

Broad Strategy for Development of the Korean Agricultural Sector

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Introduction

Korea made a commitment to governmental economic development planning with the drafting of the First Five Year Plan in 1962. The First Five Year Plan, covering the period 1962 through 1966, and the Second Five Year Plan, covering the period 1967 through 1971, concentrated primarily upon building a social infrastructure base, developing basic industry, and securing a foothold in export markets for a variety of Korean products. During this period, development in the agricultural sector was considered of relatively minor priority. The agricultural sector was essentially told to wait as the initial development thrust took place in sectors considered more important.

By the time it was necessary to begin drafting the Third Five Year Plan for the period 1972 through 1976, it had become evident that, while the first two Five Year Plans appeared to have achieved the desired results, the decision to place agricultural sector development at a low priority had created a lag relative to the rest of the economy which required consideration and action. Thus, the Third Five Year Plan places strong emphasis on the development of rural Korea and the agricultural sector. The more recent launching of the "New Community Movement" action program supports and extends the governmental commitment to development of rural Korea.

As government planners and policy makers in MAF and EPB and on the Blue House staff wrestled with the problems of planning agricultural development, even in the relatively short five year time frame, they were confronted by a paucity of reliable data and economic analysis upon which to base their planning judgments. Equally as disturbing, they had no comprehensive economic tool or framework for projecting the consequences of their planning and policy decisions. The need for a comprehensive agricultural sector study was

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evident. Thus, in mid-1971 the Korean Agricultural Sector Study team was formed.¹⁾

The objectives of the project include:

1. To carry out a study of the Korean agricultural sector including an inventory of resources available, demands on the sector, its physical and economic structure, and its social, political, and institutional environment; to analyze the consequences of following alternate development strategies and to recommend a development strategy, policies and programs to achieve development goals consistent with national values relative to agricultural sector development over a fifteen year planning horizon.
2. To develop a computerized simulation model of the agricultural sector for use as a continuing policy planning tool to improve and develop the capabilities of Korean decision makers in planning, policy formulation, and program development.
3. To develop a Korean capacity for further development of such a model, for updating projections, and for analyzing policy alternatives as conditions change and as new and improved data becomes available.

The following discussion details the KASS approach to accomplishing the first of these objectives and the progress made toward the other two, a summary of the analysis of the agricultural sector, and a presentation of the major policy and programs constituting the KASS recommended development strategy for the Korean agricultural sector over the next one and one-half decades.

The KASS Approach

The problem of Korean agricultural sector development is comprised of literally thousands of separate and interrelated problems. Population and rising urban incomes are pressing against limited agricultural resources and the ability of traditional agriculture to increase and adapt food production to the demands. Food prices are high while farm incomes are low. Scarce foreign exchange is increasingly being used for foodstuffs importation. More animal proteins are needed in the diet. Labor is rapidly moving out of agriculture as the rural to urban exodus quickens. Agricultural credit is in short supply and costly. Income distribution is a problem within agriculture, within the urban sector, between sectors, and among regions. Administrative and institutional problems in the agriculture establishment constrain the capacity of government to effectively deal with the problems of agricultural sector development. The list could go on,

1) The project is cooperative among the government of the Republic of Korea, the U.S. Agency for International Development, and Michigan State University. Action agencies include the Agricultural Economics Research Institute, Ministry of Agriculture and Forestry, ROK, and the Department of Agricultural Economics, Michigan State University. Liaison and monitoring by AID was established through the Rural Development Division, USAID/K.

but it is long enough to illustrate that an early KASS task was to find a way to categorize, simplify, and interrelate the problems in order to effectively analyze and deal with them.

The fact that the KASS team had both a short term objective of producing a comprehensive agricultural sector study, and a longer term objective of developing a computerized agricultural sector simulation model was very useful indeed at this point. The complementarities between the two objectives were obvious. By first concentrating on developing those components of the simulation model which could best serve in the completion of the sector study, researcher time could be saved, and researchers more clearly focused upon their individual tasks in contributing to the total effort. Conversely, by counting on these model components to save their time, researchers could devote their energies to collection of specific data required by the model and to understanding how the agricultural sector functions within its environment, which, incidentally, was a valuable input in conceptualizing the model components.

To further simplify the task before them, the KASS team postulated a priori three alternative sets of strategies and policies for agricultural sector development and focused their analysis on the consequences of following each of these strategies. The three alternative strategy sets postulated for analysis can be characterized as:

Strategy Set 1. Continuation of the agricultural policies and rural development strategies laid down in Korea's Third Five Year Plan (TFYP) as published.

Strategy Set 2. 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, and increased investments in the rural infrastructure to eliminate marketing and transportation bottlenecks.

Strategy Set 3. Greater reliance on international sources of agricultural products and on the private domestic market mechanism.

After defining each of the three alternative strategies for Korean agricultural development, the KASS team raised questions as to what data and what subjects would need to be investigated in order to understand how Korean agriculture would operate under each of the three alternatives. Some twenty working parties were established, each composed of specialists from Michigan State University working with professionals in the Agricultural Economics Research Institute and from other Korean agencies and institutions. These working parties dealt with and produced working papers on such subjects as crop and livestock production, land and water resource development, credit, agricultural supply response, price, income and subsidy policies,

research and technological advance, agricultural guidance system and rural education, rural infrastructure, administrative process and institutions, population, migration and employment, capital formation, and food demand and nutrition. Recognizing that the information and skills required to produce the data needed for the study was multidisciplinary in nature, the groups assigned to produce the working papers included specialists in sociology, public administration, extension and adult education, industrial psychology, research administration, and technical agriculture as well as agricultural economists and systems scientists accustomed to working with a wide range of information about technical, institutional, and human change.

While the working parties were carrying out their tasks, another group started the process of modeling the operation of the Korean agricultural economy. A model of the Korean agricultural economy was required which would permit estimation of the consequences through time of following not only the three policy strategy sets defined, but other alternatives well. The strict time limitation imposed upon the sector report made it necessary to work with an abbreviated version of the conceptualized model which, eventually, will be constructed. This abbreviated version used in producing the sector study is represented by Figure 1. It can be characterized as a "man and computer" rather than just a "computer" model. The "man" components enclosed in dashed lines in Figure 1 include yield projections, resource allocation, and price adjustment. In each of these three instances, projections were developed for 1975, 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 projections then became inputs into the computerized components of the model. A "manual" iterative procedure was used to adjust these variables in making the projections. 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 analysis to correspond to each of the policy strategy sets. These policy variables are designated P in Figure 1. Also indicated in Figure 1 are the variables or criteria produced to indicate the consequences of following each of the alternative strategies.

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

1. An agricultural production component including annual crop production, perennial crop production, and livestock production (in rudimentary form). The annual and perennial crop subcomponents compute for three regions and twelve agricultural commodities—output, supply, farm consumption, income, costs, returns to land and labor, and seasonal labor requirements. The rudimentary livestock subcomponent computes output and value added for each of six livestock commodities.

2. An urban demand component computes nonfarm consumer demands for 19 agriculture commodities or commodity groups, and one aggregate nonfood commodity as a function of price, income, and population.

3. A population component projects age and sex specific, rural farm population, and urban nonfarm population as a function of time dependent birth rates, death rates, and migration rates.

4. A dynamic national input/output model projects urban nonfarm gross national product, income, and rate of urban consumer expenditure.

Since the mechanisms for adjusting prices, allocating resources to different crops, and adjusting yields were not yet programmed to link the components outlined in Figure 1, it was necessary to use a "manual" iterative procedure.

The KASS model can be characterized as general with respect to techniques, kinds of data and information used in building and usable in operating it, subject matter, and philosophic orientation. It is general in the sense that it traces 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 are used by decision makers themselves. Premature application of maximizing techniques were avoided in situations where both the KASS team and decision makers realized that the multiplicity of consequences to be sought and avoided made it impossible to develop a single objective function for maximization or optimization. The model is also general with respect to sources of data and techniques since it accepts data and information from many sources including time series, carefully controlled experiments, both fact and judgement of informed persons, survey data, opinions, and so forth, as well as information provided by more traditional forms of econometric models.

Throughout the study, an important concern of KASS investigators was to understand the broad national values providing the philosophical environment and orientation for agricultural sector development. Four national value constellations appear to be of major importance in this regard. They are concerned with (1) achievement of improved food supplies both quantitatively and qualitatively, (2) realization of a higher quality of life in rural Korea, (3) contributions from the agricultural sector to the development of Korea, (4) administrative and political processes affecting Korean agricultural development.

Not all of these values are explicitly stated by Korean policy makers or written in official policy documents. They are, however, articulated by a variety of sources— "revealed preference" in existing policy, discussions with policy makers, preference patterns among rural residents, and the political environment.

The value of increasing domestic food supplies is important in setting goals related to the level of self-sufficiency. At present, Korea is a food deficit country. In addition to improved nutrition, Korea values food self-sufficiency for various nationalistic reasons. Gaining on self-sufficiency involves reducing population growth and the greater cost that may result from producing rather than importing certain food items. Also involved is the desirability of using Korean land and under employed labor to produce as much income as feasible.

Within the constellation concerning the quality of rural life are higher rural incomes, more equitable income distributions, general and vocational education, communications, electrification, and exploitation of other energy resources, improved sanitation and health care services, stable prices, and other changes that may increase personal freedom for rural people and generally reduce the "drudgery" of rural life.

Finally, the 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 Korea looks toward the possibility of increasingly peaceful relationships in communications with the North. Included is the capacity to change and develop as a nation without periodic destruction of physical capital, human beings, and culture. Some of the traditional values of Korea's rural life will be lost with modernization, but they need not be deliberately destroyed. Also included are the values of efficient and equitable administration in the public sector, effective and sound planning and policy formulation, and program execution, and local self-determination.

Demands on the Agricultural Sector

The development of the agricultural sector must proceed within the constraints of the national value constellations detailed 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 individually entrepreneurial, producing with sharply limited and nearly fully developed arable land resources in a relatively harsh temperate zone climate, dependent almost entirely upon human and animal power, relying upon moderately well developed irrigation facilities but which lack adequate drainage, researching and innovating new biological technology at less than an optimum rate while using substantial fertilizer and plant protection chemicals, heavily dependent upon government dominated markets for supply of most modern production factors presently utilized, and commercialized to the extent of about half of total production being sold off the farm.

External forces influencing the course of agricultural development include a rapidly growing nonfarm economy with 1985 GNP projected at over three times the 1970 level; total urban

consumption projected to increase at 9 percent per year; a population increase requiring the nation by 1985 to feed, clothe, and house approximately one additional person for every three people in the 1970 population; and substantial shifts in the mix of food products demanded including a strong preference for rice over barley, growing demand for livestock and dairy products, and fruit, and greater use of more highly processed foods.

The Korean agricultural economy is atypical 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 out-migration from agriculture is expected to accelerate in the next fifteen 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 low rate of modern technological innovation and meager and 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 fifteen years without the introduction of substantial cost reducing biological and chemical technologies as well as labor saving improvements in agricultural production. While the demand in Korea for livestock and dairy products, fruits and vegetables is substantial and growing, the markets for such commodities are relatively thin and will remain so during the next one and one-half decades. Substantial opportunities will exist to expand the production of such higher quality "nonstaple products," however, it must be recognized that effective demand for these products will be satiated with relatively small absolute increases in production.

Against this backdrop the KASS study indicates that the demands on Korean agriculture over the next fifteen years will be:

1. A 50 percent increase in the volume of agricultural production with 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 rural to urban migrants to help develop Korea's industries and urban economy. These migrants 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. KASS projections indicate that off-farm migration will increase to over half a million annually by 1975 and to nearly a million per year in the late 1980's. This contribution to the non-farm labor force will reduce the absolute number in the farm population from 15.9 million in 1972 to approximately 9 million in 1985 and will reduce the proportion of the farm population to the total population from approximately half in 1970 to about one-fifth in 1985.
3. A 100 percent increase by 1985 in raw materials supplied to Korean industry. Major

industrial raw materials produced by Korean agriculture at present include silk, some tobacco, limited leather, rush, rapé, sesame, perilla, and straw. Korean agriculture can provide raw materials for a major expansion in food marketing and processing as well as industrial production by the nonfarm economy. In the next fifteen years the food marketing industry will expand as much as two and one-half times, while the processing industry will expand even more.

4. A decrease in net foreign exchange required for the purchase of agricultural products. Principal Korean agricultural exports include silk, ginseng, apples, vegetables, tobacco, and crude botanical medicines. The potential exists for expansion of those products now exported as well as for opening new markets for other agricultural products. More important to the Korean economy than agriculture's role as export earner is its role as a foreign exchange saver. In 1970, the net of agricultural imports over agricultural exports was about 140 million dollars. Measures can be taken to change the consumption mix and to increase production toward closure of this gap for a substantial savings in foreign exchange.

5. The contribution of capital, human and other resources on a net basis to the development of the nonfarm economy of Korea. Of major importance is the transfer of substantial claims on rural resource earnings to nonfarm residents via inheritances from farmers to their migrating descendants. With rural property values increasing as a result of more favorable treatment of agriculture, this transfer plus the value of human capital transferred through migration should exceed the value of subsidies and other assistance flowing to farms from the nonfarm economy. Further, the need to expand food production by 50 percent from about the same land base will require major expansions in farm generated capital for use within the agricultural sector. The additional capital will consist of converting forest to cropland, development of more and better water control facilities, expansion of livestock breeding herds and orchards, and will require at least a doubling and perhaps more than a tripling of current capital investments in these areas.

6. Conversion of approximately 40,000 hectares annually from agriculture and forest lands to urban housing and industrial and commercial sites, parks, reservoirs, and urban service areas. Of this 40,000 hectares annually converted, about half will come from agricultural land and the remainder from forest land unless a combination of population, rural industrialization, and land policies are focused to change present trends.

As a result of studying the projections for the three alternatives chosen for analysis in view of the values, resources, constraints, and demands detailed above, it was determined that the Third Five Year Plan (TFYP) for agricultural development can be substantially improved, 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 a more rapid migration of people out of the agricultural sector than could be readily absorbed by the nonagricultural economy, and greater reliance on the domestic price system and competitive market mechanism would be desirable. Also on the basis of the knowledge gained through analysis of the three alternative strategies, the KASS team in consultation with government decision makers determined that a fourth strategy could be proposed which would be superior to any of the three analyzed.

Through analysis of the three alternative strategies, with an understanding of relevant values, and keeping in mind the resources available, the constraints, and the projected demands, the following specific set of goals were selected for Korean agricultural development demands.

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; 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 forage and barley in excess of food needs.

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 38,000 won in 1971 to 156,000 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 farm 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 fifty 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 10 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 602 billion won in 1971 to about 935 billion won in 1975 and 1,352 billion won in 1985, approximately 30 percent higher than would be attained by continuation of 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; the development of improved and greatly expanded facilities for assembling, storing, grading, processing and transporting $2\frac{1}{2}$ to 3 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 IR-667 rice; development and importation of improved perennial forage varieties for uplands and of 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.

KASS Recommended Development Strategy Policies and Programs

The KASS recommended strategy for developing Korean agriculture (Alternative IV) involves short and long term elements. In the short run, KASS recommends changes in the agricultural price and supporting service policies for agriculture to increase agricultural output by attaining greater efficiency within presently available technology and by more fully utilizing Korea's land resources. These policies place heavier reliance on the private sector to provide modern farm inputs and to market agricultural products, and should provide for decreasing the inequities in the distribution of income between the farm and the nonfarm sectors. In the long run, KASS recommends increased investments in research and adoption of new technology and effective population control.

The importance of the long run dimension of the KASS recommended strategy becomes apparent when one examines the projections as to possible future production (given present technology) and possible future consumption (given the present population growth rates). 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.

In support of this general development strategy, the following policies and programs are recommended:

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 hectareage per farm should be developed in the next few years for implementation in the late 1970's. This should consist of periodically reviewing and raising the three hectare limitation gradually so that 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.

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 protein, 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.

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 should be encouraged 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.

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, and improved institutional environment, and the provision of equitable access to skills, land and other assets. 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.

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 $2\frac{1}{2}$ to 3 fold expansion in farm product marketing activities, and an even greater expansion in the marketing of modern farm inputs and services.

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

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 plans coordination unit to be established in the Planning Coordinators 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, 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. An Institute for Agricultural Economics and Statistics (IAES) should be established and placed administratively under a director with the same status as the planning coordinator and the assistant vice ministers. A statistics branch should be under a coordinator of statistics and an agricultural economics branch under a coordinator of agricultural economics. Functional units in the agricultural economics branch should include an agricultural outlook unit and a policy analysis unit administratively under the director of agricultural economics, but, physically located near the office of the vice minister.

f. 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.

g. The MAF should be organized on functional lines to include planning coordination, food management and marketing, and agricultural economics and statistics.

Results Attainable Under the KASS Recommended Development Strategy

The KASS team 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 Tables 1 and 2 along with the results of Alternative I (extension of TFYP). The recommended policies and programs are potentially capable of producing the following results.

Table 1. Selected Projected Consequences of the TFYP Development Strategy (Alternative I) and the KASS Recommended Development Strategy for the Agricultural Sector of Korea, 1975, 1980, 1985

Consequences	Alternatives	Units	1975	1980	1985
1. Population-Total:	Alt. I	1,000 pers.	34,670	37,610	40,900
	KASS		34,630	37,180	39,480
2. Population-Rural:	Alt. I	1,000 pers.	15,460	13,090	9,050
	KASS		15,450	12,930	8,670
3. Urban Consumer price Index:	Alt. I	1970=100	103	103	104
	KASS		109	108	108
4. Urban Non-food Expenditures -Per capita:	Alt. I	1,000 won	73	96	122
	KASS		68	92	119
5. Urban Food Expenditures ¹⁾ -Per capita:	Alt. I	1,000 won	45	49	54
	KASS		50	55	63
6. Total Urban Consumption:	Alt. I	Billion won	2,274	3,566	5,593
	KASS		2,274	3,566	5,593
7. Food Portion of Total Urban Consumption Expenditure:	Alt. I	Percent	38	34	31
	KASS		42	37	34
8. Gross Agr. Income-Total: ²⁾	Alt. I	Billion won	849	953	1,150
	KASS		1,205	1,406	1,672
9. Gross Agr. Income ²⁾ -Per capita:	Alt. I	1,000 won	55	73	127
	KASS		78	109	193
10. Agr. Value Added-Total:	Alt. I	Billion won	752	873	1,055
	KASS		884	1,037	1,228
11. Agr. Value Added-per capita:	Alt. I	1,000 won	49	67	117
	KASS		57	80	142
12. Fertilizer Requirement:	Alt. I	Million MT	1.1	1.3	1.6
	KASS		1.4	2.0	2.3
13. Pesticide and Other Chemical Requirement:	Alt. I	Billion 1970 won	8.3	10.0	11.9
	KASS		8.3	10.0	12.0
14. Capital Requirement:	Alt. I	Billion 1970 won	51	69	141
	KASS		57	74	151
15. Net Foreign Exchange Required for Purchase of Agricultural Products:	Alt. I	Billion won	104	155	220
	KASS		63	60	69

1) These figures are about 10 percent low due to food items (mainly condiments) not included in food expenditures.

2) Includes income from non-agricultural sources.

Table 2. Supply and Disappearance of Four Selected Food Commodity Groups Under Alt. I and KASS Recommended Policy Strategies, Korea, 1975, 1980, 1985

Commodity	Year	Supply			Self Sufficiency (Percent)	Disappearance			Un-accounted Total (Percent)		
		Production	Import (Surplus)	Total Food Supply		Rural	Urban	Total		Un-accounted For	
	Million MT.....		Million MT.....						
Rice: Alt. I	1975	4.191	.876	5.067	82.8	1.784	2.316	4.100	.966	19.1	
	1980	4.301	1.255	5.556	77.5	1.639	2.920	4.559	.998	18.0	
	1985	4.426	1.608	6.034	73.4	1.233	3.761	4.994	1.040	17.3	
	KASS	1975	4.623	.467	5.090	90.8	1.806	2.213	4.019	1.071	21.0
		1980	5.155	.321	5.476	94.1	1.664	2.307	4.271	1.205	22.0
		1985	5.614	.226	5.840	96.1	1.241	3.269	4.510	1.303	22.3
Barley: Alt. I	1975	2.125	.061	2.186	97.2	1.347	.569	1.916	.271	12.4	
	1980	2.300	(.296)	2.004	114.8	1.131	.570	1.701	.303	15.1	
	1985	2.497	(.852)	1.645	151.8	.662	.637	1.299	.346	21.1	
	KASS	1975	2.395	(.196)	2.199	108.9	1.285	.602	1.887	.312	14.2
		1980	2.324	(.227)	2.047	113.5	1.016	.721	1.737	.310	15.1
		1985	2.056	(.543)	1.513	135.9	.515	.712	1.227	.286	18.9
Wheat: ¹⁾ Alt. I	1975	.373	1.004	1.377	27.1	.359	.979	1.338	.037	2.7	
	1980	.383	1.391	1.774	21.6	.320	1.414	1.734	.040	2.3	
	1985	.391	1.838	2.229	17.5	.281	1.905	2.186	.044	2.0	
	KASS	1975	.399	.794	1.193	33.4	.327	.824	1.151	.042	3.5
		1980	.668	1.005	1.673	39.9	.295	1.290	1.585	.088	5.3
		1985	1.012	1.124	2.136	47.4	.275	1.714	1.989	.146	6.8
Livestock: Alt. I	1975	.569	(.013)	.556	102.5	.094	.401	.495	.061	11.2	
	1980	.959	(.019)	.940	102.0	.114	.704	.818	.122	12.9	
	1985	1.646	(.031)	1.615	101.9	.131	1.258	1.389	.226	13.9	
	KASS	1975	.558	(.003)	.555	100.5	.116	.381	.497	.058	10.4
		1980	.966	(.017)	.949	101.8	.154	.683	.837	.110	11.6
		1985	1.583	(.012)	1.571	100.8	.172	1.191	1.363	.208	13.2

1) Wheat imports are underestimated by about 600,000 M.T.

Near attainment of self-sufficiency in rice can be achieved in the mid-1970's. It is estimated that this would take place at a production of 4.6 million metric tons in 1975 at a consumer 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. 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.

Self-sufficiency in feed grains would not be achieved, but a surplus of barley for human food would develop by 1975. Food grains would need to be imported to provide feed for poultry, dairy and meat production. In the late 1970's 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 and forage varieties under the recommended research program, substantial quantities of barley and forage could become available to further offset the need for imported feed grains by 1985.

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 further reduced by success in developing new wheat varieties capable of being double cropped with rice.

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 60,000 won per person as compared with a projected 49,000 won under Alternative I and by 1985 the figures are 156 thousand won and 117 thousand won respectively.

Net returns to farmers for land and family and operator labor would be higher than for present policies resulting in higher land values and a reduction in the rate of decline in persons in agriculture, and a more equitable distribution of income between the farm and nonfarm sectors. The 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 likely congregate in urban slums and thus contribute more to Korea's social problems than to her GNP or export earnings. Even the higher rural incomes, however, will be low relative to higher urban incomes, and both rural and urban poverty will still need to be attacked as a separate national problem.

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, and about 150 billion won less in 1985. Korea would become less dependent on foreign food supplies than under Alternative I policies and programs.

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, water control facilities, and other enterprises) will be stimulated.

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 agricultural value added of 1,228 billion won as compared to 934 billion won under Alternative I.

Projected input requirements for our recommendations are in total higher than those for Alternative I. 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 Alternative I. By 1985, fertilizer requirements are $2\frac{1}{2}$ times the 1971 level under KASS recommendations, and two times the 1971 level under Alternative I. Agricultural chemical requirements increase only slightly under both alternatives.

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 MT 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.

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 that it would level off after 1985. Finally, the net foreign exchange required for purchase of agricultural products declines to about three-fourths the 1971 level by 1975. The requirements projected are 63, 60, and 69 billion won in 1975, 1980, and 1985 respectively.

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 I do not include income from nonagricultural 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. 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 and declines to about 34 percent in 1985. Further, the consumer price index increases only moderately from 100 in 1970 to 108 in 1985, compared to 102 for Alternative I, due to the higher food prices under KASS recommendations. These figures further stress the conclusion that inequities between farm and nonfarm incomes are so important that the transfer of income to farmers via higher food prices does not create an inequitable income distribution, and that rural poverty cannot be corrected by redistribution income only within agriculture.

Current Limitations and Future Directions

Any study is only as reliable as the assumptions, the theoretical foundation, the data, the conceptualization of the model, and the analysis provided to produce it. And a study is only relevant in helping decision makers solve practical problems if it provides them with reliable and useful answers to the specific problems with which they are confronted.

The core of the question is the need for validation or verification of the projections produced by the model and the related problem of placing confidence limits on the information used in model construction. As indicated above, the KASS model synthesizes and uses data from a variety of sources and combines many types of components including optimizing components where appropriate. Also, unlike many of the more specialized models, the KASS model is required to predict a variety of consequences, both of the kind decision makers would wish to attain, and the kind they wish to avoid, of doing things which have not been done before, or if done, have no recorded outcomes. Present statistical techniques are not capable of adequately dealing with the task of establishing appropriate confidence intervals for the various kinds of data going into such models or confidence limits for each of the criteria variables projected such models. Even though the so called Bayesian advances in statistics have done much to legitimize the type of work KASS is doing, statistical theory is still primitive for choices among more than two alternatives, particularly when they involve utilization of several kinds and sources of data, and are possible prescriptions to solve more than one problem each of which involves the attainment of multiple desirable consequences and the avoidance of multiple undesirable consequences for which a common denominator is unknown, or at best, poorly defined.

While the difficulties of validation and verification are recognized for the KASS type model, they are still possible. The more rigorous statistical and econometric methods of verification and validation involve application of the tests of (1) consistency with observed and recorded experience, (2) logical internal consistency of the concepts, (3) interpersonal transmissibility 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 not, the four general tests were applied less rigorously. These tests have been applied repeatedly either formally or informally in bringing the KASS model to its present stage of development. The process of this type of testing is continuous and the tests are applied in assembling data, modifying and developing model components, combining smaller into larger model components, and evaluating model output, and each time new data becomes available and is used in the model.

It is a well recognized fact that the data on the Korean agricultural sector is inadequate, and in many cases, inaccurate. A model such as the one under development by KASS can be a useful device for focusing on the specific data needed for certain kinds of economic analysis. Since it uses data from many sources and since it is a system model requiring internal consistency, data inaccuracies can in many cases be brought to light. Furthermore, it is possible through sensitivity analysis 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 kind of information can be useful in determining where the greatest payoffs are to be found in allocating resources to the collection of further and more accurate data.

The present KASS model is still very rough and tentative. It was put together rapidly in a short period of time in order to help the KASS team meet their deadline with the agricultural sector analysis. Future plans call for the refinement and expansion of the present components and of the data used by them. In addition, a number of new components are in process and on the drawing boards for inclusion as part of the KASS model.

The process of developing a better understanding of how the Korean agricultural sector operates and its interactions with the environment within which it operates as a basis for prescribing solutions to agricultural development problems will be a never ending one. While the KASS analysis to date contains projections fifteen years in the future, the prescriptions and recommendations cannot be expected to remain valid for more than a short period of time. These prescriptions will need updating by an on-going cyclical analysis of the Korean agricultural sector and by continued interaction between the investigators carrying out the analysis and the relevant decision makers.