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KOREAN AGRICULTURAL SECTOR ANALYSIS AND RECOMMENDED DEVELOPMENT STRATEGIES, 1971-1985: KOREAN AGRICULTURAL SECTOR STUDY TEAM 1972

George E. Rossmiller, et al

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15. Supplementary Notes

16. Abstracts

A 15-year planning horizon was used for projecting the consequences of following three alternative policy strategies for agricultural development. Alternative I was based on the Third Five-Year Plan (TFYP) for 1972-76. Alternative II was based on improved allocation of resources among programs, coupled with a higher rice price policy. Alternative III was based on an allocation of resources among programs consistent with a free market policy regarding the price of domestic and imported food grains.

Examination of the consequences of the three alternatives led to the development of a fourth strategy for Korean agricultural development. It is hoped this analysis will provide a better context in which to consider revisions in the current five-year plan as well as help in formulating future five-year plans.

The analysis and the recommendations contained in this study are derived from two sources: (1) a series of some twenty working papers covering different aspects of Korean agriculture which were prepared by specialists from Michigan State University working in Korea with Korean professionals in the Agricultural Economics Research Institute of the Ministry of Agriculture and Forestry (MAF-AERI) and from other agencies and institutions, and (2) a set of projections for the three policy strategy alternatives outlined above showing consequences for output, supply, consumption, income, cost, returns to land and labor, and seasonal labor requirements for 19 commodity groups as computed by a preliminary simulation model constructed by KASS for the Korean agricultural economy.

Chapter 2 deals with the place of agriculture in the Korean economy, while Chaper 3 surveys Korea's agricultural resource base. Methodolog ical issues involved in the KASS approach for reaching prescriptive conclusions are taken up in Chapter 4. Both basic

17b. Identifiers/Open-Ended Terms

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Abstracts Continued

and instrumental values are considered in Chapter 5 for use in conjunction with information on the projected consequences of following the three alternative strategy sets mentioned above to prescribe policies, programs and projects to reach appropriate goals in developing Korean agriculture. The projects are found in Chapter 6 and the prescriptions in Chapter 7.

Korean

Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985

Korean Agricultural Sector Study Team 1972

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Foreword

This study was financed jointly by the Government of the Republic of Korea and the United States Agency for International Development (USAID). On the Korean side, the Agricultural Economics Research Institute (AERI) is the implementing agency. On the U.S. side, the Department of Agricultural Economics of Michigan State University is the implementing agency. The joint organization of AERI and MSU is called the Korean Agricultural Sector Study Team (KASS).

The Korean Government has provided the physical facilities of AERI, the services of a large number of Korean researchers from outside as well as within AERI and has covered considerable computational costs primarily through the National Computer Center, MOST. The U.S. has provided the services of the Agricultural Economics Department at Michigan State University (AID/EAD-184 Korea). Work under this contract is coordinated with and draws: (1) support from the results of the simulation development contract (AID/CSD-1557), and (2) both personnel and results from the current simulation adaptation contract (AID/CSD-2975). The latter contracts were or are between the Technical Assistance Bureau, AID, and MSU, for the purpose of developing analytical techniques and capacity to do a more economical and effective agricultural sector analysis.

Some history of the origin of these contracts is in order. One of the origins of these contracts was in an agricultural sector study for Nigeria[1] somewhat similar to the present study. That study was based on an informal, generalized systems simulation approach which was not computerized. Consideration was given to computerizing computational routines and techniques in that study. This was not done however, because the necessary conversions of informal components into formal mathematical computing instructions and routines had not been carried out.[2] The high cost of the Nigerian "paper and pencil" sector study and the limited usefulness of other more specialized sector studies made it clear that more formal, cheaper and more efficient general computerized models were needed.

The Agency for International Development therefore contracted with Michigan State University to develop such a model along with the necessary formal mathematical computing instructions and routines sometimes referred to as "software." Though the Nigerian agricultural sector was modeled by MSU in carrying out its contract with AID, the work was done so that the model components and associated computing instructions and routines would be useful in a wide variety of situations and countries. For instance, one demographic component and associated routines have been modified and adapted repeatedly for modeling rural and urban human populations, livestock herds and orchards. Much of the KASS model is a direct transfer of immediately useful components from earlier work. It was the availability of software components which could be reassembled in ways applicable to Korean agriculture that made it possible in a period of only seven months to assemble the necessary descriptive information; to determine how the Korean agricultural sector is structured, operates, and responds to policy alternatives; and then to develop and write a preliminary report on recommendations for developing Korean agriculture over the next fifteen years. Without the improved analytical techniques from the simulation development and adaptation contracts the research reported here would have taken much longer and

[1] G. L. Johnson, *et. al.*, *Strategies and Recommendations for Nigerian Rural Development, 1969-1985*, Consortium for the Study of Nigerian Rural Development, Michigan State University, E. Lansing, Michigan, 1969.

[2] T. J. Manetsch, *et. al.*, *A Generalized Simulation Approach to Agricultural Sector Analysis with Special Reference to Nigeria*, Institute of International Agriculture, Michigan State University, East Lansing, Michigan, 1971.

cost much more. This project well illustrates the advantages of combining central funding to improve techniques and analytical methods with mission funding of problematic research.

As will be indicated in the main text of this report, the Korean Agricultural Sector Study Team depended on interactions with informed Koreans and with decision makers from Korean, donor, and grantor agencies as well as on its own investigations in acquiring the necessary information on which to base recommendations. Thus, while the projections presented in this report are the sole responsibility of KASS, the recommendations as to policies and programs reflect in part the opinions of Korean donor and grantor agency administrators as well as of KASS investigators. Despite this, KASS accepts full responsibility for the policies and programs recommended in this report. Special acknowledgement should be extended to Park, Jin Hwan, Advisor to the President; Rhee, Duck Young, Vice Minister of Agriculture and Forestry; and Yang, Yoon Sae, Assistant Vice Minister for their interactive assistance. Other Korean contributors included Kim, Dong Hi, Director, Agricultural Economics Research Institute (AERI), MAF; Kim, Dong Min, AERI; Suh, Han Hyeck, AERI; Kim, Young Sik, AERI; Kim, Sang Gee, AERI; Kim, Byeong Do, AERI; Lee, Bu Kwon, AERI; Shim, Soon Koo, AERI; Kim, Kwang Hee, MAF; Ryu, Byung Su, MAF; Chung, Moo Nam, Office of Rural Development, MAF; Kim, Yong Jin, National Agricultural Cooperative Federation (NACF); Shim, Kyo Bo, NACF; and Suh, Won Ho, NACF. Special recognition should be given to Professors Kim, Sung Hoon and Kim, Ho Tak, and to Mr. Aubrey Denton-Thompson, FAO country representative in Seoul, in addition to USAID personnel including Director Michael H.B. Adler; Francis Jones, Chief RDD; Marc Winter; Alan Sudholt; Roger Sedjo; Vern Wakefield; Robert Morrow; Kim, Chung Ho; Hwang, Eui Gak; and Hong, Jae Hee. Among Korean students at MSU, Lee, Jeung Han and Lee, Seong Woo made important contributions to the report. In Washington, Phil Smith, Francis LeBeau, Arthur Coutu, Cleo Shook, Robert Laubis, John Cooper and Chester Bell, James Brown, James Dalton, and Ed Glaezer provided both administrative support and valuable information and criticism. MSU's contribution was under the general directorship of Glenn Johnson and the field directorship of Ed Rossmiller with Thomas Manetsch providing the major leadership in building the important KASS simulation model. The National Computer Center of the Ministry of Science and Technology provided computer and programmer services for most of the computer runs of the simulation model. Preliminary development work on the model was carried out at the computer facilities of the Korean Institute of Science and Technology and Michigan State University. Special mention should be made of James Williams; Lee, Bu Kwon; Lee, Mushin; Jun, In Soo; Rho, Keysoo; and Seol, In Joon in Seoul; and Gloria Page in East Lansing, who programmed the computers. Other MSU contributors include: Raleigh Barlowe, J. Allan Beegle, John Brake, Derek Byerlee, Tom W. Carroll, Kwong-Yuan Chong, Robert Deans, John Ferris, Carl Frost, Robert Gustafson, Hartwig de Haen, William Haley, Dale Hathaway, Marvin Hayenga, Leonard Kyle, Henry Larzelere, Lawrence Libby, Mason Miller, James Shaffer, Vernon Sorenson, Warren Vincent, Sylvan Wittwer, and Karl Wright. George Tolley from the University of Chicago was particularly helpful as was Mel Blase who contributed to the project planning effort. Special recognition should be extended to the editors Addiann Hinds, Francoise Murray and Kathleen Schoonmaker; and to Judy Pardee; Janet Poncin; Doris Gullion; Cho, Jeong Suk; Cho, Nam Hyon; Kim, Kyeong Soo; Kathy Kohl; Nita Campbell; and Kay Cooper for secretarial assistance; administrative services for U.S. personnel were provided by Hanna Evans, AID/W and Eleanor Noonan, Bert Pulaski, and Janet Poncin, MSU.

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The Main KASS Recommendations and a Summary of Research Results

A prosperous and productive agriculture and a healthy energetic rural population enjoying a high quality rural life are important assets for any country. Korea can have such assets by following the recommendations outlined in this report.

The Main KASS Recommendations

The KASS overall strategy for developing Korean agriculture involves short- and long-term elements.

1. In the short run, we recommend changes in agricultural price and supporting service policies for agriculture
   a. to increase agricultural output by attaining greater efficiency within presently available technology and by more fully utilizing Korea's fixed land capital and human resources,
   b. which rely more heavily on the private sector to provide modern inputs and to market agricultural products, and
   c. which would decrease inequities in the distribution of income between the farm and nonfarm sectors to match off-farm migration with the rate at which new urban jobs can be created.
2. In the long run, our recommended strategy depends on expanded investments in research on new varieties of rice, food grains, feed grains, and forages, and on an effective family planning program.

The greatly expanded research program on new varieties will serve, in the long run, to promote agricultural production, while the family planning program will serve to reduce the demand for agricultural products. The importance of the long-run dimension of our recommended strategy becomes apparent when examining projections as to possible future production (from present technology) and possible future consumption (under present population growth rates). Almost regardless of what is done to utilize present technologies and resources, the demand for rice, which will be about equal to production in the late 1970s, will begin to outpace rice supply, again at present rates of population growth. Even with governmental regulations to force the substitution of barley for rice in human diets, there is some indication it will be hard to attain and maintain food grain (rice) self-sufficiency after about 1980. It is crucial that technology advances be attained and that population growth be contained.

The long-run strategy will combine with the short-run strategy of providing higher grain prices to maintain farm employment, increase farm incomes and hold off-farm migration at levels consistent with Korea's capacity to generate off-farm employment opportunities.

The specific policies and programs needed to execute the above strategies are presented in brief form in the last section of the summary to follow and in detail in Chapter 7 of the main report. These policies and programs will develop a Korean agricultural sector probably capable of filling Korea's needs for rice and definitely capable of filling her needs for barley for human consumption, as well as providing a substantial excess of barley for the production of livestock. In turn, an expanded livestock industry will provide increased meat products to upgrade the Korean diet. In the next 15 years agricultural output can increase 50 percent on essentially the same land while using 40 percent less labor. We estimate that by 1985, favorable agricultural development policies and programs can increase gross agricultural income 305 billion Won, or over 22 percent annually over the policies and programs laid down in the Third Five-Year Plan (TFYP) as published. In the same period, we estimate that Korean agriculture will be able to contribute over 10 million well-trained people for the development of the nonfarm economy while more

than doubling its production of raw materials for industry. By 1975, import requirements for agricultural products can be cut to around 40 billion Won below the level needed with the TFYP strategy, and 100 billion Won less than with a free import, low food price policy. We envision an agricultural population benefiting from higher food grain prices, better incomes, electrification, family planning, improved and extended roads, better communications, and an improved educational system. An important improvement will be more and better services to Korean agriculture from the Ministry of Agriculture and Forestry (MAF), the Ministry of Home Affairs (MHA), and the Economic Planning Board (EPB).

While Korea does not have abundant underutilized land on which to base its agriculture, it does have (1) competent, hard-working, essentially literate people capable of operating agricultural systems similar to those of Japan, Taiwan and certain West European countries, (2) modest unexploited land frontiers in her winter paddy lands and convertible forest land, (3) an opportunity to use more land-substitute capital, and (4) unexploited opportunities to develop new biochemical technologies. The Korean climate is harsh for raising forage crops and cereals. However, reputable agricultural scientists believe that a substantially expanded program of research on new varieties, improved water control mechanisms, and mechanization will make it possible, in the long run, to greatly increase production of rice, other food grains, and feed grains and forage for the production of dairy and beef products. While awaiting research results there are substantial opportunities to derive gains from agricultural policy adjustments to shift the price structure in favor of the production and consumption of commodities which can be produced at a comparative advantage in Korea and to more fully exploit winter paddies and uplands.

Summary

The recommended strategies summarized above and the policies and programs are based in part on two sources: (1) a series of some 20 working papers on different aspects of Korean agriculture prepared by specialists from Michigan State University working with professionals in the Agricultural Economics Research Institute of the Ministry of Agriculture and Forestry and from other Korean and international agencies and institutions, and (2) a set of projections made for three alternative strategies and policies as to their impacts on agricultural output, supply, consumption, income, costs, returns to land and labor, and seasonal labor requirements as computed by a preliminary computerized simulation model of the Korean agricultural economy.

The three alternative sets of strategies and policies can be characterized as:

1. A continuation of the agricultural policies and rural development strategies laid down in the TFYP as published.
2. A modification of the TFYP including higher agricultural product and consumer food prices, increased investment in research and rural guidance, improvements in guidance efficiency, concentration on high pay-off land and water development projects, increased investments in the rural infrastructure to eliminate marketing and transportation bottlenecks, and a more effective family-planning program.
3. A placing of greater reliance on international sources of agricultural products and on the private domestic market mechanism.

Analysis of projections for these three alternatives simplified the task of dealing with Korea's multitudinous rural development problems and yielded an improved understanding of how the agricultural sector would respond to alternative development strategies and programs.

In general, the three sets of projections indicated that:

1. The TFYP for agriculture can be substantially improved.
2. Rapid adjustment of domestic prices toward free international trade levels would impose exceptionally heavy income and capital losses on rural people and would probably create more rapid migration of people out of the agricultural sector than could be readily absorbed by the nonagricultural economy, but
3. That greater reliance on the domestic price system and competitive market would be desirable.

Throughout the study, KASS investigators were concerned with broad national values of major importance with respect to Korean agricultural development. These were judged to be the values of:

1. Achieving improved food supplies both quantitatively and qualitatively.

2. Realizing a higher quality of life in rural Korea.
3. Utilizing contributions from the agricultural sector in the development of Korea.
4. Improving administrative and political processes affecting Korean agricultural development.

Though not all these values are explicitly stated by Korean policy makers or written in official policy documents, they are articulated by a variety of ways—in the "revealed preferences" found in existing policies, in discussions with policy makers, in preference patterns among rural residents, and in the political environment. Interactions between KASS investigators and Korean decision makers and administrators revealed that minimizing the number of unemployed urban slum dwellers who migrate prematurely from rural areas was highly valued and that attainment of objectives with respect to this value was related to higher food grain prices and, hence, higher rural incomes and greater grain self-sufficiency.

More explicitly, in Korea certain agricultural values are expressed as demands placed on the farm sector by the Korean society. Demands on Korean agriculture over the next 15 years will include:

1. A 50 percent increase in the volume of agricultural production from approximately the same arable land area and 40 percent less labor, and with the production mix shifting to more livestock and dairy products, fruits and vegetables.
2. Up to 10 million healthy, well-trained people to help develop Korea's industries and urban economy. These migrants will take with them substantial claims on the earnings of agricultural land and capital which will also contribute to the development of the nonfarm sector.
3. A 100 percent increase by 1985 in raw materials supplied to Korean industry.
4. A two and one-half times expansion in the food marketing industry and an even greater expansion in the food processing industry.
5. An expansion in food grain production to decrease the foreign exchange required for the purchase of agricultural products.
6. A net contribution of capital, human and other resources to develop the nonfarm economy of Korea.
7. A 50 percent expansion in food production from about the same land base. Major expansions in farm-generated capital for use within the agricultural sector will be required.
8. Approximately 40,000 hectares annually for urban housing and industrial and commercial sites, streets, parks, reservoirs, and urban service areas.

The development of Korea's agricultural sector must proceed within the constraints of the values and demands discussed above, the natural biological and human resources available, and the changing social, economic, and political environment within which the agricultural sector functions. Present day Korean agriculture can be characterized as: (1) being based on small holdings controlled by individual entrepreneurs, (2) possessing only limited and nearly fully developed arable land resources in a relatively harsh, temperate zone climate, (3) using mainly human and animal power, (4) relying upon moderately well-developed irrigation systems which often lack adequate drainage, (5) researching and innovating new biological technology at less than an optimum rate while using substantial fertilizer and plant protection chemicals, (6) depending upon government-dominated markets for supply of most modern production factors presently utilized, and (7) being commercialized to the extent of selling about half of total production off farms.

External forces influencing the course of Korea's agricultural development include: (1) a rapidly growing nonfarm economy with 1985 GNP projected at over three times the 1970 level, (2) total urban consumption projected to increase at 9 percent per year, (3) a population increase requiring the nation to feed, clothe, and house approximately one additional person for every three people in the 1970 population by 1985, (4) substantial shifts in the mix of food products resulting from a strong preference for rice over barley, a growing demand for livestock, dairy products, and fruit, and greater use of more highly processed foods.

The Korean agricultural sector is not typical of the less developed agricultural economies of the world. Korean industry is developing rapidly and the proportion of the population engaged in farming has fallen below one-half. The current rapid outmigration from agriculture is expected to accelerate in the next 15 years. With industrialization and off-farm migration, Korean agriculture is not faced with a lack of effective demand for staple foodstuffs. It is faced, however, with a lack of modern technology and meager, fragmented land resources which currently mean high production

costs for staple foods. It is not likely that Korea will both attain and maintain self-sufficiency in staple foods over the next 15 years without the substantial introduction of cost-reducing biological and chemical technologies as well as labor-saving improvements in agricultural production. While the demand for livestock and dairy products, fruits and vegetables is substantial and growing, the Korean markets for such commodities are relatively thin and will remain so during the next one and one-half decades. Though short-run opportunities will exist to expand the production of such higher quality "nonstaple products," it must be recognized that effective demand for these products will be satiated with relatively small increases in production.

As a result of studying the projections for the three alternatives in view of the values, resources, constraints, and demands briefly discussed above, goals were established for Korean agricultural development. The process of establishing goals included interactions with Korean decision makers and administrators as well as analysis and study by KASS investigators.

Goals

The specific set of goals selected on the basis of the KASS projections discussed above, a study of relevant values, and Korea's agricultural resources is as follows:

1. *With respect to food:* Near rice self-sufficiency by 1975, and self-sufficiency levels thereafter consistent with increasing agricultural incomes, foreign exchange availabilities, and biological and technological advances; complete self-sufficiency in food barley by 1975 and thereafter; food grain imports and consumer prices set at levels consistent with the above goals on rice and barley; complete self-sufficiency in other food grains and potatoes by 1975 and thereafter to at least 1985; continued self-sufficiency for fruits and vegetables; complete self-sufficiency for meat by 1975 and until at least 1985; complete self-sufficiency in poultry products by 1975 and thereafter; 90 percent self-sufficiency in dairy products by 1975 and through 1985; and imports of feed grains and other feedstuffs at levels consistent with the above stated self-sufficiency goals for meat, poultry products, and dairy products and consistent with domestic ability to produce barley in excess of food needs and forage as feeds.

2. *With respect to quality of rural life:* An increase in average total annual real per capita value added in agriculture at the annual rate of 9 percent. This would be a change from 36,000 Won in 1971 to 142,000 Won in 1985, both in constant 1970 Won; an increase in per capita annual incomes from agriculture as a percentage of urban incomes from 33 percent in 1971 to 69 percent in 1985; installation of electricity in all rural homes by 1985 with wiring capable of running household appliances and machinery including pumps; substantial upgrading of education and vocational training; land tenure changes to allow farm sizes to increase to sizes which permit those remaining on farms to attain the rural per capita income levels specified above; the construction or maintenance and repair of roads capable of bearing light truck traffic during most of the year to each village of over 50 households; the removal of much drudgery from rural life by mechanization; the maintenance of a moderately equal income distribution in Korean agriculture by maintaining equity in the ownership of the means of producing income; participation in family planning and population management programs to reduce the natural increase rate in the rural areas from the present rate to 1.7 by 1975 and to 1.3 percent by 1985; and reduction in the rate at which population is now concentrating in major urban centers.

3. *With respect to overall development:* Around ten million well-trained people released from agriculture from 1970 to 1985 to help develop Korea's industries and urban economy; more than double the amount of raw materials presently supplied to Korean industry by 1985; an increase in value added by Korean agriculture from about 565 billion Won in 1971 to about 890 billion Won in 1975 and 1,230 billion Won in 1985, approximately 30 percent higher than would be attained by continuation of the TFYP as published; a decrease of 20 billion Won per year in net foreign exchange required for the purchase of agricultural products between 1971 and 1975.

4. *With respect to the administration of government programs for agriculture:* More effective coordination of provincial and local administration of MAF; increased use of the private sector in importing or manufacturing and distributing modern factors of agricultural production; continued reliance on the private sector for product marketing services; establishment of a system of collecting, assembling, processing and distributing data and information on the performance of the agricultural sector (such a system should be independent of government agencies and administrators charged

with responsibility for administering developmental programs and projects); coordination of planning and decision units including bureaus under the effective control of the Minister of Agriculture and Forestry, his Vice Minister and his Assistant Vice Ministers; development of competence to analyze the problems of the agricultural sector (independent of the agencies and personnel charged with administering agricultural development programs); improvement in the planning, coordination and liaison between the MAF and the appropriate units of its semiautonomous agencies such as National Agricultural Cooperatives Federation (NACF), Agricultural Development Corporation (ADC), and Agriculture and Fishery Development Corporation (AFDC) as well as Economic Planning Board (EPB) and Ministry of Home Affairs (MHA); the development of increased competence within agencies administering agricultural development programs and projects to analyze the problems of administering those programs and projects; reduced reliance on hastily-conceived rural development projects and greater reliance on fundamental improvements in the administration of sound development policies, programs and projects; and a well conceived and executed plan for developing the Korean agricultural sector. This is essential for the economic and social well-being of all Korean people—rural and urban—and for political stability, both domestically and in Korea's relationships with the rest of the world.

5. *With respect to population growth:* In order to keep demand for food consistent with supply, net annual population growth rates of 1.5 percent by 1975, 1.3 percent by 1980 and 1.1 percent by 1985 should be targeted.

6. *With respect to production capacity:* Attaining the food production goals established above implies attainment of several instrumental goals concerning: full development of Korea's limited paddy lands; upland conversion to both farming and improved forestry; full development of Korean water resources including drainage; expanded inland, coastal, and high seas fisheries; the development of improved and greatly expanded facilities for assembling, storing, grading, processing and transporting two and one-half to three times more farm products to urban areas by 1985 than now handled; development of wheat and other cereal varieties for Korean conditions and needs, to be more extensively double cropped with new varieties such as IR667 rice; development and importation of improved perennial forage varieties for uplands and for annual forage varieties for winter paddy lands, particularly in the present single cropping regions; an improved agricultural credit system; the creation, in place, of substantial farm-produced capital in the form of breeding stock, orchards, water management structures, etc.; and a substantial improvement in the rural guidance system.

Achieving the above goals requires strategies, policies and programs.

KASS Recommended Development Strategies, Policies and Programs

The KASS recommended strategy for developing Korean agriculture involves short- and long-term elements:

1. In the short run, KASS recommends changes in the agricultural price and supporting service policies for agriculture:
   a. to increase agricultural output by attaining greater efficiency within presently available technology and by more fully utilizing Korea's land resources
   b. which rely more heavily on the private sector to provide modern farm inputs and to market agricultural products, and
   c. which would decrease inequities in the distribution of income between the farm and the nonfarm sectors and to match off-farm migration to the rate at which new urban jobs can be created.
2. In the long run, KASS recommends expanded investments in research on new varieties of rice, food grains, feed grains, and forages, and on an effective family planning program.

The greatly expanded research program on new varieties will serve, in the long run, to promote agricultural production, while the family planning program will serve to reduce the demand for agricultural products. The importance of the long-run dimension of our recommended strategy becomes apparent when examining projections as to possible future production (from present technology) and possible future consumption (under present population growth rates). Almost regardless of what is done to utilize present technologies and resources, the demand for rice will begin to outpace rice supply within a decade at present rates of population growth. Even with governmental regulations to force the substitution of barley for rice in human diets, there is some indication it will be hard to attain and maintain food grain (rice) self-

sufficiency after about 1980. It is crucial that technology advances be attained and that population growth be contained.

The long-run strategy will combine with the short-run strategy of providing higher grain prices to maintain farm employment, increase farm incomes and hold off-farm migration at levels consistent with Korea's capacity to generate off-farm employment opportunities.

The specific policies and programs needed to execute the above strategies follow and are presented in detail in Chapter 7 of the main report:

1. A policy of support and promotion of both land- and labor-saving technology should be maintained with increased agricultural production geared to domestic market demand and with capital substitution for agricultural labor at a rate geared to the manpower absorption capacity of the nonagricultural sector. In support of this and other policies, the following programs are recommended:
   a. A substantially expanded research program to concentrate on new varieties and species of rice, winter cereals, and forage (both annuals for winter paddies and perennials for uplands); a correlary research program in soil nutrient requirements, plant protection, cultivation practices, drainage, irrigation, and water control management; and adaptation to mechanization should be carried out.
   b. A farm enlargement program for orderly and equitable increases in hectarage per farm should be developed in the next few years for implementation in the late 1970s. This should consist of periodically reviewing and raising the three-hectare limitation gradually so it does not become a constraint on expansion by bonafide farmers. Land tenure rules should be relaxed to permit farmland rental, and capital should be provided to finance land purchases.
   c. An extended agricultural credit program should be established to provide short-term operational credit and intermediate-term credit for financing the increased volume of purchased inputs which will be required by the agricultural sector, including improved feeds, fertilizer, plant protection chemicals, machinery, and equipment.
   d. An expanded rural guidance program with greater emphasis on education to serve private farmers, and a reduced emphasis on promotion of governmental action programs.
   e. A livestock production program which makes use of imported as well as domestic feed grains and forage produced on both upland and winter paddy and which takes advantage of the efficiency of poultry in converting high-quality feed concentrates into animal proteins, the ability of hogs to convert garbage and lower quality concentrates into high protein food for humans, and the ability of ruminants to convert domestically producible roughage into high quality animal proteins. Further, high seas, offshore and aquicultural production of fish and other products for export, domestic human use, and as a source of high protein animal feed should be supported.

2. A policy of developing land and water resources should be continued recognizing that many of the most favorable investments have already been made and that increases in Korean wage rates will make some projects dependent on the present large quantities of cheap labor unprofitable in the future. Programs should include:
   a. Improvement of irrigation and drainage systems and water control management facilities and techniques, particularly to increase the potential for production with high-yielding, short-strawed rice varieties and for improved yield and expanded area of double cropping paddy.
   b. Private and public investments where advantageous to develop convertible forest land and other upland for use in the production of fruit, mulberry, forage crops and beef and dairy products.
   c. Expanded reforestation of land which has been judged as unsuitable for cultivation or forage production.

3. A policy of improving income and social equity between the farm and the nonfarm sectors and which includes higher domestic prices for farm products, improved technology, an improved institutional environment, and the provision of equitable access to skills, land and other assets. An objective of this policy should be to maintain farm incomes at levels which will result in off-farm migration at levels consistent with the capacity of the nonfarm economy to generate employment opportunities. The following supportive programs are recommended:
   a. A food grain management program which should (1) maintain a stable structure of prices to farmers to increase their income and to encourage production of a desirable mix of

food grains, (2) maintain a price structure to consumers to constrain demand for rice while shifting consumption from rice to barley, and (3) maintain farm incomes at levels which will help equate off-farm migration with the capacity of the nonfarm economy to generate employment opportunities for off-farm migrants. Consumption of wheat relative to rice should be encouraged, but discouraged relative to barley. This will require placing heavy reliance on the price system and market adjustments insofar as domestic agriculture is concerned, while at the same time insulating the domestic market from international forces by managing grain imports to maintain and stabilize domestic grain price levels.

b. A nationally supported general education program and expanded vocational training program for rural areas to insure high productivity of both future farmers and off-farm migrants going to industrial employment.

4. A policy of national support for rural infrastructure improvement in order to improve agricultural production, product marketing, input supply, and quality of rural life. Programs should include:

a. A rural road improvement program to permit greater access of rural people to urban centers and to undergird a prospective two and one-half to threefold expansion in farm product marketing activities, and an even greater expansion in the marketing of modern farm inputs and services. The program should provide for construction, maintenance, and repair of roads capable of bearing light truck traffic during most of the year to each village of over 50 households.

b. A rural electrification program providing for the installation of electricity in all rural homes by 1985 with wiring capable of running household appliances as well as productive implements such as threshers, pumps, and other machinery.

c. Programs to upgrade the health and sanitation, energy utilization, education, transportation, and communication, cultural and welfare facilities in rural areas to improve the quality of rural living, and to provide the basis for the promotion and dispersion of agribusiness and other industries into rural areas both for the benefit of those areas and in the long-run interest of obtaining a better geographic distribution of Korea's population.

5. A policy of decreasing the proportionate role of government and governmentally controlled agencies in favor of the private sector in the agricultural product markets and especially in the markets for modern factors of agricultural development. Programs should include:

a. Provision of profit incentives and investment credit to the private sector for the transport, assemblage, grading, processing, storage and distribution of agricultural products and the delivery of agricultural inputs, supplies and services.

b. A program of public regulation to insure pure, sanitary, correctly measured, and properly labeled agricultural products from farmer to domestic consumer or export.

6. A population control policy with a vigorous family planning program aimed at decreasing the net annual population growth rate to 1.5 percent by 1975, 1.3 percent by 1980, and 1.1 percent by 1985.

7. A policy of improving agricultural policy formulation procedures, programs and project design, and public administration and execution. Programs for improvement and reorganization of governmental structures serving agriculture should include:

a. A new planning coordination unit to be established in the planning coordination office of MAF to aid in planning responsibilities.

b. The planning units now located in the various divisions and bureaus of MAF should remain under the administrative control of their respective units but be physically consolidated and housed near the office of their respective assistant vice ministers to insure internal as well as across division and across bureau coordination, and to provide the vice minister and assistant vice ministers the coordinated information and analysis they need for key decision making.

c. MAF officials should be given some degree of authority over the appointment, pay scales, and operations of officials responsible for agricultural programs at the provincial and local levels.

d. More nonadministrative methods of program implementation should be used to achieve policy objectives.

e. The present Agricultural Economics Research Institute (AERI) should be renamed the Institute for Agricultural Economics and Statistics (IAES) and be placed administratively under a director with the same status as the planning coordinator and the assistant vice ministers.

f. A statistics branch should be under a coordi-

nator of statistics, and an agricultural economics branch under a coordinator of agricultural economics.

g. Another functional unit in the agricultural economics branch should be a policy analysis unit administratively under the director of agricultural economics, but physically located near the office of the vice minister.

h. Long-run research measuring the structural elements of the agricultural sector and planning, coordination and liaison between MAF and EPB and the other ministries should be done to provide for wide support and contribution from all parties involved.

i. It is recommended that the MAF be organized on functional lines, with a Planning Coordinator, Assistant Vice Minister for Production, Assistant Vice Minister for Food Management and Marketing, and a Director of the Institute for Agricultural Economics and Statistics.

Results Attainable from KASS Recommendations

KASS investigators used the simulation model developed during the study to compute the results of adopting the policies and programs recommended above. The results are found in Table S-1. Index number comparisons of projected results for KASS recommendations with projected results of present policies and programs are displayed in Table S-2. The recommended policies and programs are potentially capable of producing the following results:

1. Near attainment of self-sufficiency in rice in the mid-1970s.[1] It is estimated this would take place at a production of 4.6 million metric tons in 1975 at a price of 150,000 Won (1970) per metric ton. Imports would be reduced to about 470 thousand metric tons. The KASS projections assume that rice prices increase uniformly to 1975 price levels. If rice price increases are more rapid it may be possible to attain self-sufficiency or near self-sufficiency earlier than 1975. Near self-sufficiency in rice is maintained through 1985 with further import reduction to about 225 thousand metric tons without direct governmental administration of rice and barley consumption. These projections assume adaptation of presently existing technologies. With success in developing new rice varieties under the recommended agricultural research program, complete rice self-sufficiency at lower consumer prices would be attainable.

2. There would not be self-sufficiency in feed grains, but a surplus of barley for human food would develop by 1975. Feed grains would need to be imported to provide feed for poultry, dairy and meat production. In the late 1970s, modest quantities of barley would be available to partially offset the need for imported feed grain. These projections assume present varieties of barley. With success in developing new barley varieties under the recommended research program, substantial quantities of barley could become available to further offset the need for imported feed grains by 1985. Further, success in adapting new forage varieties would permit increased forage for dairy and beef production, thus partially replacing projected imports of feed grains for production of poultry and other animal proteins.

3. Wheat imports are sharply reduced from those now in prospect due to the recommended higher wheat prices. Wheat imports are about 200,000 MT less than Alternative I in 1975 and about 800,000 MT less in 1985. Wheat imports could be reduced substantially below these figures by success in developing new wheat varieties capable of being double cropped with rice under the recommended agricultural research program.

4. By the year 1975, it is estimated that average per capita daily consumption would be about 2,600 calories and 70-75 grams of protein. These estimates are about 4 percent less than the prospective 1975 values under Alternative I and about the same as present levels. By 1985, calories increase to about 2,740 and protein to about 80 grams per capita per day. The nutritional content of the rural diet is about the same as the urban diet with respect to calorie intake but inferior in protein content. Success in developing new cereal and forage varieties would permit these projected consumption levels to be improved.

5. Agricultural value added per capita would be higher than under Alternative I due to both higher farm produce prices and somewhat higher production. In 1975 agricultural value added per capita would average 57,000 Won per person as compared with a projected 43,000 Won under Alternative I and by 1985 the figures are 142,000 Won and 103,000 Won, respectively.

6. Under these recommendations, net returns to farmers for land and family and operator labor would be higher than for present policies resulting in:

[1] KASS projections are based on average production yields.

a. Higher land values.
b. A reduction in the rate of decline in persons in agriculture. This curtailment of off-farm migration would likely affect the aged, the very young and the unskilled. In effect, higher rural incomes would permit such people to

TABLE S-1
Projected Consequences of the KASS Recommended Development Strategy for the Agricultural Sector of Korea, 1975, '80, '85

Consequences	Units*	1971	1975	1980	1985
Population—total	1,000 persons	31,690†	34,630	37,180	39,480
Population—urban	1,000 persons	15,820†	19,190	24,250	30,810
Population—rural‡	1,000 persons	15,870†	15,450	12,930	8,670
Calorie consumption—rural	cal/day/cap	2,630	2,603	2,670	2,748
Calorie consumption—urban	cal/day/cap	2,534	2,577	2,691	2,730
Protein consumption—rural	grams/day/cap	65	65	70	77
Protein consumption—urban	grams/day/cap	73	78	86	89
Urban consumer price index	1970 = 100	104	109	108	108
Urban nonfood expenditures—total	bil. Won	929	1,310	2,230	3,669
Urban nonfood expenditures—per capita	1,000 Won	57	68	92	119
Urban food expenditures—total§	bil. Won	658	964	1,336	1,925
Urban food expenditures—per capita	1,000 Won	42	50	55	63
Total urban consumption	bil. Won	1,587	2,274	3,566	5,593
Food portion of total urban consumption expenditure§	percentage	41	42	37	34
Gross agriculture income—total	bil. Won	859	1,205	1,406	1,672
Gross agriculture income—per capita//	1,000 Won	54	78	109	193
Agriculture value added—total	bil. Won	565	890	1,040	1,230
Agriculture value added—per capita	1,000 Won	36	57	80	142
Returns per hectare (rice)#	1,000 Won	169	321	356	364
Returns per man-year (rice)#,**	1,000 Won	240	440	470	460
Fertilizer requirement	mil. MT	.9	1.4	2.0	2.3
Pesticide and other chemical requirement index	1970 = 100	105	126	152	182
Capital requirement index‡	1970 = 100	111	163	212	432
Expenditure on fertilizer††	bil. Won	20	28	34	35
Expenditure on pesticides and other chemicals††	bil. Won	6.6	6.4	5.9	5.4
Expenditure on capital††	bil. Won	38	50	57	103
Taxes paid index	1970 = 100	116	199	247	288
Net foreign exchange required for purchase of agricultural products (excl. feed grains)‡‡	bil. Won	52	24	16	15
Net foreign exchange required for purchase of agricultural products (incl. feed grains)	bil. Won	82	63	60	69

* Monetary units are in constant 1970 Won.
† These data are values for the year 1970.
‡ These projections are based upon the same migration rates assumed for Alternative II. One would, however, expect a reduced off-farm migration under the better rural economic conditions prevailing in the KASS recommended strategy. The higher rural-labor supply in the KASS recommended alternative would reduce the need for mechanization and related capital investments.
§ These figures are about 10 percent low due to food items (mainly condiments) not included in food expenditure.
// Includes income from nonagricultural sources.
Without imputing land and family labor costs.
** A man-year is defined as 2,000 man hours.
†† Expenditures allow for relative price changes of factor inputs in 1970 Won.
‡‡ In these computations surplus barley (available for livestock feed) is valued at world prices as an export item.

TABLE S-2
Index Number Comparisons of Selected Consequences of KASS Recommendation with a Continuation of TFYP as published, 1971 = 100, Korea, 1975, '80 '85

Consequences	1975		1980		1985	
	TFYP as Published	KASS Recom.	TFYP as Published	KASS Recom.	TFYP as Published	KASS Recom.
	...I...		...I...		...I...	
Population—total	107	107	116	115	127	122
Population—urban	117	117	149	148	194	188
Population—rural	97	97	82	81	57	54
Calorie consumption—rural	100	99	102	102	104	104
Calorie consumption—urban	106	102	108	106	111	108
Protein consumption—rural	100	100	105	108	114	118
Protein consumption—urban	109	107	116	118	121	122
Urban nonfood expenditures—total	148	141	247	240	406	395
Urban nonfood expenditures—per capita	126	119	166	161	209	209
Urban food expenditures—total	137	147	191	203	273	293
Urban food expenditures—per capita	115	119	126	131	138	150
Total urban consumption	143	143	225	225	352	352
Gross agriculture income—total	123	140	138	164	164	195
Gross agriculture income—per capita	127	144	169	202	290	357
Agriculture value added—total	129	156	147	183	173	217
Agriculture value added—per capita	132	158	179	222	303	394
Fertilizer requirement	137	156	161	222	192	256
Pesticide and other chemical requirement	120	120	145	145	174	174
Capital requirement	134	146	182	190	371	387
Expenditure on fertilizer	116	140	121	170	126	175
Expenditure on pesticides and other chemicals	97	97	89	89	82	82
Expenditure on capital	122	132	143	150	259	271
Taxes paid	141	171	169	213	193	248
Net foreign exchange required (excl. feed grains)	104	46	181	31	259	29
Net foreign exchange required (incl. feed grains)	117	78	171	74	243	85
Rice production	108	116	110	130	114	141
Rice consumption	110	106	122	113	134	119
Barley production	105	115	113	112	123	99
Barley consumption	101	103	90	95	68	67
Wheat production	100	106	103	177	105	268
Wheat consumption	110	98	143	136	180	170

stay in agriculture rather than be driven out by low farm earnings to accept low-paid, urban jobs or even unemployment where they would likely congregate in urban slums and thus contribute more to Korea's social problems than to her GNP or export earnings.

c. A more equal distribution of income between the farm and nonfarm sectors. However, even the higher rural incomes will be low relative to higher urban incomes. Rural and urban poverty will still need to be attacked as a separate national problem even though the recommendations contained herein will be of some help.

7. Agricultural imports and consequent costs in scarce foreign exchange would be reduced. Total agricultural imports would be over 40 billion Won less than under Alternative I in 1975, about 90 billion Won less in 1980, and about 145 billion less in 1985. With reference to a free grain importation policy, agricultural imports would be 100 billion Won less in 1975 and 300 billion less in 1985.

Projected foreign exchange requirements under the recommended alternative are 63 billion Won in 1975, 60 billion Won in 1980, and 69 billion Won in 1985. Korea would become less dependent on foreign food supplies than under present policies and programs and much less than under a free import, low food price alternative.

8. The effects of the KASS recommendations on capital accumulation in agriculture are mixed. Increased rural incomes will increase property values and, hence, the value of existing investments and the resource base available to pledge as collateral for additional investments. The likely decrease in rural-urban migration will reduce the need for farm mechanization and related capital investment, but higher farm incomes will probably increase use of some labor-saving equipment in order to remove the drudgery of hand and animal labor. Other agricultural investments (i.e., in livestock, orchards, vegetable production and other enterprises) will be stimulated. However, since an important component of the KASS recommendations is the development of improved paddy drainage systems, further capital accumulation is likely in this area. In total, a net increase in capital accumulation in agriculture is likely to result from these recommendations.

9. Due primarily to the higher rice price and the resultant increase in production, the recommended policies and programs result in a larger gross agricultural income and agricultural value added than any of the other three alternative strategies considered in the study. KASS recommendations provide a projected 1985 gross agricultural income of 1,672 billion Won and an agricultural value added of 1,230 billion Won as compared to 1,367 billion Won and 934 billion Won under the TFYP.

10. Projected input requirements for our recommendations are in total higher than those for the TFYP. Projected numbers of five-horsepower tillers for the KASS recommended strategy are approximately 50,000 units in 1975, 115,000 units in 1980, and 350,000 units in 1985, compared with 46,000, 98,000, and 343,000 units, respectively, under the TFYP. By 1985, fertilizer requirements are two and one-half times the 1971 level under KASS recommendations, and two times the 1971 level under the TFYP. Agricultural chemical requirements increase only slightly under both alternatives.

11. Under the KASS recommended programs and policies, there would be less pressure from low farm incomes for unskilled farm persons to migrate to low-paid urban jobs and possibly unemployment. Instead, migration would be more closely attuned to the creation of industrial employment and those migrating would be better trained to fill productive urban positions.

12. Relative to the TFYP, the prices of rice and wheat are raised while the price of barley is lowered. Even with the substantially higher rice and wheat prices, the food portion of total urban consumption expenditure remains almost constant until 1975 at about 42 percent, declines to 37 percent in 1980, and declines even further to 34 percent in 1985. Further, the consumer price index increases only moderately from 100 in 1970 to 108 in 1985, compared to 102 for the TFYP, due to the higher food prices under KASS recommendations.

13. The rice import gap is narrowed considerably from the other alternatives. It also continues to decrease throughout the projection period. The fact that the rice import gap is relatively small (226,000 tons by 1985) coupled with the fact that the KASS yield and acreage projections may be rather conservative indicate that rice self-sufficiency can be reached in the seventies and maintained in the eighties provided the research effort on new rice, other food grain, feed grain and forages is successful. In case the research program is not successful, various administrative constraints may need to be employed to further decrease rice consumption and to further expand human consumption of barley.

14. Even with a steep decline in the barley price after 1975 to levels at which barley can compete with imported feed grain, an excess of 543,000 tons over requirements for domestic food consumption is noted by 1985 which can be used to partially replace imported feed grains. The wheat deficit continues to mount for some time although it appears it would level off after 1985. The wheat deficit is approximately 55 percent of the level projected under the TFYP. Finally, the net foreign exchange required for purchase of agricultural products (excluding feed grains) declines to about half the 1971 level by 1975, and even further by 1985. The requirements projected are 24, 16 and 15 billion Won in 1975, 1980 and 1985, respectively.

15. Assuming an average propensity to save of .12 by the urban population, an estimate of urban per capita income was calculated from the urban consumption expenditure figures used in the analysis. While the per capita agricultural value added figures in Table S-2 do not include income from nonagricultural sources, they show that per capita income from agricultural sources is 33 percent of urban consumer income in 1971 and that it increases during the projection period to 42 percent

in 1975, 48 percent in 1980 and 69 percent in 1985. These figures further stress the conclusion that inequities between farm and nonfarm incomes are so important that (1) the transfer of income to farmers via higher food prices does not create an inequitable income distribution, and (2) that rural poverty cannot be corrected by redistributing income only within agriculture. The improved distribution of income between the agriculture and the nonagriculture sectors is attained at the cost of a higher per capita urban food expenditure relative to the TFYP of about 11 percent in 1975, 12 percent in 1980 and 15 percent in 1985. However, as pointed out in number 12 above, the food portion of total urban consumption expenditures declines from about 42 percent in 1975 to 34 percent in 1985.

I

Introduction

Korean agriculture stands at a critical juncture in 1972. Faced with a very high population density and a low land cultivation density, high rates of migration from farms to urban areas with rapid urbanization; and the use of valuable foreign exchange for basic food grains to supplement inadequate domestic production for a growing population, Korea must make critical decisions regarding the future development of her agricultural resources. It is appropriate at this point in time to take a long-range look at the future of Korean agriculture; hence this sector study.

Objectives

The major objectives of the Korean Agricultural Sector Study (KASS) are:

1. To provide Korean agricultural policy makers with insight into the economic and social consequences over a 15-year planning horizon of following alternative strategies in developing Korea's agricultural sector.
2. To provide the Republic of Korea Government (ROKG) and the United States Agency for International Development (USAID) with a comprehensive study and analysis of the components comprising the agricultural sector, including the Ministry of Agriculture and Forestry (MAF) and related government organizations: and to make recommendations relative to those changes in policy, program, investment, organizational and other areas considered necessary to attain and sustain a given agricultural sector growth rate.
3. To recommend strategies, policies and programs to achieve specific development goals for the agricultural sector that are consistent with national values relative to food self-sufficiency levels, improved rural life, upgraded contributions of the agricultural sector to the general economy, and administrative and political stability.
4. To make a preliminary identification of priority investment areas and to improve the investment knowledge base available to the Korean government, international organizations, donor countries, and USAID, in enabling wiser decisions in agricultural sector development investment.
5. To improve and develop the capabilities of the MAF in program evaluation, analysis, program development, and policy formulation, with, as a secondary goal, provision of a base of information about Korean agriculture which can be incorporated into the simulation model being developed as a policy planning tool for updating projections and analyzing consequences of policy alternatives in light of changing conditions and the availability of improved data.

Scope of the Sector Study

The scope of the sector study is best understood in terms of the major agricultural policy inputs and the two main channels for money, goods, services, and manpower: one within the agricultural sector, and the other between the agricultural sector and the rest of the economy (Figure I-1).

The agricultural sector comprises land, labor, and capital resources producing the farm products consumed on the farm or flowing into the agricultural marketing system. In a study of this scope, it was not possible to treat individually each commodity produced by Korean agriculture. In order to simplify the analysis, commodities have been divided into the following 19 product groups: rice, barley, wheat, other grains, fruit, pulses, vegetables, potatoes, tobacco, forage, silk, industrial crops, beef, milk, pork, chicken, eggs, fish and residual.

The agricultural marketing system channels farm

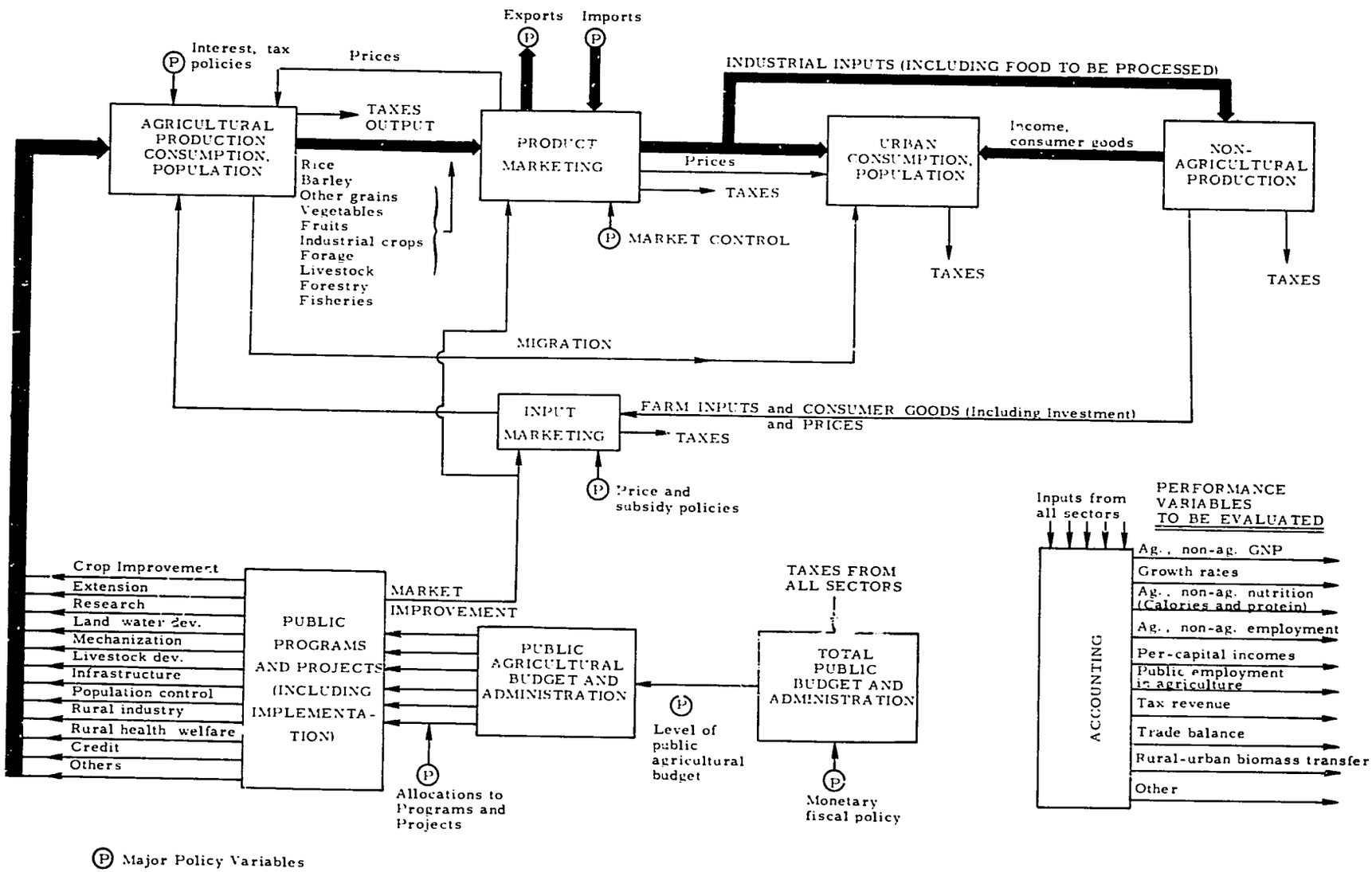

FIGURE I-1. Korean agricultural sector analysis: major sub-sectors, flows, outputs, and policy inputs.

products directly to consumers or to the agricultural processing industries. The Korean market system operating at a given level of government control distributes that portion of agricultural production necessary to satisfy sector requirements. The system also serves the vital functions of exporting certain Korean products to the world markets and importing agricultural products to make up food deficits. The major inputs to the agricultural sector from the urban industrial sector include three basic products required to raise the level of agricultural technology: chemicals to control pests and diseases, fertilizer and farm machinery and fuel.

For this study, the Korean population is divided into a "rural" farm population and an "urban" nonfarm population. A major output from the agricultural sector is the net migration from farms into the nonfarm economy.

The government follows a set of policies (denoted by Ⓟ in Figure I-1) which controls the flows and processes outlined above including a flow of tax revenue to government to finance government programs. The government allocates a certain portion of total revenues to agriculture and then suballocates this amount among various public programs and projects related to agricultural development. These programs include crop improvement, rural guidance, research, land and water development, mechanization, livestock development, improvement in infrastructure, rural industry, credit, rural health and welfare, including family planning.

Performance Variables

Allocations for current and future programs must be made with reference to the probable effect of programs and projects on a set of "performance variables" or economic indicators. These decisions are not easily made because of the multiplicity of indicators which measure the many different consequences desired by policy makers and the undesirable consequences to be avoided. Usually there are many performance variables, rather than just one, which a policy maker needs to consider in evaluating the effectiveness of various programs and projects. Typical important performance variables include gross agricultural product, gross nonagricultural product, sector growth rates, nutritional levels in terms of calories and proteins, per capita incomes in each sector, employment levels, tax revenues and trade balances.

Alternative Policy Strategies Studied

A 15-year planning horizon was used for projecting the consequences of following three alternative policy strategies for agricultural development. Alternative I was based on the Third Five-Year Plan (TFYP) for 1972-76. Alternative II was based on improved allocation of resources among programs, coupled with a higher rice price policy. Alternative III was based on an allocation of resources among programs consistent with a free market policy regarding the price of domestic and imported food grains.

Examination of the consequences of the three alternatives led to the development of a fourth strategy for Korean agricultural development. It is hoped this analysis will provide a better context in which to consider revisions in the current five-year plan as well as help in formulating future five-year plans.

Analytical Approach

The analysis and the recommendations contained in this study are derived from two sources: (1) a series of some twenty working papers covering different aspects of Korean agriculture which were prepared by specialists from Michigan State University working in Korea with Korean professionals in the Agricultural Economics Research Institute of the Ministry of Agriculture and Forestry (MAF-AERI) and from other agencies and institutions[1], and (2) a set of projections for the three policy strategy alternatives outlined above showing consequences for output, supply, consumption, income, cost, returns to land and labor, and seasonal labor requirements for 19 commodity groups as computed by a preliminary simulation model constructed by KASS for the Korean agricultural economy.

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[1] Some of the results produced by these working papers are available as KASS Special Reports: "The National Agricultural Cooperative Federation: An Appraisal," "Rural Infrastructure," "An Analysis of New Land Development in Korea," "An Analysis of Supply Response on Major Agricultural Commodities in Korea," "Agricultural Research and Guidance," "Population, Migration, and Agricultural Labor Supply," "Agricultural Marketing," "Crop Production Data and Relationships."

Organization of This Report

Chapter 2 will deal with the place of agriculture in the Korean economy, while Chapter 3 will survey Korea's agricultural resource base. Methodological issues involved in the KASS approach for reaching prescriptive conclusions are taken up in Chapter 4. Both basic and instrumental values are considered in Chapter 5 for use in conjunction with information on the projected consequences of following the three alternative strategy sets mentioned above to prescribe policies, programs and projects to reach appropriate goals in developing Korean agriculture. The projects are found in Chapter 6 and the prescriptions in Chapter 7.

II

The Korean Economy and Its Agriculture

Introduction

In discussing the Korean economy and its agriculture, emphasis will be placed on historical perspective, anticipated future growth of the whole economy, and the anticipated demands on Korean agriculture in relation to food, raw materials, manpower, exports and imports, capital, land, and the general quality of the social, political and physical environment.

Historical Perspective

The national economy has experienced phenomenal growth since the early 1960s. Comprehensive governmental economic planning for development was instituted with the First Five-Year Plan in 1962.

The first two Five-Year Plans covering the periods 1962-1966 and 1967-1971 concentrated mainly upon building a sound social superstructure, developing basic industry, and securing a sound export market for a variety of Korean products. During this period the agricultural sector was, in essence, told to tighten its belt and wait its turn because the initial development thrust in the other sectors was considered more important. In retrospect, the decisions made and carried out in the first two five-year plans stressing the nonfarm sector appear to have achieved the desired results. But the decision to push agriculture lower on the priority list has created a lag relative to the nonagricultural sector which now must be considered. Thus, the Third Five-Year Plan (TFYP) for the period 1972 through 1976 turns heavy attention toward development of rural Korea and the agricultural sector.

A review of some of the major economic indicators during the 1960s will be useful in placing the Korean economy and its agricultural sector in perspective. Table II-1 compares the general economic level of the nonagricultural and agricultural sectors between 1959 and 1969, in 1965 prices. During the ten-year period, the average annual growth rate of the total economy was 8.2 percent, while agriculture, forestry and fisheries grew at an average rate of 4.2 percent. If forestry and fisheries are separated from agriculture, the growth rate for agriculture was somewhat less at 3.8 percent, a respectable rate for an agricultural sector in a developing country. Nevertheless, agriculture is hard pressed to meet the demands of the rapidly expanding urban-industrial sector. Of the total Gross National Product (GNP) in 1959, the agricultural sector's contribution was 42.3 percent. Due to the rapid growth of the nonfarm economy during the 1960s, the agricultural contribution to GNP in 1969 has dropped to 28.4 percent.

Per Capita GNP Growth

Nonagricultural per capita GNP grew by 81 percent during the ten-year period, while agricultural per capita GNP grew only 38 percent. While agricultural per capita GNP was 53 percent of nonagricultural per capita GNP in 1959, it slipped during the period to only 40 percent in 1969. As in many other countries, the gap in income levels between the agricultural and the urban-industrial sectors was becoming a serious problem by the end of the 1960s.

The General Organization of Korean Agriculture

Korean agriculture is dependent almost entirely upon human and animal draft power. For the most part, Korean agriculture is individually entrepreneurial, with government supplying most of the modern production factors presently utilized. Korea lags behind Japan and Taiwan in biological technology with relatively poor yields for many upland crops, and a high-yielding, short-strawed rice only now being introduced. However, there is

Table II-1
Economic Indicators for Korea, 1959-69, in 1965 Prices*

Indicator	1959	1969	Increase 1959-69	Annual Growth Rate 1959-69
	.....billion Won.....		.....percentage.....	
Gross national product	575.8	1,306.2	126.8	8.2
Agriculture GNP	243.7	370.4	52.0	4.2
Farming	225.7	328.4	45.9	3.8
Forestry	9.8	21.2	116.9	7.7
Fishery	8.8	20.8	137.2	8.6
	.....percentage.....			
Agriculture as share of GNP	42.3	28.4		
	.....thousands.....			
Population, total	24,291	31,410	29.3	2.6
Nonfarm	10,165	15,821	55.6	4.5
Farm	14,126	15,589	10.4	1.0
	.....percentage.....			
Nonfarm/total	41.8	50.4		
Farm/total	58.2	49.6		
Per capita GNP:	.....Won.....			
Nonagriculture	32,678	59,151	81.0	6.1
Agriculture	17,249	23,758	37.7	3.2
	.....percentage.....			
Agriculture/nonagriculture	52.8	40.2		

SOURCE: *Major Statistics in Charts.* Bureau of Statistics, Economic Planning Board, Republic of Korea, 1971, p. 125.
* 1965 rate of exchange: 271 Won = 1 U.S. dollar.

substantial use of fertilizer and plant protection materials. Irrigation facilities are moderately well developed, but water control practices need improvement particularly for the new short-strawed, high-yielding rice, IR667.

Like most agricultural economies developed or underdeveloped and organized on a free enterprise basis, Korean agriculture can be characterized as possessing underutilized labor and traditional capital. Labor is underutilized in the sense that there is so much of it on farms that its earnings are low at the margin.

Similarly, returns to traditional capital in Korean agriculture are so low it is difficult for Korean farmers to justify acquisition of more such capital. On the other hand, because such capital is often so specialized to agricultural production, it is difficult for Korean farmers to disinvest in capital and reinvest in other more profitable alternatives, draft cattle being an outstanding exception. Korea is a land-short economy and agricultural land is a valuable resource; however, there is evidence that land values are so high that returns on investment in land compare unfavorably with investments elsewhere in the economy. The Korean agricultural economy, thus, is characterized as yielding low returns simultaneously to land, labor and traditional capital.

Future Growth of the Korean Economy

Most of the previous overall projections for the Korean economy have been oriented toward the five-year plans. The most widely used are variants of a model featuring demands for output of major sectors, with domestic savings and foreign exchange availability introduced as possible constraints on growth. The use of demand-oriented models and extrapolation of recent growth rates is more appropriate to a five-year planning effort than to a more distant 1985 projection.

There appears to be little research available on long-term growth strategies for Korea, particularly relating to the question of allocation of labor and capital resources between the agricultural and industrial sectors although some initial work is underway at the Korean Development Institute. The limitations of the Korean Agricultural Sector Study (KASS) results, in this respect, will be discussed for each policy alternative.

Projections of the main aggregates of the Korean economy under the Third Five-Year Plan (TFYP)

policies indicate an annual average GNP growth rate of 8.6 percent for the period 1970-1976. This is led largely by an average 22 percent annual growth rate in commodity exports. In the light of the 1971 export performance, these TFYP projections may be optimistic.

After 1976, only one set of official projections was found—the Ministry of Construction Projections to 1981. These projections are a simple extrapolation of the TFYP although, significantly, the growth rate of exports is reduced to 10 percent annually after 1976. Similarly, imports are projected to grow much less rapidly in this period, reflecting, in part, the high import content of export goods. Investment grows more rapidly than GNP, reflecting a continuing adoption of more capital intensive techniques. These projections are subject to uncomfortable margins of error, chiefly because of uncertainty about long-run growth of exports and imports in Korea.

Adverse Growth Factors

Several demand factors might slow growth during the next several years relative to usual assumptions between now and 1985. The grinding down of the Vietnam War reduces remittances to the homeland by Koreans in Vietnam, reduces U. S. procurement of war materials in Korea, and has indirect effects on demands for Korea's exports by other nations affected by the war slowdown. Another demand factor unfavorable to growth is a reduction in Korean outlays by U. S. Armed Forces and the United States Agency for International Development (USAID). Still other demand factors, also unfavorable to growth, center on U. S. trade, with dollar devaluation and quotas having direct effects on Korea's exports and on Japanese demand for Korean exports. Additionally, increasing competition in world markets by the People's Republic of China could have an adverse effect on Korean export markets. Although increasing trade by China is speculative at this point in time, recent developments indicate a high probability of such a development before 1985.

A large component of Korea's exports is based on processing imported raw materials with low-cost skilled labor. The basis for this type of industry may erode as domestic wage rates increase and as material exporters develop processing capabilities of their own.

A final international factor which may adversely affect the future growth rate is the foreign debt obligation. For the analysis period, foreign debt repayment becomes an important consideration in projecting overall investments because of investor skepticism about future Korean ability to supply foreign currency to repay debts. Another indirect effect may be that the Korean government's fears about repayment abilities will result in various restrictions on an expansion in foreign debt. In either case, a slowing in the expansion of the foreign debt would slow capital inflow and act to slow growth. The ratio of debt repayment obligations to repayment ability from export earnings is unusually high compared to other countries such as Taiwan. A further rise in this ratio might make Korea untenably vulnerable to even a temporary balance of payments reversal. However, as both debt repayment obligations and export earnings are rising rapidly, there is some room for continued growth of foreign debt without raising the ratio of obligations to repayment ability.

If used to import capital to expand export industries, an increase in foreign debt obligations creates ability to repay the obligations. However, it may do so with a lag. A more important reason for debt obligations exceeding repayment ability could be that many loans are used to employ existing domestic resources and to expand infrastructure and domestic consumption goods industries. They may contribute only indirectly, and in some cases, not at all to foreign debt repayment ability. These considerations have led to some KASS conservatism concerning the growth rate for the next 15 years.

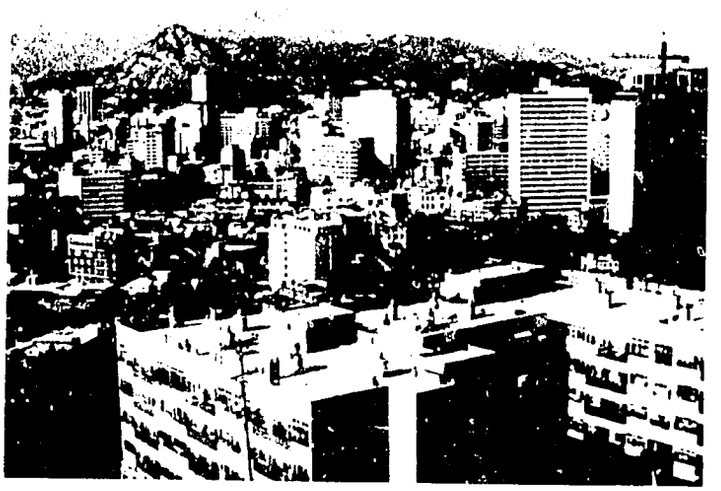
We will proceed with the agricultural sector analysis on the basis that the 9 percent growth rate projected in the TFYP for urban consumption is an upper bound. In the analysis in Chapters 6 and 7 we will recognize, at least qualitatively, the possible dampening effects indicated above.

Future Demands on Korean Agriculture

In addition to examining the present position of Korea's agriculture in her total economy, we need to take a broad look at Korea's expectations for her agricultural economy in the years ahead.

Among the agricultural contributions to an overall economy are: (1) food; (2) employees for industry and urban projects; (3) raw materials for industry; (4) export earnings and foreign exchange savings; (5) savings, government revenues, and newly formed capital to develop both the farm and nonfarm economies; (6) land for nonagricultural uses, and (7) an environment favorable to quality life styles for farmers, rural residents and urbanites seeking relaxation and recreation in a rural setting.

Modernization has been rapid in Korean cities, but slow in reaching her farms. Farm and rural modernization is now required to meet the demand of an expanding, wealthier urban population and to benefit farm people and rural residents.



Today's Korea

Each of these seven contributions will be discussed separately to: (1) describe the current level of each contribution, (2) quantify, where possible, the general level of future needs while indicating some of the forces influencing those needs, and (3) indicate, in a general way, some of the constraints on the ability of Korean agriculture to make needed contributions.

Food for an Expanding, Wealthier Population

Official census findings show that the population of the Republic of Korea increased from 16.2 million in 1944, to 20.2 million in 1949, to 25.0 million in 1960, and 31.8 million in mid-1970. The population expanded rapidly to almost double in the 26 years following 1944, and in part, reflected the immigration of people from North Korea. South Korean agriculture has been called upon to feed, clothe, and house twice the resident population it supplied at the end of World War II.

David Smith of the Population Council projects a total population of 40.9 million in 1985 with the assumption of a low fertility variant, 41.8 million with a moderate fertility variant, and 46.3 million with a high fertility variant. If the population increases at the moderate level, the nation in 1985 should plan to feed, clothe, and house approximately one additional person for every three people in the 1970 population.

By 1985, the Korean GNP will probably be over three times the 1970 level, with the increase for the nonagricultural sector almost fourfold.

In addition to the influence of population numbers and income, food consumption also is determined by food prices. Food prices rise to reduce consumption when production plus food imports (less food exports, if any) do not keep up with population and incomes; conversely, food prices fall when the reverse is true. Korean food prices relative to other prices are now rising, a development which will reduce the need to import to close the difference between production and demand.

From 1961 to 1969, Korean annual imports averaged 136,000 metric tons (MT) of rice, 111,000 MT of barley, 642,000 MT of wheat, and 40,000 MT of other grains. For the same years Korean production averaged 3,611,000 MT of rice, 2,020,000 MT of barley, 320,000 MT of wheat, and 118,000 MT of other grains.[1]

[1] National Agricultural Cooperative Federation, *Agricultural Yearbook 1970*, p. 82, 35.

In the years ahead, Korea's food grain pricing policies, import policies and agricultural production policies and programs will determine her food price levels, consumption rates, imports and grain production levels. Since our ultimate purpose is to present a set of recommendations concerning such policies and related programs, detailed food requirements, production and price levels will not be projected here. Instead we note that anticipated population growth and income increases may require a 50 percent expansion by 1985 in Korea's capacity to produce food. Wise policies and effective administration of programs will be required to achieve adequate food supplies at reasonable prices without causing excessive foreign exchange drains.

In addition to changes in the demand for quantity of food, there will be substantial changes in the demand for quality of food. In recent years Koreans have expressed a strong preference for rice over barley. Rice consumption was suppressed during the Japanese occupation and depressed afterwards by low income levels. In future, increased incomes should allow for expressed needs in terms of effective market demand for meats, poultry products, milk, fruits, and higher quality alcoholic beverages. Along with such shifts to higher quality foods will come preferences for more food processing and marketing services. It is estimated that the demand and need for such services will call for a 250 percent expansion in food processing and market services, while food production expands only 50 percent.

The Korean agricultural economy is somewhat unique among the less developed agricultural sectors of the world. Korean industry is developing rapidly and the proportion of the population engaged in farming has fallen below one-half. The current rapid outmigration from agriculture is expected to accelerate in the next fifteen years. With industrialization and off-farm migration, the demand for staple foods will go up rapidly. Korean agriculture is not faced with a lack of effective demand for foodstuffs. It is faced, however, with poorly developed technologies and meager land resources which mean high production costs for staple foods. It is not likely that Korea will both attain and maintain self-sufficiency in staple foods over the next fifteen years without the introduction of substantial cost-reducing biological and chemical technologies as well as labor-saving improvements in agricultural production. Thus, Korea is unique in that there is a fairly strong assured demand for staple foods.

While the demand in Korea for livestock, dairy,

and poultry products, and fruits and vegetables is substantial and growing, the markets for such commodities are relatively thin and will continue to be so for the next twenty years or so. There will be substantial opportunities to expand production of such "higher quality" nonstaple products over the next decade and a half; however, it must be recognized that effective demand for these products will be satiated with relatively small absolute increases in production.

Labor for the Nonfarm Sector

While students of agriculture commonly and reasonably regard off-farm migration as a drain on agricultural resources, the movement can also be regarded as a contribution of the agricultural sector to the development of the urban-industrial sector.

The Korean agricultural sector is contributing about 300,000 persons annually to the nonagricultural economy, including a relatively high proportion of young men and women. Our KASS projections indicate that the demand for these farm people and the off-farm migration will increase to over half a million annually around 1975, and to nearly a million in the late 1980s.

This contribution to the nonfarm labor force is likely to reduce the absolute number in the farm population from 15.9 million in 1972 to approximately 9 million in 1985, and to reduce the proportion of the farm population to the total population from approximately half in 1970 to less than a quarter in 1985.

If the national interests are to be well served by this massive outmigration, it is important that the rural migrants who join an increasingly sophisticated industry be well educated and in good health. Investments in rural education, health and sanitation are partially for the benefit of the rural economy; however, as the rural labor force diminishes, such investments increasingly benefit the nonfarm sector. In a real sense, both the farm and nonfarm sectors should bear the cost of producing this supply of manpower for the nonfarm sector.

Raw Materials for a Rapidly Expanding Industry

Except for labor, Korean agriculture has not had sufficient resources to produce many industrial raw materials, the main exceptions being silk, and some tobacco, limited leather, rush and straw. More recently, rape and sesame seed and perilla have expanded at the expense of cotton and hemp production.

Availability of land for mulberry leaf production does not constrain silk production as much as demand and the uncertain role the People's Republic of China will play in the future world silk market.

There are interesting possibilities concerning the expansion of rape seed production on winter paddy land. While the demand for oil is more than adequate, the question is whether the cost of producing vegetable oils in Korea compares favorably with importing soybean and linseed oil from North America, palm oil from the tropics or even sunflower oil from abroad. Oils for human consumption are not strictly industrial, yet they do provide part of the basis for the food processing and marketing industry.

Korean agriculture can provide raw materials for a major expansion in food marketing and processing by the nonfarm economy. In the next 12 to 15 years, the food marketing industry may expand as much as two and a half times, while the processing industry will expand even more.

Increased Export Earnings and Import Replacement

Two of Korea's agricultural export earners are silk and ginseng. Other items include apples, vegetables (mostly to U.S. military establishments), tobacco and crude botanical medicines. Korea's silk exports were 2,918 MT in 1971, valued at 46 million dollars and accounting for 46 percent of Korea's agricultural exports and for 5.5 percent of total exports.

Agricultural exports have increased almost seven times since 1961 from 12.6 million dollars to 100.5 million dollars; however, agriculture's share of total exports decreased from 30.8 percent in 1961 to 12.0 percent in 1970.

More important to the Korean economy than her role as export earner is Korean agriculture's role as a foreign exchange saver. In 1970, Korea's agricultural imports exceeded the value of her agricultural exports by the difference between 239.8 million dollars and 100.5 million dollars. If the consumption mix can be changed and production increased to close this gap, a substantial savings can be made in foreign exchange.

Capital for Increased Rural and Urban Productivity

Korean agriculture is probably a greater source of capital for development of the farm and non-

farm economies than is commonly realized in lender and grantor circles because of the overlooked processes of (1) income transfer associated with migration, and (2) the formation or production of specialized capital in agriculture by the person who "saves" and invests without utilizing the services of money markets.

Korea's development plans are not being financed with surpluses forcibly extracted from agriculture with taxes, unfavorable terms of exchange from state trading corporations, or by investments by wealthy rural families. Though it appears that agriculture is a substantial beneficiary of subsidies and other forms of developmental assistance, so much income is being transferred from farm to city and capital created and used in agriculture that the direction of the net flow is in doubt.

For instance, the average 300,000 migrants leaving Korean agriculture will probably receive an inheritance of about one-tenth to one-fifth of the value of total assets of his family farm, or between 90,000 and 180,000 W per migrant. Currently, claims on the agricultural capital stock of between 27 and 54 billion Won flow with migrants toward the city each year. Over the next 15 years, off-farm migration is expected to average over twice the current figure and be around 900,000 in 1985. The annual claim transfer in connection with migration may approach 80 to 160 billion W annually by 1985, for an annual average of between 50 and 100 billion W per year over the period. Offsetting this is a reverse flow of income from migrants to rural areas in the form of gifts to parents and younger siblings. According to the Farm Household economy survey, these donations amount to less than a third of the income outflows associated with inheritances. The net flow of claims against the capital stock in agriculture in 1970 was in the neighborhood of 18 to 34 billion W and may range between 50 and 100 billion in 1985. Over time, the income flows to pay off these claims approximately equal the claims.

Offsetting this outflow of income is the net flow of government revenues and expenditures into agriculture. Current subsidies probably amount to about 52 billion W annually. Government revenues originating in agriculture in 1970 amounted to about 7.2 billion W, leaving a net 1970 transfer to agriculture of about 45 billion W on government account. This figure is from 100 to 200 percent of the income flows associated with inheritance. Korean agriculture probably receives more per year than it contributes in the way of government revenues and money to develop the nonfarm economy. However, the above calculations ignore two less monetized contributions from agriculture to the nonfarm economy. One of these is the value of human capital in off-farm migrants, and the other is the fact that the labor and much of the capital used in producing agricultural products for the nonfarm economy is very low-paid. Taking this into account, agriculture is clearly a net contributor to the development of the Korean nonfarm economy.

Korean agriculture has generated much of its own capital in the past. Buildings, cultivated trees, livestock, and equipment are worth about 140 billion W. The need to expand food production by 50 percent from about the same land base will require major expansions in farm-generated capital to convert forest to cropland, and development of more and better water controls. With an expanding demand for livestock and poultry products, vegetables and fruits, much extra capital will be required for breeding herds and orchards: the necessary expansion will require at least a doubling and perhaps more than a tripling of such capital investments. Part of the livestock investment will result from the conversion of draft cattle to beef cattle and a shift from feeding roughage to draft animals to feeding beef and dairy animals.

The shift away from farm-produced investment and operating capital to equipment and supplies purchased from the nonfarm sector will greatly expand the need for credit. However, it should be noted that the land previously needed to produce draft animals will be needed to produce new beef and dairy feeds and forage, as well as to produce new orchards, mulberry plantations, etc.

Land for Nonagricultural Use

With increasing urbanization, changes can be expected in the demand for land resources. Thousands of hectares will be needed for urban growth. More land will be needed for new urban and suburban housing, industrial and commerical sites, streets, parks, reservoirs, and urban service areas. Steps will be taken to secure adequate urban water supplies. There will also be increased use of land for national, provincial, and local highways and roads. Offsetting a small part of this will be a reduced need for rural homesites as the rural population declines. KASS projects the annual loss of land to such uses at about 40,000 hectares annually, about half of which will come from prime agricultural land and the remainder from forest land.

The General Quality of the Social, Political and Physical Environment

Korean agriculture has more to contribute to the quality of the national environment than educated manpower, its products, and land for homes, recreation, roads, etc. A prosperous, productive, socially and politically stable agriculture well served by a well governed infrastructure is an important environmental asset for a nation. Such an agriculture is a pleasant part of a country. Further, it is capable of controlling its own wastes, conserving its own soil and water resources; thus reducing erosion, stream siltation and nutrification, and reforesting uplands unsuited for crop and forage production.

III

The Resource Base of Korea's Agriculture

Introduction

The preceding chapter outlined the expectations of Korean agriculture during the projection period in terms of meeting substantial needs for food, manpower, industrial raw materials, export earnings and foreign exchange savings, capital for development, and land for use by the nonfarm sector. This chapter identifies and discusses the resources available in Korean agriculture to accomplish such ends.

Korea's agricultural resources include: (1) land and land substitutes, (2) water and water control facilities, (3) labor and labor-saving animals and equipment, (4) capital, (5) technology, and (6) infrastructure, both public and private. Each of these resource groupings or categories will be discussed separately. The balance between needs or ends (discussed in the last chapter) and means or resources (the subject of this chapter) will be discussed in a preliminary way in the first pages of the next chapter. This balancing of needs against resources defines the general magnitude of the development problem for Korean agriculture.

Before describing Korea's agricultural resources, it is necessary to present the regional breakdown of Korean agriculture used in the analysis behind the projections presented later in this report.

Cropping Regions for the KASS Analysis

Cropping systems in Korea can be defined in many ways, but clearly a *basic* dichotomy exists between upland and paddy cropping patterns. Further, climatic transitions along the peninsula give rise to an important subclassification of paddy cropping patterns according to the feasibility of growing a second crop with rice in a given year. This difference in climates gives rise to the single cropping paddy and double cropping paddy. There are three basic cropping systems:

1. Upland,
2. Single cropping paddy,
3. Double cropping paddy.

Most Korean farms belong to one of these cropping systems or are a blend of the basic systems.

Ideally, all farms in Korea should be classified according to these three systems and whatever mixtures of them are appropriate as a basis for our analysis. This is clearly impossible, at least in the short run, since all data are recorded by political/geographical sub-divisions—province, gun (county), myun (multivillage), and ri or dong (village) rather than by cropping systems. The next best thing was to group political/geographical subdivisions according to the cropping system dominant in each sub-division. Theoretically, this can be done as finely as desired, but the data processing and analysis required rapidly multiplies as finer sub-divisions are considered. Thus, a compromise regionalization scheme was devised. In essence, the compromise scheme classifies the provinces of Korea according to whether they are *dominated* by:

1. An upland cropping system,
2. A single cropping paddy system,
3. A double cropping paddy system.

Though our compromise lacks the precision of a more detailed regional breakdown, it allows a much more realistic analysis than can be based on national data alone. In the process of determining the regional boundaries based upon these cropping distinctions, calculations of the ratio of paddy land to total arable land were made for each gun. On the basis of these calculations, it appeared that, with the exception of a few gun, the division between upland and paddy (both single and double cropped) could follow provincial boundaries. The decision to define regions along provincial boundaries was made (1) to conserve limited time and manpower resources available for the Korean Agri-

cultural Sector Study (KASS), and (2) in the conviction that deviations of the different cropping systems from provincial boundaries were small enough to not impair the integrity of the regionalization scheme. Chungcheoneg Bug Do, however, appeared to be borderline and further analysis was required.

An index based on the ratio of paddy to arable land does not provide a measure of difference in the yield and quality factors. Therefore, in addition to calculating the paddy-arable land ratio for each province, a further ratio based on the value of rice production to the value of total agricultural production was calculated. These two ratios were weighted equally to provide the ratio used in placing provinces in the paddy or upland category. The northeast province of Ganweon Do, the central province of Chungcheoneg Bug Do, and Jeju Do fall in the upland region by this analysis

The next step was to determine the dividing line between single and double crop paddy. This was done by reviewing a map prepared by the Agricultural Economics Research Institute (AERI) on the basis of myun data indicating the dominance of single or double crop paddy. A final determination was made by calculating the ratio of double crop to total paddy in each myun. An overriding consideration was to follow provincial lines in delineating areas. The result was Figure III-1 which presents graphically the regional breakdown used in describing Korea's agricultural resources and which will be followed throughout the analysis.

Resource Earnings and Commitment Levels

Before examining the resource base for Korean agriculture, it seems advantageous to discuss Korean farms in terms of earnings and overcommitted and undercommitted resources in agricultural production.

While Korea has income levels sufficient to transform her nutritional needs into demands for more output than Korean farms produce, resources are now overcommitted to Korean agriculture, on private account. Korean agricultural incomes are low, both on a per capita basis and at the margin by resource categories. Average incomes are such that the earnings of labor in Korean agriculture cannot possibly be as high as in urban pursuits. The same is true of earnings of traditional forms of capital employed in Korean agriculture. The low levels of earnings indicate it is unlikely that the earning power of land at the margin in Korean agriculture is high enough to cover prices paid for land, though land prices are imperfectly known because of legal contraints on the free operation of a land market.

There are many different kinds of labor and income levels on Korean farms. The variations stem from differentials in age, training, experience and sex. For any labor category, there tend to be two market wage rates: on-farm wage rate or return to labor required to attract laborers of the same age, skill, experience and sex into agriculture; and the off-farm wage rate which similar laborers would receive if they leave agriculture. Due to migration, commuting, and other transfer costs, these two substantially different wage rates bound the earning power of laborers on farms. Relative to off-farm wage rates, farm laborers are undercommitted. Relative to the cost of acquiring more laborers, farm laborers are overcommitted. The cost of using Korean labor to produce agricultural products, in turn, is bounded by the two wage rates referred to above.

Similarly, durable forms of traditional capital such as equipment, tools, water control structures, fences, irrigation bunds, livestock, fruit trees, etc., all have two prices. In some cases, the salvage value of a capital item is zero or even negative, while in other cases acquisition costs are high. It is our observation that Korean agriculture is organized so that the earning power of most forms of traditional capital at the margin falls between these two bounds and is determined by opportunity costs or shadow prices within Korean agriculture.

With the Korean land market operating under the legal constraints of transfer as imperfectly as it does, it is somewhat more difficult to generalize the conclusions of the preceding paragraph to land as well as capital. However, it is likely that the legal constraints on the sale of land make the private acquisition price for land very high and the net receipts for land sold much lower. Generally speaking, land prices seem high relative to farmers' earnings; which indicates that opportunity costs or shadow prices govern the value of land in accordance with Ricardian land rent and land value principles. For the economy as a whole, land acquisition costs are very high.

In conclusion, it is extremely important to keep in mind the roles played by acquisition costs, salvage prices and opportunity or shadow values in discussing labor, capital and land resources, including the forms of capital which substitute for land and for labor.[1]

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[1] Glenn L. Johnson and Leroy Quance, *The Overproduction Trap*, Baltimore: Johns Hopkins Press, 1972 (forthcoming).

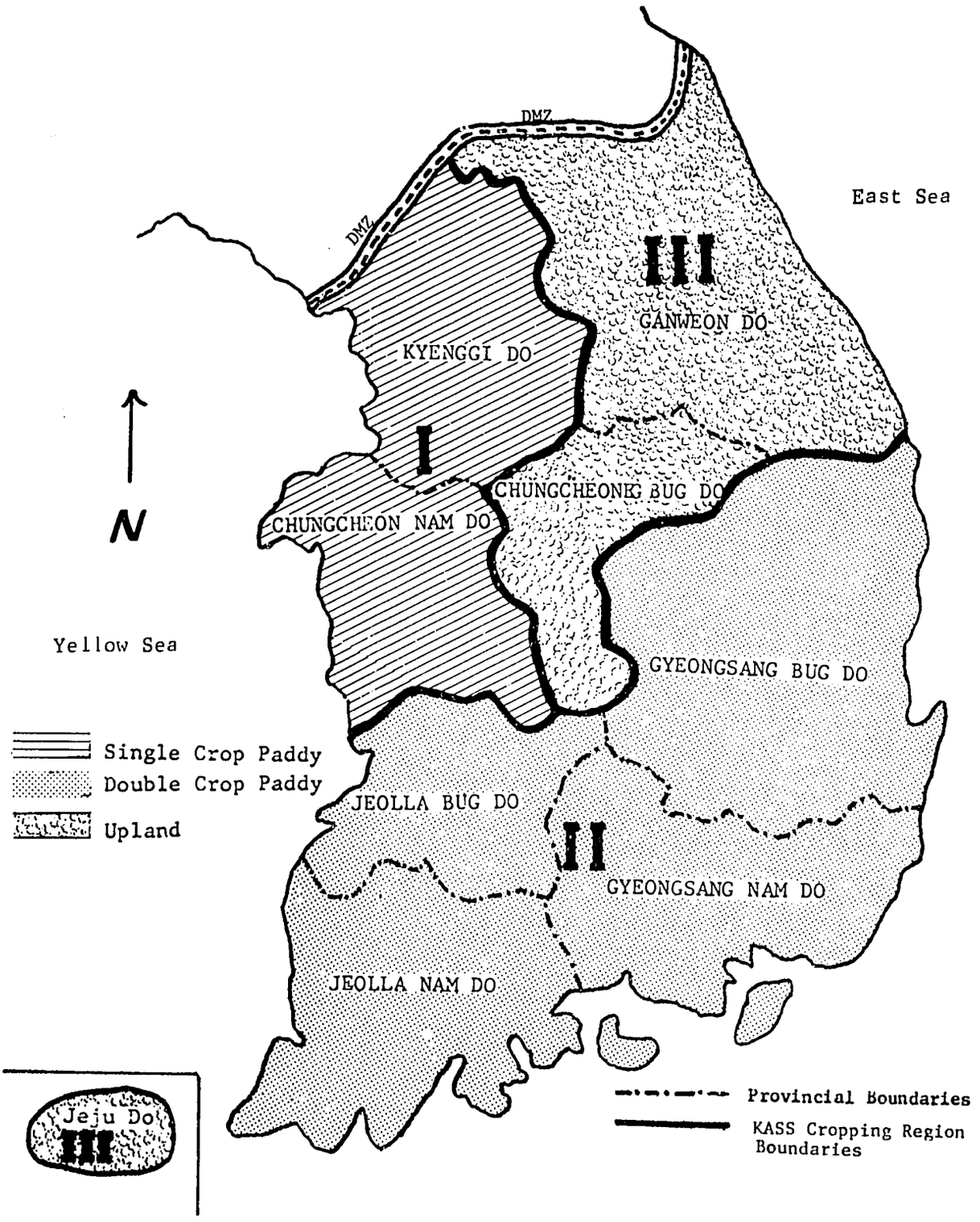


FIGURE III-1. Provincial and cropping region boundaries of Korea.

Land and Land Substitutes

According to the official statistics for 1969, South Korea has a total land area of 9,847,750 hectares of which over 2.3 million hectares or 25.7 percent are in farmed cropland. The nation has about 1.3 million hectares of paddy, or about 650 thousand hectares each of double cropped and single cropped paddy. The remaining one million-plus hectares of cropland are cultivated uplands.

For nearly three decades prior to the Korean War, the arable land base of the present Republic remained relatively constant. However, in the decade immediately after the war there was a decline of 8 percent from the former stable level of arable land. During the 1960s there was a direct effort to reverse this trend and, indeed, to increase the total land base for agricultural production to exceed the pre-war level. Large-scale tideland development projects were undertaken at costs exceeding one million Won per hectare, or more than twice the selling price for paddy land during the same period. The results to date have not been sufficiently encouraging to attract large sums of new investment capital required for any appreciable change in land area through tideland reclamation. However, additional uplands and tideland areas can and will be brought into use. These reclamation activities will produce some high quality lands, but more often than not will involve the addition of lands that, for some time, will be near the extensive margin for economic use. Unfortunately, the nation must look to reclamation of low quality land to offset the loss of the often quite productive lands that shift out of agriculture to industrial, urban housing, highway, and reservoir uses.

Various ministries of government have been given extensive responsibilities for natural resource development. The Ministry of Agriculture and Forestry (MAF) has planned about one-third of its total investment outlays in the 1972-76 period (Third Five-Year Plan) for development of the agricultural production base. Of a total of 496,952 million Won (including 23,005 million to be administered by the Ministry of Communication and Public Health), 173,534 million are planned for the agricultural base in million Won as follows: 18,246 for water resource development, 45,394 for land consolidation, 4,800 for tidewater development, 53,334 for the four big river basin multipurpose projects and the remaining 51,780 million Won for such other activities as bench terracing, afforestation and the control of soil erosion. Other parts of the MAF planned investments have direct implications for a changed pattern of land use (limestone application 4,866 million Won, development to new cash crops 12,696, pasture development 7,806, new plantings to mulberry 2,800, rural road construction 16,241, etc.).

Figures published by the Ministry of Construction project the reclamation and development of approximately 265,200 hectares of new farmland by 1981 and the loss of around 178,200 hectares as shown in Tables III-1 and III-2. This will provide the nation an initial increase of 87,000 hectares of farmland. However, it will have 4,700 fewer hectares of paddy, and much of the land sacrificed to other uses has production potential far superior to that of the newly developed lands.

TABLE III-1
Projected Agricultural Land Use, 1970-76 and 1976-81, Korea

Classification	1970	1976	1981
	..... thousands of hectares		
Paddy	1,293.7	1,248.7	1,249.0
Upland	1,036.7	1,124.7	1,168.4
Total farm land	2,330.4	2,373.4	2,417.4

SOURCE: Dr. Barlowe's interpretation of data reported by Kim Byeong Do, Kim Dong Min, and Warren H. Vincent, *Projected Land Development and Related Projects of Korea*, pp.8-11. (Progress Report, Agricultural Sector Analysis Study, December 1970.)

TABLE III-2
Anticipated Shifts in Agricultural Land Use by 1981, Korea

Classification	Area Reclamated	Area Lost to Other Uses
	..... thousands of hectares	
Tideland paddy	27.7	72.4
Upland	237.5	105.8
Total	265.2	178.2

SOURCE: See Table III-1.

It is logical that emphasis be given to the potential for developing cropland,[2] but it should be recognized that the potential for bringing in additional land areas is limited. Because of trends in cropland areas, current plans for new upland development, and the impact of the increasing demand

[2] Sung Hwan Ban, *The Long-Run Productivity Growth in Korean Agricultural Development: 1910-1968*, Doctoral dissertation, University of Minnesota, 1971.

for urban and industrial lands, highways, reservoirs, and possible park areas, the nation may be hard pressed to retain its present area of farmland.

Technical opportunities for new farm land developments in Korea are great, but economic opportunities are far more limited. About two-thirds of the total land area is classified as forest. Much of this area is suitable only for trees, while some of it is bare rock, and virtually all of it is mountainous or hilly upland. Nearly all the area suitable for development as paddy or as terraced upland has already been developed. Korea has followed the normal historical process of first developing those lands that are most fertile, and easiest and least costly to develop.

Of the 9.8 million hectares of land area, nearly 6.7 million hectares or 67.8 percent have been classified as forest, including 321,000 in "convertible forest," 5.9 million in "reserved forest" and 425,000 hectares in "other forest land." Prospects for increasing the total arable land base are limited to the 321,000 hectares of convertible forests which are the sparsely forested mountain areas with slopes not greater than 24 degrees. Approximately 36,000 hectares of protective forest are contained within the 321,000-hectare area defined as convertible forest, and exclusion of the protective forest reduces the potential land area with a less than 24-degree slope to 285,739 hectares.

What proportion of this approximately 286,000 hectares would in fact be available for agricultural production? Taking into account a number of factors, including inaccessibility and the amount of land lost to alternative uses, an estimated 70 percent of the total potential land would be available for agricultural production, leaving about one-half of the approximately 200,000 hectares in the double cropping region. Of the 200,000 hectares of upland developable, approximately 41,000 hectares have been classified as suitable for upland crop production, 45,000 suitable for orchards (apples, pears, grapes), 74,000 hectares with thin soil depth potentially usable for pasture, and 40,000 with steep slopes potentially usable mainly for mulberry and grass.

A linear programming analysis was made by KASS to determine the upland cropping pattern which would maximize the discounted net cash flow on the 85,000 hectares of land with a slope of less than 10 degrees. Assuming 1965-69 technology and 1969 prices, development costs in addition to operating costs, unpaid family labor for development of land, and 1969 estimates of available farm labor, it was determined that, excepting grapes, most fruit crops in most areas would yield a negative discounted (@ 18 percent interest rate) net cash flow stream. Likewise, unless it becomes possible to raise more than one crop annually on the same land, the net cash flow stream is relatively low for traditional upland crops. However, when budgets were proposed holding all assumptions the same except price, and using 1970 prices, additional single crops became realistic possibilities. This determination underscores the importance of favorable price relationships if certain kinds of cropping patterns are to be encouraged.

The linear programming solution using 1969 prices favored barley, wheat, sweet potatoes, vegetables, mulberry, grapes and pears. However, with 1970 prices, additional crops of soybeans, white potatoes and apples were brought into the solution.

The amount of labor required for land development varies with the price relationships and differing crop combinations. An average requirement of about 1,500 hours per hectare can be expected. For all regions, the 1969 supply of labor is apparently more than adequate for meeting initial land development requirements as well as the annual crop labor requirements.

A long-range upland development program should emphasize:

1. Prospective favorable long-term returns to producers which can result from profitable price relationships and improved technology.
2. The need to avoid labor-intensive fruit crops in areas potentially subject to rapid outmigration of farm labor unless attention is given to possible labor-saving technology.
3. Possible need for government subsidy as an incentive for initial land development as well as additional incentives to raise the productivity level and maintain that level.

Appraisals of resource categories require grouping of substitutes; thus, land substitutes should be considered along with land, particularly in a land-short Asian economy such as Korea has. The chief land substitute is fertilizer, either natural organic material or chemical. Other substitutes are pesticides and herbicides, and capital investments in leveling, bench terracing, and bunding, which converts less usable forms of land into forms which permit them to compete with naturally more usable forms. Still another substitute is improved varieties with optimum combinations of comple-

mentary inputs. For generations, Asian farmers have used land and its substitutes much more intensively than their American, Oceanic and even European counterparts. In a real sense they responded to the scarcity of land and the abundance of labor by emphasizing the preindustrial, land-saving technology; available materials such as human, animal and plant wastes as fertilizer; and land and water management structures constructed with abundant supplies of cheap labor.

Four important developments are taking place with Korea's industrialization which drastically affect her use of land substitutes.

1. Low cost chemical fertilizers are now available in quantities which far surpass that of available organic fertilizers.
2. Labor is getting scarcer and more expensive in Korean agriculture, a factor which tips the balance still further in favor of the cheaper, more potent chemical fertilizers and away from natural organic fertilizers and traditional land management structures constructed with human energy.
3. Plant breeders are developing modern varieties which use chemical fertilizers, particularly nitrogen, more effectively.
4. Rising per capita nonfarm income relative to per capita farm income is increasing the rate of rural-urban migration.

Korea's land reform established a small-holder system of agriculture, with land holdings now too small to permit per capita farm incomes to keep up with the increasing incomes anticipated for urban residents in the next two decades. As off-farm migration takes place, hectares available per man will increase. In order to expedite farm size expansion, farm land rental should be permitted; the three-hectare farm size limitation should be reviewed periodically and adjusted upward when it appears to constrain expansion by bonafide farmers; and long-term credit should be made available for farm land purchase. Paralleling the increase in farm size will be greater use of purchased inputs, less use of organic fertilizer, less investment and probably considerable disinvestment in traditional land management capital, more investment in modern land management capital permitting the use of labor-saving equipment, a shift of marginal rice land to other uses, and the conversion of forest land to uses consistent with a shift in demand towards higher protein foods and fruits and the replacement of human and animal labor by mechanical power.

Though fertilizer is decreasing in price relative to other inputs (see Table III-3), credit purchases are particularly expensive under the Grain-Fertilizer Exchange Program, a consideration which probably reduces the use of both credit and fertilizer. Fertilizer distribution is a monopoly entrusted by the government to the National Agricultural Cooperatives Federation (NACF). The distribution channels are shown in Figure III-2, with the proportion of total volume handled by the different channels.

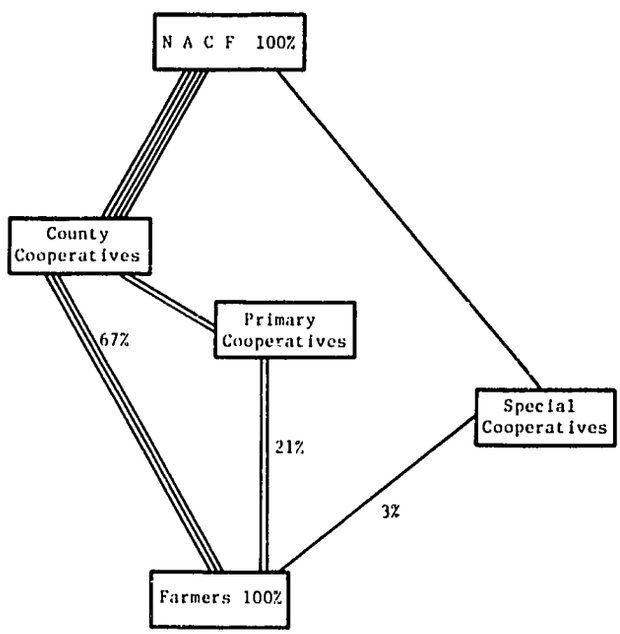


FIGURE III-2. Fertilizer purchase channels used by Korean farmers. (Source: Brake, *et al.*, "The National Agricultural Cooperative Federation: An Appraisal," KASS Special Report No. 1, AERI-MSU, 1972.)

Most significant in the past has been the tie between credit purchases and the required repayment in kind, with rare exceptions, as part of the Government Grain Management Program. Credit sales require repayment in grain at prices set at 300 Won above the Government Grain Purchase Price, and in 1969 and 1970 about 1,000 Won less than the farm market price.[3] The effective interest rate on short-term credit purchases of fertilizer was very high. Since 1972, farmers have had the option

[3] For example, in November 1969 the farm price of rice was 5,699 Won and the government purchase price was 4,200, making the repayment price 4,500 Won, nearly a 20 percent difference.

TABLE III-3
Price Indexes for Major Purchased Farm Inputs

Year/Month	Seeds	Livestock	Fertilizer	Farm Chemicals	Farm Implements
	.....	.....	percentage	.....	.....
1965	100.0	100.0	100.0	100.0	100.0
1966	110.5	124.5	100.0	103.6	112.4
1967	96.3	178.3	87.2	99.7	121.3
1968	112.3	278.6	87.2	113.7	135.5
1969	189.7	290.3	93.5	114.9	145.4
1970	273.0	335.1	96.6	109.7	168.3
1970					
Aug.	275.7	354.6	96.6	112.6	172.0
Sept.	260.7	353.8	96.6	114.8	174.3
Oct.	260.7	345.8	96.6	113.2	176.1
Nov.	260.7	352.1	96.6	113.2	177.7
Dec.	260.7	357.3	96.6	113.2	177.1
1971					
Jan.	260.7	366.5	96.6	113.2	178.3
Feb.	268.3	377.6	96.6	113.2	177.4
Mar.	271.3	404.5	96.6	112.0	179.2
April	266.6	463.2	96.6	113.3	184.4
May	266.6	468.0	96.6	112.8	186.0
June	266.6	461.8	96.6	112.7	186.9
July	266.6	466.0	96.6	113.4	188.4
Aug.	316.0	478.7	96.6	113.4	186.5
Sept.	342.6	484.7	96.6	113.7	191.4
Oct.	342.6	498.5	96.6	113.7	191.4

of payment in kind or cash, but subsistence farmers without cash are penalized.

The low percentage of fertilizer sold by NACF on credit is probably related to the conditions of the loan agreements. Planned interest rates for 1972 for the first 6 to 8 months are at 8.4 percent, for the next 12 months 19 percent, and for overdue loans, over about 1½ years, the rate is 31.2 percent.

The net effect of the combination of pricing practices and credit terms for fertilizers is difficult to determine. The government has a long-term purchase agreement for fertilizer which appears to be at prices above the world market price. NACF sells at an interest rate nominally below the market rate for subsistence farmers but tied to a disadvantageous barter agreement. The government-established margin for NACF on fertilizer sales is too low to provide sales incentive.

The barter arrangement on fertilizer and low NACF margins are reducing fertilizer sales and the effectiveness of the NACF input supply program. The potential exists for a highly rational, low-cost system.

Table III-4 indicates the rate of increase in fertilizer use in the past three years.

TABLE III-4
Extent and Rate of Increase in Use of Fertilizer, Korea, 1968-71

Year	Annual Sales of Nutrients	Annual Rate of Increase
	metric tons	percentage
1968	478,460	....
1969	534,689	11.8
1970	562,902	6.6
1971	605,137	6.2

Water Resources and Water Control Facilities

Irrigated paddies have been expanded from around 700,000 hectares in 1966 to over a million hectares by 1970. Water resource developments are planned to bring irrigation water to an additional 176,000 hectares by 1976. As a part of the comprehensive development projects envisaged for the Han, Kum, Nakdong, and Yongsan River basins, new and supplemental water resources will be developed for agricultural purposes.

Land and water are inputs which can be combined in varying proportions. If the amount of

water is controllable, an optimum quantity exists and is ordinarily found by trial and error if not directly. Where the optimum is not attainable without water controls, those controls are established, as feasible, by either drainage or irrigation facilities. As many such facilities must be large in scale, government often is involved in their financing and construction. If the charges which government makes for water control services are out of line with the cost of producing such services, more or less than optimum usage of water takes place. Korea is fortunate in that public irrigation charges are fairly closely aligned with costs.

Construction and operation of much of Korea's water application and removal facilities depend upon large amounts of low-cost labor. As the supply of labor diminishes in Korean agriculture and as wage rates increase, traditional water control facilities will become less and less economical to construct and operate. Eventually, disinvestment will take place followed by reinvestment in more modern facilities requiring much less labor for operation and maintenance. The paddy rearrangement scheme is an example of such disinvestment and reinvestment.

Korea lacks detailed knowledge of her deep, underground water resources, though there is the general conviction that they may be extensive. As pressure increases on Korea's land resources, it may prove advantageous to pump water for early and late season irrigation of fruits, vegetables, and intensive "green chop" forage crops on upland soils.

Labor and Labor Substitutes

Korea's agricultural manpower was about 4.9 million persons in 1970, with about 1.1 million located in the single crop paddy area, about 3.1 million in the double crop paddy area and over .7 million in the upland. This labor force is .4 million more than the U. S. agricultural labor force which handles almost 60 times as much crop land and a total cattle herd almost 100 times the size of Korea's. The Korean farm population increased only slightly from 1959 to 1970, while agricultural output increased by over 50 percent.

KASS projections indicate that manpower employed in Korean agriculture will increase to over 5 million by about 1975 before starting to decline in absolute numbers as a result of off-farm migration in response to higher wages and employment opportunities in urban and industrial areas.

By 1985, Korea's agricultural labor force may be one-third less than at present, while the need for agricultural output may increase by as much as 50 percent. Clearly, Korea will have to turn increasingly to labor substitutes. Fortunately, the western world has a vast body of labor-saving technology available to other nations for modification and adoption as needed. Some students fear that labor shortages will curtail agricultural production in the less developed world; others feel that western labor-saving technologies will be prematurely adopted. The problem, of course, is to adopt them as needed. Japan and Taiwan have found a near optimum rate of adoption. The most serious cases of premature adoption have occurred in some centrally controlled economies, as in the Soviet Union and Ghana under the Nkrumah regime.

Labor-substitute capital includes draft animals, tractors, power pumps, and threshers, etc. In 1970, Korean farmers had approximately one million cattle for draft purposes or one for every five persons in the agricultural force. There also were 12,000 rototillers, 69 tractors, 41,000 powered threshers and 54,000 power-driven water pumps. Not allowing for multiple use of motors and engines, this indicates an average of about one motor or engine for every 40 agricultural laborers. Thus, Korean agriculture depends heavily on the direct expenditure of human energy.

The dependence on human energy is further indicated by such manually operated capital items as: 441,000 rake threshers, 401,000 rolling hand threshers, 56,000 hand pumps, and 511,000 weeders.

Human and animal power and farm-produced equipment are being replaced by mechanical power and sophisticated equipment manufactured in the nonagricultural sector or imported from abroad. The result of this change will be profound since farmers will have to pay acquisition costs for equipment rather than produce it with their own underemployed land and labor, particularly in off seasons.

If the agricultural labor force is reduced by as much as 40 percent in the next 15 years and if draft cattle are converted to beef or dairy production, there will be a very substantial demand for both small tractors and power tillers probably in the 5- to 12-horsepower range, and various other kinds of mechanized equipment. On the assumptions that 80 percent or roughly 800,000 draft animals are replaced at the rate of one power tiller for four bullocks, 200,000 new tillers or tractors will be needed. These, plus the 200,000 remaining draft cattle and attachments for the power tillers, plus other engines, motors and pieces of power

equipment required to replace 1.7 million farm workers, would be worth roughly 10 times the present stock of draft cattle, tractors and power equipment.

Capital: Total, Land-Neutral and Labor-Neutral

The capital resource base of any country is complex. Part of the capital is land-saving, another part is labor-saving, while still a third part is relatively neutral with respect to land and labor. Land- and labor-substitute capital were discussed in connection with land and labor. Further, water control capital has been discussed in connection with water and irrigation. This section now turns to (1) labor-neutral and land-neutral capital not involving water management, and (2) the process of generating all forms of agricultural capital.

Korea's neutral capital base includes, in addition to very extensive water control structures, her breeding herds for producing meat and poultry products, orchards, mulberry plantations, cocoon producing facilities, vinyl house facilities, agricultural buildings, etc. In recent years, Korea's Holstein herd has expanded to over 23,000 head from about 6,500 in 1965. Over 5,000 modern poultry farms are presently in operation. Over two and a half million other farms keep chickens, with over 20,000 farms having between 100 and 500 chickens per farm and another 20,000 or so have between 50 and 100 chickens totalling over 23 million chickens. There are also about 700,000 rabbits, ducks, turkeys and geese.

Korea's pork-producing capital is widely dispersed and devoted mainly to producing pork using garbage and by-products as feed. Over 40 percent of the farmers keep pigs. Of these, 96 percent have one or two head while around 600 have more than 19 head. In total, over one million head are kept.

Beef cattle capital, as contrasted to power-producing cattle capital, is hard to measure in Korea. Forty percent of the farms have cattle, about 1.3 million head in total. Of the farms with cattle, 98 percent have only one or two used first as sources of power and then sold for beef. In addition to these dual-purpose cattle, there are approximately 3,000 specialized beef animals produced for slaughter.

In the years ahead as labor becomes scarcer and more expensive, Korea will disinvest in cattle as a source of power and invest in all sorts of breeding stock for producing livestock and poultry products for human consumption. Forage will be freed for use in producing livestock products other than animal draft power. Presently, little capital is invested in forage-producing pasture stands, fences, etc. In the future, additional capital of this nature will be required.

Korea's silk-producing capital is substantial, consisting of about 85,000 hectares of mulberry plantations, buildings, and equipment, plus the biological capital represented by the silkworm breeding stock.

In addition, substantial capital investments have been made in fruit and vegetable production. In the case of vegetables, investments in vinyl houses and mushroom facilities are expanding rapidly. Land in fruit orchards totals over 60,000 hectares devoted to apples, peaches, pears, grapes, oranges and persimmons and plums in that order as measured by hectarage.

Some capital is durable; some, such as fertilizer, gasoline and seeds, is operational and used up in a single production period. Included among operating capital items are the new plant protection chemicals now used at the rate of about 25,000 MT annually and likely to increase rapidly in the future. This shift to modern technologies will commercialize or institutionalize the supply of many production materials away from the farms which use them.

Earlier in this chapter, discussions of labor and land substitutes revealed the use of over a million draft cattle, much man-powered equipment, and less than one motor or engine per 40 agricultural laborers. In the case of land substitutes, fertilizer consumption is now running at around 560,000 tons of nutrients, almost double levels in the late 1950s.

It is difficult to assess the total value of Korean agricultural capital. However, the value of the average farm household's assets is about 915,000 W. There are about 2.5 million households. Thus, the value of farm household assets is about 2.3 trillion Won, or well over 5 billion U. S. dollars depending on the rate of exchange used in making the conversion. Of the 2.3 trillion W, about 65 percent represents the value of land. Trees and buildings account for another 11 percent while animals and large equipment represent another 4 percent. About 15 percent of the 2.3 trillion Won, or 345 billion Won, represents mainly farm-produced, durable capital. Though the future will involve a great expansion in the use of capital goods produced in the nonfarm sector, it also will involve much more capital produced in the farm sector such as breeding stock, orchards, mulberry plantations, forage stands, etc. This extremely important type of capital is often

neglected by planning agencies, students of farm credit, international lending agencies, central bank authorities and government officials concerned with the operation of money markets. The farmer who uses his own underemployed labor, traditional capital and land to create such capital receives the capital created as an increment in his real income. That increment is automatically saved and invested without passing through either the private capital market or governmental hands, and often without even being noted in the national accounts as agricultural development. However, maintenance of an environment conducive to the generation of such capital is important. Higher prices for the products produced with such capital encourages its generation. Higher off-farm opportunity values for resources used in generating such capital discourage its formation. In the years ahead off-farm wages will rise. But so will prices for livestock products. The future of silk prices is less certain. Fruit prices are likely to increase. With price policy management, conditions for the formation of some kinds of farm-produced capital will be kept favorable in Korea, despite the increase in wage rates.[4]

The Level of Technology

Korean agricultural technology is characterized as:

1. Labor-intensive, involving the use of one motor or machine for every 40 farm workers.
2. A partial animal agriculture, involving the use of one draft bull or cow for every four men.
3. An irrigation agriculture, with water control technology inferior to Japan's and Taiwan's, but better than in the Philippines.
4. Primarily a rice economy with varieties, plant protection and fertilization technologies inferior to Japan's and similar to Taiwan's; its rice technology presses hard on the world's northern boundary for rice production and depends significantly upon a mid-summer peak in precipitation. Yields are high in a harsh environment.
5. Having a cattle technology which is power, not milk or meat oriented, though meat has always been an important by-product. Despite Korea's temperate zone climate, modern beef, dairy, hog and poultry technologies from Europe and North America are now in the process of being adapted and innovated.
6. Neglecting forage production technologies. Traditionally, forage has been a by-product of the grains and low productivity forest (better called bush) lands.
7. Relatively advanced in traditional fruit and vegetable production.
8. Having marketing and food processing technologies which are effective but traditional with the exception of mushrooms and some efforts to process laver, fruit and vegetables for export. Dry cereals do get delivered and little processing is required. Small quantities of fruit and flowers are marketed in remarkably high quality. Vegetables are marketed effectively with most processing into kimchi taking place in individual homes.

Current efforts to improve agricultural technology are lodged mainly in the Office of Rural Development (ORD), (described in the section on infrastructure in this chapter). In ORD, top priority is given to food grains with rice as number one. Many resources are being directed to the development of high-yielding, high protein, early-maturing, short stiff-strawed, lodging-resistant, fertilizer-responsive varieties, which have insect (leaf hopper), disease (blast), and cold resistance. Introduction and improvement of strains of IR667 is expected to give a 30 percent increase in yield. During the 1970-71 rice crop this year, IR667 was grown in some 500 strictly supervised areas of the country. The seed provided by these demonstration plots and seed multiplication areas will be used during the 1972-73 rice crop year to plant about 200,000 hectares of the approximately 1.2 million hectares of rice paddy area. Eventually, under existing conditions, IR667 can be adapted on about 450,000 hectares. Research work is underway to develop a wheat variety with a growing season of 10 to 15 days shorter than the present season. A combination of IR667, which matures approximately 10-12 days earlier than indigenous varieties currently used, and a wheat variety with a relatively shorter growing season would allow, at least in the southern part of the country, a rice/wheat rotation in place of the present rice/barley rotation. Shorter season wheat varieties are needed for the production of noodles and alcohol and perhaps bread

[4] Glenn L. Johnson, "Capital in Agriculture," *International Encyclopedia of Social Sciences*, New York: Macmillan Company, Vol. 1, pp. 229-236; and Glenn L. Johnson, "Factor Markets and Economic Development," Chapter 6 in *Economic Development of Tropical Agriculture*, by W. W. McPherson, Gainesville: University of Florida Press, 1968.

grains; in the future wheat will probably become more prominent relative to barley.

Emphasis is on dissemination of new rice seeds and on yield-increasing technologies for barley and other crops.

Attention is also being given to soybeans, both as an oil and food crop. New high-yielding varieties of rape with a 45 percent increase in oil content are being developed as an alternative for wheat and barley in double cropping with rice. Synthetic corn hybrids are proving resistant to leaf blights.

Soil fertility studies have revealed that up to 95 percent of the rice paddy soils in Korea are deficient in silica and that 99 percent of all the soils are short in boron. The pH, organic matter, nitrogen, cation exchange capacity, magnesium, calcium and potassium levels of soils all are considerably less than those in Japan and have less potential productivity. Significant research programs are underway with mushrooms, with emphasis on growing structures, spawn culture, improved growing practices, selection of new strains and disease and insect control. Yields have increased fourfold since 1967. Important research efforts are occurring in agricultural engineering and crop utilization, including generation of methane from human and animal wastes for use as fuel, rice transplanting machines, improved storage structures for cereal grains, and improved quality in processed fruits and vegetables.

Improved utilization of rape oil seed cake is another priority study. Sericulture research is characterized by a five-pronged program: breeding silkworms with superior yields of cocoon and silk quality, mulberry breeding and culture, improved rearing of silkworms by feeding, pest control in both mulberry and silkworm, and improved cocoon processing in the making of silk. Research in horticulture is focused on new and improved winter hardy apples, including dwarfing rootstocks, peaches, grapes, both *vinefera* and *labrusca*, and pears. The most important vegetables are Chinese cabbage and radishes. Research is being initiated to make asparagus an important crop in Korea. Attention is being directed to red peppers to improve production and to develop mosaic resistant varieties. There is research on winter production of flowers and vegetables under plastic and other improved techniques in protected cultivation.

In the livestock industry, attention is directed toward improved grass-legume pastures for hilly areas, the possible use of Italian rye grass for winter paddy in the southern areas, and improvement of the nutritive value of native grasses. Limited feeding trials indicate that native Korean cattle gain at approximately the same daily rate as standard beef breeds, and show great resistance to tuberculosis. Additional research is indicated and the potential appears good. Animal research includes crossing native cattle with other types, greater utilization of by-products in feeding cattle, swine and poultry, including rice straw for cattle. Pure lines of Leghorn laying hens have been imported. Studies in animal disease are focusing on tuberculosis, and improved vaccines are being developed for control of hog cholera, blackleg in sheep and goats, and Marek's disease in poultry.

In general, the research effort could be more adaptive and applied. In some areas training of researchers needs strengthening, and research priorities should be reviewed and reordered in line with developmental needs in agriculture during the next 15 years. A research program along these lines is recommended in Chapter 7.

Infrastructure

The infrastructure of the agricultural sector is that part of the public and private capital base providing the institutional environment within which agriculture operates and the services it enjoys. Infrastructural constraints often suppress production levels and slow the rate of commercialization in the agricultural sector. The following kinds of infrastructure will be considered: (1) governmental administrative capacity at all levels for formulating and executing policies, programs, and projects for the operation and development of the agricultural sector, (2) agricultural markets and their regulation, both product and input, public and private, (3) agricultural research and guidance system, (4) general and vocational education in rural areas, (5) an agricultural credit system, (6) physical facilities serving rural areas including communication, transportation, energy, and health and sanitation systems, (7) systems for gathering, distributing, and using economic intelligence, and (8) capacity to analyze agricultural development problems.

Administrative Structures

The Korean administrative structure for making and executing public decisions concerning agricultural development is extensive but uncoordinated, and there are often separations between responsibility and authority. Coordination and focus of responsibility are problems for governmental bu-

reaucracies worldwide, and Korean problems are similar to those found elsewhere. The lack of coordination and separation of authority exists for budgeting, planning, personnel administration, policy execution, and program operation, both within MAF and between MAF, the Ministry of Home Affairs (MHA), the Economic Planning Board (EPB) and other agencies at all governmental levels. Administrative problems within MAF involve the relative independence of bureau and division chiefs from higher administrative authority, a lack of internal coordination as part of the decision-making process, and MAF's lack of administrative authority over those portions of semi-autonomous agencies such as NACF and the Agricultural Development Corporation (ADC) which execute policy, program, and project decisions for which MAF has ultimate responsibility. In addition, many MAF policies and programs are carried out through administrative channels at the provincial and local levels by persons responsible to the Ministry of Home Affairs. These administrative considerations, plus the relatively low salary levels in the civil service system, make it difficult to recruit and retain personnel who are competent in and enthusiastic about agricultural matters, despite the very substantial progress made in training competent civil servants in recent years.

Fifty percent more output from essentially the same land, and one-third less labor by 1985 is going to require effective public decision making and administration, regardless of how much reliance is placed on the private sector. The many changes which will occur in the agricultural sector in the years ahead will require a flexible governmental administrative sector which is responsive and adaptable to the changing needs of agriculture and rural people.

Market Facilities—Public and Private

With a substantial increase in total population and a high rate of rural-to-urban migration, agricultural production must commercialize at a rapid rate to keep pace. Rough estimates indicate that the agricultural *product marketing system* will be required to handle a two and one-half to threefold increase in volume between 1970 and 1985. The required expansion in marketing services will vary greatly by type of service and commodity. Changing incomes, preferences, and technologies, both rural and urban, will influence relative requirements of the marketing system. Specialization in farm production and expanded farm incomes will increase rural market demand for a more varied diet and for some products which are now self-sufficiency foods. The general shift in relative diet composition from grains to nongrains will affect the demand for various types of marketing services. Finally, the demand for processing and convenient retailing will increase due to changes in life styles and employment patterns. As more women enter the work force and opportunity costs of domestic services increase, the demand for processing and convenience in shopping will increase.

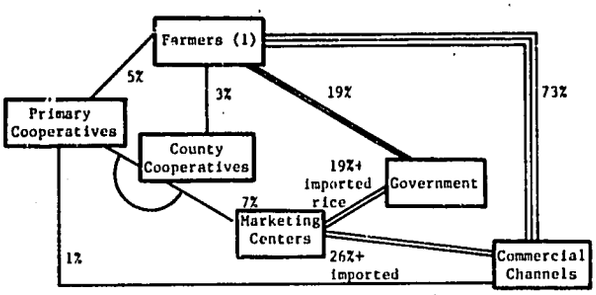
Agricultural products are marketed primarily through the private sector. NACF handles an almost negligible amount of agricultural marketings except for acting as the purchasing agent for the MAF grain program. Government is involved in regulation, inspection, and licensing of various types of processing and marketing firms. Figures III-3 through III-7 are channel maps for rice and four commodity groups showing the marketing and proportion of marketing flowing through various channels.

The public sector dominates in the *agricultural input markets* for modern factors of production. These are the markets supplying the land and labor substitutes so crucial to the necessary expansion of agricultural production. Supply is handled largely through NACF. Figures III-8, 9 and 10 show input market channels for four types of modern inputs with proportions of total inputs used flowing through each channel.

Public responsibility will become greater in total but not proportionally as the agricultural marketing system becomes larger and more complex. The private portion of the marketing system is likely to grow even faster to perhaps three to four times its present size. The need for greater public regulation and quality inspection is obvious. If direct intervention in the market is used as the policy tool for price and distribution stabilization, additional demands will be placed on the public sector in terms of budget and administrative capacity.

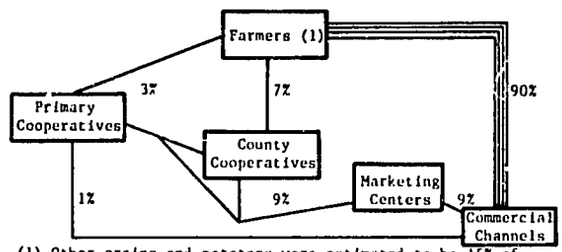
Public Agricultural Research Facilities

Agricultural research is carried out primarily by the Office of Rural Development (ORD) at Suwon under MAF, and by the Provincial ORD offices with experiment station facilities in each province. In recent years a segmentation of the administration of federally controlled agricultural research away from ORD has occurred. The Institute of Agricultural Engineering, the Agricultural Economics Research Institute, and the National Animal



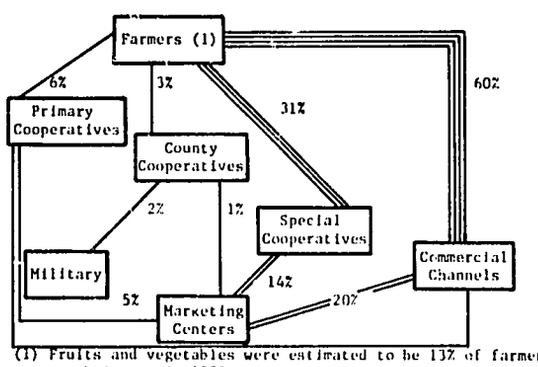
(1) Domestic rice was estimated to be 53% of farmers' cash income in 1970 Ref. 1, page 149.

FIGURE III-3. Domestic rice market channels, Korea. (Source: Same as for Figure III-7.)



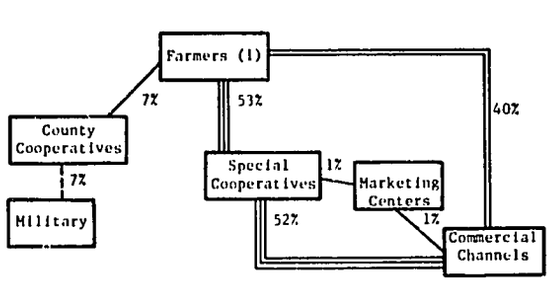
(1) Other grains and potatoes were estimated to be 15% of farmers' cash income in 1970 - Ref. 1, page 149.

FIGURE III-4. Market channels for other grains and potatoes, Korea. (Source: Same as for Figure III-7.)



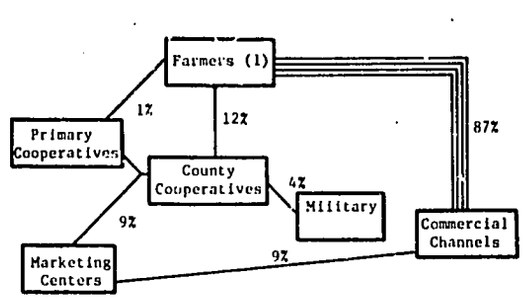
(1) Fruits and vegetables were estimated to be 13% of farmers' cash income in 1970.

FIGURE III-5. Market channels for fruits and vegetables, Korea. (Source: Same as for Figure III-7.)



(1) Livestock and livestock products were estimated to be 11% of farmers' cash income in 1970, Ref. 1, page 149.

FIGURE III-6. Market channels for livestock and livestock products, Korea. (Source: Same as for Figure III-7.)



(1) Other produce was estimated to be 8% of farmers' cash income in 1970. Ref. 1, page 149.

FIGURE III-7. Market channels for other produce, Korea. (Source: Brake, et al., "The National Agricultural Cooperative Federation: An Appraisal," KASS Special Report No. 1, AERI-MSU, 1972.)

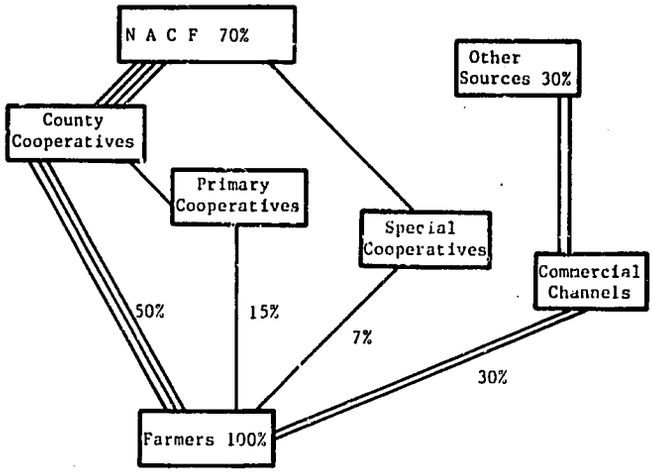


FIGURE III-8. Farm chemical purchase channels used by Korean farmers. (Source: Same as for Figure III-7.)

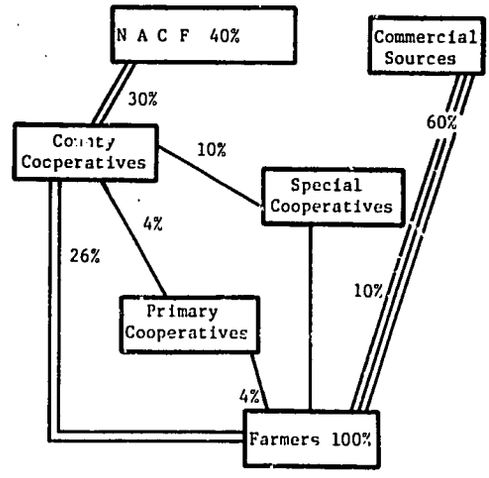


FIGURE III-9. Farm implement purchase channels used by Korean farmers. (Source: Same as for Figure III-7.)

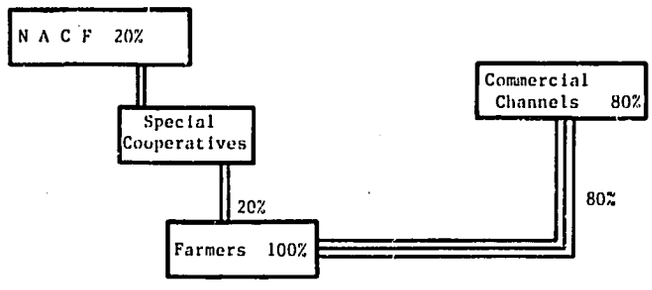


FIGURE III-10. Feed purchase channels used by Korean farmers. (Source: Same as for Figure III-7.)

Breeding Station were recently established as separate units under the Vice Minister of Agriculture. Provincial level sericulture, animal science, and veterinary science research efforts are administered directly by ORD. No agricultural economics or agricultural engineering research programs are carried out by the provinces. There is a lack of liaison and coordination among these research units and their programs.

The colleges of agriculture in Korea are viewed almost totally as training units for students, and their potential contribution to an agricultural research program is virtually untapped. Colleges of agriculture training students for research and guidance at the B.S., M.S., and Ph.D. levels have proliferated. With a few exceptions, these colleges lack adequately trained faculty. College libraries are inadequate both in terms of quality and quantity. Research laboratories, facilities and equipment are relatively nonexistent in the universities and most of the meager research which is done occurs in teaching laboratories.

Agricultural research at ORD is characterized by the best facilities, equipment, and financial support in Korea, but the training of the ORD research scientists is inadequate to effectively utilize the resources. Of the 513 ORD scientists in 1971, 409 had B.S. degrees and 51 had M.S. degrees. Only 14 had Ph.D.s and most of them were working in administrative positions.

The development and training of human resources for research (and guidance) is an important key to future agricultural progress and is the responsibility of the colleges of agriculture. Resources for human training and development are fragmented among many small agricultural colleges. College faculties are not tapped as research resources through research grants, contracts, and graduate scholarships. Recent changes in attitude and agreements have improved the coordination between MAF and the Ministry of Education, and even more can be done in the future.

Rural Guidance Facilities

Both ORD and the NACF employ field guidance workers. Examination of the former shows ORD also is responsible for operation of the government's rural guidance system. Staffing in 1971 consisted of 6,051 personnel, about half with B.S. degrees and half with high school level education. The proportion of college graduates has declined in recent years. Low salaries, few chances for promotion and poor working conditions, and inadequate logistical support contribute to low morale and make recruitment and retention difficult. While the total ORD guidance budget appears reasonable, it is estimated that over 50 percent passes through the organization to support various programs and projects as direct payments to rural people. In this sense it is more of a governmental agency than an educational agency.

Pressure is created for ORD guidance staff to achieve the goals of government programs. The guidance worker can be both an educator and an advocator of government programs when those programs fit local needs and are clearly profitable to the farmers or rural people concerned. But when the ORD worker advocates or promotes government programs which do not meet these conditions, he stands to lose credibility, which lowers his effectiveness and ability as an educator. Care must be taken to avoid this role conflict.

Finally, since ORD has shifted from an organization with full control over its programs and personnel, to one in which the Provincial Office of Rural Development (PORD) and local offices are largely financed and directed through local political units, much of the original impetus to build a fine educational organization has dissipated. Demands from the local administrative units cut the time and energy of guidance workers to devote to ORD programs. Again, credibility is impaired.

To meet the agricultural sector development challenges, ORD must become more agriculture and farmer oriented, strengthen and support its staff, and establish a feedback system to permit more local level judgment to be incorporated in ORD's national programs and projects.

General Education Facilities in Rural Korea

The literacy rate in Korea is high; some estimates place it at over 90 percent. Education for one's children is placed high on the priority list of necessities. The educational system is administered by the Ministry of Education and includes elementary, middle schools and high schools, public and private colleges and universities. Quality varies considerably and parents in a position to choose will go to great lengths to be sure their children go to the "right" school. Unfortunately, a relatively high proportion of "right" schools are located in Seoul and relatively few in rural areas.

In 1971 there were 100 public and 15 private agricultural high schools in Korea, with 39,788 students of which 5,182 were girls. Of the gradu-

ates from these schools in 1971, about 6.4 percent went on to higher education and approximately 33 percent went into payroll employment. No statistics are available, but rough estimates indicate about 30 percent of the agricultural high school graduates returned to farming.

The quality of education in the agricultural high schools is relatively low because of inadequate equipment and facilities to teach the curriculum properly and lack of staff.

As migration increases from rural to urban areas, the urban sector has an increasing stake in the quality of education offered in the rural areas. The rural education system will be called upon to produce persons equipped with skills transferable to the industrial sector to make migrants employable, as well as to produce persons with the basic knowledge and skills required in agriculture.

The Agricultural Credit System

As agriculture transforms from traditional to modern and as the scale of individual farm firms expands, heavier demands are made on the agricultural credit delivery system. A 1968 NACF farm credit survey shows the average farmer borrowed 25,148 W: 26.5 percent from credit institutions (almost exclusively NACF) and 73.5 percent from private sources. Of private sources, other farmers furnish 41.8 percent, relatives and friends 19.8 percent, traders and merchants 18.1 percent, professional money lenders 8.6 percent, Ke 5.9 percent, and manufacturers and processors 5.8 percent.

Substantial changes in credit sources were noted between the 1968 and the 1970 credit surveys. The 1970 survey shows average farmer borrowings of 29,508, with 33.7 percent supplied by institutional credit sources. Of the remaining 66.3 percent from private sources, other farmers furnished 71.0 percent, a large increase from the 1968 survey, traders and merchants furnished 8.2 percent, money lenders 2.6 percent, Ke 12.1 percent, and other sources 6.1 percent. Thus it appears farmers are turning toward more institutional credit, each other, and the Ke, and away from the other sources in obtaining their credit.

The average interest rate paid for all credit was 59 percent per annum with some credit from private sources carrying interest rates in excess of 10 percent per month. NACF credit averaged about 13 percent per annum.

As agricultural credit needs increase, the public sector, through NACF, will be called upon to provide the largest share of the increase.

While NACF is a private federation of cooperatives with deposit funds of its own to lend, it also is charged with the responsibility of carrying out government policy with government funds or with government subsidy. NACF is often caught in the middle in discharging its duties as both a private and public agency. An example is its attempts to operate as a business-like credit agency while at the same time making poor risk loans on the recommendation of local government officials.

Government subsidized credit, because of its favorable terms, sets up a system where potential favors and payoffs may be necessary to qualify for loans.

Government subsidized funds do not come close to meeting the demand as shown by the large proportion of total rural credit which comes from private sources. NACF deposit funds from both rural and urban sources fall far short of meeting the rural credit demand. There is very little long-term credit available for capital improvements.

Procedures for extending credit often lead to poor results. In myun and county cooperatives, local village leaders decide who receives loans. This approach often leads to splitting the loan funds equally among a large number of people so that none receives enough funds to make major capital investments of a productivity enhancement nature.

Rural credit has a twofold purpose. For best use of funds, the government desires credit to be used to increase food production (and thereby, national income). Yet much rural credit is used, necessarily, for consumption purposes. While the increased food production objective is primary, a policy to ease the interest burden of marginal or subsistence farmers also has merit on social and humanitarian grounds. Unfortunately, there is too little institutional credit available to satisfy either objective.

Reorganization and added support for public credit agencies will be required to provide an agricultural credit delivery system capable of supplying the credit needs of the agricultural sector in the next 15 years.

Physical Facilities to Service Agriculture

Physical facilities in the form of communication and transportation systems and energy delivery systems are important components in increasing agricultural production, marketing and improvement of rural living conditions. Of the existing road networks as of January 1, 1971, 9.5 percent are paved, 82.1 percent unpaved, and 8.4 percent require major repairs to make them serviceable as

unpaved roads. Of the 8,122 km of national roads, 23.6 percent are paved while only 1.8 percent of the 10,894 km of provincial and 3.1 percent of the 15,216 km of city and gun roads are paved.

The proportion of roads permitting trucks to bring inputs to the farm and take products from farm to market is a key characteristic in agricultural development. Approximately 33 percent of the 32,485 villages responding to a 1969 Ministry of Construction survey had farm access roads of such poor quality that major truck deliveries and pick-ups could not be made as needed.

Those villages far from myun roads have particularly poor access characteristics. The types of roads of particular importance to rural or agricultural development are *feeder* roads, defined in three categories:

1. Those connecting the village to a national or other larger road,
2. Those connecting farm to village,
3. Those connecting village to village.

The Ministry of Home Affairs implements the feeder road construction program through the section on rural development, Bureau of Local Government.[5] Road construction by the Ministry of Construction is concerned primarily with major highways. Roads concerned with paddy rearrangement are built by the Ministry of Agriculture.

As of a 1969 survey, MHA estimated that a total of 46,167 km of feeder roads are needed, allocated among the provinces. The total consists of:

1. 19,640 km of village to national roads,
2. 10,277 km of farm to village,
3. 16,233 km of village to village.

Of the 46,000 km of feeder roads needed, 27,000 were constructed in 1970 and 1971. Another 19,000 km are being planned.

Agricultural development is characterized by increasing use of purchased inputs, substitution of capital for labor, and intensification of land use. Thus, an adequate road and transportation system is a prerequisite for shifts from subsistence to commercial farm operations with a variety of products for sale.

Per capita demand for *electrical power* is increasing rapidly. Most of the new demand is expressed by large-scale industrial consumers, particularly chemical, metal and machinery plants. Industrial demand is about 75 percent of the total; residential about 15 percent.

The institutional system for power generation and delivery includes: (1) Korean Electric Company (KEC), a semiprivate company, 50 percent of which is owned and operated by the Ministry of Commerce and Industry, (2) KOWACO, a quasi-governmental power company, regulated by Ministry of Construction, (3) private power companies selling electric power to KEC.

Most of the projected increases in power generation comes from thermal power. Hydro, as a percentage of the total supply, will decline to approximately 3 percent in 1976, but as of 1972 the hydro power potential is largely unexploited. Power production is a key aspect of river basin planning programs.

With greater emphasis on rural development in the Third Five-Year Plan, attention is being directed toward bringing electricity to rural areas, 1 million farm and fishing households is the goal for the five years, to raise the total electrification rate to 70.3 percent by 1976. The extent of rural electrification by province is suggested in Table III-5.

About 28 percent of the myun in rural Korea have no villages with electrical power. Only 1.2 percent are fully electrified and only 11.8 percent are more than half electrified. A higher percentage of rural households is electrified than rural villages, since the larger villages are more apt to have electrification.

But even under the most optimistic conditions, full electrification is a number of years away and its universal use for lighting and cooking even further. In the meantime, the traditional sources of energy for these purposes are straw, wood, leaves, and grass with some coal and oil.

ORD is presently placing major emphasis upon the installation of methane generators throughout the country as an additional energy source. The methane generator is a device consisting of a covered pit full of human and animal waste, with a half-inch plastic hose at the top to conduct methane to a small burner, used for cooking.

While at first glance the methane generator sounds bizarre and impractical, economic and other impact information gathered by ORD suggest that it is not a bad investment for the country.

As of 1971, 172 public health centers across the country were being operated by the Ministry of Public Health. The budget for these centers is provided by both the central government which em-

[5] Based on discussions with Mr. Kim, Hyung Ho, Section Chief.

TABLE III-5
Rural Electrification in Korea, 1970*

Province	Total Rural Villages	KEC (Korean Electric Co.)		On Farm Generation		None	
	number	villages	percentage	villages	percentage	villages	percentage
Kyonggi	4,249	908	21.4	50	1.2	3,291	77.
Kangwon	2,579	269	10.4	20	.8	2,290	88.
Chungpuk	2,751	417	15.2	17	.6	2,317	84.
Chungnam	3,129	744	23.8	7	.2	2,378	76.
Chollapukto	3,717	993	26.7	39	1.0	2,685	72.
Chollanamdo	4,758	966	20.3	25	5.3	3,767	79.
Kyongpuk	6,619	993	15.0	57	.9	5,569	84.
Kyongnam	4,683	1,077	23.0	166	3.5	3,440	73.
TOTAL	32,485	6,367	19.6	381	1.2	25,737	79.

* Park, Jin Hwan, "Problems and Policy Programs in the Agricultural Sector, Third Plan Period," Unpublished report, 1970. Even though present monetary cost of installation is higher and economic returns lower in rural than urban areas, Park has indicated that the central government sees a higher long-run net social return from rural electrification than from improved service to urban areas. As with other aspects of rural development, electrification can contribute to living quality beyond only agricultural income impacts.

phasizes medical services and family planning, and local governments that emphasize sanitation and environmental quality. According to the TFYP, the number of centers will be increased by 1976 to 192, with 1,342 subsection offices at the myun level.

A recent survey[6] reveals *inadequate and low quality rural health care.* Survey statistics indicate that of the 14,472 persons responding, 11.8 percent received hospital or clinic health care, 10.3 percent received "care" from herb doctors, and 55 percent tried to cure their illnesses with drugs available from pharmacies without the aid of a medical doctor. Part of the problem is the reluctance of doctors to practice in rural areas. Another part is inadequate physical facilities. Still another is that modern medical treatment is expensive and few rural people can afford it.

Rural development requires a health services component, not only for the productivity and well being of those presently in residence but as a complement to population dispersion policies and rural industrialization programs.

Economic Intelligence

Korea's agricultural economic intelligence system is weak. Ideally, the agricultural economic intelligence system of a mixed economy such as Korea's should supply reliable data and analysis to both private and public decision makers on prices, production, resource base, resource use, acreage, yields, etc. In general, these data are needed by public and private agencies; they should be reliable and part of the public domain. In addition, both public and private agencies also need internal administrative and operational data on their own operations, to be gathered by the using agency; these data may or may not be part of the public domain.

On the surface, Korean economic intelligence appears to be better than it is. Unlike some countries where the gathering and analysis of agricultural data are controlled by operating agencies, Korea's data are relatively continuous, and are not started and stopped in accordance with the current interests of agricultural administrators. Their shortcomings tend to rise out of (1) reliance on public operating agencies to produce data on their own operations, and (2) failure to adequately staff and insulate governmental organizations supposedly independent of operating administrative influences. Thus data often are biased to indicate attainment of administrative and political objectives. As a result of deficiencies in data, both public administrators and private entrepreneurs are less well informed about agriculture than required for effective public and private decision making and administration.

At the private level, Korea's agricultural market news is poorly developed. NACF market news re-

[6] The survey was conducted by the Rural Sanitation Research Agency under a contract with the Ministry of Public Health and Social Affairs.

porting and outlook work serve NACF and MAF better than farmers and entrepreneurs in Korea's agricultural product and input markets.

Capacity to Analyze Agricultural Development Problems

Facilities for conducting public analyses of, and research on, a country's agricultural development problems are an important component of its infrastructure. If absent, agricultural policies, programs, and projects suffer from poor design, execution and evaluation.

Korea's facilities for conducting such analyses and research are semi-developed, inadequately supported, and poorly coordinated. They are located in the President's office, in the higher echelons of MAF, in AERI of MAF, in NACF, in EPB, in the Korean Development Institute (KDI) and in various university departments. In addition, such bilateral and multilateral international agencies as IBRD, FAO, USAID and the assistance agencies of various countries engage in various analyses, of which KASS and this report are examples.

The lack of coordination has serious consequences. In the First Five-Year Plan and in the Second Five-Year Plan, the agricultural sector was planned primarily in EPB and, hence, did not benefit from direct contact with the technical expertise and close experience with farm problems ordinarily found in a ministry of agriculture. By contrast, the agricultural components of the Third Five-Year Plan (TFYP) originated in MAF and were scaled down by EPB to a magnitude consistent with the national plan. The difficulties with the TFYP formation involve:

1. Relative autonomy of bureau chiefs in MAF which stood in the way of developing an integrated analysis and plan for agriculture.
2. Lack of reliable economic intelligence (as discussed above).
3. Lack of MAF contact with farmers as a result of MHA administration of agricultural programs at local levels.

AERI, which was transferred from ORD at Suwon to Seoul, suffers from lack of reliable data and is, itself, insulated from agriculture by the MHA/MAF split between national responsibility and local administration. Further, AERI is more often used by top level policy makers than by the bureau chiefs who do much of the preliminary planning for MAF.

KDI has not placed emphasis on analysis of agricultural development problems and agricultural sector planning though, obviously, agricultural development is so much a part of Korean development that the two must be closely integrated.

IV

The KASS Approach and Some Related Methodological Issues

Introduction

The Korean Agricultural Sector Study (KASS) approach to the study of Korea's agricultural sector is practical and intended to assist in reaching prescriptions for solving Korea's agricultural development problems. KASS viewed its task as one of developing as much of the necessary information for making prescriptions as feasible within its resource limits. Included in the sources of information are decision makers from the Republic of Korea Government (ROKG); the United States Agency for International Development, Korea (USAID/K); the Agency for International Development, Washington (AID/W) and from grantor, donor and lender agencies. The prescriptions reached in this study are not exclusively those of KASS, but are, instead, partially the outgrowth of interactions with relevant decision makers.

Reaching prescriptive conclusions to solve agricultural development problems requires development of positive and normative knowledge. Included in such knowledge is an understanding of the processes of decision making and administration of public and private agencies and of individual decision makers. This wide range of required information inevitably raises basic, troublesome, and confusing questions concerning philosophies of science and research methods, political economy, political science and law. To forestall such troublesome confusion, this chapter utilizes a glossary of terms (that begins on page 34) in describing the KASS approach and in discussing methodological issues. This chapter contains:

1. A general description of the problem-solving processes,
2. A specific description of the KASS approach to the problem of Korea's agricultural sector,
3. A discussion of related methodological issues,
4. A statement of the implication of this chapter for the remainder of this KASS report.

The Problem-Solving Process

The problem-solving process, as diagrammed in Figure IV-1, includes six steps which all draw on and produce both normative and nonnormative knowledge. Development problems of an agricultural sector grow out of changes or the lack of changes in its environment, mainly with respect to technology, institutions, and people. Acquiring knowledge about such changes requires the efforts of a wide variety of specialists such as technical scientists, political scientists, sociologists, psychologists and educators, statisticians, and students of business administration. The plant breeder, not the economist, is central to the solution of a problem that requires new plant varieties. Similarly, agronomists, chemists and biologists create new fertilizers, herbicides and pesticides; chemists, physicists, engineers, and designers create nonagricultural technologies; educators change people; and politicians and political scientists create new political institutions.

As Figure IV-1 indicates, both normative and nonnormative information, as defined on page 34, are used in all steps of the problem-solving processes. A problem cannot be defined without normative concepts of goodness and badness as well as concepts about the current situation and how the phenomena under study are related. Normative concepts indicate what is important and, hence, what kinds of nonnormative information should be observed and analyzed. The decision rules followed by decision makers utilize both normative and nonnormative information to indicate which set of goals would, if attained through appropriate action, best "maximize human interests and purposes . . . " (see page 34). Action is, of course, oriented towards attaining the goals or targets judged by decision makers to be worthwhile, all things both normative and nonnormative considered. Responsibility bearing is, of course, both normative and nonnormative. The decision maker is responsible for the bad as well as the good consequences

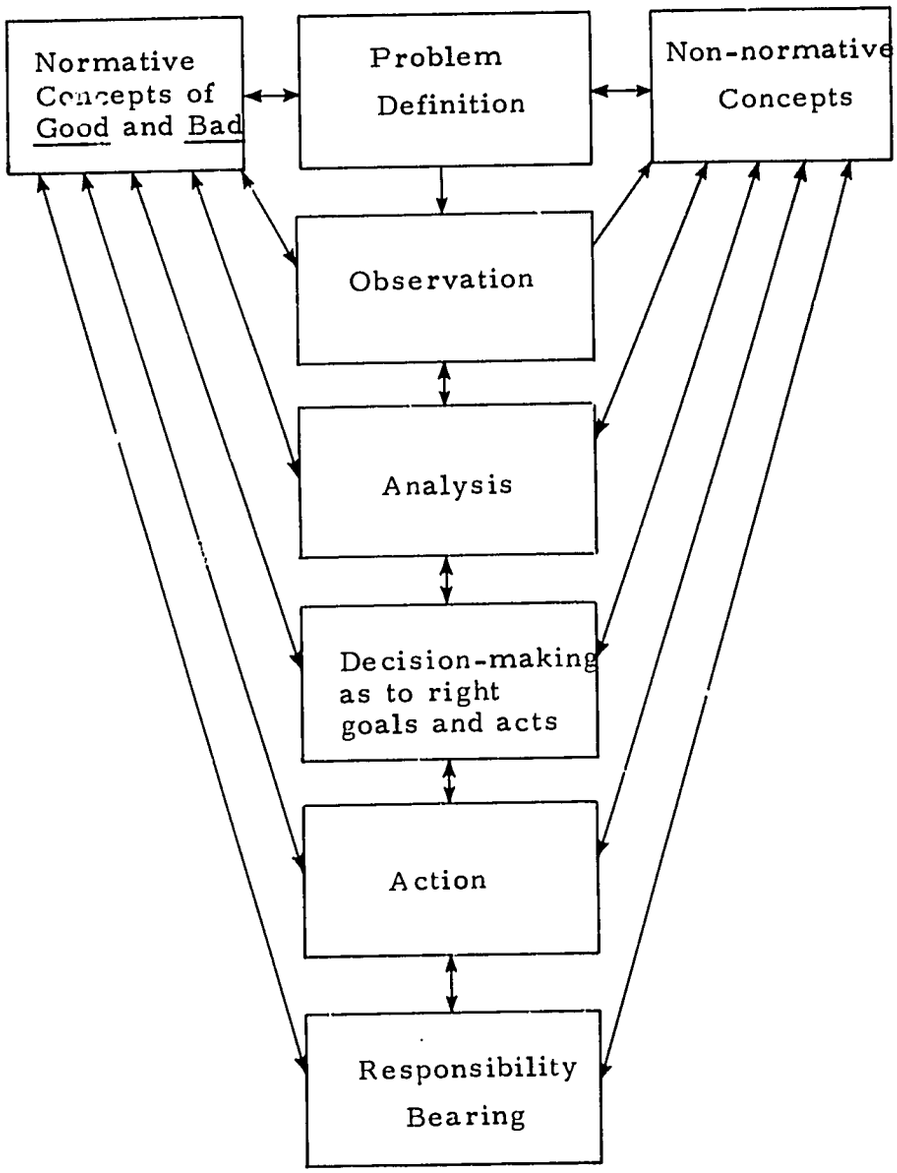


FIGURE IV-1. Six steps in a problem-solving process. (Source: Adapted from *A Study of Managerial Processes of Midwestern Farmers,* Johnson, G. L., Halter, A. H., Jensen, H. R., Thomas, D. W., eds., Iowa State University Press, Ames, Iowa, 1961. See also "The Role of the University in Economic Development," J. S. McLean Visiting Professor Lecture, Dept. of Ag. Econ., University of Guelph, Publication No. AE 70/2, March 23, 1970.)

of his actions and which he receives depends upon whether the consequences he is trying to control actually materialize.

At this point, clearly defined terms are needed in order to discuss the efforts of KASS researchers and relevant decision makers to reach prescriptive conclusions as to how Korean agriculture ought to be organized on the basis of normative and nonnormative knowledge about the past, present and future of Korean agriculture. When building models concerning an agricultural sector, statisticians, mathematicians and theorists insist that symbols and variables be precisely defined for the purposes of the study at hand. A similar need exists when discussing the approach and methodology followed by a research organization such as KASS. Both readers and writers need to have explicitly stated definitions, if they are to understand each other. They cannot rely upon chance meanings of words and terms obtained as a result of their accidental encounters with these terms being used to discuss widely differing philosophies which attach different meanings and, indeed, claim that some terms can have no empirical meaning. Thus, a long glossary is presented below to help the reader understand precisely the ways in which terms such as normative, nonnormative, good, bad, right, wrong, prescriptive, etc., are used in this report.[1]

Glossary of Terms

Concept: This term is used to mean either a word or a sentence which has a specific meaning.

Belief: The meaning of a concept about the nature of reality. This reality is conceived to include values. There are not only nonnormative beliefs related to descriptive states of affairs, past, present or future, but also normative beliefs which include values in all senses that this word is used in this report.

A Fact Concept: A word or sentence which has as its meaning an actual state of affairs, past, present or future.

Fact: The meaning of a concept of "what is," "what has been" or "what will be." Facts can be both normative and nonnormative or positive. Thus, the fact/value dichotomy is rejected.

Value or Normative Belief: The meaning of a concept of the "goodness" or "badness" per se of a condition, situation, or thing. A *value concept* is a word or sentence which has as its meaning the goodness or badness per se of a condition, situation or thing.

Good and Bad: Adjectives used to modify the word value. A good value exists when a condition, situation or thing contributes to the attainment of human interests and purposes. Conversely, a bad value exists when a situation, condition or thing frustrates or detracts from the attainment of human interests and purposes. On occasion the words *good* and *bad* are used as nouns denoting good values and bad values.

Instrumental Value: The meaning of a concept of "goodness" or "badness" insofar as it is derived from more basic values. For example, the concept "it is good for man to have money" may be based on the more basic value concept that "it is good for a man to be able to provide food and shelter for his family."

More Basic Value: This contrasts with an instrumental value in that it is a good for the sake of which instrumental values are actualized. More basic values may ordinarily be actualized by a number of different instrumental values. In our example above, providing food and shelter for his family might be realized by other means than having money. It should be noticed (1) an instrumental value detached from the more basic value with which it is connected may very well be bad in the sense discussed below, and (2) still more basic values such as that of life itself may make the values of food and shelter which are more basic than money into instrumental values.

Nonnormative or Positive Belief: The meaning of a concept about a condition, situation or thing not pertaining to its goodness or badness. As defined here use of the synonym "positive" does not imply acceptance of the positivistic assertion that normative facts and experiences do not exist.

An Action: An attempt to establish or attain a specific condition.

A Goal: A condition, not yet established or attained, which some entity is trying or could try to attain.

Right and Wrong: Adjectives used to modify the words "action" and "goal" or choices and decisions about actions and goals. This distinction is from C. I. Lewis, *The Ground and Nature of the Right*, New York: Columbia University Press, 1955.

A Right Action or Goal: An action or goal determined to be best in view of the nonnormative and normative beliefs involved where "best" means "that which maximizes human interests and purposes as indicated by the value concepts involved."

A Wrong Action or Goal: An action or goal other than the right action or goal.

True and False: Words applied to sentences when men suppose them to express beliefs which do or do not conform to reality.

Objectivity: Applied to an investigator, the ideal of an investigator being unbiased, fair, impartial and accurate in the sense that he is willing to subject his concepts, both normative and nonnormative, to tests as to their objectivity. Applied to a concept, a concept is regarded as objective if it has thus far passed the tests of (1)

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[1] These definitions will be adhered to in the remainder of this report. They are taken from Glenn L. Johnson and Lewis K. Zerby, *What Economists Do About Values: Case Studies of Their Answers to Questions They Don't Dare Ask*, Michigan State Agricultural Experiment Station, East Lansing, Michigan, 1973.

logical consistency with previously accepted concepts and with other new concepts based on experience, (2) clarity, and (3) workability.

Kinds of Knowledge: From Glenn L. Johnson, *The Role of the University and Its Economists in Economic Development*, Guelph: Department of Agricultural Economics, University of Guelph, Ontario, Publication No. AE701, March, 1970.

(1) Nonprescriptive which does not indicate rightness or wrongness of goals or actions. Nonprescriptive knowledge can be either
abstract (theoretical)
normative (about good and bad) or
nonnormative
descriptive or factual
normative (about good and bad) or
nonnormative or positive

(2) Prescriptive which indicates rightness or wrongness of acts and goals and is always both normative and positive. Prescriptive knowledge can be
abstract (theoretical) and
factually descriptive of right or wrong goals and actions.

Noneconomists and certain forgetful economists need to be told that economics does, in fact, deal with the attainment of nonmonetary values, and that treating nonmonetary values as noneconomic is a serious error which results in elimination of consumption and welfare economics from the discipline of economics! It is hard to conceive of a single value about which questions of efficiency do not arise when trying to attain the value (if it is a good) or to avoid it (if it is a bad). Further, it is even harder to think of purely economic or purely social values; attainment of the so-called economic values is attended by social consequences, and conversely, as noted, there are economic questions of efficiency involved in attaining or avoiding the so-called social values. In effect, the dichotomy of economic and social values appears to be false.

Figure IV-2 illustrates the calculus commonly used by economists to prescribe right actions. In this case the problem is one of ascertaining the "right" amount of nitrogen to apply and the "right" yield of rice to attain. The nonnormative function relating rice yield to nitrogen applied has been transformed into a gross income or value productivity function by multiplying yield by price (a measure of value). The total cost function is the sum of fixed cost and the product of nitrogen applied and its price (value). Gross income is regarded as *good* and total cost as *bad*. The right action is defined as the one which maximizes the difference between *good* and *bad* which, in this case, is profit.

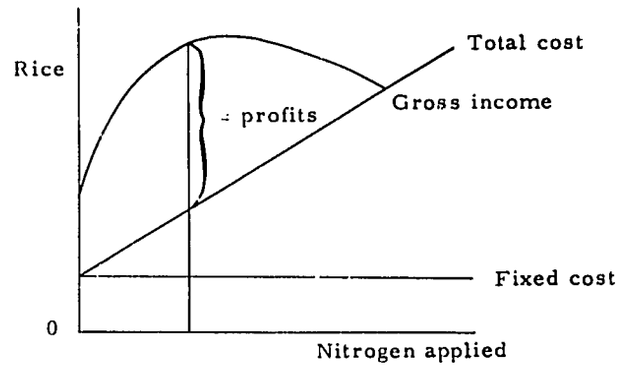


FIGURE IV-2. Value productivity and input cost functions for determining the most profitable amounts of rice to produce and nitrogen to use.

This same basic calculus is used in dealing with nonmonetary values; in consumption and welfare economics, *bad* is subtracted from *good* and the difference is maximized.

However, it must be recognized that Figure IV-2 is based on simplified assumptions, many of which are not met for many of the tough development problems involving technical, institutional and human changes brought about by processes operating beyond markets. When these assumptions are not met, the calculus is not immediately applicable.

Basically, the calculus assumes the following:

1. A normative common denominator (such as dollars or utility) which permits: different *bads* to be added together, different *goods* to be added together, and subtraction of the total *bads* from the total *goods*.
2. That the normative common denominator considered above is either interpersonally valid or is never used to subtract *bads* imposed on one person from *goods* conferred on another.
3. That the order in which programs and projects (actions) are taken is unimportant or that actions can be ranked in the order of their decreasing net advantage per unit of sacrificed *good* or incurred *bad*. As shown in Figure IV-2, it does not matter which of the several units of nitrogen involved is applied first, second, or third, etc. The question of order is a fundamental difficulty behind the concerns about processes commonly expressed by students of public administration, production managers, sociologists, engineers, political scientists, and environmentalists.
4. That the rule for defining the best is simply one of subtracting *bad* from *good* and adopting that which maximizes the difference.

Many of the problems of economic development do not meet the requirements for applying the simple calculus of static production, consumption and welfare economics. The order in which actions are taken is often of crucial importance, yet the best order is not obvious. This is especially true when the problem involves invention and creation of new technologies, institutions and new kinds of people (through education and motivation, for instance). Also, it is difficult to find appropriate common denominators when trying to subtract the *badness* of higher rice prices for poor urban dwellers from the *goodness* of greater national rice self-sufficiency. When a problem involves several individuals (as in a family, community or nation), the common denominator must have interpersonal validity if the calculus is to be applied. The remaining complication arises from imperfect knowledge. When outcomes of actions are uncertain, the "right" action is not always defined as the one expected to maximize the difference between *good* and *bad*. Instead, do decision makers, for instance, appropriately do that for which the worst that could happen is better than the worst for any other possible action? Or do they maximize the average expected difference? Or satisfice or flip a coin? Or fight or go to war to settle the question, especially if they are having trouble finding an interpersonally valid common denominator?

KASS investigators recognized that the four difficulties described above would be encountered in attempting to solve the development problems of Korean agriculture. Like other problem-solving teams before them, KASS workers sought to handle these difficulties by studying both the structure of the agricultural sector and its problems to acquire an understanding of how the agricultural economy operates. However, unlike many other teams before them in many other countries, they also attempted to develop an efficient computerized capacity to project the consequences of prescribing alternative solutions to the problems of Korean agricultural development.

KASS Approach

The broad general development problem of Korean agriculture is made up of literally thousands of problems and sub-problems. Korea has a problem of attaining increased food production, in general and for specific crops; it also has a problem of high urban food prices and of low incomes to its farmers. The Korean diet is not adequate; more protein is needed, particularly meat, poultry products, fish, and dairy products. There is also a problem of population control. There is an income distribution problem within agriculture, within the urban sector, and between the two sectors. This income distribution problem also shows up regionally within the country. There is a problem of developing Korea's water resources and of controlling their use as well as of developing paddy and uplands. There are administrative problems in the agricultural establishment which interfere with the capacity of the Korean government to assist its agriculture. Farm labor problems are numerous, both for the farm entrepreneurs experiencing labor shortages and for laborers who find their earnings lower than those in Korea's rapidly developing industry. Korean farms are small and so fragmented that few people own enough land to produce incomes comparable to those emerging for people in the nonfarm sector. There is the problem of the low social status attached to agriculture and to farmers. There is a need to decentralize industry into rural areas. Korea's food markets are in need of modernization and rapid expansion; markets for modern sectors of production for agriculture are not well developed and function poorly. Economic intelligence available to the private agricultural sector and to the Korean government is inadequate.

Analysis and Understanding

Basic to solving the multiplicity of problems are the needs to simplify the analysis and acquire an understanding of how Korean agriculture operates. The list of problems cited above could be expanded almost without limit, but it is already long enough to indicate that KASS could not tackle all the individual problems encountered in Korea's developing agricultural economy. Ways had to be found to economize on the time and resources of researchers assigned to the study.

The need to simplify the list of problems was closely related to the need to acquire an understanding of how Korea's agricultural sector operates, both internally and with respect to the other sectors of the economy. This understanding must be relevant in the sense that it tells how the agricultural sector would respond to policies and programs and, for that matter, projects designed to handle problems such as listed above. Korea's agricultural development problems were examined in enough detail to set up three broad alternative ways of organizing Korean agriculture to (1) simplify the analysis, and (2) acquire an understanding of how the Korean agricultural sector is put to-

gether, how it operates as now organized, and how it would operate if it were reorganized to follow alternative policies and programs. Thus, KASS has studied the three broad policy strategy alternatives for Korean agriculture which can be described briefly as:

1. Continuation of the agricultural policies and rural development strategies laid down in Korea's Third Five-Year Plan (TFYP),
2. Modification of the TFYP including higher agricultural product and consumer food prices and increased efficiency in attaining national agricultural goals through shifts in policy priorities and program emphasis from that plan, and
3. A policy strategy alternative involving greater Korean reliance on international sources of agricultural products and on the domestic market mechanism.

By concentrating on questions concerning the empirical consequences of following these three broad alternatives over the 1970 to 1985 period, the KASS team has been able to acquire considerable empirical understanding of how Korea's agricultural sector works. This deeper understanding is relevant to analyzing and solving the kinds of detailed problems taken into account in setting up the three broad alternative policy strategy sets.

Presentation of detailed descriptions of the three policy strategy alternatives is delayed until Chapter 6 which presents KASS estimates of the consequences of following them. Those alternatives are so important for the KASS analysis that they must be described in detail; preliminary description would detract from the overall KASS approach described here.

Working Papers

After defining each of the three alternative ways of operating Korean agriculture, the KASS team raised questions as to what data and what subjects would have to be investigated in order to understand how Korean agriculture would operate under each of the three alternatives. Over twenty working parties were established and working papers produced. Each working party included a specialist in each particular subject from Michigan State University and one, two or even three Korean experts in the same subject matter. The working papers deal with such subjects as crop and livestock production, upland development, credit, the National Agricultural Cooperatives Federation (NACF), water resources, price income and subsidy policies, research and technological advance, extension, rural institutions and infrastructure, administrative processes, population, capital formation, employment and migration, and nutrition. In several instances, the working paper teams developed informal projections based on a wide variety of data, information sources, and judgments. Later these projections were used as inputs in the more formal simulation model which was handled on a computer as described later in this chapter. (See Appendix C for a complete listing of working papers and authors.) Recognizing that information and skills from many disciplines was required, the groups assigned to produce working papers included a sociologist, another trained in public administration, an extension personnel specialist, an industrial psychologist, an animal husbandryman, and an experiment station director as well as agricultural economists and systems scientists accustomed to working with a wide range of information about technical, institutional and human change. The importance of these working parties and papers in the KASS approach cannot be overemphasized.

While the various working papers were being produced, another group started the process of modeling the operation of the Korean agricultural economy. Michigan State University personnel, operating under AID/csd contract 2975, were available to transfer to the Korean model components which previously had been developed for work in Nigeria and Brazil.

There was constant MSU-Korean interaction between people writing the working papers and those designing the model. Information revealed by the working parties in each working paper changed the model and the model, in its turn, was the source of questions addressed to the various working parties. The many-faceted process of examining Korean agricultural development problems, defining those problems, establishing working parties and working papers, and of modeling the Korean agricultural economy was continuous, with steady feedback and reformulation as the project proceeded. Figure IV-3 diagrams the model development process and, as such, is closely related to the general problem-solving process diagrammed in Figure IV-1.

KASS personnel wanted a model of the Korean agricultural economy which would permit estimation of the consequences through time of following, not only the three policy strategy sets defined, but other alternatives as well. Because the Agricultural Economics Research Institute (AERI), the

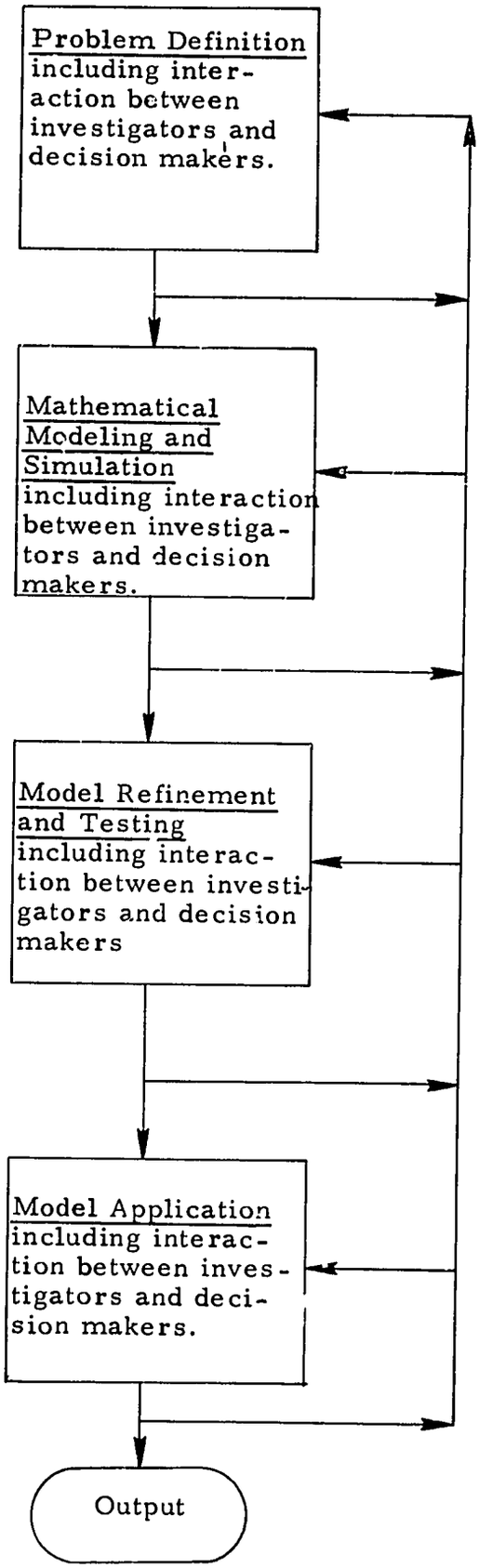


FIGURE IV-3. Model formulation as an iterative problem-investigating process.

most directly involved Korean agency, has direct long-term responsibilities for economic research on Korea's agricultural sector, a model was designed to be (1) capable of handling a broad range of future policy alternatives, and (2) specific and relevant enough to the Korean situation to handle the three policy strategies in a manner directly related to Korea's agricultural development problems and her experiences with the TFYP.

To project the consequences through time of following the three alternative policy strategy sets, the model had to handle a set of variables which could be manipulated by analysts to correspond to each of the policy strategy sets. These policy variables are designated Ⓟ in Figure IV-4. Figure IV-4 gives the reader a quick graphic view of the whole model developed by KASS. At the top of the diagram are four major components of the model: (1) agricultural production and consumption, (2) agricultural product marketing, (3) urban consumption, and (4) nonagricultural production reached via an abbreviated version of the Korean National input/output table. More detail concerning the agricultural sector is provided by other major components dealing with agricultural input markets, public agricultural development programs, public administration, the national budget, and international trade. While the entire model shown in Figure IV-4 was not yet developed when this report was written, the diagram represents what the KASS group hopes to develop in Phase Two of its work. The strict time limitation imposed on this report by the contract between Michigan State University (MSU), the Republic of Korea Government (ROKG) and the United States Agency for International Development (USAID) made it necessary to work with an abbreviated version of the model which eventually will be constructed. That model is represented by Figure IV-5. Special attention should be called to different parts of Figure IV-5 to help the reader see that the model used by KASS is really a "man and computer" rather than just a "computer" model. The "man" components which are enclosed in dashed lines in Figure IV-5, include: (1) yield projections, (2) resource allocation, and (3) price adjustment. In each of these three instances, projections were developed for 1980 and 1985 on an informal basis using paper and pencil or desk calculators and drawing on a wide variety of data and sources of information. These "man-made" projections become inputs into the computerized components of the model. Tables VI-3, VI-4, VI-5 and VI-6 contain some of the man-made projections with respect to yields, resource allocations and prices.

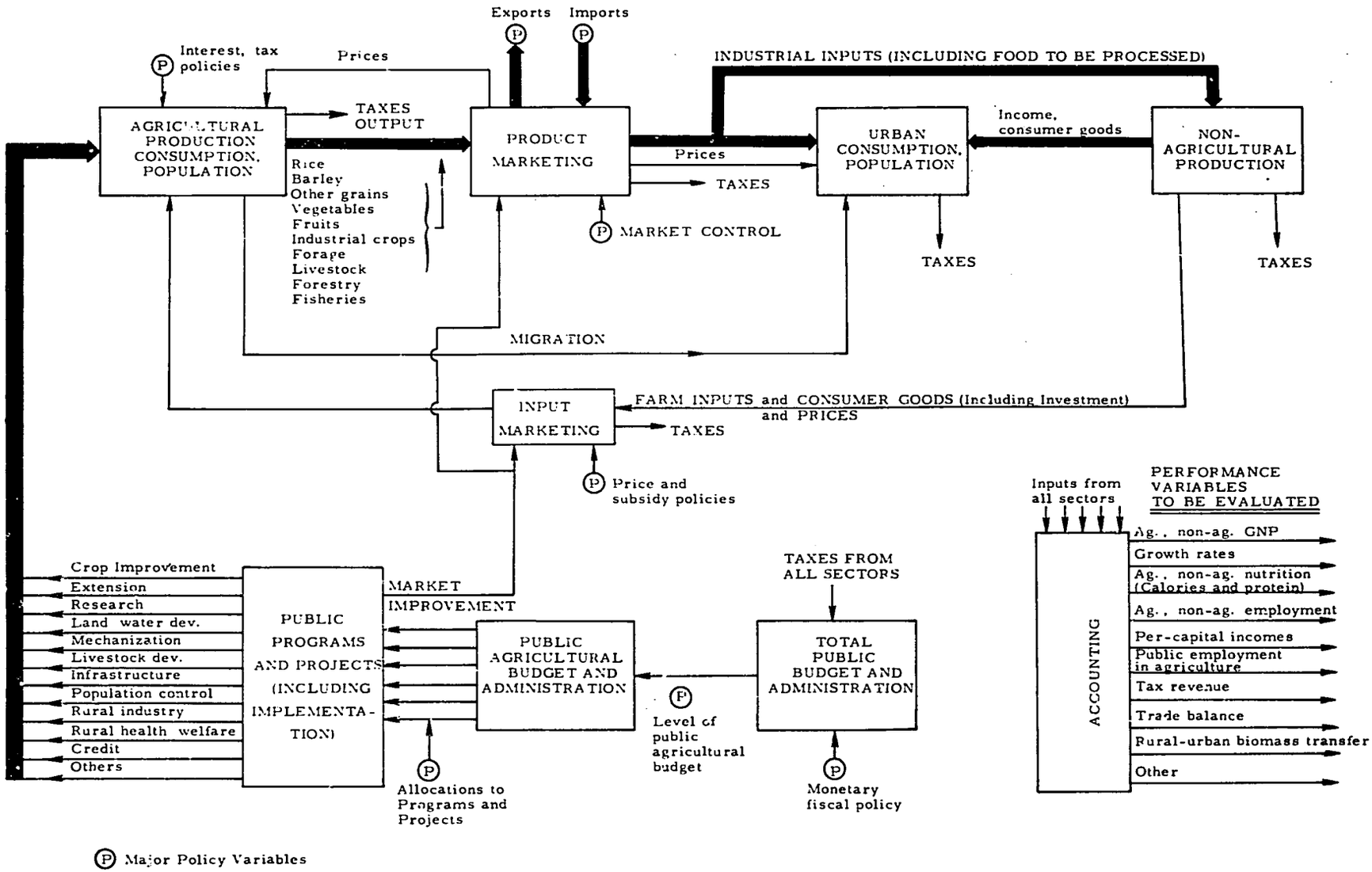


FIGURE IV-4. Korean agricultural sector analysis: major sub-sectors, flows, outputs, and policy inputs.

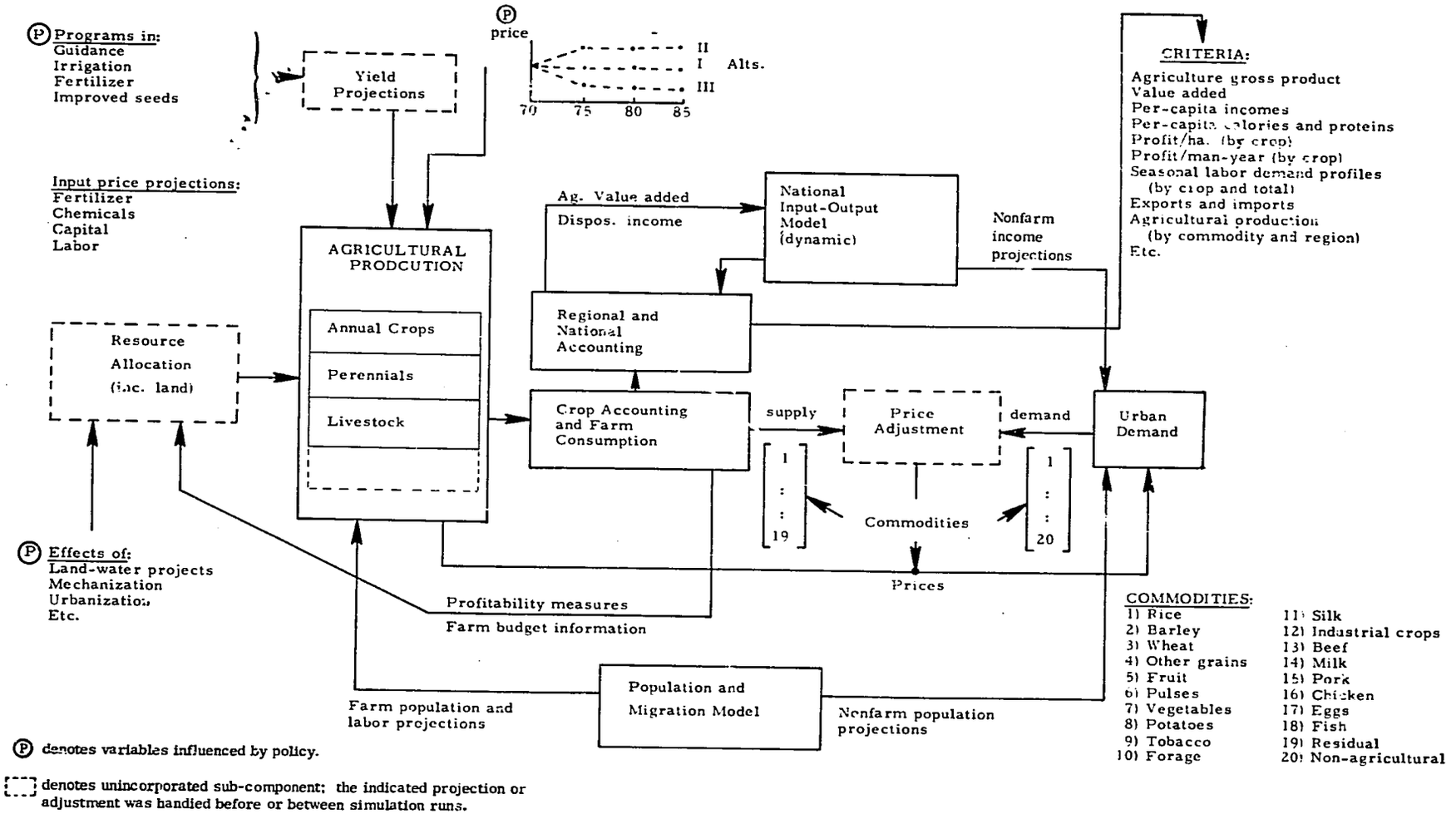


FIGURE IV-5. Diagram of iterative operational model of Korean agricultural sector actually used to project consequences of alternative policy strategies.

Specific components developed to help prepare the projections for the sector analysis include:

1. Sub-components of the agricultural production model: annual crop production, perennial crop production, and livestock production (rudimentary version). The annual and perennial crop sub-components compute for three regions and 12 agricultural commodities; output, supply, farm consumption, income, costs, returns to land and labor, and seasonal labor requirements. The rudimentary livestock sub-component computes output and value added for each of 6 livestock commodities.
2. An urban demand model which computes nonfarm consumer demands for 19 agriculturally-based commodities and one aggregate nonfood commodity as a function of price, income, and population.
3. A population model which projects the rural farm population and the urban nonfarm population as a function of time-dependent birthrates, death rates, and migration rates.
4. A dynamic national input/output model which projects urban nonfarm Gross National Product (GNP) and income.

Certain mechanisms for adjusting prices, allocating areas to different crops, and adjusting yields have not yet been programmed to link the components outlined above. (These mechanisms are enclosed by dotted lines in Figure IV-5). Therefore, in making the current projections on the computer, it was necessary to use a "manual" iterative procedure to adjust yields, crop areas, and prices in order to equate production with consumption and to bring exports and imports into line with current levels and reasonable projections for the future under various alternatives.

As a result of this iterative procedure, projections of the following (and other) variables are produced for 1975, 1980, and 1985 for the several policy alternatives: farm output, consumption, farm income, farm income per capita, farm consumed calories and protein per capita, returns to land and labor, value added from agriculture, urban consumption by commodity, urban price indices, ratio of urban food expenditure to total urban expenditure, and imports and exports by commodity.

Figure IV-5 is an oversimplified version of several hundred equations which express the relationships being modeled in quantitative form for computing purposes. Those equations can be examined in Appendix A.

Development of KASS Model

The KASS model is: (1) general, (2) simulated, (3) computerized, and (4) represents a system.

The KASS model is *general* with respect to (*a*) techniques, (*b*) kinds of data and information used in building and usable in operating it, (*c*) subject matter, and (*d*) philosophic orientation. It is our observation that there is a credibility gap among both public and private decision makers concerning highly *specialized* models and analyses. KASS attempted to avoid this gap by building a *general* model to trace the consequences through time of following alternative courses of action based on at least as wide a range of kinds and sources of data and information as Korean, grantor, and lender decision makers use without specializing in any one technique to the exclusion of techniques frequently used effectively by relevant decision makers. In addition, KASS carefully avoided premature application of maximization techniques in situations where decision makers realize that the multiplicity of *goods* sought and *bads* avoided has not yet been reduced to a common denominator to be maximized.

Korean administrators are seeking so many different *goods* and avoiding so many different *bads* in developing their agriculture that it is very difficult for them or anyone to find a common denominator for a maximizing model. Consider, for instance, the *goods* of (1) adequate food, (2) political stability, (3) off-farm migrants to develop industry, and (4) education. Also consider the *bads* of (1) unequal incomes between farm and urban people, (2) dependence on food imports, (3) water and air pollution, (4) urban slums, (5) destructive revolution, (6) malnutrition, (7) illiteracy, etc. Who can determine, before analysis, a common denominator among such divergent *goods* and *bads*? And how can one be sure that the damages imposed on some by unequal agricultural growth are greater or lesser than benefits conferred on others? Who can know ahead of time the best order in which to execute the projects within a program, and the programs within a policy? And, if knowledge is uncertain, how can one know whether decision making should be cautious or chance taking?

Because of such complex questions, the KASS team preferred, initially at least, to use general models to project the consequences of following alternative courses of action—in terms of several *goods* attained and *bads* incurred. In Figure IV-4 these variables are indicated in the lower right hand corner as *performance variables* and in Figure IV-5

Interaction was an important aspect of the KASS approach.

as *criteria.* The KASS group views itself as assisting public decision makers by (1) making projections of such variables available, and (2) helping to reach prescriptive decisions as to the right action to take concerning policies and programs. The KASS approach is *general* with respect to the use or nonuse of maximizing models.

It is also general with respect to sources of data and techniques, as it accepts data and information from many sources, that is, time series, carefully controlled experiments, the normative and nonnormative judgments of informed men, survey data, and opinions, etc.

The KASS approach is designed to trace the consequences of alternative courses of action through time. Therefore, it can be viewed as capable of *simulating* the performance of Korean agriculture under Alternative Policy Strategy sets. It is this ability to trace consequences through time which makes it a *simulation* approach. Simple planning and budgeting models employed long before the existence of even simple mechanical desk calculators were simulation approaches. Historically, such approaches attained and maintained high credibility among both public and private decision makers. It is a mistake to assume that only a computerized approach can be a simulation approach and that all simulation models are computerized. To do so is to ignore some of the most effective simulation work done and most of the actual basis for private and public decision making.

The model was constructed so that it could be *computerized.* Personnel, time and costs can be reduced severalfold by using electronic computers.[2] The KASS model is also a *systems* model in which the Korean agricultural sector is viewed as a system made up of sub-systems, and which is itself a sub-system of a still larger system, the national economy of Korea. Fortunately, the Korean national economy is modeled in a general way so that the more detailed KASS agricultural model can relate agriculture to the rest of the economy. When and if a general systems simulation model of the nonagricultural sector of Korea is developed in the detail being created for agriculture, it will be easier to study more fully the farm/nonfarm interactions for the entire Korean economy.

Methodological and Philosophic Issues

While many methodological issues are involved in a study of this kind, only three will be discussed here: (1) validation and verification, (2) difficulties in describing the KASS model, and (3) the appropriate roles of researchers with respect to practical problem-solving activities having prescriptive objectives.

Validation and Verification

A problem of general models of the type developed by KASS involves the need for validating or verifying the projections produced. Closely related is the problem of placing confidence limits on the information used in constructing the model itself.

Unlike specialized models based on data from scientific experiments, definite sets of time series, or controlled observations on operating systems, these models are general with respect to the kinds and sources of data and information used in constructing them. Though some of the data are experimental, many different experiments are involved. Other data used are judgmental, but of different reliability. Still other data are from time series, while some are "synthesized" or "simulated" from various combinations of data. Still further, the model is used to predict the consequences of doing things never done in the past or, if done, having outcomes not recorded. The situation is further complicated by the use of several kinds of information in complex computations to forecast attainment and incurrence of a wide variety of *goods* and *bads.* Statistical procedures and theory are advancing rapidly, but are still not advanced enough to deal adequately with the task of establishing (1) appropriate confidence intervals for the various kinds of data going into models of the type developed by KASS, or (2) confidence limits for each of the criteria variables (measures of *goodness* and *badness*) the model forecasts. The so-called Bayesian advances in statistics have done much to legitimize the KASS use of a wide variety of sources and types of data. Unfortunately, similar progress on setting specifications for complex forecasts has not yet been made. Statistical theory is primitive for choices among more than two alternatives, particularly when the alternatives (1) involve utilization of several kinds and sources of data, and (2) are possible prescriptions to solve

[2] Glenn L. Johnson, O. J. Scoville, George K. Dike, and Carl K. Eicher, *Strategies and Recommendations for Nigerian Rural Development, 1969/1985,* review by Peter Kilby, *American Journal of Agricultural Economics,* 53: 375-376, May, 1971; and Glenn L. Johnson, "Peter Kilby's Review of Strategies and Recommendations for Nigerian Rural Development, 1969/1985," *Am. J. Agr. Econ.* 53: 678, November, 1971.

more than one problem, each of which involves the attainment of multiple *goods* and the avoidance of multiple *bads* for which a common denomiator is poorly known, if known at all.

Recognition of these validation and verification difficulties, however, does not mean the situation is hopeless. Generally speaking, the more rigorous statistical and econometric methods of verification and validation involve application of tests of

1. consistency with observed and recorded experience,
2. logical internal consistency of the concepts,
3. interpersonal transmissability of concepts (including estimates and forecasts), and
4. workability when used to solve problems, this being a special case of the first.

The complex phenomena which KASS has analyzed and forecasted are verifiable or validatable as true, or rejectable as false according to the same criteria. In carrying out such validations or rejections, the rigorous tests of statistics were used if available and applicable. If statistical tests were not available, then less rigorous application of the above four general tests were made.

These tests have been applied repeatedly in bringing the KASS model to its present stage of development. They have been applied in assembling data, modifying and developing model components, combining smaller into larger model components and in evaluating model output. The process of testing is never-ending. It takes place each time new data become available and, hence, each time a new use is made of the model. However, it must be stressed that the KASS model is still very rough and tentative. It was put together rapidly between September, 1971 and mid-March, 1972, (in Figure IV-5 form rather than Figure IV-4 form) to meet the deadline imposed on KASS by both Korean and U. S. government officials. It yields usable estimates of the consequences of following each of the three specified policy strategy alternatives over the 15-year period, 1970-85.

In the future, it will be possible to introduce still more information about possible inaccuracies and variations in the data used by the model to obtain an indication of the consequences of possible variations and errors in the data. This process of testing the sensitivity of the projections produced by a model to possible errors in the data is very helpful in finding out how much "garbage" is generated by the "garbage data" which go in. If information of a probabilistic nature is available on the data, the model can be operated repeatedly to indicate the range which would result over time in the output or performance variables generated by the model. The process of studying such characteristics of a model is referred to as "Monte Carlo" analysis, partly because it is useful in indicating to a decision maker the extent of the gamble he takes in following any given alternative.

The problem of verification and validation becomes particularly complex with respect to prescriptions made to solve problems. Here, the question is one of whether it is true that the action prescribed is the right action to solve the problems involved. Such questions involve both the normative and nonnormative (or positive) contents of the model as well as the prescriptions themselves. Thus, the following discussion of verification falls under three headings: the positive or nonnormative, the normative, and the prescriptive.

The positive or nonnormative content of a model is verified or rejected according to procedures described above. It must be pointed out, however, that verification is never final, even for positive or nonnormative information. The positive elements of earlier versions of the KASS model which have not met these tests have been eliminated and replaced, while the elements retained are merely those which have not yet failed these tests and, as such, must not be regarded as immutable knowledge but as fallible in the best scientific tradition.

KASS, in effect, used the same criteria in verifying the *normative content* of its models. The output or performance variables which we have used are normative. As such, they describe characteristics of conditions, situations and things having to do with their *goodness* and *badness* (as contrasted to nonnormative components which do not deal with *goodness* and *badness*). We have not tried to define the meaning of *good* and *bad*; instead, we have taken them to be primitive terms like the words weight and distance on the nonnormative side which we either do or do not know the meaning of from experience and which are, hence, basically undefinable. In testing our normative concepts and components, we have applied the tests of logical consistency and have drawn upon the experience of mankind (and Koreans in particular) with the *goodness* and *badness* of such things, conditions and situations as high versus low per capita incomes, adequate versus inadequate nutrition, the presence or lack of food self-sufficiency, etc. A certain degree of interpersonal transmissability of some normative concepts has been attained. Still other normative concepts considered

by KASS are unworkable in terms of solving Korean agricultural development problems.

Prescriptive concepts as to what is right or wrong to do depend upon the decision-making rule employed as well as on the normative and positive concepts used. In economics, decision-making rules normally employed assume a common denominator among the *goods* and *bads* so a single objective function can be defined for maximization. Generally speaking, the KASS simulation models do not assume a specific decision-making rule in prescribing solutions. In general, KASS has not assumed the existence of a common denominator among the *goods* and the *bads* involved; instead a number of different measures of *good* and *bad* have been used as multiple-criteria variables without attempting to reduce them to a single objective function. Furthermore, no prior existence of a known order has been assumed or accepted as appropriate in which to execute sequences of actions in developing a program or sequences of programs in executing a policy. Instead, KASS has been flexible and left these things unspecified in the model. KASS investigators have traced out paths of certain performance variables through time without arriving at direct prescriptions as to what projects, programs and policies are right. In this sense, the prescriptive components of the KASS models are very incomplete. We prefer to leave them that way.

We could make untested, uninvestigated, and probably unrealistic assumptions in order to establish a single objective function, the necessary second order conditions for maximizing that function, and the decision rule to use. Rather than proceeding in such an unrealistic way, however, we chose to build models which would predict the time paths of various criteria variables for display to relevant decision makers. It was the interaction between decision makers and investigators concerning projections based on the initial KASS model which resulted in improvement of that model and, eventually, in the prescriptions reported herein. In making these improvements, the normative and nonnormative components and the initial model were modified or extended, thereby (1) minimizing the need for arbitrary assumptions and unnecessary rigidities in order to reach prescriptions, and (2) thus increasing the model's realism, applicability and usefulness. It was only after substantial interactions between decision makers and investigators, that prescriptions could be reached. Thus, these prescriptions are based on more than just KASS research.

In discussing verification and validation of positive concepts above, it was stressed that positive concepts, information, estimates, and forecasts are *tentative* and are not presented as *absolutely and finally true*; instead, they are accepted as tentatively true after having merely survived the four tests discussed above. Similarly, the above discussion of normative concepts and information also reveals the tentative nature of any concept accepted as true. As prescriptions depend upon both normative and positive information, they too must be regarded as tentative and subject to rejection on the basis of further application of the four general tests. This stance applies to the prescriptions for solving Korea's agricultural development problems presented herein. The passage of time will reveal inaccuracies in both the positive and normative information used in reaching these prescriptions. Furthermore, the passage of time will reveal nonnormative information and values not even conceived by KASS investigators and the decision makers with whom they worked. Therefore, the process of developing a better understanding of how the Korean agricultural sector operates as a basis for prescribing solutions to Korea's agricultural development problems will be a never-ending one. While this report contains projections 15 years into the future, the prescriptions reached cannot be expected to remain valid for more than a short period into the future. These prescriptions will have to be updated by an ongoing cyclical analysis of the Korean agricultural sector and by continued interaction between the investigators carrying out such analyses and the relevant decision makers.

Complexity of the KASS Model

The KASS model is difficult to describe. Methodologically, analysts like studies and approaches that are easily described. However, it is hard to be concise about general models of the type developed by KASS. Because such a model involves a wide variety of techniques and model components, it is even harder to describe for professional economists and mathematicians than it would be if specialized in one technique. This result is true whether or not such models are computerized; it also is true without respect to level of analysis. A general, open analysis of a single enterprise on a farm involving technological, human and institutional change is difficult to describe in terms of mathematics and economic theory. The general KASS model of the Korean agrciultural sector is a complex mixture of different sub-models; hence,

descriptions of the KASS model are messy, and lack what the mathematician calls "elegance" and what the theorist means when he says "a model is beautiful." Fortunately, such models are often acceptable to decision makers because a messy general model (1) can correspond to the messy real world in which decision makers operate, and (2) can utilize the wide range of information typically considered by decision makers.

Roles of Researchers

Both the KASS study and KASS investigators relate to a perceived role for researchers to play in seeking prescriptions to practical problems. That role has deep roots in philosophy. Those roots are immediately apparent to persons moderately sensitive to philosophic issues and questions from the glossary of terms at the beginning of this chapter. The consequences of these same philosophic roots also appear in this chapter's discussion of the KASS approach to organizing information used in interaction with decision makers in arriving at prescriptions for solution to Korea's agricultural development problems.

The tests for truth or verification and validation discussed above indicate deep philosophic roots in the tradition of positivism. However, the glossary of terms and the approach followed by KASS reject the positivistic assertion that no objectivity or truth is possible about normative matters. Instead, KASS is also normativistic but applies positivistic criteria for testing normative concepts. The KASS approach and glossary are also pragmatic as KASS applied the test of workability in verifying or rejecting concepts, but points out that the use of this test is really a special case of a positivistic test of the consistency of a concept using observations and experiences. However, KASS researchers have not accepted the pragmatic position that normative and positive truth are always interdependent, though the KASS stress on interaction between investigators and decision makers recognizes the likelihood that some positivistic and normative truths are so interrelated in problematic situations that decision makers or problem solvers are likely to understand such truths better than investigators who have no responsibility for making such decisions. The KASS approach has not rejected the possibility of assuming answers to normative questions in order to answer questions concerning the best way to obtain certain *goods* or to minimize incurrence of certain *bads*; however, the KASS approach has also involved the acquisition of normative knowledge and the analysis of logical interrelationships among the *goods* and *bads*. (See Chapter 5.)

It is clear that both KASS investigators and the KASS approach have been very general philosophically in perceiving the role which researchers should play in working to reach prescriptions for solving the practical agricultural development problems of Korea. KASS has been willing to use the strengths of any philosophic position but has been unwilling to let the constraints of a philosophic position keep it from utilizing the strengths of another. As a result, KASS investigators conceived their roles to be those of assembling normative and positive knowledge and of working and interacting with decision makers in utilizing such knowledge to reach prescriptions on how to solve Korea's agricultural development problems.

Implications for the KASS Report

The approach and methodological issues discussed above imply the organization of the remainder of this report. In accordance with Figure IV-1, normative information is presented in Chapter 5 on values, while Chapter 6 concentrates rather heavily on positivistic information concerning the nature and operating characteristics of Korea's agricultural sector. Positive and normative information from Chapters 6 and 5 is converted into right goals in the first part of Chapter 7. These goals were set in interaction with Korean, lender, and grantor decision makers. The last part of Chapter 7 translates the goals into policy and programs recommended as right for Korea.

V

Values and Public Choices for Korean Agriculture

Korean Agricultural Sector Study (KASS) accumulation of normative information about the Korean agricultural sector was begun when Koreans and their American counterparts started discussions about Korean agricultural development problems and began selecting performance variables. Some performance variables were judged more important than others because they measured attainment of more highly valued conditions, situations and consequences. The process of building normative knowledge progressed in continuing interactions with Korean, United States Agency for International Development (USAID), United Nations Development Program (UNDP), International Bank for Reconstruction and Development (IBRD) and other decision makers. Repeatedly, normative information was subjected to tests of logical consistency, consistency with new observations and experiences, clarity, and workability as discussed in Chapter 4. Value constellations and relationships among values in development of Korean agriculture are examined in this chapter.

Four Value Constellations

Normative knowledge was sought by KASS investigators concerning broad national values providing the philosophical environment and orientation for agricultural sector development. Four national value constellations appear to be important for Korean agricultural development. They are those associated with:

1. Quantitatively and qualitatively improved food supplies,
2. Realization of a higher quality of life in rural Korea,
3. Contributions from the agricultural sector to the development of Korea and,
4. Administrative and political processes affecting Korean agriculture.

Though these values are not explicitly stated by Korean policy makers or policy documents, a review of policies, programs, and projects, particularly as found in the Third Five-Year Plan (TFYP), and interactions with policy makers have led to identification of these four value constellations as partial determinants of the directions in which the agricultural sector should be developed.

Government achieves values through policies designed to achieve specific goals while hopefully minimizing the adverse effects of attaining those goals. A policy strategy set, such as the TFYP, is formulated with mutually supportive programs and projects designed to achieve a set of goals which, hopefully, maximize the difference between *goods* and *bads* involved in these value constellations, within each constellation and among them. The remainder of this chapter will examine normative relationships involved in the four value constellations to improve capacity to weigh one *good* against others where a *good* can be realized only by giving up other *goods* or increasing *bads*.

Food Supplies

The value of increasing adequate food supplies is important in setting goals related to the level of self-sufficiency. In some countries, like Great Britain, the goal may be a maximum level of food imports to supplement domestic production. In other countries, such as the U. S. and Nigeria, the goal allows for maintaining a domestic production level which provides a minimum level of agricultural exports and export earnings.

At present, Korea is a food deficit country. Korea values food self-sufficiency for military and nationalistic reasons. Gaining self-sufficiency involves the cost of reducing population growth and, possibly, the higher cost of producing rather than of importing food. Also desired is the use of Korean land and underemployed labor to produce as much income as feasible.

Rural Life

The second constellation involves the values of rural life. Within this constellation are the values of higher rural incomes, more equal income distributions, general and vocational education, communications, reduced drudgery, personal freedom, electricity and other energy resources, sanitation and health care services, and the avoidance of pollution, underemployment and unstable prices.

Overall Development

The third constellation of values encompasses Korean agriculture's contribution to the nation's overall development. Among the conditions, situations and things valued within this constellation are:

1. Food produced by Korean agriculture and considered in the first constellation,
2. Migrants furnished to develop the nonfarm economy,
3. Foreign exchange which can be saved or earned,
4. Land that can be furnished to the nonfarm sector, either directly or in the production of recreational services, and
5. Capital which can be generated to develop both the farm and nonfarm sectors.

Administrative and Political Processes

The fourth constellation of values, having to do with the administrative and political processes affecting and affected by the agricultural sector cannot be ignored. This constellation is important as Koreans seek more peaceful relationships and communications with the North; it is also important and relevant to the possibility of military invasion, subversion and political infiltration. Sacrifices already paid by the Korean people to attain the values within this constellation have been great; they were paid during the war with the Japanese and again in the Korean War. Also included is the value of being able to change and develop rapidly without destruction of physical capital, human beings, and culture; and the value of local self-determination. Some of the traditional values of Korea's rural life will be lost with modernization, but they need not be deliberately destroyed. Social values can be attained without sacrificing individual values, as demonstrated time and time again in many countries such as the U. S., England, Sweden, Switzerland and, recently, Japan and Taiwan. There appear to be superior combinations of social and individual goods attainable in mixed economies and political systems which are not attainable in either wholly individualistic societies or wholly controlled societies. Koreans are sensitive to comparisons of their agriculture and quality of rural life with those of neighboring countries; they are sensitive also to the value of Korean national economic and military strength which can be generated in the agricultural sector.

The above four value constellations and their constituent values have been taken into account in establishing the KASS recommendations for Korean agricultural development found in Chapter 7. This was done interactively by KASS and Korean decision makers in two steps: realistic goals or targets were set for the Korean agricultural economy over the next fifteen years, and policies and programs were recommended for achievement of these goals. These developmental targets or goals are specified in Chapter 7, along with recommended policies and programs to attain them. These goals relate to the values discussed in this chapter; forthcoming demands on the agricultural sector, as detailed in Chapter 2; resource constraints examined in Chapter 3; and more positivistic knowledge contained in Chapter 6 concerning the operations of the agricultural sector.

While definite analyses are made in Chapter 6 and firm recommendations are made in Chapter 7, the positive (nonnormative) and normative knowledge on which they are based are often precarious and unreliable. KASS analysis and recommendations, therefore, are subject to modification through improvement and correction on the basis of further experience, incorporation of new observations, better analysis techniques, and added information, particularly that which comes from further interaction with experienced administrators and decision makers in Korean and related lender and grantor organizations.

Relationships among Developmental Values for Korean Agriculture

As defined in the glossary of Chapter 4, values can be viewed as either instrumental or basic. Those definitions take into account those vertical relationships among values encountered when considering the value of a resource which is a means of attaining a more basic value; for example, fertilizer has value because it is a means of producing rice which has the more basic value of providing nutrition. Similarly, vocational training has value be-

cause it is a means of increasing the production of more basic goods and services. At other times, the relationships among values are horizontal having to do with two or more values on essentially the same plane such as the values of rice and barley, both of which provide nutrients for the sustenance of human beings, but neither of which is a means of attaining the other. Because of these vertical and horizontal relationships among values, this chapter discusses ultimate or basic values sought by Korean decision makers, and the values of different actions, programs and policies which serve as means of attaining more ultimate or basic values.

In many circumstances, means, which have instrumental value, can be used to accomplish several different basic objectives. In some circumstances, the means available to society are relatively fixed. If such means are useful in attaining two or more basic values, their value is determined by what the economist calls the principle of opportunity cost; i.e., the cost of using the means to attain a more basic value is the sacrificed attainment of the other values which could have been secured with the same means.

In reading the two paragraphs above, it must be remembered that both monetary and nonmonetary values are under consideration; thus, the opportunity costs discussed in the preceding paragraph are nonmonetary as well as monetary. In the discussions of values to be presented in the remainder of this chapter, there will be many references to nonmonetary as well as monetary opportunity costs in considering alternative uses for scarce means.

Decision makers have before them at any given time a number of values among which they can choose, both the basic values to be achieved and the means to attain those basic values. These choices are basic in setting the goals and targets to be attained in developing Korea's agricultural economy. The following discussion considers both vertical and horizontal relationships among values important for Korean agricultural sector development.

Improved Food Supplies

In considering the value constellation of improved food supplies, attention must be given to the value of Korea's food-producing resources and costs of (1) supplementing those resources, (2) importing food, and (3) reducing the consumption of food. Costs, as a measure of value, are normative, and nonmonetary as well as monetary.

Because Korea is now a food deficit country, two means are possible over time to balance Korean food production with consumption. Figure V-1 reveals diagrammatically how these two means are related to values, constraints and other means of attaining values in the food supply constellation. (In this figure and in the text which follows, numbers in brackets refer to the correspondingly numbered lines in Figures V-1 through V-3.) On the one hand are policies designed to increase the supply of food [8]. Study of these diagrams reveals (1) the roles played by the instrumental values of means in attaining more basic values, and (2) the importance of alternative uses for means in determining their value, or opportunity cost (nonmonetary as well as monetary), in attaining a given value.

Population growth rates can be affected by population control [2] and through outmigration [3]. Korea is already near the forefront of developing nations in control of the population growth rate with a rate of just under 2 percent per year in 1971, and a goal of 1.5 percent during the TFYP. Investments in family planning programs [4] have provided information [7] and devices [6]. If a 1.5 percent growth rate is achievable with present investments in population control programs, what would lower this rate to 1 percent or even less? Are there other means such as economic incentives or penalties [5], which would contribute to a lower rate at a lower cost?

Another means of attaining a more favorable balance between population and food supply is through increasing the supply of food [8]. This can be done through increasing domestic food production [9], through importation of food products [10], and increasing marketing efficiency [11]. Even with effective population control, Korea probably will need all these means to increase food supplies.

Imports, while contributing to the solution of the population food balance problem, have some potentially unfavorable consequences. One direct effect is a drain on scarce and valuable foreign exchange; another may be to depress domestic farmer prices and incomes through competition with domestic production. Both these *bads* may be offset through allocation of released domestic resources from import substitution agricultural production to export production, whether agricultural or industrial; to industrial import substitution production; and through import policies designed to manage domestic prices at acceptable levels.

Domestic agricultural production [9] can be increased through increasing yields [12] on the existing land and livestock base or through increasing

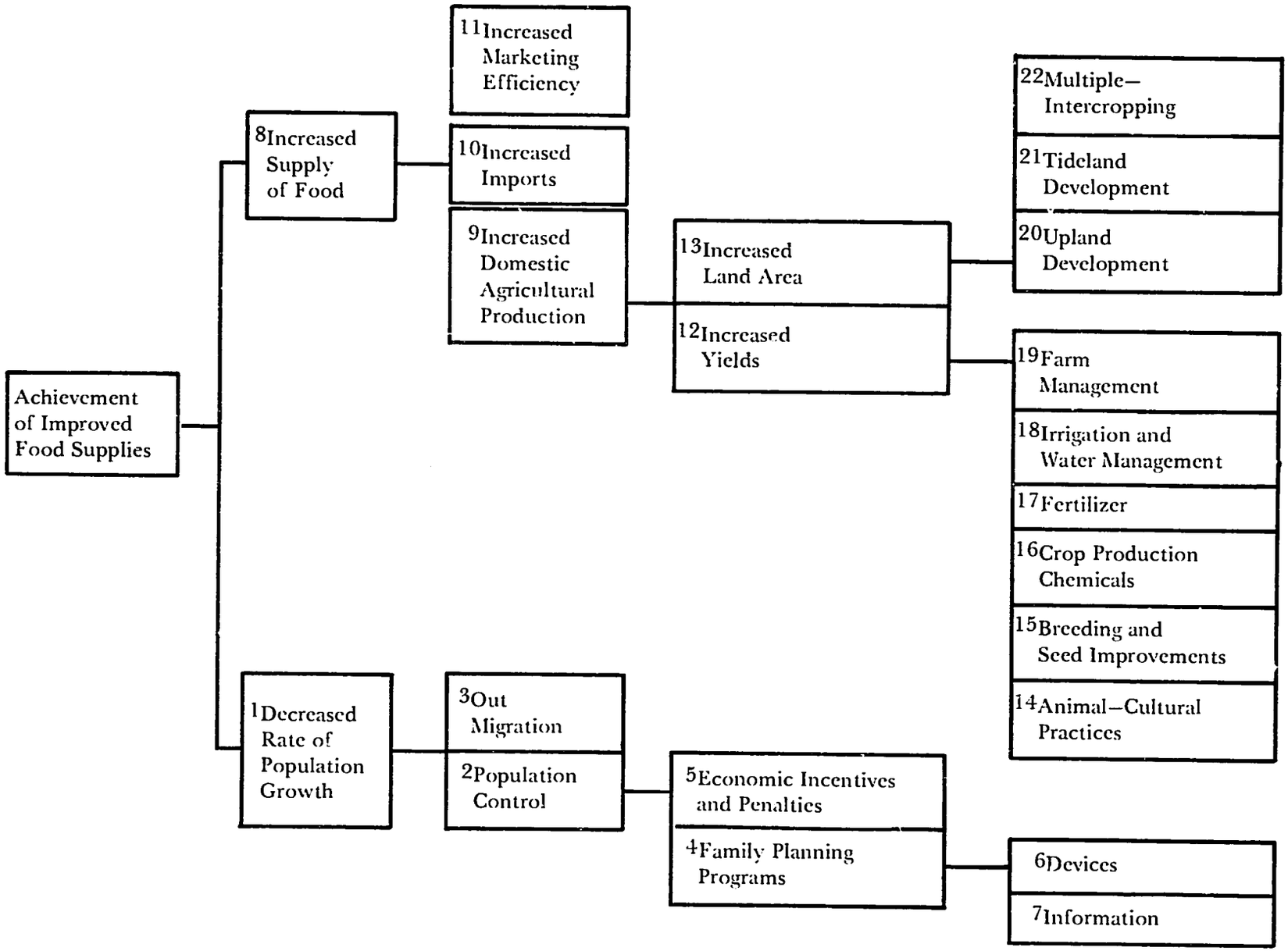


FIGURE V-1. Values and constraints in balance of food production and consumption.

the land area [13] allocated to agriculture for the support of either food crop production or livestock. Increased yields can be attained with new or existing technologies [14-19]. Improved cultural and animal care practices through new methods, techniques, and better management can improve yields at a relatively low cost. Selective breeding, development of new seed varieties, application of crop protection chemicals, use of proper amounts and kinds of fertilizer, and development of new irrigation and water management all can contribute to increased yields per unit of land area. In many cases, these technologies are complementary and must be introduced as a package if they are to have value in increasing yields beyond those attainable when one or more components are missing. A broadly based aggressive and continuing agricultural research program, along with an effective delivery system to disseminate the information and research results to farmers, have substantial instrumental values.

The land area valuable for agricultural production can be increased through reclamation programs including upland development projects [20] and tideland development projects [21]. Another means of increasing effective land area is through extension of the techniques of multiple cropping and inter-cropping. Investments in reclamation projects in Korea have provided mixed results and, on the whole, have enjoyed only limited success. The opportunity costs as well as the institutional arrangements necessary for successful upland development, require further study and investigation. Tideland reclamation for agricultural purposes probably can be justified only as a part of more general multipurpose river or shoreline development projects. Extensive multiple cropping [22] is practiced on paddylands, particularly double crop paddy and a rice-barley combination. Some upland multiple and intercropping is in evidence and a fast growing technique is the use of vinyl covering for protection and environmental control to extend the effective growing season and intensify land use. Vinyl covering techniques are used on an estimated 1,200 hectares in Korea. Unanswered questions involve the value of governmental and private investments in institutions and programs to extend and reserve existing agricultural land for agricultural purposes.

The means to increase domestic agricultural production through increasing yields and increasing land area are many. Intensive analysis of the values to be gained from investments in research, development and extension of these various means is required, as is research on the values sacrificed in attaining such more basic values.

Improved Rural Life

During the first two five-year plans, the priorities for Korean economic development were directed toward building a social superstructure and basic industry. Emphasis now is turning to values of the conditions, situations and things which contribute to the quality of rural life. These include higher agricultural incomes [23], control of income distributions [51] both between agriculture and other sectors of the economy, and within agriculture itself, expansion of rural infrastructure [54], and preservation of personal freedom [67].

Since agriculture represents a large proportion of the population and activity of rural Korea, increasing per capita agricultural incomes [23] is a direct means of upgrading the quality of rural life. Per capita incomes can be increased, in turn, by increasing the value of agricultural production [24] thus providing more income to share among a given number of farmers. A decrease in the number of farmers [39] also would increase per capita incomes of those remaining. Decreasing costs per unit of output [36] while maintaining prices is a third means.

The value of agricultural production can be increased both by increasing agricultural prices [25] and by decreasing the volume of production [26]. Prices can be increased by increasing relative demand [27], decreasing relative supply [29], and increasing marketing efficiency [28]. Demand is increased through increases in population [30] (more mouths to feed), increases in per capita income [31] (people eat more and higher value food), and increased exports [32]. It is clear there are many levels of instrumental values and, hence, opportunity costs or values, both monetary and nonmonetary. If the net effect of these factors is great enough to increase demand faster than supply, relative demand increases and puts upward pressure on prices.

Another means of increasing demand at least slightly and making it more uniform over time is through the operation of various government programs [33]. One such program used in Korea for several commodities, most notably rice, is buffer stock operations designed to stabilize price over the crop year. The government purchases rice when supply is large (at harvest), stores and then releases

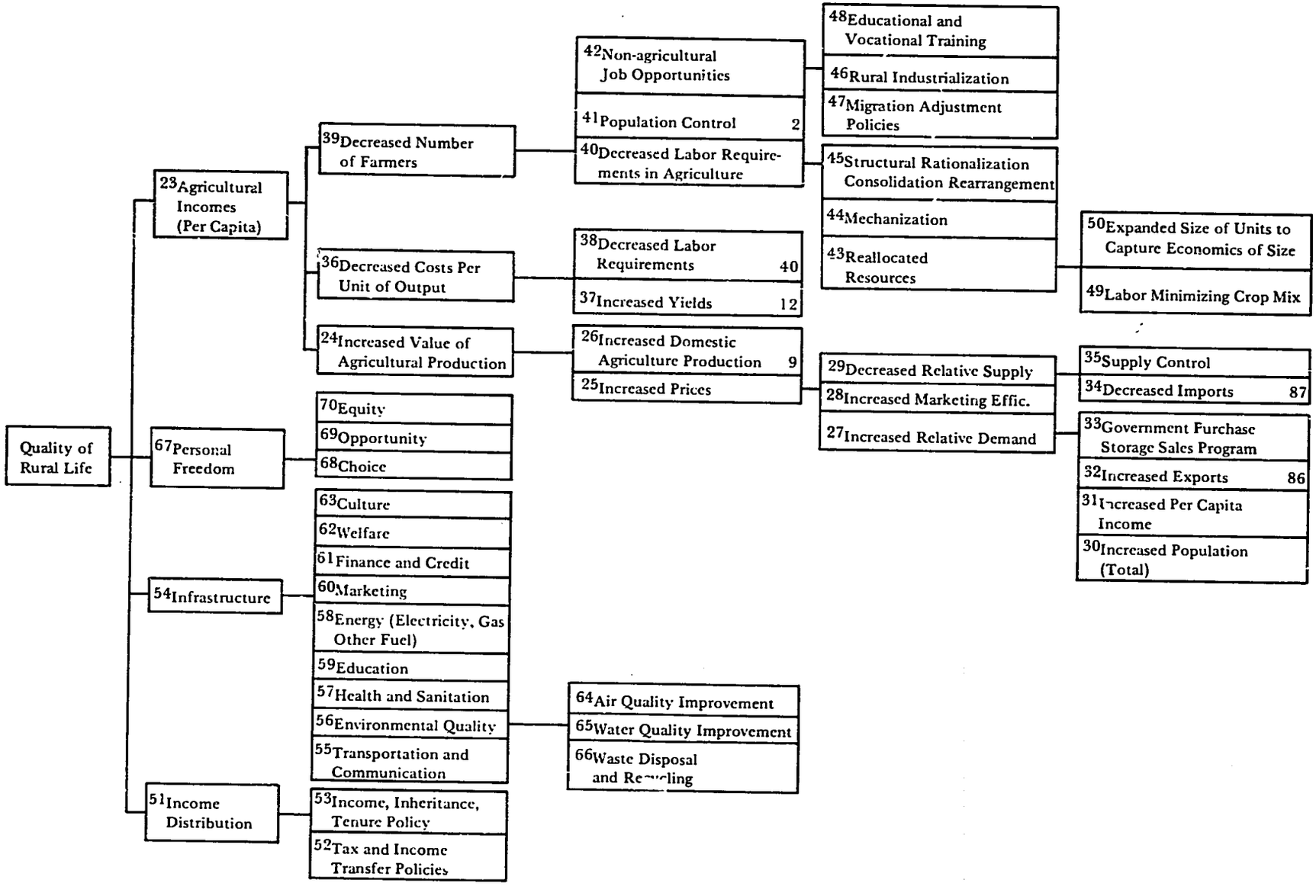


FIGURE V-2. Values contributing to quality of rural life.

it to supplement market stocks when market demand pushes price upward against a dwindling market supply later in the year.

On the supply side, in a food deficit country such as Korea, relative supply [29] can be affected by agricultural import policies. A decrease in imports [34] will decrease relative supply and increase domestic prices. Another possible valuable effect is to decrease the direct foreign exchange requirement. But other consequences of this kind of policy include effects on consumer prices, nutrition, and domestic resource allocation which must be considered.

Other supply control measures [35] can be taken between commodities through pricing, subsidies, licensing, or contracts to shift resources to produce the desired output mix. Analysis is necessary to determine consequences of specific policy actions. In any case, one of the most effective means of increasing prices from the supply side in a food deficit country is through import restraints with selective supplemental measures on an individual commodity basis.

Measures to increase marketing efficiency [28] also can have the value of increasing producer prices to the extent that market savings are passed on to producers, and of lowering food prices to consumers to the extent savings are passed on to consumers. Adequate facilities for bringing buyers, sellers, and products together; facilities for storage, transportation and communication; and processing facilities are necessary to improve market efficiency.

Another means of increasing the value of agricultural production is to increase production as measured by domestic agricultural products [26]. Measures to accomplish this are indicated under [9] in Figure V-1.[1] Increased agricultural production must receive major consideration because it contributes to attainment of values concerning food, quality of life, the development of Korea, and its strength to compete with the north.

Per capita agricultural incomes can also be increased by decreasing the number of farmers [38]; for this to be accomplished, the agricultural sector must be restructured in such a way that fewer farmers are needed [40] in total, and that seasonal peaks in labor requirements are minimized. In addition, the farmers who are willing and able to leave agriculture must have alternate employment opportunities in the nonfarm economy [42]. A somewhat less significant force contributing to a decline in the number of farmers is general population control [41] which affects both growth and employment.

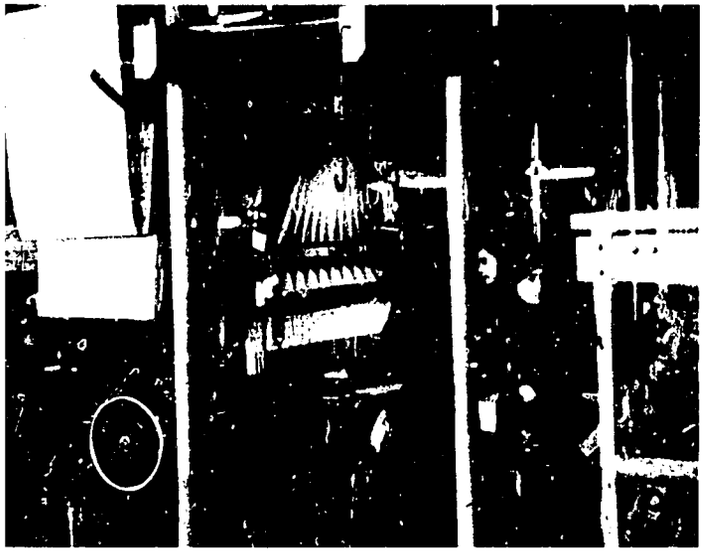
Labor requirements in agriculture can be reduced in several ways. These may include mechanization [44], land rearrangement and consolidation [45], reallocation of resources [43] to produce a labor minimizing crop mix [49], and reducing the number and increasing the size of individual farms to make more efficient use of existing labor and other resources [50]. Pressures for these kinds of adjustments will build as labor supply becomes less plentiful in rural areas and as agricultural labor wage rates rise. Some adjustments to a shortage of labor may cost relatively little; other kinds, such as full-scale mechanization programs, may require considerable cash outlays from farmers. As labor flows out of agriculture and agriculture becomes more commercialized in input and output markets, capital requirements will multiply and credit needs will become acute. Delivery of adequate and timely credit at reasonable cost to the agricultural sector will be a major challenge during the 1970s.

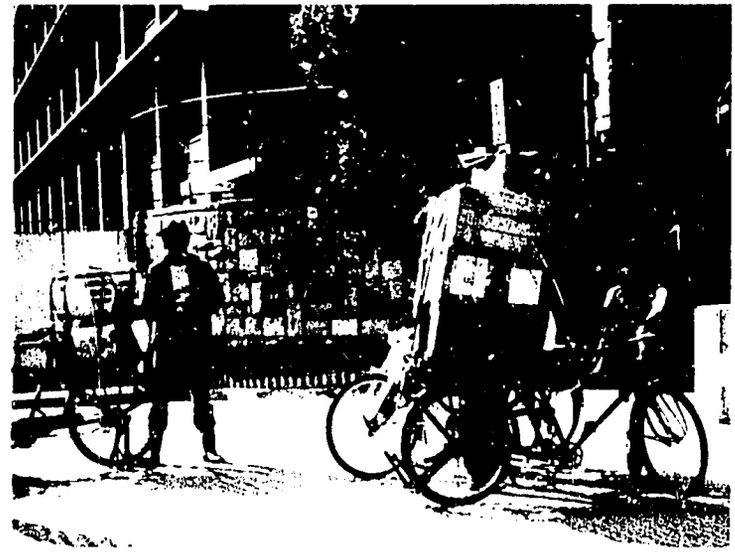
For those people who leave agriculture, a number of means of providing nonagricultural job opportunities [42] will be necessary. Of course, growth in urban areas and urban industrial and service employment is necessary. In order to pull enough labor from rural areas to man the growing urban industrial complex, migration adjustment policies [46], possibly in the form of migration and resettlement allowances, may be used; if the rate of off-farm migration continues, these kinds of programs could even have negative value. Urban areas may suffer from having to provide services for jobless migrants, and rural areas may suffer from loss of labor and transfer of rural wealth with migrants. A population dispersion policy with rural industrialization [47] would slow the rural-to-urban migration rate. In any case, as the total economy develops, the compulsory basic education age level is expected to increase, and additional vocational training and retraining investments [59] will be required to provide the industrial labor market with laborers of necessary skill and education. These skills must be provided in rural areas, and government should be willing to use investment transfers to upgrade the rural educational resources.

The third method of increasing per capita agricultural income is to decrease the cost per unit of output [36], thus increasing the net return with a

[1] Numbers in lower right corner of blocks in Figures V-1, V-2, and V-3 refer to those blocks elsewhere in the figures and indicate linkages to complete the line of reasoning.

Mechanization Will Reduce Drudgery...





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By 1985, more than ten million Koreans will have migrated to urban areas. If properly educated, these off-farm migrants will find productive employment in the cities as employees are needed to man growing urban projects and enterprises. If not educated, they may be forced to turn to nonproductive jobs in order to earn a living.

As mechanization replaces men and cattle in the agricultural sector, drudgery will be greatly reduced. Quality life-styles for farmers and rural residents will be more easily attained.

given set of product prices. This can be accomplished by increasing yields per unit of land area [37] and/or per unit of labor input [38]. Both land-saving and labor-saving technologies can contribute to this objective. Labor-saving devices can greatly increase the quality of rural life by reducing the drudgery of and the amount of hard, slow-paced labor.

Another means of improving the quality of rural life is to control the distribution of income [51], both within the agricultural sector and between the agricultural and nonagricultural sectors. Korea's agricultural development policies have not been geared to problems of intra-agriculture income distribution; and many policies, particularly price and income policies, tend to widen rather than close the distribution of incomes. This is not unique to Korea, but a general problem faced by most countries in formulating policies dealing with agriculture.

Tax and transfer policies [52] including income and inheritance taxes, and tenure policies [53] can be used to bring about the desired inter- and intra-agricultural income distributions.

One can argue, with a great deal of justification, that policies and investments affecting the environment within which agriculture operates contribute more to agriculture's achievement of national goals than many of the policies and investments which could be directed specifically at the agricultural sector itself. As the ratio of nonfarm to farm population increases and agriculture becomes more commercialized, infrastructural investments [54] supporting agriculture and its urban markets must increase. To increase the effectiveness of production and marketing of agricultural products, infrastructural investments in transportation, communications [55], rural electrification [58], marketing [60], and credit [61] institutions and systems become crucial. In addition, as farmers and rural people see many of the advantages afforded their urban cousins, they also become more interested in contributing to their own personal well-being and that of their children through better medical health and sanitation facilities [57], cultural acitvities [63], educational opportunities [59], environmental quality [56], and investments in their general welfare [62]. Some of these infrastructural improvements are not discussed in the sector study; others are treated lightly, while those directly pertaining to agricultural production and marketing are analyzed in more depth.

While the sector study does not treat directly the subject of personal freedom [67] empirically as a contributing component of the quality of rural life, it is an implicit consideration in the formulation of the policies and programs recommended in Chapter 7 to develop the agricultural sector. Those recommended policies and programs are based on consideration of their consequences upon rural people's freedom of choice [68], their freedom and level of opportunity [69], and equity [70]. Further, farm management and market decisions, for example, are more likely to reflect better use of resources if farmers and marketers, responding to their environment, decide what actions they will take, rather than being directed in their actions.

Agricultural Contributions to Korean Development

In addition to supplying food, many other valuable contributions are expected from Korea's agriculture to development of the nonfarm economy. Figure V-3 diagrams some of the interactions among these valued contributions and means of attaining them. General economic and social development can be enhanced through increases in gross national product (GNP) [71], improved urban quality of life [78], and a favorable balance of payments situation [85]. The agricultural sector can contribute to these components in a number of ways.

Total GNP [71] can be increased through increasing agricultural GNP or by increasing the value of agricultural production [72]. One means for increasing the value of agricultural production is found under [24]. The other means for increasing total GNP is to increase nonagricultural GNP [73]. Agriculture can contribute to the increase in nonagricultural GNP through providing agricultural production inputs into nonagricultural industries [75], such as providing the raw materials for agribusiness processing firms like canning companies, meat processing firms, and milk and dairy products processing plants. Another means is through supplying excess labor capacity from rural areas to urban industries as urban industrial jobs become available [76]. Still another way is through increasing the use of purchased inputs [77] in agriculture, provided these inputs are produced in the domestic nonfarm economy. Finally, with the transfer of people from rural to urban areas, we also can expect some wealth transfers as a part of the migration process; including proceeds from selling farms or the inherited share of farm businesses. These assets from the agricultural sector can be provided as direct investment [74] to the urban sector to

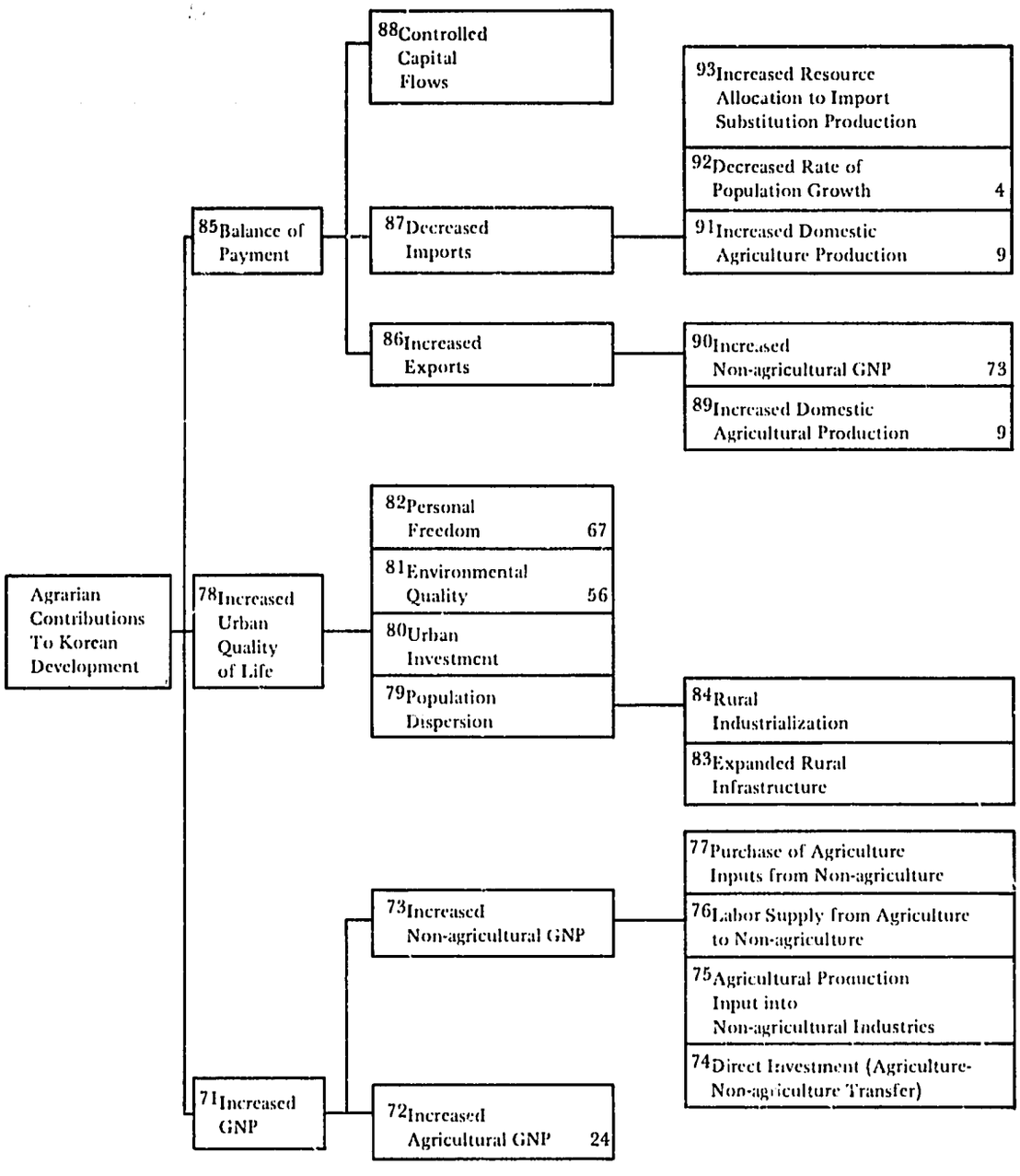

FIGURE V-3. Agrarian contributions to Korean development.

increase industrial capacity to produce goods and services and nonfarm GNP.

There are a number of means by which urban quality of life [78] can be enhanced, such as increasing urban investments in infrastructure [80], investments in environmental quality [81], and increases in the degree of personal freedom allowed [82]. As urban centers become larger, more concentrated, and congested, the population dispersion policies [79] and rural industrialization [84] become necessary for potential rural-to-urban migrators to find job opportunities without migrating. Another prerequisite for population dispersion and probably even for rural industrialization is the expansion of the rural infrastructure [83] already discussed. Urban environmental quality can be enhanced through population and industrial dispersion policies which provide for air quality improvement [64] and water quality improvement [65]. A great deal of attention should be focused on the problem of waste disposal and recycling in both rural and urban areas [66].

Another means the KASS Team considered in the agricultural sector's contribution to general, social, and economic development is through helping maintain a balance of payments [85] in Korea's economic relationships with the rest of the world. Over the past several years, Korea has been running a chronic deficit in its balance of payments. Several devaluations since the Korean War have not succeeded in correcting this deficit. The three main components of the balance of payments are exports, imports, and long-term capital flows. Korea has been building a large debt repayment schedule through borrowings on a long-term loan basis at a relatively high rate during the last several years. No slackening in the rate of debt increase is expected for the next several years. Since the debt repayment schedule is in foreign currencies, devaluations cause a larger Won debt burden. To the extent of the increase in the size of the Won commitment on the debt due to devaluation, the effect of a devaluation in correcting the deficit balance of payments is negated. The long-term capital flow [88] must be rationalized over time in order to stabilize the balance of payments problem. On the trade side, there are two ways to help correct a balance of payments deficit: increase exports [86] and decrease imports [87]. In terms of the agricultural sector, exports can be increased through increasing domestic agricultural production [89]. However, an increase in output may not increase exports. Domestic production policies and trade policies should allocate resources to exportable production. Agriculture can contribute to increased exports also through the means discussed above in increasing nonagricultural GNP, again coupled with policies promoting exportable production [90].

The other means of stabilizing the balance of payments is through a decrease in imports. Imports can be decreased, or at least increased at a slower rate, by policies which decrease the rate of population growth [92], (decreased population lowers demand for imported items). A more effective way might be through increased domestic agricultural production [91] stressing policies which contribute to increased production of import substitution products. The same argument can be made for increasing nonagricultural GNP by providing resources to the nonfarm economy for import substitution production [93]. This assumes that the increase in export plus import substitution production is greater than the increased import plus export diversion, due to larger per capita incomes and the marginal propensities to consume and import.

Korean agriculture now has considerable underemployed labor during part of each year; it also has some underutilized upland as well as considerable unutilized winter paddy land. With off-farm migration and mechanization, labor underemployment will decrease and additional land now producing forage for draft cattle plus land not suitable for power mechanization will become available. Further, traditional forms of capital are often underutilized. In the past, such land, labor and capital resources have produced substantial amounts of agricultural capital. In Chapter 3, the present stock of such capital was placed at about 350 billion Won. Fortunately, such farm-generated capital does not have to move through capital markets and, hence, is immune to the usual malfunctions of the private and public agricultural money markets of less developed agricultural systems. The generation of such capital depends, however, on favorable price and taxation policies to make it privately advantageous for individual farmers.[2]

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[2] Glenn L. Johnson, "Capital in Agriculture," *International Encyclopedia of Social Sciences*, New York: Macmillan Company, Vol. 1, pp. 229-236; and Glenn L. Johnson, "Factor Markets and Economic Development," Chapter 6 in *Economic Development of Tropical Agriculture*, by W. W. McPherson, Gainesville: University of Florida Press, 1968.

Administrative and Political Considerations

A prerequisite to the planning and policy formulation and program development necessary to attain the values for Korean agriculture is a governmental organization and administrative structure, at all levels, flexible and responsive to the needs of rural and urban Koreans. Choices must be made, complementarities exploited, conflicts resolved, and policies executed in a manner designed to achieve goals with the physical, human, technical and institutional resources available, with a minimum of adverse economic and social consequences, and with both short-run needs and long-run requirements considered. Values in government administrative capacity are necessarily political. In the case of Korea, the political considerations are domestic and foreign, relative to neighboring countries. The magnitude of the expectations from Korean agriculture in the long run is so great that failure will be politically disasterous domestically and possibly in the political relationship with North Korea.

Effective administration of agricultural development policies, programs and projects involves, among other considerations, the values of

1. Coordination of decision making and planning responsibility with administrative control of persons and agencies executing the decisions,
2. Reliable sources of information on the performance of those executing the decisions and of the phenomena being controlled,
3. Sufficient insulation from the political arena of decisions and administration for technical and economic agricultural systems to permit such systems to function without political disruption,
4. Provision for technical agricultural competence to influence the planning and administrative process at all levels, and
5. Analytical capacity to take into account the full range of relevant information, using the full range of available techniques as appropriate and uncontrolled by administrative and political personnel.

Summary

This chapter has examined four major value constellations identified by the KASS team in interaction with Korean decision makers and others. Public choices within and among these four value constellations were discussed, and instrumental and more basic values examined. As many means of attaining basic values are useful in attaining more than one value, the opportunity cost (or value) principle was often employed in the discussion. Nonmonetary as well as monetary values are involved.

In Chapter 6 the consequences of following three alternative policy strategy sets arising from different combinations and relative weighting of values are analyzed.

In Chapter 7, a fourth policy strategy set is recommended. That policy strategy set evolved from interaction between KASS investigators and decision makers, mainly Korean but also from relevant donor, lender and grantor agencies including USAID/Seoul and AID/Washington. The recommended policy strategy set presented in Chapter 7 is based on (1) the normative knowledge presented in this chapter, (2) the more positivistic knowledge following in Chapter 6, and (3) both normative and positive information growing out of the interactions with decision makers. Figure IV-1 indicates how the two kinds of information from this chapter and the next feed into the policy strategy set recommended for Korea in Chapter 7.

VI

Summary of Projections for Each of the Three Alternative Policy Strategy Sets

Introduction

The Korean Agricultural Sector Study (KASS) approach outlined in Chapter 4 helps provide decision makers with knowledge about how the agricultural sector works as a basis for reaching prescriptions, and points out that the information used in reaching such prescriptions in interactions with decision makers pertains to both values and positive information. Chapter 5 presented normative information about the instrumental and more basic values important to the Korean agricultural sector. This chapter presents the positive information assembled and generated by KASS concerning operation of the Korean agricultural sector during the next 15 years. Chapters 5 and 6 provide the basis for the prescriptive conclusions reached in Chapter 7.

In Chapter 4 it was seen that use of the three policy strategy sets was a way of classifying and simplifying the multitudinous problems of Korea's agriculture into a manageable number of relevant alternatives. Also discussed was the fact that one of the major reasons for studying and modeling the Korean Agricultural Sector under each strategy set (or alternative) was to understand the operation of the agricultural sector as a system. The KASS team was convinced that it would be possible to design alternatives superior to the three policy strategy sets examined herein once an understanding of how the Korean agricultural sector operates was attained.

In this chapter the three alternative policy strategies are described in detail. Basic assumptions regarding important data inputs used to make the projections are discussed followed by a discussion and presentation of the data, information and informal projections used as inputs in the more formal simulation model described in Chapter 4 and Appendix A. The projected consequences of following each alternative with respect to achieving basic values and developing Korea's agricultural resource base between 1970 and 1985 to provide insights into the operation of the economy follow. These insights provide lessons and guidelines in reaching recommendations for Korea's agricultural development over the next 15 years. Those recommendations are developed in Chapter 7 after setting feasible goals or targets. Policies and programs are recommended in that chapter for attaining the specified goals.

The Three Policy Strategy Alternatives Analyzed by KASS

Briefly, the three policy strategy alternatives are:

1. a continuation of the agricultural policies and rural development strategies laid down in Korea's Third Five-Year Plan (TFYP),
2. a modification of the TFYP including higher agricultural product and consumer food prices and increased efficiency in attaining national agricultural goals through shifts in policy, priorities, and program emphasis, and
3. a policy strategy alternative involving greater reliance on international sources of agricultural products and on the domestic market mechanism.

Alternative I

This policy strategy set corresponds to the TFYP, 1972 to 1976. The major policy goals for agriculture, detailed in the TFYP, include (1) increasing the production of agricultural products with an emphasis on attaining full self-sufficiency in food grains, particularly rice by 1976, (2) increasing incomes for farmers with an emphasis upon narrowing the farm-nonfarm income gap, (3) establishing an expanded agricultural production base, and (4) improving the quality of rural life with emphasis on infrastructure and public

services development. Auxiliary policy goals contributing to those listed above include (1) improving the marketing system, (2) encouraging the export of agricultural products, and (3) improving agricultural research and extension efforts.

A number of broad program directions to contribute to the accomplishment of the policy goals are identified in the TFYP. Though the TFYP was modified almost before it became effective, the projections made by KASS are for the original version. Alternative I involves expanded use of new inputs, particularly IR667 and associated fertilizer and plant protection inputs. Substantial subsidies are used and the price of rice is higher than under the Second Five-Year Plan (SFYP). Provision is also made for expanding the land base with land and water development projects. Other programs provide for mechanization and improvements in rural infrastructure.

The major means of increasing agricultural production include encouraging use of modern inputs under direct supervision of the Office of Rural Development (ORD). Strong emphasis is placed on the new rice variety, IR667. During the 1970-71 rice crop year, IR667 was grown in some 500 strictly supervised plots in Korea. The seed provided by these areas, designated as demonstration plots as well as seed multiplication projects, is to be used during the 1972-73 rice crop year to plant approximately 200,000 hectares of the approximately 1.2 million hectares of existing rice paddy area with new seed. Research is underway to develop a wheat variety with a 10- to 15-day shorter growing season than those presently used. Since IR667 matures approximately 10-12 days earlier than the indigenous varieties now used, and if a shorter season wheat variety can be developed, it would be possible to establish a rice-wheat rotation rather than the present rice-barley rotation. It appears that wheat will be more prominent than barley in the Korean diet, particularly if a wheat variety more suitable to making bread can be developed.

Programs to improve the distribution of fertilizer and to expand the use of crop protection chemicals are also underway. Agricultural advisors from the local ORD offices work directly with farmers to provide fertilizer application recommendations and chemical use instruction.

Presently, approximately one-third of the Korean farms are less than .5 hectare in size, one-third between .5 hectare and one hectare and one-third over one hectare. Thus, about one-third of the farms are subsistence, while the rest are in various stages of commercialization. In order to encourage the commercialization of agriculture and thereby increase the income to farmers, the TFYP encourages farmers to raise cash income types of agricultural products through price and subsidy incentives. Prime among these are the expansion of sericulture and livestock production. In addition, partly to contribute to increased agricultural incomes and partly to move toward the goal of food grain self-sufficiency, the price of rice has been raised to provide incentives for producers and to discourage rice consumption. While the present government policy has shifted toward a higher rice price than originally envisioned in the TFYP, KASS Alternative I adheres to the original moderate rice prices.

The present agricultural land base in Korea is intensively utilized. During the 1960s some emphasis was placed on bringing new land into cultivation through bench terracing and tideland reclamation projects with varying degrees of success. The emphasis has now switched to water resource development and the installation or improvement of irrigation systems. A major concentration along these lines in the TFYP is the four big river basin projects, which is designed to develop the four major river basins of Korea for irrigation and other purposes. Emphasis is also placed on land consolidation and paddy rearrangement to facilitate farm mechanization. Better water management is also stressed.

The farm mechanization plan includes the provision of government subsidies for mechanization efforts along with the domestic production of machines, and ORD training programs for rural youth in the use of these machines. A parallel program is aimed at establishing a number of local repair centers in rural areas and training personnel to operate them.

Policy makers have recognized that many of the bottlenecks to commercialization of agriculture and improvement of farm incomes lie in the lagging development of the rural infrastructure. Some of the rural development emphasis is placed on building roads and increasing rural electrification. In addition, improvements in the communications networks, roof construction, rural sanitation, and medical care in rural health centers is planned.

The TFYP also attempts to improve the marketing system by stabilizing agricultural prices and improving its efficiency. During the TFYP, the government intends to extend the use of processing, grading, and classification systems in the marketing of agricultural products. Also as a price stabilizing and quality measure, government sub-

sidies are being provided for the construction of adequate storage facilities.

Even though the emphasis is upon self-sufficiency in food grains, particularly rice, each of the past several years has seen an increase in the amount of imported food grains. Importation of food grains contributes to the outflow of scarce foreign exchange. As a partially offsetting measure, the government is promoting the production of exportable agricultural products. Sericulture and livestock products for both domestic use and export are being heavily promoted during the TFYP.

To fulfill the policy goals, public and private investment is contemplated for several specific projects during the TFYP. Table VI-1 shows these projects in detail and the level of investment by project. Investments include loans, local government investment, and private investment as well as funds provided by the central government. Using the TFYP level and relative concentrations of budget for each of the components, Alternative I continues the same magnitude and direction through 1985. Where appropriate, the description of Alternatives II and III will indicate deviations from Alternative I.

Alternative II

Alternative II represents a departure from Alternative I, though it retains the policy objectives and the levels of commitment of the TFYP. Alternative II seeks increased effectiveness and efficiency in the attainment of the national goals of food self-sufficiency and rural income generation. Specifically, this policy set includes components similar to those found in the TFYP, but with different emphasis and levels of investment.

Further stimulation of agricultural production and commercialization of the agricultural sector is sought through increased research and guidance efforts and improvements in guidance efficiency. A two- to threefold increase in government budget for both research and guidance efforts is provided to increase the number and improve the quality of personnel, and to provide additional logistical and facility support for research and guidance workers. Guidance activities are directed generally toward those areas which have a relatively high marginal return to farmer education. Research funds are directed toward areas of investigation in which technological breakthroughs appear probable and profitable.

Long-term planned investments in selected land areas, such as extending projects to bring convertible forest land and tideland into agricultural production, are programmed where promising. Public funds will be allocated to land development programs as determined by long-run costs and returns to land development investments. Developmental costs are shared between government and farmer-recipients of the gains from investments on the basis of long-term low interest loans.

Approximately 50-70 percent of Korea's paddy land is irrigated. With the planned four big river basin projects, new paddy land will be introduced to irrigation. Flooding and poor water management capabilities have had a substantial detrimental effect on agricultural output in past years; particularly for rice. The proposed four big river basin projects will introduce flood control, which should minimize flooding and eliminate its damaging effect on agricultural production in affected areas. The proposed dams will provide rural electrification for farms and rural industrial development.

This strategy set, or alternative, includes a rice import policy which maintains relatively high prices for both producers and consumers under a one-price system to expand production, reduce consumption and shift demand to other foods. Rice imports are controlled to raise prices. Careful attention is given to complementary price policies for wheat, barley and other important food items affected by the rice policies. A rice price, approximately 15 to 20 percent higher than under Alternative I, is maintained. Imports are reduced from Alternative I levels to maintain the higher price target. Other commodities, both domestically produced and imported, will be imported at reduced levels to maintain higher prices.

The Alternative I paddy rearrangement policy will continue to be pursued vigorously to permit a higher level of mechanization and improved water management practices. While Alternative I provides for a specific program and investment level for farm mechanization, Alternative II will adjust the rate in farm mechanization as appropriate to meet the demand for agricultural products without excessive under- or overemployment. Government credit and subsidy programs will be the major policy instruments for controlling the rate of mechanization in terms of level and timing.

Further reduction in the population growth rate will be encouraged through increased investments in population control measures to achieve a growth rate of approximately 1 percent per year by 1985. A population dispersion policy would include de-

TABLE VI-1
Projected Investment* in Agricultural Sector in the Third Five-Year Plan, Korea, 1972-76

Program and Specific Projects	Total Cost	Yearly Allocation				
		1972	1973	1974	1975	1976
	.....	million Won	.....			
TOTAL	447,854	81,691	87,130	93,772	93,950	91,311
Increase in agricultural production	119,455	21,636	21,642	23,544	25,396	27,237
Increase in rice production	25,336	4,054	4,687	5,219	5,574	5,802
IR 667 (300,000 ha.)	2,779	555	555	555	555	559
Limestone supply (2,500,000 MT)	4,866	973	973	973	973	974
Ag. chemicals supply (22,000 MT)	5,132	989	1,014	1,027	1,049	1,053
Other measures	12,559	1,537	2,145	2,664	2,997	3,216
Increase in industrial crop production	36,504	6,209	6,574	7,304	8,015	8,402
Hemp, ramie, etc.	12,678	2,025	2,285	2,501	2,773	3,094
Construction of vinyl house (2,500 ha.)	15,230	3,046	3,046	3,046	3,046	3,046
Others	8,596	1,138	1,243	1,757	2,196	2,262
Promotion of livestock production	34,305	7,410	6,185	6,359	6,679	7,672
Raising Korean cattle (395,100 head)	13,115	2,299	2,329	2,623	2,835	3,029
Milk cow import (3,420 head)	1,389	695	694	....	....	....
Creating hog production area (68 place)	1,328	78	137	215	332	566
Creating chicken production units (1 unit)	371	62	73	68	74	94
Improvement of other domestic animals (131,000 head)	3,126	594	604	637	623	668
Creating pastures (50,000 ha.)	7,805	1,561	1,561	1,561	1,561	1,561
Feed (3,428 MT)	4,500	500	500	1,000	1,000	1,500
Sanitation facilities (90 place)	1,355	305	287	255	254	254
National cattle ranch (1 place)	1,316	1,316	....	....	....	....
Sericulture development	23,310	3,963	4,196	4,662	5,128	5,361
Mulberry tree plants (300 million)	2,800	560	560	560	560	560
Silk worm breeding units (1,160)	2,372	629	514	400	400	429
Silk worm rooms (116,000)	11,600	1,600	2,000	2,200	2,800	3,000
Others	6,538	1,174	1,122	1,502	1,368	1,372
Establishment of agricultural production base	122,824	24,874	26,195	24,135	25,504	22,116
Water resource development (244,000 ha.)	18,246	9,096	3,054	3,048	3,048	....
Land consolidation (250,000 ha.)	45,374	4,920	10,245	10,245	9,982	9,982
Big four river basin (105,000 ha.)	53,334	10,577	11,722	9,668	11,300	10,067
Land expansion (60,000 ha.)	4,800	120	960	960	960	1,800
Others (105,000 ha.)	1,070	161	214	214	214	267
Farm mechanization	40,625	6,094	6,094	8,125	8,125	12,187
Cultivator (38,740 units)	14,721	2,090	2,546	2,964	3,321	3,800
Other machines	25,904	4,004	3,548	5,161	4,804	8,387
Improvement in marketing systems	26,598	3,260	6,336	8,707	4,881	3,414
Improvement in system	7,180	....	3,050	3,050	1,050	30
Improvement in facilities	19,418	3,260	3,286	5,657	3,831	3,384
Agricultural research and guidance	18,352	2,930	3,300	3,670	4,037	4,415
Improvement in rural environment†	92,241	18,400	18,400	19,900	19,900	15,641
Rural electrification (1 million houses)	34,000	7,000	7,000	7,000	7,000	6,000
Roof-top (1.4 million houses)	42,000	8,400	8,400	8,400	8,400	8,400
Rural road (7,900 km)	16,241	3,000	3,000	4,500	4,500	1,241
Others	27,759	4,497	5,163	5,691	6,107	6,301

* Including loans, local government investment, and private investment. Some of the figures presented above may differ slightly from official figures.
† To be carried out by other ministries.

velopment of rural industry as a source of full- and part-time employment for farmers and farm family members.

Increased investments in infrastructural programs directed toward the elimination of marketing and transportation bottlenecks which impede agricultural development will be introduced. Continuation of the rural electrification program and health program investments will be provided along with other infrastructural investments which prove useful in increasing the effective supply of agricultural products and improving the quality of rural life to the extent necessary to carry out population dispersion policies.

In summary, Alternative II can be described as a modification of the TFYP. TFYP policy objectives are unchanged, but financial commitments and budget allocations may vary. The differences in emphasis and in investments include:

1. Improvements in research and guidance (extension), with emphasis on areas thought to have high marginal returns to research and guidance. Examples include further improvements in rice, industrial and other crops grown in rotation with rice; upland crops and livestock—particularly poultry and eggs,
2. Closer control of land and water development projects to concentrate on high payoffs,
3. Still higher rice prices than in the original TFYP to provide an incentive for expanded rice production and reduced consumption,
4. Emphasis on mechanization as needed to fill labor gaps,
5. Increased investments in population control over the original TFYP along with population dispersal, and
6. Concentration of infrastructural programs that will eliminate transportation and marketing bottlenecks to agricultural development.

While Alternative II seeks more effective resource utilization, it may be more expensive for the Republic of Korea (ROK) than Alternative I. With greater efficiency and higher budget levels, Alternative II should be somewhat more favorable to the agricultural sector than Alternative I.

Alternative III

Under this policy strategy set, greater reliance is placed on the competitive market to allocate productive resources and ration goods to consumers. It also signals the direction and emphasis of agricultural research and extension, and provides the government with cues as to the direction of policy formulation and program development that will encourage the necessary economic and social adjustments consistent with competitive market forces. An open economy free trade policy is assumed for agricultural products and inputs.

Market equilibrium prices are assumed without government price support or subsidy intervention, except for stabilization purposes, in either the agricultural input or product markets. Since import supplies are perfectly elastic, world market prices provide the base for a major portion of the domestic price structure and price level for agricultural products and inputs. Commodity prices based on world market prices include rice, wheat, barley, feed grains, soybeans, beef and milk powder. Prices of vegetables, fruits, eggs, poultry, pork and fish will be calculated at a level to equate domestic supply and demand under appropriate assumptions concerning general price levels, population and per capita incomes.

Price stabilization programs are aimed at smoothing short-term seasonal fluctuations rather than shifting the overall supply-demand equilibrium in any given (say 3-year) period. Costs of storage and program administration are considered in establishing purchase and sale prices.

No subsidies are provided for individual inputs (in order to maintain efficient market allocation of resources). Resource transfers are provided to the agricultural sector via government supply of low-cost credit funds to provide adequate financing of operational inputs and mechanization for optimum resource allocation on individual farms.

No direct consumer rationing or subsidies are provided by government and no direct government restrictions or licensing of food and feed grain, beef and milk products are imposed. Development of standards and grades with government inspection and regulation is encouraged for quality and health standard control of both domestic production and imported commodities. No export restrictions or subsidies by government for agricultural products are imposed and government regulation and inspection of quality standards is encouraged.

Under Alternative III, long-term land and water development projects are undertaken under government leadership, with government providing long-term financing at low interest rates. Loans will be paid off by project beneficiaries.

Research and guidance investments are made in line with market forces. Emphasis will be on mechanization, grains, export-oriented agricultural products, fruits, vegetables, livestock, and farm

management. Investments are contemplated as an indirect resource transfer to the agricultural sector and as a long-term investment in the national interest.

Infrastructural improvements (roads, electricity, health, water, sanitation, communications, education, cultural activities, etc.) are made to (1) improve the efficiency of agriculture, (2) create a favorable environment for rural industrial development, and (3) improve the quality of rural life.

Industrial development is promoted in rural areas to provide job opportunities and to reduce the rural-to-urban migration rate. In line with this emphasis, investments in vocational retraining and training incentives are introduced.

This alternative includes agricultural policies designed to develop the agricultural sector through investments in infrastructure and institutions, better control of food quality standards, industrialization and population dispersion policies to develop sources of nonagricultural income in rural areas, and transition policies to ease the economic and social consequences of adjustment to the new policy strategy. Possibilities of direct income or resource ownership transfers to the agricultural sector are kept open. It will be assumed that the transition to free market conditions will take place gradually, perhaps in a three- to five-year period.

Table VI-2 briefly summarizes the policy components of the three policy alternatives.

TABLE VI-2
Summary of Policy Components of Alternatives II and III Relative to Alternative I (TFYP)

Policy Component	Emphasis or Position Relative to Alternative I	
	Alt. II	Alt. III
Research and guidance programs	More	Same
Land and water development	Same	Less
Labor substitutes	As needed	As needed
Food price	Higher	Lower
Import policies	Same (Restricted)	Open
Infrastructure investment	More	Less
Family planning program	More	More

Data and Informal Projections Underlying the Computerized Projections for the Three Policy Strategy Alternatives

The structure of the simulation model and the iterative procedures used to make the projections are discussed briefly in Chapter 4 and in greater detail in Appendix A. This section presents the most important data inputs to the simulated projections of agricultural production: yields, commodity prices, crop hectarages, demand elasticities and population. The various data inputs to the simulation model were initially prepared as a set of "informal" projections by the research teams who prepared working papers concerned with yields, land use, and demand elasticities, etc. Various standard statistical methods often involving least squares regression analyses were used to prepare many of these projections.

Several of the data inputs—most notably the projections of land allocation and commodity prices—were then adjusted during a set of iterative, "tuning" computer runs with the agricultural production simulation model to bring estimated production and consumption into better balance. The original set of yield projections was not adjusted during this iterative tuning process. Procedures were incorporated into the urban demand model to adjust the urban income demand elasticities for food to keep the estimated consumption of the various foods in reasonable balance with one another as incomes rise. The population projections, although prepared by a sub-component of the simulation computer program, relied heavily on a set of informal projections of a declining birthrate under moderate and intensive family planning programs, a declining death rate, and an increase in rural-to-urban migration to match increasing off-farm employment opportunities.

Yields

One of the most important data inputs into the computer simulation was the set of informal yield projections for the various cropping activities. Table VI-3 summarizes these projections for eleven crops, 1975, 1980, and 1985 under the three alternatives. Table B-1 of Appendix B contains more detailed breakdowns of yield projections by cropping regions.[1]

Yields were projected under Alternative I on the basis of the trends during the past five to ten years. For rice yields, Alternative I projections were adjusted above the 1960-70 trend line under the assumption that by 1973, IR667 would be planted on the maximum suitable area of 300,000 hectares

[1] Karl T. Wright, Kim, Young Sik, Kim, Kwang Hee, "Crop Production Data and Relationships," Special Report No. 8.

TABLE VI-3
Yield Projections for Eleven Crop Groups under
Three Alternative Strategies for 1975, '80, '85

Crop Group	Average Yield* 1968-70	Alternative	Basis for Alt. I Projections†	Policy Factor‡	Projected Yield* 1975	1980	1985	1985 Index (1968-70 = 100)
	kg/tanbo				.....kg/tanbo.....			
Rice	311	I	(a)	1.0	353	369	385	124
		II		2.0	369	401	433	139
		III		0.5	345	353	361	116
Barley	215	I	(c)	1.0	231	246	261	121
		II		1.7	241	266	291	135
		III		0.5	223	230	237	110
Wheat	226	I	(c)	1.0	232	244	256	113
		II		1.7	240	260	280	124
		III		0.5	226	232	238	105
Other grains	92	I	(b)	1.0	118	147	176	191
		II		1.5	132	175	218	237
		III		0.5	103	117	131	142
Fruits	739	I	(d)	1.0	800	850	900	122
		II		1.2	810	870	930	126
		III		1.2	810	870	930	126
Pulses	74	I	(b)	1.0	84	96	108	146
		II		1.7	92	112	132	178
		III		0.5	78	84	90	122
Vegetables	1,060	I	(c)	1.0	1,100	1,150	1,200	113
		II		1.2	1,110	1,170	1,230	116
		III		1.2	1,110	1,170	1,230	116
Potatoes (fresh weight)	1,431	I	(d)	1.0	1,500	1,550	1,600	112
		II		1.5	1,525	1,600	1,675	117
		III		0.5	1,475	1,500	1,525	107
Tobacco	154	I	(b)	1.0	170	175	180	118
		II		1.2	171	177	183	119
		III		1.0	170	175	180	118
Mulberry (cocoon)	21	I	(d)	1.0	30	35	40	190
		II		1.2	31	37	43	205
		III		1.0	30	35	40	190
Industrial crops	89	I	(b)	1.0	120	146	172	193
		II		1.2	125	156	187	210
		III		1.0	120	146	172	193

* Yields in Korea usually are expressed in kilograms per tanbo. One tanbo equals one-tenth hectare. To convert the yield data to metric ton per hectare, move the decimal point left two places.

† Basis for making Alternative I yield projections:
(a) 1960-70 trend plus IR667 on 300,000 hectares with 25 percent yield increase
(b) 1960-70 trend
(c) 1965-70 trend
(d) Past trend modified by judgment

‡ The slope of the projected trend line for Alternative I was multiplied by the "policy factor" to obtain the slope of the projected trend lines for Alternatives II and III. The policy factor represents an estimate of the impact on yields of differences in producer price, extension and research emphasis, and development and maintenance of irrigation facilities. Rural manpower and/or machinery were assumed to be adequate under all three alternatives.

(approximately 25 percent of the total rice area) and would yield a 25 percent increase over the indigenous varieties. The projections for potatoes, fruits, and mulberry under Alternative I were arrived at by considering past trends but estimating future trends primarily on a judgmental basis.

The yield projections for the eleven crops under Alternatives II and III were made on the basis of judgment as to the impact on the "nominal" yield projections under Alternative I of factors such as price, extension and research, rate of fertilizer application, and development and maintenance of irrigation facilities. Judgment as to the impact of these factors under different alternatives was quantified in terms of the "policy factors" presented in Table VI-1. The slope of the projected trend line for Alternative 1 was multiplied by the appropriate policy factors to obtain the slope of the projected trend lines for Alternatives II and III. Rural manpower and/or machinery were assumed to be adequate under all three alternatives.

Under Alternative II, with the highest incentives provided for agricultural production, the major factors considered in yield projections by crop groups were as follows:

1. Rice
   a. Higher price due to the limited importation compared to Alternatives I and III
   b. More emphasis on extension and research
   c. Increased irrigation development
2. Barley, wheat and pulses
   a. Higher prices due to the limited importation compared to Alternatives I and III
   b. More emphasis on extension and research
3. Other grains and potatoes
   a. Higher prices due to the substitution effects to the above four crop groups
   b. More emphasis on extension and research
4. Vegetable, fruits, industrial crops, mulberry, tobacco
   a. More emphasis on extension and research

Under Alternative III prices of commodities such as rice, wheat, barley and soybeans were based on world market prices and were lower than for Alternatives I and II. Therefore, the smallest price incentives are given to these four crop groups as well as other grains and potatoes in Alternative III compared to other alternatives. The following major factors were considered in the yield projections of crop groups in Alternative III:

1. Rice, barley, wheat, pulses, other grains and potatoes
   a. Lower price due to unrestricted imports and consequent substitution effects
   b. Less emphasis on extension and research and irrigation development compared to Alternative II
2. Vegetables and fruits
   a. Higher prices due to the income effect
   b. Less emphasis on extension and research compared to Alternative II
3. Mulberry, tobacco and industrial crops
   a. No change of price structure because those crop groups are major export crops
   b. Less emphasis on extension and research

In Table VI-3 the 1985 yield index indicates that the highest percentage increase in yields are expected for "other grains, industrial crops, mulberry, and pulses." Moderate increases in yields are expected for rice and barley, while lower yield increases are expected for fruits, wheat. tobacoo, potatoes, and vegetables.

Land Allocation

The total number of hectares cultivated during 1971 under the major cropping enterprises was estimated to be 3.6 million hectares. As discussed in Chapter 3, Korea has an estimated 2.3 million hectares of cropland. Thus, approximately 1.3 million hectares of cropland or approximately 55 percent of the total cropland is being multi-cropped. Under Alternative I, the total cultivated hectarage was projected to increase 7.7 percent between 1971 and 1985; under Alternative II, increase 12.5 percent; and under Alternative III, decrease 10.1 percent.[2]

Table VI-4 presents the projections of land allocation to 11 cropping enterprises under the three alternatives between 1971 and 1985. Table B-2 in Appendix B gives a detailed breakdown by cropping region. In 1971, rice accounts for approximately 34 percent of the total hectarage cultivated during the year; this percentage is expected to decline slightly by 1985. The total food grain crops account for approximately 70 percent of the total hectarage in 1971. Depending on the alternative, this area is expected to decrease to approximately 60 percent of the total hectarage with the area allocated to "superior" foods increasing from 30 percent in 1971 to 40 percent in 1985.

Commodity Prices

Table VI-5 summarizes the price projections for

[2] *Ibid.*

TABLE VI-4
Projections of Land Allocation to 11 Cropping Enterprises under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Cropping Enterprise*	Alter-native	Land Area 1971	1975	1980	1985	Pr 1971	age of Total Area '5	1980	1985
		.....thousand hectares.....				.....percentage.....			
TOTAL	I	3,600	3,682	3,766	3,877	100.0	100.0	100.0	100.0
	II	3,608	3,730	3,920	4,060	100.0	100.0	100.0	100.0
	III	3,538	3,390	3,279	3,180	100.0	100.0	100.0	100.0
Rice	I	1,222	1,190	1,169	1,153	33.9	32.3	31.0	29.7
	II	1,230	1,234	1,249	1,262	34.1	33.1	31.9	31.1
	III	1,197	1,073	980	902	33.8	31.6	29.9	25.2
Barley	I	948	939	952	975	26.3	25.5	25.3	25.2
	II	955	973	1,024	1,066	26.5	26.1	26.1	26.3
	III	928	846	801	762	26.2	25.0	24.4	24.0
Wheat	I	170	166	162	158	4.7	4.5	4.3	4.1
	II	170	172	174	173	4.7	4.6	4.4	4.3
	III	167	152	137	123	4.7	4.5	4.2	3.9
Other grains	I	137	107	68	35	3.8	2.9	1.8	0.9
	II	137	110	74	36	3.8	3.0	1.9	0.9
	III	134	95	59	32	3.8	2.8	1.8	1.0
Fruits	I	64	83	105	126	1.8	2.3	2.8	3.3
	II	64	83	105	126	1.8	2.2	2.7	3.1
	III	64	83	105	126	1.8	2.5	3.2	4.0
Pulses	I	379	379	385	424	10.5	10.3	10.2	10.9
	II	375	357	408	426	10.4	9.6	10.4	10.5
	III	372	342	323	303	10.5	10.1	9.8	9.5
Vegetables	I	245	318	360	390	6.8	8.6	10.0	10.1
	II	241	302	327	349	6.7	8.1	8.3	8.6
	III	243	311	338	358	6.9	9.2	10.3	11.3
Potatoes	I	203	247	275	305	5.9	6.7	7.3	7.9
	II	206	255	296	333	5.7	6.8	7.6	8.2
	III	199	223	232	237	5.6	6.6	7.1	7.5
Tobacco	I	42	52	60	69	1.2	1.4	1.6	1.8
	II	41	49	50	56	1.1	1.3	1.2	1.4
	III	41	51	59	66	1.2	1.5	1.8	2.1
Mulberry	I	102	113	132	138	2.8	3.1	3.5	3.6
	II	101	110	124	141	2.8	3.0	3.2	3.5
	III	105	129	154	176	3.0	3.8	4.7	5.5
Industrial crops	I	88	88	98	104	2.4	2.4	2.6	2.7
	II	88	85	89	92	2.4	2.3	2.3	2.3
	III	88	85	91	95	2.5	2.5	2.8	3.0

* No estimates were available on the allocation of land to the production of forage crops.

TABLE VI-5
Consumer Price Projections for 17 Agricultural Commodities under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Commodity	Alternative	1971	1975	1980	1985
		.....million Won/metric tons.....			
Rice	I	.091	.110	.110	.110
	II	.095	.132	.132	.132
	III	.083	.072	.079	.079
Barley	I	.039	.051	.051	.051
	II	.052	.072	.072	.072
	III	.046	.045	.045	.045
Wheat	I	.030	.038	.038	.038
	II	.030	.038	.038	.038
	III	.028	.030	.030	.030
Other grains	I	.041	.046	.057	.058
	II	.049	.063	.072	.075
	III	.037	.029	.029	.032
Fruits	I	.085	.082	.087	.087
	II	.082	.076	.086	.096
	III	.088	.082	.085	.097
Pulses	I	.115	.115	.115	.115
	II	.122	.150	.150	.150
	III	.095	.095	.095	.095
Vegetables	I	.079	.068	.076	.094
	II	.080	.074	.086	.100
	III	.080	.069	.077	.090
Potatoes	I	.103	.087	.091	.100
	II	.093	.079	.081	.087
	III	.103	.103	.103	.103
Tobacco	I	.308	.308	.308	.308
	II	.308	.308	.308	.308
	III	.308	.308	.308	.308
Silk	I	.461	.461	.461	.461
	II	.461	.461	.461	.461
	III	.461	.461	.461	.461
Industrial crops	I	.159	.159	.159	.159
	II	.159	.159	.159	.159
	III	.159	.159	.159	.159
Beef	I	.751	.906	.860	.850
	II	.767	.999	1.144	1.353
	III	.693	.543	.543	.543
Milk	I	.075	.103	.063	.061
	II	.078	.106	.087	.108
	III	.110	.110	.110	.110
Pork	I	.343	.304	.366	.365
	II	.354	.350	.398	.436
	III	.338	.338	.338	.338
Chicken	I	.533	.501	.536	.533
	II	.488	.398	.390	.383
	III	.495	.416	.405	.401
Eggs	I	.275	.297	.248	.270
	II	.266	.248	.165	.165
	III	.267	.253	.192	.174
Fish	I	.247	.216	.208	.197
	II	.258	.244	.230	.250
	III	.195	.195	.195	.195

17 agricultural commodities under the three alternatives from 1971 to 1985. In general, the consumer prices for basic food grains are the highest under Alternative II and lowest under Alternative III. Prices under Alternative I are "moderate." Under Alternative II there is a concerted effort through government research and extension programs to shift the emphasis in the production of livestock from beef to poultry with its higher output/feed conversion ratios. This effort in Alternative II results in higher prices for beef and lower prices for chicken and eggs than under Alternative I.

For purposes of comparison, Table VI-6 presents projections for the world prices of rice, wheat, feed grain, pulses, and beef in 1971 prices at dockside in Pusan over the 15-year planning horizon of this sector study. In the 1980s, livestock production should expand in the less developed countries causing increased demand for feed grains. However, feed grain control programs in many countries could lead to general price stability or even a decrease from 1970 prices.

Under Alternative II the consumer price of rice was set to rise to approximately 2.0 times the 1970 world price; under Alternative I, 1.6 times; and under Alternative III, 1.2 times. By comparison the consumer price of rice in Japan in 1972 was over 2.5 times the 1970 world price.

The price of wheat under Alternatives I and II was set to rise to 1.6 times the 1970 world price and under Alternative III, 1.25 times.

The price of beef in 1985 under Alternative I was set at 2.6 times the projected world beef price in 1985; under Alternative II, 4.2 times; and under Alternative III, 1.7 times.

TABLE VI-6
Projections of World Prices of Rice, Wheat, Feed Grain, Pulses, and Beef in 1971 Prices at Dockside in Pusan, Korea, 1970, '80, '85

Commodity	1970*	1975	1980	1985	1970*	1975	1980	1985
	dollars/MT				million Won/MT†			
Rice	150	139	153	153	.0675	.0625	.0690	.0690
Wheat	53	58	58	58	.0240	.0260	.0260	.0260
Feed grain	77	56	56	62	.0345	.0250	.0250	.0280
Pulses	183	183	183	183	.0825	.0825	.0825	.0825
Beef	978	722	722	722	.5500	.3250	.3250	.3250

SOURCE: Based on discussions with personnel in the Trade and Commodity Projections Branch, International Bank for Reconstruction and Development, and the Economic Research Service, U. S. Department of Agriculture, and other sources.
* The 1970 price is adjusted if the 1971 price was unusually high or low in order to make the price an appropriate basis for trend projection.
† Conversion rate: 1 U.S. dollar = 450 won (assumed equilibrium rate).

Food Demand Elasticities

The urban income elasticities, the urban price elasticities and the rural income elasticities for 15 food commodities were estimated through use of least squares regression analysis, consumer survey data, and other statistical sources. Table VI-7 presents the results.

Consumption is most responsive to rises in urban

TABLE VI-7
Income and Price Elasticities of Food Demand, Rural and Urban, by Commodity Groups, Korea, 1970*

Commodity	Urban Income Elasticity†	Urban Price Elasticity	Rural Income Elasticity‡
Rice	- .1	- .4	.06
Barley	-1.0	-1.0	- .2
Wheat	1.5	- .6	.2
Other grains	0.	- .4	0.
Fruit	1.0	-1.0	.8
Pulses	.8	- .4	.8
Vegetables	.4	- .8	.4
Potatoes	.5	-1.0	- .2
Beef	1.7	- .48	1.7
Milk	3.5	- .4	3.5
Pork	.5	-1.5	.5
Chicken	1.0	-1.3	1.0
Eggs	1.3	- .4	1.3
Fish	.35	- .7	.35
Residual (sugars, fats, etc.)	1.3	- .5	1.3

* Cross price elasticities were taken as zero except for the following urban values: Rice price–barley quantity 1.3, rice price–wheat quantity .31, barley price–rice quantity .2, barley price–wheat quantity .041, wheat price–rice quantity .14, and wheat price–barley quantity .5.
† Values calculated are for 1970. Urban income elasticities were assumed to change through time as per capita consumption levels changed.
‡ Data did not permit estimation of rural price elasticities.

income for milk, beef, wheat, eggs, the residual group (includes sugars, fats, etc.), chicken, and fruit. Rice exhibits a slight negative elasticity, while barley showed a very negative elasticity.

Consumption was most affected by price rises in the urban sector for pork, chicken, barley, fruit and potatoes. Least affected would be rice, other grains group, pulses, milk, beef, and eggs.

In the rural sector most products exhibited approximately the same elasticities. Rice was very slightly positive and barley was somewhat negative.

Two points should be made clear. First, the elasticities presented in Table VI-7 should be considered very approximate since they are estimated from limited survey data. Also, urban income elasticities were allowed to change through the time of a simulation run so that consumption of the various commodity groups would remain in reasonable balance with each other as incomes rise. Further, all elasticities are likely to be asymmetrical in direction and magnitude of change in both income and prices.

Population

Fundamental to the interpretation of the projections of the agricultural production model are (1) the population projections prepared by the population component of the simulation model, and (2) the migration projections prepared by one of the working groups.

There is general agreement that Korea has achieved a remarkable decline in the population increase rate during the past decade—from approximately 3 percent in 1960 to approximately 2 percent in 1970.[3] However, the Korean family planning program has a large task over the next 15 years if Korea is to maintain a continuing reduction in the rate of population growth. As a result of the "baby boom" from 1953 to 1963, there will be a surge in the number of women passing through the childbearing ages starting in about 1976.

The main difference among the three alternative strategy sets with respect to population is the introduction of a more intensive family planning program under Alternatives II and III than the moderate program currently being conducted under the TFYP (Alternative I). Figure VI-1 shows the effect on the yearly rate of population growth of a moderate family planning program operating at or near existing levels (Alternative I). The rate of population growth falls to 1.6 percent per year in 1976 and then begins to rise slightly as the number of fertile women increases before falling off again to 1.65 percent per year in 1985. In contrast, a much more intensive family planning program (Alternatives II and III) designed to offset the

[3] The 1970 rate is still uncertain. Estimates range from 1.8 percent to 2.2 percent.

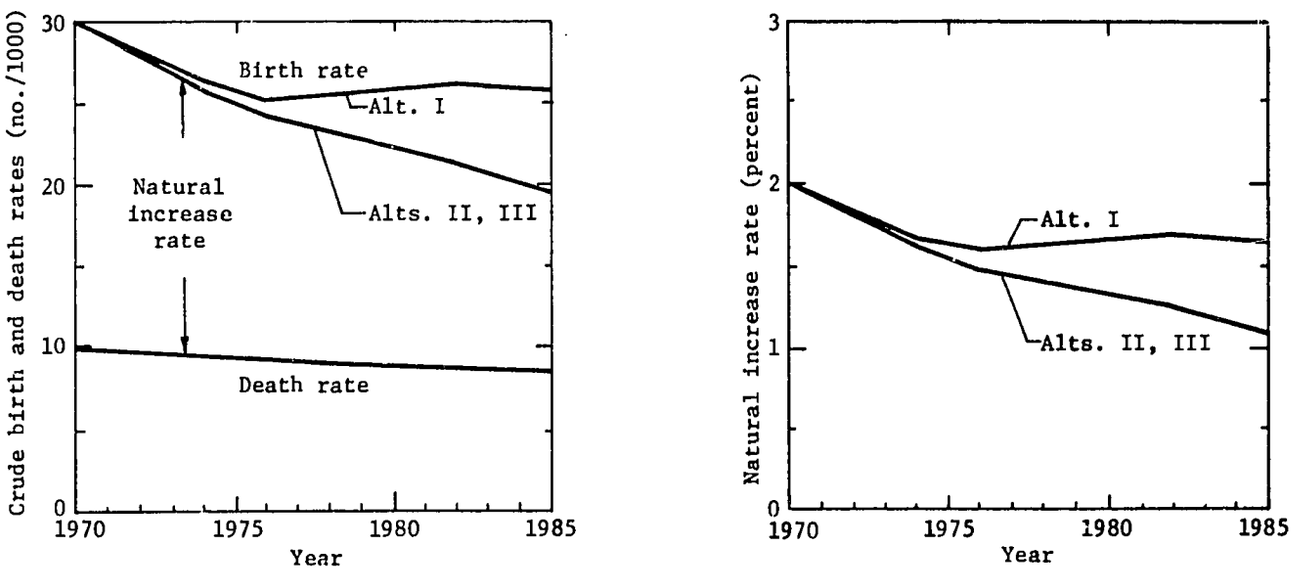


FIGURE VI-1. Projected crude birth rate, crude death rate, and natural increase rate, Korea, 1970-1985. Projections for Alternative I are based on a moderate family planning program while projections for Alternatives II and III are based on a more intensive family planning program.

effects of the surge of fertile women might achieve a population growth rate of approximately 1.1 percent per year by 1985. However, there is little agreement among resident demographers as to whether a more intensive family planning program would in fact achieve a 1.1 percent rate of growth by 1985, a major source of uncertainty being the role of induced abortion. Fertility surveys indicate that induced abortions in Seoul may run as high as 700 per 1,000 live births, with rates in other areas likely to increase.

With respect to rural-urban migration, the projections were based on the assumption that people would leave agriculture to fill jobs created by 7 percent per year expansion of employment between 1970 and 1985, with a 5 percent unemployment rate. This produced a "nominal" rate of rural-urban migration (presented later in Table VI-15). There are several problems with these projections of rural-urban migration rates. *First*, with respect to the assumption of a 7 percent expansion of urban employment over the entire 15-year period, it appears that actual rates are running higher during the beginning of the period and will probably be lower toward the end of the period as the use of labor-saving technology in the urban industrial sector increases. Also, as the rural labor force decreases, the increase in the urban labor force must approach the rate of increase of the total available labor force which is lower than 7 percent. Further, there may be feedback to the urban sector from differences in economic activity in the agricultural sector under the three alternatives which could affect the growth rate of urban unemployment. *Second*, differences in the marginal earnings of labor in agriculture among the three alternatives will affect off-farm migration. Under Alternative III with lower returns to land and labor than Alternative II, marginal farm workers would be much more inclined to leave agriculture to take low paid urban jobs and to take their chances in the underemployed/unemployed pool of urban workers. At a number of points in subsequent sections of this report, allowances will be made for substantially higher off-farm migration rates under Alternative III and somewhat lower rates under Alternative II. *Third*, the off-farm migration rates in each cropping region were assumed to be approximately the same. Until the full results of the 1970 census including the occupational breakdowns are published, there are not sufficient data to assume otherwise. Data available on outmigration from communities under 20,000 indicated that rates may be highest in the double crop region, moderate in the upland region, and lowest in the single crop region. However, this study is concerned with *off-farm* migration, not simply rural-urban migration. Rural-urban migration rates based on community size are confounded by the fact that communities under 20,000 in the vicinity of Seoul, for example, are increasing, not decreasing.

As a result of these theoretical and empirical problems, we have not said how much higher and lower the rates for Alternatives II and III respectively will be than the nominal rates.

Table VI-8 presents projections for the total population, the urban nonfarm population, and the rural farm population (total and by cropping region). If a more intensive family planning program has the effect on lowering the crude birth rates as shown in Figure VI-1, the projected population under Alternatives II and III in 1985 is estimated to be 39.5 million, approximately 1.4 million less than the 40.9 million projected for Alternative I with its moderate family planning program. The most important aspect of the projections shown in Table VI-8, however, is major change in the structure of the population. Whereas the population in 1970 is split approximately between half urban and half rural, by 1985 the population is expected to be three-quarter urban and only one-quarter rural. The rural farm population will decline from 15.9 million in 1970 to between 8.7 and 9.1 million in 1985, while the urban nonfarm population will increase from 15.8 million in 1970 to between 30.8 million and 31.9 million in 1985. At several points in later portions of this report, per capita projections will be qualified by noting the likelihood of larger urban populations under Alternative III than projected in Table VI-8 because of underestimation of off-farm migration for Alternative III.

Table VI-9 presents the projections for nonfarm employment and farm employment by cropping region. Nonfarm employment is projected to rise from 4.7 million in 1970 to 11.6 million in 1985. Farm employment was about 4.9 million in 1970 and will rise slightly until 1975 because a surge of young people will be entering the farm labor force during the 1970s to replace those lost through rural-urban migration. After 1975 the farm labor force will decline slowly until 1980 and then, more rapidly, decline to 3.3 million in 1985. The reader should note, however, that the previously discussed qualifications concerning projected rural-urban migration also apply to the projections presented in Table VI-9.

TABLE VI-8
Population Projections (Total, Urban, Rural, and Regional Rural) under Three Alternative Strategies, Korea, 1970, '75, '80, '85

Population Group	Alternative*	1970	1975	1980	1985
		.....thousands.....			
TOTAL	I	31,690	34,670	37,610	40,900
	II, III	31,690	34,630	37,180	39,480
Urban (nonfarm)	I	15,820	19,210	24,520	31,850
	II	15,820	19,190	24,250	30,810
	III	Alt. II projections used in subsequent computations. See text and footnote below.†			
Rural (farm)	I	15,870	15,460	13,090	9,050
	II	15,870	15,450	12,930	8,670
	III	Alt. II projections used in subsequent computations. See text and footnote below.‡			
Single crop region	I	3,500	3,410	2,890	2,000
	II	3,500	3,410	2,850	1,920
	III	(See above)			
Double crop region	I	10,000	9,740	8,240	5,690
	II	10,000	9,730	8,140	5,450
	III	(See above)			
Upland region	I	2,370	2,310	1,960	1,360
	II	2,370	2,310	1,940	1,300
	III	(See above)			

* Projections for Alternative I are based on a moderate family planning program while projections for Alternatives II and III are based on a more intensive family planning program.

† The urban population projections for Alternative III should actually be somewhat greater than the projections for Alternative II because rural-urban migration is likely to be higher under III due to the adverse treatment of agriculture.

‡ The rural population projections for Alternative III should actually be somewhat less than the projections for Alternative II because rural-urban migration is likely to be higher under III due to the adverse treatment of agriculture.

TABLE VI-9
Projected Nonfarm Employment and Nominal Farm Employment by Region, Korea, 1970, '75, '80, '85

Region	1970	1975	1980	1985
	.....thousands.....			
TOTAL	9,574	11,473	13,205	14,920
Nonfarm	4,724	6,343	8,475	11,580
*Farm**	4,850	5,130	4,730	3,340
Single crop region	1,070	1,130	1,040	740
Double crop region	3,050	3,230	2,980	2,100
Upland region	730	770	710	500

* Farm employment projections for Alternative III with less favorable conditions in agriculture than Alternative I will be lower than the "nominal" projections given above, while farm employment projections for Alternative II with more favorable conditions in agriculture may be somewhat higher than the "nominal" projections (see text for discussion). Changes in the effects of the family planning program between 1970 and 1985 will not affect employment levels during this period because persons born during this period will not enter the labor force until after 1985.

KASS Projected Consequences of Policy Strategy Alternatives

We now present the projected consequences of the three alternative policy strategy sets and an analysis of the effectiveness of each alternative in achieving the basic values discussed in the previous chapter.

As explained in Chapter 4, the KASS approach involved (1) the construction of a computerized simulation model for use in projecting the consequences of following each of the three alternative policy sets, and (2) several working papers concerning the setting in which the production, marketing and consumption of agricultural production take place under each of the three sets. These working papers contained the informal projections used as inputs in the computerized simulation model.

The background material presented in the working paper on the administration of governmental agencies dealing with agriculture suggests qualifications which should be made regarding the attainability of the projections produced by the simulation model for the three alternatives. In making the projections, it was generally assumed that the necessary governmental decisions would be made and implemented at least as effectively as in Korea's recent past—despite the substantial increases in governmental activity required under Alternatives I and II. Under these two alternatives, greater reliance will have to be placed on decisions of the Ministry of Agriculture and Forestry (MAF) which, however good, are poorly coordinated with the Ministry of Home Affairs' (MHA) administration of provincial and local activities that deliver modern inputs and services to farmers. Under Alternative III, however, the task of delivering new factors of production would be smaller and more entrusted to the private sector. Domestic production would be controlled by market forces. Since fewer administrative difficulties would be encountered with the third alternative, there is some basis for believing that Alternative III projections may be the most attainable of the three sets. Between Alternatives I and II it is difficult to say which set of projections is more attainable. Alternative I seems to rely more on administrative arrangements and exhortations to increase production, while Alternative II places more reliance on price incentives and free domestic markets to balance production and consumption. This suggests that projections for Alternative I may be too optimistic. However, Alternative II does not specify whether or not the markets for modern factors of agriculture will be publicly or privately run. If they are publicly run, a tremendous burden will be placed on Korea's governmental establishment for serving agriculture. Thus, projections for Alternative II may also be too optimistic.

Food Production, Self-Sufficiency, Food Expenditures and Consumption

Agricultural planners are very concerned with increasing the quantity and quality of food produced, and with attaining food self-sufficiency. These concerns are based, to a significant extent, on desires to conserve foreign exchange and the importance of self-sufficiency in war.

Table VI-10 presents the projections for the production, import (or surplus), percentage of self-sufficiency, and consumption of the eight basic food crops (rice, barley, wheat, other grains, fruits, pulses, vegetables, and potatoes) and six livestock commodities (beef, milk, pork, chicken, eggs, fish). Table B-4 in Appendix B gives a detailed breakdown of the production figures by cropping region.

The projections in Table VI-10 indicate that Alternative II would increase rice production over Alternative I by about 1 million metric tons by 1985. Alternative III would reduce rice production by about 1.2 million metric tons. These KASS projections also highlight an interesting point concerning rice self-sufficiency: none of the three alternatives is capable of attaining rice self-sufficiency by 1975, 1980 or even 1985. Under Alternative I, KASS projections indicate that rice self-sufficiency would decline from 83 percent in 1975 to approximately 73 percent in 1985. It is estimated this would take place at a production rate of 4.2 million MT in 1975, and at a 1970 consumer price of 110,000 Won per MT. At this price level, domestic consumption would be about 130 kilograms per capita. Under Alternative II, rice self-sufficiency would reach approximately 88 percent unless consumption is reduced with direct controls and then increased slightly to about 89 percent in 1985. Estimates are that this would take place at a production rate of 4.5 million MT in 1975 at a 1970 consumer price of 132,000 Won per MT. Under Alternative III with the price of rice allowed to fall to a little above the world price, self-sufficiency would start declining immediately to 72 percent in 1975 and 57 percent in 1985. Domestic production in 1975 will be about 3.7 million metric tons at a price of 72,000 Won per metric ton.

In spite of substantial increases in production

TABLE VI-10
Supply and Disappearance of Fourteen Food Commodity Groups under Three Policy Strategy Alternatives, Korea, 1971, '75, '80, '85*

Commodity and Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self-Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for‡	Disappearance: Unaccounted for/Total§
		.....million metric tons.....			percentage	.....million metric tons.....			percentage
Rice									
Alt. I	1971	3.894	.731	4.625	84.2	1.746	1.984	.896	18.8
	1975	4.191	.876	5.067	82.8	1.784	2.316	.966	19.1
	1980	4.301	1.255	5.556	77.5	1.639	2.920	.998	18.0
	1985	4.426	1.608	6.034	73.4	1.233	3.761	1.040	17.3
Alt. II	1971	3.961	.763	4.724	83.9	1.746	2.065	.912	19.3
	1975	4.540	.612	5.152	88.0	1.797	2.309	1.051	20.4
	1980	4.996	.688	5.684	87.9	1.652	2.865	1.166	20.5
	1985	5.451	.656	6.107	89.3	1.229	3.587	1.288	21.1
Alt. III	1971	3.800	.923	4.723	80.4	1.746	2.105	.837	17.7
	1975	3.692	1.462	5.154	71.6	1.759	2.549	.846	16.4
	1980	3.451	1.960	5.411	63.8	1.592	3.027	.793	14.7
	1985	3.247	2.431	5.678	57.2	1.153	3.769	.755	13.3
Barley									
Alt. I	1971	2.029	.127	2.156	94.1	1.381	519	.256	11.9
	1975	2.125	.061	2.186	97.2	1.347	.569	.271	12.4
	1980	2.300	(.296)	2.004	114.8	1.131	.570	.303	15.1
	1985	2.497	(.852)	1.645	151.8	.662	.637	.346	21.0
Alt. II	1971	2.062	.008	2.070	99.7	1.381	.429	.261	12.6
	1975	2.301	(.135)	2.166	106.2	1.306	.562	.298	13.8
	1980	2.675	(.711)	1.964	136.2	1.049	.552	.360	18.3
	1985	3.046	(1.476)	1.570	194.0	.546	.593	.429	27.3
Alt. III	1971	1.975	.030	2.005	98.5	1.381	.377	.248	12.4
	1975	1.852	.112	1.964	94.3	1.407	.328	.229	11.7
	1980	1.808	.053	1.861	97.2	1.208	.425	.229	12.3
	1985	1.774	(.301)	1.473	120.4	.747	.489	.237	16.1
Wheat//									
Alt. I	1971	.373	.888	1.261	29.6	.476	.737	.037	2.9
	1975	.373	1.004	1.377	27.1	.359	.979	.037	2.7
	1980	.383	1.391	1.774	21.6	.320	1.414	.040	2.3
	1985	.391	1.838	2.229	17.5	.281	1.905	.044	2.0
Alt. II	1971	.378	.886	1.264	29.9	.476	.741	.038	3.0
	1975	.399	1.008	1.407	28.4	.372	.995	.040	2.8
	1980	.438	1.360	1.798	24.4	.342	1.409	.047	2.6
	1985	.470	1.728	2.198	21.4	.305	1.836	.055	2.5
Alt. III	1971	.366	.917	1.283	28.5	.476	.758	.036	2.8
	1975	.333	1.178	1.511	22.0	.445	1.023	.033	2.2
	1980	.308	1.585	1.893	16.3	.403	1.445	.031	1.6
	1985	.284	1.917	2.281	12.5	.320	1.848	.028	1.2
Other grains									
Alt. I	1971	.133	.020	.153	85.8	.089	.049	.015	9.8
	1975	.127	.032	.159	81.9	.090	.054	.014	9.0
	1980	.100	.055	.155	64.5	.081	.064	.010	6.5
	1985	.061	.086	.144	42.4	.058	.083	.006	4.2

* The results presented in this table ignore carry-ins and carry-outs from year to year.
† Total food supply is defined as production plus imports (or production minus surplus).
‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing losses and "production deflators."
§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).
// Wheat imports are underestimated by about 600,000 MT.

continued

TABLE VI-10 *(continued)*

Commodity and Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self-Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for‡	Disappearance: Unaccounted for/Total§
		.....million metric tons.....			percentage	.....million metric tons.....			percentage
Other grains (con't)									
Alt. II	1971	.137	.012	.149	91.9	.089	.044	.015	10.0
	1975	.145	.008	.153	94.8	.090	.047	.017	11.1
	1980	.130	.022	.152	85.5	.080	.057	.015	9.9
	1985	.079	.057	.136	58.1	.056	.071	.009	6.6
Alt. III	1971	.127	.027	.154	82.5	.089	.050	.014	9.1
	1975	.097	.067	.154	63.0	.090	.065	.010	6.5
	1980	.069	.101	.170	40.5	.080	.082	.007	4.1
	1985	.042	.119	.161	26.1	.056	.100	.004	2.5
Fruits									
Alt. I	1971	.491	.004	.495	99.2	.095	.262	.138	27.9
	1975	.698	(.008)	.690	101.2	.110	.378	.201	29.1
	1980	.991	(.017)	.974	101.2	.121	.560	.293	30.1
	1985	1.336	(.018)	1.318	101.4	.126	.790	.402	30.5
Alt. II	1971	.491	.009	.500	98.2	.095	.267	.138	27.6
	1975	.693	.015	.708	97.9	.122	.391	.199	28.1
	1980	.991	(.017)	.974	101.7	.140	.545	.289	29.7
	1985	1.336	(.028)	1.308	102.1	.148	.761	.398	30.4
Alt. III	1971	.491	(.000)	.491	100.0	.095	.258	.138	28.1
	1975	.698	(.002)	.696	100.3	.092	.398	.205	29.5
	1980	.991	(.001)	.990	100.1	.096	.596	.298	30.1
	1985	1.336	(.025)	1.311	101.9	.093	.810	.409	31.2
Pulses									
Alt. I	1971	.288	.026	.314	91.7	.111	.180	.023	7.3
	1975	.318	.074	.392	81.1	.128	.240	.025	6.4
	1980	.369	.133	.502	73.5	.142	.331	.029	5.8
	1985	.420	.207	.627	67.0	.150	.443	.033	5.3
Alt. II	1971	.291	.016	.307	94.8	.111	.172	.023	7.5
	1975	.329	.051	.380	86.6	.141	.213	.025	6.6
	1980	.457	.057	5.14	88.9	.164	.313	.036	7.0
	1985	.562	.080	.642	87.5	.176	.420	.046	7.2
Alt. III	1971	.278	.052	.330	84.2	.111	.198	.022	6.7
	1975	.267	.120	.387	69.0	.108	.258	.021	5.4
	1980	.272	.198	.469	58.0	.113	.335	.021	4.5
	1985	.273	.289	.562	48.6	.111	.430	.021	3.7
Vegetables									
Alt. I	1971	2.613	.036	2.649	98.6	.825	1.152	.671	25.3
	1975	3.495	(.041)	3.454	101.2	.894	1.621	.940	27.2
	1980	4.136	(.047)	4.089	101.1	.904	2.043	1.143	27.6
	1985	4.680	(.089)	4.591	101.9	.827	2.431	1.332	29.0
Alt. II	1971	2.584	.044	2.628	98.2	.825	1.140	.662	25.2
	1975	3.351	(.035)	3.316	101.1	.941	1.494	.884	26.7
	1980	3.823	.033	3.856	99.1	.987	1.864	1.026	26.6
	1985	4.290	.077	4.367	98.2	.924	2.321	1.188	27.2
Alt. III	1971	2.093	.040	2.643	98.5	.825	1.149	.668	25.3
	1975	3.451	(.062)	3.389	101.8	.819	1.629	.941	27.7
	1980	3.952	(.004)	3.948	100.1	.792	2.049	1.106	28.0
	1985	4.401	.034	4.435	99.2	.675	2.487	1.274	28.7

† Total food supply is defined as production plus imports (or production minus surplus).

‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing losses and "production deflators."

§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).

continued

TABLE VI-10 (*continued*)

Commodity and Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self-Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for‡	Disappearance: Unaccounted for/Total§
		.....million metric tons.....			percentage	.....million metric tons.....			percentage
Potatoes									
Alt. I	1971	.839	(.027)	.812	103.3	.286	.420	.131	16.1
	1975	1.074	(.002)	1.072	100.2	.279	.622	.176	16.4
	1980	1.236	(.039)	1.197	103.3	.234	.830	.212	17.7
	1985	1.416	(.037)	1.379	102.7	.137	1.059	.255	18.5
Alt. II	1971	.849	.024	.873	97.2	.286	.454	.133	15.2
	1975	1.128	(.007)	1.121	100.6	.271	.663	.187	16.7
	1980	1.373	(.031)	1.342	102.3	.220	.894	.239	17.8
	1985	1.617	(.088)	1.529	105.8	.120	1.152	.295	19.3
Alt. III	1971	.817	.020	.837	97.6	.286	.424	.127	15.2
	1975	.954	.040	.994	96.0	.291	.551	.152	15.3
	1980	1.010	.171	1.181	85.5	.250	.764	.167	14.1
	1985	1.048	.347	1.395	75.1	.155	1.057	.184	13.2
Beef									
Alt. I	1971	.041	(.001)	.040	102.5	.003	.034	.003	7.5
	1975	.058	(.001)	.057	101.8	.004	.050	.004	8.8
	1980	.104	(.001)	.103	101.0	.005	.091	.007	6.8
	1985	.179	....	.179	100.0	.006	.161	.012	6.7
Alt. II	1971	.040	.000	.040	100.0	.003	.033	.003	7.5
	1975	.053	.000	.053	100.0	.004	.044	.004	7.5
	1980	.090	(.002)	.088	102.3	.005	.077	.006	6.8
	1985	.143	.001	.142	100.7	.007	.127	.010	7.0
Alt. III	1971	.038	.003	.041	92.7	.003	.036	.003	7.3
	1975	.043	.030	.073	58.9	.004	.067	.003	7.5
	1980	.050	.075	.125	40.0	.004	.117	.003	2.4
	1985	.058	.153	.211	27.4	.005	.203	.004	1.9
Milk									
Alt. I	1971	.053	(.001)	.052	101.9	.006	.037	.009	17.3
	1975	.100	(.003)	.097	103.1	.012	.068	.018	18.6
	1980	.279	(.009)	.270	103.3	.019	.200	.051	18.9
	1985	.620	(.016)	.604	102.6	.026	.462	.115	19.0
Alt. II	1971	.051	(.001)	.050	102.0	.006	.035	.009	18.0
	1975	.090	....	.090	100.0	.015	.061	.015	16.7
	1980	.236	(.002)	.234	100.8	.023	.169	.042	17.9
	1985	.490	.110	.600	81.7	.031	.380	.090	15.0
Alt. III	1971	.041	.007	.048	85.4	.006	.035	.007	14.6
	1975	.040	.055	.095	42.1	.005	.083	.007	7.4
	1980	.020	.196	.216	9.3	.009	.204	.003	1.4
	1985	.000	.503	.503	0.0	.014	.486	....	.0
Pork									
Alt. I	1971	.089	.001	.090	98.9	.024	.063	.004	4.4
	1975	.132	(.002)	.130	101.5	.028	.096	.006	4.6
	1980	.139	(.003)	.136	102.2	.026	.103	.006	4.4
	1985	.185	(.003)	.182	101.6	.025	.148	.009	4.9
Alt. II	1971	.085	.002	.087	97.7	.024	.059	.003	3.4
	1975	.110	....	.110	100.0	.027	.078	.005	4.5
	1980	.130	(.004)	.126	103.2	.027	.093	.006	4.8
	1985	.155	(.004)	.151	102.6	.026	.118	.007	4.6

† Total food supply is defined as production plus imports (or production minus surplus).

‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing losses and "production deflators."

§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).

continued

TABLE VI-10 (*continued*)

Commodity and Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self-Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for‡	Disappearance: Unaccounted for/Total§
		.....million metric tons			percentage	.....million metric tons			percentage
Pork (con't)									
Alt. III	1971	.081	.010	.091	89.0	.024	.064	.003	3.3
	1975	.090	.019	.109	82.6	.024	.082	.004	3.7
	1980	.103	.039	.142	72.5	.023	.115	.004	2.8
	1985	.118	.070	.188	62.8	.021	.162	.005	2.7
Chicken									
Alt. I	1971	.052	.001	.053	102.0	.009	.043	.001	2.0
	1975	.079	(.003)	.076	103.9	.010	.064	.001	1.3
	1980	.109	(.003)	.106	102.8	.011	.093	.002	1.9
	1985	.165	(.003)	.162	101.9	.013	.147	.003	1.9
Alt. II	1971	.055	.002	.057	96.5	.009	.047	.001	1.8
	1975	.095	.000	.095	100.0	.013	.080	.002	2.0
	1980	.150	(.004)	.146	102.7	.016	.128	.003	2.1
	1985	.225	(.004)	.221	101.8	.017	.200	.004	1.8
Alt. III	1971	.055	.002	.057	96.5	.009	.047	.0009	1.6
	1975	.095	.000	.095	100.0	.010	.084	.002	2.0
	1980	.150	(.004)	.146	102.7	.011	.132	.003	2.1
	1985	.225	(.005)	.220	102.3	.011	.204	.004	1.8
Eggs									
Alt. I	1971	.142	.001	.143	99.3	.034	.087	.022	15.4
	1975	.200	(.004)	.196	102.0	.040	.123	.033	16.8
	1980	.328	(.003)	.325	100.9	.053	.217	.055	16.9
	1985	.497	(.009)	.488	101.8	.061	.340	.086	17.6
Alt. II	1971	.144	(.001)	.143	100.7	.034	.087	.023	16.1
	1975	.210	(.001)	.209	100.5	.051	.126	.033	15.8
	1980	.360	(.004)	.356	101.7	.070	.227	.059	16.7
	1985	.570	(.007)	.563	101.2	.082	.383	.097	17.2
Alt. III	1971	.144	.002	.146	98.6	.034	.089	.023	15.8
	1975	.210	.000	.210	100.0	.034	.140	.032	15.2
	1980	.360	(.004)	.356	101.1	.045	.249	.063	17.7
	1985	.570	(.009)	.561	101.6	.049	.410	.102	18.2
Fish									
Alt. I	1971	.683	.008	.691	98.8	.159	.453	.079	11.4
	1975	.895	.001	.896	99.9	.154	.631	.111	12.4
	1980	1.290	(.018)	1.272	101.6	.163	.940	.169	13.3
	1985	1.740	(.012)	1.728	100.7	.151	1.338	.238	13.8
Alt. II	1971	.683	(.004)	.679	100.6	.159	.442	.079	11.6
	1975	.895	(.015)	.880	101.7	.148	.619	.112	12.7
	1980	1.290	.007	1.297	99.5	.164	.964	.169	13.0
	1985	1.740	.002	1.742	99.9	.148	1.351	.239	13.9
Alt. III	1971	.683	.092	.775	88.1	.159	.537	.079	10.2
	1975	.895	(.002)	.893	100.2	.158	.624	.111	12.4
	1980	1.290	(.118)	1.172	101.1	.151	.850	.170	14.5
	1985	1.740	(.211)	1.529	113.8	.126	1.161	.242	15.8

† Total food supply is defined as production plus imports (or production minus surplus).

‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing losses and "production deflators."

§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).

under Alternatives I and II and decreases in urban per capita consumption due to higher food prices, the following factors acting mainly on the demand sides keep rice demand moving ahead of production:

1. Rapid growth of the urban population, and consumption patterns which include more rice than do rural consumption patterns.
2. Overall population growth.
3. An increase in per capita consumption in rural areas due to aging of young people in the rural population (the rural population now contains an unusually high proportion of children and infants). This amounts to about a 1/2 percent per year increase in rural per capita consumption levels during the 1970s.
4. Increases in rural per capita consumption levels due to the substantial increases in rural per capita incomes.
5. Loss of over 5 percent of prime rice paddy hectarage to urbanization under Alternative I by 1985. (Rice hectarage under Alternative II would rise less than 3 percent as new but probably more marginal land is brought into production through land development programs aimed at offsetting losses to urbanization.)

Although none of the alternatives achieves self-sufficiency, Alternative II with the rice price set at approximately double the world price comes closest.

The consumption patterns for barley under a price structure similar to that for rice (Alternative I—moderate price, Alternative II—high price, and Alternative III—low price) are markedly different. The more negative income and price elasticities for barley as compared to rice result in declining demand for barley with rising incomes. Hence, barley self-sufficiency is maintained at high levels under all three alternatives during the 1970s, with supplies exceeding human consumption developing under Alternative I and, particularly, Alternative II during the 1980s. By 1985, KASS projections indicate a 50 percent surplus under Alternative I, an 85 percent surplus under Alternative II, and a 16 percent surplus under Alternative III given the current relationship of food consumption to income, prices and place of residency and projected incomes, prices and migrations.

Given the small resource base for wheat production in Korea, wheat imports will continue to increase during the next 15 years. By 1985 wheat imports are projected to be approximately 1.8 million metric tons (Alternative III will be somewhat higher). Like Japan, Korea is expected to maintain only about 20 percent self-sufficiency in wheat during this period.

If we compare rural and urban consumption in 1971 (see Table VI-10) when the total population is about equally divided between rural and urban areas, some interesting comparisons emerge. Approximately 2.6 times as much barley is consumed in the rural areas as in the urban. For all the other food commodities, consumption is higher in urban than in rural areas.

Projected livestock production under the three alternative strategies is presented in Table VI-10. Under Alternative II more efficient production is attained through improvement in production technology. There is a shift in emphasis from beef and pork toward poultry products as a means of meeting the protein needs of Korean people. Beef production expands substantially from 1970 to 1985 under Alternative I, but only moderately under Alternative III. Milk production is reduced to zero under Alternative III due to import competition. None of the alternatives provides for conversion of resources now devoted to producing low quality forage for draft cattle to the production of high quality roughage for beef and dairy products.

Table VI-10 also indicates the extent to which the urban marketing system will have to expand between 1971 and 1985. For example, consider the *increase* in physical quantities transported to the urban sector by 1985 under Alternative II as compared to 1971 for various crop commodities: rice, 80 percent; barley, 50 percent; wheat, 160 percent; potatoes, 150 percent; pulses, 150 percent; vegetables, 65 percent; and fruit, 190 percent. Livestock commodities, while less important, will expand severalfold. Along with this expansion in the physical quantities handled will go additional marketing services which are also responsive to income growth. Thus, a two- to threefold expansion in product market services is projected before the late 1980s.

Per capita nutritional levels would be affected by the three alternatives including the resultant differences in food prices (see Table VI-11). The projections of this table indicate that both rural and urban calorie intakes are not substantially changed from one alternative to another. Calorie intakes increase by 5 to 10 percent from 1971 to 1985. Calorie intakes for rural people are somewhat lower than those of urban people, reflecting the lower income levels of rural people. The poorer

TABLE VI-11
Projected Nutrition Levels, Rural and Urban, Korea, 1971, '75, '80, '85

Population Group and Alternative	Calories 1971	1975	1980	1985	Protein 1971	1975	1980	1985
	calories/capita/day				grams/capita/day			
Rural								
Alternative I	2,630	2,620	2,680	2,740	64.5	64.7	68.0	73.9
Alternative II	2,630	2,630	2,700	2,780	64.5	65.4	69.9	76.7
Alternative III	2,630	2,680	2,740	2,770	64.5	65.5	68.2	71.8
Urban								
Alternative I	2,570	2,720	2,790	2,850	74.8	82.0	87.2	90.7
Alternative II	2,570	2,700	2,780	2,830	73.9	80.7	87.6	91.4
Alternative III	2,600	2,770	2,860	2,920	78.3	84.0	88.4	91.8

quality rural diets are also reflected by the lower protein intakes (due mainly to higher intakes of animal protein by urban people). As would be expected, Alternative III favors urban consumers but results in less protein intakes for rural people. While average nutritional levels improve somewhat over Alternative I due to lower food prices for urban consumers, they remain about the same for rural people relative to the other two alternatives. This is partially offset by the tendency for Alternative III projections to underestimate urban population as a result of underestimating off-farm migration under Alternative III.

Table VI-12 indicates the impacts of the three alternatives on the aggregate urban consumer price index. Price increases under Alternative II are about double those of Alternative I. *Alternative III decreases* urban prices somewhat more than the increases resulting from Alternative II. These differentials are due mainly to the impacts of three alternatives on food prices also shown in Table VI-12. Offsetting the advantages of lower urban food prices are (1) the burden of low incomes placed on rural people, as outlined in the subsequently presented projections having to do with the quality of rural life, (2) loss of the military and political advantages of greater food self-sufficiency, (3) the danger of a premature exodus of rural people to underemployment in urban slums, and (4) heavier foreign exchange drains.

Table VI-13 indicates that urban nonfood expenditures are highest under Alternative III where food prices and expenditures are lower. This results largely from a lower food price index under Alternative III than under either of the other two alternatives.

The drain on foreign exchange from purchase of rice and other agricultural commodities under Alternative I will be approximately 80 billion (1970) Won in 1975, 110 billion in 1980 and 160 billion in 1985. However, under Alternative II the drain on foreign exchange from rice and other agricultural purchases will be reduced as compared to Alternative I. This saving will be augmented by a saving in feed grain imports. Agricultural foreign exchange deficits would be about 23 billion Won less than those of Alternative I in 1975, about 48 billion Won less in 1980 and about 60 billion less in 1985, all in 1970 Won relative to Alternative I. Under Alternative III, foreign exchange drains are much heavier than for Alternative I. In 1975 about 130 billion 1970 Won of imports are required to satisfy domestic food demands. In 1985 the figure is 320 billion Won, 160 over Alternative I.

TABLE VI-12
Projected Urban Consumer Price Indexes (Overall and Food) under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Alternative	Overall Price Index 1971	1975	1980	1985	Food Price Index 1971	1975	1980	1985
	index (1970 = 100)				index (1970 = 100)			
I	100.4	102.8	102.2	101.9	107	110	110	112
II	101.4	105.6	104.4	103.6	110	120	120	125
III	99.5	97.8	98.8	98.8	100	92	94	96

Agriculture's Contribution to Overall National Development

Korean agriculture has much to offer in addition to food. In producing food, agricultural production adds to the value of Korean production and to her Gross National Product (GNP). Other contributions include a surplus of manpower to help staff Korean industry and trade, the production and reinvestment of capital, the transfer of income and capital claims through inheritances to off-farm migrants, the production of industrial raw materials, and land for urban and rural but nonfarm use.

As seen in Table VI-14, value added in Korean agriculture by 1985 under Alternative III is only slightly over half what it is for Alternative II. The

TABLE VI-13
Projected Urban Expenditure on Food and Nonfood Commodities under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Urban Expenditure	Alternative	1971	1975	1980	1985
		billion Won			
Food*	I	635	867	1,211	1,731
	II	652	936	1,308	1,882
	III	620	759	1,074	1,525
Nonfood	I	952	1,407	2,356	3,862
	II	934	1,338	2,259	3,711
	III	967	1,515	2,492	4,068
TOTAL	I	1,587	2,274	3,566	5,593
	II	1,587	2,274	3,566	5,593
	III	1,587	2,274	3,566	5,593
		percentage			
Food/Total	I	40.0	38.1	34.0	30.9
	II	41.1	41.1	36.7	33.6
	III	39.0	33.4	30.1	27.3

* Food expenditure is about 10 percent low because certain food items (mainly condiments) are not included.

TABLE VI-14
Projected Gross Agricultural Income and Agricultural Value Added by Regions under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Crop Region and Alternative	Gross Agricultural Income*				Agricultural Value Added			
	1971	1975	1980	1985	1971	1975	1980	1985
	billion Won				billion Won			
Total								
Alternative I	832	1,027	1,152	1,368	541	698	796	934
Alternative II	858	1,160	1,364	1,615	567	826	1,000	1,166
Alternative III	784	802	880	966	501	511	593	666
Single crop Region								
Alternative I	203	249	282	335	139	179	203	239
Alternative II	210	282	330	399	145	215	253	299
Alternative III	191	193	213	231	128	129	151	171
Double crop region								
Alternative I	518	637	709	838	331	428	486	566
Alternative II	530	715	843	994	348	507	615	716
Alternative III	480	490	533	852	307	311	358	398
Upland region								
Alternative I	115	140	161	194	71	91	107	129
Alternative II	118	150	187	210	73	104	127	152
Alternative III	110	113	130	139	66	71	84	97

* Includes income from nonfarm sources.

table shows that substantial increases in agricultural value added result from Alternative I and that significant further increases result from Alternative II. These are due to the combination of high producer prices and increased yields and output. Under Alternative III, agricultural value added declines sharply with respect to Alternative I.

One of the important contributions Korean agriculture makes to the nonfarm economy is labor for industrial and nonfarm pursuits. Table VI-15 shows KASS projections of off-farm migration by cropping regions. In the next fifteen years, about 10 million persons are expected to leave farms for urban life and employment. As explained in the earlier section of this chapter on the data and informal projections used in making the computerized projections, off-farm migration rates were not adjusted for differences in agricultural earnings under the three alternatives. Thus, the substantial decreases in farm earnings under Alternative III are not reflected in the migration data in Table VI-15 or in the population data in Table IV-8. As the off-farm migration figures in Table VI-15 are closely related to the projected capacity of Korean industry to absorb labor effectively, increases in off-farm migration under Alternative III should be expected to add little to the Korean economy. Most of the additional migrants would be unskilled older people so disadvantaged they would be forced to accept low-paid nonfarm positions pushing carts, cleaning streets, etc. in which they would contribute little more to Korea than in the agricultural employment they leave. Further, their migration would add to the low-income, slum problems of Korean cities.

TABLE VI-15
Off-Farm Migration by Region, Korea, 1970, '75, '80, '85*

Region	1970	1975	1980	1985
	.....thousand migrants.....			
TOTAL	292	545	862	948
Single crop region	60	122	190	208
Double crop region	186	343	543	597
Upland region	46	80	129	143

* This table refers to the off-farm migration of men, women, and children approximately half of whom will fill employment positions created in the urban sector. Employment in the urban sector was assumed to grow at approximately seven percent per year over the fifteen-year period. The actual off-farm migration particularly in the early years may be higher as some people migrate to the "urban fringe" without finding employment. Also these projections must be considered very rough because they do not take into account regional differences in off-farm migration rates interregional migration, or differences in the total migration rates between Alternatives I, II, III which would result from differences between the rural and urban wage rates.

One of the important contributions of Korean agriculture to the overall economy will be the human capital invested in the 10 million or more people projected to migrate off Korean farms before 1985. Even if uneducated, a substantial amount of resources, time and money are invested in producing a young migrant. If they are educated in addition, the costs increase correspondingly. While KASS has not attempted to place a monetary value on this contribution to the nonfarm economy, it is clear the contribution is very substantial and important. It is the judgment of KASS investigators that the educational investment in off-farm migrants for urban pursuits is so important that the burden of making this investment should not be left entirely with the agricultural sector.

For Korea to grow and develop, much more agrarian and urban capital will be required. Part of the agrarian capital needed is producable in agriculture with labor, land and existing capital fixed in agriculture and employed on an opportunity cost basis. Examples of such capital include beef and dairy cattle, orchards, water control structures, some kinds of wells, some buildings, land leveling, forests, homemade tools, forage stands, and seeds. When agriculture is profitable, the creation of such capital competes more effectively on an opportunity cost basis with other uses for fixed farm labor, land, and existing capital and more such capital is created.

While KASS has not developed projections as to the extent of such capital formation under the three policy strategy alternatives, it is clear that much more such capital would be generated under Alternative II than III. The dairy industry, for instance, would prosper under II, but disappear under III. The beef industry, too, would be much larger under II than III, as would the cereal subsectors with their demands for water control, land development structures, seeds, handmade tools and storage facilities.

Korean agriculture will contribute substantial hectarages of land to urban and nonagricultural uses. Some of this will be prime paddy land around Korea's major cities which have been located since ancient times in good rice-growing areas. Other land contributed will be marginal farm land for roads, housing, factories and recreational uses. KASS informal projections are that around over 200,000 hectares will pass from farm to nonfarm use, with more passing under Alternative III than

II. Less than half of this transfer will be paddy land.

Industrial crop production would fare better under Alternative III provided that alternative does not permit free importation of tobacco, and Chinese competition for silk does not develop. Table VI-16 shows industrial crop production about doubling by 1985 as silk is probably over and other crops are probably underestimated.

TABLE VI-16
Projected Production of Tobacco, Silk Cocoon, and Other Industrial Crops under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Crop Group and Alternative	1971	1975	1980	1985
	.....million MT.....			
Tobacco				
Alternative I	66	87	105	124
Alternative II	65	84	87	103
Alternative III	66	84	107	119
*Silk cocoon**				
Alternative I	22	34	45	54
Alternative II	23	34	46	60
Alternative III	25	38	53	70
Other industrial crops				
Alternative I	84	106	142	179
Alternative II	85	106	138	172
Alternative III	84	101	133	164

* Production overestimated after 1975. Due to poor profitability, farmers are likely to shift away from silk production.

As pointed out in Chapter 3, Korean agriculture contributes capital and income flows to and receives capital and income flows from the nonfarm economy. Flows from agriculture include those associated with migration and taxes, while those to agriculture include government expenditures and subsidies actually reaching farmers as well as gifts from nonfarmers to farmers. Under Alternative II, the inheritance flows associated with off-farm migration would increase along with land values, while Table VI-17 indicates that tax payments would increase to two and one-half times the 1970 payments. Under Alternative III the tax increase would be about 60 percent. Under modifications of Alternative II, net income flows from agriculture to develop the rest of the Korean economy may reach 75 billion Won annually by 1985.

TABLE VI-17
Projected Index of Producer Taxes Paid on Agricultural Products, Korea, 1971, '75, '80, '85

Alternative	1971	1975	1980	1985
	.....index (1970 = 100).....			
I	109	154	184	209
II	113	180	220	258
III	109	118	140	154

While KASS has not had substantial resources to devote to an analysis of forestry in the national economy, it is clear that large quantities of rough upland are suitable only for forest production. Due to gross growth rates which seldom exceed 5 percent per year, it is difficult to be highly enthusiastic about returns on forestry investments in an economy with internal interest rates much higher than the net return which goes with such growth rates. However, there are (1) nonmonetary and some monetary returns associated with forestry investment including reduced runoff, stream flow stabilization, reduced erosion and siltation, beauty, decentralized employment, and the industries which can be based on cellulose and lumber, and (2) seasonally underemployed labor and underemployed uplands both with low opportunity costs and which can be used to grow and transport seedlings and, later, care for and harvest forest products.

The Korean economy needs the fishing products of Korean coastal and internal waters as well as the products and foreign exchange earnings of her high seas fishing industry. As KASS resources for studying Korea's fisheries have been limited, few projections are available; however, it is clear that fresh and salt water products are important domestically and that marine products are foreign exchange earners. It is also clear that fishermen's earnings are low. A detailed sub-sector study of fisheries is needed to identify the policies, programs and projects required to bring Korea's internal, coastal and high seas fishery resources to their full productivity and to insure earnings to fishermen more comparable with those to be earned elsewhere in the Korean economy.

The Quality of Rural Life

The KASS projections reveal considerable information about the quality of rural life likely to exist under the three alternatives.

In a low income rural sector, income differentials are crucial in setting the limits to what can and cannot be enjoyed. Table VI-14 (previously presented) shows projected gross agricultural incomes and Table VI-18 presents value added per capita in agriculture by regions. Agricultural incomes and

TABLE VI-18
Projected Agricultural Value Added
Per Capita by Region under Three Alternative Strategies,
Korea, 1971, '75, '80, '85

Crop Region and Alternative	1971	1975	1980	1985
	.....thousand Won.....			
Single crop region				
Alternative I	40	52	67	108
Alternative II	41	62	83	135
Alternative III	37	37	49	77
Double crop region				
Alternative I	33	43	56	90
Alternative II	35	52	71	114
Alternative III	31	32	41	63
Upland region				
Alternative I	30	39	51	86
Alternative II	31	44	61	101
Alternative III	28	30	41	64

value added on a per capita basis are significantly lower for Alternative III than for II and are also higher for II than for I. Per capita value added for Alternative III is only slightly over half what it is for Alternative II, though that figure is underestimated because off-farm migration is underestimated for Alternative III (see Table VI-15). Clearly the higher prices for rice in the second alternative do much to improve the income position of farm people while the income and price consequences of free grain imports under Alternative III are disasterous for farmers. Rural value added per capita would be higher under Alternative II due to both higher farm product prices and higher production. In 1975 it would average 51,000 Won/person under Alternative II as compared with 43,000 under Alternative I. Under Alternative III, value added per capita, which declines sharply with respect to Alternative II, about 30,000 Won in 1975 and 63,000 Won in 1985 (both of which are probably underestimated as a result of underestimating off-farm migration).

With respect to distribution of rural income, Alternative I tends to favor farmers who sell an appreciable part of their produce and those who have ready access to guidance, markets, credit and other production inputs necessary for improving crop yields and expanding net income. Without policy and program emphasis to deal with such questions and the distribution of farm asset ownership, this alternative results in moderate additional disparities in rural income distribution. Alternative II has similar, but more pronounced effects mainly as a result of giving some farmers more adequate incomes while leaving others in poverty. It must be stressed, however, that both alternatives would partially offset the gap which has been widening between farm and nonfarm incomes. Generally speaking, the disparity between farm and nonfarm incomes is more important than disparities among farm incomes in a given region. There are also farm income disparities among cropping regions. Unfavorable effects on income distributions can be at least partially offset by special programs (i.e., credit, education, land, technology, breeding stock, etc.) to redistribute income earning assets to poverty stricken small farmers from the nonfarm economy, poverty (rural or urban) being a national problem.

Under Alternative III, all farmers are worse off financially; commerical farmers are affected most adversely. Income distribution gaps would narrow in Alternative III, mainly in the sense that rural poverty would be more equally distributed to all.

Table VI-19 indicates the impact of the three alternatives on returns to land and labor above nonland and nonlabor charges. As rice is the most important crop, returns are presented for rice. The returns per hectare are substantially higher for Alternative II than for I and are still lower for Alternative III. This will have serious impacts on land values and on the capacity of Korean agriculture to finance its own development both for production and for infrastructural improvement. It will greatly affect the net worth of farm families and, hence, the quality of life they enjoy. On a per man-year basis, essentially the same story appears. Returns per man-year under Alternative III are substantially less than those under Alternatives I and II. Clearly, returns to labor will be drastically reduced under Alternative III. Undoubtedly, this would affect the rural population and off-farm migration rates causing older, less well-trained people to migrate to urban slums where they would add to urban congestion problems and be less well off than in agriculture under Alternative II.

The quality of rural life is also determined by the value of locally owned and controlled property, since both private and public goods and services can be financed with the earnings of such property. Under Alternative II, the values of land and other assets would be substantially higher than under III.

The quality of rural life would be substantially enhanced by the elimination of the drudgery associated with the use of human and animal power to produce rice, forage and other crops. Under Alternative II as many as 400,000 tillers may be used,

TABLE VI-19
Projected Returns per Man-Year and per Hectare without Imputing Land Costs and Family and Operator Labor Costs for Rice by Region, Korea, 1971, '75, '80, '85

Crop Region and Alternative	Returns per Man-Year*				Returns per Hectare			
	1971	1975	1980	1985	1971	1975	1980	1985
	..... thousand Won				..... thousand Won			
Single crop region								
Alternative I	233	312	310	292	163	230	231	222
Alternative II	246	400	410	404	175	299	313	322
Alternative III	210	178	203	182	144	130	149	136
Double crop region								
Alternative I	216	290	294	276	150	209	214	205
Alternative II	230	370	392	385	160	271	296	301
Alternative III	194	168	192	171	134	120	138	125
Upland region								
Alternative I	180	240	250	233	122	175	174	163
Alternative II	198	340	342	335	131	230	242	244
Alternative III	164	141	162	141	107	95	110	97

* A man-year is defined here as 2,000 man-hours.

while under Alternative III few tillers would be used, though the acreage tilled would be reduced over 20 percent and the labor used would receive low returns for hard work.

Administrative Structures for Rural Development

Though the present computerized model does not project the consequences of alternative administrative structures for Korean agricultural development, working papers on that subject produced considerable information and numerous insights on the subject.[4]

Korean agriculture is controlled by a mixture of governmental agencies and private market operations. Even with heavy reliance on both the private sector and the market system to perform the functions required in the operation of an economy, the public sector's role is large and important. Governments must establish goals, formulate policies, plan programs, execute projects and carry out the many activities the private sector finds impossible or cannot do well. The overall responsibility for macroeconomic planning and budgeting in Korea rests with the Economic Planning Board (EPB). Planning for effective agricultural sector development focuses in the MAF, with EPB providing general guidelines to provide general coordination between agricultural planning and planning in the rest of the economy.

A problem of obvious concern to decision makers in MAF is the inadequate coordination of the planning function, both within the agency and between MAF and other ministries and agencies of government involved in agricultural sector development and the administration of agricultural programs. The planning function of MAF is now scattered throughout every bureau and division of the ministry and in each associated organization. Thus, the planning coordinator's office of MAF is primarily engaged in reviewing plans produced by bureaus and short-run day-to-day activities. This appears to result in inconsistencies and a large degree of autonomy for poorly coordinated individual bureau activities. To be effective, planning must represent a degree of unity with respect to organizational purpose by function which is not apparent in the present system.

Another serious deficiency in the present planning process appears to be the lack of effective local and provincial government input into the plans of MAF and its associated organizations. Plans often appear to have too little relationship to local needs and priorities, and as such, are received

[4] Dale E. Hathaway and George E. Rossmiller, "The Organization of the Ministry of Agriculture and Forestry," KASS Special Working Paper and Vern L. Sorenson, Carl F. Frost, John R. Brake, Henry E. Larzelere, James D. Shaffer, George E. Rossmiller, Yong Jin Kim, Kyo Bo Shim, Won Ho Suh, "The National Agricultural Cooperative Federation: An Appraisal," Special Report Number 1.

without enthusiasm by the local officials expected to carry out programs.

Another side to the problem is that MAF is heavily dependent for program execution at the local and provincial level upon officials appointed by and answering to the MHA. The quality, enthusiasm and technical abilities of these provincial and local officials appointed as agricultural administrative officers appears to vary widely, yet the success of the MAF program execution depends heavily upon them. In addition, MAF officials also rely on MAF-related, but semi-autonomous, organizations such as the National Agriculture Cooperative Federation (NACF), the Agricultural Development Corporation (ADC), and the Agriculture and Fishery Development Corporation (AFDC), as channels of program administration. Thus, the responsible officials in MAF have planning and program responsibility without the authority to effectively control the administrative structure necessary to execute that responsibility.

In general, the top officials in MAF appear to be competent, dedicated, and committed to the improvement of Korean agriculture. However, they are seriously handicapped by a lack of adequate and reliable statistics and inadequate economic intelligence and analysis for program planning and execution. A continuous flow of accurate and adequate statistics regarding agriculture and farm people is a prerequisite and an absolute necessity for the formulation of sound economic policy and the planning of effective programs. Neither economic analysis nor evaluation of program preformance is possible without an accurate and adequate statistical base. Korean agricultural statistical sources are fragmented with both duplication and huge gaps. Some are collected by statistical agencies and some are obtained through administrative channels. The two sources are often inconsistent and there is no way of judging the accuracy of either. The present statistical service of MAF concentrates largely on gathering production statistics, while statistics on prices, marketing, farm income, credit use, interest rates, and other matters are gathered elsewhere, if at all.

In order to be effective as a tool for policy making at both the macro and micro levels, agricultural economics work must have several components: (1) there must be basic long-range research measuring the structural elements of the economy, (2) there must be effective short-range economic forecast or outlook work, (3) there must be economic policy analysts who can translate short-run outlook and long-run basic analysis into specific policy recommendations, and (4) in governments with a central planning agency such as Korea, there must be a planning coordination group to provide liaison between the ministries and the central planning agency.

KASS projections indicate that the amount of public administration services required to execute agricultural policies, programs and projects will be much greater under Alternative II than under III. There will be needs for better coordination of Economic Planning Board (EPB), MAF and MHA decision making at the national level with better administration at the local level. The collection, processing, analysis, and use of economic data and intelligence must be substantially improved to permit government to carry out the functions assigned to it under Alternative II. Further, it can be anticipated that the rural poverty and consequent greater off-farm migration under Alternative III would bring about political demands for modification of that alternative which would require greater administrative effectiveness than currently existing in Korea.

Projections Concerning Resource Base and Input Requirements

The rates of agricultural growth projected under Alternatives I, II and III result in substantially different demands for the various kinds of productive resources, both expendable and durable. Included among the expendables are fertilizers, fungicides, pesticides, fuel and other petroleum products, seeds and labor. Durables include land improvements, water control facilities, power equipment, breeding herds, orchards, fences, buildings, forage stands, etc.

Table VI-20 projects requirements and expenditures for expendables for the three policy alternatives. Fertilizer requirements increase by about 100 percent to 1985 under Alternative I, by 150 percent under Alternative II, but only by 40 percent under Alternative III. A similar pattern exists for capital requirements (mainly machinery and related inputs and services). Pesticide usage is not projected to change much among the three alternatives, though reduced expenditures will result from price decline. Physical capital requirements increase three and a half times to 1985 under Alternative I, fourfold under Alternative II, but only twofold under Alternative III; while capital expenditures increase less due to price declines (relative to other commodities). In Table VI-20, the annual capital charges are a rough index of the credit need. Credit needs will increase from two- to threefold as a result of expanded production be-

fore 1985 under Alternatives I and II. For Alternative III, about a 50 percent expansion is indicated. However, the need for credit will also increase as a result of farm consolidation and increases in farm sizes resulting from off-farm migration and the need to enlarge farm businesses to permit per capita farm incomes to keep pace with rising urban incomes.

Feed grain and bran requirements for livestock production are reduced considerably under Alternative II (see Table VI-21). Under Alternative III, domestic production of milk would be curtailed by

TABLE VI-20
Annual Requirements and Expenditures for Fertilizers, Pesticides, and Capital under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Input	Alternative	Quantity Required 1971	1975	1980	1985	Expenditure 1971	1975	1980	1985
		.....million MT.....				.....billion Won.....			
Fertilizer	I	.84	1.15	1.35	1.61	18.7	22.4	23.2	24.0
	II	.90	1.43	1.90	2.26	20.0	28.0	32.7	33.8
	III	.80	.93	1.03	1.11	17.8	18.1	17.8	16.7
		.....index (1970 = 100).....							
Pesticides, etc.	I	105	125	152	181	6.6	6.4	5.9	5.4
	II	105	126	152	182	6.6	6.4	5.9	5.4
	III	104	122	146	173	6.6	6.2	5.6	5.1
Annual capital charges*	I	109	147	197	403	37.3	44.9	53.0	95.9
	II	112	163	210	430	38.4	49.9	56.7	102.0
	III	101	103	107	216	34.4	31.7	38.7	51.3

* Expenditures on machinery, buildings, maintenance and related consumable inputs reduced to an annual basis.

TABLE VI-21
Projected Livestock Feed Requirements under Three Alternative Strategies, Korea, 1970, '75, '80, '85

Livestock Enterprise	Alternative	Feed Grain 1970	1975	1980	1985	Bran 1970	1975	1980	1985
		.....thousand metric tons.....				.....thousand metric tons.....			
TOTAL	I	728	1,103	1,270	1,707	1,033	1,490	1,708	2,316
	II	720	1,051	1,189	1,583	978	1,205	1,372	1,784
	III	694	989	1,102	1,437	922	1,055	1,135	1,355
Beef	I	71	77	112	169	287	311	454	685
	II	66	54	76	127	266	219	306	516
	III	69	54	47	45	284	217	191	182
Dairy	I	14	23	49	91	17	28	61	114
	II	14	18	28	51	17	23	35	64
	III	11	5	4	0	14	11	4	0
Pork	I	174	279	274	342	477	767	752	940
	II	158	203	211	218	435	558	581	599
	III	133	150	178	206	365	422	490	568
Poultry, meat	I	53	106	128	199	17	34	41	64
	II	53	141	185	273	17	46	60	88
	III	53	141	185	273	17	46	60	88
Poultry, eggs	I	416	618	707	906	235	350	400	513
	II	429	635	689	914	243	359	390	517
	III	429	635	689	914	243	359	390	517

imports, but pork, chicken and egg production would follow the plan outlined for Alternative II. None of the alternatives will achieve self-sufficiency in feed grains. Therefore, it will be necessary to import feed grains for poultry, meat, and dairy production. Feed grain imports are reduced considerably under Alternative II compared to Alternative I. Feed grain use under Alternative III also will be somewhat less because of increased importation of meat and dairy products.

Forage requirements, as indicated in Table VI-21, will change as Korea's draft cattle herd, which now consumes low quality, by-product roughage, is converted to modern beef and dairy production. The required shift will be greater under Alternative II than under I. As dairy product imports would drive Korean milk producers out of business under Alternative III, the demands for high quality forage would be greatly reduced. Considerable developmental research will be required to produce high quality forages on either converted uplands or winter paddies.

Labor requirements decrease with increased use of tillers and associated equipment and draft cattle, as substitutes for labor. The total use of labor and labor substitutes is partially determined by pricing and importation policies which govern farm output and, hence, the use of labor and its substitutes. Thus, this discussion of labor utilization should be read together with the later discussions of hectarages, mechanical tillers and draft animals.

Table VI-22 projects labor availability and utilization with both (1) traditional equipment and draft cattle, and (2) modern equipment and tillers. Projected labor utilization drops sharply from 1971 to 1985. The substitution of power tillers for both human labor and cattle power is reflected in the breakdown between labor used with traditional and modern equipment. The unfavorable prices in Alternative III delays the introduction of power equipment until after 1980; traditional labor utilization for the third alternative remains high even though total labor utilization is lower than for Alternative II. The use of labor substitutes is virtually nonexistent for Alternative III until after 1980.

The underutilization of available labor supplies in Table VI-22 for the third alternative reflects the probability that off-farm migration would be greater than estimated by KASS.

Requirements for improved seeds will increase over the projection period, particularly under the first and second alternatives.

The durable resource base for Korean agriculture includes land, water control facilities, machinery and power equipment, orchards, mulberry plantations, dairy and beef breeding herds, draft cattle and forage stands. KASS projections and studies cover only part of this list. In some cases, KASS projections come from the formal computerized simulation model and, in other instances, from the working papers.

TABLE VI-22
Projected Agricultural Labor Availability and Utilization with Traditional and Modern Equipment, Korea, 1971, '75, '80, '85

Item and Alternative	1971	1975	1980	1985
	..... thousand man-years			
*Labor available**				
Alternative I	541	553	540	429
Alternative II	542	555	541	431
Alternative III	533	546	529	422
Labor utilized with:				
Traditional equipment and draft cattle				
Alternative I	532	519	460	258
Alternative II	533	506	438	133
Alternative III	524	521 †	503 †	326
Modern equipment				
Alternative I	9	34	74	171
Alternative II	9	49	103	298
Alternative III	9	0	0	96

* Total represents total available, not necessarily utilized.
† Labor utilized under Alternative III in 1975 and 1980 is less than total available. The excess would probably migrate.

According to Table VI-23, land utilization by Korean agriculture would increase about 15 percent by 1985 under the Alternative II. For Alternative II, a more moderate rate of increase takes place through 1980 followed by a decline between 1980 and 1985. Under Alternative III, the decline is continuous averaging about .6 percent per year.

The expansions in land utilization under Alternatives I and II imply substantial further investment in paddy and upland development to offset the losses of both paddy and upland to nonfarm uses discussed earlier in this chapter. Roughly 25,000 hectares of paddy and over 200,000 hectares of upland can be added to offset losses of around 75,000 hectares of paddy and a 100,000 hectares of upland. The increase in land utilization is projected to come largely from increased double cropping under Alternatives I and II. Under Alternative III less land development and much less double cropping would be required.

KASS does not have even rough projections to

TABLE VI-23
Projected Agricultural Land Availability and Utilization with Traditional and Modern Equipment, Korea, 1971, '75, '80, '85

Item and Alternative	1971	1975	1980	1985
	.....million hectares.....			
*Land available**				
Alternative I	3.50	3.69	3.77	3.85
Alternative II	3.50	3.75	3.89	4.02
Alternative III	3.50	3.39	3.27	3.16
Land utilized with:				
Traditional equipment and draft cattle				
Alternative I	3.40	3.32	2.98	1.10
Alternative II	3.40	3.23	2.80	.85
Alternative III	3.40	3.39	3.27	2.12
Modern equipment				
Alternative I	.10	.37	.79	2.75
Alternative II	.10	.52	1.09	3.17
Alternative III	.10	0	0	1.04

* A double cropped hectare is counted as two hectares.

present concerning water control facilities, though requirements are much higher under the first and second alternatives and lower under the third.

Draft cattle requirements will decrease under the first and second alternatives with power tillers replacing men and cattle. Under the third alternative, however, draft animal requirements will remain substantial until between 1980 and 1985, as the low grain prices will justify less mechanization.

Requirements for dairy and beef breeding stock will increase substantially under the first and less so under the second alternative. This can be seen clearly from Table VI-10 which shows four- to fivefold expansions in beef production by 1985 under Alternatives I and II, respectively, but only a 50 percent expansion for the third alternative. In the case of dairy products, the expansions under I and II are twelve- and tenfold, while milk production is eliminated under the third alternative.

Table VI-24 presents KASS projections of power tiller requirements for the four projection years. This table shows around a thirtyfold increase in power tiller usage over the 1971-85 period for the first and second alternatives. On the assumption that one tiller can replace four bullocks, this number would free most of the cattle herd from draft work for either human consumption or conversion to beef production alone. Under the third alternative, tiller adoption would not start until in the 1980s, and the cattle herd would be required for draft purposes until then. With cheap imported beef under that alternative, there would be less competition from consumers; and despite lower grain prices, it would probably be more advantageous to work the cattle than consume or convert them to beef production alone.

TABLE VI-24
Power Tillers (5 HP) Required under Three Alternative Strategies, Korea, 1971, '75, '80, '85

Alternative	1971	1975	1980	1985
	.....units.....			
I	12,000	46,000	98,000	343,000
II	12,000	65,000	136,000	396,000
III	12,000	0	0	130,000

Korea has no significant power tiller service industry. Repair, fuel and lubrication facilities would have to be established commensurate with power tiller usage.

Appendix B contains nine figures on seasonal labor utilization by regions for each of the three alternatives. While the data plotted in those figures are difficult to interpret, they indicate a bimodal demand for labor with a peak in June to harvest winter grains and plant paddy and a second peak in the fall to harvest the main summer paddy crop. A separate linear programming analysis (LP) indicates that the introduction of rice transplanters would be advantageous now to help meet the early summer peak and continue so throughout the projection period, even under Alternative III conditions. By 1975, the same LP analysis indicates that grain harvestors can be advantageously introduced.

A wide variety of expendable and durable inputs are used by Korean agriculture. Further, some are farm produced, others are not. Of those not produced on farms, some are imported, others are domestically produced. For these reasons it is difficult to quantify the overall expansion in input markets which will take place in the next fifteen years under the three alternatives.

Under Alternative II, the projected expansion in the equipment market is thirtyfold before 1985, while fertilizers more than double, pesticides almost double, and feeds more than double. If forage production is modernized, limestone applications will expand substantially. After allowing for increased services as well as for the increased quantities of inputs, a tenfold expansion in agricultural inputs may take place by 1985 under Alternative II. Under Alternative III, the expansion would be much smaller, perhaps not more than two- or threefold.

Results of Sensitivity Tests to Changes in Input Variables

Sensitivity analysis or testing is an important way of evaluating the quality of data used in an agricultural sector analysis. The basic idea is to determine in a rough way how sensitive the criteria or performance variables projected by the KASS model are to possible errors or variations in input variables such as discussed above under the heading "Data and Informal Projections Underlying the Computerized Projections for the Three Policy Strategy Alternatives." Sensitivity tests sometimes indicate that apparently reliable data are still inadequate for the purposes of a model and that, conversely, data of questionable reliability are quite adequate.

Table VI-25 summarizes tests designed to test the sensitivity of KASS projections for Alternative II to errors in input data. While the scope of this analysis was limited, much more of this kind of evaluation can be conducted in a subsequent phase with a more refined simulation model. In most cases, data were a "guesstimated" single standard deviation away from the value used in making Alternative II projections. The "base" run (Run 1 of Table VI-25) was made with all parameters set at the values used in making Alternative II projections. In subsequent runs, one parameter at a time was varied away from the base run values. The table, therefore, displays the changes due to changes in *individual* parameters.

Several kinds of conclusions can be drawn from these results. In certain cases, results were found to be relatively insensitive to errors in the values of individual input variables (Runs 2, 3, 4, 10). In such cases the analysis indicates areas where existing data, although inaccurate, are probably adequate given the insensitivity of results to errors in these data. In other cases (Runs 5, 8, 9, 11, 12, 13) relatively significant changes in projected results indicate areas where the quality of the analysis would likely be significantly improved by acquiring more or better data. In at least two cases (Runs 6, 7), results are inconclusive because the substantial uncertainty existing with respect to the input variable which makes it still more difficult, in these cases, to "guesstimate" a standard deviation change from the base run value for the variable. In these cases, too, more or better data are called for in subsequent analyses.

In the case of Runs 14 and 15, the results indicate considerable sensitivity to two parameters which can, in some measure, be influenced by government policies aimed at reducing both on-farm losses of commodities and the target growth rate of the economy as a whole; such testing could be extended to provide information as to the potential consequences of policy actions taken in these areas. In the case of Run 14, further work should be directed at determining whether, in fact, farm losses are as large as the data of the base run suggest. If they are, attention should be directed at means of reducing these losses. Run 15 provides information as to the consequences of an actual urban consumption growth rate less than the TFYP target, a distinct possibility in light of recent economic conditions. Run 15 results can also be interpreted as indicating the effects of a reduction in the target. In a global sense, the results of Table VI-25 indicate that the projections presented in this chapter are subject to considerable error due to limitations of the data on *individual* variables used in the model.

It is important to note, however, that there is a factor which acts to reduce absolute as well as relative errors in the projections. That factor is the compensatory nature of errors and variations among *different* input variables. Some errors bias results in one direction while other errors bias results in the opposite. As the projections presented in this report are based on estimates of many different input variables, their reliability is greater than indicated by the tests reported in Table VI-25 which involved changes in only one input variable at a time. Thus, KASS model projections of aggregates such as value added, per capita income and nutritional intakes are inherently more reliable than projections made for individual variables. This important fact should be taken into account in interpreting the results of this chapter.

It should also be noted that while *absolute* projections for the three alternatives are particularly subject to error, the *relative* error would be much less when comparing the results of one alternative with the results of another, as many errors that affect one alternative will have a similar effect on other alternatives.

Conclusions Based on Projections for the Three Alternative Policy Strategy Sets

The projections summarized above for the three alternative strategies span reasonably well the feasible alternatives available to Korean agricultural decision makers and provide a number of useful insights into the operation of the agricultural econ-

TABLE VI-25
Results of Testing the Sensitivity of the Simulated Projections of Alternative II to Changes in Input Data*

Run No.	Specific Test Performed	Consumer Food Price Index (1985)	Urban Calories per Capita (1985)	Urban Food/Total Expend.† (1985)	Summed Value of Ag. Import (1971-85)	Rice Deficit (1985)	Sum of Ag. Value Added (1971-85)
		index	cal./cap.	ratio	bil. Won	mil. MT	bil. Won
1	Base run	1.253	2,829	.344	852	.854	13,575
2	Urban income elasticity for rice in 1970 changed from -.1 to 0	1.253	2,837	.344	870	.880	13,575
3	Urban income elasticity for rice in 1970 changed from -.1 to -.2	1.253	2,820	.343	834	.826	13,575
4	Urban income elasticity for barley in 1970 changed from -1.0 to -.75	1.253	2,831	.344	855	.854	13,575
5	Urban rice price elasticity changed from -.4 to -.6	1.248	2,744	.338	696	.587	13,575
6	Elasticity relating change in urban barley demand to change in rice price changed from 1.3 to 1.8	1.253	2,846	.344	876	.854	13,575
7	Elasticity relating change in urban wheat demand to change in rice price changed from .314 to .5	1.253	2,832	.344	863	.854	13,575
8	Long-run urban per capita rice consumption target changed from 100 kg to 110 kg	1.254	2,854	.345	879	.931	13,575
9	Long-run urban per capita wheat consumption target changed from 60 kg to 80 kg	1.254	3,022	.347	943	.855	13,575
10	Urban income elasticity for non-ag. goods and services in 1970 changed from 1.38 to 1.5	1.253	2,827	.343	827	.855	13,575
11	Rural income demand elasticity changed from .06 to .1	1.253	2,829	.344	891	.932	13,575
12	Marketing margin for rice changed from .15 to .2‡	1.266	2,813	.346	799	.796	13,575
13	Rural price elasticity of demand for rice changed from 0 to -.2	1.253	2,829	.344	725	.735	13,575
14	Proportion of farm loss for rice changed from .17 to .085§	1.253	2,829	.344	525	.412	14,220
15	Growth rate in urban consumption changed from 9% to 7%	1.276	2,697	.405	-38//	.947	13,575

*In the above simulation runs one parameter at a time was changed from base run parameter values. The data assumptions upon which these runs are based are slightly different from those of Table VI-10.
† Ratio of urban food expenditure to total urban expenditure (1985).
‡ The effect of this change is to raise the consumer price of rice by 5 percent.
§ The effect of this change is to increase total net rice production by 8.5 percent.
// These results must be viewed as tentative due to limitations in the current model which limit the accuracy of import projections. Under the lower urban consumption growth rate aggregate import requirements would be reduced substantially but the model results do not provide an accurate estimate of the change in value of agricultural imports.

omy and its important linkages to the rest of the Korean economy.

KASS projections under Alternative I reveal that the original TFYP was reasonably well conceived and that it was inherently capable of producing substantial results. However, the long-run infeasibility of this alternative becomes increasingly apparent as projections are extended into the future. It is after 1975 that off-farm migration, higher urban incomes and rising wage rates will have their major impacts on the agricultural sector. In the long run, the product markets for Korean agriculture will have to expand much beyond limits contemplated in the TFYP to between two and three times their present capacity. This alternative will require substantial mechanization investments by the late 1970s due to the outmigration of labor, higher wage rates and the inroads which increasing demands for meat will make into the the stock of draft cattle. From 1975 on, power tillers and associated equipment will have to be introduced rapidly. There may be one eighth as many power tillers as there are now draft cattle, or over 136,000 tillers on Korean farms in 1980. Also, there is likely to be a 50 percent increase in the use of fertilizers and plant protection materials from 1970 to 1985. In total, Korea's agricultural markets for modern agricultural inputs must expand severalfold from 1970 to 1985. The rates of expansion are so rapid that advance preparations should be begun in the TFYP.

The projected advantages of Alternative II over Alternative I and the fact that current policies are moving toward Alternative II in the area of grain prices again speaks well for current Korean decision-making efforts. However, projected results are not actual results. The question remains as to whether these results would actually be attained.

Alternative II projections should be expected to correspond more closely to reality than those for the first alternative. Reasons for this include more reliance on price incentives and free markets than on exhortations to increase production and bring consumption in line with production and, hence, less reliance on poorly coordinated public agricultural and home affairs agencies. Thus, while Alternative II does not provide for greater attention to administrative reform than Alternative I, there is some basis for expecting Alternative II projections to be more fully attained than those for Alternative I. However, it must also be pointed out that Alternative II relies on effectiveness of governmentally operated family planning programs and does not specify whether or not the markets for modern factors of agriculture will be publicly or privately run. If it is assumed that the latter are turned over, increasingly, to private hands, the projections for Alternative II are more likely to be attained than those for Alternative I.

Projections for Alternative III are probably quite attainable since they depend very little on coordination of MAF decisions with provincial and local administration in the delivery of expanded quantities of physical inputs and services to farmers. Grains would be centrally imported and delivered. Curtailment of domestic production would be brought about by market forces. The task of delivering improved factors of production would be smaller and would be entrusted to the private sector. Thus, the administrative difficulty with the third alternative is less; however, there are serious difficulties with respect to the consequences of the third alternative.

Alternative III projections reveal the following consequences of free grain imports and world price levels for grains in Korea: farmers would suffer and the quality of rural life would deteriorate; excessive, premature, off-farm migration would probably further congest urban slums; and large amounts of foreign exchange would be used to buy cereals and only a low level of food self-sufficiency would be reached. Offsetting these disadvantages would be the advantages of (1) lower food prices for urban dwellers, and (2) a larger pool of both younger and older, less skilled, low-cost labor in urban centers on which to base export industries to earn foreign exchange.

Interactions with Korean decision makers indicate that the consequences of Alternative III are, on balance, unacceptable to Korean decision makers. This judgment is not contrary to the economic logic used to reach prescriptive conclusions concerning right actions. The current situation in Korea is markedly different from the projected situation if Alternative III were in effect. Putting Alternative III into effect would hurt many people in order to benefit others in ways which prevent economic theory from evaluating as either increasing or decreasing general welfare. Free trade advocates and persons with pro-urban biases are not in a position to argue that Korean decision makers are wrong in rejecting Alternative III and that Alternative III would better maximize welfare.[5] The pre-

[5] Johnson, Harry G., "The Cost of Protection and the Scientific Tariff," *Journal of Political Economics*, 68: 327-45, August, 1960. Lipsy, R. G., and Kevin Lancaster, "The General Theory of Second Best," *Rev. Econ. Studies*, 24: 11-32, 1956-1957, and Fishlow, Albert and Paul A. David, "Optimal Resource Allocation in an Imperfect Market Setting," *J. Polit. Econ.*, 69: 529-546, Dec., 1961.

conditions for using the maximization techniques of economics are simply not met and another basis for deciding what is right must be used.

The projections presented in the first part of this chapter along with information produced in the various working papers yield several detailed conclusions.

I.

KASS projections indicate it will be difficult for Korea to attain total grain self-sufficiency in view of prospective increases in population and incomes. Attempts to attain food self-sufficiency in Korea require: resource augmentation; creation and use of improved varieties; the use of land substitutes; plant protection materials, and price incentives to expand production and curtail consumption; direct regulation of consumption; population control; and capital equipment to replace off-farm migrants and draft cattle.

A. KASS studies and projections indicate that, important as land augmentation is, enough land cannot be added to close the food gap without doing many other things.

B. Similarly, water controls, particularly drainage, are a source of expanded production but cannot be relied on to carry the burden alone.

C. Land substitutes, mainly chemical fertilizers, are also required. However, Korean fertilization rates will approach the biological capacity of her main cereal species and varieties before reaching rice self-sufficiency.

D. Plant protection materials (pesticides and fungicides) have a contribution to make, but elimination of losses due to pests and diseases will not be enough.

E. The biological capacity of Korean cereals must be greatly improved to reach 100 percent rice self-sufficiency if that is to be a Korean goal, and to reduce the cost of cereal production whether or not 100 percent rice self-sufficiency is targeted. Though additional high-yielding rice varieties are needed, Korea's northern location makes it important to obtain improved, short-maturity cereal varieties for planting winter paddies. Though rice can be double cropped in the south, improved barley and wheat varieties and, perhaps, triticale are needed for winter cropping in northern paddies. The northern winter paddies are, in a sense, the Korean land frontier awaiting new varieties to permit their full exploitation. New varieties to expand the biological capacity of cereals to absorb fertilizer on existing hectarages and to expand cereal production onto presently unused winter paddies are one of the most important ways of reaching cereal self-sufficiency.

F. Price is an important instrument for equating production and consumption of any product including cereal grains. High rice prices curtail consumption, expand production, and conserve foreign exchange if maintained by restricting food imports at lower world prices. KASS projections indicate that unused capacity to produce winter barley and lower income demand elasticities for barley than for rice will make it possible for barley production to exceed consumption. It also appears that without better biological technologies, a rice price high enough to constrain consumption to the production which would be forthcoming at that price would probably be politically unacceptable. On the other hand, a barley price which would equate rice production and consumption would be low relative to a rice price which would equate rice consumption with production. Thus, while prices are powerful instruments for equating consumption with production, self-sufficiency in rice may have to depend on direct regulation of consumption in the short run, and changing preferences in the long run.

1. Direct regulations requiring the blending of barley with rice and the replacement of rice on riceless days with wheat products (noodles and bread), white potatoes and sweet potatoes may be required in the short run.
2. In the long run, Korean preferences are likely to shift to other starches with modernization of food processing and distribution. Sweet potatoes are an important potential source of industrial starch. As beer replaces mokoli, barley will become more important in the Korean diet. Young Koreans are developing tastes for french fried potatoes. Then, too, there will be substitution of meat, poultry and dairy products for cereals in the human diet. Barley and perhaps sweet potatoes may be used for livestock feed.

G. Reduced population growth rates help equate consumption with production but the impact is long run. Without a low rate of population increase, Korea has little long-run chance of maintaining self-sufficiency though KASS projections show little impact of population control programs in the next decade and a half.

H. KASS projections indicate that substantial amounts of power equipment will be required starting during the seventies to replace off-farm migrants and draft cattle. With favorable agricultural prices, the labor requirements of agriculture can be satisfied with appropriate levels of mechaniza-

tion as labor leaves to take nonfarm employment. With unfavorable farm prices, migration would be more rapid and likely to proceed before creation of off-farm employment opportunities.

I. Decentralization of industry would be helpful on several counts. It would:

1. Keep laborers in the countryside who could both (*a*) farm some of their small paddies which would not be used if they migrated, and (*b*) work for larger farmers in the peak labor requirement periods.
2. Provide productive off-farm employment for laborers for the most part of the year when agriculture does not.
3. Help prevent urban congestion and give a more equal regional distribution of income.

II.

The need for high food prices to stimulate domestic production and constrain domestic consumption and Korean inability and/or unwillingness to utilize more than 10 million migrants from agriculture in industry to generate enough foreign exchange to pay for food inputs has important implications. Jointly, they indicate that increases in Korean real incomes and output may be overestimated. If domestic food prices must rise because the foreign exchange payments for food inputs cannot be sustained, overall per capita consumptions and real incomes must fall or fail to increase as much as anticipated. Higher food prices to attain self-sufficiency, in effect, reduce per capita real incomes to realistic levels.

III.

KASS projections indicate an expanding demand for animal proteins. Relative to existing levels, animal protein production and consumption will expand severalfold; however, in absolute terms, the market will remain thin until Korean incomes rise above levels attainable in the next decade and a half. Conclusions from the projections about livestock production are:

A. Most of the national Korean cattle herd can be freed from the production of draft power over the next fifteen years.

B. In this period care should be taken lest the draft cattle herd be eaten:

1. without replacement with more specialized dairy or beef animals
2. or, instead of being converted to beef production.

C. Before Korea can have a modern dairy and beef industry, she will have to develop production of higher quality forage. The land resources for producing forage include those now producing low quality, by-product roughage for the present dual purpose draft/beef herd, plus convertible upland and unutilized winter paddies.

D. The development of high quality forage production will require additional research on soils and such winter roughages as the kales and stock beets, as well as on the more traditional forage grasses and legumes.

E. Holstein-Friesian dairy cows are still priced at levels reflecting international air freight charges. In the future it will be possible for Korea to produce its own dairy animals to lower the investment required per cow.

F. Poultry and pork production are easily expanded if imported feeds are used to any level Korean consumers are prepared to buy. At some future date, the question must be faced as to whether domestically produced barley is to be used for livestock feed as well as human food. At that time, the relationships among Korean barley and rice prices will have to be re-examined relative to world prices for feed grains.

IV.

There will be an expanding demand for vegetables and fruits. Korean farmers are resourceful, imaginative producers, as evidenced by vinyl house vegetable production and high quality fruits. With cereal production and grain-fed livestock production expensive to develop, vegetables compete effectively with rice for the use of paddies and with fruit for the use of upland. With increasing urbanization of domestic consumers, and some possibilities of exporting mushrooms and certain other vegetables and fruits, marketing and processing facilities will become more important constraints than in the past.

V.

Industrial crops are much needed, particularly vegetable oils, industrial starches and fibers. Korean agriculture is short on land resources and has been long on labor. The shortage of land suitable for industrial crops and large supplies of labor has meant that Korea's industrial crops have been labor intensive—mainly silk, tobacco and matting or by-product straw rice. As industry develops, agricultural labor supplies will diminish and it will be

increasingly difficult and expensive to produce labor-intensive crops for industrial use.

VI.

With respect to agricultural markets, KASS projections indicate that product markets will have to expand up to three times, and markets for modern inputs up to ten times their present size, the exact extent depending on the degree of food self-sufficiency targeted.

A. Korean markets for modern factors of production are governmentally controlled and operated, while those for traditional factors are mainly privately operated. There are substantial administrative difficulties in the government administration of modern factor markets. Unless these are surmounted, less reliance should be placed on governmental and more on private agencies to operate modern factor markets. The availability of trained civil servants and their salary levels indicate that great difficulty would be experienced in proportionally expanding the participation of the Korean government in the markets for modern factors of agricultural production. This suggests that the role of the Korean government in the marketing of modern factors of production should be reduced substantially in years ahead.

B. Private markets for traditional factors of production such as draft cattle, orchards, hand tools, seeds, etc. run relatively well. While traditional credit markets involve high interest rates and charges, costs to creditors are also high for the small loans commonly extended. Probably more important than the monetary transactions involved in savings and investment is the generation, saving and reinvestment of physical capital by the producer who is also the investor and who produces the capital on an opportunity cost basis with his own fixed labor, capital and land. Examples include cattle, orchards, forage stands, land improvements, and water control facilities. This important capital market is often neglected by students of agricultural credit and credit institutions who concentrate on interfirm monetary transactions to the neglect of intrafirm opportunity cost adjustments and physical processes.

C. Agricultural product markets are mainly traditional and private. Unless the problems of administering agricultural agencies are overcome, there are good reasons for leaving the markets in private hands. And, even if considerable progress is made on administrative problems, it is likely to be advantageous to concentrate governmental efforts on the provision of marketing infrastructure such as roads, public terminals, market information, and enforcement of grades and quality standards.

VII.

KASS studies indicate that infrastructure has a productive importance probably as great as the contribution it makes to the quality of rural life. Though the complementarity between such things as the knowledge distributed by a rural guidance system and production activities makes it difficult to isolate the contribution of either alone, it is clear that both are necessary in order to attain expansions in production. Six infrastructure developments have this kind of complementarity: the rural guidance system; rural electrification; agricultural credit; roads and transport; communication; and education, both general and vocational for both rural and urban pursuits. None of these can be neglected. Another infrastructural development important in the years ahead will be changes in the land tenure system which will permit farms to be consolidated as off-farm migration occurs. Unless farms are permitted to get larger, (1) Korean farmers will make up a disadvantaged, low-paid peasantry, or (2) be subsidized enough to permit them to have incomes comparable with urban dwellers despite business too small to produce respectable levels of living without subsidy.

VIII.

Income distribution inequalities in Korea are probably more important between farmers and nonfarmers than within agriculture. However, within agriculture, the more commercial farmers would benefit more than less commercial farmers from favorable price relationships. Unfavorable price relationships would depress incomes of both groups, but would drive more of the less commercial farmers to migrate—transferring part of Korea's rural poverty problem to urban slums.

IX.

Fisheries and forestry, particularly the former, have much to offer Korea. KASS resources have not permitted sufficient study of them. Special sub-sector simulation analyses are needed.

Superior Alternatives Are Possible

In the discussion above, it was seen that all three policy sets studied by KASS can be improved.

Each has strengths and each has weaknesses. Though still low, relative to urban incomes, the higher farm incomes of the second alternative indicate some very real possibilities for improving the quality of rural life. On the other hand, the second alternative raises food costs for urban people and creates a barley surplus problem in the late 1970s. Though the third alternative results in lower food prices, it drastically reduces farm incomes and imposes losses upon rural residents not easily justifiable in terms of benefits conferred upon others while losing self-sufficiency and increasing foreign exchange drains to buy food. The second alternative which places higher domestic reliance on free prices and markets indicates that considerable efficiencies are to be obtained domestically via this route.

Thus, it is clear that a fourth alternative can be formulated which will be superior to any one of the three investigated. The knowledge about how the Korean agricultural sector operates which was acquired in making projections concerning the three alternatives provides much help in devising the fourth alternative. Chapter 5 looked at the values involved in the operation of Korea's agricultural sector. That information, when related to the resource constraints considered in Chapter 3 and to the conclusions reached in this chapter about how the Korean agricultural sector operates, is useful in setting goals to further develop Korea's agricultural sector. The next chapter will be devoted to the stating of goals and the development of policy and program proposals to attain those goals.

VII

A Recommended Policy Strategy Set for Korean Agricultural Sector Development

This chapter presents the findings of the KASS study in the form of (1) goals believed to be realistic and attainable between now and 1985 in view of the resource and institutional constraints examined in Chapter 3, the value constellations detailed in Chapter 5, and the less normative projections for the three alternatives just examined in Chapter 6, (2) a brief description of a recommended development strategy including the specific policy and program recommendations implied by the recommended development strategy to attain the selected goals, and (3) the projected consequences of following the recommended policies and programs from 1972 until 1985.

It should be stressed that selection of the goals was based on both the KASS analysis and interaction between KASS investigators and various Korean, U. S. Agency for International Development (USAID) and other donor and grantor officials. These goals represent what is judged to be reasonable and attainable. Following the selection of goals and targets, policy and program recommendations were established to attain these goals. These recommendations were also established interactively between KASS team members and decision makers and are reported in two subsections in this chapter: one on policies and another on the programs required to reach the selected goals or targets.

Development Goals for Korean Agriculture

In view of the values involved, the constraints of Korea's resource base, the costs of producing more food versus importation, the costs of constraining population growth and our understanding of how the Korean agricultural sector operates (as revealed by the projections for Alternatives I, II and III), the following goals are recommended for Korean agriculture. These goals are discussed under four headings: food supplies, the quality of rural life, overall development of nonfarm sector, and administration.

Food Supplies

Goals for food production pertain to both the supply of and demand for food, as well as the degree of national self-sufficiency attained. While demand will press hard on food supply in the decades ahead, quite satisfactory targets or goals can be set and attained for Korea. Specifically, it is recommended that Korea seek as goals:

1. Near rice self-sufficiency by 1975, and self-sufficiency levels thereafter consistent with increasing agricultural incomes, foreign exchange availabilities, and biological and technological advances.
2. Complete self-sufficiency in food barley by 1975 and thereafter.
3. Levels for food grain imports and consumer prices that are consistent with the goals on rice and barley.
4. Complete self-sufficiency in other food grains and potatoes by 1975, and to 1985.
5. Continued self-sufficiency for fruits and vegetables.
6. Complete self-sufficiency for meat by 1975, and to 1985.
7. Complete self-sufficiency in poultry products by 1975, and to 1985.
8. Complete self-sufficiency in dairy products by 1975, and 90 percent to 1985.
9. The importation of feed grains and other feedstuffs at levels consistent with (*a*) stated self-sufficiency goals for meat, poultry products, and dairy products and (*b*) domestic ability to produce food surplus barley and forage as sources of feed.
10. In order to help keep demand for food consistent with supply, a net annual population growth rate of 1.5 percent by 1975,

1.4 percent by 1980 and 1.1 percent by 1985.

11. Attaining the food production goals established above implies attainment of several instrumental goals concerning production capacity. These include:
    a. Full development of Korea's limited paddy lands;
    b. Upland conversion to both farming and improved forestry;
    c. Full development of Korean water resources, particularly drainage;
    d. Expanded inland, coastal, and high seas fisheries;
    e. The development of improved and greatly expanded facilities for assembling, storing, grading, processing and transporting 2½ to 3 times more farm products to urban areas by 1985 than now handled;
    f. Development of wheat and other cereal varieties for Korean conditions and needs, to be more extensively double cropped with IR667 rice;
    g. The development and/or importation of improved perennial forage varieties for uplands and of annual forage varieties for winter paddy lands, particularly in the present single cropping regions;
    h. An improved agricultural credit system;
    i. The creation "in place" of substantial farm-produced capital in the form of breeding stock, orchards, water management structures, etc.;
    j. A substantial improvement in the rural guidance system.

Quality of Rural Life

The following goals are set concerning the quality of rural life:

1. An increase in average total annual real per capita value added in agriculture at the annual rate of 9 percent. This would be a change from 36,000 Won in 1971, to 142,000 Won in 1985, both in constant 1970 prices.
2. An increase in per capita annual incomes from agriculture as a percentage of urban incomes from 33 percent in 1971, to 69 percent in 1985.
3. Installation of electricity in all rural homes by 1985 with wiring capable of running household appliances and machinery including pumps.
4. Substantial upgrading of education, in general, and of urban as well as rural vocational training, in particular.
5. Land tenure changes with respect to farm ownership limitations and rental restrictions which will allow farm sizes to increase with off-farm migration to sizes which permit those remaining on farms to attain the income levels specified above. The appropriate size will vary between single and double crop paddy areas, and between upland and paddy areas.
6. The construction or maintenance and repair of roads capable of bearing truck traffic to each village of over 50 households.
7. The removal of much drudgery from rural life by mechanization for land capable of being economically mechanized at a rate consistent with the development of off-farm employment opportunities.
8. The maintenance of a moderately equal income distribution in Korean agriculture by (*a*) maintaining equity in the ownership of land, access to technical advice and credit, the acquisition of human capital in the form of education and vocational training, and of working capital and (*b*) through inheritance and income taxes.
9. Participation in family planning and population management programs to reduce the natural increase rate in the rural areas from the present rate to 1.9 percent by 1975, and to 1.5 percent by 1985.
10. Reduction in the rate at which population is now concentrating in major urban centers with appropriate measures to (*a*) maintain incomes for agriculture, and (*b*) disperse industry to rural areas.

Overall Development of the Nonfarm Sector

On the basis of discussions in Chapters 2 and 5, the following additional contributions from Korean agriculture will be expected to maintain general Korean development.

1. Up to 10 million well trained people from 1970 to 1985 to help develop Korea's industries and urban economy.

2. A 100 percent increase by 1985 in raw materials supplied to Korean industry.
3. An increase in value added for Korean agriculture from 565 billion Won in 1971, to about 890 billion Won in 1975, and 1,230 billion Won in 1985. This goal is approximately 30 percent higher than would be attained from a continuation of present policies.
4. A decrease of 20 billion Won per year in net foreign exchange required for the purchase of agricultural products (less feed grains) between 1971 and 1975.
5. The transfer of substantial claims on rural resource earnings to nonfarm residents via inheritances from farmers to their migrating descendents. With rural property values building as a result of more favorable treatment of agriculture, this transfer, plus the value of human capital transferred with migrants, should exceed the value of subsidies and other assistance flowing to farms from the nonfarm economy and, thus, contribute on a net basis to the development of the nonfarm economy of Korea.

Administration

On the basis of the discussion of value constellations in Chapter 5, the projections presented in Chapter 6, and various constraints considered by KASS investigators, the following administrative and semipolitical goals are established:

1. More effective coordination of provincial and local administration of public agricultural programs with the central administration of the Ministry of Agriculture and Forestry (MAF).
2. Increased use of the private sector for importing or manufacturing and distributing modern factors of production. Assuming a threefold real Won volume expansion of such activity by 1985, a reasonable goal would be an 80 percent increase if these factors of production were transferred to private hands.
3. Continued reliance on the private sector for product marketing services while such activities expand two and one-half- to threefold in the next fifteen years.
4. Establishment of a system of collecting, assembling, processing and disseminating data on the performance of the agricultural sector. Such a system should be independent of government agency administrators charged with responsibility for administering developmental programs and projects.
5. Coordination of planning and decision units, including bureaus under the effective control of the Minister, the Vice Minister and the Assistant Vice Ministers.
6. Development of a competence for analyzing problems of the agricultural sector. This competence should be independent of the agencies and personnel charged with administering agricultural development programs.
7. Improvement in the planning, coordination and liaison between the MAF and the appropriate units of its semiautonomous agencies, such as the National Agriculture Cooperative Federation (NACF), the Agricultural Development Corporation (ADC), and the Agriculture and Fishery Development Corporation (AFDC) as well as the Economic Planning Board (EPB) and the Ministry of Home Affairs (MHA).
8. The development of increased competence within agencies administering agricultural development programs and projects to analyze the problems of administering those programs and projects.
9. Reduced reliance on hastily conceived rural development projects and greater reliance on fundamental improvements in the administration of sound development policies, programs and projects.

The Recommended Policy Strategy Set

The above goals established for Korean agriculture are both inspiring and formidable. KASS projections presented at the end of this chapter indicate that many of these goals can be attained under the policies and programs recommended in this section. A high degree of rice self-sufficiency is attainable by the mid-1970s and probably nearly maintainable through 1985 with present varieties. An important part of our recommended strategy for developing Korea's agriculture is an expansion of research on new cereal and forage varieties to exploit Korea's remaining land frontiers (unutilized winter paddies and convertible upland forest lands). Success in developing or finding the required varieties would assure food grain, perhaps feed grain, and animal protein self-sufficiency for the forseeable future, given adequate population controls. Self-sufficiency in barley is clearly attainable even with present variables. Substantial reductions in grain imports from levels anticipated in Alternative II are clearly possible. The Korean diet

can be maintained or improved despite increases in population. The quality of rural life can be improved with higher per capita incomes, industrial dispersal, and better public services. Premature off-farm migration into urban slums because of low farm incomes can be avoided, while giving farmers appropriate opportunities to migrate to higher-paying industrial employment as these opportunities materialize. Substantial capital can be accumulated in agriculture.

The recommended policy strategy set to attain the above goals represents a modification of Alternative II (described in detail in Chapter 6). Alternative II was modified to further increase the effectiveness of the agricultural sector in meeting Korea's needs, given the resource constraints discussed in Chapter 3, and to correct problems and deficiencies. In this section, our recommended policy strategy is described briefly in terms of its departures from Alternative II. Specific policies and programs to implement the recommended policy strategy set follow.

In formulating the recommended policy strategy set, policy changes in four areas were made in Alternative II. *First*, changes were made in food and feed grain price policies to make more effective use of arable land and to restrain rice consumption to move Korea closer to self-sufficiency in grains. Specifically, consumer rice and wheat prices are higher than those in Alternative II. (See Table VII-1 for the specific grain price policy assumptions of Alternative IV.) A two-price system for barley is maintained through 1975 to simultaneously stimulate barley production and consumption. The overall impact of these price policies is to shift consumer demand away from rice and wheat (and, hence, reduce import requirements) and to stimulate barley consumption. Government costs of maintaining the two-price system for barley are partially offset by earnings on imported rice and wheat. The two-price system for barley is phased out between 1975 and 1980, as rising incomes shift consumer demand away from barley. Barley producer prices are allowed to fall and barley land is diverted to other competing commodities such as rape, potatoes, wheat, and feed grain and forage crops. In the late 1970s, improvements in production technology stimulated by research and guidance programs will increase farmer opportunities to substitute such alternative crops for barley.

TABLE VII-1
Alternative IV Price Assumptions (in 1970 Won) for Rice, Barley and Wheat, Korea, 1971, '75, '80, '85*

Commodity and Price	1971	1975	1980	1985
	..... thousand Won per MT			
Rice				
Producer price	86.0	130.0	130.0	130.0
Consumer price	99.0	150.0	150.0	150.0
Import price†	67.5	62.5	69.0	69.0
Barley				
Producer price	46.0	65.0	40.0	40.0
Consumer price	50.0	60.0	46.0	46.0
Wheat				
Producer price	29.0	48.0	48.0	48.0
Consumer price	33.0	55.0	55.0	55.0
Import price†	24.0	26.0	26.0	26.0

* Prices are assumed to change uniformly between the five-year time intervals. Import prices are at port of entry. An additional 15 percent markup is assumed in moving imported grains to consumers.

† Import prices calculated on the basis of an assumed equilibrium exchange rate of one U.S. dollar equals 450 Won.

A *second* emphasis is on investment in programs to improve drainage on paddy lands not properly drained at present. Such projects produce a number of benefits, including higher rice yields, increased area available for double cropping and increased yield of the second crop.

A *third* emphasis is on the development and importation of improved winter cereals to be double cropped on winter paddy land and on forage crops, including perennial forages for convertible upland, forest lands and annual forage crops for use on winter paddy land. The attainment of self-sufficiency in rice, other food grains, feed grains and animal proteins depends, in the long run, upon success in acquiring these new cereal and forage varieties.

Fourthly, our recommendation departs from Alternative II in that it emphasizes changes in food technology to shift consumer demand in directions that make better use of Korea's limited agricultural production resources. In particular, new technology for processing white potatoes, sweet potatoes, fruits and vegetables should diversify consumer tastes and shift some consumption away from rice and other food grains. Since there is potential for expanding potato, vegetable and fruit production in Korea without serious competition with other crops, this shift in consumption patterns would make more effective use of scarce production resources.

Policy Recommendations

The first step in attaining these goals for food production, rural life, contributions of agriculture

to overall development, and administration, is to express them in terms of recommended agricultural policies which are translatable into specific programs and projects. Many of these policies are presently being followed by the Korean government in one form or another. It is recommended that the government continue to follow or adopt the following agricultural policies:

1. A policy on grain management, in which a price structure is established to *encourage* the production of rice and the production and consumption of barley, and to *discourage* the consumption of rice. Consumption of wheat relative to rice should be encouraged but discouraged relative to barley.
2. A policy of placing heavy reliance on the price system and market adjustments insofar as domestic agriculture is concerned, while insulating the domestic market from international forces with managed grain imports to maintain and stabilize domestic grain price levels. This policy should include the use of supplemental administrative measures to further close the rice self-sufficiency gap if necessary. These would include measures such as mixing rice and barley, regulations of rice use, import licensing, riceless days in restaurants, etc., some of which are presently being used. The effectiveness of such measures need to be assessed as experience is accumulated with their use.
3. A policy of maintaining equitable incomes in agriculture and between the farm and nonfarm areas with (*a*) high domestic prices for farm products, (*b*) improved technology, (*c*) a favorable institutional environment, and (*d*) the provision of equitable access to skills, land and other assets through public assistance, and progressive taxation. In this connection, it should be recognized that Korea's rural poverty problem is part of a national problem, and that most Korean farm incomes are low. National equalization of earning power, in both urban and rural areas, should be paid for by *all* the well-to-do. Burdening agriculture's wealthier farmers with responsibility for the rural poor, while these farmers themselves are poor, would perpetuate a rural peasantry and lead to premature migration to unemployment and/or low paid employment in urban slums.
4. A policy of critically evaluating both the monetary and nonmonetary consequences of public investments to improve Korean agriculture.
5. A policy of depending on market forces, inheritances to migrants, and inheritance taxes to transfer capital accumulation from the farm to the nonfarm sector. In reviewing the inheritance laws and tax rules, care must be exercised that they do not result in undue concentration of ownership, operational fragmentation or unreasonably small farms.
6. A policy of providing for public regulation to insure pure, sanitary, correctly measured and labeled agricultural products from farmer to domestic consumer or for export.
7. A policy of fully developing land and water resources while recognizing that many of the most favorable investments have been made and that increases in Korean wage rates will make projects dependent on the present large quantities of cheap labor less feasible in the future. One of the major potential areas of development appears to be the installation of improved drainage systems, particularly in the double crop paddy area.
8. A policy of encouraging private and of making public investments in the development of convertible forest land and other upland for the production of fruit, mulberry leaves, forage crops, beef and dairy products.
9. A policy of providing national support in rural areas to upgrade and standardize the quality of general and vocational education for both rural and urban pursuits that improves the productivity of off-farm migrants as well as farm people.
10. A policy of using a higher proportion of the present rural guidance systems to further the interests of individual farmers to the exclusion of responsibility for administering noneducational programs.
11. A policy of encouraging poultry, dairy, beef and pork production with imported as well as domestic feed grains and with forage produced on both upland and winter paddies.
12. A policy of expanding reforestation of land

which has been carefully judged unsuitable for cultivation or forage production.

13. A policy of actively supporting high seas, offshore and aquiculture production of fish and marine products for export, domestic human use and as a source of high protein livestock and poultry feed.
14. A policy of dispersing industry into rural areas for the benefit of residents of those areas and in the long-run interest of attaining a better geographic distribution of Korea's population.
15. A policy of shifting over the next 10 to 15 years from an almost total reliance on government and governmentally controlled agencies to procure and distribute modern factors of agricultural production to about an 80 percent reliance on the private sector to procure these factors.
16. A policy of decreasing the proportionate role of government and governmentally controlled agencies in agriculture product markets by confining that role mainly to the procurement and wholesale distribution of imported grains—leaving the transport, assemblage, processing, storage and distribution of domestic farm products in private hands.
17. A policy of expanding support for research on improved varieties of grains and forages and, in the case of forages, for the importation of species not now used in Korea.
18. A policy of greatly expanded research on rice, winter cereals, and forages, both perennials for uplands and annuals for winter paddies. This policy is one of the two strategic long-run elements in the recommended policy strategy set. Success in obtaining improved winter cereals as well as rice varieties will permit presently underutilized winter paddies to be used to fill cereal needs not likely to be met after 1975 with present varieties. Success in obtaining forage varieties will permit utilization of Korea's potential for growing forages to be used in producing dairy and beef products.
19. A policy of expanding and making more effective Korea's successful family planning and population control program. This policy is the second of the two strategic long-run elements in the recommended policy strategy set. By holding down population growth, per capita nutritional levels can be maintained from domestic production, assuming a successfully pursued policy of improved biological technology.
20. A policy of improving policy formation, program and project design and, even more importantly, public administration and execution for agriculture.

Program Recommendations

The specific goals listed in the first part of this chapter can be attained through the policies outlined above which, in turn, can be implemented with the programs recommended below.

1. *Food Grain Management Program.* The government grain program should be designed to achieve the following objectives:

a. relatively high and stable prices to farmers to increase their incomes and to encourage the production of the desired mix of food grains, mainly rice and barley, and
b. relatively high prices to consumers to narrow the gap between demand and domestic production thus decreasing import requirements and the maintenance of a consumer price differential between rice and barley to discourage rice and encourage barley consumption.

For rice, the domestic price support program should be augmented with import management to achieve desired results. The beginning government price support level for the next rice year should be announced before planting time to allow farmers the opportunity to allocate their resources to best advantage. Rice storage and holding costs should be taken into account and the government price support adjusted month-by-month during the market year. KASS estimates indicate these costs require an upward adjustment in price of approximately two and one-half percent per month. Since most farmers require cash at harvest time to settle operational debts, a nonrecourse loan provision should be included in the program, whereby farmers can receive a loan at harvest with the option of later in the year selling the rice on the market and paying off the loan or delivering the rice to the government. This allows the farmer to receive cash at harvest time when he needs it and also encourages him to store his grain until required by the market.

The government can manage the amount of rice flowing into the market each month by manipulating the monthly price adjustment or by simply calling in a portion of the grain pledged against the nonrecourse loans. Rice imports can be used to

control the consumer price and should be managed totally by the government as at present.

Government rice acquired from domestic producers or imported should be released directly into commercial channels, rather than through the present 32 government release points in the major cities. This method would avoid the criticism often levied against the government release system which holds down the rice price in the major cities, but allows the price in smaller rural towns and villages to soar above desired levels, distorting the welfare impacts of the present program. It would also avoid a potential black market operation in which government-released rice is remilled and sold into commercial channels.

To encourage rice production and discourage rice consumption while shifting consumption to barley and wheat, grain prices must be adjusted relative to each other and their general level increased. The internal producer rice price stated in terms of the world price should rise to about two times the world price by 1975, and be adjusted in future years as appropriate to achieve desired results. The barley program should maintain consumer prices at a level about .4 of rice consumer price levels to encourage replacement of rice with barley. Producer prices for barley at about one-half the producer rice price would encourage domestic production to supply the demand until 1975. At present, this calls for a two-price system for barley with a producer subsidy. The government barley program should include a nonrecourse loan provision as at present and release of government-acquired barley through commercial channels. Between 1975 and 1980, the two-price system subsidy should be phased out. The wheat price should be increased to about 1.85 times world price levels by 1975.

No domestic program should be necessary for other food grains at the present time. If, however, a suitable variety of wheat can be developed for Korean needs, a government wheat program may need to be established to encourage wheat production in double cropping patterns with rice.

The proposed grain management program has both governmental costs and revenues which change with the level of domestic production and imports. The revenues are derived from the importation of rice and wheat at world market prices or under even more favorable terms such as through PL480 and their sale at a higher price. For estimating the revenue flows, the prices, margins, production, and import levels presented in these recommendations were used.

The costs associated with the domestic price stabilization program are calculated under a set of limiting assumptions. It is assumed the government will purchase an average of 30 percent of the domestic rice flowing into marketing channels at the average producer price, that the rice will be held for an average of six months at a monthly cost of 2.5 percent of the purchase price for holding and storage, and that the release price to wholesalers will be 10 percent above the purchased price to allow a 5 percent margin between wholesale and retail.

Table VII-2 indicates the returns and costs based on the above assumptions for the components of the grain management program. It also indicates the maximum loan fund necessary for making nonrecourse loans on *all* rice flowing through marketing channels. It is extremely doubtful that all commercial rice farmers would request nonrecourse loans on all their marketable rice at the same time. The two-price program on barley phases in between 1970 and 1975, and out between 1975 and 1980. Further, it is assumed that the government subsidy is paid on all barley produced. Thus, the 1975 figure shown is a maximum yearly cost for this program under the given assumptions.

TABLE VII-2
Returns and Costs of the Grain Management Program, Korea, 1971, '75, '80 and '85

Item	1971	1975	1980	1985
	.....billion Won.....			
Revenues	20.03	56.85	52.07	58.69
Rice imports	15.50	36.95	26.64	28.90
Wheat imports	4.53	19.90	25.43	29.79
Costs				
Rice stabilization cost	1.18	6.54	8.52	11.29
Barley two price program	0.0	35.33	0.0	0.0
Maximum rice loan fund	98.70	226.85	295.49	391.43
Maximum barley loan fund	21.0	39.3	29.8	31.1

The net program cost is very sensitive to production and import levels—particularly rice imports. If rice imports are substantially less than those assumed, grain management revenue would be considerably less. In this event it may be necessary or desirable to revise the government barley program to make it less costly.

2. *Research Program.* An expanded research program should be started at once to further develop:

a. Improved varieties of rice, barley and wheat

with the objectives of increasing double grain cropping of paddies and responsiveness to high-level fertilization.

b. The introduction of new species and improvement in varieties of forage for uplands and winter paddies. For winter paddies, emphasis should be on annual grasses and, possibly, the kales and root crops used in Europe for fodder. For uplands, perennials will be required. Fall and spring irrigation should not be neglected.

c. A corollary research program in soil nutrient requirements, plant protection, drainage irrigation, and water control management to maximize returns from *a* and *b* above.

KASS projections indicate that, regardless of improvements in public policies and in input delivery systems, Korea will begin to experience increasing food grain deficits after the late 1970s unless her biochemical food grain-producing technologies are improved. Despite family planning and population management, larger numbers of wealthier people will expand the demand for food grains and feed grain products. It is, therefore, essential that Korea make a greater, more concentrated effort to develop improved varieties of rice, other food grains, particularly wheat and barley, and feed grains. Interrelated with the varietal research and seed production should be research on cultural practices and adaptation to mechanization.

While agricultural sector investments in technical agricultural research may appear to have been substantial, they have not been large enough to permit the development of sufficiently large cadres of highly trained and skilled plant breeders, research facilities, and administrative capacity at the individual research project level. In the opinion of KASS investigators, Korea's capacity to develop new rice, food grain and feed grain varieties should be greatly expanded in the immediate future to be ready for the expanded demands of the late 1970s and early 1980s. Further, the system of commercial production and distribution of modern seeds should be developed to meet requirements. This may require governmental support in the early stages.

There is not time to develop all the necessary skills in Korea before the new varieties are needed. Foreign plant breeders, soil scientists, agronomists, and agricultural economists are needed to form multidisciplinary research teams on long-term assignments. There is a similar need for project managers and administrators. While the overall administration of the Office of Rural Development (ORD) at Suwon is adequate for present operational levels, the number of projects which should be established will exceed the number of people and project administrators now available or likely to be available in the near future. This is especially true for research on new species and varieties of forage crops.

In the past, forage production has been a scavenging operation, with by-products of grain production and forest reserves used to "feed and fuel" draft cattle. Meat production has been a by-product of the draft cattle herd or based upon feeding garbage to hogs and allowing poultry to scavenge for food. As the draft animal herd is reduced and finally liquidated by the introduction of power tillers and related machinery, there will be an opportunity to convert the traditional herd or replace it with specialized beef and dairy cattle. At that time the demands for dairy and beef products will be considerably higher than at present and it will pay to convert unused winter paddy and develop additional upland for forage and feed barley production particularly if improved food grain, feed grain and forage varieties are available.

Among the varieties of winter forages which should be investigated for production on winter paddies are the annual grasses, the cabbages, kales and root crops long used in Europe as winter forage. In the uplands, attention should be given to the possibility of pumping deep underground water supplies to provide early spring and late fall irrigation of intensive forage crops. Drainage projects in the double crop paddy region could add significantly to winter cropping potential. Livestock product prices will be high and it will pay increasingly to invest in intensive forage production practices.

A Food and Agriculture Organization/International Bank for Reconstruction and Development (FAO/IBRD) project is presently under consideration for research, production, and distribution of certified and/or registered seed for four crops, and for limited crop improvement research on four crops, including forage and pasture grasses. The research component, in addition to support for ORD, would require multidisciplinary foreign technical assistance and a training support component for the College of Agriculture, Seoul National University at Suwon to improve post graduate competencies in plant breeding, entomology, pathology, physiology, and agricultural chemistry. The total project involves a cost of six to eight million dollars over a five-year period, of which the research component would cost more than one million dollars. This project would certainly provide for the initial developmental phase of a mod-

ern seed industry supported by an effective crop improvement capability. Additional research investments may be required to complement the work done under this project, particularly in forage research.

3. *Extension Program.* A strong, viable and flexible guidance system is needed to do this job. The educational aspects of the present guidance organization suffers because of requirements to push centrally directed governmental action programs—regardless of whether they meet the needs of local conditions or are profitable to farmers. There is also inadequate budget for logistical support of field workers, and a lack of personnel trained in extension methods and technical subject matter. The program also lacks feedback and evaluation.

A philosophy of serving farmers through an educational role must be developed. Hiring policies and salaries should be adjusted to attract higher quality personnel. An intensive in-service training program should be instituted to teach both extension methods and modern technical subject matter. In Korea today there is an average of one guidance worker for every 465 farm households. Though there is some need for additional specialized personnel, those presently in the system should be better supported so they can do their jobs more effectively. Adequate office space, office supplies, materials, and transportation should be provided each field guidance worker so he can work effectively with every household in his area of responsibility.

A conservative estimate of annual costs of improving the guidance system is 3.73 billion Won, computed as follows:

a. Increase the average guidance worker's salary by 25 percent. Such an increase would bring their salaries into line with those paid to college educators of similar skill levels. There are obviously many factors that influence job selection, but this increase would make guidance work somewhat more competitive. Total cost—6,000 workers—5,500 Won per month; yearly, 396 million Won.
b. Reducing the guidance worker's household ratio to one worker per 223 households would require an additional 6,000 workers. At the higher pay rate of 29,500 Won, total monthly cost would be 177 million and the annual cost 2,124 million Won.
c. Operating allowances for country guidance offices average 590,000 Won per month. Doubling that amount to allow for added workers and a higher level of support would require 101 million Won per month, or 1,212 million Won per year. These costs do not include capital costs for expanded guidance facilities, publicly provided in-service training, or specialized education equipment. The total monthly costs would be 311 million Won, for an annual cost of 3.73 billion Won.

4. *Farm Enlargement Program.* A program for orderly and equitable increases in hectarage per farm should be developed in the next few years for implementation in the late 1970s. The three-hectare limitations on farm size should be periodically reviewed and raised gradually so as to not become a constraint on expansion by those whose main occupation is farming. In addition land tenure rules should be relaxed to permit farmland rental, and credit institutions and sources should be developed to provide capital for land transfers by sale.

5. *Farm Technical Training Program.* A program should be developed to train farmers in the mechanical skills needed to operate, maintain and repair power equipment and to handle modern fertilizers, plant protection materials, irrigation water, dairy cattle, beef cattle, poultry, hogs, grain varieties and forages.

Also needed are training programs to prepare rural people for roles in the greatly expanded input supply and product marketing and processing systems. Agricultural high schools and ORD guidance should jointly plan, develop, introduce, and staff educational and training programs and curricula in modern farm management, modern technical agriculture subject matter, and agribusiness management and marketing. These educational programs should be designed to help rural people take advantage of opportunities made *privately* advantageous by governmental policies and programs, both in production agriculture and in agribusiness. Guidance programs to exhort farmers to do that which is socially or politically advantageous to others, but of little obvious private benefit, have been unsuccessful the world over. The same policies which make it privately advantageous to expand production will also favor adoption of new practices and factors of production and will also make it advantageous to generate farm-produced capital with underutilized labor, traditional forms of capital, underutilized upland, convertible forest land and winter paddy. Thus, there are good reasons to think production policies which are privately advantageous are also socially advantageous.

6. *Credit Program.* The higher farm incomes and land values which will accompany the price programs recommended above will both increase the credit base and the demand for credit among farmers. Credit used will expand considerably. Credit programs are needed that will subsidize the acquisition of modern inputs and equipment by small, poor farmers, not otherwise in position to expand.

KASS projections indicate a 130 percent increase in expenditures on modern inputs and taxes by 1985. If short- and medium-term credit needs are assumed to increase proportionately with these capital requirements, total credit requirements will expand from about 73.8 billion Won in 1971, to about 118.1 billion Won in 1975, 125.5 billion Won in 1980, and 169.7 billion Won in 1985. If farmers shift to institutional sources for their credit at lower interest rates, the quantity demanded will be greater. This shift will depend largely upon availability of credit funds through institutional sources. Part of the agricultural credit can be supplied by machinery dealers and other suppliers.

Presently, the most viable rural credit institution is the National Agriculture Cooperative Federation (NACF). KASS has made recommendations concerning the organization and function of NACF in a separate report. Assuming those recommendations will be accepted and carried out, NACF, in the short run, will be the logical institution to carry the major burden of the expanding agricultural credit facilities. If NACF is to carry out this role effectively, a simplification of the interest rate structure now in operation will be needed, the process for obtaining loans must be streamlined, and the amount of credit funds greatly expanded through increases in the mutual savings program, the possible sale of debt debentures, an increase in government sources of credit funds, and possible tapping of foreign and international loan sources.

Long-term credit will also be needed for land purchase. Projections for KASS recommendations indicate that in 1985 the number of farm households will be about 1.7 million, or approximately two-thirds the 1970 number. This means the average farm size will increase about a third between 1970 and 1985, to approximately 1.4 hectares. Accordingly, about a third of the agricultural land will be subject to consolidation by 1985.

Ownership transfers will take place gradually over a number of years, particularly if the rules on farm land rental are relaxed. Long-term credit needs for land purchase will undoubtedly increase sharply, however, between 1971 and 1985.

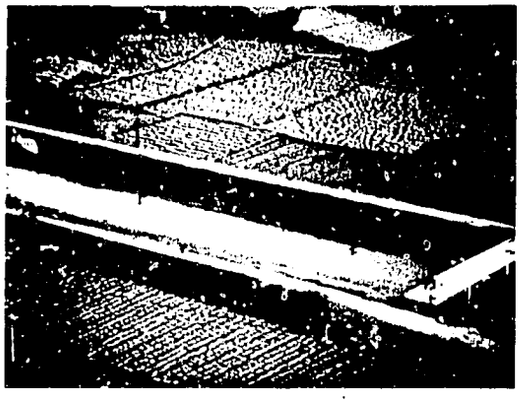
It may be necessary for the government to develop an institutional environment within which land transfer is encouraged and credit requirements are partially provided by government funding or under government credit guarantees. Government cost would depend upon level of involvement. If the government's share reaches a half to three-fourths of the sales, its loan volume would range between 175 billion Won and 260 billion Won by the 1980s. A subsidy of 10 percentage points on the interest rate would involve government outlays of around 20-25 billion Won per year at that time. This subsidy would amount to about 150 billion Won over the 1970-85 period with a gradual expansion of the programs.

Prices on land, particularly paddy land, will tend to increase relative to the general price level because of higher rice prices, higher net return to agriculture as projected under Alternative IV, and because of pressures from urbanization and industrial growth. This could amount to as much as 50 percent by 1985. If this increase occurs, the average value of cultivated farm land in Korea would be over two trillion Won for the 1970-85 period. The transfer of a third of this land would mean a shift of resources valued at about 690 billion Won. If one-half of these sales require credit, the financing would amount to nearly 350 billion Won.

7. *Land and Water Resource Development Programs.* Korean land and water development projects have included irrigation, paddy rearrangement, upland development (including bench terracing), and tideland reclamation in addition to improving old facilities. Irrigation is accomplished on about 70 percent of the potentially irrigable paddy land. The irrigation component in the four big river basin development projects will almost complete the irrigation feasible on Korea's paddy land. Some tideland development is also included in the four river basin projects which is probably only feasible as a component of such multi-purpose projects.

Potential projects in more precise water control management, particularly drainage, depth control, and timeliness of application to allow production of IR667 and subsequent improved varieties of rice on a greater portion of total paddy land than presently possible should be investigated. MAF rough estimates indicate the potential for increased yields and increased double cropping on about 30 percent of the total paddy land through improved water control management.

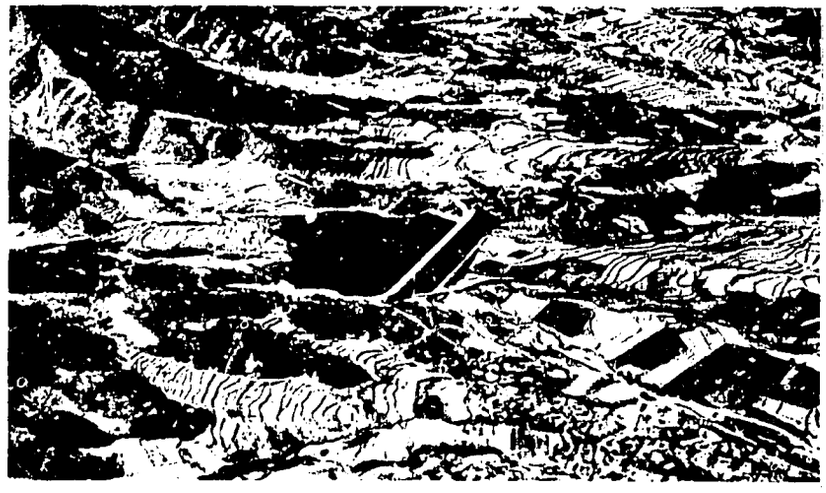
Much of the past upland development has been less than totally successful as a result of both administrative and operational problems. KASS



Improved Land Use

Questions concerning the best use for Korea's land include extent of:

- *upland conversion to forestry, forages and other crops*
- *paddy rearrangement*
- *paddy conversion to vegetables, fruit and nonfarm use*
- *double cropping of paddies for rice, other grains and vegetables*
- *water control*



estimates approximately 200,000 hectares of upland is potentially usable for agriculture through conversion of forest land. As the demand for fruits, vegetables, dairy and meat products expands, it will become increasingly feasible to develop these lands for fruit and forage production. Coupled with investments in forage research recommended below, investment opportunities should be investigated in connection with conversion of forest land into forage production as well as for tree fruits (apples, pears) and grapes. Of the 200,000 hectares of upland potentially developable, approximately 41,000 hectares are suitable for upland grain crops and vegetables, approximately 45,000 for orchards, 74,000 with thin soil depth and potentially usable for pasture, and 40,000 with steep slopes potentially usable for mulberry and grass.

KASS estimates indicate a labor requirement of 113 days and a cost of 65,425 Won per hectare for developing upland without bench terracing, and 180 days and 104,220 Won per hectare for upland development with bench terracing. (Cost based on 1970 hired wage rate of 579 Won.) Assuming the 41,000 hectares for all upland crops need bench terracing but the other uses will not and assuming all potential land to be developed, the cost would be approximately 14.7 billion (1970) Won and 25.4 million man days of labor. (10.4 billion Won and 18.0 million man days for 159,000 hectares without bench terracing and 4.3 billion Won and 7.4 million man days for 41,000 hectares with bench terracing.) Further investment in selected paddy rearrangement programs is warranted. Advantages of paddy rearrangement include:

a. provision of an internal transportation network allowing better machine and hauling access to fields,
b. greater machine and labor efficiency in production operations, and
c. more effective water management including drainage and irrigation.

Selection of projects should be based heavily on improvement in water management to the extent that IR667 and similar high-yielding, short-straw rice can be cultivated. In particular, the current plan of rearranging 417,000 hectares at a total cost of 75.7 billion Won should be completed by 1985. The construction of drainage facilities costs are somewhat more difficult. There is more than one way to construct the drainage facilities and the technical feasibility of each method depends on soil composition. At this point, the method that appears feasible over most of the paddy in need of drainage is the close ditch method at a cost of 36,600 Won per hectare. There are approximately 385,000 hectares of land in need of some form of drainage, for a total cost of 16.8 billion Won by 1985.

The central government presently has 34 uncompleted irrigation projects involving 25,380 hectares for which completion funding is running short. In addition, there are some 80 irrigation projects covering 22,300 hectares funded from provincial government sources in various stages of completion which also lack adequate completion funding. The centrally funded projects with a total cost estimate of 4.4 billion Won have spent 14.2 percent of the estimated cost, while the provincial projects have spent 17.6 percent of an estimated total cost of 7.3 billion Won. KASS did not attempt further analysis, but potential for investment should be investigated through a review of these projects and evaluation to determine feasibility and economic potentials of completion.

Deep underground water supplies have never been fully inventoried. As paddy land irrigation and drainage reaches full potential and with increasing demands for agricultural production, irrigation of upland becomes more feasible and "storage" of water in rice paddies becomes less necessary. Coupled with forage, irrigation and drainage research, this possible area of development should be appraised with respect to the provision of irrigation water for fruit, vegetable, forage, and other upland crops.

8. *Market and Product Quality Regulation Programs.* Korea's program for insuring the purity, sanitation, proper measurement, and accurate grading of agricultural products is not adequate. Poor sanitation both constrains exports and imposes poor health and productivity losses on the population.

This type of regulation is a powerful tool to discourage undesired and encourage desirable practices. For example, well conceived and enforced rules on the sanitation levels of fresh vegetables flowing into market channels could retard the use of raw "night soil" as fertilizer, and may at the same time encourage installation of methane generators, the by-product of which can safely be used as fertilizer. Strict rules concerning the level and type of allowable foreign matter in marketed grain could do much more to control rodents than present exhortation programs. With the present regulatory and inspection network, the government cost

of an expanded and strengthened regulatory program would be minimal. Public costs are discussed in section 15.

9. *Rural General Education and Vocational Training Programs.* A program to upgrade general education, but especially vocational training for both urban and rural employment, is recommended for rural Korea.

KASS projects that 10 million people will migrate out of agriculture into the urban areas during the next 15 years. Estimating the value of this agricultural contribution to the nonfarm sector is difficult at best, but assuming that one-third, or 100,000 of the 300,000 present yearly migrants have three years of education beyond the compulsory six years at a cost of 100,000 Won per person, the present educational cost transfer is 10 billion Won per year. Further assuming that about half the approximate 900,000 persons projected to be migrating in 1985 have the same nine years of education, the education cost transfer will have climbed to about 50 billion 1970 Won per year. It is in the interest of all Koreans that these migrants be educated and well trained in a usable skill which will increase Korea's GNP and export earnings.

Investments in general education and vocational training in rural Korea should provide for urban as well as rural vocational training, and for general education for both those staying in agriculture and those migrating. It is extremely important that migrants be trained in the skills developed or demanded by Korea's rapidly expanding industrial sector. The agricultural sector should not be expected to provide this training. To the extent that rural families migrate to urban areas to provide higher quality education for their children, upgrading the quality of rural education would stem the migration tide. However, data from a recent study are revealing.[1] The study found no significant difference between rural and urban areas in the public expenditures per student. But the private expenditure per student varied greatly. Table VII-3 indicates the direct private expenditure on education per student in large cities, small and medium size cities, and rural areas in 1968. For all categories—grade school, junior and senior high school—the private expenditure per student was greater in large than in small and medium size cities, and in rural areas the expenditure was lowest.

TABLE VII-3
Direct Private Expenditure on Education Per Student, Korea, 1968

Level and Area	Cost per Student	Small and Medium Cities
	Won	Percentage
Grade School (age 6-11)		
Large cities	10,550	218
Small/med. cities	4,847	100
Rural areas	2,889	60
Junior high (age 12-14)		
Large cities	17,454	174
Small/med. cities	10,028	100
Rural areas	7,540	75
Senior high (age 15-17)		
Large cities	20,481	134
Small/med. cities	15,249	100
Rural areas	11,114	74

SOURCE: "A Study for Projection of Private and Public Expenditures on Education for 1968." Central Education Research Institute, August 1968, Seoul, Korea.

KASS population projections for school-age youth and estimated enrollments are shown in Table VII-4 for 1970-85. The cost of increasing the quality of rural education can be calculated on the basis of the assumptions made in Table VII-4 concerning the number of students attending school relative to potential student population, and on the further assumption that equal cost per student will provide equal quality of education between rural and urban areas. The latter assumption is hazardous and additional empirical analysis should be done to determine its validity.

If the assumptions are accepted at least for the sake of getting rough estimates, the total cost of increasing the educational investment per rural student to the level found in small and medium size cities is indicated in Table VII-5. The 1968 cost differential figures were inflated by 25 percent based on the change in the consumer price index. The yearly cost of providing comparable quality education to rural students, as found in small and medium size cities under the assumptions, ranges from 9.8 billion Won in 1970, to a peak of 11.5 billion Won in 1980, and then decreases to 7.3 billion Won in 1985.

10. *Road Improvement Program.* The approximate threefold expansion in product markets and the potential tenfold expansion in agricultural in-

[1] "A Study for Projection of Private and Public Expenditures on Education for 1968." Central Education Research Institute, August, 1969, Seoul, Korea.

TABLE VII-4
Rural Population, Number of Youth by School Age Category, and Number of Students, 1970 and Projections for 1975, '80 '85, Korea

	1970		1975		1980		1985	
	Total	Students	Total	Students	Total	Students	Total	Students
	....thousands		.....thousands		....thousands.....		....thousands	
Rural population	15,870	....	15,413	....	13,825	....	9,145	....
Age 6-11 (grade school)	3,214	3,118	2,905	2,817	2,141	2,076	1,347	1,306
Age 12-14 (junior high)	1,280	452	1,452	726*	1,256	1,130†	617	574‡
Age 15-16 (senior high)	1,012	146	1,323	363*	1,170	565†	624	459‡

* Ratio of students to potential students assumed to increase to 50 percent for junior high with a dropout rate of 50 percent to senior high in 1975.
† Nine years of compulsory education assumed for 1980 and thereafter. Dropout rate from junior to senior high assumed to remain at 50 percent.
‡ Enrollment rate in junior high assumed to be 93 percent with dropout rate to senior high reduced to 30 percent.

TABLE VII-5
Total Costs of Increasing per Student Investment in Education in Rural Areas to Equal Investment in Small and Medium Size Cities, Korea, 1970-85

	1970	1975	1980	1985
	.....million Won.....			
TOTAL	9,764	11,000	11,488	7,339
Grade school	7,608	6,873	5,065	3,187
Junior high	1,401	2,251	3,503	1,779
Senior high	755	1,876	2,920	2,272

put markets will put a substantial burden on the nation's rural feeder roads during the next 15 years. Increased activity in building new roads and improving existing ones should be started before 1975, intensified between 1975 and 1980 and continued thereafter.

Additional study is required to determine the most appropriate balance between building new roads and improving existing ones. Present emphasis is on the latter. Transportation of people and goods from village to village or between farm and village has resulted in a road or path system of impressive dimensions but of poor quality. Costs per kilometer of new road range from 30 million Won for national roads, to 5 million Won for village roads. About half the cost is in construction, the other half in paving. Investments in rural roads should be geared to the pattern and rate of agricultural commercialization.

A 1969 survey by MHA estimates that a total of 46,167 km of feeder roads are needed. These would include 19,640 km of village to national roads, 16,223 km of village to village roads, and 10,277 km of farm to village roads. About 27,000 km of these roads were constructed in 1970 and 1971. If we assume that the 19,000 km still to be constructed is proportional to the types of roads needed as indicated above, and that by 1985 the 1969 estimates fall short of the need by 30 percent, (a conservative assumption, given the KASS projection of demands on the agricultural sector, the expansion in agricultural product and input markets, and its rate of commercialization), feeder road needs include 10,520 km of village to national, 8,670 km of village to village, and 5,510 km of farm to village roads. At approximate costs of 3 million, 2 million, and 1 million Won per kilometer for construction and surfacing, the cost for feeder roads would be 31.6 billion, 17.3 billion, and 5.5 billion Won for national-village, village-village, and farm-village roads respectively. The total cost, including 3.8 billion Won for improving existing roads, will be 58.2 billion Won. This figure comes to about 15 billion Won more by 1985 than current Economic Planning Board and Ministry of Home Affairs estimates.

11. *Rural Electrification Program.* Rural electrification will be used initially for lighting, as it was in the United States. It will, however, become quickly indispensable as a production input source of power, particularly for electric motors to drive threshers and pumps for irrigation. The cost of electrification is approximately 50,000 Won per farm household. Under the Third Five-Year Plan (TFYP) estimates, 20,000 Won is paid by the electric company (often with help from local governments) and the farmer pays 30,000 Won under a loan arrangement at 7.5 percent interest after a five-year grace period. Only 1.2 percent of the

myon in rural Korea are fully electrified, while 27.7 percent have no electricity.

In 1970, 683,000 of the 2,488,000 farm households had electricity. KASS estimates indicate that by 1985, the total number of farm households will drop to approximately 1,700,000. To achieve total rural electrification by 1985, about 1 million additional farm households must be electrified. Assuming TFYP cost estimates of 50,000 Won per household, electrification would cost 50 billion in 1970 Won. Due to the predicted decline in farm households, this cost is substantially below the Economic Planning Board estimate of 94 billion Won.

12. *Rural Industrialization Program.* Industrial programs are beyond the experience and expertise of KASS personnel; however, programs to disperse industry more widely over the countryside are recommended for a number of reasons, including:

a. the need to keep industrial laborers near farming areas where they could help out during peak seasons, and
b. the need to reduce the extent of the two- to threefold expansion in the agricultural product market now in prospect by keeping consumers nearer producing areas. While there are undoubtedly many industries which can be dispersed, obvious ones include agribusiness industries that supply, repair, maintain and service the power equipment and machinery which will be introduced during the next 15 years. Others include the construction, maintenance, and operation of facilities for rural electrical systems, feeder roads, schools, sanitation schemes, and agricultural produce assembling, transporting, processing, and distribution industries. Much of the dispersion will come naturally, particularly with agribusiness firms. The government can, however, take an active role in encouraging industrial dispersion through appropriate incentives and penalties such as tax rate differentials, pollution control regulations, etc.

13. *Livestock Program.* KASS demand estimates indicate that under the 1970 consumer food price structure (including with increasing incomes and population), consumption of meat, fish, poultry, eggs, and dairy products will increase severalfold. Improved forage varieties will need to be developed or imported for use on uplands and in northern winter paddies as a basis for beef and dairy production.

A multi-pronged program is recommended to supply Korea's livestock-based protein needs while minimizing feed grain imports and contributing to more equitable distribution of farm income. The program includes:

a. Emphasis on research and guidance in hog, livestock and poultry production (in particular) within the limits of effective demand for these products at prices which will cover feed import costs. The program emphasis on poultry and egg production should take advantage of the high feed-to-meat and egg conversion efficiency of poultry which is almost twice that of hogs and three to four times better than for cattle. However, it should not be forgotten that hogs consume feed (garbage, sweet potatoes, etc.) which is not appropriate for chickens, and that only ruminants (dairy cows and beef animals) can consume the roughages producable from certain Korean land resources.
b. Extension of improved egg and broiler production technology to many small farmers to equalize the income distributions, and
c. Product and input price policies should reflect production costs to shift consumption and production to an economically appropriate combination of beef, dairy, pork and poultry products.

KASS estimates that a heavier emphasis on a poultry and egg production program is capable of providing the same livestock, poultry, and dairy-based nutrients provided by the livestock program of the TFYP with about 20 percent less imported feed grain and a much wider distribution of farm income. Given a broad guidance program, about 500,000 farm households each could be earning 55,000 (1970) Won of net income from poultry and egg production alone by 1980. If the guidance program were aimed at low income farmers, a substantial improvement in income distribution could result. With proper development and utilization of Korea's forage-producing resources to produce beef and dairy products feed grain imports can probably be greatly reduced for beef and dairy products.

14. *Government Marketing Services Program.* The NACF functions as a state trading corporation in both the product and factor markets. Its record seems mixed. The sources of its difficulties are detailed in a separate KASS report on NACF, along with a number of recommendations designed to make it a more viable farmer-oriented institution.

Additional investments contributing to NACF growth should be conditioned upon reorganization and administrative reform. Even with such administrative reform, it seems unwise to expand NACF operations commensurate with the growth of demand for product and input marketing services in agriculture.

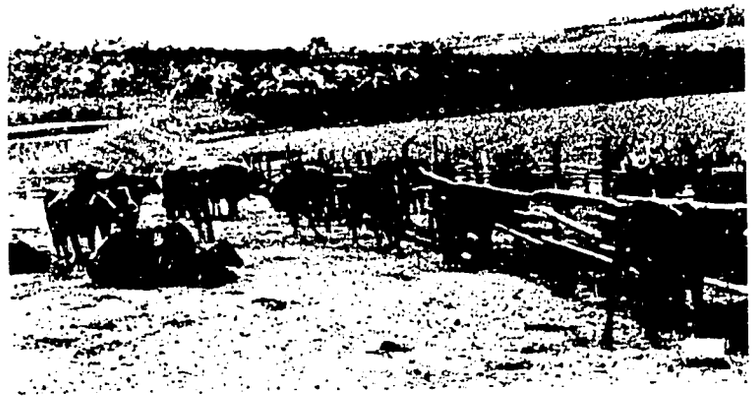
a. It is recommended that over the next 15 years, the NACF input supply and product marketing volume should not be more than double present levels.
b. Holding NACF growth to double its present size over the next 15 years would mean that its share of the market for modern agricultural inputs would probably fall from about 85 percent to 20 percent, and that its share of the agricultural product market would remain about where it is, at 10 to 15 percent.

15. *Private Sector Agricultural Input Supply and Product Marketing Services.*

a. One of the most important areas for expansion is in the agriculture power machinery and equipment market. This runs from importation and production through distribution, to the provision of repair parts, maintenance services, and the supply of fuels and lubricants. Operator, maintenance and repair training is an important aspect of this system. There is virtually no modern agricultural power equipment market in Korea at this time.

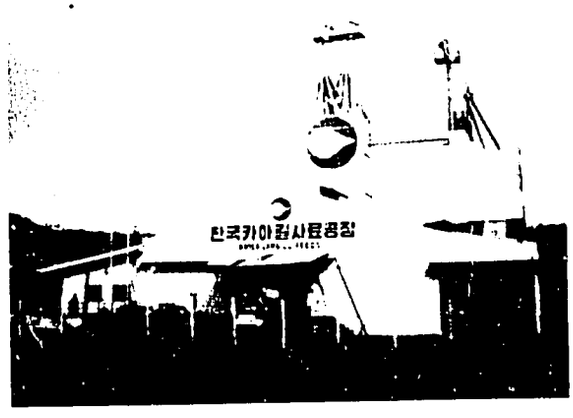
   Exotech Systems, Inc., a private consulting firm, is presently under contract with the Republic of Korea Government (ROKG) to carry out an agricultural mechanization feasibility study. Their preliminary investigations indicate that a five-horsepower tiller with rotary, mouldboard and furrow plows, iron wheels, and trailer working 650 hours per year would have a life of seven years and would cost initially 283,000 Won. Maintenance and repair would cost approximately 10 percent of purchase cost per year; 1,270 liters of gasoline and 25 liters of oil would be required. KASS estimates of wage rates, production increases, and rural-to-urban migration roughly indicate a demand for about 350,000 tillers between now and 1985, with the demand increasing abruptly after 1975. By 1985 this calculates to a 99.0 billion Won investment in machines, a yearly cost of 9.9 billion Won for maintenance, repairs and service and a yearly requirement for 444.5 million liters of gasoline and 7.5 million liters of oil. Recommendations on how to organize farm machinery programs are left mainly to Exotech.
b. With the adaptation of new plant varieties, better water management, and more sophisticated farm management, heavier application of fertilizer and lime will be required for optimum production levels. KASS estimates indicate an increase in fertilizer usage of about 2.6 times present levels. Additional manufacturing and delivery network capacity will be required to handle this increased volume. It is recommended that the task of supplying the greatly increased demands for purchased agricultural inputs and services should be the responsibility of the private sector. The task of making technical recommendations, educating farmers in the use of these modern inputs, and training in the operation, maintenance, service and repair of farm machinery should be at least partially the responsibility of the ORD guidance system and of vocational and technical training schools. Capital and investment requirements for the manufacture or import, distribution, and delivery of input supplies and services should be jointly provided from private, governmental, and foreign loan sources.

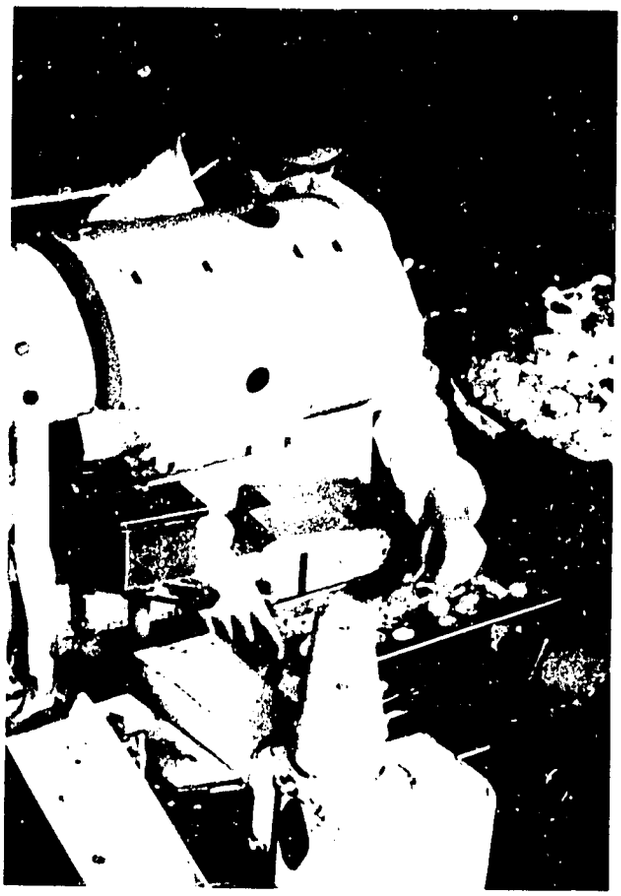
   With increased urbanization, increased population, increased incomes, and changing life styles projected by KASS, the volume, quality, and form of agricultural products flowing through the marketing channels will change drastically.
c. It is recommended that a comprehensive study be completed of capital and investment requirements in: (1) milk bottling and dairy processing plants and the use of sterilization techniques to greatly extend the shelf life of milk without refrigeration, (2) slaughter houses, (3) meat processing facilities, (4) fruit and vegetable canning and processing facilities, and (5) grain handling, processing, and storage facilities.
d. Market regulation, licensing, and tax policies should be reviewed and adjusted to encourage the timely flow of agricultural products through modern, sanitary and efficient marketing channels. A case in point is the present tax levied on livestock slaughtered in modern, sanitary, government-inspected facilities which has the effect of shifting much of the slaughtering to nongovernment-approved, unsanitary slaughtering operations. The tax



Expanding the Beef and Dairy Industries

As Korea replaces human and animal power with mechanical power, draft animal production will be converted to beef and dairy production to meet a growing demand for beef and dairy products. Better forages and more commercial feeds will be required.





Marketing Agricultural Products

With increased urbanization and a larger population, Korea's capacity to market agricultural products must increase two- to three-fold in the next fifteen years.

To modernize her markets, Korea will need more:

- *assembly facilities*
- *processing plants*
- *quality controls*
- *better transportation*

should be removed and the presently noninspected and nonapproved slaughter facilities brought under the quality regulation program.

e. The needed expansion in the agricultural product marketing system should be done through the private sector, allowing government with its scarce resources to carry out other activities not suited to the private sector. Capital and investment funds for this expansion should be provided from private, government and foreign loan and investment sources.

Some indication of prospective public and private costs of recommended changes in product and inputs markets and industries can be obtained by estimating the change in flows of products and inputs. Under these recommendations, urban consumption of grain and pulses will nearly double by 1985. Vegetable and pork consumption in urban areas will also double; fruit and potato consumption will increase threefold; while beef, chicken and egg consumption will expand almost fourfold. Milk consumption in urban areas will increase nearly 10 times between 1971 and 1985. While the demand for marketing services will not expand by these magnitudes in the rural areas (on grain and potatoes, less such services will be required in rural areas), the net effect for the nation as a whole will approximate the increased demands from the growing urban population. Not only will there be more people to feed, but the consumption pattern will change and more services per unit of food marketed will be required.

Without allowing for increased processing (or increased efficiency), the flow of marketing services will have to increase by two and a half times to accommodate the urban population of 1985. This increase will cost an estimated 220 billion Won. Half this increase will be on grains, pulses, vegetables and potatoes (Table VII-6).

If farm- or village-to-market roads are adequate as provided by increased appropriations discussed in the section on road improvement, the expansion in marketing facilities to handle the increased product flow need not involve large sums of public investment. More grain storage, truck, processing and handling facilities will be required, but these can be financed largely by private capital. Government funds might be used to (1) guide the expansion, and (2) provide facilitating functions to improve the efficiency and performance of the private sector.

With expanded output, inspection operations would involve increased public expenditures. The National Agricultural Products Inspection Office has had about 1,200 inspectors throughout the country.[2] The average inspector handles 15,000 sok of grains and 19,000 kg of fruits, vegetables and industrial crops per year—a workload which is regarded as excessively heavy. These inspectors have been paid an average of about 276,000 Won per year. The expanded production would eventually require at least 1,500 more inspectors. Assuming somewhat higher salaries and adding an

[2] NACF—IMI Joint Marketing Research Group, *Preliminary Agricultural Marketing Survey in Korea*, June, 1968, p. 413.

TABLE VII-6
Estimation of Flows of Marketing Services under Alternative IV, Assuming a Constant Level per Unit of Product, Korea, 1971 to 1985

	Marketing Cost* 1971	Urban Consumption 1971-85	Marketing Cost† 1985	Change 1971-85
	million Won	ratio	million Won	million Won
TOTAL	140,382	....	362,164	221,782
Grains and pulses	45,636	1.91	87,165	41,529
Fruit	8,725	2.84	24,779	16,054
Vegetables	36,530	2.03	74,156	37,626
Potatoes	19,750	2.98	58,855	39,105
Beef	10,154	3.70	37,570	27,416
Milk	1,186	9.71	11,516	10,330
Pork	4,820	2.03	9,785	4,965
Chicken	7,647	4.23	32,347	24,700
Eggs	5,934	4.38	25,991	20,057

* Marketing Margin times total urban consumption.
† Marketing cost in 1971 times ratio of urban consumption in 1985 relative to 1971.

overhead allowance of 20 percent of salaries, this expansion would increase the government budget in 1985 by 600 million Won per year. These additional costs would increase gradually over time, aggregating to about 4.5 billion Won for the entire 1971-85 period. Some economies may be realized in the inspection service with increased total volume and with fewer producers. On the other hand, the role of the inspectors may also be increased by the adoption of a comprehensive grading program.

With the commercialization of Korean agriculture will come a greater need for coordination of the marketing system. The government will have to assume an expanded role in facilitating this coordination. The structure is already available for obtaining crop and livestock estimates and market news. Some expansion and reorganization of these activities will be necessary, but will not require substantial additional outlays. Greater emphasis should be placed on the analysis of the information and the dissemination of market news and outlook information. This total program could probably be accomplished for an additional 400 million Won per year, or about 3 billion Won over the 15-year period from 1970-85 if expanded gradually.

Seasonal price increments on farm products should be large enough to encourage private investment in storage facilities. Should the government decide to guide this expansion, some rather substantial outlays may be required. On grain alone, additional storage facilities for 2.5 million MT will be necessary by 1985 under our recommendations. Assume the cost of providing adequate on-farm storage and complementary off-farm storage to be 30,000 Won/MT.[3] For these recommendations, KASS projects production of grain and pulses at 9.32 million MT by 1985, an increase of 2.46 million MT over 1971. This would then require an investment of an additional 74 billion Won in storage facilities, since current facilities are used to capacity. A 20 percent government subsidy to build such storages would involve a public investment of 15 billion Won.

Four specific input flows were examined under these recommended policies and programs to determine the extent of investment requirements in the farm supply industry. Chemical use is to expand by nearly 75 percent, concentrate requirements for livestock will double, fertilizer use will increase two and a half times and capital requirements will increase nearly four times (Table VII-7).

[3] Estimated commercial storage facility costs ranged from 15,000 Won/MT to 37,000 Won/MT in 1968 according to a Kansas State study for AID entitled, "Review of Grain Storage Handling, Processing and Distribution Problems and Proposals in the Republic of Korea," p. 59 and 71.

TABLE VII-7
Estimated Flows of Farm Input Supplies under Recommended Policies and Programs, Korea, 1971 and 1985

Item	Unit	1971	1985	Ratio of 1985 to 1971
Input flow				
Fertilizer	million MT	.9	2.3	2.6
Chemicals	billion Won	6.9	12.0	1.7
Capital requirements	billion Won	39.0	151.0	3.9
Concentrate requirements	million MT	1.7	3.4	2.0
Government cost total	billion Won	4.3	9.7	2.3
Fertilizer*	billion Won	2.4	4.2	1.7
Chemicals†	billion Won	.9	1.6	1.8
Credit subsidies‡	billion Won	1.0	3.9	3.9
Mixed feed sales§	million MT	1.2//	1.5	1.2

* Based on a subsidy of 12 percent of the manufacturer's price.
† Based on the same relationship as in 1970 when government cost was .9 billion Won or about 13 percent of total expenditures.
‡ Assumes a 20 percentage point subsidy on government sources of credit which is estimated to be 13 percent of total agricultural credit.
§ Based on increased commercialization of grain marketing and modified by the expanded use of barley raised for feed rather than imported.
// 1970.

Since direct governmental subsidies are involved with fertilizer, chemicals and credit, these public costs would increase proportionally with input flows assuming current programs continue. A rough estimate is that these expenditures would more than double by 1985, or increase by over 5 billion Won. If new fertilizer plants are efficient enough to operate without subsidy, the increase to 1985 would be around 2.5 billion Won. Gradual expansion over the 15 years then would require a total government outlay of about 20 to 40 billion Won.

Divergent trends would affect the mixed feed industry. A higher percentage of grain produced would be sold off farms which would increase the commercialization of bran. On the other hand, more barley would be used for livestock feed, reducing import requirements and lessening the demand on facilities needed for imported feed grain. On balance, the demand for mixing facilities would still double. This would not necessarily mean a doubling in investment requirements, since feed mixing plants have been operating below capacity.[4]

A number of expanded government marketing programs could accompany the increased volume of outputs and inputs of Korean agriculture under Alternative IV. Of the specific activities enumerated, the increased public costs would amount to a minimum of 28 billion Won over 1971-1985—about 8 billion Won for expansion and reorganization of inspection, grading, market news, crop and livestock estimates and an outlook program; and about 20 billion Won for continuation of current subsidy rates on agricultural inputs. If the government subsidized storage construction, this would add perhaps 15 billion Won on grain alone. If new fertilizer plants are subsidized, another 20 billion Won could be added to public costs. The upper range of increased public outlays in the marketing and input industries would be around 65 billion Won over the 1971-1985 period.

16. *Forestry Program.* Although KASS did not investigate the forestry area in great detail, some analysis was necessary concerning the potentially convertible forest land for agricultural purposes. Investments in proper reforestation can provide Korea with a useful economic asset and a viable forestry and forest products industry in the years ahead. Present reforestation programs should be strengthened with additional land classification work and economic analysis to concentrate reforestation on land not usable for forage, upland crops, mulberry or fruit production under the demand conditions, wage rates, labor supplies, and levels of mechanization likely to prevail over the lifetime of the species planted.

17. *Fisheries Program.* Again, while KASS did not analyse the fisheries sector in detail, it was necessary to do some analysis since fish and fish products are prominent in the Korean diet and substitute for other animal protein sources such as meat, eggs, and dairy products. As an important source of high-quality protein for both human and animal consumption domestically, and as a foreign exchange earner, the fishing industry and aquiculture should be supported with programs to assist with credit, sanitation, inspection, entry into foreign markets and technology. In establishing these programs, the government of Korea should concentrate its limited personnel and financial resources in areas where private industry cannot do the job, leaving much of the industry in private hands. One such area is to survey and analyze the biological limits to the annual fish catch level in the in-shore and coastal fishing areas. Research on the extension of these biological limits to allow higher annual catch levels as well as research on more efficient methods of aquiculture should be provided.

18. *Family Planning Program.* The following recommendations are made for family planning:

a. Field workers should be provided higher quality training and motivation to upgrade their roles as para-medical professionals who provide a quality service to meet the needs of increasing numbers of women entering the childbearing ages. The number of eligible couples per field worker should at least remain at present ratio levels (currently 1,600 couples in rural areas and 2,400 couples in urban areas per worker).
b. Considerable effort should be focused on reaching the young adult migrants flowing into the rapidly growing, low income urban areas.
c. Information should be distributed by the family planning program to emphasize decreasing the average size of family. In order to capitalize on the trend toward marrying at a later

[4] A Study of 12 feed mixing plants in 1966 indicated they were operating at 33 percent of capacity. Agricultural Economics Research Institute, *Feed Supply and Use for Livestock Production in Korea.* MOST- USAID Trust Fund Project, 1968, p. 280.

age, the information campaign should also emphasize a delay between marriage and starting a family by pointing out the economic advantages of delay, particularly for young couples in the urban areas.

d. Perhaps there should be somewhat less emphasis on field workers achieving their quota of acceptors and more emphasis on the professional para-medical services of couples from permanent locations both before and after acceptance, particularly to better handle the problem of side effects and the high incidence of IUD removal.

e. The family planning program already follows the practice of providing modest economic incentives to acceptors (free contraceptives, except the small 30-Won fee for a cycle of pills) as well as payments to private doctors on a per case basis. These incentives should be continued.

f. The family planning approach to population control is important, but is by no means the only possible means. In addition, the government should review present and potential tax and transfer policies, education policies, and other economic and social instruments for their effect on population control.

The actual costs associated with the above recommendations depend on the extent to which they are adopted. Since the past family planning program has been quite successful, we will assume that expenditures per woman of childbearing age will continue at the 1970 rate of 147 Won per woman. During the period of 1971-1975, this population will be 20.46 million, during 1981-1985 it will be 26.99 million. Employing the unit cost of 147 Won, the implied total cost of the recommended family planning program is 10.32 billion or 688 million Won per year between 1971 and 1985.

19. *Government Organization and Administrative Reform Program.* The following changes were recommended in the organization and administration of MAF and other agencies administering agricultural policies and programs. Foreign technical assistance is recommended in carrying out these recommendations.

a. In order to achieve better planning coordination within the MAF, a new plans coordination unit should be established administratively under the planning coordinator to serve as his staff to aid in planning responsibilities.

b. The planning units now located in the various divisions and bureaus should remain under the administrative control of their respective units, but be physically consolidated and housed near the office of their respective assistant vice ministers to insure internal as well as across division and across bureau coordination, and to provide the vice ministers the coordinated information and analysis they need for key decision making. Thus, responsible officials in MAF have planning and program responsibility without the authority to control effectively the administrative structure necessary to execute that responsibility.

c. MAF officials should be given some degree of authority over the appointment, pay scales, and operations of officials responsible for agricultural programs at the provincial and local levels. It is recognized that this would represent a complete departure from the present government structure, and as such, might be unacceptable for reasons outside the Ministry of Agriculture and Forestry.

d. If this recommendation proves infeasible, MAF should strongly consider using more nonadministrative methods of program implementation to achieve its policy objectives. The policies and programs recommended by KASS move in this direction.

e. The present Agricultural Economics Research Institute (AERI) should be renamed the Institute for Agricultural Economics and Statistics (IAES) and be placed administratively under a director with the same status as the planning coordinator and the assistant vice ministers.

f. The statistics branch should be under a coordinator of statistics and the agricultural economics branch under a coordinator of agricultural economics. The statistics branch should have no program responsibility other than to provide accurate agricultural and economic statistics to all planning and administrative units of the government. Previous studies of statistical needs by outside experts should be re-examined and a special working team of outside and Korean experts be convened to recommend a detailed plan to gather and process the necessary agricultural and economic statistics. Among the items which should be examined is the use of sampling methods—methods to insure that statistics gathered on individuals will not be used for tax regulation or other commercial purposes, and the use of aerial surveys for gathering crop and land use statistics.

g. The agricultural economics branch of IAES

should include as one of its major functions the economic outlook work for MAF. This unit should be staffed with competent, professional economists who are paid salaries high enough to hold them in their jobs for a number of years. They must have job continuity in order to develop a deep understanding of their subject matter. They should not be expected to do day-to-day policy analysis, but should provide the basis for competent policy analysis by providing a continuous flow of information on the economic situation and prospects relating to agriculture.

h. Another functional unit in the agricultural economics branch should be a policy analysis unit administratively under the director of agricultural economics, but physically located near the office of the vice minister. He should have the responsibility of providing the minister and vice minister with economic analysis of various policy proposals, evaluation of economic implications of plans made by the various divisions and bureaus, and whatever else the top officials need in the way of economic analysis.

i. The two functions remaining are long-run research measuring the structural elements of the agricultural sector and planning coordination and liaison between MAF and EPB and the other ministries. Special attention must be given to building the institutional arrangements to accomplish each of these functions so they are flexible and adaptive enough to provide for wide support and maximum contribution from all parties involved.

The long-range research should be applied and coordinated with the needs of government agencies. But those engaging in research should not be expected to do short-run analysis for MAF or EPB officials for planning and program review purposes. The institutional framework should make use of the talents of professionals in the universities and in the private sector as well as those in government.

j. The planning coordinator function must be institutionalized so as to draw upon the work performed in satisfying each of the other three functions. Agricultural sector and simulation analysis can make a substantial contribution to these efforts but how it should be integrated and under what institutional arrangements these functions should be performed is a question requiring further thought and analysis. Premature decisions at this point could create many long-run problems.

k. It is recognized that commodity coordination is necessary for effective program planning and execution. However, the present structure seems to sacrifice coordinated planning in an attempt to achieve improved program execution. If the recommendation regarding the use of more indirect policy instruments were adopted, it would appear that functional rather than commodity coordination would be more effective and that adequate horizontal coordination could be achieved by the proposed plans coordination unit. Therefore, it is recommended that the MAF be organized on functional lines, with a Planning Coordinator, Assistant Vice Minister for Production, Assistant Vice Minister for Marketing, and a Director of the Institute for Agricultural Economics and Statistics. The commodity coordination would be maintained by the proposed plans coordination unit, and the functional coordination would substantially enhance the achievement of the programs recommended above in sections 1 through 19.

Projected Consequences of Policies and Programs under the Recommended Policy Strategy Set

The goals specified in the first part of this chapter have been expressed as a fourth recommended policy strategy set judged by KASS investigators and public decision makers as superior to either of the three alternatives outlined in Chapter 4, and described in detail in Chapter 6. The implications of this fourth, superior policy strategy set have been spelled out above in terms of specific policy and program recommendations.

This section presents projections as to the overall consequences of following these policy and program recommendations.

These projections, from the KASS simulation model, indicate more or less accurately the extent to which the targeted goals for Korean agriculture will be attained by the recommended policies and programs. They are also useful in indicating the degree of superiority of the recommended policy strategy set.

Results Attainable from the Recommended Policy Strategy Set

The simulation model was operated for the years

TABLE VII-8
Projected Consequences of the KASS Recommended Development Strategy for the Agricultural Sector of Korea, 1975, '80, '85

Consequences	Units*	1971	1975	1980	1985
Population—total	1,000 persons	31,690†	34,630	37,180	39,480
Population—urban	1,000 persons	15,820†	19,190	24,250	30,810
Population—rural‡	1,000 persons	15,870†	15,450	12,930	8,670
Calorie consumption—rural	cal/day/cap	2,630	2,603	2,670	2,748
Calorie consumption—urban	cal/day/cap	2,534	2,577	2,691	2,730
Protein consumption—rural	grams/day/cap	65	65	70	77
Protein consumption—urban	grams/day/cap	73	78	86	89
Urban consumer price index	1970 = 100	104	109	108	108
Urban nonfood expenditures—total	bil. Won	929	1,310	2,230	3,669
Urban nonfood expenditures—per capita	1,000 Won	57	66	92	119
Urban food expenditures—total§	bil. Won	658	964	1,336	1,925
Urban food expenditures—per capita	1,000 Won	42	50	55	63
Total urban consumption	bil. Won	1,587	2,274	3,566	5,593
Food portion of total urban consumption expenditure§	percentage	41	42	37	34
Gross agriculture income—total	bil. Won	859	1,205	1,406	1,672
Gross agriculture income—per capita//	1,000 Won	54	78	109	193
Agriculture value added—total	bil. Won	565	890	1,040	1,230
Agriculture value added—per capita	1,000 Won	36	57	80	142
Returns per hectare (rice)#	1,000 Won	169	321	356	364
Returns per man-year (rice)#,**	1,000 Won	240	440	470	460
Fertilizer requirement	mil. MT	.9	1.4	2.0	2.3
Pesticide and other chemical requirement index	1970 = 100	105	126	152	182
Capital requirement index‡	1970 = 100	111	163	212	432
Expenditure on fertilizer††	bil. Won	20	28	34	35
Expenditure on pesticides and other chemicals††	bil. Won	6.6	6.4	5.9	5.4
Expenditure on capital††	bil. Won	38	50	57	103
Taxes paid index	1970 = 100	116	199	247	288
Net foreign exchange required for purchase of agricultural products (excl. feed grains)‡‡	bil. Won	52	24	16	15
Net foreign exchange required for purchase of agricultural products (incl. feed grains)	bil. Won	82	63	60	69

* Monetary units are in constant 1970 Won.
† These data are values for the year 1970.
‡ These projections are based upon the same migration rates assumed for Alternative II. One would, however, expect a reduced off-farm migration under the better rural economic conditions prevailing in the KASS recommended strategy. The higher rural-labor supply in the KASS recommended alternative would reduce the need for mechanization and related capital investments.
§ These figures are about 10 percent low due to food items (mainly condiments) not included in food expenditure.
// Includes income from nonagricultural sources.
Without imputing land and family labor costs.
** A man-year is defined as 2,000 man hours.
†† Expenditures allow for relative price changes of factor inputs in 1970 Won.
‡‡ In these computations surplus barley (available for livestock feed) is valued at world prices as an export item.

1975, 1980 and 1985 with inputs reflecting the policies and programs recommended in this chapter. The output of these operations consists of projected values for the criterion or performance variable listed in Table VII-8. Table VII-9 summarizes land utilization for 11 crop commodities, while Table VII-10 deals with supply and disappearance. References to these tables indicate that the recommended alternative is potentially capable of producing the following results.

1. Attainment or near attainment of self-sufficiency in rice in the mid-1970s.[5] It is estimated this would take place at a production of 4.6 million MT in 1975, at a price of 150,000 1970 Won per MT. The KASS projections assume that consumer prices increase uniformly to 1975 levels. If consumer price increases are more rapid it may be possible to attain self-sufficiency or near self-sufficiency earlier than 1975. Under this alternative, near self-sufficiency in rice is maintained through 1985 without direct governmental administration of rice and barley consumption. These projections assume present technologies. With success in developing new rice varieties under the recommended agricultural research program, complete rice self-sufficiency would be attainable.
2. Self-sufficiency in barley. In the late 1970s, modest quantities of barley would be available to offset partially the need for imported feed grain. These projections assume present varieties of barley. With success in developing new barley varieties under the recommended research program, substantial quantities of barley could become available to almost completely offset the need for imported feed grains by 1985.
3. Wheat imports are sharply reduced from those of Alternative II due to the higher wheat prices of Alternative IV. Wheat imports are about 200,000 MT less in 1975 than in Alternative II, and about 600,000 MT less in 1985. Wheat imports could be reduced substantially below these figures with success in developing wheat varieties under the agricultural research program recommended since these projections assume present technologies.
4. There would not be self-sufficiency in feed grains. These would be imported to provide feed for poultry, dairy and meat production, though in smaller quantities than under Alternative I due to greater emphasis on poultry production. As indicated in 2 above, success in developing superior varieties of barley would be of considerable help in attaining greater self-sufficiency in feed grain production. Further, success in obtaining forage varieties would permit Korea to produce forage for dairy and beef production to replace projected imports of feed grains for the production of poultry and other animal proteins.
5. By the year 1975, it is estimated that average

[5] KASS projections are based on average production yields.

TABLE VII-9
Projected Land Allocation to 11 Cropping Enterprises under the KASS Recommended Development Strategy for the Agricultural Sector of Korea, 1971, '75, '80, '85

	Land Area				Percentage of Total Area			
Commodity*	1971	1975	1980	1985	1971	1975	1980	1985
	....thousand hectares....				....percentage....			
TOTAL	3,606	3,730	3,967	4,081	100.0	100.0	100.0	100.0
Rice	1,230	1,234	1,249	1,262	34.1	33.1	31.5	30.9
Barley	955	973	844	686	26.5	26.1	21.3	16.8
Wheat	170	172	265	373	4.7	4.6	6.7	9.1
Other grains	137	110	74	36	3.8	2.9	1.9	.9
Fruits	64	83	103	126	1.8	2.2	2.6	3.1
Pulses	375	357	408	426	10.4	9.6	10.3	10.4
Vegetables	241	302	327	349	6.7	8.1	8.2	8.6
Potatoes	204	255	334	384	5.7	6.8	8.4	9.4
Tobacco	41	49	50	56	1.1	1.3	1.3	1.4
Mulberry	101	110	124	141	2.8	3.0	3.1	3.5
Industrial crops	88	85	189	242	2.4	2.3	4.7	5.9

* No estimates were made on the allocation of land to the production of forage crops.

TABLE VII-10
Supply and Disappearance of 14 Food Commodity Groups and 3 Industrial Crop Groups under the KASS Recommended Development Strategy for the Agricultural Sector of Korea, 1971, '75, '80, '85*

Commodity Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for	Disappearance: Unaccounted for/Total§
		.....million MT.....			percentage	.....million MT.....			percentage
Rice	1971	3.977	.725	4.702	84.6	1.746	2.041	.915	19.5
	1975	4.623	.467	5.090	90.8	1.806	2.213	1.071	21.0
	1980	5.155	.321	5.476	94.1	1.664	2.607	1.105	22.0
	1985	5.614	.226	5.840	96.1	1.241	3.269	1.330	22.8
Barley//	1971	2.081	.010	2.091	99.5	1.381	.447	.263	12.6
	1975	2.395	(.196)	2.199	108.9	1.285	.602	.312	14.2
	1980	2.324	(.277)	2.047	113.5	1.016	.721	.310	15.1
	1985	2.056	(.543)	1.513	135.9	.515	.712	.286	18.9
Wheat#	1971	.378	.838	1.216	31.1	.476	.692	.038	3.1
	1975	.399	.794	1.193	33.5	.327	.824	.042	3.5
	1980	.668	1.005	1.673	39.9	.295	1.290	.088	5.3
	1985	1.012	1.124	2.136	47.4	.275	1.714	.146	6.8
Other grains	1971	.137	.012	.149	92.0	.089	.044	.015	10.1
	1975	.145	.008	.153	94.8	.090	.047	.017	11.1
	1980	.130	.022	.152	85.5	.080	.057	.015	9.9
	1985	.079	.057	.146	54.1	.056	.071	.009	6.2
Fruit	1971	.491	.008	.499	98.4	.095	.266	.138	27.7
	1975	.698	.014	.712	98.0	.128	.385	.197	27.7
	1980	.991	(.015)	.976	101.5	.149	.540	.287	29.4
	1985	1.336	(.028)	1.308	102.1	.157	.755	.396	30.3
Pulses	1971	.291	.016	.307	94.8	.111	.172	.023	7.5
	1975	.329	.055	.345	95.4	.148	.211	.025	7.3
	1980	.457	.066	.523	87.4	.175	.312	.036	6.9
	1985	.562	.089	.651	86.3	.186	.420	.046	7.1
Vegetables	1971	2.584	.041	2.625	98.4	.825	1.138	.662	25.2
	1975	3.351	(.022)	3.329	100.7	.966	1.483	.879	26.3
	1980	3.823	.058	3.881	98.5	1.022	1.840	1.019	26.3
	1985	4.290	.099	4.389	97.7	.952	2.256	1.183	26.9
Potatoes	1971	.849	.038	.887	95.7	.286	.468	.133	15.0
	1975	1.128	.043	1.171	96.3	.266	7.18	.188	16.1
	1980	1.558	(.044)	1.514	102.9	.210	1.030	.275	18.2
	1985	1.866	(.047)	1.819	102.6	.107	1.368	.344	18.9
Beef	1971	.040	(.001)	.039	102.6	.003	.033	.003	7.7
	1975	.053	(.002)	.051	103.9	.004	.043	.003	5.9
	1980	.090	(.003)	.087	103.4	.006	.075	.006	6.9
	1985	.143	(.000)	.143	100.0	.007	.126	.010	7.0
Milk	1971	.051	(.001)	.050	102.0	.006	.035	.009	18.0
	1975	.090	(.001)	.089	101.1	.016	.058	.015	16.9
	1980	.236	(.005)	.231	102.2	.026	.164	.042	18.2
	1985	.490	(.003)	.487	100.6	.033	.370	.089	18.3

* The results presented in this table ignore carry-ins and carry-outs from year to year.

† Total food supply is defined as production plus imports (or production minus surplus).

‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing and production losses and "production deflators."

§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).

// Surplus barley is utilized for livestock feed.

Wheat imports are underestimated by about 600,000 MT.

continued

TABLE VII-10 *(continued)*

Commodity Alternative	Year	Supply: Production	Supply: Import (Surplus)	Supply: Total Food Supply†	Supply: Self Sufficiency	Disappearance: Consumption: Rural	Disappearance: Consumption: Urban	Disappearance: Unaccounted for	Disappearance: Unaccounted for/Total§
		.....million MT.....			percentage	.....million MT.....			percentage
Pork	1971	.085	(.002)	.083	102.4	.024	.059	.003	3.6
	1975	.110	....	.110	100.0	.028	.078	.005	4.5
	1980	.130	(.003)	.127	102.4	.029	.093	.006	4.7
	1985	.155	(.003)	.152	102.0	.027	.118	.007	4.6
Chicken	1971	.055	.002	.057	96.5	.009	.047	.001	1.8
	1975	.095	....	.095	100.0	.014	.079	.002	2.1
	1980	.150	(.004)	.146	102.7	.017	.127	.003	2.1
	1985	.225	(.005)	.220	102.3	.018	.198	.004	1.8
Eggs	1971	.144	(.002)	.138	104.3	.034	.086	.023	16.7
	1975	.210	....	.210	100.0	.054	.123	.032	15.2
	1980	.360	(.002)	.358	100.6	.076	.224	.058	16.2
	1985	.570	(.007)	.563	101.2	.087	.379	.097	17.2
Fish	1971	.683	(.005)	.678	100.7	.159	.441	.079	11.6
	1975	.895	(.016)	.879	101.8	.153	.615	.111	12.6
	1980	1.290	.009	1.299	99.3	.170	.960	.168	12.9
	1985	1.740	(.002)	1.738	100.1	.154	1.346	.238	13.7
Tobacco**	1971	.065	(.056)	....	....	....	....	.008	....
	1975	.084	(.073)	....	....	....	....	.011	....
	1980	.087	(.077)	....	....	....	....	.011	....
	1985	.103	(.089)	....	....	....	....	.013	....
Mulberry**,†† (cocoon)	1971	.023	(.023)	....	....	....	....	.001	....
	1975	.034	(.033)	....	....	....	....	.001	....
	1980	.046	(.044)	....	....	....	....	.001	....
	1985	.060	(.058)	....	....	....	....	.002	....
Industrial** crops	1971	.085	(.078)	....	....	....	....	.007	....
	1975	.106	(.098)	....	....	....	....	.008	....
	1980	.294	(.272)	....	....	....	....	.023	....
	1985	.453	(.417)	....	....	....	....	.036	....

† Total food supply is defined as production plus imports (or production minus surplus).

‡ "Unaccounted for" is the difference between the total food supply and rural and urban consumption. It includes marketing and production losses and "production deflators."

§ "Unaccounted for/Total" is the proportion of the "total food supply" which is unaccounted for. Unusually low or high percentages may indicate inconsistencies among the various data inputs to the supply and demand components of the simulation model (e.g., yields, hectarages, quantities imported, consumer survey data, price and income demand elasticities).

** Domestic consumption data were not available.

†† Domestic over-estimated after 1975. Due to poor profitability farmers are likely to shift away from silk production.

per capita daily consumption would be about 4 percent less than under Alternative II, but about the same as present levels. As was the case with Alternative II, the nutritional content of the rural diet is about the same as the urban diet with respect to calorie intake, but inferior in protein content. Success in developing new cereal and forage varieties would permit these projected consumption levels to be exceeded.

6. Rural value added per capita would be higher than under Alternative II due to both higher farm produce prices and somewhat higher production. In 1975, rural value added per capita would average 57,000 Won as compared with 51,000 under Alternative II. Gross agricultural income in 1975 will be about 80,000 Won per person under this alternative. Urban per capita consumption in 1975 will be about 120,000 Won.
7. Under this alternative, returns to labor and land above costs other than for land and family and operator labor would be somewhat higher than for Alternative II (as much as 30 percent for rice, but substantially less than 30 percent for most other commodities).
   a. One result will be still higher land values.
   b. Another will be the retention of more people in agriculture and a downward shading of the rural per capita income and value added projections of number 6 above. This curtailment of off-farm migration would likely affect the older, the very young and the unskilled. In effect, higher rural incomes would permit such people to stay in agriculture rather than be driven out by low farm earnings to accept low-paid, urban jobs or even unemployment where they would congregate in urban slums while contributing more to Korea's social problems than to her GNP or export earnings.
   c. A third result will be a more equal distribution of income between the farm and nonfarm sector. While incomes will be somewhat less equally distributed in agriculture, even the higher rural incomes will be low relative to higher urban incomes. The problem of both rural and urban poverty will still need to be attacked as a separate national problem, even though the recommendations contained herein will be of some help.
8. The drain on foreign exchange from rice and other agricultural purchases will be reduced as compared with Alternative II. Agricultural imports will be about 12 billion Won less than Alternative II in 1975, and about 40 billion less in 1980. With reference to Alternative I, agricultural imports are 35 billion Won less in 1975, and 85 billion less in 1980.
9. Internationally and militarily, Korea would be less dependent on foreign food supplies than under Alternative II, and much less than under Alternative III which was the high import, low food price alternative.
10. The effects of Alternative IV on capital accumulation in agriculture with reference to Alternative II are not clear. The increased rural incomes over Alternative II will increase property values and, hence, both investment and the available resource base usable as collateral for other investments. The likely decrease in rural-urban migration will reduce the need for farm mechanization and related capital investment, but ability to pay will probably increase such investments in order to remove the drudgery of hand and animal labor. Other agricultural investments (i.e., in livestock, orchards, vegetable production and other enterprises) will be stimulated, however. Since an important policy component of Alternative IV is the development of improved paddy drainage systems, further capital accumulation in agriculture is likely in this area. In total, a net increase in capital accumulation in agriculture is likely over Alternative II.

The KASS recommended strategy was also run under the assumption that the population control effort might not be as successful as desired, or, in other words, that the population might grow to 40.9 million in 1985 as projected under Alternative I rather than the 39.5 million as projected under the other alternatives. The simulated projections indicate that net foreign exchange required for purchasing agricultural products (less feed grains) might rise to 24 billion Won in 1980 and to 43 billion Won in 1985 as compared to the 16 billion Won and 15 billion Won, respectively, presented in Table VII-8. Likewise, under a less successful population control program per capita agricultural incomes decrease slightly and urban per capita food expenditures increase slightly over results presented above. Thus, as might be expected, by 1985 both rural and urban people are somewhat worse off and much larger amounts of scarce foreign

exchange are required for purchasing food imports if the population grows at a faster rate than assumed for the results presented in Table VII-8.

Comparisons of Results for Recommended Policy Strategy Set with the Three Alternatives

Relative to the other three policy strategy alternatives, the recommended policy strategy set yields projected consequences which appear, in total, to be quite favorable.

Due primarily to the higher rice price and the resultant increase in production, the recommended policies and programs result in a larger gross agricultural income and agricultural value added than any of the three alternative strategies. Our recommendations provide a projected gross agricultural income of 1,670 billion Won and an agricultural value added of 1,230 billion Won as compared to 1,615 billion Won and 1,165 billion Won, respectively, by Alternative II.

Projected input requirements change only slightly between Alternative II and these recommendations.

Since rural-to-urban migration would probably be slowed due to higher rural incomes, the projected number of power tillers and related equipment would be slightly less than in Alternative II. The KASS recommended strategy projections on numbers of five-horsepower tillers are approximately 50,000 units in 1975, 115,000 units in 1980 and 350,000 units in 1985.

Under the recommended programs and policies, there would be less pressure from low farm incomes for unskilled farm persons to migrate to low-paid urban jobs and possibly unemployment. Instead, migration would be more closely attuned to the creation of industrial employment and those migrating would be better trained to fill productive urban positions.

Relative to Alternative II, the prices of rice and wheat are raised, while the price of barley is lowered. Even with the substantially higher rice and wheat prices, the food proportion of total urban consumption expenditure remains almost constant until 1975 at about 42 percent, declines to 37 percent in 1980, and declines even further to 34 percent in 1985. Nutrition levels, as measured by calories and protein, compare favorably to Alternative II. The comparisons assume current trends in yields; if the recommended research program to develop and import new cereal and forage varieties is successful, even greater advantages should materialize in the last half of the 1972-85 period.

The rice import gap is narrowed considerably from the other alternatives, but even more importantly, it drops to about 230,000 tons throughout the projection period. The fact that the rice import gap is relatively small couples with the fact that the KASS yield and acreage projections may be rather conservative. This indicates that rice self-sufficiency can be reached in the 1970s and maintained in the 1980s provided the research effort on new rice, other food grain, feed grain and forages is successful. In case the research program is not successful, various administrative constraints may be needed to decrease rice consumption further and expand human consumption of barley.

Even with a steep decline in the barley price after 1975 to levels at which barley can compete with imported feed grain, an excess of 540,000 tons over requirements for domestic food consumption is noted; this can be used to replace imported feed grains. The wheat deficit continues to mount for some time under our recommendation as under Alternative II, although it appears to be leveling off at about 1.1 million metric tons by 1985. The wheat import deficit is approximately two-thirds the level projected under Alternative II. Finally, the net foreign exchange required for purchase of agricultural products (less feed grains) declines to about half the 1971 level by 1975 and declines further through 1985. With success in the research program on new cereal and forage varieties, the wheat deficit and feed grain imports would be further reduced in the 1975 to 1985 period.

Assuming an average propensity to save of .12 by the urban population, an estimate of urban per capita income was calculated from the urban consumption expenditure figures used in the analysis. The per capita agricultural value added figures in Table VII-8 do not include income from nonagricultural sources, but they do reflect the per capita income from agricultural sources. Thus, per capita agricultural income from agricultural sources is 33 percent of urban consumer income in 1971, and increases during the projection period to 42 percent in 1975, 48 percent in 1980, and 69 percent in 1985. These figures further stress the conclusion that inequities between farm and nonfarm incomes are so important that (1) the transfer of income to farmers via higher food prices does not create an inequitable income distribution, and (2) that rural poverty cannot be corrected equitably by redistributing income only within farming.

The improved distribution of income between agriculture and the nonagriculture sector is relative to the other alternatives analyzed and is attained at

the cost of an increase in urban food expenditures of about 3 percent between 1971 and 1975, and about 2 percent in 1980 and 1985 over Alternative II. Furthermore, consumers may feel their level of living has been lowered since they will be consuming larger quantities of barley and smaller quantities of rice and wheat unless the research program to develop better varieties of cereals and forages is successful.

Summary

This KASS effort is the first major extended analysis undertaken of the Korean agricultural sector and its development problems. It indicates the importance of agricultural sector development as an integral part of the total Korean economy and points up many problems and bottlenecks which must be alleviated in order to do an effective job of sector development.

In addition to setting targets and reaching policy and program recommendations, this report indicates that intense as the problems are today, they will intensify after 1975. Despite today's pressures, Korean agricultural policy makers should prepare themselves for the much heavier demands which will be placed upon them in the years ahead, and particularly after 1975. These preparations should include, at the minimum, a streamlining and reorganization of the institutions serving agriculture, including MAF, in order to be prepared to carry out assigned roles effectively in the future. Action organizations which implement programs as well as planning organizations can upgrade the skills of key personnel and develop administrative structures within which they can function effectively. Preparations should also include the establishment of a much improved capacity for doing more quantitative sectoral, policy and program analysis.

Though a host of studies are needed to evaluate and plan adequately the many programs which have or will become a part of agricultural sector development in Korea, a prime need is to upgrade the capacity to put them all together to determine their implications for the agricultural sector and for the entire economy of Korea. Thus, this agricultural sector analysis starts what should remain a continuing exercise with increased staff and run by Koreans. Such a continuing effort will require: (1) continual development and extension of a model showing how the Korean agricultural sector operates, both internally and as a part of the entire Korean economy, and (2) a much extended base of reliable data on the agricultural sector.

Appendixes

Appendix A

Computer Simulation Models

The purposes of this appendix are:

1. To describe the role that simulation models have played in the foregoing sector study of Korean rural development;
2. To discuss structural details of these models and further modeling work necessary to achieve a comprehensive agricultural sector simulation for Korea.

In the attainment of its objectives, the Korean Agricultural Sector Study (KASS) examined the consequences of pursuing three alternative strategies for agricultural sector development and then developed a fourth recommended strategy, also presented in the report. The first policy alternative, broadly speaking, involves continuation to 1985 of policies outlined in the Third Five-Year Plan (TFYP) for the years 1972-1976. The major goals of the plan are an increase in the level of food self-sufficiency and increased growth of rural income. This alternative includes relatively high food grain prices to stimulate supply and inhibit demand and substantial investments in programs and projects to expand agricultural production. Alternative II accepts the goals of the TFYP but seeks more effective and efficient attainment by reallocation of the public budget for rural development and modification of the regulatory policies of the TFYP. Specifically, Alternative II includes higher food grain prices than Alternative I, increased emphasis on population control, and substantial increases in budget allocations to research and extension efforts to improve the level and extent of application of agricultural technology. The third policy alternative is an abrupt departure from Alternatives I and II; this alternative moves the agricultural sector of Korea toward greater reliance on the competitive market domestically and toward free trade in world markets for agricultural inputs and outputs. Public policies are directed into areas which will stimulate and enhance the adjustments to free market conditions.

The impact of alternative policies upon a number of performance criteria (agricultural income, value added, imports/exports, per capita incomes and nutritional levels, etc.) were projected through time from 1971 to 1985. Extensive use of simulation models was made in this analysis and projection work. Much of what follows will describe these models and their application to the sector analysis.

Overall Model Description

Figure A-1 illustrates the scope of a comprehensive agricultural sector model envisioned for Korea. The broad outlines of the model used to make sector analysis projections are shown in Figure A-2. This appendix presents a general description of the model of Figure A-2 and its use in projecting the performance of the Korean agricultural sector under three alternative policy strategies. As shown in the diagrams the model disaggregates agricultural

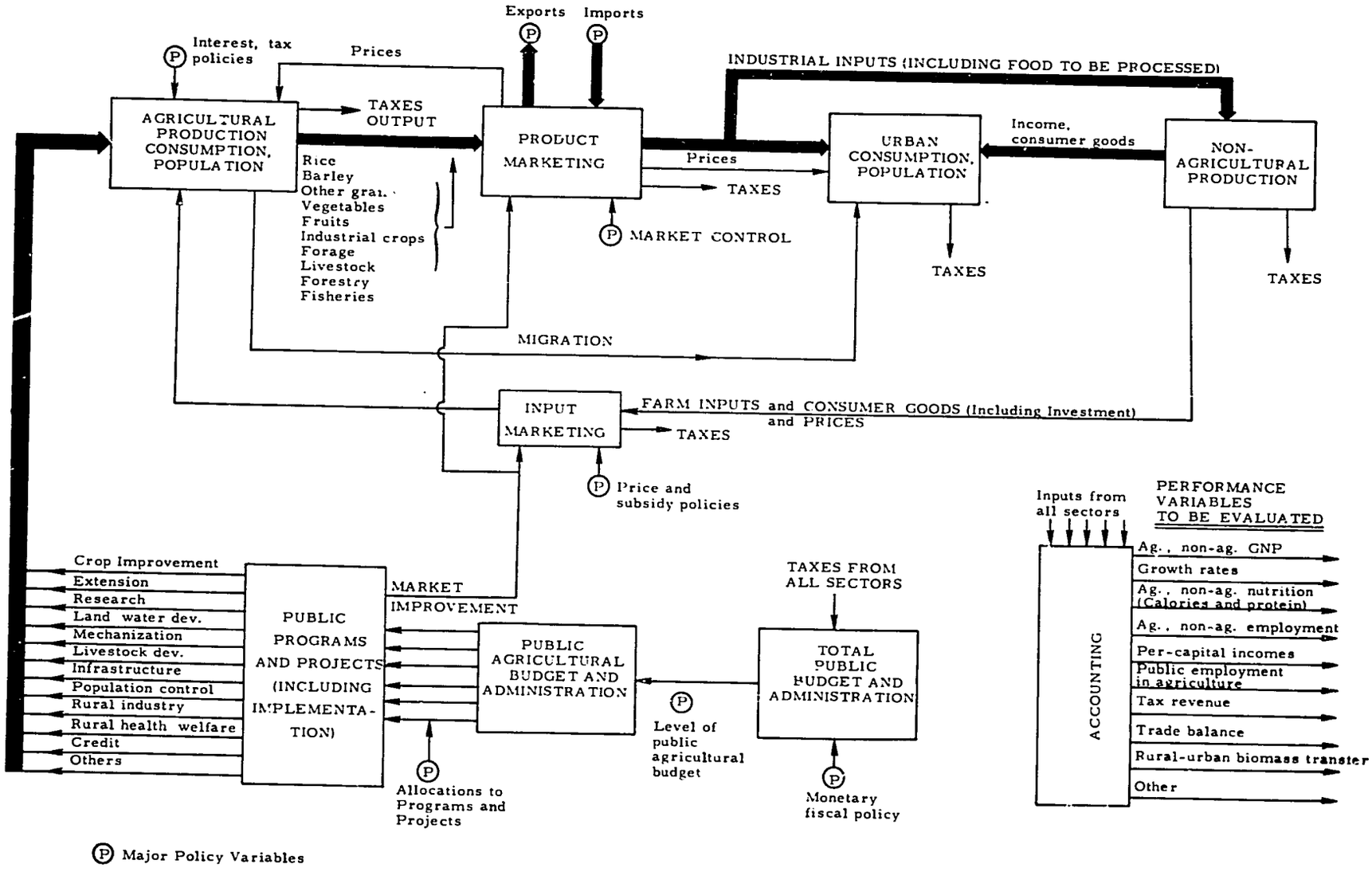


FIGURE A-1. Korean agricultural sector analysis: major sub-sectors, flows, outputs, and policy inputs.

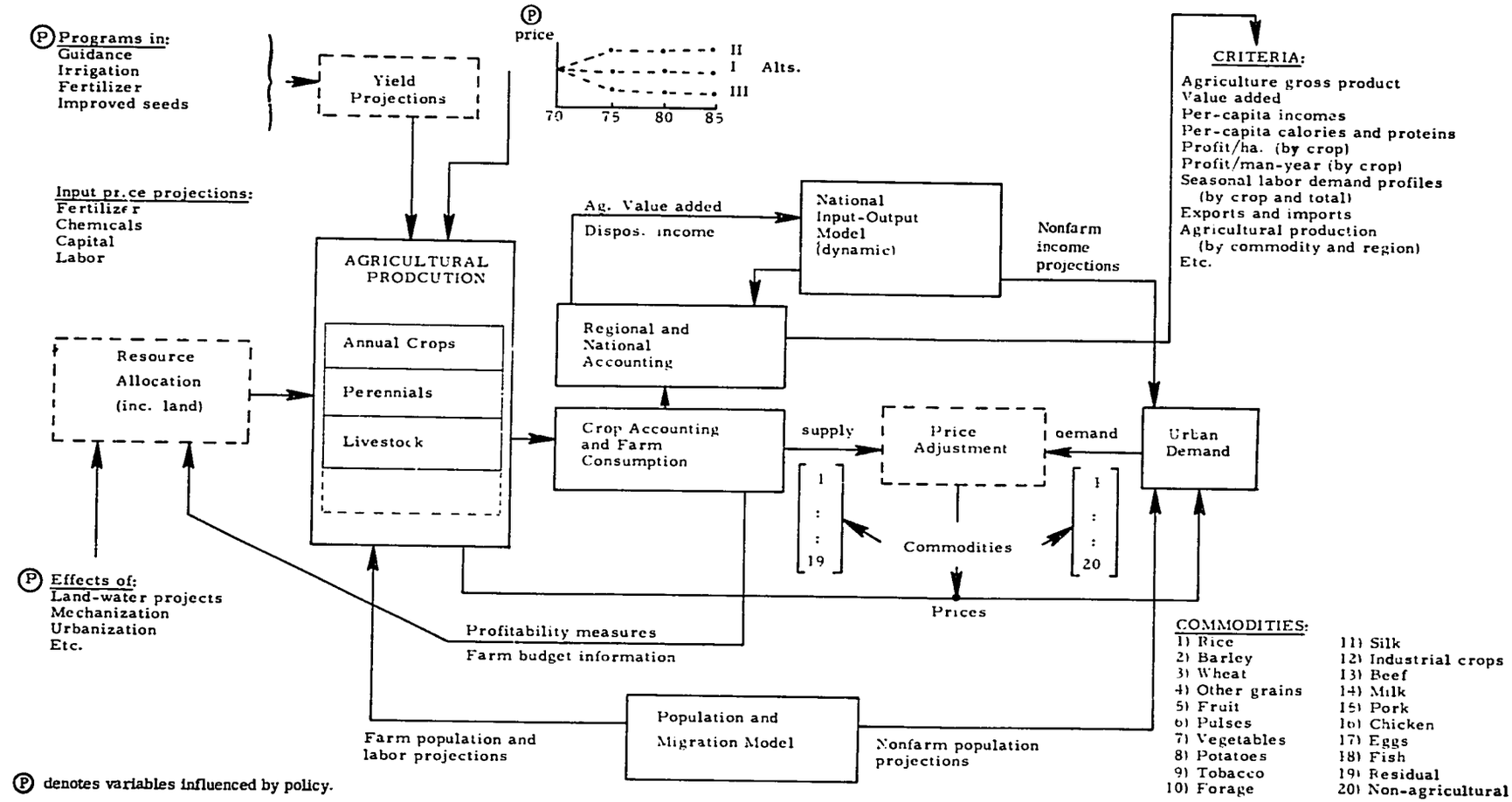


FIGURE A-2. Diagram of iterative operational model of Korean agricultural sector actually used to project consequences of alternative policy strategies.

production into 19 commodities or commodity groups.[1] These commodities were selected on the basis of current or potential importance and include such important individual items as rice, barley and wheat and, as commodity groups, collections of relatively homogeneous items such as "vegetables," "fruits" and "industrial crops." On the production side, the model is disaggregated according to three regions within the country, with regions defined according to cropping patterns which are determined fundamentally by climatic and topological factors. The three regions include a "single cropping paddy" region in the northwest of the Republic where paddy rice without a second crop is the dominant pattern; the "double cropping paddy" region at the southern end of the peninsula where, due to a longer growing season, a second crop can be grown after paddy rice; and a "mountains" region in the northeast where upland cropping patterns dominate.

The model disaggregates consumption of agricultural products according to the 19 crops or crop groups mentioned above and also according to a rural/urban classification. Agricultural supply is thus computed as the difference between production and farm consumption plus losses (by items). Rural consumption by item is computed as a function of agricultural income, producer prices, agricultural population and the nutritional requirements of the agricultural population as influenced by age and sex distribution. The latter are computed by the population component of the model while agricultural income is computed by the production component. The determination of model prices will be discussed later.

Urban consumption of the 19 food items is computed for the urban population by the urban demand model shown in Figure A-2. This model component also computes the demand of urban people for nonagricultural goods and services and interactions between agricultural and nonagricultural demands as influenced by growth in total urban income, urban population, and food prices. The urban demand model receives, as time varying inputs, urban population from the population component and total consumption from a macro model of the nonagricultural economy.

The population and migration model component, shown in Figure A-2 and referred to above, computes the age and sex compositions of the rural and urban populations as influenced by migration rates, death rates, birth rates and population-control programs which affect the latter. This component also computes agricultural labor supply as determined by age and sex distributions and participation rates.

As indicated in the figure, the model used in making projections contains a partial model of agricultural production. The production component is partial in the sense that a number of variables which eventually will be endogenous must now be supplied exogenously. These include crop yields (MT/ha) over time as they are influenced by the three policy alternatives and land areas allocated to enterprises (by regions) by an iterative process to be described. Yield projections for the three policy alternatives were made on the basis of research and field data, estimation of the impacts of government programs to promote improved technology, and trend information. Projections of total arable land by region were made including the effects of urbanization and programs to expand agricultural land area. Agricultural price inputs to the production model are determined by policies and supply/demand interactions. This component received agricultural population and labor force from the population/migration model. Given these as major inputs the production model computes a number of variables including the following: total production by enterprise and region; seasonal production, as during harvest season; seasonal labor requirements; farm consumption and storage of output; sales (supply); gross income by crop (region specific),

[1] They are: (1) rice, (2) barley, (3) wheat, (4) other grains, (5) fruits, (6) pulses, (7) vegetables, (8) potatoes, (9) tobacco, (10) forage, (11) silk, (12) industrial crops, (13) beef, (14) milk, (15) pork, (16) chicken, (17) eggs, (18) fish, and (19) agricultural residual.

by region and by sector as a whole; demands for and expenditures on inputs by type (fertilizer, chemicals, capital, labor, etc.) by crop, region and sector; gross profit by enterprise and region; returns above land and labor, to land and labor, by crop by region; gross income per capita by region; and per capita rural intake of calories and protein.

Use of the Model in Agricultural Sector Projections

We will now describe the iterative approach used to make agricultural sector projections for KASS. The approach, used for each alternative in turn, will be described as it was applied to specific alternatives. To begin the iterative process, the following variables are supplied as exogenous variables to the model structure shown in Figure A-2:

1. Grain prices (rice, barley, wheat) for 1970, '75, '80, '85 as determined by policy for the particular alternative.
2. A tentative set of prices for commodities with prices determined by domestic supply and demand.
3. A projection of total urban consumption for 1970, '75, '80, '85 (Won/yr). (Consistent with Third Five-Year Plan projections urban consumption is initially assumed to grow at 9 percent under the three alternatives.)
4. Yield projections (MT/ha) by enterprise, 1970, '75, '80, '85.
5. Projections of total arable land by regions, 1970, '75, '80, '85.
6. A tentative allocation of land area to crops by region, 1970, '75, '80, '85.

Given these inputs the model shown in Figure A-2 (consisting of production, demand and population components) was run through time from 1970 to 1985. In addition to the criterion or performance variables, these models computed over time a number of variables needed for further iterations of the process being described. These variables included:

1. Deficits and surpluses (MT/yr) by commodity by year.
2. Average producer returns per hectare and per man-year by commodity by year.
3. Agricultural sector value added by year.

The first two variables were used to make changes in commodity prices and crop area allocations for subsequent iterations. Specifically, nonpolicy determined prices are adjusted upward or downward as a function of net excess demand. Land is reallocated on the basis of relative crop profitabilities, available arable land in each region and constraints imposed by regional cropping systems. This iterative process is continued on the first two variables until supply-demand equilibrium is approximately established over the time interval, 1970-85.

Given this equilibrium it is possible to carry out iterations between the agricultural and nonagricultural models to correct for any significant changes in urban demand for agricultural commodities due to changes in agricultural imports, exports, and value added away from the values used to make initial projections of nonagricultural consumption. These iterations have not been important in Korea where agricultural income and value added are a relatively small proportion of national aggregates (about 27 percent in 1970 and 18 percent in 1985).

The results of this iterative process are summarized in the Tables VI-1 through VI-8 presented in Chapter VI and Appendix B.

Detailed Model Description

In this section we present a detailed description of the components which make up the

KASS model of Figure A-2. We will begin with the production component, next describe the urban demand component, and conclude with a description of the population model.

The Production Component

The broad outlines of the production component are shown in Figure A-2. The sub-components shown in solid outlines were completed and used at the time KASS projections were made; those in dashed outline were not completed at that time. The structural details of the four sub-components used in the projections (annual crop production, perennial crop production, crop accounting and regional/national accounting) will be discussed below.

In brief the functions of these four sub-components are as follows:

1. *Annual Crop Production*: computes output, sales, labor, etc. *as they vary seasonally over the harvest year* by crop by region. This component is useful when it is of interest to study, in detail, seasonal labor requirements and seasonal flows, stocks and price behavior. This part of the model can be by-passed if simulation based on yearly averages is adequate.
2. *Perennial Crop Production*: computes output, input requirements, etc. for perennial commodities (fruits here) as they are determined by new planting rates, removal rates, and age distribution of trees.
3. *Crop Accounting*: performs yearly accounting by crop, to compute variables such as gross and net income, expenditures by input type, returns to land and labor, and other variables all by crop by region.
4. *Regional/National Accounting*: aggregates across crops to obtain regional and sector income, expenditures, value added, per capita income, calorie and protein consumption, etc.

The Annual Crop Production Sub-component (PRODN): Some of the more important structural equations of this sub-component follow. (Recall that this sub-component is not used in the model if simulation is to be based on yearly average values of variables.)

Total yearly output for a given crop in a given region for a given policy alternative is given by

$$\mathrm{OUTPUT}_{ijk}(t) = \mathrm{A}_{ijk}(t)\ \mathrm{YLD}_{ijk}(t), \tag{1}$$

where

OUTPUT = total production—MT/yr,
A = area—hectares,
YLD = yield—MT/hectare,
i = alternative index ($i = 1,2,3$),
j = region index ($j = 1,2,3$),
k = commodity index ($k = 1,2,\ldots,12$),
t = time.

This total output is distributed over the harvest season by a distributed delay.[2] Mathematically this seasonally distributed output, $\mathrm{RH}_{ijk}(t)$, is the solution of a KMth order differential equation which has as a forcing function the variable

$$\mathrm{A1}(t) = \mathrm{OUTPUT}_{ijk}(t)\ \delta(\mathrm{NT} - \mathrm{NTSH}_k). \tag{2}$$

[2] Simulated in the computer model by a DELDT subroutine.

Here $\delta(\ )$ is the Dirac delta function, NT is the number of time intervals, DT, that have elapsed since the start of a calendar year and NTSH*DT is the time at which the harvest process is to be started for a particular crop. The change in the harvest rate over a year is illustrated in Figure A-3.

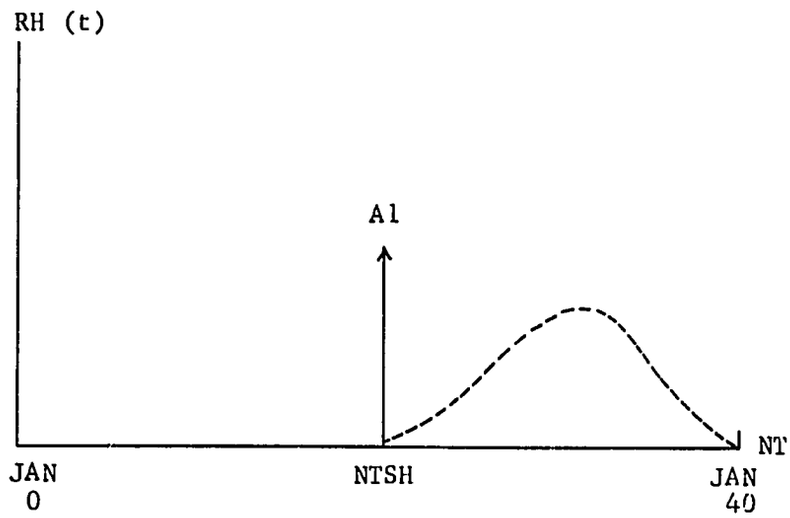


FIGURE A-3. Seasonal harvest rate.

Simulation of Seasonal Production

The shape of the harvest curve in Figure A-3 can be adjusted to approximate reality by the parameters KM and DELM of the differential equation describing the process. By adjusting the variable NTSH the harvest can be adjusted to occur at the correct time during the crop year. All this is readily simulated in the model using the DELDT subroutine [Llewellyn, 1965]. It can be shown that the total area under the RH curve is OUTPUT as required.

Given the seasonal harvest rate, RH, the labor required to carry out harvest related work is given by

$$HL_{ijk}(t) = LABPUO_{jk}(t)\ RH_{ijk}(t), \tag{3}$$

where

HL = harvest related labor—man-years/yr,
LABPUO = labor per unit of output—man-years/MT,
i,j,k = index alternatives, regions and crops.

In like manner, the model simulates the seasonal distribution of non-harvest related labor (NHL) by crop by region. The total seasonal labor profile for a given crop in a given region (TSLP) is given by:

$$TSLP_{ijk}(t) = HL_{ijk}(t) + NHL_{ijk}(t). \tag{4}$$

By the following equations this sub-component of the production model computes consumption, farm storage and sales,

$$CON_{ijk}(t) = PCCON_{ik}(t)\ RPOP_{ij}(t), \tag{5}$$

where

CON = total consumption of commodity k in region j—MT/yr,
RPOP = total farm population in region j (may differ among alternatives).

The variable PCCON is per capita food consumption given by

$$\begin{aligned} PCCON_{ik}(t) = PCCON_k(1970)\{1 + ELASIR_k\ [GIPCA_{ij}(t) \\ - GIPCA_{ij}(1970)]/GIPCA_{ij}(1970) + ELASPR_k\ [PAVG_{ik}(t) \\ - PAVG_{ik}(1970)]/PAVG_{ik}(1970)\}, \end{aligned} \tag{6}$$

where

PCCON$_k$(1970) = per capita rural consumption of commodity k in 1970—MT/person-yr,
ELASIR = rural income elasticity,
GIPCA = gross income per capita—Won6person-yr,
ELASPR = price elasticity,
PAVG = average price—W/MT.

The total quantity of farm storage (QFS) is computed by Equation 7[3]:

$$QFS_{ijk}(t + DT) = QFS_{ijk}(t) + DT\ [RH_{ijk}(t) - CON_{ijk}(t) - SALES_{ijk}(t)], \tag{7}$$

where

QFS = quantity of farm storage—MT,
RH = rate output is harvested—MT/yr,
CON = consumption rate—MT/yr,
SALES = sales rate—MT/yr,
DT = time increment used in simulation (normally .025 yr.).

$$SALES_{ijk}(t) = FN1\ [QFS_{ijk}(t) - QFSD_{ijk}(t)], \tag{8}$$

where

QFS = actual storage—MT,
QFSD = desired storage to satisfy family needs until the next harvest—MT,
FN1 = a function of price and other variables which influence sales (currently taken as a constant).

This sales equation introduces feedback which tends to equate actual farm storage to that required to satisfy family needs until the next harvest (QFSD).

The variable QFSD is computed as:

$$QFSD_{ijk}(t + DT) = QFSD_{ijk}(t) + [DT/DSS]\ [QFSDU_{ijk}(t) - QFSD_{ijk}(t)], \tag{9}$$

$$QFSDU_{ijk}(t) = TTSH_{jk}(t)\ CON_{ijk}(t), \tag{9a}$$

where

QFSDU = an unlagged version of QFSD,
TTSH = total time (years) to start of the next harvest,

[3] This equation is a numerical approximation of the integral equation

$$QFS_{ijk}(t + DT) = QFS_{ijk}(t) + \int_t^{t+DT} [RH_{ijk}(x) - CON_{ijk}(x) - SALES_{ijk}(x)]dx.$$

CON = regional rural consumption of commodity k—MT/yr,
DSS = a smoothing delay factor—years,
DT = time increment used in simulation.

QFSD is simply the total quantity of storage needed to satisfy family consumption needs until the start of the next harvest. The lag factor is introduced to more realistically simulate farmers' storage decisions during the harvest period. (Once the harvest has started farmers will not immediately set aside stocks for next year's consumption; the first part of the harvest is normally sold to satisfy needs for cash while storage for consumption takes place later in the harvest.) The introduction of this lag factor results in a more realistic simulation of farm sales during the harvest period.

The annual crop production sub-component also computes a *total* seasonal labor requirement profile for each of the three regions. This goes as follows:

$$\mathrm{RTSLP}_{ij}(t) = \sum_{k=1}^{12} \mathrm{TSLP}_{ijk}(t), \tag{10}$$

$$\mathrm{RTSLI}_{ij}(t) = \mathrm{RTSLP}_{ij}(t)/\mathrm{AGMP}_j(t). \tag{11}$$

In these equations RTSLP is the total number of full time labor units required to carry out regional crop activities in region j at time t. (The labor unit used here is an adult male working full time or 24 hrs/day, 365 days/year.) AGMP is the available manpower measured in the same units and is computed by the population component of the overall model as a function of birth, death and migration rates and the age/sex distribution and labor participation. The variable RTSLI is therefore a regional seasonal labor utilization index, to measure the total participation of the available labor force required to carry out farm crop work at various times of the year. This index is based on labor requirements inherent in 1970 technology and does not reflect the impacts of farm mechanization. The index can be used, however, to help determine needs for mechanization in terms of regional location and timing (during the year and from year to year as cropping patterns and labor supply change).

The Perennial Production Sub-component (PEREN): This sub-component is used to simulate the production of fruit (apples, pears and others as an aggregate bundle) in the Korean model. Following Abkin[4] a distributed lag model is used to simulate perennial production in terms of four production cohorts: Cohort 1, newly planted trees which are not yielding output; Cohort 2, young trees in a state of rising yields; Cohort 3, mature trees at maximum yields; and Cohort 4, old trees in a state of declining yields. This production process is simulated by four calls to DELDT subroutine, [Llewellyn, 1965][5].

A description of this process follows:

$$\begin{aligned}\text{CALL DELDT } (&\mathrm{RLIN}_{ij1}(t), \mathrm{RLOUT}_{ij1}(t), \mathrm{RINTP1}_{ij}(t), \mathrm{DPER}_1, \\ &\mathrm{IDTPER}_1, 1., \mathrm{KPER}_1),\end{aligned} \tag{12}$$

where

RLIN_{ij1} = rate land enters the first cohort, i.e., the new

[4] Michael H. Abkin, "Policy-making for Economic Development: A System Simulation Model of the Agricultural Economy of Southern Nigeria." Ph.D. dissertation, Michigan State University, 1972.

[5] This is the same approach used to simulate seasonal production in the annual production sub-component discussed earlier.

planting rate in region j under alternative i—ha/yr;

$RLOUT_{ij1}$ = rate land leaves Cohort 1 and enters a period of rising yields (this is the output variable of this call to DELDT)—ha/yr;

$DPER_1$ = average length of time trees remain in Cohort 1—years;

$KPER_1$ = a parameter that determines the probability distribution for the length of time individual trees remain in Cohort 1;

$RINTP1, IDTPER_1$ = other variables associated with the use of the DELDT subroutine.

The purpose of this call to subroutine DELDT is to compute $RLOUT_{ij1}$, the rate trees leave Cohort 1. This rate minus any losses becomes the input to Cohort 2, $RINPER_{ij1}(t)$:

$$RINPER_{ij1}(t) = RLOUT_{ij1}(t) - PHR_{ij1}(t). \tag{13}$$

PHR_{ij1} is the rate at which trees are lost (due to disease, deliberate cutting, etc.) before entering Cohort 2. The remaining three production cohorts are simulated by the following calls to DELDT in exactly the manner described above:

$$\text{CALL DELDT } (RINPER_{ij1}(t), RLOUT_{ij2}(t), RINTP2_{ij}(t), DPER_2, IDTPER_2, 1., KPER_2), \tag{14}$$

$$RINPER_{ij2}(t) = RLOUT_{ij2}(t) - PHR_{ij2}(t), \tag{15}$$

$$\text{CALL DELDT } (RINPER_{ij2}(t), RLOUT_{ij3}(t), RINTP3_{ij}(t), DPER_3, IDTPER_3, 1., KPER_3), \tag{16}$$

$$RINPER_{ij3}(t) = RLOUT_{ij3}(t) - PHR_{ij3}(t), \tag{17}$$

$$\text{CALL DELDT } (RINPER_{ij3}(t), RLOUT_{ij4}(t), RINTP4_{ij}(t), DPER_4, IDTPER_4, 1., KPER_4). \tag{18}$$

The variable $RLOUT_{ij4}$ in Equation 18 is the rate at which trees go out of production as a result of old age (the rate trees leave Cohort 4). Given this basic model of the perennial production process, it is possible to compute the land area in each cohort, total output and other variables of importance in the sector model.

Total land in each cohort is computed in Equations 19-22 as

$$LPER_{ij1}(t) = \sum_{n=1}^{KPER_1} RINTP1_{ijn}(t)\,(IDTPER_1\, DPER_1/KPER_1), \tag{19}$$

$$LPER_{ij2}(t) = \sum_{n=1}^{KPER_2} RINTP2_{ijn}(t)\,(IDTPER_2\, DPER_2/KPER_2), \tag{20}$$

$$LPER_{ij3}(t) = \sum_{n=1}^{KPER_3} RINTP3_{ijn}(t)\,(IDTPER_3\, DPER_3/KPER_3), \tag{21}$$

$$\mathrm{LPER}_{ij4}(t) = \sum_{n=1}^{\mathrm{KPER}_4} \mathrm{RINTP4}_{ijn}(t)\ (\mathrm{IDTPER}_4\ \mathrm{DPER}_4/\mathrm{KPER}_4). \tag{22}$$

Here $\mathrm{LPER}_{ijm}(t)$ (m = 1,2,3,4) is the total land (hectares) in each cohort at time t. The variables RINTP1, . . . , RINTP4 are the so-called "intermediate rates" computed by the DELDT subroutine. Each is itself an array. (The index n runs over the elements of each of these arrays.) Given these land areas, total perennial output is computed as

$$\mathrm{OUTPUT}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CYLD}_m\ \mathrm{LPER}_{ijm}(t), \tag{23}$$

and average yield, YLD, as

$$\mathrm{YLD}_{ij5}(t) = \mathrm{OUTPUT}_{ij5}(t)/\sum_{m=1}^{4} \mathrm{LPER}_{ijm}(t), \tag{24}$$

where CYLD_m are the yields of individual cohorts (here the third subscript defines perennial variables when k = 5). Similarly average input requirements (averaged across the four cohorts) are computed as

$$\mathrm{LABPHA}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CLAB}_m\ \mathrm{LPER}_{ijm}(t)/\mathrm{AP}_{ij}(t), \tag{25}$$

$$\mathrm{LABPUO}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CLPUO}_m\ \mathrm{LPER}_{ijm}(t)/\mathrm{AP}_{ij}(t), \tag{26}$$

$$\mathrm{FRTPHA}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CFRT}_m\ \mathrm{LPER}_{ijm}(t)/\mathrm{AP}_{ij}(t), \tag{27}$$

$$\mathrm{PSTPHA}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CPST}_m\ \mathrm{LPER}_{ijm}(t)/\mathrm{AP}_{ij}(t), \tag{28}$$

$$\mathrm{CAPPHA}_{ij5}(t) = \sum_{m=1}^{4} \mathrm{CCAP}_m\ \mathrm{LPER}_{ijm}(t)/\mathrm{AP}_{ij}(t), \tag{29}$$

where

LABPHA_{ij5} = average labor per hectare for perennials (in region j under alternative i) exclusive of harvest related labor—man-years/year,
LABPUO_{ij5} = average perennial harvest related labor—man-years/MT,
FRTPHA_{ij5} = average perennial fertilizer requirement—MT/ha.,
PSTPHA_{ij5} = average perennial pesticide requirement—1970 Won/ha.,
CAPPHA_{ij5} = average perennial capital requirement (includes operation and depreciation of capital)—1970 Won/ha.,
$\mathrm{CLAB}_m, \ldots, \mathrm{CCAP}_m$ = respective cohort input requirements (m = 1,2,3,4),
LPER_{ijm} = land in cohort m in region j under alternative i—hectares,
$\mathrm{AP}_{ij}(t) = \sum_{m=1}^{4} \mathrm{LPER}(t)$ = total land in perennials.

These average yields and input requirements are used in sub-component PRODN, discussed earlier, and in the crop-accounting sub-component, to be discussed later, in computation of seasonal labor requirements and crop and regional accounting for perennials. The main purpose served by this sub-component has been to make physical and economic variables associated with perennial production dependent upon tree age distributions, maturation delays and new planting rates.

The Crop Accounting Sub-component (CROPAC): This sub-component is a very straightforward module of the total model which performs a number of needed computations on a crop basis and lays a foundation for regional and national accounting. This sub-component computes annual average variables on an annual basis. Following are some of the more important equations included in the sub-component.

Expenditures on inputs by commodity are computed as the product of prices, requirements per hectare and area allocated to each commodity:

expenditure on fertilizer (EXFERT),

$$\mathrm{EXFERT}_{ijk}(t) = \mathrm{PFRT}_k(t)\ \mathrm{FRTPHA}_{ijk}(t)\ \mathrm{A}_{ijk}(t); \tag{30}$$

expenditure on pesticides and other chemicals (EXPEST),

$$\mathrm{EXPEST}_{ijk}(t) = \mathrm{PPEST}_k(t)\ \mathrm{PSTPHA}_{ijk}(t)\ \mathrm{A}_{ijk}(t); \tag{31}$$

expenditure on capital inputs (EXCAP),

$$\mathrm{EXCAP}_{ijk}(t) = \mathrm{PCAP}_k(t)\ \mathrm{CAPPHA}_{ijk}(t)\ \mathrm{A}_{ijk}(t); \tag{32}$$

expenditures on other inputs (EXOTH),

$$\mathrm{EXOTH}_{ijk}(t) = \mathrm{POI}_k(t)\ \mathrm{OIPHA}_{ijk}(t)\ \mathrm{A}_{ijk}(t); \tag{33}$$

expenditures on rent and other land charges,

$$\mathrm{EXRNT}_{ijk}(t) = \mathrm{RPHA}_{jk}(t)\ \mathrm{A}_{ijk}(t); \tag{34}$$

expenditures on seed (EXSD),

$$\mathrm{EXSD}_{ijk}(t) = \mathrm{PSD}_k(t)\ \mathrm{SDPHA}_{ijk}(t)\ \mathrm{A}_{ijk}(t); \tag{35}$$

expenditure on labor (EXLAB),

$$\mathrm{EXLAB}_{ijk}(t) = \mathrm{WR}_j(t)\ \mathrm{PCTHL}_{ijk}(t)\ \mathrm{EMP}_{ijk}(t), \tag{36}$$

$$\mathrm{EMP}_{ijk}(t) = \mathrm{LABPHA}_{ik}(t)\ \mathrm{A}_{ijk}(t) + \mathrm{LABPUO}_{ik}(t)\ \mathrm{OUTPUT}_{ijk}(t); \tag{36a}$$

where

WR = wage rate—Won/man-year,
PCTHL = proportion of total labor which is hired,
EMP = employment—man equivalents,
LABPHA = pre-harvest labor—man-years/acre-year,
LABPUO = harvest labor—man-years/MT.

Total expenditures on inputs for commodity k in region j under alternative i are given by

$$\begin{aligned} TEXPC_{ijk}(t) = {} & EXFERT_{ijk}(t) + EXPEST_{ijk}(t) + EXCAP_{ijk}(t) \\ & + EXOTH_{ijk}(t) + EXRNT_{ijk}(t) + EXLAB_{ijk}(t) \\ & + EXSD_{ijk}(t). \end{aligned} \tag{37}$$

Gross income, YG, per commodity is computed by Equation 38.

$$YG_{ijk}(t) = PAVG_{ik}(t)\, OUTPUT_{ijk}(t)\, [1 - PFLOSS_k], \tag{38}$$

where PAVG is an average price over the year, PFLOSS is the proportion of loss, and output is

$$OUTPUT_{ijk}(t) = YLD_{ijk}(t)\, A_{ijk}(t), \tag{39}$$

the product of yield and area.

Gross profit by commodity, PFTG, is computed as

$$PFTG_{ijk}(t) = YG_{ijk}(t) - TEXPC_{ijk}(t). \tag{40}$$

Producer taxes are computed separately for rice and other commodities in accordance with current tax policies. Rice tax $PTAX_{ij1}(t)$ is given by

$$PTAX_{ij1}(t) = \{\max\ RT1\ [OUTPUT_{ij1}(t) - RED]\ PAVG_{ij1}(t), 0\}, \tag{41}$$

where RED is the part of output not subject to tax. This part is determined by current rice yields relative to normal year yields. For other commodities producer taxes are computed as

$$\underset{k \neq 1}{PTAX_{ijk}(t)} = \max\ [TAXR_{ik}(t)\, PFTN_{ijk}(t), 0]. \tag{42}$$

Here TAXR is the policy determined tax rate and PFTN is net profit by commodity computed as

$$PFTN_{ijk}(t) = PFTG_{ijk}(t) - CON_{ijk}(t)\, PAVG_{ijk}(t), \tag{43}$$

or gross profit minus the value of the product consumed by farm families.

The model currently computes several measures of returns to land and labor based on PFTG and PFTN above. These criteria are respectively gross and net returns above family land and labor to land (Won/hectare) and to labor (Won/man-year):

$$PFTGPA_{ijk}(t) = PFTG_{ijk}(t)/A_{ijk}(t), \tag{44}$$
$$PFTNPA_{ijk}(t) = [PFTN_{ijk}(t) - PTAX_{ijk}(t)]\ /A_{ijk}(t), \tag{45}$$
$$PFTGPL_{ijk}(t) = PFTG_{ijk}(t)/EMP_{ijk}(t), \tag{46}$$
$$PFTNPL_{ijk}(t) = [PFTN_{ijk}(t) - PTAX_{ijk}(t)]\ /EMP_{ijk}(t). \tag{47}$$

Other criteria can be readily computed as desired.

This component also computes calories and protein produced and consumed by commodity. Total calories and protein produced by commodity are respectively

$$CALPC_{ijk}(t) = OUTPUT_{ijk}(t)\, CALPU_k, \tag{48}$$
$$PROTPC_{ijk}(t) = OUTPUT_{ijk}(t)\, PROTPU_k, \tag{49}$$

where CALPU and PROTPU are the per-unit calorie and protein contents of the 12 commodities or commodity groups produced in the model. Total calories and protein consumed by farm people by commodity, by region, by alternative are computed by

$$FCCAL_{ijk}(t) = CALPC_k CON_{ijk}(t), \quad (50)$$
$$FCPROT_{ijk}(t) = PROTPC_k CON_{ijk}(t). \quad (51)$$

FCCAL represents farm-consumed calories (calories/year), and FCPROT farm-consumed protein (MT/yr).

The crop-accounting sub-component also computes the production of crop by-products and their nutritional content as livestock inputs. Total residue produced by commodity, RESPC, is computed as

$$RESPC_{ijk}(t) = A_{ijk}(t)\, RESPU_{ik}, \quad (52)$$

where RESPU is the residue produced per hectare (MT/ha). Total digestible nutrients (TDN) is computed by commodity, region and alternative as

$$TDNPC_{ijk}(t) = RESPC_{ijk}(t)\, TDNPR_k, \quad (53)$$

where TDNPR is the proportion of TDN per unit of crop residue.

This concludes description of the most important equations of the crop-accounting sub-component of the production component. Many of the variables computed by this module become inputs to the regional/national accounting sub-component to be described next.

The Regional/National Accounting Sub-component: This sub-component also carries out its computations on an annual basis. Equations 54-60 compute respectively regional expenditures on fertilizer, pesticide and other chemicals, capital inputs, "other" inputs (including lime), hired labor, seed, and rent and other land charges (not including the imputed cost of family owned land) for region j under alternative i:

$$REXFRT_{ij}(t) = \sum_{k=1}^{12} EXFRT_{ijk}(t), \quad (54)$$

$$REXPST_{ij}(t) = \sum_{k=1}^{12} EXPEST_{ijk}(t), \quad (55)$$

$$REXCAP_{ij}(t) = \sum_{k=1}^{12} EXCAP_{ijk}(t), \quad (56)$$

$$REXOTH_{ij}(t) = \sum_{k=1}^{12} EXOTH_{ijk}(t), \quad (57)$$

$$REXLAB_{ij}(t) = \sum_{k=1}^{12} EXLAB_{ijk}(t), \quad (58)$$

$$REXSD_{ij}(t) = \sum_{k=1}^{12} EXSD_{ijk}(t), \quad (59)$$

$$REXRNT_{ij}(t) = \sum_{k=1}^{12} EXRNT_{ijk}(t). \quad (60)$$

Total regional gross income RYG from crop production is computed as

$$RYG_{ij}(t) = \sum_{k=1}^{12} YG_{ijk}(t), \quad (61)$$

where YG is gross income per crop computed in the crop-accounting sub-component. Total

regional expenditure on crop inputs, REXCI, is computed from total expenditures by crop, TEXPC, as

$$\mathrm{REXCI}_{ij}(t) = \sum_{k=1}^{12} \mathrm{TEXPC}_{ijk}(t). \tag{62}$$

Regional cash income is simply

$$\mathrm{RYC}_{ij}(t) = \sum_{k=1}^{12} \mathrm{YC}_{ijk}(t). \tag{63}$$

Value added from crop production, VAP, is next computed on a regional basis:

$$\begin{aligned}\mathrm{VAP}_{ij}(t) = \mathrm{RYG}_{ij}(t) - \mathrm{REXFRT}_{ij}(t) - \mathrm{REXPST}_{ij}(t) \\ - \mathrm{REXCAP}_{ij}(t) - \mathrm{REXOTH}_{ij}(t).\end{aligned} \tag{64}$$

Note that only inputs to production which come from outside the agricultural sector result in deductions from gross income; items such as the value of hired labor, draft animal services and seed are therefore included in agricultural value added.

Regional taxes from crop production, RPTAX, are computed as

$$\mathrm{RPTAX}_{ij}(t) = \sum_{k=1}^{12} \mathrm{PTAX}_{ijk}(t), \tag{65}$$

where taxes paid by commodity, PTAX_{ijk}, were previously computed by the crop-accounting sub-component.

This sub-component next performs computations which lead to agricultural disposable income—an important variable needed to model interactions between the agricultural sector and the rest of the economy. This portion of the model is in rudimentary form at the present time and will be refined later. Specifically, it does not yet include income from livestock production nor does it compute (a) disposable income net of food expenditure, or (b) agricultural demands for food items to supplement consumption out of production. Following is a description of this part of the model in its current state. Total farm income (net cash flow), TFINC, is given by

$$\mathrm{TFINC}_{ij}(t) = \mathrm{RYC}_{ij}(t) + \mathrm{RCRDT}_{ij}(t) + \mathrm{OTHINC}_{ij}(t), \tag{66}$$

where

RYC = regional net cash income from crops—W/yr,
RCRDT = regional credit received—W/yr,
OTHINC = other income earned by rural people (from marketing, services, manufacturing, etc.).

Regional expenditure on hired labor is not included in TFINC because it is a payment from the agricultural sector to the agricultural sector. Debt service, NDS, is computed as

$$\mathrm{NDS}_{ij}(t) = \max(0., \mathrm{CDS}(t)\ \mathrm{NDBT}_{ij}(t)), \tag{67}$$

where CDS is determined by loan repayment schedules. In its current form the model does not compute separately the interest earned by agricultural savings; the assumption is made that, in the net, agriculture is in debt. This area too needs further attention in the model.

Regional agricultural indebtedness, NDBT, is computed as

$$NDBT_{ij}(t + DT) = NDBT_{ij}(t) + [RCRDT_{ij}(t) - NDS_{ij}(t)]\ DT, \tag{68}$$

where RCRDT is credit received in Won/yr, NDS is debt service payment (Won/yr) and DT is the time increment used in the simulation. Interest charges on indebtedness are simply

$$RINT_{ij}(t) = PCR_i(t)\ NDBT_{ij}(t), \tag{69}$$

where PCR is the interest rate.

Regional disposable income is then calculated from the above variables as

$$RDIN_{ij}(t) = TFINC_{ij}(t) - RINT_{ij}(t) - NDS_{ij}(t) - RPTAX_{ij}(t) - REXCI_{ij}(t) - RINV_{ij}(t), \tag{70}$$

where

RDIN = regional disposable income (for nonagricultural goods and services and purchased food)[6]—Won/yr,
TFINC = total farm income (less livestock income at present)—Won/yr,
RINT = interest payments—Won/yr,
NDS = debt service payments—Won/yr,
RPTAX = producer taxes—Won/yr,
REXCI = expenditure on production inputs—Won/yr,
RINV = regional investment (to be computed endogenously in the resource allocation component of the model).

The regional/national accounting component next computes regional measures of rural income and nutrition on a per capita basis.

Gross income per capita (from crop production) is computed as

$$GIPCP_{ij}(t) = RYG_{ij}(t)/RPOP_{ij}(t), \tag{71}$$

where $RPOP_{ij}$ is the regional rural farm population.

Total gross income per capita is given by GIPCA:

$$GIPCA_{ij}(t) = GIPCP_{ij}(t) + OTHINC_{ij}(t)/RPOP_{ij}(t) + GIPCL_{ij}(t). \tag{72}$$

In Equation 72 the last terms on the right are contributions of nonagricultural income and income from livestock production to gross per capita income.

A better measure of rural well-being is agricultural value added per capita computed as

$$VALAPC_{ij}(t) = [VAP_{ij}(t) + RVALAL_{ij}(t)]\ /RPOP_{ij}(t), \tag{73}$$

or the sum of value added per capita from crop production and livestock production. The latter is computed by the livestock production sub-component.

A further measure of rural well-being which reflects nonagricultural income of rural people is a supplemented value added, SVALA—

$$SVALA_{ij}(t) = VAP_{ij}(t) + VALV_{ij}(t) + OTHINC_{ij}(t), \tag{74}$$

[6] As mentioned above, with further work this stream can be separated into food and nonfood components.

and its corresponding per capita value, SVALPC—

$$\mathrm{SVALPC}_{ij}(t) = \mathrm{SVALA}_{ij}(t)/\mathrm{RPOP}_{ij}(t). \tag{75}$$

Per capita calorie and protein consumption levels of rural people are computed as follows:

$$\mathrm{TFCALP}_{ij}(t) = \mathrm{FCALPC}_{ij}(t) + \mathrm{FCALL}_i(t), \tag{76}$$

$$\mathrm{TFPRP}_{ij}(t) = \mathrm{FPROPC}_{ij}(t) + \mathrm{FPRTL}_i(t), \tag{77}$$

where

TFCALP_{ij} = total farm-consumed calories per capita in region j under alternative i,

TFPRP_{ij} = total farm-consumed protein (MT) per capita in region j under alternative i,

FCALPC = rural calories per capita from crops

$$= \sum_{k=1}^{12} \mathrm{CALCFO}_{ijk}(t)/\mathrm{RPOP}_{ij}(t),$$

FCALL = rural calories per capita from livestock

$$= \sum_{k=13}^{19} \mathrm{PCCON}_{ijk}(t)\ \mathrm{CALPU}_k,$$

FPROPC = rural protein per capita from crops

$$= \sum_{k=1}^{12} \mathrm{FCPROT}_{ijk}(t)/\mathrm{RPOP}_{ij}(t),$$

FPRTL = rural protein per capita from livestock

$$= \sum_{k=13}^{19} \mathrm{PCCON}_{ijk}(t)\ \mathrm{PROTPU}_k.$$

In these definitions CALCFO_{ijk} and FCPROT_{ijk} are crop-specific farm-consumed calories and protein (computed in CROPAC). PCCON_{ijk} (k = 13 - 19) are rural per capita consumption levels of livestock products and CALPU_k and PROTPU_k (k = 13 - 19) are the per unit calorie and protein contents of the livestock products.[7]

The sub-component also computes total regional TDN from crop residues produced for livestock nutrition as

$$\mathrm{TDNRES}_{ij}(t) = \sum_{k=1}^{12} \mathrm{TDNPC}_{ijk}(t), \tag{78}$$

where TDNPC_{ijk} is the TDN by-products produced from crop k in region j.

The regional/national accounting sub-component concludes by aggregating across regions to obtain variables of interest for the agricultural sector as a whole. National expenditures on crop inputs and input requirements are computed as follows:

fertilizer expenditure (Won/yr),

$$\mathrm{TEXFRT}_i(t) = \sum_{j=1}^{3} \mathrm{REXFRT}_{ij}(t); \tag{79}$$

[7] The index k applies to livestock products when it takes on the value 13-19. Specifically k = 13 represents beef, 14—milk, 15—pork, 16—chicken, 17—eggs, 18—fish and 19—a food residual.

pesticide and other chemicals expenditure (Won/yr),

$$\mathrm{TEXPST}_i(t) = \sum_{j=1}^{3} \mathrm{REXPST}_{ij}(t); \tag{80}$$

expenditure on capital inputs (Won/yr),

$$\mathrm{TEXCAP}_i(t) = \sum_{j=1}^{3} \mathrm{REXCAP}_{ij}(t); \tag{81}$$

expenditure on other inputs (Won/yr),

$$\mathrm{TEXOTH}_i(t) = \sum_{j=1}^{3} \mathrm{REXOTH}_{ij}(t); \tag{82}$$

expenditure on hired labor (Won/yr),

$$\mathrm{TEXLAB}_i(t) = \sum_{j=1}^{3} \mathrm{REXLAB}_{ij}(t); \tag{83}$$

expenditure on seed (Won/yr),

$$\mathrm{TEXSD}_i(t) = \sum_{j=1}^{3} \mathrm{REXSD}_{ij}(t); \tag{84}$$

expenditure on rent and other land charges (Won/yr),

$$\mathrm{TEXRNT}_i(t) = \sum_{j=1}^{3} \mathrm{REXRNT}_{ij}(t); \tag{85}$$

total quantity of fertilizer consumed (MT/yr),

$$\mathrm{TQFERT}_i(t) = \sum_{j=1}^{3} \mathrm{QFERT}_{ij}(t); \tag{86}$$

total quantity of pesticide and chemicals consumed (units/yr),

$$\mathrm{TQPEST}_i(t) = \sum_{j=1}^{3} \mathrm{QPEST}_{ij}(t); \tag{87}$$

total quantity of capital (units/yr),

$$\mathrm{TQCAP}_i(t) = \sum_{j=1}^{3} \mathrm{QCAP}_{ij}(t); \tag{88}$$

total quantity of other inputs consumed (units/yr),

$$\mathrm{TQOTH}_i(t) = \sum_{j=1}^{3} \mathrm{QOTH}_{ij}(t). \tag{89}$$

Total gross and cash income (TYGAP and TYCAP) from crop production are computed as

$$\mathrm{TYGAP}_i(t) = \sum_{j=1}^{3} \mathrm{RYG}_{ij}(t), \tag{90}$$

$$\mathrm{TYCAP}_i(t) = \sum_{j=1}^{3} \mathrm{RYC}_{ij}(t). \tag{91}$$

Total sector value added from agricultural production (crops and livestock) is given by

$$\mathrm{TVAP}_i(t) = \sum_{j=1}^{3} \mathrm{VAA}_{ij}(t).^{\ddagger} \tag{92}$$

‡ The variable VAA is in turn computed by $\mathrm{VAA}_{ij}(t) = \mathrm{VAP}_{ij}(t) + \mathrm{RVALAL}_{ij}(t)$ where RVALAL is regional value added from livestock computed in the livestock production sub-component.

Total supplemented value added is

$$TSVA_i(t) = \sum_{j=1}^{3} SVALA_{ij}(t). \tag{93}$$

Total producer taxes (less taxes on livestock production at present) is given by

$$TPTAX_i(t) = \sum_{j=1}^{3} RPTAX_{ij}(t). \tag{94}$$

Agricultural disposable income (also less income from livestock production at present) is

$$TAGDIP_i(t) = \sum_{j=1}^{3} RDIN_{ij}(t). \tag{95}$$

We now compute income, value added and supplemented value added on a sector average per capita basis. Gross sector income per capita from crop production is GIPCPN:

$$GIPCPN_i(t) = TYGAP_i(t)/TRPOP_i(t), \tag{96}$$

where TRPOP is total rural population computed in the demographic component.

Gross sector per capita income including income from livestock and other sources is GIPCAN:

$$GIPCAN_i(t) = GIPCPN_i(t) + \sum_{j=1}^{3} OTHINC_{ij}(t)/TRPOP_i(t) + GIPCL(t)/TRPOP_i(t). \tag{97}$$

The terms on the right are sector gross income per capita from crops, other (nonagricultural) sources and livestock, respectively.

Value added and supplemented value added per capita are TVAPC and SVAPC:

$$TVAPC_i(t) = TVAP_i(t)/TRPOP_i(t), \tag{98}$$

$$SVAPC_i(t) = TSVA_i(t)/TRPOP_i(t). \tag{99}$$

Finally, the regional/national accounting component computes total output and total supply for the 12 crops of the model. Total output (MT/yr) is given by

$$TOUTPT_{ik}(t) = \sum_{j=1}^{3} OUTPUT_{ijk}(t). \tag{100}$$

Total supply to urban markets (MT/yr) is computed as

$$TDSUP_{ik}(t) = TOUTPT_{ik}(t)\,[1 - PFLOSS_k] - PCCON_{ik}(t)\,TRPOP_i(t). \tag{101}$$

In Equation 101 PFLOSS is the proportion of output lost on farms and the last term is the product consumed by rural people.

Total farm losses by commodity, FLOSS, are

$$FLOSS_{ik}(t) = TOUTPT_{ik}(t)\,PFLSS_k. \tag{102}$$

This concludes description of the regional/national accounting sub-component of the production model. We now turn our attention briefly to the rudimentary livestock production sub-component used in the Phase I model.

Rudimentary Livestock Production Sub-component (PRODLV): The basic purpose of this module of the model was to compute livestock output, gross income, value added from livestock and other variables under the three policy alternatives. The livestock area will receive much more attention in later sector models.

Basically, livestock output in the model is determined by policy for each of the three

alternative strategies for agricultural sector development. Alternative I is an extension of policies laid down in the Third Five-Year Plan. It seeks to expand livestock production on all fronts and meet rising consumer demands. Alternative II shifts emphasis toward poultry and eggs and away from beef, pork and milk in order to take advantage of higher poultry feed conversion efficiencies. As a result, under Alternative II beef and pork prices are higher than under Alternative I and consumption of these is reduced. Poultry and egg consumption are increased due to lower producer costs and market prices, resulting from intensive guidance programs to promote improved production practices. Under the free trade Alternative III, imports of livestock products are permitted and domestic output drops sharply for items which are internationally traded.

Output of livestock (MT/yr) for commodity k under Alternative i, $\mathrm{OUTLVN}_{ik}(t)$, is defined by policy over time interval 1971-1985.[8] Gross income and value added from livestock are simply

$$\mathrm{GINCL}_{ik}(t) = \mathrm{PAVG}_{ik}(t)\ \mathrm{OUTLVN}_{ik}(t), \qquad k = 13,14,\ldots,19, \tag{103}$$

$$\mathrm{VALALV}_{ik}(t) = \mathrm{PRPVA}_k\ \mathrm{GINCL}_{ik}(t), \tag{104}$$

where

GINCL_{ik} = gross income from livestock commodity k under Alternative i at producer prices—Won/yr,
PAVG_{ik} = yearly average producer prices,
VALALV_{ik} = value added from livestock commodity k under Alternative i—Won/yr,
PRPVA_k = proportion of gross income which is value added.

Total supply of livestock products to cash markets is TDSUP given by

$$\mathrm{TDSUP}_{ik}(t) = \mathrm{OUTLVN}_{ik}(t)\ [1 - \mathrm{PFLOSS}_k] - \mathrm{RDEM}_k(t), \qquad k = 13,\ldots,19‡, \tag{105}$$

where PFLOSS is proportion of output lost at the farm level and RDEM is the rural demand for livestock products given by

$$\mathrm{RDEM}_{ik}(t) = \mathrm{PCCON}_{ik}(t)\ \mathrm{POP}_1(t). \tag{106}$$

Here PCCON and POP_1 are rural per capita consumption levels and total rural population respectively (equivalent to TRPOP defined earlier).

Total gross income from livestock (GIL) and total value added from livestock (TVAVAL) are[9]

$$\mathrm{GIL}_i(t) = \sum_{k=13}^{17} \mathrm{GINCL}_{ik}(t), \tag{107}$$

$$\mathrm{TVALAL}_i(t) = \sum_{k=13}^{17} \mathrm{VALALV}_{ik}(t). \tag{108}$$

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[8] The model receives policy-determined outputs for the years 1970, '75, '80 and '85 and uses the TABLIE function (Llewellyn, 1965, see Bibliography) to compute values for intermediate years by linear interpolation.

‡ Commodity 19 is actually a food residual category. For convenience it is handled in this part of the model.

[9] In these equations the index k runs only as far as 17. This properly leaves fish (commodity 18) and agricultural residual (commodity 19) out of computations of returns to farm livestock enterprises.

Per capita gross income from livestock enterprises, GIPCL, is

$$GIPCL_i(t) = GIL_i(t)/POP_1(t), \tag{109}$$

and regional contributions of livestock to agricultural value added are computed as

$$RVALAL_{ijk}(t) = RPOP_{ij}(t)\ TVALAL_{ik}/POP_1(t), \tag{110}$$

where

RVALAL = regional value added from livestock enterprises—Won/yr,
$RPOP_{ij}$ = population in region j,
POP_1 = total agricultural population.

This sub-component concludes with computation of the contributions of livestock products to rural nutritional levels. Farm consumed calories from livestock, FCCAL, is calculated as

$$FCCAL_i(t) = \sum_{k=13}^{19} PCCON_{ik}(t)\ CALPU_k, \tag{111}$$

and farm consumed protein FPRTL as

$$FPRTL_i(t) = \sum_{k=13}^{19} PCCON_{ik}(t)\ PROTPU_k. \tag{112}$$

Here CALPU and PROTPU are, respectively, the calorie and protein content of the respective commodities.

The Urban Demand Component (DEMAND)

This component computes the demands for 19 agricultural commodities, and an aggregate nonagricultural commodity as influenced by prices, total consumption of urban people and the urban population as influenced, in turn, by birth, death and migration rates. A detailed description of the structure of the component follows.

Mathematically, demand for the kth commodity is computed by equations something like the following (more details will follow):

$$Q_k(t) = [AO_k P_1^{e_{k1}} P_2^{e_{k2}} \ldots P_k^{e_{kk}} \ldots P_{20}^{e_{k20}} (CONSU(t)/POP_2(t))^{K\eta_k}]\ POP_2(t), \quad k = 1,2,\ldots,20, \tag{113}$$

subject to the budget constraint

$$\sum_{k=1}^{20} Q_k(t)\ P_k(t) = CONSU(t). \tag{114}$$

In these equations:

Q_k = demand for the kth commodity ($k = 1,2,\ldots,20$) in metric tons/yr except for commodities 19 and 20 (food residual and nonagricultural demand) which are expressed in Won/yr,

P_k = commodity prices Won/MT (k = 1,2, . . . ,18) and dimensionless indices based on 1970 prices for k = 19 and 20,
e_{kj} = price elasticities,
e_{Ik} = income elasticities,
CONSU = urban consumption as obtained from a two-sector model of the Korean economy—Won/yr,
POP_2 = urban population as computed by the population component—persons,
K = a parameter used to satisfy the budget constraint.

The term in major brackets in Equation 113 is per capita consumption for the kth commodity and is a function of price and income levels. The parameter K is computed for each point in time to satisfy the budget constraint of Equation 114. While there does not appear to be any completely satisfactory way of adjusting the Q_k's in order to continuously satisfy the budget constraint through time, there are advantages associated with applying the factor K to the income term in the exponent as in Equation 113. Specifically, if there is an income effect due to price changes, this effect will be distributed across commodities in proportion to the income elasticities; a commodity with zero income elasticity will have zero change in per capita consumption as a result of income effects due to price changes in other commodities, etc. (Using the term AO to satisfy the budget constraint would increase demand for all commodities by the same factor in the event of income effect producing price changes.)

While conceptually the formulation of Equations 113 and 114 is quite simple, a recursive approach was used to conveniently implement the simulation, due primarily to the nonlinear equations which are involved in satisfying the budget constraint. Another complication is the fact that for realistic simulation of consumer behavior the income elasticities are themselves dependent upon other variables of the demand model. Essentially, the approach assumed a piecewise linear approximation to Equation 113. This approach is described in detail in what follows.

Demand for the kth commodity at time t is computed as

$$PCCONU_k(t) = AO_k(t-DT) + \sum_{j=1}^{20} A_{kj}(t-DT)\, CPU_j(t) + K(t)\, B_k(t-DT)\, CONSU(t)/POP_2(t), \tag{115}$$

$$Q_k(t) = PCCONU_k(t)\, POP_2(t). \tag{115a}$$

In these equations PCCONU is urban per capita consumption and CPU_k is the urban consumer price for commodity k. Other terms in Equation 115 are computed as

$$AO_k(t-DT) = PCCONU_k(t-DT) - K(t-DT)B_k(t-DT)\, CONSU(t-DT)/POP_2(t-DT) - \sum_{j=1}^{20} A_{kj}(t-DT)\, CPU_j(t-DT). \tag{116}$$

(This ensures that the kth demand curve for the interval $(t-DT,t)$ passes through $PCCONU_k(t-DT)$.)

$$A_{kj}(t-DT) = ELASP_{kj}\, Q_k(t-DT)/(CPU_j(t-DT)\, POP_2(t-DT)), \tag{117}$$

where

$ELASP_{kj}$ = percent change in Q_k per percent change in CPU_j.

$$B_k(t-DT) = ELASI_k(t-DT)\, Q_k(t-DT)/CONSU(t-DT), \tag{118}$$

where

$$ELASI_k = \text{the income elasticity of demand for commodity } k.$$

Income elasticities, $ELASI_k$, are in turn functions of the difference between current consumption levels and "target" consumption levels. Income elasticities in the model, then, approach zero as actual per capita consumption levels approach desired or "target" levels.[10] The equations which implement this behavior follow. Target consumption levels are estimated from consumer behavior in other countries with similar consumption patterns but at a more advanced level of development, mainly in Japan, and from judgment.

These time-varying income elasticities are computed as

$$ELASI_k(t\text{-}DT) = ELASI_k(0)\,[PCCONT_k - PCCONU_k(t\text{-}DT)]\,/\,[PCCONT_k - PCCONU_k(0)], \tag{119}$$

where

$ELASI_k(0)$ = income elasticity for commodity k at the start of a simulation run ($t = 0$),

$PCCONU_k(0)$ = per capita consumption of commodity k at the start of a simulation run ($t = 0$)—MT/person-year,

$PCCONT_k$ = target level of per capita consumption as discussed above—MT/person-year.

In this equation the income elasticity is $ELASI_k(0)$ when $t = 0$ and approaches zero as $PCCONU_k$ approaches $PCCONT_k$ as required.

The parameter K in Equation 115 is computed to satisfy the budget constraint at time t, in order that

$$\sum_{k=1}^{20} Q_k(t)\,CPU_k(t) = CONSU(t). \tag{120}$$

On combining Equation 115 and Equation 120, $K(t)$ is determined as

$$K(t) = [CONSU(t) - \sum_{k=1}^{20} AO_k(t\text{-}DT)CPU_k(t)POP_2(t) - \sum_{k=1}^{20}\sum_{j=1}^{20} A_{kj}(t\text{-}DT) \tag{121}$$

$$CPU_j(t)CPU_k(t)POP_2(t)]\,/\,[CONSU(t)\sum_{k=1}^{20} B_k(t\text{-}DT)CPU_k(t)].$$

To summarize this recursive procedure for computing demands subject to the budget constraint, we will construct the sequence of computations as they are carried out in the model. Computation begins with given 1970 values for

price elasticities ($ELASP_k$),
income elasticities ($ELASI_k$),
per capita consumption levels ($PCCONU_k(0)$),
target consumption levels ($PCCONT_k$),
urban population (POP_2),
consumption levels (Q_k)

[10] "Targets" are never attained in the model. For some commodities, such as nonagricultural goods, they are set arbitrarily high.

The subsequent computing sequence is

a.) compute AO_k, A_{kj} and B_k for time t-DT;
b.) compute CPU_k, POP_2 and CONSU for time t;
c.) compute $K(t)$ from previously computed values;
d.) compute Q_k and $PCCONU_k$ for time t;
e.) compute $ELASI_k$ for time t;
f.) update time by DT (usually it is equal to one year) and repeat a.) through f.), if the end of the simulation run has not been reached.

This recursive procedure is controlled by the executive program of the overall simulation model.

In addition to its main functions described above, the demand component performs certain auxiliary computations described below. The component computes urban consumer prices, CPU, given producer prices and marketing margins:

$$CPU_k(t) = [1 + MM_k]\ PAVG_k(t), \qquad k = 1,2,\ldots,19, \tag{122}$$

where $PAVG_k$ is the yearly average producer price[11] and MM_k is the commodity specific marketing margin.

Urban per capita caloric and protein consumption levels, CALPCU and PROPCU, are computed as

$$CALPCU(t) = \sum_{k=1}^{19} PCCONU_k(t)\ CALPU_k \tag{123}$$

and

$$PROPCU(t) = \sum_{k=1}^{19} PCCONU_k(t)\ PROTPU_k, \tag{124}$$

where $PCCONU_k$ is the per capita consumption level for commodity k and $CALPU_k$ and $PROTPU_k$ are the respective caloric and protein contents per unit of consumption.

The urban demand component also computes total food expenditure (TEXPF) in Won per year and the ratio of food consumption to total consumption (RFTEX):

$$TEXPF(t) = \sum_{k=1}^{19} Q_k(t)\ CPU_k(t), \tag{125}$$

$$RFTEX(t) = TEXPF(t)/CONSU(t), \tag{126}$$

where CONSU is total urban consumption (Won/yr).

Finally, the component computes a number of consumer price indices through time. These include a rice price index (CRPI),

$$CRPI(t) = CPU_1(t)/CPU_1(0); \tag{127}$$

an "other grain" price index, COGPI,

$$COGPI(t) = \sum_k CPU_k(t)\ Q_k(t)/\sum_k CPU_k(0)\ Q_k(t), \tag{128}$$

[11] Producer prices are determined in the model by policies and supply/demand interactions.

$k = 2$ (barley),
$k = 3$ (wheat),
$k = 4$ (miscellaneous grains),
$k = 6$ (pulses);

a consumer meat price index (CMPI),

$$\mathrm{CMPI}(t) = \sum_k \mathrm{CPU}_k(t)\, Q_k(t) / \sum_k \mathrm{CPU}_k(0)\, Q_k(t), \tag{129}$$

$k = 13$ (beef),
$k = 15$ (pork),
$k = 16$ (chicken),
$k = 17$ (eggs),
$k = 18$ (fish);

a food price index (CPFI),

$$\mathrm{CPFI}(t) = \sum_{k=1}^{19} \mathrm{CPU}_k(t)\, Q_k(t) / \sum_{k=1}^{19} \mathrm{CPU}_k(0)\, Q_k(t); \tag{130}$$

and finally, an overall consumer price index which includes nonfood as well as food,[12]

$$\mathrm{CPI}(t) = \sum_{k=1}^{20} \mathrm{CPU}_k(t)\, Q_k(t) / \sum_{k=1}^{20} \mathrm{CPU}_k(0)\, Q_k(t). \tag{131}$$

In computing the above indices, $\mathrm{CPU}_k(0)$ is the urban consumer price in 1970 for commodity k.

As with description of other components, much programming detail has been omitted from the urban demand component of the simulation model. The major premises upon which the model is built have been presented, and should also serve as a guide to the interested reader who wishes to study the computer program in detail.

The National Criterion Component

This small component computes annual summary criteria for the model as a whole by bringing together variables from the various components of the model and performs a number of other auxiliary functions. Details of its structure follow.

The component computes total national deficits, DEFCIT_k, for agricultural commodities as

$$\mathrm{DEFCIT}_k(t) = Q_k(t) - \mathrm{TDSUP}_k(t)\,(1 - \mathrm{PMLOSS}_k), \tag{132}$$

where Q is urban demand, TDSUP is total domestic supply (after rural consumption and farm losses) and PMLOSS is the proportion of marketed supply lost before reaching the consumer.[13] Marketing losses are

$$\mathrm{FMLOSS}_k(t) = \mathrm{TDSUP}_k(t)\, \mathrm{PMLOSS}_k. \tag{133}$$

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[12] The model takes nonfood prices CPU_{20} as fixed. The model, therefore, computes the impact of food prices on aggregate price levels.

[13] TDSUP is computed by the Regional/National accounting component (Equation 101) and Q by the urban demand component (Equation 121).

The value of deficit $DEFCIT_k$ is given by

$$VALDEF_k\ (t) = \begin{cases} DEFCIT_k\ (t)\ PWLDIM_k(t) & \text{if } DEFCIT_k > 0 \\ DEFCIT_k\ (t)\ PWLDEX_k(t) & \text{if } DEFCIT_k \leqslant 0. \end{cases} \tag{134}$$

Here $PWLDIM_k$ is the world import price at Korean ports converted to 1970 Won:

$$PWLDIM_k(t) = 450\ (DWLDP_k(t) + DTRCST)\ (IMU), \tag{135}$$

where DWLDP is the dollar world price of commodity k; DTRCST, the dollar transport cost to Korean ports; IMU, an import markup to account for import costs; and 450 (Won/$), an estimate of the real exchange rate in 1970.

PWLDEX is the world export price for Korean exports computed as

$$PWLDEX_k(t) = PWLDIM_k(t) - 450\ (DTRCST). \tag{136}$$

The second term on the right subtracts the Won value of transport to Korean ports.

The total value of Korean agricultural deficits is computed as

$$TVALDF(t) = \sum_{k=1}^{19} VALDEF_k(t), \tag{137}$$

where $VALDEF_k$ is defined above by Equation 134.

This component also computes the total land required to satisfy internal demand for each agricultural commodity. This variable C_k is computed as

$$C_k(t) = [RDEM_k(t)\ (1 + PFLOSS_k) + Q_k(t)\ (1 + PMLOSS_k + PFLOSS_k)]\ /AYLD_k(t), \tag{138}$$

where $RDEM_k$ is rural demand, Q_k urban demand, $PFLOSS_k$ and $PMLOSS_k$ farm and market losses, and $AYLD_k$ the average national yield.

In concluding description of the structure of the simulation model, we will briefly describe the demographic component of the model.

Demographic Component

The Korean Demographic Model is designed to project growth of the rural and urban populations of Korea by taking into account:

1. Fairly rapid decline in birth rates resulting from the family planning program, delay in the average age at marriage, and other influences
2. Continuing gradual decline in infant mortality and general death rates and
3. Migration of rural people from the three ecological regions (single-crop paddy, double-crop paddy, and upland) into the urban "pool" (currently undifferentiated by region).

The model also provides an estimate of the labor manpower available for agricultural production in each of the three ecological regions and the nutritional requirements in terms of calories and proteins for the rural and urban populations. This model can run alone or be coupled to the larger simulation model being designed to simulate the agricultural sector of Korea.

Data Requirements: The current version of the demographic model has the following data requirements:

1. *Rural-Urban, Age, Sex Distribution*: The current version requires that the Korean population can be divided into two main streams, the rural farm population and the

urban nonfarm population. The rural population for this study is defined as that part of the total population living with family units earning a "significant" part of their livelihood in agriculture. The urban population is defined to include all other people.[14] The rural and urban population are further subdivided into two-year age-sex cohorts.

The division of the population into the rural farm population and the urban nonfarm population was carried as follows. Census data (as projected to 1969 by Beegle *et. al.*, see Bibliography) were available on the age-sex distribution of people living in communities over 20,000 and in communities under 20,000. The distributions are noticeably different: communities under 20,000 have a higher percentage of persons under twenty years of age than do communities over 20,000. These two distributions were taken as good approximations of the distributions for the rural farm population and the urban nonfarm population.

Data were also available on the percentage of each rural age-sex cohort which was economically active in agricultural production. When this distribution was multiplied by the age-sex distribution of persons living in communities under 20,000, the resulting figure for the total number employed in agriculture was approximately 5 percent below the figure currently accepted for the total number employed in agriculture—4.8 million in 1969. Although the number of persons living in communities under 20,000 is a good approximation to the "rural" population, nevertheless a better approximation was obtained by increasing this number by 5 percent with the same age-sex distribution. The urban nonfarm population was taken as the residual population. The percentage distributions of two-year age cohorts for the rural and urban populations are shown in Figure B-1 of Appendix B.

2. *Vital Statistical Data*: The model requires age specific birth rates for seven five-year age cohorts from fifteen to forty-nine for both the rural and urban populations projected at ten-year intervals for the length of the simulation run. In the current version these projected birth rates must take into account both the decline in fertility and the decreasing percentage of married women in the younger fertile age groups over the time of the simulation. There is also an additional parameter which can be used to adjust the birth rates up or down from the nominal data supplied initially. The nominal projections on the declining birth rates were based on "moderate fertility" projections assumed by the Population Council in 1970.[15] The sex ratio at birth must also be supplied.

   Mortality tables at two different points in time are required; the model interpolates linearly to determine the death rates at any point in time. In the current model it is assumed that Korea achieved Level W-17 in 1970 and will achieve Level W-19 by 1990 as given in Coale and Demeny's model life tables.[16]

3. *Migration Data*: In order for the model to transfer persons from the rural population stream to the urban stream, net age-sex specific migration rates expressed as a percentage of the cohort migrating per year must be supplied. This selectivity rate is provided at some nominal average overall migration rate, say 5 percent per year, and

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[14] These definitions are somewhat different than those used by most demographers, who normally divided the population into rural and urban on the basis of community size. However, the rural farm/urban nonfarm division was adopted in this case to facilitate interfacing the demographic model with the agricultural sector model. Perhaps, "agricultural population" and "nonagricultural population" would have been more accurate terms but these terms seem unwieldy, particularly if one were to refer to "agricultural-nonagricultural migration."

[15] The Population Council, *Population Projections, Republic of Korea 1960-2001*, Seoul: September, 1970.

[16] Ansley J. Coale and Paul Demeny, *Regional Model Life Tables and Stable Populations*, Princeton: University of Princeton Press, 1968.

then adjusted up or down during a simulation run depending on whether the overall rate moves up or down.[17] It is assumed that the shape of the selectivity distribution remains unaltered during a simulation. For example, if the percentage of out-migration of rural males age 20-25 is twice as high as for males age 50-55, this ratio remains the same regardless of the overall level of migration.

The overall rate of migration is determined as a weighted average of regional rural off-farm migration rates. In the current version these rates were adjusted externally to yield approximately 7 percent growth of employment in the urban-industrial sector over the next fifteen years.

It should be noted at this point that although there were three rural ecological regions, there was only one rural population stream, which was divided in the two-year age-sex cohorts. At the regional level only aggregate variables like percent of total rural population in a region were included in the simulation. It was assumed that the rural population stream was fairly homogeneous throughout the rural regions of Korea and therefore only one rural population stream was needed for the detailed age structure for the simulation. No regional breakdown was made for the urban population stream; rather it was treated as one urban pool into which migrants from the three rural regions flow.

4. *Nutritional Requirements*: In order to compute the total and per capita nutritional requirements, the model requires caloric and protein requirements for each five-year cohort for males and females.
5. *Economically Active Population*: The proportion of each five-year cohort for rural males and females which are economically active in agricultural production is needed as an input to the model.[18]

In all of the above cases in which data are supplied in terms of five-year age cohorts, the model interpolates to find the corresponding values for multiplying by the number of persons in each two-year cohort of the population streams.

Outputs: Outputs from the demographic model as a function of time currently include:

Total population (rural, urban, total)
Crude birth rate (total)
Crude death rate (total)
Natural increase rate (total)
Rural-urban migration rate (regional rural, total)
Total calories required (rural, urban, total)
Total protein required (rural, urban, total)
Calories required per capita (rural, urban)
Protein required per capita (rural, urban)
Rural population distribution across regions
Agricultural labor force (regional rural)
Population "pyramids" (rural, urban).

Population Structure and Dynamics, An Overview: The rural population and the urban population are each divided into forty-five two-year age cohorts for males and females.

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[17] The migration selectivity data was taken from Beegle *et al.*, (see Bibliography) who had used as their primary source *Some Findings From the Special Demographic Survey (1966)* Seoul: Bureau of Statistics, Economic Planning Board, 1968.

[18] Data for these projections were taken from the *Annual Report on the Economically Active Population*, Seoul: Economic Planning Board, 1970, p. 22.

Because the population is divided into two-year age cohorts, the model will update the population levels in each of the cohorts at two-year intervals. The first step in this updating process is to compute the number of births during a two-year cycle as a function of the number of females in each of the child-bearing cohorts and the age specific fertility rates for these cohorts. The fertility rates for the rural population of Korea are set higher than the fertility rates for the urban population. The number of infants who enter the first male and female age cohorts of each population stream is equal to the number of live births minus infant mortality.

The remaining age cohorts are updated in a similar fashion. The persons in a given age-sex cohort at the beginning of a two-year cycle minus those that die during the two-year cycle are shifted into the next older age group at the end of the cycle. Deaths are computed by applying age-sex specific death rates (interpolated from five-year cohort input data) to each of the two-year age cohorts. Also, during each two-year cycle the model determined the number of persons who migrate from each rural age-sex cohort to the respective urban age-sex cohort as a function of time dependent, age-sex specific, rural-urban migration rates.

Every two years the model updates the population cohorts in the above manner. At each update, the values for the various output variables are calculated for two points in time, the beginning and the end of the next two-year time period. These two values are used to calculate a rate of change of the particular variable over the time period. These rates of change are used to calculate interpolated values for the output variables needed at each increment of time for which computations are made in other components of the model during the two-year period of the population update cycle.

Conclusions

Conclusions center on some of the more significant problems faced in the development and application of the model and briefly indicate areas for further work leading to the comprehensive sector simulation model.

In Korea, as undoubtedly in most other developing countries, there are problems with respect to reliable data for analysis. Particular problems were encountered in reconciling commodity production and disappearance data and in determining marketing margins. Many commodity specific supply and demand elasticities were estimated by the Korean Agricultural Sector Study team and pooled with estimates of others. Often wide discrepancies were noted. Discrepancies also were noted in different farm and urban household surveys designed to measure private consumption of basic food items.

As a result of these and other problems, it was often necessary to rework or "massage" the data. Data sources were pooled and values accepted for the model on the basis of internal consistency and credibility of the various sources. Once in the model a number of consistency checks were used to determine areas where adjustments in model coefficients were necessary. Examples of these consistency checks include ensuring that production, consumption and loss estimates square with relatively more accurate estimates of exports, imports and carryovers. Urban and rural intakes of calories and protein must lie between certain reasonable limits at all points in time and in spite of price and income changes. One also expects that *total* per capita consumption of certain food groups such as grains, meat and poultry, etc., will not change significantly as relative prices of competitive members of a food group change.

These and other consistency checks identified needs for changes in model coefficients and, further, helped to identify more appropriate values for particular coefficients of the model. In a given situation it may be possible to correct a model deficiency by altering the

value of a number of model parameters. The choice can be reduced sometimes to a change in one or more particular coefficients—with the knowledge that changes in other candidate coefficients will solve one problem and create one or more others. For example, apparent surpluses existed for major food grains. A check of aggregate per capita caloric consumption of both rural and urban people disclosed that these levels were already straining the upper limits of credibility. It was therefore apparent that per capita consumption levels of these grains should not be increased but that production should be decreased, losses increased, or both.

While not a very elegant undertaking, this data "massaging" is necessary when data are unreliable. Another means used to cope with data problems is so called "sensitivity analysis." Attention is focused on the model coefficients which are likely to have the most significant impacts on the variables of interest to decision makers and the question is posed: What are the effects of errors in model coefficients upon the *relative ranking* of various policy alternatives? How likely are data errors to result in the wrong policy choices? Only limited sensitivity analysis has been feasible within the scope of the study. Much more of this kind of investigation will be necessary and feasible with the more detailed simulation model planned for the Korean sector analysis project.

It is apparent from the above discussion that projections made for specific commodities of the model, such as production, consumption, import requirements, etc., are subject to considerable error. They should be used, therefore, with caution. It is also true that the aggregate variables of the model (income, value added, per capita incomes, aggregate price indices, total value of imports and exports, nutritional levels, etc.) are subject to relatively less error being constructed from numerous component variables.

We turn our attention now to a brief discussion of some of the more important unfinished tasks which lie ahead in the development of a comprehensive agricultural sector simulation model for Korea. As mentioned above, this model should be capable of applying sensitivity analysis to the many coefficients of the model and summarizing the impacts of these coefficient changes upon a number of variables of interest to decision makers. It should do so rapidly and for many coefficients adjusted either singly or in groups. It is anticipated that this part of the model will follow the approach taken in the Nigerian agricultural sector simulation (Manetsch *et al.*, see Bibliography).

With respect to the model testing and adjustment, the capability to make historical runs against past behavior of the Korean agricultural economy also must be developed. In this mode of operation the model compares its own outputs with past time series from the real world and computes measures of "goodness of fit." These measures are then used to make model adjustments which result in an improved "fit." This overall process is another means of determining appropriate values for model coefficients which do not have accurately known values.

A number of new model components must be developed to achieve the comprehensive simulation model outlined in Figure A-1. One, a livestock production component, is currently under construction. This component is being designed to simulate the production of various livestock commodities (beef, pork, chicken, milk, etc.) when supplied with the appropriate inputs and coefficients for particular enterprises. The model simulates production on the basis of age specific cohorts and generates output, income, costs, etc., as they depend upon the dynamics of the production process. This component is similar in structure to the perennial crop production sub-component discussed above though inherently more complex.

One of the most important components to be constructed is the so-called "production resource allocation" component. The purpose of this component is to allocate land, labor

and capital to the various production enterprises of the model in response to changes in input and output prices, credit availability, availability of new technology (biological, mechanical, etc.), federal programs to develop land and water resources and other factors. Construction of this component will draw on the work of Day, *et al.* (see Bibliography), the Nigerian agricultural sector model (see Manetsch, *et al.*, Bibliography), and other sources.

Attention also must be directed at modeling, at least at an aggregative level, government programs which influence the rural sector (land and water development, road development, rural guidance, family planning, mechanization, etc.) and their responses to changes in budget allocations.

Another important area related to public policy and its impact on sector development is food grain marketing and management. Attention must be given to modeling public purchases sales and stocks of food grains and the public and private costs and benefits of alternative grain price policies. Attention also must be given to the modeling of private marketing and processing including investments and their impacts upon income, employment, product losses, marketing margins, etc.

Much more attention must be given in the model to interactions between the rural and urban sectors. A key issue is the impact of alternative agricultural policies upon the economy as a whole. Sub-issues include multiplier effects of expanded rural consumption of inputs from the nonagricultural sector, increased consumption of agricultural products by the nonagricultural sector, impacts on rural-urban migration rates and their consequences and effects of allocating more or less investment to the rural sector where these investments compete with nonagricultural investments for limited capital resources.

Clearly, the unfinished business at hand will provide challenging work for investigators for years to come. In the next year or two of anticipated Korean-U.S. collaboration, work will proceed on at least two fronts. Some of the more important and tractable areas of the model will be developed to enhance its usefulness to Korea as an aid to sector planning. At the same time, institutional arrangements permitting development of a Korean team to continue this work will proceed. This human resource development would include: advanced graduate education in the many areas relevant to a sector analysis, such as economics, demography, system science, computer science, public administration, technical agriculture, etc.; "on the job" experiences; and thesis research in areas directly relevant to Korean agricultural sector analysis and development.

Appendix B

Additional Projections

This appendix includes some additional projections which supplement those presented in Chapters 6 and 7. The simulation model itself produces many more results too voluminous to be presented anywhere in this report. A complete list of the input data, projections, and compuer program that produced the results is on file with the Agricultural Economics Research Institute of the Ministry of Agriculture and Forestry, Seoul, Korea.

Regional Yields

Table B-1 presents a summary of yields for 12 crop groups by region (I—Single Crop Region; II—Double Crop Region; III—Upland Region) for Alternatives I, II, and III.

Regional Land Utilization

Land utilization by crop group in the three regions is presented in Table B-2 for Alternatives I, II, and III. Land utilization in the three regions for the KASS recommended strategy (Alternative IV) is presented in Table B-3.

Population Projections

Figure B-1 presents the urban (nonfarm) and rural (farm) population distributions by age and sex in 1969. As can be seen, there is a much higher percentage of young people under 18 years of age in the rural population than in the urban population. Figure B-2 presents the projected urban and rural distributions in 1985 resulting from a "moderate" family planning program conducted under Alternative I while Figure B-3 presents the same projections for a more intensive family planning program conducted under Alternatives II and III. Figure B-3 shows a lower percentage of persons under the age of 15 than does Figure B-2 as a result of the difference in the two family planning programs. Figure B-4 projects the number of women entering the ages of peak fertility between 1970 and 1985. This figure gives an indication as to why the natural increase rate will level off after 1975 unless a more intensive family planning program is undertaken to handle the surge in the number of fertile women.

Regional Production

Table B-4 presents the projections of production for 11 commodity groups under Alternatives I, II, and III in the three regions while Table B-5 presents similar projections for the KASS recommended strategy (Alternative IV).

Seasonal Labor Utilization

Figure B-5 presents a seasonal agricultural labor utilization index by region for Alternatives I, II and III. The index is defined as the proportion of total labor utilization at 1970 levels of mechanization. The upward shift in the profiles between 1971 and 1984 provides a rough indication as to the rate at which mechanization should be introduced to relieve the increasing demands on the decreasing agricultural labor force.

TABLE B-1
Crop Yields by Crops and Crop Groups under Three Policy Strategy Alternatives, by Region, Korea, 1971, '75, '80, '85

Commodity and Alternative	1971			1975			1980			1985		
	Region*			Region*			Region*			Region*		
	I	II	III	I	II	III	I	II	III	I	II	III
	.....metric tons/ha.....			.....metric tons/ha.....			.....metric tons/ha.....			.....metric tons/ha.....		
Rice												
Alt. I	3.379	3.184	2.691	3.734	3.518	2.974	3.902	3.677	3.107	4.070	3.835	3.241
Alt. II	3.412	3.215	2.717	3.902	3.676	3.107	4.241	3.996	3.377	4.579	4.315	3.647
Alt. III	3.362	3.168	2.677	3.649	3.438	2.905	3.734	3.518	2.974	3.816	3.596	3.039
Barley												
Alt. I	2.008	2.211	1.806	2.123	2.337	1.908	2.265	2.494	2.036	2.402	2.644	2.159
Alt. II	2.027	2.232	1.823	2.218	2.442	1.994	2.449	2.697	2.202	2.679	2.949	2.408
Alt. III	1.995	2.196	1.793	2.053	2.261	1.846	2.117	2.330	1.903	2.182	2.402	1.962
Wheat												
Alt. I	2.201	2.201	2.201	2.247	2.247	2.247	2.363	2.363	2.363	2.479	2.479	2.479
Alt. II	2.217	2.217	2.217	2.324	2.324	2.324	2.518	2.518	2.518	2.711	2.711	2.711
Alt. III	2.190	2.190	2.190	2.190	2.190	2.190	2.247	2.247	2.247	2.306	2.306	2.306
Other grains												
Alt. I	.972	.972	.972	1.179	1.179	1.179	1.469	1.469	1.469	1.760	1.760	1.760
Alt. II	1.000	1.000	1.000	1.319	1.319	1.319	1.750	1.750	1.750	2.179	2.179	2.179
Alt. III	.942	.942	.942	1.029	1.029	1.029	1.169	1.169	1.169	1.309	1.309	1.309
Fruits												
Alt. I	7.713	7.596	7.630	8.648	8.386	8.488	9.638	9.390	9.493	10.720	10.490	10.580
Alt. II	7.713	7.596	7.630	8.648	8.386	8.488	9.638	9.390	9.493	10.720	10.490	10.580
Alt. III	7.713	7.596	7.630	8.648	8.386	8.488	9.638	9.390	9.493	10.720	10.490	10.580
Pulses												
Alt. I	.760	.760	.760	.840	.840	.840	.960	.960	.960	1.080	1.080	1.080
Alt. II	.776	.776	.776	.920	.920	.920	1.120	1.120	1.120	1.319	1.319	1.319
Alt. III	.748	.748	.748	.780	.780	.780	.840	.840	.840	.900	.900	.900
Vegetables												
Alt. I	10.680	10.680	10.680	10.990	10.990	10.990	11.490	11.490	11.490	12.000	12.000	12.000
Alt. II	10.700	10.700	10.700	11.100	11.100	11.100	11.690	11.690	11.690	12.300	12.300	12.300
Alt. III	10.700	10.700	10.700	11.100	11.100	11.100	11.690	11.690	11.690	12.300	12.300	12.300
Potatoes												
Alt. I	4.118	4.118	4.118	4.350	4.350	4.350	4.495	4.495	4.495	4.640	4.640	4.640
Alt. II	4.133	4.133	4.133	4.423	4.423	4.423	4.640	4.640	4.640	4.858	4.858	4.858
Alt. III	4.104	4.104	4.104	4.278	4.278	4.278	4.350	4.350	4.350	4.423	4.423	4.423
Tobacco												
Alt. I	1.572	1.572	1.572	1.699	1.699	1.699	1.749	1.749	1.749	1.799	1.799	1.799
Alt. II	1.574	1.574	1.574	1.709	1.709	1.709	1.762	1.762	1.762	1.829	1.829	1.829
Alt. III	1.572	1.572	1.572	1.699	1.699	1.699	1.749	1.749	1.749	1.799	1.799	1.799
Forage												
Alt. I	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Alt. II	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Alt. III	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Mulberry												
Alt. I	.227	.227	.227	.297	.297	.297	.346	.346	.346	.396	.396	.396
Alt. II	.229	.229	.229	.307	.307	.307	.366	.366	.366	.426	.426	.426
Alt. III	.227	.227	.227	.297	.297	.297	.346	.346	.346	.396	.396	.396
Industrial crops												
Alt. I	.952	.952	.952	1.200	1.200	1.200	1.459	1.459	1.459	1.719	1.719	1.719
Alt. II	.962	.962	.962	1.249	1.249	1.249	1.559	1.559	1.559	1.870	1.870	1.870
Alt. III	.952	.952	.952	1.200	1.200	1.200	1.459	1.459	1.459	1.719	1.719	1.719

*,Regions: I—single crop region; II—double crop region; III -upland region.

TABLE B-2

Land Utilization by Crops and Crop Groups under Three Policy Strategy Alternatives by Region, Korea, 1971, '75, '80 and '85

Commodity	Alternative	1971 Region* I	1971 Region* II	1971 Region* III	1971 Total	1975 Region* I	1975 Region* I	1975 Region* III	1975 Total	1980 Region* I	1980 Region* II	1980 Region* III	1980 Total	1985 Region* I	1985 Region* II	1985 Region* III	1985 Total
		.....thousand hectares.....				.....thousand hectares.....				.....thousand hectares.....				.....thousand hectares.....			
TOTAL	I	796	2,255	549	3,600	818	2,303	561	3,682	842	2,358	566	3,766	890	2,412	575	3,877
	II	800	2,259	549	3,608	840	2,332	558	3,730	876	2,460	584	3,920	907	2,555	598	4,060
	III	785	2,216	537	3,538	758	2,115	517	3,390	735	2,047	497	3,279	714	1,985	481	3,180
Rice	I	348	743	131	1,222	339	724	127	1,190	333	711	125	1,169	329	701	123	1,153
	II	350	748	132	1,230	352	750	132	1,234	356	759	134	1,249	360	767	135	1,262
	III	341	729	127	1,197	306	652	115	1,073	279	596	105	980	257	548	97	902
Barley	I	135	718	95	948	133	712	94	939	135	722	95	952	138	739	98	975
	II	136	723	96	955	138	97	973	146	776	102	1,024	151	808	107	1,066	....
	III	132	703	93	928	120	641	85	846	114	607	80	801	108	578	76	762
Wheat	I	34	107	29	170	33	105	28	166	33	102	27	162	32	100	26	158
	II	34	107	29	170	35	108	29	172	35	110	29	174	35	109	29	173
	III	34	105	28	167	31	96	25	152	28	86	23	137	25	77	21	123
Other grains	I	12	64	61	137	9	50	48	107	6	32	30	68	3	16	16	35
	II	12	64	61	137	10	51	49	110	7	34	33	74	3	17	16	36
	III	12	62	60	134	8	44	43	95	5	28	26	59	3	15	14	32
Fruit	I	19	36	9	64	25	46	12	83	31	59	15	105	37	71	18	126
	II	19	36	9	64	25	46	12	83	31	59	15	105	37	71	18	126
	III	19	36	9	64	25	46	12	83	31	59	15	105	37	71	18	126
Pulses	I	112	179	88	379	112	179	88	379	114	181	90	385	150	183	91	424
	II	113	175	87	375	116	161	80	357	121	192	95	408	126	201	99	426
	III	110	175	87	372	101	161	80	342	96	152	75	323	90	143	70	303
Vegetables	I	77	132	36	245	100	171	47	318	113	194	53	360	123	210	57	390
	II	76	130	35	241	95	163	44	302	103	176	48	327	110	188	51	349
	III	77	131	35	243	98	168	45	311	107	182	49	338	113	193	52	358
Potatoes	I	26	132	45	203	32	160	55	247	36	178	61	275	39	198	58	305
	II	27	133	46	206	33	165	57	255	38	192	66	296	43	216	74	333
	III	26	129	44	199	29	144	50	223	30	150	52	232	30	154	53	237
Tobacco	I	6	23	13	42	8	28	16	52	9	33	18	60	10	38	21	69
	II	6	23	12	41	7	27	15	49	7	28	15	50	8	31	17	56
	III	6	23	12	41	8	28	15	51	9	32	18	59	10	36	20	66
Mulberry	I	15	63	24	102	15	70	28	113	18	82	32	132	14	88	36	138
	II	15	62	24	101	17	67	26	110	19	76	29	124	21	87	33	141
	III	16	65	24	105	20	79	30	129	23	95	36	154	27	108	41	176
Industrial crops	I	12	58	18	88	12	58	18	88	14	64	20	98	15	68	21	104
	II	12	58	18	88	12	56	17	85	13	58	18	89	13	60	19	92
	III	12	58	18	88	12	56	17	85	13	60	18	91	14	62	19	95

* Regions: I—single crop region; II—double crop region; III—upland region.

TABLE B-3
Projected Land Utilization for 11 Crop Groups, by Region and Total, under KASS Recommended Agricultural Development Strategy (Alternative IV), Korea, 1971, '75, '80, '85

Commodity*	1971				1975				1980				1985			
	Region†			Total	Region†			Total	Region†			Total	Region†			Total
	I	II	III		I	II	III		I	II	III		I	II	III	
	.....thousand hectares.....				.....thousand hectares.....				.....thousand hectares.....				.....thousand hectares.....			
TOTAL	800	2,259	547	3,606	840	2332	558	3,730	886	2,498	583	3,965	907	2,575	599	4,081
Rice	350	748	132	1,230	352	750	132	1,234	356	759	134	1,249	360	767	135	1,262
Barley	136	723	96	955	138	738	97	973	126	656	62	844	91	538	57	686
Wheat	34	107	29	170	35	108	29	172	65	160	40	265	95	239	39	373
Other grains	12	64	61	137	10	51	49	110	7	34	33	74	3	17	16	36
Fruit	19	36	9	64	25	46	12	83	31	57	15	103	37	71	18	126
Pulses	113	175	87	375	116	161	80	357	121	192	95	408	126	201	99	426
Vegetables	76	130	35	241	95	163	44	302	103	176	48	327	110	188	51	349
Potatoes	27	133	44	204	33	165	57	255	38	202	94	334	43	226	115	384
Tobacco	6	23	12	41	7	27	15	49	7	28	15	50	8	31	17	56
Mulberry	15	62	24	101	17	67	26	110	19	76	29	124	21	87	33	141
Industrial crops	12	58	18	88	12	56	17	85	13	158	18	189	13	210	19	242

* No estimates were made on the allocation of land to the production of forage crops
† Regions: I—single crop region; II—double crop region; III upland region.

TABLE B-4
Projected Production of Agricultural Crop Commodities by Region under Strategy Alternatives I, II, III, Korea, 1971, '75, '80, '85

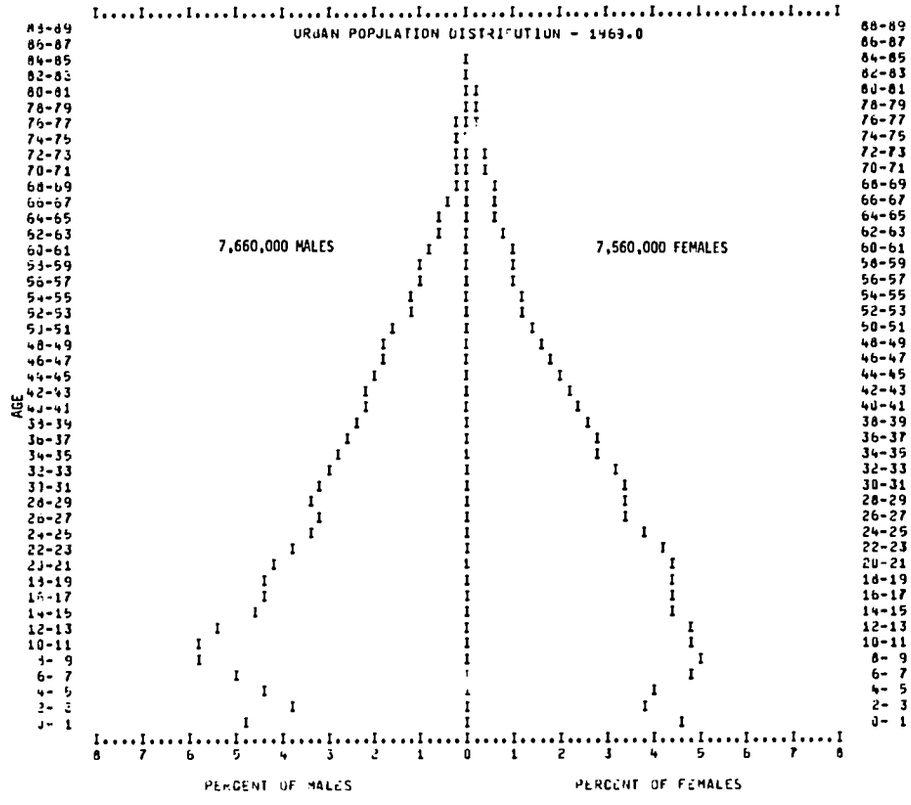
Commodity	Alternative	1971 Region* I	1971 Region* II	1971 Region* III	1971 Total	1975 Region* I	1975 Region* II	1975 Region* III	1975 Total	1980 Region* I	1980 Region* II	1980 Region* III	1980 Total	1985 Region* I	1985 Region* II	1985 Region* III	1985 Total
		..... million metric tons				..... million metric tons				..... million metric tons				..... million metric tons			
Rice	I	1.175	2.366	.353	3.894	1.266	2.547	.378	4.191	1.299	2.614	.388	4.301	1.339	2.688	.399	4.426
	II	1.196	2.406	.359	3.961	1.373	2.757	.410	4.540	1.510	3.033	.453	4.996	1.649	3.310	.492	5.451
	III	1.147	2.309	.344	3.800	1.116	2.242	.334	3.702	1.042	2.097	.312	3.451	.981	1.971	.293	3.247
Barley	I	.270	1.587	.172	2.029	.282	1.664	.179	2.125	.306	1.801	.193	2.300	.331	1.954	.212	2.497
	II	.275	1.613	.174	2.062	.306	1.802	.193	2.301	.358	2.092	.225	2.675	.405	2.383	.258	3.046
	III	.263	1.545	.167	1.975	.246	1.449	.157	1.852	.241	1.415	.152	1.808	.236	1.389	.149	1.774
Wheat	I	.075	.235	.063	.373	.074	.236	.063	.373	.078	.241	.064	.383	.079	.248	.064	.391
	II	.076	.238	.064	.378	.081	.251	.067	.399	.088	.277	.073	.438	.095	.296	.079	.470
	III	.074	.230	.062	.366	.068	.210	.055	.333	.063	.193	.052	.308	.058	.178	.048	.284
Other grains	I	.012	.062	.059	.133	.011	.059	.057	.127	.009	.047	.044	.100	.005	.028	.028	.061
	II	.012	.064	.061	.137	.013	.067	.065	.145	.012	.060	.058	.130	.007	.037	.035	.079
	III	.011	.059	.057	.127	.008	.045	.044	.097	.006	.033	.030	.069	.004	.020	.018	.042
Fruit	I	.150	.271	.070	.491	.213	.385	.100	.698	.298	.551	.142	.991	.398	.746	.192	1.336
	II	.150	.271	.070	.491	.213	.385	.100	.698	.298	.551	.142	.991	.398	.746	.192	1.336
	III	.150	.271	.070	.491	.212	.385	.100	.697	.298	.551	.142	.991	.398	.746	.192	1.336
Pulses	I	.085	.136	.067	.288	.094	.150	.074	.318	.109	.174	.086	.369	.124	.198	.098	.420
	II	.088	.136	.067	.291	.107	.148	.074	.329	.136	.215	.106	.457	.166	.265	.131	.562
	III	.082	.131	.065	.278	.079	.126	.062	.267	.080	.128	.063	.271	.081	.129	.063	.273
Vegetables	I	.823	1.407	.383	2.613	1.099	1.879	.517	3.495	1.298	2.229	.609	4.136	1.476	2.520	.684	4.680
	II	.814	1.392	.278	2.584	1.054	1.809	.488	3.351	1.204	2.058	.561	3.823	1.352	2.311	.627	4.290
	III	.820	1.403	.380	2.603	1.088	1.864	.499	3.451	1.251	2.128	.573	3.952	1.389	2.373	.639	4.401
Potatoes	I	.108	.544	.187	.839	.139	.696	.239	1.074	.162	.800	.274	1.236	.181	.919	.316	1.416
	II	.110	.550	.189	.849	.146	.730	.252	1.128	.176	.891	.306	1.373	.209	1.049	.359	1.617
	III	.106	.529	.182	.817	.124	.616	.214	.954	.131	.653	.226	1.010	.133	.681	.234	1.048
Tobacco	I	.010	.036	.020	.066	.014	.048	.027	.089	.016	.058	.031	.105	.018	.068	.038	.124
	II	.009	.036	.020	.065	.012	.046	.026	.084	.012	.049	.026	.087	.015	.051	.031	.103
	III	.010	.036	.020	.066	.016	.048	.025	.089	.016	.056	.035	.107	.018	.065	.036	.119
Mulberries cocoon†	I	.003	.014	.005	.022	.005	.021	.008	.034	.006	.028	.011	.045	.005	.035	.014	.054
	II	.004	.014	.005	.023	.005	.021	.008	.034	.007	.028	.011	.046	.009	.037	.014	.060
	III	.004	.015	.006	.025	.006	.023	.009	.038	.008	.033	.012	.053	.011	.043	.016	.070
Industrial crops	I	.012	.055	.017	.084	.014	.070	.022	.106	.020	.093	.029	.142	.026	.117	.036	.179
	II	.012	.056	.017	.085	.015	.070	.021	.106	.020	.090	.028	.138	.024	.112	.036	.172
	III	.012	.055	.017	.084	.014	.067	.020	.101	.019	.088	.026	.133	.024	.107	.033	.164

* Regions: I—single crop region; II—double crop region; III upland region.
† Production overestimated after 1975. Due to poor profitability farmers are likely to shift away from silk production.

TABLE B-5
Projected Production of Agricultural Crop Commodities by Region and Total under KASS Recommended Agricultural Development Strategy (Alternative IV), Korea, 1971, '75, '80, '85

Commodity	Year	Region*			Total
		I	II	III	
		.....million metric tons.....			
Rice	1971	1.201	2.416	.360	3.977
	1975	1.398	2.807	.418	4.623
	1980	1.558	3.130	.467	5.155
	1985	1.698	3.409	.507	5.614
Barley	1971	.277	1.628	.176	2.081
	1975	.319	1.874	.202	2.395
	1980	.324	1.857	.143	2.324
	1985	.255	1.657	.144	2.056
Wheat	1971	.076	.238	.064	.378
	1975	.081	.251	.067	.399
	1980	.164	.403	.101	.668
	1985	.258	.648	.106	1.012
Other grains	1971	.012	.064	.061	.137
	1975	.013	.067	.065	.145
	1980	.012	.060	.058	.130
	1985	.007	.037	.035	.079
Fruit	1971	.150	.271	.070	.491
	1975	.213	.385	.100	.698
	1980	.298	.551	.142	.991
	1985	.398	.746	.192	1.336
Pulses	1971	.088	.136	.067	.291
	1975	.107	.148	.074	.329
	1980	.135	.215	.106	.457
	1985	.166	.265	.131	.562
Vegetables	1971	.314	1.392	.378	2.584
	1975	1.054	1.809	.488	3.351
	1980	1.204	2.058	.561	3.823
	1985	1.352	2.311	.627	4.290
Potatoes	1971	.110	.550	.189	.849
	1975	.146	.730	.252	1.128
	1980	.176	.937	.445	1.558
	1985	.209	1.098	.559	1.866
Tobacco	1971	.009	.036	.020	.065
	1975	.012	.046	.026	.084
	1980	.012	.049	.026	.087
	1985	.015	.057	.031	.103
Mulberry†	1971	.004	.014	.005	.023
	1975	.005	.021	.008	.034
	1980	.007	.028	.011	.046
	1985	.009	.037	.014	.060
Industrial crops	1971	.012	.056	.017	.085
	1975	.015	.070	.021	.106
	1980	.020	.246	.028	.294
	1985	.024	.393	.036	.453

* Regions: I—single crop region; II—double crop region; III—upland region.
† Production overestimated after 1975. Due to poor profitability farmers are likely to shift away from silk production.



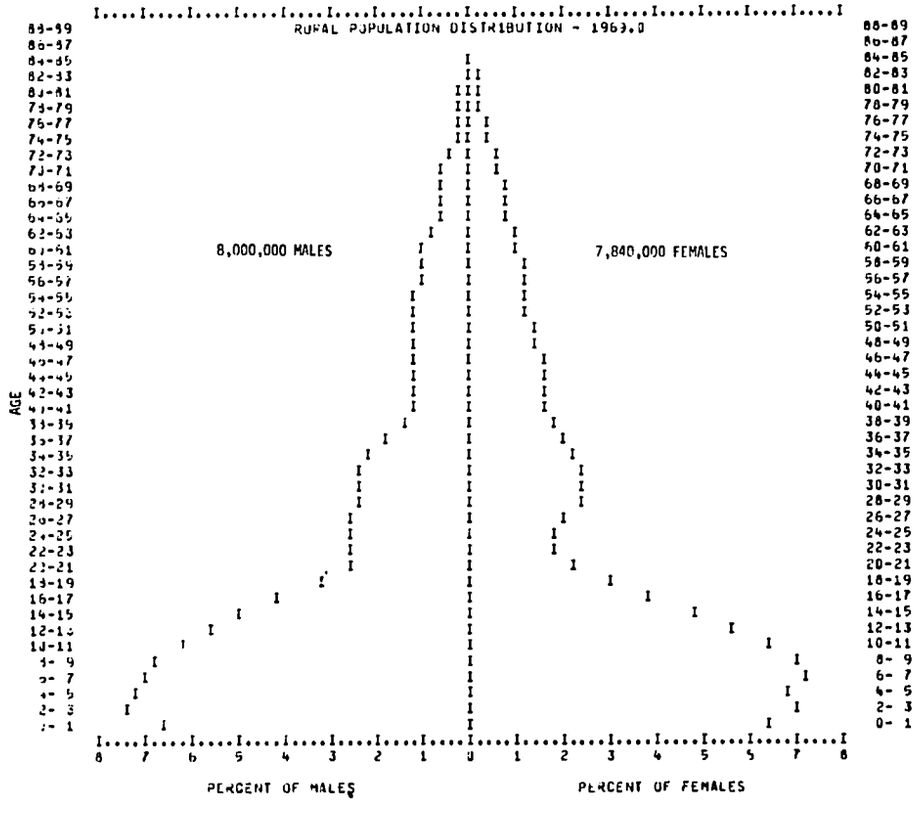
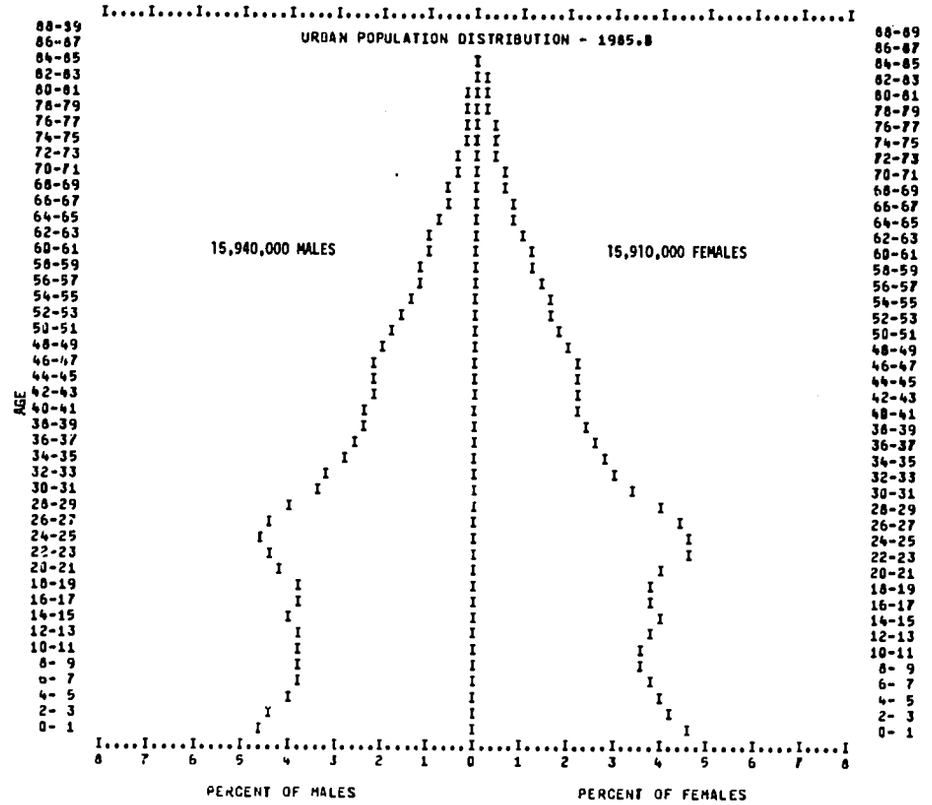


FIGURE B-1. Urban and rural population distributions by age and sex in 1969, Korea.



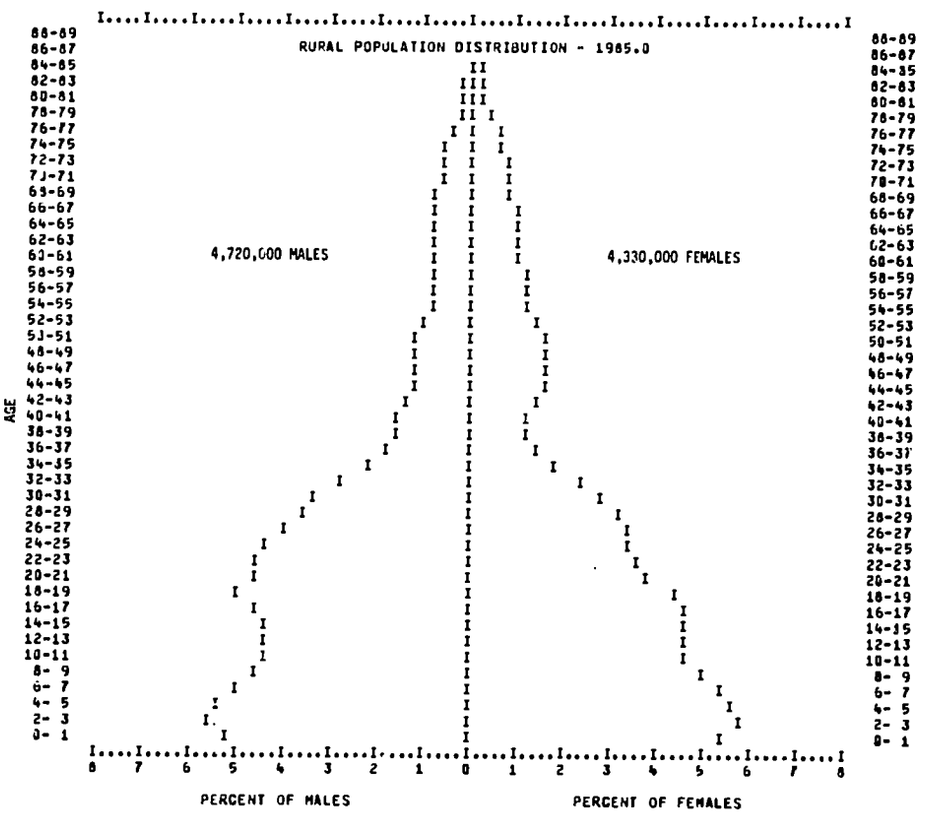
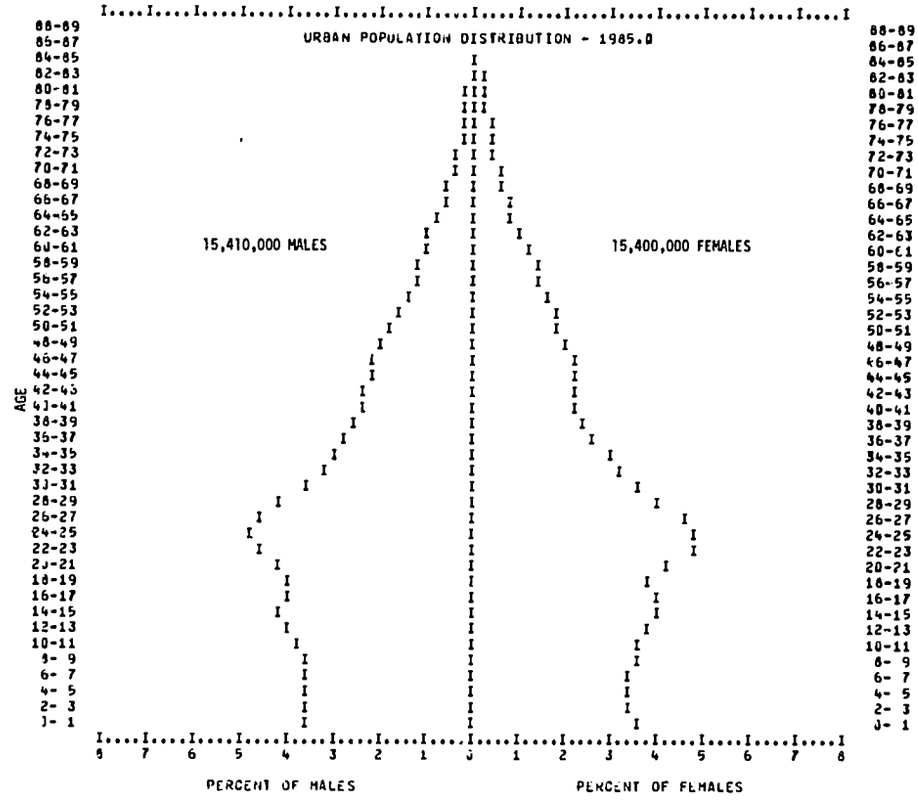


FIGURE B-2. Projected urban and rural population distributions by age and sex in 1985 resulting from a "moderate" family planning program under Alternative I, Korea.



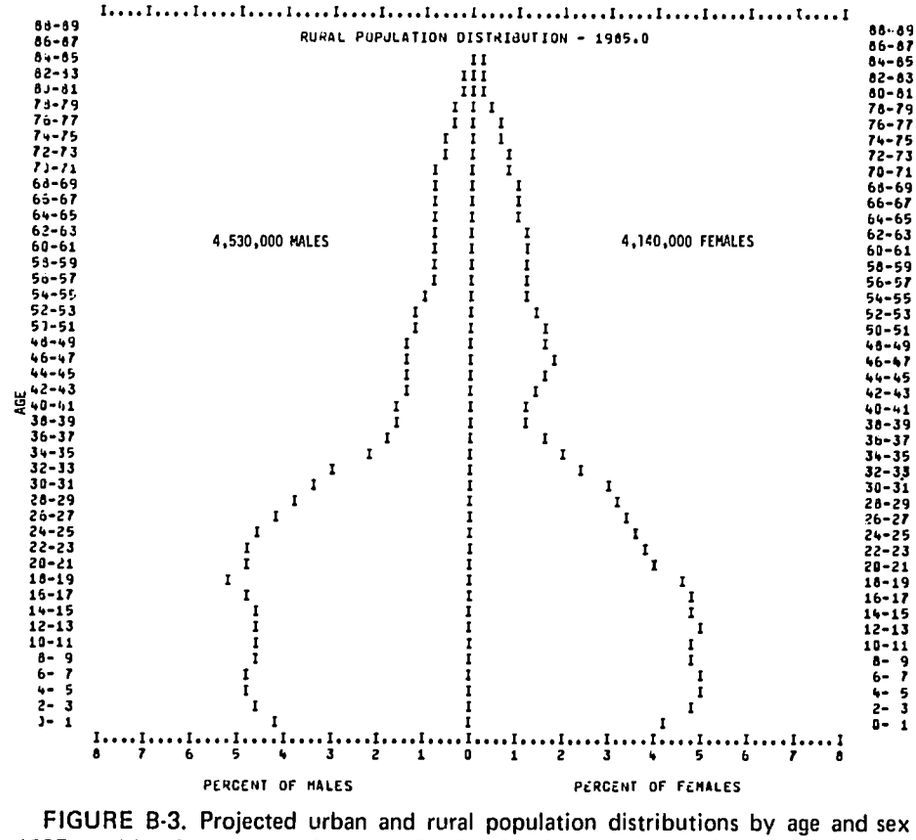


FIGURE B-3. Projected urban and rural population distributions by age and sex in 1985 resulting from a more intensive family planning program under Alternatives II and III and KASS recommended strategy (Alternative IV), Korea.

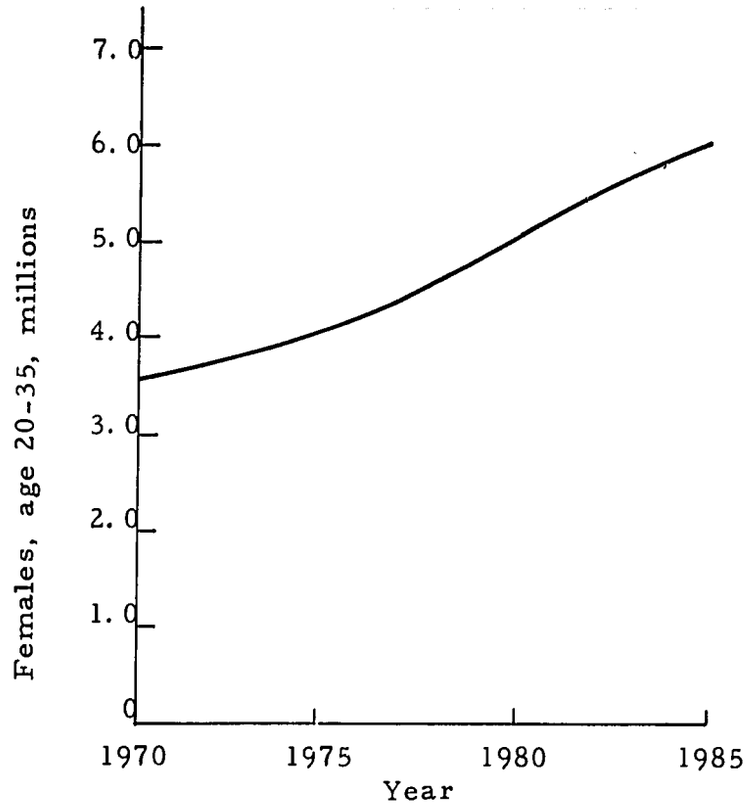


FIGURE B-4. Projected female population between ages of 20 and 35, 1970-1985, Korea.

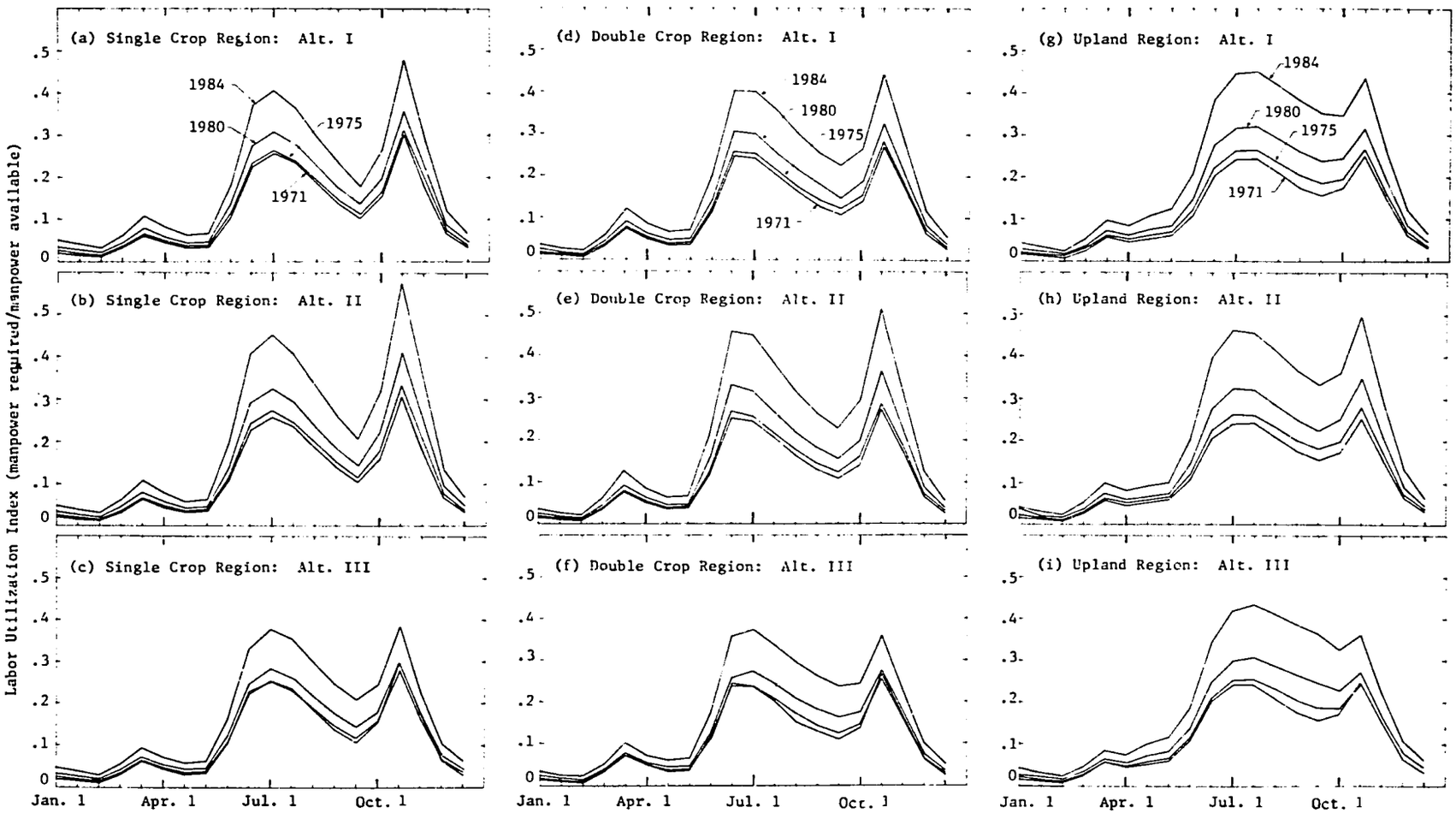


FIGURE B-5. Seasonal agricultural labor utilization index by region for Alternatives I, II, III, Korea, 1971, '75, '80, '84. The index is defined as the proportion of total labor force utilization at 1970 levels of mechanization. Thus, an index value of 1.0 indicates that the total labor force is working 24 hours per day, 365 days per year. For these projections the total labor force was defined as the *average* number of persons employed in agriculture over a year. The seasonal expansion and contraction of the number of persons working in agriculture (as much as 40 percent above and below the average) was not taken into account in computing the index. The upward shift in the profiles between 1971 and 1984 provides a rough indication as to the rate at which mechanization should be introduced to relieve the increasing demands on the decreasing agricultural labor force.

Appendix C

KASS Publications and Working Parties

Korean Agricultural Sector Study
Special Reports

KASS Special Report 1, "The National Agricultural Cooperative Federation: An Appraisal," John R. Brake, Carl F. Frost, Henry E. Larzelere, George E. Rossmiller, James D. Shaffer, and Vernon L. Sorenson.

KASS Special Report 2, "Rural Infrastructure," Sang Gee Kim and Lawrence W. Libby.

KASS Special Report 3, "An Analysis of New Land Development in Korea," Raleigh Barlowe, William J. Haley, Byeong Do Kim, Byung Su Ryu, and Warren H. Vincent.

KASS Special Report 4, "An Analysis of Supply Response on Major Agricultural Commodities in Korea," John N. Ferris and Han Hyeck Suh.

KASS Special Report 5, "Agricultural Research and Guidance," Moo Nam Chung, Mason E. Miller, and Sylvan H. Wittwer.

KASS Special Report 6, "Population, Migration, and Agricultural Labor Supply," J. Allan Beegle, Tom W. Carroll, Dale E. Hathaway, and Byeong Do Kim.

KASS Special Report 7, "Organization and Performance of the Agricultural Marketing System in Korea," Sang Kuk Han, Yong Sun Hong, Chang Seo Park, James D. Shaffer, Won Jun Song, Kee Won Suh, and Won Ho Suh.

KASS Special Report 8, "Crop Production Data and Relationships," Young Sik Kim, Kwang Hee Kim, and Karl T. Wright.

Korean Agricultural Sector Study
Working Parties and/ or Papers

Aggregate Demand, Price Level, Employment, Balance of Payments

Byerlee, Derek R.
Haley, William J.
Kim, Dong Min
Tolley, George S.
Gustafson, Robert L.
Hwang, Eui Gak
Suh, Han Hyeck

Agricultural Credit System

Brake, John R.
Kim, Yong Jin

Agricultural Marketing System Organization and Performance

Shaffer, James D.
Suh, Won Ho

Agricultural Price, Income, Tax, Subsidy

Ferris, John N.
Rossmiller, George E.
Kim, Chung Ho
Suh, Han Hyeck

Capital Formation, Saving, Investment, Disinvestment

Brake, John R.
Kim, Dong Min
Johnson, Glenn L.

Crop Production and Data

Kim, Kwang Hee
Wright, Karl T.
Kim, Young Sik

Domestic Agricultural Supply Analysis

Ferris, John N.
Suh, Han Hyeck

Extension, Education, Training

Chung, Moo Nam
Miller, Mason E.

Food Demand Relationships

Hayenga, Marvin L.
Ryu, Byung Su

Korean Agricultural Study Planning

Johnson, Glenn L.
Kim, Dong Hi
Manetsch, Thomas J.
Rossmiller, George E.
Suh, Han Hyeck

Korean Cooperatives

Larzelere, Henry
Shim, Kyo Bo

Korean Fisheries

Hwang, Eui Gak
Rossmiller, George E.

Korean Population and Demographic Characteristics

Beegle, J. Allan
Carroll, Tom W.
Kim, Byeong Do

Korean Sector Study Guidelines

Kim, Dong Hi
Manetsch, Thomas J.
Rossmiller, George E.
Suh, Han Hyeck

Land and Water Development and Policy

Barlowe, Raleigh
Haley, William J.
Kim, Byeong Do
Ryu, Byung Su
Vincent, Warren H.

Livestock Production and Marketing

Deans, Robert
Hong, Jae Hee
Kim, Young Sik
Kyle, Leonard
Manetsch, Thomas J.

Manpower Implications of Mechanization

Hathaway, Dale E.
Kim, Byeong Do
Kim, Chung Ho
Rossmiller, George E.

Ministry of Agriculture and Forestry Organization

Hathaway, Dale E.
Kim, Chung Ho
Kim, Kwang Hee
Rossmiller, George E.

National Agricultural Cooperative Federation

Frost, Carl F.
Sorenson, Vernon L.
Suh, Won Ho

Research and Technology Advancement

Chung, Moo Nam
Johnson, Glenn L.
Wittwer, Sylvan

Rural Infrastructure

Kim, Sang Gee
Libby, Lawrence W.

Trade Policy, PL 480

Kim, Dong Min
Rossmiller, George E.
Suh, Han Hyeck

Appendix D

Bibliography

Abkin, Michael H. "Policy Making for Economic Development: A System Simulation Model of the Agricultural Economy of Southern Nigeria." Unpublished Ph.D. dissertation, Michigan State University, 1972.

Adelman, Irma, and Kim, Mahn Je. "An Econometric Model of the Korean Economy (1956-1966)." *Practical Approaches to Development Planning.* Edited by Irma Adelman. Baltimore: Johns Hopkins Press, 1969.

Adler, M. H. B. "Opening Remarks Made By Director Adler at the Grain Price and Marketing Policy Seminar at Academy House," New York, June 22, 1971. (Mimeographed.)

Agricultural Development Corporation. *Creating a Progressive Rural Structure.* Seoul, 1969.

Agricultural Development Corporation and Ministry of Agriculture and Forestry. *Utilization of Land Capacity Survey from 1962 to 1968.* Seoul, 1969.

Agricultural Development Corporation. *Rural Modernization.* Seoul, n.d.

Agriculture and Fishery Development Corporation. *Agriculture and Fishery Development Corporation* (Annual Report). Seoul, 1968.

——. *A Drive for Agricultural Modernization in Korea.* Seoul, February, 1969.

——. *Activities and Accomplishments of the Agriculture and Fishery Development Corporation: A Program of Rural Development in Korea.* Seoul, March, 1970.

——. *A Program of Agro-Industry Development of Korea.* Seoul, March, 1971.

Asian Development Bank. "Report on the Institutional Aspects of the Agriculture and Fishery Development Corporation." August, 1968.

Ban, Sung Hwan. *A Study of the Marketing of Rice: By 300 Farmers in Four Villages, Kyunggi-do, for the 1965-66 Rice Year.* Suwon: Seoul National University, College of Agriculture, Department of Agricultural Economics, Korea, 1967.

——. *The Long-Run Productivity Growth in Korean Agricultural Development: 1910-1968.* Doctoral dissertation, University of Minnesota, 1971.

Bank of Korea. *Price Statistics Summary, 1968.* Seoul, 1968.

——. *1966 Input and Output Tables.* (Korean Language.) Seoul, 1970.

——. *1968 Input and Output Tables.* (English Language.) Seoul, 1970.

——. *Economic Statistics Yearbook, 1970.* Seoul, 1971.

——. *Review of Korean Economy, 1970.* Seoul, Korea, 1971.

——. *Economic Statistics Yearbook, 1971.* Seoul, 1971.

——. *Principal Economic Indicators.* No. 5. Seoul, March, 1971.

Barlowe, Raleigh, *et al.* "Land Development and Policy and Analysis of New Land Development in Korea." Korean Agricultural Sector Study (KASS) Special Report 5. East Lansing: Michigan State University.

Barlowe, Raleigh. "Land and Water Development Policy Issues in Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, January, 1972.

Barse, Joseph R. *Japan's Food Demand and 1985 Grain Import Prospects.* Washington, D.C.:

Economic Research Service, U. S. Department of Agriculture, Foreign Agricultural Economic Report 53, June, 1969.

Beegle, J. Allan, *et al.* "Population, Migration, and Agricultural Labor Supply." Korean Agricultural Sector Study (KASS) Special Report 6. East Lansing: Michigan State University.

Beegle, J. Allan, and Kim, Byeong Do. "The Population of the Republic of Korea (Revised)." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Brake, John, and Kim, Yong Jin. "The Credit Delivery System in Korea." Korean Agricultural Sector Study (KASS) Paper, East Lansing: Michigan State University, December, 1971.

Brake, John R., *et al.* "Capital Formation, Savings Investment, Disinvestment." Korean Agricultural Sector Team Paper 9. Seoul: KASS, 1972.

Brown, James R., and Lin Sein. *Land Reform in Developing Countries*, 1967.

Byerlee, D. R. "Macro Economic Projections of the Korean Economy Under Alternative Food Grain Pricing Policies." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Carroll, Tom W. "Status Report on the Korean Demographic Model." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, May, 1972.

Central Education Research Institute. "A Study for Projection of Private and Public Expenditures on Education for 1968." Seoul: August, 1969.

Choi, Hyun Ok. *Rice Production in Korea: A Report to be Presented at the Eleventh Session of the International Rice Commission, Tokyo, Japan, October 28-November 2, 1968.* Suwon: Office of Rural Development, Ministry of Agriculture and Forestry, 1968.

Chung, Nam Kyu and Oh, Heung Keun. *An Introduction to Korea Agriculture.* Suwon: Office of Rural Development, 1962.

Cole, David C., and Lyman, Princeton N. *Korean Development: The Interplay of Politics and Economics.*

Community Development Foundation. "Computer Summary Reports: CDF Program—Korea," Seoul, n.d. (Mimeographed.)

Cox, Milo L. "Memorandum: Indicators of a Need for an Agricultural Sector Analysis in Korea." Washington, D. C., January 22, 1970.

Daley, Rex F. *An Agricultural Outlook Service for Korea—With Analytical Appendix.* Seoul: Rural Development Division, United States Mission to Korea, 1968.

Day, R. H., and Singh, Inderjit. "A Microeconometric Study of Agricultural Development." Madison: University of Wisconsin Social Systems Research Institute, 1971.

DeWitt, Nicholas. *Status of Research and Manpower Trends for Educational Planning in Korea and Estimates of Supply—Demand for High-Level Manpower.* Seoul: Indiana University Center for Applied Manpower and Occupational Studies, Midwest Universities Consortium for International Activities and United States Agency for International Development, 1970.

Donald, Gordon, ed. *Development Digest.* Vol. VIII, No. 4. October, 1970. (Rural Education, Pesticides, Marketing and the Farmer, Economic Transition.) Washington: National Planning Association, 1970.

——. *Development Digest.* Vol. X, No. 1. January, 1972. (Population, Weaker, Industrial Employment.) Washington: National Planning Association, 1970.

Draper, William H., Jr., *et al. Population and Family Planning in the People's Republic of China.* Washington D. C.: The Victor-Bostrom Fund and the Population Crisis Committee, Spring, 1971.

East-West Food Institute. *Statement for East-West National Review Board.* Honolulu: University of Hawaii, East-West Food Institute, n.d.

Economic Planning Board. *Korea Statistical Yearbook.* Vol. 17. Seoul, 1970.

——. *Major Statistics in Charts.* Bureau of Statistics, Republic of Korea, 1971, p. 125.

——. *Outline of Agricultural Development Plan Under Five-Year Economic Development Plan.* Seoul, February, 1971.

Egen, Jean. "Academics Against Terracide." *Far Eastern Economic Review*. November, 1971.

Farm Management Guideline of Special or Industrial Crops, 1971. Seoul, Korea, 1971.

Fei, John C. H., and Ranis, Gustav. *Agriculture in the Open Economy*.

——. *Development and Employment in the Open Dualistic Economy*.

Ferris, John N., and Suh, Han Hyeck. "An Analysis of Supply Response on Major Agricultural Commodities in Korea." Korean Agricultural Sector Study (KASS) Special Report. East Lansing: Michigan State University.

Ferris, John N., and Suh, Han Hyeck. "Domestic Agricultural Supply Analysis." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Ferris, John N., *et al.* "Agricultural Price, Income Tax, Subsidy Policy." Korean Agricultural Sector Team Paper 8. Seoul: KASS, 1972.

Fishlow, Albert, and David, Paul A. "Optimal Resource Allocation In An Imperfect Market Setting." *Journal of Political Economy*, 69 (December, 1961), 529-546.

Food and Agriculture Organization of the United Nations. *Forest Survey—Republic of Korea—Interim Project*. Seoul, Korea, 1971.

——. *Reinvestment Survey of the Nakdong Basin: Results, Conclusions and Recommendations*. Seoul, Korea, 1971.

Fortune, Mark. *Mobilizing for Urbanization: Consultant Report*. Seoul, Korea, 1971.

Frost, Carl F. "National Agricultural Cooperatives Federation." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Gattoni, Louis A. *Korea Fruit Culture*. Seoul: Rural Development Division, United States Agency for International Development, 1970.

Ghali, Moheb, and Renaud, Bertrand. *Regional Investment and Regional Growth: Some Empirical Evidence*. Honolulu: Economic Research Center, University of Hawaii, 1971.

——. *The Consumption Function at the Regional Level: The Case of Hawaii*. Honolulu: Economic Research Center, University of Hawaii, 1971.

Goreux, Louis Marie. *Prospects for Lesser Developing Countries (LDC) Agricultural Trade: Preliminary Report*. New York: National Bureau of Economic Research, Inc., December, 1967.

Gormely, Patrick, *et al. Review of Grain Storage, Handling, Processing, and Distribution Problems and Proposals in the Republic of Korea*. Seoul: Kansas State University Department of Grain Science and Industry and United States Agency for International Development, September, 1968.

Gustafson, Robert L., and Hwang, Eui Gak. "The Demand for Non-Food and Food by Non-Farmers and Farmers." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University. February, 1972.

Gustafson, Robert L., and Tolley, G. S., *et al.* "Monetary, Fiscal, Price Level, Employment, Balance of Payments." Korean Agricultural Sector Team Paper 15A. Seoul: KASS, 1972.

Hahm, Pyong Choon. "The Korean Political Tradition and Law." *The Royal Asiatic Society, 2nd ed.* 1971. (This essay was published earlier under the title "The Korean People and Their Property Rights," *The American Journal of Comparative Law*, Vol. 12, 1963.)

Hahn, Sang Ki. *Development of Modern System of Breeding Improved Small Grains*. Seoul: Seoul National University, College of Agriculture, Korea, 1970.

Halbert, H., and Larsen, A. *Study of Cooperatives in Korea: National Agricultural Cooperatives Federation*. Seoul, Korea, 1966.

Haley, W. J. "Tentative Projections on Selected Macro Aggregates." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, November, 1971.

Halpern, Carl; Kriesel, Herbert C.; Larzelere, Henry E.; and Laurent, Charles K. *Agricultural Marketing in Tanzania Background Research and Policy Proposals*. June, 1970.

Han, Kee Chun, and Pak, Ki Hyuk. *An Analysis of Food Consumption in the Republic of Korea*. Seoul: Yonsei University, Korea, 1969.

, Kee Chun; Han, Woong Bin; Lee, Ki Hong; ık, Ki Hyak; and Park, Jin Hwan. *A Study of ınd Tenure in Korea.* Seoul: Korea Land Eco- ɔmics Research Center, 1966.

ıaway, Dale E., *et al.* "Ministry of Agriculture ıd Forestry Organization." Korean Agricultural ɜctor Team Paper 14. Seoul: KASS, 1972.

enga, Marvin L., and Ryu, Byung Seu. "Food emand Relationships in Korea." Korean Agri- ıltural Sector Study (KASS) Paper. East Lan- ng: Michigan State University, March, 1972.

dy, Earl O., and Coutu, Arthur J. "A Develop- ıent Analysis Package and Method to Improve ıe Economic Planning of Agriculture and At- ıin National Goals in Thailand." Bangkok, hailand: Office of Agricultural Development, Inited States Operations Mission, July, 1971. Mimeographed.)

itute of Agricultural Science. *List of Research ublications in Agricultural Science 1937-1968.* uwon: Seoul National University College of ıgriculture, n.d.

rnational Development Review. Vol. 2. Wash- ıgton D. C.: Society for International Develop- ıent, 1972.

ıson, Glenn L., and Kim, Dong Hi. "Tentative houghts on the Korean Agricultural Sector tudy (KASS) by Agricultural Economics Re- ɜarch Institute (AERI) and the Michigan State Iniveristy—United States Agency for Inter- ational Development (MSU-USAID) Contract Iroup." Seoul, July 7, 1971. (Mimeographed.)

ıson, Glenn L., and Quance, Leroy. *The Over- roduction Trap.* Baltimore: Johns Hopkins ress, 1972 (forthcoming).

nson, Glenn L., and Zerby, Lewis K. *What conomists Do About Values: Case Studies of heir Answers to Questions They Don't Dare sk.* East Lansing: Michigan State Agricultural xperiment Station, 1973.

nson, Glenn L. "Factor Markets and Economic levelopment." Chapter 6 in *Economic Develop- ıent of Tropical Agriculture,* by W. W. McPher- ɔn. Gainesville: University of Florida Press, 968.

—. "Capital In Agriculture." *International Encyclopedia of Social Sciences.* Vol. 1, 229-236. New York: Macmillan Company.

——. "The Role of the University and Its Economists in Economic Development." Publication No. AE701. Guelph: Department of Agricultural Economics, University of Guelph, Ontario, March, 1970.

——. "Peter Kilby's Review of Strategies and Recommendations for Nigerian Rural Development, 1960/1985." *American Journal of Agricultural Economics,* 53 (November, 1971), 678.

Johnson, Harry G. "The Cost of Protection and the Scientific Tariff," *Journal of Political Economy,* 68 (August, 1960), 327-45.

Jones, William O. *Measuring the Effective-Less of Agricultural Marketing in Contributing to Economic Development: Some African Examples.* Stanford: Stanford University Food Research Institute, 1970.

Joo, Yong Jae; Lee, Jeung Ham; and Suh, Joong Il. *Structural Variables in Demand Functions for Agricultural Products: Grains.* (Based on time series data.)

Kang, Chang Kyu. *The Influence of "Ke" Societies Upon Ri-Dong Agricultural Cooperative Association.* Seoul: Choong-Puk National College, 1969.

Karcz, Jerzy F. "Comparative Study of Transformation of Agriculture in Centrally Planned Economies: The Soviet Union, Eastern Europe, and Mainland China." New York: National Bureau of Economic Research, Inc., December 1, 1967. (Mimeographed.)

Kim, Chung Ho. "Government Support to the Agricultural Sector." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Kim, Dong Hi. "Regional Imbalance in Economic Development in Korea." Unpublished course paper, 1969.

——. "Testing Development Models of Fei-Ranis and Jorgenson in the Case of Korea, 1957 to 1967." Unpublished course work.

Kim, Hyong Chun. "Korea's Export Success, 1960-69." *Finance and Development.* Vol. 8. No. 1. Washington: International Monetary Fund and the World Bank Group, March, 1971.

Kim, S. H. "Equidemiological Studies on the Relationship Between Soil Composition and Infestation of Ascarias and Hookworm." Unpublished Department of Parasitology, Yonsei University, Seoul, Korea, 1970.

Kim, Sang Gee. *The Impact of PL480 Shipments on Prices and Domestic Production of Food Grain in Korea.* Seoul: Agricultural Economics Research Institute, Ministry of Agriculture and Forestry, Korea, 1970.

Kim, Sung Hoon. "The Structure and Functioning of Rural Credit in Korea: An Empirical Analysis." Preliminary draft of Ph.D. dissertation for submission to the Department of Agricultural Economics, University of Hawaii, n.d.

Kim, Yong Jin. "An Econometric Analysis of the South Korean Food Grain Section." Unpublished M.S. dissertation, University of Maryland, 1969.

Kim, Young Bok. "Grain Management Special Account." Unpublished manuscript, Rural Development Division, United States Agency for International Development, Seoul, Korea, 1971.

Kling, John O., *et al. Present Status and Future Prospects of Agricultural Processing Related to the Livestock Industry in Korea.* Seoul: United States Operations Mission to Korea, Rural Development Division, February, 1968.

Koo, Jae Suh. *A Study of the Regional Characteristics of Korean Agriculture.* Seoul: Korea University, College of Agriculture, International Agricultural Resource Research Institute, 1967.

Koo, Jae Suh, *et al. An Economic Analysis of Upland Cropping Patterns.* Seoul: Seoul Municipal College of Agriculture, Ministry of Science and Technology, and United States Agency for International Development, 1969.

Korea Exchange Bank. *The Businessman's Guide to Korea.* Seoul, August, 1969.

"Korea General Information File." Data and Statistics Sheets. 14 p. n.d.

Korea Herald. *Korean Frontier: Special Supplement on Presidential, House Elections.* Vol. 2. No. 3. Seoul, March, 1971.

——. "Park Calls for Pursuit of International Peace, Strengthening of Democracy at Home." Seoul: *Korea Herald,* Vol. XVIII. No. 271, Friday, July 2, 1971.

Korea Information Service, Inc. *Korea Today.* Vol. 1. No. 29, Seoul, 1971.

Korea Water Resources Development Corporation. *Han River Basin Study.* Appendix H., Reconnaissance Report Water Resource Study, Appendix Volume 3, Republic of Korea Ministry of Construction 1971.

Korean Association for Parasite Eradication. "Statistics of Parasitic Infections Among School Children." Seoul, 1971.

Korean Institute of Agricultural Economics. *A Study of Food Grains Policy in Korea.* Seoul, 1965.

——. *A Study of Sericultural Production and Related Industry in Korea.* Seoul, 1968.

Korean Social Science Research Institute. *Report on Field Study in Employment and Income Patterns of Farm Household in Rural Community in Korea.* Seoul, 1969.

Kyle, Leonard, *et al.* "Livestock Production and Marketing in the Republic of Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Lanning, G. J. "Water Law." Appendix N. *Han River Basin Study.* Reconnaissance Report Water Resource Study, Appendix Volume 3, Republic of Korea Ministry of Construction 1971.

Larzelere, Henry, and Shim, Kyon Bo. "Korean Cooperatives." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Lee, Chul Choo. *Drying Characteristics and Drying Facilities of Sweet Potato.* Seoul: Seoul National University, Department of Agricultural Engineering, College of Agriculture, 1968.

Lee, Jeung Han. "Needs for Farm Adjustment to a Growing Economy and Conditions for Farm Mechanization." Korea, Chinju Agricultural College, August 31, 1971. (Mimeographed.)

——. "Potentials of Hog Supply: Adaptability of Some New Production Factors Related to Hog

Production in Korea." Korea, Chinju Agricultural College, 1971. (Mimeographed.)

Lee, K. W. "Some Effects of Roads on Agricultural Production and Rural Life." Unpublished M. S. dissertation, Seoul National University, 1969.

Lee, Seong Woo. "Supply and Demand Projection for Rice in Korea (1970-1980)." Unpublished M. S. dissertation, Michigan State University, 1970.

Lele, Uma J. *A Note on Durastic Models.* Paper No. 45. Ithaca: Cornell University, Department of Agricultural Economics, June, 1971.

Lewis, Robert D. "End of Tour Report." Seoul, June 28, 1967. (Mimeographed.)

Libby, Lawrence W., and Kim, Sang Gee. "Rural Infrastructure." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Libby, Lawrence W., and Kim, Sang Gee. "Rural Infrastructure." Korean Agricultural Sector Study (KASS) Special Report 4. East Lansing: Michigan State University.

Lipsy, R. G., and Lancaster, Kevin. "The General Theory of Second Best." *Review of Economic Studies*, 24 (1956-1957), 11-32.

Little, Arthur D., Inc. *Cost and Availability of Barley Straw in Korea: Report to United States Agency for International Development.* February, 1966.

Llewellyn, Robert. FORDYN. *An Industrial Dynamics Simulator.* Raleigh: North Carolina State University, 1965.

Malone, Carl C., and Johnson, Shermon E. "The Intensive Agricultural Development Problem in India." *Agricultural Economics Research.* Vol. 23. No. 2. April, 1971.

Manetsch, T. J., *et al. A Generalized Simulation Approach to Agricultural Sector Analysis with Special Reference to Nigeria.* East Lansing: Michigan State University, 1971.

Manetsch, T. J. Unpublished course notes developed for SYS 812. Michigan State University, Department of Electrical Engineering and Systems Science, 1971.

Mehren, George L. "Preliminary Analysis of the Third Five-Year Plan for the Agricultural Sector Republic of Korea." New York, The Agribusiness Council, Inc., November, 1969. (Mimeographed.)

Micka, Edward S. *An Evaluation of the Livestock Sector in the Third Five Year Plan of the Republic of Korea.* Seoul: United States Agency for International Development, Rural Development Division.

Miller, Mason E., and Wittwer, Sylvan H. "Suggestions and Recommendations for Agricultural Research and Extension Work in Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, April, 1972.

Miller, Mason E. "Extension, Education, and Training." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Ministry of Agriculture and Forestry. *Annual Report on Agriculture.* Seoul, 1969.

——. *Livestock Industry Development Policy in 1969.* Seoul, February, 1969.

——. *Agriculture in Korea.* Seoul, 1970.

——. *Bulletin of the Agricultural Economics Research Institute.* Seoul, 1970.

——. *Food Crop Statistics.* Seoul, 1971.

——. *Outline of Agricultural Economics Research Institute.* Seoul, 1970.

——. *Rodent Control in Korea.* Seoul, 1970.

——. *Report on the Results of Farm Household Economy Survey and Production Cost Survey of Agricultural Products.* Seoul, 1970.

——. "A Study on Effects of Rural-to-Urban Migration on Agriculture in Korea." A Proposal. (Typed, 4 p.) Ministry of Agriculture and Forestry, Agricultural Economic Research Institute, n.d.

——. *A Summary of Korean Agriculture, Forestry, and Fisheries and Major Policies.* Seoul, 1970.

——. *Yearbook of Agriculture and Forestry Statistics.* Seoul, October, 1970.

——. "1970 Agriculture Census Advance Report." Seoul, December, 1970. (Mimeographed.)

——. "Agriculture, Forestry and Fisheries Policies, 1971: The Year of Advance Without Cease." Seoul, 1971. (Mimeographed.)

Ministry of Construction. "Highway Development Plan." Unpublished, Seoul.

Ministry of Culture and Information. *Facts About Korea.* Seoul, 1970.

Ministry of Finance. "An Outline of Korean Tax Laws." Seoul: Tax Systems Bureau, MF, 1972.

——. "An Outline of Tax Reform: 1972." Tax Systems Bureau, KF, n.d.

Ministry of Health and Social Affairs. "Major Policies and Programs of the Ministry of Health and Social Affairs." Seoul, 1971.

Ministry of Science and Technology. *Feed Supply and Use for Livestock Production in Korea.* Seoul, 1968.

——. *A Survey of the Major Fruits in Kyungpook Province.* Korea, 1968.

Morrow, Robert B., and Sherper, Kenneth H. *Land Reform in South Korea.* Seoul: United States Agency for International Development, Spring Review, 1971.

National Academy of Science. "The Future of United States Technical Cooperation with Korea: A Report to the Agency for International Development." New York, November, 1969. (Mimeographed.)

National Agricultural Cooperatives Federation. *Agricultural Cooperatives in Korea.* Seoul, 1970.

——. "Agricultural Cooperative Law." Seoul, 1969.

——. *Agricultural Demand and Price Analysis.* Seoul, 1969.

——. *Agricultural Yearbook, 1963.* Seoul, 1963.

——. *Agricultural Year Book.* Seoul, 1970.

——. "Draft Report of the Republic of Korea Agricultural Credit Mission." Seoul, n.d. (Mimeographed.)

——. *Statistical Analysis of Demand.* Seoul, 1969.

——. *Rural Credit Survey in Korea.* Seoul: National Agricultural Cooperatives Federation, Research Department, 1965.

National Agricultural Cooperatives Federation and IMI Joint Marketing Research Group. *Preliminary Agricultural Marketing Survey in Korea.* June, 1968.

New Agriculture and Forest, Inc. *Farm Machinery Yearbook, 1971.* Tokyo, 1971. (Japanese and English Languages.)

Nicholls, William H. *The Transformation of Agriculture in a Semi-Industrialized Country: The Case of Brazil.* New York: National Bureau of Economic Research, Inc., 1967.

Norton, Kathryn. *Introduction to Village Korea.* Seoul: United States Operations to Korea.

Office of Rural Development. *Rural Guidance Work in Korea: A Decade of Rural Progress, 1957-1967.* Suwon, 1967.

——. *Feed Supply and Use for Livestock Production in Korea: Final Report.* Suwon: Office of Rural Development Institute of Agricultural Economics, Ministry of Science and Technology and United States Agency for International Development, 1968.

——. *Outline of Office of Rural Development: Organization and Function.* Suwon, 1968.

——. *Rural Guidance Work in Korea, 1969.* Suwon, 1969.

——. *Agricultural Research in Korea.* Suwon: ORD, 1969.

——. *Agricultural Research in Korea.* Suwon: ORD, 1970.

——. *Rural Guidance Work in Korea, 1970.* Suwon, 1970.

——. "The Use of Methane Gas to Improve Rural Food Problems." Seoul, 1970.

——. *Rural Guidance Work in Korea, 1971.* Suwon, 1971.

——. *A Brief Description of Rural Youth Work in Korea.* Seoul, 1971.

——. *Community Development Program in Korea: Its Effort for 10 Years (1958-68).* Suwon, n.d.

Ohkawa, Kazushi, and Johnston, Bruce F. *The Transferability of the Japanese Pattern of Modernizing Traditional Agriculture.* New York: National Bureau of Economic Research, Inc., 1967.

Owen, Wyn F. *Two Rural Sectors: Their Characteristics and Roles in the Development Process.* (The Rural Transitional Sector and the Commercial Farming Sector.) (Occasional Papers No. 1, March, 1971.) Bloomington: Indiana University, International Development Research Center, 1971.

Pak, Ki Hyuk. "Economic Effects of Farmland Reform in the Republic of Korea." n.d.

Park, Chung Hee. *Our Nation's Path: A New Horizon in Asia. Vol. I.* Seoul: Hollym Corporation, 1970.

——. *The Country, the Revolution and I: A New Horizon in Asia. Vol. II.* Seoul: Hollym Corporation, 1970.

——. *Major Speeches by Korea's Park Chung Hee.* Seoul: Hollym Corporation, 1970.

——. *Commemorative Address.* Seoul, August 15, 1971.

Park, Jin Hwan. *An Economic Analysis of Land Development Activities in Korea with Special Reference on Upland Development Programs in 1962-1967.* Seoul: Seoul National University, College of Agriculture, Department of Agricultural Economics, 1969.

——. "Problems and Policy Programs in the Agricultural Sector, Third Plan Period." Unpublished report, 1970.

Parsons, Kenneth H. *Issues in Land Tenure Policy for Korea.* Seoul: United States Mission to Korea, 1965.

Peru Ministry of Agriculture and United States Agency for International Development. *Evaluation of Peruvian Agriculture Relative to US-AID Assistance.* Vol. I and II. Lima, June, 1971.

Phillips, Richard. *Feasibility Analysis for Agricultural Projects.* Seoul: Ministry of Agriculture and Forestry, and United States Agency for International Development, 1970.

Piekarski, G. *Medical Parasitology.* University of Bonn, 1962.

Platt, Kenneth B., and Kapp, Lawrence C. *Proposed Program for Production and Use of Limestone to Increase Agricultural Productivity in the Republic of Korea.* Seoul: United States Agency for International Development, Rural Development Division, March, 1969.

"Problems and Policy Programs in the Agricultural Sector, Third Plan Period." Unpublished, 1970.

Republic of Korea. *Agriculture in Korea.* Seoul, 1964.

——. *South Korea (Map).* n.d.

——. "Plan for Mechanization of Agriculture." 1975.

——. *Third Five Year Economic Development Plan.* 1971.

Renaud, Bertrand M. *Trade and Economic Expansion in Hawaii: The Impact of Tourism on a Small Agricultural Economy.* Honolulu: University of Hawaii, Economic Research Center, 1971.

——. *Industrial Location and Regional Policy in Korea.* (An Analysis of the Conflicts Between National Growth and Regional Income Equality in a Rapidly Growing Economy.) Honolulu: University of Hawaii, Economic Research Center, August, 1971.

——. *Urbanization in Korea: Problems and Prospects.* Honolulu: University of Hawaii, Economic Research Center, 1971.

Reutlinger, Shlomo. *Techniques for Project Appraisal Under Uncertainty.* World Bank Staff Occasional Papers No. 10. Baltimore: Johns Hopkins Press, 1970.

Rhee, S. Y., *et al. Time Series Process or User's Manual.* Seoul: Korean Institute of Science and Technology, August, 1971.

Rossmiller, George E., and Manetsch, Thomas J. "Korean Agricultural Sector Study Guideline." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, October, 1971.

Rossmiller, George E., *et al.* "Fisheries." Korean Agricultural Sector Team Paper 20. Seoul: KASS, 1972.

——. "Trade Policy, PL480." Korean Agricultural Sector Team Paper 15B. Seoul: KASS, 1972.

Sandee, J. "A Programming Model for a Dual Economy." National Bureau of Economic Research, Inc., New York, December 2, 1967. (Mimeographed.)

Seerley, Robert W. *Evaluation of Three Korean Applicants for PL480 Grain.* Brookings: South Dakota State University, 1965.

Seol, In Joon. "Analysis of Supply and Demand Structure." Unpublished M.A. dissertation, New Mexico State University, 1971.

Seoul National University. *The Seoul National University Economic Review, Vol. III.* Seoul: Seoul National University, College of Commerce, Institute of Economic Research, 1969.

Shaffer, James D., *et al.* "Review of Organization and Performance of the Agricultural Marketing System in Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Shaffer, James D., *et al.* "Organization and Performance of the Agricultural Marketing System in Korea." Korean Agricultural Sector Study (KASS) Special Report 7. East Lansing: Michigan State University.

Shim, Young Kun. *Household Consumption Patterns of Food Grains in Suwon: A Report of Field Survey, Winter 1966-67.* Suwon: Seoul National University College of Agriculture, Department of Agricultural Economics, December, 1967.

——. *Economic Analysis of Double Cropping in Paddy Fields.* Suwon: Seoul National University College of Agriculture, 1968.

Smith, Wesley G., and Engelslad, Orvis P. *Projected Fertilizer Needs of Korea 1967-1971.* Seoul: Tennessee Valley Authority Fertilizer Consultant Team, June 30, 1965.

Sochurek, Howard. "South Korea: Success Story in Asia." *National Geographic,* Vol. 135, No. 3 (March, 1969), 301-44.

Sorenson, Vernon L. "The National Agricultural Cooperatives Federation." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, February, 1972.

Sorenson, Vernon L., *et al.* "The National Agricultural Cooperative Federation: An Appraisal." Korean Agricultural Sector Study (KASS) Special Report 1. East Lansing: Michigan State University.

Strand, Norma V. *Review and Recommendations on Collection and Handling of Farm Statistics in the Ministry of Agriculture and Forestry, Republic of Korea.* Seoul: United States Agency for International Development, Rural Development Division, February, 1969.

Strand, Norman V. *Review and Recommendations, Statistics Division, Ministry of Agriculture and Forestry, Korea.* Seoul, September, 1968.

Suh, B. K. *The Strategy for Agricultural Development in Korea.* Seoul: Samhwa Corporation, 1971.

Szczepanik, Edward F. *Agricultural Capital Formation in Selected Developing Countries.* Rome: Food and Agriculture Organization of the United Nations, Agricultural Planning Studies, 1971.

Thorbecke, Erik and Field, Alfred. *Quantitative and Policy Relationships Between Agriculture, Nonagriculture and Foreign Trade Throughout the Growth Process: The Case of Argentina and Peru.* New York: National Bureau of Economic Research, Inc., December, 1967.

Tichenour, Phillip J., and Ruttan, Vernon W. *Resource Allocation in Agricultural Research: The Minnesota Symposium.* St. Paul: University of Minnesota Agricultural Experiment Station and Department of Agricultural Economics, 1969.

Tolley, G. S. "Research Needs for Korean Grain Price Policies." Unpublished, Seoul, Korea, n.d.

——. "Rice Price Policy in Korea." Unpublished, n.d.

——. "Rice Price Policy in Korea." 1970. (Mimeographed.)

Union of Land Improvement Association. *Guide to Agricultural Engineering Research Center.* 1967.

——. *ULIA and Irrigation Works in Korea.* Seoul, 1969.

United Nations Development Program. "Agricultural, Forestry and Fisheries Section Extract for UNDP Country Programming Document." (Draft outline.) 1971.

United Nations Korea Redevelopment Agency. *Rehabilitation and Development of Agriculture, Forestry and Fisheries in South Korea.* New York: Columbia University Press, 1954.

United States Agency for International Development. *Evaluation: Joint Republic of Laos Government/United States Agency for International Development Accelerated Price Production Program, 1967-1969.* Vientiane, November, 1969.

——. *Korea Agricultural Development Loan—Paddy Rearrangement and Upland Development.* Washington, D. C.: Capital Assistance Paper, April, 1970.

——. *Feed Supply and Use for Livestock Production in Korea.* 1968.

——. *Korea Agricultural Credit Loan.* Washington, D. C.: Capital Assistance Paper, May, 1971.

——. *Korean Agriculture Food Grain Subsector: Supply and Demand, Farm Mechanization, Storage and Fertilizer.* Seoul, March, 1971.

——. *Agriculture Sub-Sector Loan.* Seoul: Capital Assistance Paper, March, 1971.

——. *Korea—Chungju Ammonia/Urea Plant.* Seoul: Capital Assistance Paper, n.d.

United States Department of Agriculture. *Growth in World Demand for Feed Grains Related to Meat and Livestock Products and Human Consumption of Grain.* Washington, 1970.

——. *World Demand Prospects for Wheat in 1980.* Economic Research Service, 1970.

United States Department of Agriculture and United States Agency for International Development. *Multilateral Assistance for Agricultural Development.* Washington, D. C.: Foreign Economic Development Report 10, July, 1971.

United States Operations Mission to Korea. *Revised Foodgrain Production and Consumption for 1962-64, and Projections to 1971.* Seoul: Rural Development Division, 1965.

——. *Rural Development Program Evaluation Report, Korea, 1967.* Seoul, 1967.

——. *Rural Development Program Evaluation Report.* Seoul, August, 1967.

Vincent, Warren H., and Kim, Byeong Do. "Upland Development in Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, March, 1972.

Vincent, Warren H., *et al.* "Forestry." Korean Agricultural Sector Team Paper 19. Seoul: KASS, 1972.

Wang, In Keun. *Diffusion and Acceptance of Recommended Farm Practices for Increased Food Production.* Suwon: Seoul National University College of Agriculture, 1971.

Wittwer, Sylvan, and Chung, Moo Nam. "Research and Technology Advancement." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, January, 1972.

Wittwer, Sylvan H.; Miller, Mason E.; and Chung, Moo Nam. "Agricultural Research and Guidance." Korean Agricultural Sector Study (KASS) Special Report 3. East Lansing: Michigan State University.

Wright, Karl T. "Historical Data on Crops in Korea." Korean Agricultural Sector Study (KASS) Paper. East Lansing: Michigan State University, October, 1971.

Wright, Karl T., Kim, Young Sik, and Kim, Kwang Hee. "Crop Production Data and Relationships." Korean Agricultural Sector Study (KASS) Special Report 8. East Lansing: Michigan State University.

Yoon, Chuyung. *A Break in Re-Stalemate: Korea Moves Cautiously Toward Unity.* Seoul: Ministry of Culture and Information, n.d.

Yun, Suk Koo. *Guide to Union of Land Improvement Associations.* Union of Land Improvement Association, 1962.