cheju was until recently the poorest province of Korea. It remained a distinctive subculture of Korean society, with a separate, essentially unintelligible, dialect of Korean and a society more matriarchal in practice than the mainland. A site for exiles from the court as well as outcasts and criminals, it was wracked by a peasant and communist rebellion in 1948 that significantly lowered the male population ratio and fostered continued poverty.

The normalization of relations with Japan gave Cheju an early opportunity for change. Japanese regarded Cheju as an island retreat close to home as well as inexpensive, and Cheju residents in Japan returned often with significant funds for local investment.

Fishing still remains as the mainstay of the island's economy. In recent years, there has been a growing emphasis on both the tourist and livestock industries. As a result, the relative importance of farming activities has recently somewhat declined.

The island's climate is warmer than that of the mainland. The yearly average temperature is 15.8°C with the monthly average varying between 7.5°C and 28.6°C. The island has the highest precipitation in Korea, which averages about 2000 mm per year. The climate is suitable for growing citrus fruit, particularly on both the northern and southern coasts, and for cultivating pineapples on the southern coast. The total area of the island is 1,825,000 hectares (ha) out of which the cultivated area covers 53,162 ha, accounting for only 2.7 percent of the total area. Because of its volcanic origin, the cultivable area is mostly limited to the coastal belt around the island. Paddy fields cover less than 2 percent of the cultivated land with the remaining in upland fields.

Cultivated area per capita of the farming population in Cheju was 0.22 ha in 1979, which is slightly above the national average of 0.2 ha. Because of the climatic condition, the land utilization ratio on the island is 146 percent, exceeding that of the mainland by about 16 percent. Many farmers also engage in off-farm activities (fishing, livestock, or tourism). Per hectare yields in many crops are also higher relative to those on the mainland. These factors have contributed to increased farm income in Cheju at a rate faster than that on the mainland in recent years.

Both white and sweet potatoes are important cash crops. Cheju is the only province in Korea in which white potato production is increasing, due mainly to the export market found on the mainland, particularly during the winter months. In 1979 there were about 1,000 ha of white potatoes and 12,000 of sweet potatoes. The productivities of these two crops were

11 and 23 tons per hectare respectively. Sweet potatoes are generally planted after barley or rape and harvested in the fall when they are sliced and dried prior to export to the mainland where the slices are used as a source of starch in the production of alcohol for beverages.

Vegetable production includes an estimated 1,900 tons of cucumbers, 3,000 tons of sweet melons and watermelons, 35,000 tons of Chinese cabbage, 1,300 tons of cabbage, and 7,400 tons of garlic. Thus, vegetable crops are important to the island's economy and people's diet.

The crop husbandry carried out on the island appears to be very intensive and well carried out. The fields are relatively small and walled in by volcanic rocks cleared from the fields. Herbicides are used to a very limited extent, chiefly in the citrus orchards. The use of fused phosphate was introduced to the farmers during the period 1973 to 1975; this had a very marked effect on the increase in productivity of the crops. This plant nutritional element has undoubtedly done more for Cheju's agricultural production than any other single or combined factors.

One of the striking differences between Cheju Island and the mainland is the relatively small area devoted to paddy rice cultivation, less than 900 ha each year. Rice production is practically inconsequential to the agricultural economy. Paddy fields have not been developed due to the porous nature of the soils that cannot retain water.

Another contrast between the island and mainland is the flourishing cash crop economy. In both areas, rice is the chief food but very little of it is produced in Cheju. Barley is the most important crop; 17,000 ha are grown as a winter crop. Two-thirds is naked barley for food and the remaining one-third is two-row for malt, which is grown under contract with the two breweries on the mainland. The productivity of each barley crop is about the same, 2.8 tons per hectare. Imported rice is mixed with the pearled barley to form the basic diet of the people.

Rape is the most important cash crop, as about three-fourths of Korea's production, or 21,000 tons, is from Cheju. The productivity is 2.3 tons per hectare, nearly equal to barley. The seed is exported to the mainland where it is pressed for oil, one of the important edible oils in Korea. Thus, because rape seed demands a higher price than barley, its gross revenue is about 300 percent more per bag.

The areas cultivated with soybeans has remained practically constant over the past decade at a level of slightly less than 10,000 ha and a productivity of 1.0 ton per hectare, about 25 percent lower than the national average. Some of the soybeans are consumed locally as bean sprouts, but the majority of the crop is shipped to the mainland for pressing into oil.

In short, the farmers on the island appear better off compared with their counterparts on the mainland. Among other reasons, increased per hectare yields in the mid-1970s can be singled out as the most significant contributing factor. Higher yields were realized not so much through implementation of agricultural results as by judicious uses of fertilizers. Thus, the situation in Cheju is unique and distinct from that in the mainland Korea.

APPENDIX I

PROJECT-SPECIFIC DATA

Table I-1. Chronology of the Korea Agriculture Research Project

1972	Completion of Korean Agricultural Sector Survey by Michigan State University recommending an expanded program of agricultural research.
Nov. 11, 1972	Korean Government submitted a proposal of $7 million to AID for agricultural research for the period 1974-1977.
May 17, 1973	After consultation, Korean proposal revised to $5 million for the period 1974-1978.
Sept. 3, 1973	Office of Rural Development submitted a project work plan to AID.
Dec. 5, 1973	Project paper submitted by Korea Mission to AID Washington.
Dec. 5, 1973	Project approved by AID Washington.
Jan. 28, 1974	Signing of US-ROK Loan Agreement.
Feb. 21, 1974	Korean announcement of the Agreement. (Presidential Ordinance #54)
Sept. 8, 1974	Appointment of the Korean Director and U.S. Co-Director of the project. (Co-Director Dr. Omer J. Kelley).
Nov. 14, 1974	Service Contract with the Institute of International Education (IIE) for Administrative Support in Placing Trainees, Advisors, and Procurement.
Jun. 5, 1975	1st Steering Committee Meeting held to determine interdisciplinary research priorities.
Sept. 5, 1975	2nd Steering Committee Meeting held.
Feb.6, 1976	3rd Steering Committee Meeting held.
Apr. 19, 1977	4th Steering Committee Meeting held.
Nov. 7, 1977	Terminal Date of Disbursement Authority (TDDA) and Terminal Date of Disbursement (TDD) extended TDDA : Jan. 28, 1978 --- Jan. 28, 1979 TDD : July 28, 1979 --- Sept. 30, 1980
Feb. 1, 1978	5th Steering Committee Meeting held.
Jun. 6, 1978	Arrival of project evaluation group of 3 persons from AID Washington.

Table I-2. Total Research Under AID Loan

(Unit: 1000 Won)

Class	Field	'74		'75		'76		'77		'78		Total	
		Items	Budget	Items	Budget	Items	Budget	Items	Budget	Items	Budget	Items	Budget
Experimental Research	Rice	3	10,500	17	17,099	15	16,050	12	20,746	9	8,532	56	72,943
	Wheat & Barley	5	15,500	12	14,024	30	16,958	15	11,270	3	7,500	65	65,258
	Soybean	3	3,249	11	10,174	24	17,755	17	14,672	7	6,000	62	51.850
	Potato	1	4,448	10	9,642	16	11,500	13	9,470	11	8,500	51	43,560
	Cropping System	1	3,000	13	12,244	17	20,392	17	17,984	15	14,241	63	67,861
	Sub-Total	13	36,697	63	63,183	102	82,655	74	74,142	45	44,793	297	301,470
Contract Research	Rice	-	-	1	1,400	1	2,000	2	2,875	1	2,100	5	8,375
	Wheat & Barley	-	-	1	600	2	2,220	1	830	2	1,700	6	5,350
	Soybean	-	-	1	500	1	580	2	1,440	1	600	5	3,120
	Potato	2	1,299	1	500	1	600	1	570	1	800	6	3,769
	Cropping System	14	6,209	3	1,985	3	3,065	3	7,790	3	2,800	26	21,849
	Sub-Total	16	7,508	7	4,985	8	8,465	9	13,505	8	8,000	48	42,463
	Total	29	44,205	70	68,168	110	91,120	83	87,647	53	52,793	345	343,933

Table I-3. Rice Yield of Leading Varieties and Breeding Lines

(1971-'80 Regional Yield Trials)

Year	Location	No. of Varieties		Yield (MT/ha)		
		Leading Variety	Breeding Line	Leading Variety	Breeding Line	Yield Index
1971*	Suwon	2	5	3.44	3.41	99
	Iri	2	2	3.51	3.64	104
	Milyang	2	2	3.05	3.08	101
	Ave.	-	-	3.33	3.37	101
1974	Suwon	2	11	4.28	3.88	91
	Iri	3	5	2.74	4.03	147
	Milyang	4	3	1.84	3.93	213
	Ave.	-	-	2.95	3.95	133
1977	Suwon	6	7	5.00	5.13	103
	Iri	7	5	4.44	4.27	96
	Milyang	7	3	3.80	4.21	111
	Ave.	-	-	4.41	4.54	103
1980	Suwon	6	5	4.66	4.64	100
	Iri	4	3	4.71	4.86	103
	Milyang	3	5	4.17	3.83	92
	Ave.	-	-	4.51	4.44	98

*These 1971 yield data are lower than that for Tongil as stated in other Korean publications.

Table I-4. Barley Yield of Leading Variety/Breeding Line

Year	Location	No. of Var./Line		Yield (MT/ha)			No. of Resistant Var./Line			
							Cold Tolerance		Lodging Resistance	
		Leading Variety	Breeding Line	Leading Variety	Breeding Line	Yield Index (%)	Leading Variety	Breeding Line	Leading Variety	Breeding Line
1971	Suwon	3	12	3.42	3.25	95	3	10	1	6
	Iri	-	-	-	-	-	-	-	-	-
	Milyang	4	9	4.88	5.00	102	3	8	1	6
	Ave.	-	-	4.15	4.13	100				
1974	Suwon	3	12	3.54	3.68	104	2	5	1	8
	Iri	3	12	3.30	3.47	105	1	5	1	5
	Milyang	3	13	4.57	4.93	108	1	5	1	5
	Ave.	-	-	3.80	4.03	106				
1977	Suwon	3	8	3.84	3.89	101	1	4	2	8
	Iri	3	8	4.59	4.13	90	1	4	2	3
	Milyang	3	9	3.81	4.09	107	-	6	2	4
	Ave.	-	-	4.08	4.04	99				
1980	Suwon	3	11	3.42	3.63	106	-	7	2	9
	Iri	2	11	4.00	2.64	66	-	7	2	9
	Milyang	3	12	4.18	4.44	106	-	11	2	9
	Ave.	-	-	3.87	3.57	92				

Table 1-5. Wheat Yield of Leading Variety and Breeding Line

Year	Location	No. of Var./Line		Yield (MT/ha)			No. of Resistant Var./Line			
							Cold Tolerance		Lodging Resistance	
		Leading Variety	Breeding Line	Leading Variety	Breeding Line	Yield Index	Leading Variety	Breeding Line	Leading Variety	Breeding Line
1971	Suwon	3	10	2.64	2.80	106	3	9	1	4
	Iri	3	14	4.28	4.04	94	2	9	1	8
	Milyang	3	14	4.20	3.89	93	2	9	-	3
	Ave.			3.71	3.58	96				
1974	Suwon	3	11	3.70	4.37	118	3	7	1	5
	Iri	3	12	4.43	3.88	88	2	7	1	9
	Milyang	3	13	3.75	4.25	113	2	7	1	6
	Ave.			3.96	4.17	105				
1977	Suwon	3	7	3.96	2.37	60	3	3	1	4
	Iri	3	7	4.52	4.40	97	2	4	1	7
	Milyang	3	7	4.31	4.50	104	2	6	1	6
	Ave.			4.26	3.76	88				
1980	Suwon	3	13	5.36	3.38	63	3	5	1	8
	Iri	3	11	4.10	4.33	106	3	9	1	6
	Milyang	3	14	4.43	4.48	101	3	12	1	7
	Ave.			4.63	4.06	88				

Table I-6. Soybeans (The Results of Regional Yield Trials)

Year	Location	No. of Entries		Yield (MT/ha)		Degree of SMV Resistance*					
		Released Cultivar	Breeding Line	Released Cultivar	Breeding Line	Released Cultivar			Breeding Line		
						R	M	S	R	M	S
1971	Suwon	3	14	1.78	1.90(107)	3	-	-	13	1	-
	Yuseong	2	10	2.04	1.99(98)						
	Kwangju	2	11	2.41	2.77(115)						
1974	Suwon	4	9	2.24	2.16(96)	-	3	1	-	5	4
	Yuseong	3	6	2.23	2.56(115)						
	Kwangju	2	9	3.18	3.08(97)						
1977	Suwon	2	16	2.65	2.64(100)	-	-	2	3	-	13
	Yuseong	2	9	3.12	3.12(100)						
	Kwangju	2	10	2.54	2.82(111)						
1980	Suwon	2	15	2.08	2.08(95)	1	-	1	13	-	2
	Yuseong	3	13	2.08	1.87(90)						
	Kwangju	2	15	1.81	1.76(97)						

* 1971: SMV, 1974-1980: SMV-N ( ) Yield index (%)

Table I-7. Potato Yield of Leading Varieties and Breeding Lines

Year	Location	No. of Varieties		Yield (MT/ha)			No. of Virus Resistant Varieties / Lines	
		Leading Variety	Breeding Line	Leading Variety	Breeding Line	Yield Index	Leading Variety	Breeding Line
1974	Kangnung	1	10	30.15	31.56	105	1	4
	Suwon	1	10	34.99	28.21	82	1	5
	Kwangju	1	10	23.37	24.07	103	1	-
	Ave.	-	-	29.50	27.95	95	-	-
1977	Kangnung	1	9	36.60	40.95	112	1	1
	Buchon	1	9	14.87	16.25	109	1	3
	Kwangju	1	9	21.10	20.17	96	1	3
	Ave.	-	-	24.19	25.79	107	-	-
1979	Suwon	2		13.10	12.23	93	2	3
	Kwangju	2	3	16.92	10.92	65	2	3
	Chilgok	2	3	10.68	9.30	87	2	3
	Ave.	-	-	13.57	10.82	80	-	-

Table I-8. Name and Present Position of Participants Trained Under CIRC Project

Name	Attended University	Present Position	Field
1. Ph.D Course			
Lee, Seung Chan	University of Louisiana	Agriculture Sciences Institute	Rice Insect
Hong, Byung Hee	Washington State University	Wheat & Barley Research Institute	Wheat Breeding
Cho, Eui Kyoo	University of Illinois	Agriculture Sciences Institute	Soybean Insect
Chang, Suk Hwan	Cornell University	Int'l. Cooperation Division, ORD	Biological Statistics
Lee, Young In *	University of Illinois	Agriculture Mechanization Inst.	Soybean Insect
Lee, Yong Kook	Kansas State University	" "	Farm Machinery
Kwun, Soon Kuk	Ohio State University	Professor, Seoul National Univ.	Land Development
Kim, Yong Wook	University of Missouri	Crops Experiment Station	Soybean Physiology
Kim, Soon Chul	IRRI	Yeongnam Crops Experiment Station	Weed Control
Jung, Young Sang	Ohio State University	Agriculture Sciences Institute	Soil Mangement
Kang, Yong Gir	University of Arkansas	Crops Experiment Station	Rice
Lee, Moon Hong *	University of Minnesota	Agriculture Sciences Institute	Potato Insect
Woo, Ki Dae	University of Missouri	" "	Insectology
Mok, Il Jin *	University of Wisconsin	Horticulture Experiment Station	Potato Breeding
Chung, Moo Nam *	University of Missouri	Wheat and Barley Research Inst.	Agricultural Economics
Seo, Wan Soo	" "	Farm Management Bureau, ORD	" "
Cho, Jeong Tae *	Washington State University	Horticulture Experiment Station	Potato
No, Yong Duk *	University of Wisconsin	Crops Experiment Station	Rice Physiology
Eun, Moo Young	University of Louisiana	Honam Crops Experiment Station	" "
Moon, Hun Pal *	University of California	Crops Experiment Station	Rice Breeding
Lee, Yong Seok	University of Vermont	(Deceased in 1980)	Soil Chemistry

Total 21 persons

* 7 persons are still studying in the U..S.

Table I-8 (continued)

Name	Attended University	Present Position	Field
2. M.S. Course			
Choi, Eui Kyoo	University of Illinois	Agriculture Sciences Institute	Soybean Disease
Seong, Jae Mo	University of Washington	" "	Wheat Disease
Jung, Pil Kyun	University of Alkansas	" "	Soil Physics
Jung, Dong Hee	The University of Iowa	Wheat & Barley Research Inst.	Soil Chemistry
Kim, Jang Kyu	IRRI	Agriculture Sciences Institute	Botanical Pachology
Hwang, Young Hyun	University of Wisconsin	Crops Experiment Station	Soybean Pathology
Park, Chang Seo	University of New Mexico	Agriculture Sciences Institute	Soil Physics
Chun, Jong Eun	University of Washington	Jeonbuk Province, ORD	Wheat Breeding
Jeong, Gil Woong	University of Illinois	Dankuk University	Soybean Breeding
Han, Young Il	University of Wisconsin	Alpine Experiment Station	Potato Disease
Kwak, Tae Soon	IRRI	Crops Experiment Station	Rice Breeding
Han, Hwang Gi	University of Oregon	Kangwon Province, ORD	Wheat
Cho, Wang Soo	University of Colorado	Agriculture Sciences Institute	Insect Control
Sung, Lak Choon	University of Missouri	Crops Experiment Station	Cropping Rotation
Lee, Seok Soon	University of New Hampshire	Professor, Yeongnam University	Rice Physiology
Choi, Byung Hwan	University of Oregon	Studying towards Ph.D	Wheat
Oh, Nam Hwan	University of Kansas	" "	Wheat Breeding
Total 17 persons			
3. Short-term Training			
1974 2 persons			
Han, Byung Hee		Alpine Experiment Station	Potato
Kang, Eung Hee		" " "	"
1976 5 persons			
Park, Kun Yong		Crops Experiment Station	Soybean
Huh, Han Soon		Research Bureau, ORD	Wheat
An, Soo Bong		Crops Experiment Station	Rice
Lee, Jae Chang		Chungnam National University	Cropping
Park, Jung Yun		Agriculture Sciences Institute	Wheat

Table I-8 (continued)

Name	Present Position	Field
1977 12 persons		
Oh, Yang Ho	Honam Crops Experiment Station	Wheat
Han, Wook Dong	Research Bureau, ORD	Tropical Agriculture
Chung, Young Sang	Agriculture Sciences Institute	" "
Kim, Ho Il	Crops Experiment Station	Soybean
Chu, Yeon Dae	Gyeongbuk Province, ORD	Seed Improvement
Cho, Jeong Ik	Agriculture Sciences Institute	Rice
Yun, Sang Bog	Crop Improvement Research Center, ORD	Checking AID Project (CIRC)
Kang, Yang Soon	Yeongnam Crops Experiment Station	Nitrogen
No, Nong Ju	Research Bureau, ORD	Library Information
Kim, Kang Kwon	Horticulture Experiment Station	Potato
Kim, Sun Kyung	Research Bureau, ORD	"
Mun, Myung Gui	Crops Experiment Station	Corn
1978 46 persons		
Kim, Kwang Ho	Crops Experiment Station	Rice Breeding
Jang, Chang Moon	Agriculture Sciences Institute	Wheat
Kim, Sung Pil	Crop Improvement Research Center, ORD	"
Lee, Dong Chang	Crops Experiment Station	"
Moon, Yun Ho	Yeongnam Crops Experiment Station	Crops Analysis
Lee, Jin Sook	Crop Improvement Research Center, ORD	Analysis Method
Song, Yung Nam	Kangwon National University	Wheat
Lee, Bong Ho	Yeongnam Crops Experiment Station	Barley
Oh, Yun Seop	Honam Crops Experiment Station	"
Han, Weon Sik	Farm Management Bureau, ORD	Computer
Kim, Jae Hyuk	Secretary, Deputy Director-General, ORD	Wheat
Kim, Kil Woong	Geyongbuk National University	Weed Control
Han, Dae Seong	Kangweon National University	Rice
Yuh, Han Joon	Geyongnam Province, ORD	"
Yuh, In Soo	Wheat and Barley Research Institute	Wheat
Lee, Eun Sup	" " "	Soybean
Seong, Il Jang	Horticulture Experiment Station	Potato

Table I-8 (continued)

Name	Present Position	Field
1978 (Cont'd)		
Jeong, Kun Sik	Crops Experiment Station	Rice
Cho, In Sang	Agriculture Sciences Institute	Soil
Ryu, Kyung Han	Research Bureau, ORD	Research Management
Hong, Eun Hee	Crops Experiment Station	Soybean
Cha, Kwang Ro	Wando Gun Rural Guidance Office, Junnam Province	Agriculture Information
Cho, Kyu Sun	" " " "	" "
Kim, Hwee Cheon	Horticulture Experiment Station	Seed Improvement
Chang, Seong Kun	Kangwon Province, ORD	" "
Song, Yu Han	Retirement from ORD	Computer
Oh, Hyung Youl	Agriculture Sciences Institute	Soil
Han, Sang Chan	" " "	Insect
Maeng, Don Jae	Wheat and Barley Research Institute	Wheat
Yun, Seong Ho	Crops Experiment Station	Weed Control
Kim, Kyu Weon	Crops Experiment Station	Rice
Kim, Byung Hyun	Gyeongnam Province, ORD	Soil
Hee, Sang Seok	Technical Dissemination Bureau, ORD	Plant Protection
Ryu, Jae Gi	Agriculture Sciences Institute	" "
Lee, In Jae	International Cooperation Division, ORD	Farm Management
Choi, Bock Hyun	Jeonnam National University	Cropping System
Shin, Kwan Chul	Agriculture Sciences Institute	Plant Protection
So, Jae Sun	Crops Improvement Research Institute, ORD	" "
An, Wan Sik	Wheat and Barley Research Institute	Wheat Breeding
Yun, Eui Byung	" " "	" "
Seo, Deuk Yong	Yeongnam Crops Experiment Station	" "
Chung, Tal Young	Wheat and Barley Research Institute	Barley
Park, Young Sun	Research Bureau, ORD	Agriculture Research
Ha, Yong Woong	Wheat and Barley Research Institute	Wheat
Ko, Il Woong	Rural Guidance Bureau, ORD	In the U.S.
Lee, Soon Hyung	Agriculture Sciences Institute	SEM Use

Table I-8 (continued)

Name	Present Position	Field
1979 29 persons		
Oh, Sung Do	Jeonbuk National University	Horticulture
Bae, Dong Ho	Livestock Experiment Station	Livestock
Cho, Kwang Ho	Farm Management Bureau, ORD	Livestock Management
Park, Chang Sik	Chungnam National University	Grass Development
Yun, Jin Young	Horticulture Experiment Station	Horticulture
Chang, Hak Gil	Wheat and Barley Research Institute	Wheat
Kun, Seok Dong	Crops Experiment Station	Wheat Breeding
Lee, Myung Hoon	Farm Management Bureau, ORD	Computer
Kang, Kwang Hee	Crops Experiment Station	Upland Crops
Kwon, Weon Dal	Chungbug National University	Farm Management
Kim, Seung Jae	Farm Management Bureau, ORD	FMG Analysis
Han, Sang Soo	Research Bureau, ORD	FMG Analysis
Lee, Chong Woo	Gyeonggi Province, ORD	Upland Crops
Han, Eui Dong	Chungbug Province, ORD	Soybean
Baek, Hyun Jun	Sericulture Experiment Station	Sericulture
Lee, Han Kyu	Jeonnam Province, ORD	Weed Control
Kim, Hee Kyung	Rural Guidance Bureau, ORD	Rural Nutrition
Lee, Chong Hoon	Crops Experiment Station	Rice
Hwang, Nam Youl	Jeonbug Province, ORD	Soil Analysis
Hwang, Chang Hyun	Agriculture Sciences Institute	Rice Insect
Choi, Yong Chul	" " "	Rice Disease
Kim, Ho Young	Yeongnam Crops Experiment Station	Rice Breeding
Kim, Seung Chul	Agriculture Sciences Institute	Disease Control
Jeong, Hong Do	Technical Dissemination Bureau, ORD	Rice Disease
Lee, Byung Yong	Farm Mechinery Institute	Food Processing
Moon, Hui Sook	Rural Guidance Bureau, ORD	Nutrition
Choi, Jin Kyu	Horticulture Experiment Station	Vegetable
Kim, Bock Jin	Agriculture Sciences Institute	Pollution
Oh, Joong Youl	Gyeongbug Province, ORD	Vegetable Breeding
Total 94 persons		

Table I-8 (continued)

Name	Present Position	Field
4. Participation to International Meetings and Observation		
1975 **2 persons**		
Han, Sung Kum	Farm Machinery Research Institute	Farm Machinery
Lee, Yong Kook	" " "	" "
1976 **8 persons**		
Chung, Bong Joe	(Deceased)	Soybean
Lee, Hong Seok	Seoul National University	"
Choi, Hyun Ok	Crops Experiment Station	Observation
Ham, Yong Soo	" " "	"
Lee, Chang Koo	Veterinary Research Institute	"
Huh, Moon Hee	Seoul National University	Rice
Chung, Kun Sik	Crops Experiment Station	"
Lee, Eun Woong	Seoul National University	"
1977 **14 persons**		
Lee, Chong Hoon	Crops Experiment Station	Weed Control
Kim, Kil Woong	" " "	" "
Shin, Dong Wan	Farm Management Bureau, ORD	AID Project
Chung, Bong Koo	Agriculture Sciences Institute	Disease
Chung, Hoo Sup	Seoul National University	"
Lee, Yong Seok	(Deceased)	Analysis
Park, Cheon Seo	Agriculture Sciences Institute	Soil
Choi, Hyun Ok	Crops Experiment Station	Rice
Park, Tae Kyung	Yeongnam Crops Experiment Station	"
Kim, Dong Soo	Research Bureau, ORD	"
Park, Seok Hong	Honam Crops Experiment Station	"
Chung, Bong Joe	Agriculture Sciences Institute (Deceased)	"
Park, Jong Soo	" " "	"
Kim, Soon Kwon	Crops Experiment Station	Weed Control

Table I-8 (continued)

Name	Present Position	Field
1978 14 persons		
Park, Ki Hyuk	Yeonsi University	Title 12
Ham, Young Il	Alpine Experiment Station	Potato
Kim, Young Sang	Wheat and Barley Research Institute	Wheat
Bae, Seong Ho	" " "	"
Min, Kyung Soc	" " "	"
Kim, Soon Kwon	Crops Experiment Station	Weed Control
Lim, Moo Sang	" " "	Rice
Chang, Kwon Youl	Gyeong Sang University	Agriculture
Park, Chong Moon	Governor, Kangwon Province	Observation
Hong, Soon Bum	Horticulture Experiment Station	"
Park, Tae Kyung	" " "	"
Han, Ki Hak	Agriculture Sciences Institute	"
Shin, Dong Wan	Farm Management Bureau, ORD	"
Kim, Soon Kwon	Crops Experiment Station	Agriculture
1979 44 persons		
Ji, Sul Ha	Livestock Bureau, Ministry of Agriculture and Fisheries	Livestock
Chung, Jae Hyuk	Technical Dissemination Bureau, ORD	Grass Development
Lee, Chong Seok	Horticulture Experiment Station	Observation
Kim, Duk Lae	Kangwon Province, ORD	"
Kim, Yeon Jin	Chungnam Province, ORD	"
Lee, Hong Lae	Gyeongnam Province, ORD	"
Koo, Young Seo	Jeonbug Province, ORD	"
An, Chang Soo	Gyeonggi Province, ORD	"
Um, Tae Young	Tongyoung Gun, ORD	"
Lee, Tae Seung	Jeonbug Province, ORD	"
Yang, Byung Hee	" " "	"
Jin, Kyung Youl	Gyeongbug Province, ORD	"
Kim, Chong Ho	Crops Experiment Station	"
Park, Kun Yong	Research Bureau, ORD	Soybean

Table I-8 (continued)

Name	Present Position	Field
1979 (Cont'd)		
Ryu, Kyung Ho	Prime Minister's Office	Observation
Kim, Dal Joong	Chungnam Province, ORD	"
Song, Chun Jong	Jeonnam Province, ORD	"
Lee, Yong Seok	(Deceased)	"
Choi, Choong Hak	Rural Nutrition Institute, ORD	"
Huh, Il Bum	Rural Guidance Bureau, ORD	"
Yuh, Hae Un	Technical Dissemination Bureau, ORD	"
Kang, Yong Sik	Jeonnam Younglewang Gun, ORD	"
Cho, Kwang Hoon	Gyeonggi Province, ORD	"
Park, No Kyung	Chungnam Province, ORD	"
Yuh, Young Pyo	Jeonnam Province, ORD	"
Hwang, Pil Saeng	Gyeongnam Province, ORD	"
Kim, Young Hwui	Jeju Province, ORD	"
Lee, Weon Woo	Kangwon Province, ORD	"
Koo, Kang Hui	Research Bureau, ORD	"
Lee, Dong Woo	Kangwon Province, ORD	"
Jeong, In Myung	Chungbug Province, ORD	"
Park, Gun Ho	Jeonbug Province, ORD	"
Lee, Kwang Suk	Gyeongbuk Province, ORD	"
Ryu, Chang Jae	Horticulture Experiment Station	"
Hong, Chul Sun	Research Bureau, ORD	"
Chung, Joong Rae	International Cooperation Division, ORD	"
Han, Mak Maan	Research Bureau, ORD	"
Lee, Soo Kwan	Yeongnam Crops Experiment Station	"
So, Jae Don	Honam Crops Experiment Station	"
Ryu, Un Ha	Farm Management Bureau, ORD	"
Shin, Gun Sik	Information Division, ORD	"
Cha, Kwang Ro	Wandogun Rural Guidance Office, Jeonnam Province	"
Yun, In Hwa	Farm Machinery Research Institute	"
Ryu, Chang Hyun	Agriculture Sciences Institute	"

Table I-8 (continued)

Name	Present Position	Field
1980 24 persons		
Han, Weon Sik	Farm Management Bureau, ORD	Computer
Kang, Hee Young	Chunam Province, ORD	Observation
Choi, Duk Hwan	Rural Guidance Bureau, ORD	"
Huh, Han Soon	Research Bureau, ORD	"
Shim, Sang Woo	Rural Guidance Bureau, ORD	"
Lee, Duk Yong	Technical Information Division, ORD	"
Park, Nam Jong	Agriculture Machinery Research Institute	"
Lee, Cheon Ho	Icheongun Rural Guidance Office, Gyeonggi Province	"
Lee, Hyun Soon	Kangwon Province, ORD	"
Lee, Sung Hee	Chungbug Province, ORD	"
Ryu, Dong Seok	Gyeonggi Province, ORD	"
Kim, Myung Il	Jeonbug Province, ORD	"
La, Joon Soo	Boesunggun Rural Guidance Office, Jeonnam Province	"
Choi, Eui Soon	Gyeongbuk Province, ORD	"
Kim, Seong Hwui	Gyeongnam Province, ORD	"
Ko, Tae Chong	Jeju Province, ORD	"
Choi, Eul Ho	Pusan City, ORD	"
Hong, Yu Ki	Gyeonggi Province, ORD	"
Park, Joong Soo	Agriculture Sciences Institute	"
Lee, Kyong Hwee	Technical Dissemination Bureau, ORD	"
Park, Suk Hong	Honam Experiment Station	"
Lee, Soo Kwan	Yeongnam Experiment Station	"
Chang, Seok Hwan	International Cooperation Division, ORD	"
Lee, Seok Soon	Yeongnam University	"
Total 106 persons		

Table I-9. Current Status and Utilization of Equipment Procurred by Crop Improvement Research Center Project. (Items by Institutes)

Institutes	Different Items	Total Number of Items	Amount
Crops Experiment Station	135	195	186,166.22
Honam Crops Experiment Station	48	59	58,485.49
Yeongnam Crops Experiment Station	53	75	61,512.00
Wheat & Barley Research Institute	50	73	141,498.36
Agricultural Sciences Institute	49	96	170,650.64
Horticultural Experiment Station	15	20	17,055.09
Farm Machinery Research Institute	14	16	133,725.02
Alpine Experiment Station	16	27	22,306.25
Jeju Experiment Station	4	4	7,527.00
Computer Room	2	15	247,657.00
Central Laboratory	112	320	417,200.54
Library	16	19	65,815.31
Provincial Office of Rural Development	4	27	149,86f 77
Total	518	946	1,679,465.70

APPENDIX J

SOCIOECONOMIC STATISTICS

Table J-1. Major Indicators of Korean Agriculture

Item	Unit	'62	'65	'70	'75	'78	'79
1. Land utilization							
Total land (A)	1000ha	9,843	9,843	9,848	9,881	9,895	9,897
Cultivated land (B)	"	2,063	2,256	2,298	2,240	2,222	2,207
B/A	%	21.0	22.9	23.3	22.7	22.5	22.3
Paddy	1000ha	1,223	1,286	1,273	1,277	1,312	1,311
Upland	"	840	970	1,025	963	910	896
Forest	"	6,695	6,614	6,611	6,635	6,578	6,608
Others	"	1,086	973	939	1,006	1,095	1,082
Farm size/household	ha	0.84	0.91	0.86	0.94	0.99	1.02
Paddy	"	0.50	0.52	0.48	0.54	0.59	0.60
Upland	"	0.34	0.39	0.38	0.40	0.40	0.42
Utilization ratio of cultivated land	%	143.5	147.1	142.1	140.4	134.5	130.9
2. Population							
Total population (A)	1000 person	26,513	28,705	31,435	34,681	37,019	37,605
Farm population (B)	"	15,097	15,812	14,422	13,244	11,528	10,883
B/A	%	56.9	55.1	45.9	38.2	31.1	28.9
No.of total household (A)	1000 house-hold	4,589	4,844	5,856	6,757	7,256	7,539
No.of farm Household (B)	"	2,649	2,507	2,483	2,379	2,224	2,162
B/A	%	57.7	51.8	42.4	35.2	30.7	28.7
3. Economic indicator							
G.N.P.(current price (A)	bil.won	355.5	805.7	2,684.0	9,792.9	22,917.6	29,553.7
Agri.products (current price (B)	"	118.5	265.9	611.7	1,994.4	4,236.4	5,141.0
B/A	%	33.3	33.0	22.9	20.7	18.5	17.4
G.N.P.per capita	$	86	105	243	574	1,279	1,624
Export	mil.$	55	175	882	5,003	12,500	15,056
Import	"	390	416	1,804	6,674	13,200	20,339
Balance of trade	"	*335	*241	*922	*1,671	*700	*5,283
Wholesale price index	%	16.1	28.8	42.0	100.0	136.5	162.1
Consumer price index	"	13.9	27.5	49.1	100.0	145.3	171.9
Farm household income (A)	1000won	67.9	112.2	255.8	872.9	1,884.2	2,227.5
Urban worker's income (B)	"	96.6	112.6	381.2	859.3	1,916.3	2,629.6
A/B	%	70.3	99.6	67.1	101.6	98.3	84.7

Table J-1 (continued)

Item	Unit	'62	'65	'70	'75	'78	'79
4. Agricultural indicator							
A. Consumption per household							
Urban-household							
Living expenditure	won	68,880	117,360	359,400	755,520	1,488,600	2,021,316
Food expenditure	"	34,680	66,600	145,440	333,960	594,240	737,232
Engel's coefficients	%	50.3	56.7	40.7	44.2	39.9	36.5
Farm-household							
Living expenditure	won	55,740	100,492	207,766	616,280	1,320,508	1,662,168
Food expenditure	%	31,150	53,373	95,445	291,508	505,253	628,788
Engel;s coefficients	%	55.9	53.1	45.9	47.3	38.3	37,8
B. Income per household							
Farm household							
income (A)	1000 won	67.9	112.2	255.8	872.9	1,884.2	2,227.5
Agri. income	"	54.0	88.8	194.0	714.8	1,355.7	1,531.3
Non-agri. income (B)	"	13.9	23.4	61.8	158.1	528.5	696.2
B/A	%	20.5	20.9	24.2	18.1	28.0	31.3
*Japan (B/A)	%	52.8	56.3	68.1	71.1	76.2	
C. Trade condition between agriculture & non-agriculture							
Index No. of price of farm products received by farmer	%	10.1	19.7	39.5	100.0	188.5	209.1
Index No. of price of farm supplies paid by farmer	%	13.3	25.1	44.1	100.0	190.1	216.2
Parity ratio	%	75.9	78.5	89.6	100.0	99.3	96.7
Rural wage rate	won/man-day	120	221	579	1,469	3,393	5,140

Item	Unit	'65	'70	'75	'78	'79	
D. Food consumption (man/year)							Japan ('78)
Grain & potatoes							
Rice	kg	121.8	136.4	123.6	134.7	135.6	81.6
Barley	"	36.8	37.3	36.3	18.1	14.1	0.7
Wheat	"	13.8	26.1	29.5	30.5	30.6	31.7
Corn	"	0.9	1.1	2.4	2.8	2.9	
Soybeans	"	4.4	5.3	6.4	7.0	7.2	
Potatoes	"	7.3	10.2	7.1	6.3	6.3	
Others	"	3.8	3.0	2.0	2.1	2.1	11.1
Crops Total	"	188.8	219.4	207.3	201.5	198.8	125.1

Table J-1 (continued)

Item	Unit	'65	'70	'75	'78	'79
E. Proportion domestically supplied crops						
Total	%	93.9	80.5	73.0	72.6	59.9
Rice	"	100.7	93.1	94.6	103.8	86.0
Barley	"	106.0	106.3	92.0	119.9	117.0
Soybeans	"	100.0	86.1	85.8	59.3	43.4

Item	Unit	'62	'65	'70	'75	'78	'79
F. No. of farm machine owned							
Power tiller	each	93	1,111	11,884	85,722	194,780	235,909
Tractor	"	-	-	61	564	1,601	2,035
Transplanting machine	"	-	-	-	16	531	2,416
Planting machine	"	146	303	630	953	4,468	3,773
Binder	"	-	-	-	89	3,703	12,030
Combine	"	-	-	-	56	134	505
Dryer	"	-	-	-	694	962	1,143
Power sprayer	"	714	7,579	45,008	32,956	66,342	83,588
Mist & duster	"	-	-	-	104,742	169,652	207,473
Power pump	"	12,292	26,029	54,078	65,993	180,660	187,608
Power thresher	"	8,022	18,909	41,038	127,105	185,947	203,081
G. Land improvement & expansion							
Irrigated paddy field	1000ha	682	701	1,021	1,065	1,122	1,153
% to total paddy field	%	55	56	80	84	86	87
Consolidated paddy field	ha	38,138	44,092	134,073	251,098	310,137	323,007
% to total paddy field	%	6	7	22	42	53	55
Farm land expansion & development	ha	12,961	37,220	2,953	8,440	3,891	3,218

Table J-2. Production, Cultivated Area, and Imports of Main Food Crops

Year	Items	Unit	Milled Rice	Barley	Wheat	Soybean	Potato
1977							
	Production	1000M/T	6,006	862	44.7	318.7	558
	Area	100ha	1,230	545.6	26.5	250.6	50
	Yield	kg/ha	4,880	1,580	1,680	1,270	11,300
	Import	1000M/T	-	322	1,979	151	-
1978							
	Production	1000M/T	5,797	1,388	35.7	292.8	304
	Area	1000ha	1,230	575.4	17.1	246.9	30
	Yield	kg/ha	4,710	2,410	2,090	1,190	7,820
	Import	1000M/T		-	1,587	223	-
1979							
	Production	1000M/T	5,565	1,555.5	42.0	257.1	356
	Area	1000ha	1,233	489.1	13.1	207.3	34
	Yield	kg/ha	4,510	3,180	3,210	1,240	10,580
	Import	1000M/T	520	-	1,652	422	-
1980							
	Production	1000M/T	3,557	905.9	92.0	216.3	446
	Area	1000ha	1,233	360.4	27.7	188.4	37
	Yield	kg/ha	288	2,510	330.0	1,150	11,930
	Import	1000M/T	576	-	2,000	576	-

Table J-3. Grain Marketing, Prices and Inflation Rates

Items	Unit	1977	1978	1979	1980
Rice (milled rice)					
Gov't purchase price	won/kg	325	375	457.5	572.5
Gov't selling price to Coop. middle-man.etc.	"	280.3	331.3	400	550
Consumer's price - urban	"	310.5	364.1	472.3	616.4
Purchased amount	M/T	1,403	1,355	1,301	532.8
Barley (pearled barley)					
Gov't purchase price	won/kg	202.6	241.8	287.6	345.4
Gov't selling price	"	132.3	132.3	180	230
Consumer's price	"	152.1	152.1	197.9	252.3
Purchased amount	M/T	189	484	560	483
Soybean					
Gov't purchase price	won/kg	325.1	375.1	431.3	540
Gov't selling price	"	266.7	266.7	266.7	-
Consumer's price	"	350.3	414.9	465.4	729.7
Purchased amount	M/T	1.6	1.8	4.8	0.04
Corn					
Gov't purchase price	won/kg	146	168.5	177	204
Gov't selling price	"	133	170.8	202.2	231.7
Purchased amount	M/T	25.5	32.5	55.9	62.6
Inflation Rate					
Consumer's price index		100	114	135	174
Index number of prices of farm products		100	130	145	176
Index number of prices of farm inputs		100	130	148	184

Table J-4. National Agriculture Inputs and Credit

Items		1977	1978	1979	1980
Seed (M/T) (Supplied by Seed Supply Office under Ministry of Agric. & Fisheries)	Paddy	-	-	1,039	2,035
	Barley	106	1,144	712	447
	Soybean	130	299	508	465
	Potato	4,513	898	3,414	884
	Corn	-	-	249	412
Fertilizer (1,000 M/T)		780	916	914	910
Herbicide (M/T)		3,721	4,581	5,304	6,350
Chemicals (M/T)	Fungicide	4,987	6,085	7,903	10,789
	Insecticide	14,647	15,761	11,207	11,973
Agric. Credit Funds* (billion won)		356.8	519.9	633.8	

* Interest rates are subsided at 12 percent. If not repaid the same year. interest rates are 24 percent.

Table J-5. Dissemination of Rice HYV

Year	Cultivated Area	HYV Area	Yield per ha					Increase in Production	
			HYV (A)	Ordinary (B)	Increment A/B		Nat'l. average	Amount	Value
	1,000ha	1,000ha	M/T	M/T	M/T	%	M/T	1,000M/T	billion won
1972	1,191	188	3.96	3.21	0.65	123	3.34	122	15.1
1973	1,182	121	4.81	3.50	1.31	137	3.58	159	22.6
1974	1,204	181	4.73	3.53	1.20	134	3.71	217	42.8
1975	1,218	274	5.03	3.51	1.52	143	3.86	417	101.5
1976	1,215	533	4.79	3.96	0.83	121	4.33	443	128.3
1977	1,230	660	5.53	4.23	1.30	131	4.99	858	281.7
1978	1,230	929	4.86	4.35	0.51	112	4.74	474	177.7
1979	1,233	744	4.63	4.37	0.26	106	4.53	194	88.5
Total								2,884	858

Table J-6. Budget for Research and Extension Work of Office of Rural Development by Year

unit: 1,000 won

Year	National Fund		Local Fund Provincial & County *	Total	1,000$	won/$
	Research	Extension				
1962	136,323	187,275	-	323,598	2,489	130
1963	177,923	212,751	-	390,674	3,005	130
1964	184,448	282,606	247,409	714,463	2,802	255
1965	324,748	283,895	305,100	913,743	3,372	271
1966	528,832	227,815	457,987	1,214,634	4,499	270
1967	509,571	311,700	625,426	1,446,697	5,280	274
1968	620,375	437,745	672,698	1,730,818	6,160	281
1969	914,237	538,919	1,140,927	2,594,083	8,533	304
1970	1,012,485	568,966	1,208,332	2,789,783	8,828	316
1971	1,381,973	797,420	1,897,400	4,076,793	110,930	373
1972	1,469,610	1,011,238	2,107,654	4,588,502	11,500	399
1973	1,321,294	1,032,938	2,138,950	4,493,182	11,289	398
1974	1,474,419	1,602,213	2,754,709	5,831,341	12,048	484
1975	2,279,655	2,525,916	3,147,050	7,979,621	16,489	484
1976	2,972,902	3,563,581	4,042,487	10,578,970	21,857	484
1977	3,106,374	1,948,954	5,649,819	10,705,147	22,118	484
1978	3,430,731	2,386,793	7,920,676	13,738,200	28,385	484
1979	4,300,799	2,633,042	8,263,689	15,197,530	31,400	484
1980	5,239,735	3,061,089	11,527,000	19,827,824	30,088	659
TOTAL	31,386,434	23,614,856	54,134,313	109,135,603	241,070	-

* At county level all funds are for extension; at the provincial level a small amount is funded.

APPENDIX K

BIBLIOGRAPHY

(Excluding A.I.D. Sources)

A. Government of the Republic of Korea Publications

ORD, "Annual Research Report." Wheat and Barley Research Institute, December 1979

--- "Rural Development Program in Korea," 1981.

--- "Wheat and Barley Research Institute."

--- "Guide the Honam Crops Experiment Station."

--- "A.I.D. Loan. A Comprehensive Report on Crop Improvement Research," July 1979

--- Agricultural Mechanization Research Institute. A Survey a Power Tiller Utilization in Korea, August 1980.

--- "Introducing The Horticultural Experiment Station"

--- "Outline of the Institute of Agricultural Sciences"

--- Horticultural Experiment Station, "Vegetables in Korea"

--- "Agricultural Research in Korea", 1969

--- Park, Ki-hyeok,"Analysis of the Socioeconomic Consequences of Green Revolution in Korea",1977 (In Korean)

--- Crop Experimental Station, "1981 Important Work Plan." (In Korean).

--- Yoengnam Crop Experiment Station, "Research Outline for 1981."

--- "Agricultural Research in Korea", 1970

--- "Income Accounts of Agriculture and Forestry", 1981

--- "The Effectiveness of the Tongil Rice Diffusion in Korea", 1975

--- Shin Dong-wan, "The Korean Experience of the Agricultural Extension Work with Emphasis on Rice Production", 1981

B. Books

Adelman, Irma, and Robinson, Sherman. Income Distribution Policy in Developing Countries. A Case Study of Korea. Stanford: Stanford University Press, 1978.

Aqua, Ronald. Local Institutions and Rural Development in South Korea. Ithaca: Cornell University. Special Series on Rural Local Government, Center for International Studies, 1974.

Ba , Sung Hwan; Moon,Pal Yong; Perkins, Dwight M. Rural Development Studies in the Modernization of the Republic of Korea. Cambridge: Harvard University Press, 1980.

Brown, Gilbert T. Korean Pricing Policies and Economic Development in the 1960s. Baltimore: The Johns Hopkins University Press, 1973.

Coombs, Philip H. Attacking Rural Poverty. Baltimore: The Johns Hopkins University Press, 1977.

Evenson, R.E., and Y. KisLev, 1975. Agricultural Research and Productivity. New Haven: Yale University Press.

Hopkins, Raymond F, Puchala, Donald J, and Talbot, Ross B. Food, Politics, and Agricultural Development: Case Studies in the Public Policy of Rural Modernization. Boulder: Westview Press, 1979.

Kim, In Hwan. The Green Revolution in Korea. Seoul: Seoul Association for Potash Research, 1978.

Kuznets, Paul W. Economic Growth and Structure in the Republic of Korea. New Haven: Yale University Press, 1977.

Mosher, A.T. Getting Agriculture Moving. New York: The Agricultural Development Council Inc., 1966.

The Rockefeller Foundation. Changing Roles of Women in Industrial Societies. New York: The Rockfeller Foundation, 1977.

Wade, L.L, and Kim, B.S. Economic Development of South Korea, The Political Economy of Success. New York: Praeger Publishers, 1978.

C. Monographs and Articles

Akino, M and Y. Hayami, "Efficiency and Equity in Public Research: Rice Breeding in Japan's Economic Development", American Journal of Agricultural Economics. 57: (1975): 1-10.

Barker, R., and Y. Hayami. 1976. "Price Support Versus Input Subsidy for Food Self-Sufficiency in Developing Countries," American Journal of Agricultural Economics. 58: 617-628

Griliches, Z. 1958. "Research Costs and Social Returns, Hybrid Corn and Related Innovations", Journal of Political Economy, 66: 419-431.

--------- 1964. "Research Expenditures, Education, and the Aggregate Agriculture Production Function." American Economic Review, 57: 96-174.

Hong, Dong Shik. The Educational Impact of Farmer Training Programs, Unpublished Master of Education Thesis, Seoul National University, 1973.

IRRI "Economic Consequences of the New Rice Technology", 1978 Los Banos, Philippines.

Michigan State University, "Korean Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985", 1972.

Michigan State University, "Investment Priorities in the Korean Agriculture Sector", 1972.

Shin, Dong Wan. Effects of Farming Technology Development on the Farm Household Economics, Unpublished Doctoral Dissertation, Hokkaido University, Japan, 1981.

Song, Hae Kyun. "Consciousness of the Rural Youths," The Journal of Korean Agricultural Education, 11(1), 1979.

Wallace, T.D. 1962. "Measures of Social Costs of Agricultural Programs," Journal of Farm Economics 44: 589-594.

World Bank. "Investment in International Agricultural Research: Some Economic Dimensions," Staff Working Paper No. 361, 1979.

---------- "Costs and Benefits of Agricultural Research: The State of the Art." World Bank Staff Working Paper No. 360, 1979.

PHOTOGRAPHS

The rice seedings on the upper left have already suffered damage from cold. Experimental station. Chunchon, Kangwon Province.

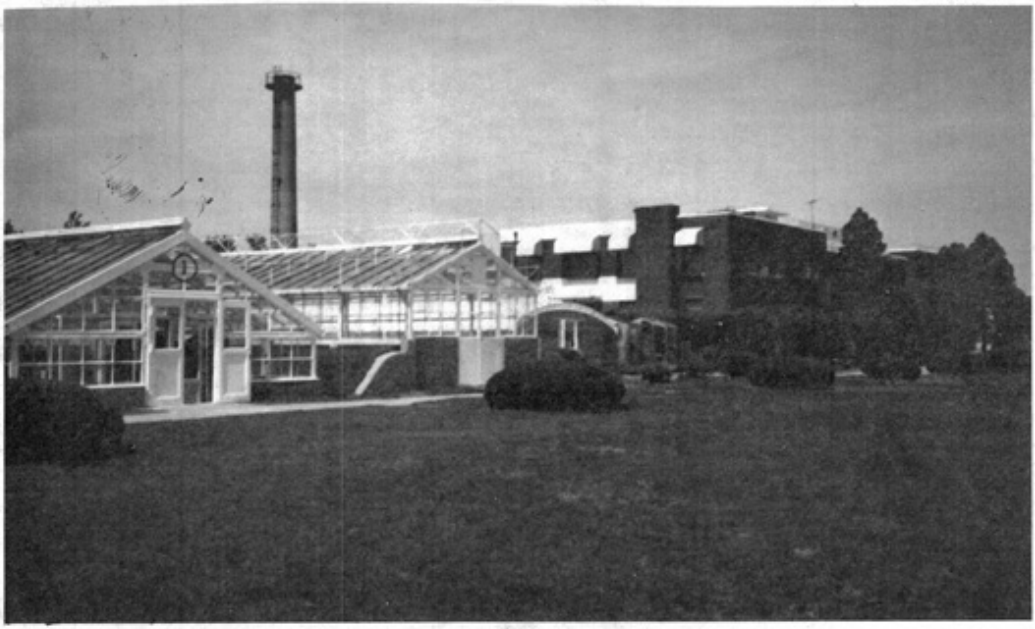
Outside a school, the local authorities prepare a new rice seedbed with plastic protection in case the first crop fails because of drought.

Plastic is used to conserve moisture and lessen weeding requirements for upland crops, such as pepper. Kangwon Province.

Women are trained to operate tillers. Taegu Office of Rural Development, North Kyongsang Province.

Farmers bunch rice seedlings before transplanting. Kyonggyi Province.

The IRI Research Station.



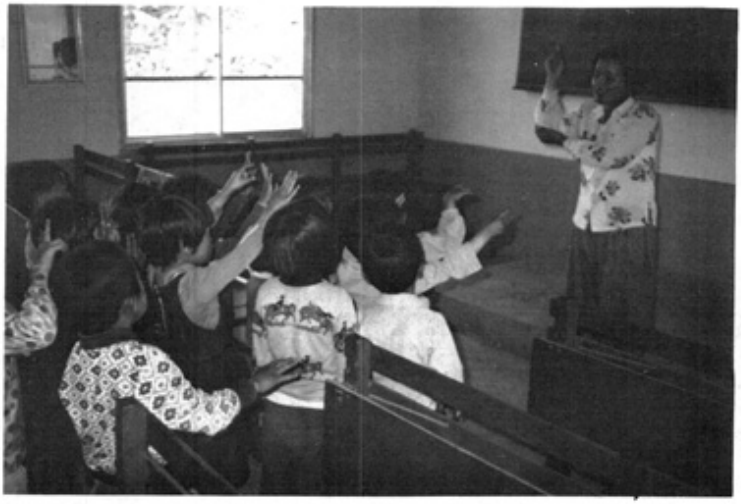
Women having luncheon in the field as they rest between transplanting sessions, South Kyongsang Province.

Research Facilities at Miryang.

Farmer prepares field for transplanting with a mechanical transplanter, South Cholla Province.

A Mechnical transplanter in use. South Cholla Province.

A farmer leads his cow to his field, while holding his plow. Note rice seedlings on background awaiting transplanting.



An extension worker operates a day care center in a Sae-Maul village hall. South Kyongsang Province.

Team inspects tongil rice in the laboratory. IRI Research Station.

The new Crop Experimental Station, Yeongduk, North Kyongsang Province.

Drying grain in the yard of a small home. Note the television aerial.

APPENDIX M
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Dr. Kim is currently a visiting economist with the Office of Economic Affairs, Bureau of Program and Policy Coordination, AID, on leave under the Intergovernmental Personnel Act from the University of Notre Dame where he is an Associate Professor of Economics. He is a graduate of Seoul National University and received his M.A. in Political Science and his Ph.D in Economics from the University of Minnesota. He was a Rockefeller Foundation visiting professor at the University of Nairobi and the University of Dar es Salaam, each on a two-year tour. He has been awarded numerous research grants for economic studies of various developing countries, has presented papers to professional societies, and has published monographs and numerous articles in professional journals. Recently, he edited Papers on the Political Economy of Tanzania.

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