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ANNUAL REPORT

FOR PERIOD

JULY 1, 1973 - JUNE 30, 1974

OF THE PROJECT ON

ADAPTING AND TESTING OF AGRICULTURAL SIMULATION MODELS TO SECTOR ANALYSIS

Contract AID/csd-2975
U. S. Agency for International Development

Agricultural Sector Analysis and Simulation Projects
Department of Agricultural Economics
Center for International Studies
Michigan State University
East Lansing, Michigan

June 30, 1974

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I. SUMMARY

A. Statistical Information

1. Project Title: Adapting and Testing of Agricultural Simulation Models to Sector Analysis
   Contract No: AID/csd-2975
2. Project Director: George E. Rossmiller, Department of Agricultural Economics, Michigan State Unviersity, East Lansing, MI 48824
3. Contract period: 1 July 1971 - 31 July 1975
4. Reporting period: 1 July 1973 - 30 June 1974
5. Total AID funding to date: $1,073,288
6. Total Expenditure and obligations through 30 June 1973: $752,106
7. Total expenditures and obligations for the reporting period: $351,029

B. Accomplishments and Utilization

Work continued during the report period on the four main areas of project activities--field applications, training program, software library, and methodological and theoretical development.

1. Field Operations--In Korean, model development focused on incorporation of international trade activities into the demand component, development of an annual price adjustment mechanism, further development of the resource allocation recursive linear programming component, continued development of the grain management program component, conceptualization and development work on a livestock component, and improvement and adjustment of the basic KASS model to accept and link to new components and to operate on the KIST as well as the NCC computer.

In Nigeria the subcontract with the University of Ibadan for the agricultural economics M.S. thesis research by Cyril Aja on the kola nut industry continues with completion and a report due in November 1974. Felix Nweke, Agricultural Economics Ph.D. candidate, is planning his dissertation research on modeling certain aspects of the Nigerian Forestry Sector.

2. Training Program--Nine students are involved in the pilot offering of the one year Basic Study Program under the Development Analysis Training

Program package. A similar size class is contemplated to begin in fall '74. Development of the required new courses, tutorial service, programming help, computer time, and intensive seminars in addition to the regular university course offerings make this a particularly intense and useful program--but an expensive one. Supplemental funding sources are being explored.

3. Software Library--Work toward building a "critical mass" of components in the software library is progressing. The Policy Advisory Board for the library met once during the reporting period and provided important guidance to the library activities. They helped define the "critical mass," recommended concentration on the user rather than the developer language, and proposed an international conference in 1975 to demonstrate library capabilities.

4. Theoretical and Methodological Advances--Several theses in agricultural economics and systems science are in progress, with one on the Colombian beef cattle industry being completed during the report period. In addition significant work in this area is taking place in Korea where linkages of special technique using components and extension of components in conformance with economic and behavioral theory is being accomplished.

5. Other Activities--During the report period, the project underwent an extensive evaluation by AID, culminating in an evaluation conference involving AID officials, the MSU team, the evaluators and representatives from FAO, Korean Government, Seoul National University, and Iowa State University. In addition MSU team members participated in international conferences, seminars, and workshops dealing with systems simulation and sector analysis.

II. OBJECTIVE AND BACKGROUND

Work in further adapting and testing agricultural simulation models to sector analysis was initiated through Contract AID/csd-2975 in July 1971. It followed Contract AID/csd-1557 (initiated in 1967) under which Michigan State University was responsible for developing the general systems simulation approach to sector analysis. Contract AID/csd-2975 along with the Korean Agricultural Sector Analysis Contract (AID/ead-184) has enabled Korean, Nigerian, Colombian and American academic and government personnel to jointly develop, test and adapt simulation models to sector analysis.

The basic objective of this project is to increase the usefulness of problem-solving developmental studies and analyses while lowering the cost of policy, program, and project development and evaluation through further development, testing, and application, under practical field conditions, of the general, systems-science, simulation approach and models (including components) developed under Contract AID/csd-1557 and the first phase of Contract AID/csd-2975.

The generalized, computerized, systems-simulation approach of this project relates directly to the key problem areas of economies, sectors and subsectors with emphasis on agriculture.[1/] The models constructed under AID/csd-1557 and the first phase of this contract were constructed on the "building block" principle. They use specialized techniques where appropriate. Examples in the Korean modeling effort are the recursive linear program for modeling farmer behavior in resource allocation at the firm level, the simple input-output component linking the agricultural and the nonagricultural sectors and the simultaneous equations and regression equations used as integral parts of the grain management program component. They have components for annual cash crops, annual food crops, perennial tree crops,

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[1/] An introduction to the basic concept of the general systems simulation approach may be found in Appendix A.

and livestock. Further, they deal with agricultural research, extension and education, transportation, interregional domestic trade, export earnings, population, domestic consumption, taxation, foreign trade, and in a rudimentary way, transactions between the farm and the nonfarm sector. In turn, each of these components is constructed of subcomponents. In the future these subcomponents should be more oriented to micro-problems as well as to integration as part of more macro-models.

Practical applications are worth doing both for their own sake and because they reveal problems with the theory, data, and techniques which must be remedied to increase the basic ability to solve practical problems. These problems require research and development efforts of the type supported by the Technical Assistance Bureau of AID/W. Critical basic needs apparent from practical work so far are to expand both micro- and macro-type analyses and to bridge the two with appropriate aggregation models and theories. This expansion must deal more specifically with the incorporation of specialized techniques such as recursive linear programming, input/output analyses, etc. into the general approach. It must also stress the international, intersectoral, interprogram and interproject usability and transferability of the components of such models. The social capital being created should be documented and stored in forms readily retrievable by other subsequent users so that AID's investment in this capital will have its full payoff. This requires a software library. Also required is the building of a capacity through training efforts among researchers and decision makers in countries and areas of application, to further develop and use the methodology. Still further the efforts must concentrate on revealing the data deficiencies and provide the basis for priorities in the collection of more adequate, accurate and relevant data. Finally, continued basic disciplinary work is necessary on the theoretical issues and data shortcomings in the various disciplines contributing to agricultural sectoral analysis.

The general, systems simulation approach: (1) has demonstrated its capacity to enhance the state of the art in sector planning in Korea, Nigeria, Colombia, and Venezuela, and (2) should be an important component of an AID program that assigns high priority to sector planning. A need, now, is to move in depth in further developing and applying the approach for evaluation

of alternatives at national, program and project levels, as well as on policy alternatives at sectoral and subsectoral levels.

The further development and application of the general, systems simulation approach for analysis in planning, policy formulation, program development, and project execution is the fundamental objective of this project. As suggested by the specific objectives, the basic need is to improve the simulation models with respect to their theoretical bases and their potential for efficient and effective application. Contributions toward meeting this need are also required from disciplines other than economics and systems science. In order to attain the objective, both applied field and disciplinary research are required.

The field research in applying existing model components is needed in order to reveal their deficiencies in operational applications in a variety of country settings and environments. It is also needed to better understand the prerequisites necessary for institutionalizing an analytical capacity using the approach into the decision making framework at various governmental levels.

And, of course, disciplinary research is needed to further develop the approach, the models, and the components based on the field experiences and theoretical advances. In particular, the components need to be improved with respect to economics, systems science, and other subject matter content. More of the existing body of economic theory as well as theory from other disciplines needs to be incorporated into the components and additional theory (economic and other) must be developed for incorporation into and guidance in conceptualizing components. The same is true with respect to existing and needed systems science theory as well as the theories of other disciplines having to do with institutional, technical and human change.

Of particular importance are the decision making theories which are under development in such related disciplines as economics, systems science,

statistics, political science, sociology and philosophy. An essential characteristic of the systems simulation approach is stress on using specific quantitative techniques and theories from applicable disciplines including the social, biological, physical and natural sciences as well as in statistics, cybernetics, mathematics, etc. In the general, systems simulation models of concern in this project.

Over the past three years of the contract, the major efforts in Korea have been directed to developing, testing, modifying and finally attaining a working simulation model. This Korean model and the earlier Nigerian model provide bases for further model development and refinement and are being successfully used as analytical tools in the planning and policy decision making process. This is particularly true in Korea where the government is directed toward agricultural sector development. Specific examples of usage include assessment of benefits from an expanded agricultural research program and projections of the Korean Ministry of Agriculture and Fisheries input into the Long Range Economic Development Plan (1973-81). AID is providing a loan for the agricultural research program and the model will be used for development of the agricultural portion of the Fourth Five-Year Plan (1976-81). The Nigerian model, developed under Contract AID/csd-1557, has been used by university and government personnel under Contract AID/afr-786 and later under Contract AID/csd-2975, to provide part of the input in development of the "Perspective Plan for Agriculture to 1985." In addition, model component applications have been made to specific agricultural sector problems in Venezuela and Colombia. The work in Colombia is in the form of a Ph.D. dissertation on the beef industry in the northern region. This work was published under the project. The work in Venezuela on the cattle industry is not part of Contract AID/csd-2975 but is a spin off from the Nigerian simulation work, financed directly by the Venezuelan government. Other utilization of project results has followed consultations, seminars, conference participation, and training with IBRD, FAO, and ADB, as well as in Japan, Egypt, Tanzania, and at the University of Missouri. Because of the nature of the inputs, the potential for methodology transfer to other countries and other problems, and anticipated usage, the contract also provides for the establishment of a software library and a training program as vital support

elements to guarantee utilization of such models. The training program and the software library are now in the initial operational stages of development.

The annual report summarizes activities during the period 1 July 1973 to 30 June 1974 in four major areas of coordinated and mutually supportive work--(1) field application and operationalization of models to agricultural sector development problems in Korea and in other locations, (2) development and operation of a training program concentrating in support of institutionalizing the approach in both host country decision-making structures and in donor and grantor agencies, (3) development of a software library for easier and more efficient transfer and application of the methodology to a variety of development problems in chosen locations around the world, and (4) methodological and theoretical development, particularly in economics and systems science at both field and campus locations. Figure 1 shows the interrelationships among the various lines of activity within the project and how they will contribute to further improved, problem-solving applications.

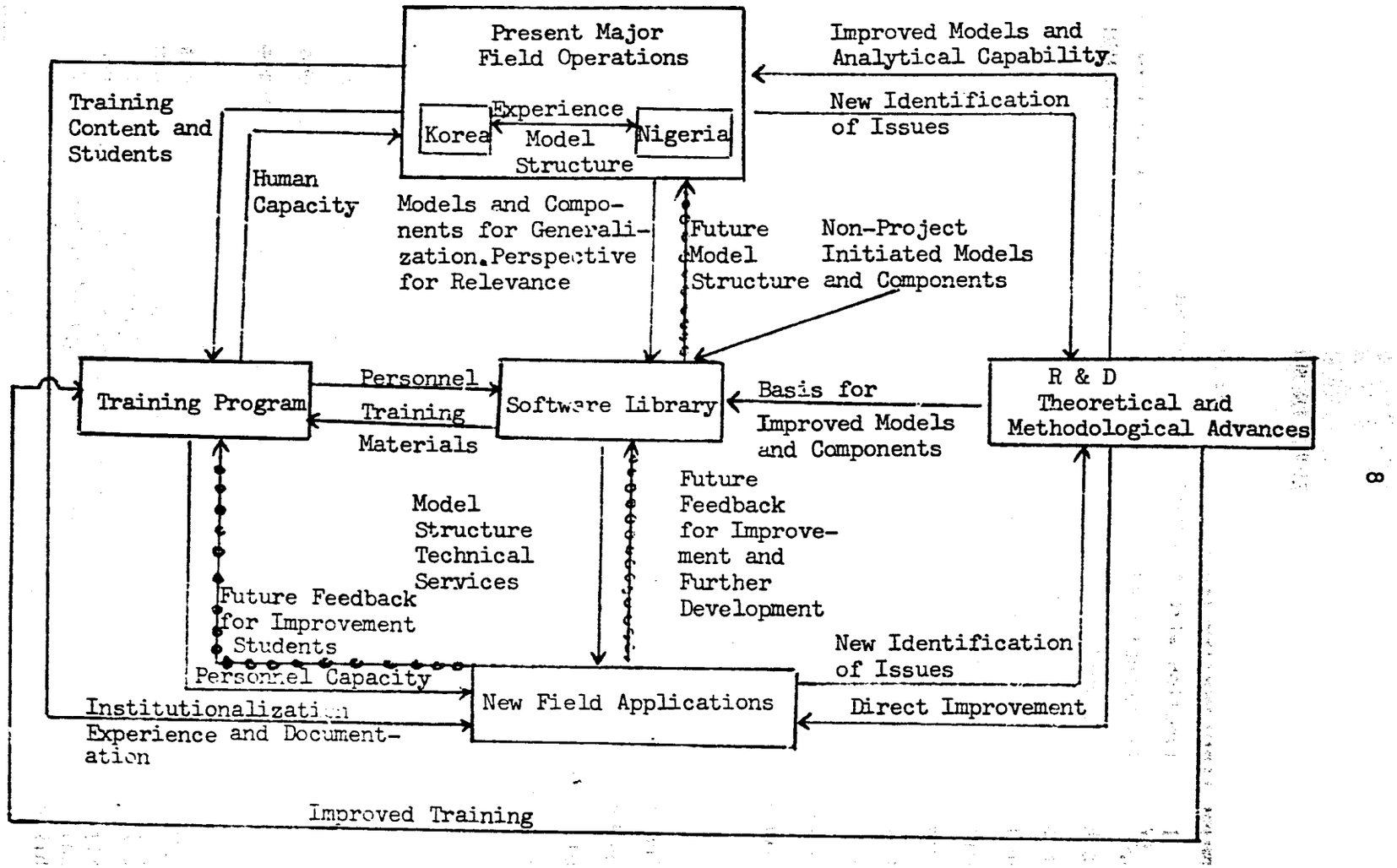

Figure 1

Linkages of Project Components

III. FIELD OPERATIONS IN KOREA

The major field application effort over the past three years has been in Korea. In conjunction with the National Agricultural Economics Research Institute,[1] (NAERI), Republic of Korea, a basic model consisting of five components has been developed, is operating, is being improved by both MSU and Korean personnel, and is being used by the Korean government in the agricultural sector development planning and policy decision making process.[2] Work continues on development of additional components and refinement of existing components. With a sector model operating as a base and providing the broad perspective, attention is now being focused on model components to tie into and complement the sector model as specific needs are assessed through interaction between the Korean Agricultural Sector Study team, Korean government decision makers, and USAID/K personnel.

Summary of Main Activities

During the past year activities of the Korean Agricultural Sector Simulation Project have centered on further development of the grain management model, an urban demand component, effects of international trade, the resource allocation component, a rudimentary livestock component, and preliminary work on revising the population component. Exploratory work was carried out on developing a computerized agricultural data base which could be used in conjunction with the sector simulation projection models.

In May and June, 1974, KASS staff members participated as members of a task force to review the government's grain price policy for the remainder of the rice year. Selected subcomponents of the existing grain management

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[1] In December, 1973, the status of the Agricultural Economics Research Institute, Ministry of Agriculture and Fisheries, was elevated by renaming it the National Agricultural Economics Research Institute, Republic of Korea. The Institute was reorganized and the Sector Analysis Division was created--an indication of the ROKG's commitment to the type of research started under this contract.

[2] For example, KASS demand projections which were prepared by a special KASS/MAF task force team were used and acknowledged in an official document "An Outline of Long Range Projections (Revised)" published by the Ministry of Agriculture and Fisheries, September 20, 1973.

model were used to analyze alternative strategies for handling the deficits in the government grain management account, and rice deficits and wheat surpluses during a period of high inflation.

In the area of training, workshops on agricultural system analysis for researchers and decision-makers were held at the Agricultural Economics Research Institute from July 30 - August 9, 1973. Informal training of three computer programmers also continued. Arrangements were made for two Koreans to attend the one-year, non-degree Development Analysis Study Program at Michigan State University beginning in September, 1973. Three additional NAERI personnel are scheduled to begin this program in September 1974.

Computer operations were improved significantly by making arrangements to use the CDC Cyber Computer at the Korea Institute of Science and Technology, through installation of a remote teletype terminal at NAERI linked to the KIST computer, and through the acquisition of a keypunch.

The field staff cooperated with the five project evaluators who traveled to Korea to evaluate various aspects of the project during the early part of 1974. Project personnel attended the two-day conference held outside Washington, DC at the end of March.

AID Evaluation Conference

During January, February and March 1974 an extensive evaluation of the Korea activity portion of this project was undertaken by the Economic and Sector Analysis Division of TAB, AID. A 6-man evaluation group critically reviewed project progress and direction both in Korea and on campus focusing on: (1) institutionalization, (2) the systems model, (3) the demographic component, (4) the recursive linear program farm resource allocation component, (5) the grain management program component and (6) the livestock component. The evaluation culminated in a 2-day conference held March 27-29, 1974, at Airlie House in Virginia and included the MSU team, the evaluators, AID representatives and an FAO representative. (See Appendix B for list of participants and presentations.) Evaluation emphasis was on economics and demography without consideration of needed contributions from

other disciplines. Although no overall formal summary and conclusion statement has been prepared as yet by AID, individual papers are available as well as tapes of the evaluation conference. An apparent major conclusion from the evaluation was that the work should continue with additional emphasis on further model development and refinement and on institutionalizing the analytical capability in Korea. Activity in other locations was not considered. Specifically development, linkage, institutionalization and use at the earliest possible date was emphasized for the grain management program component, the RLP farm resource allocation component, an expanded agricultural-nonagricultural interface component, and an improved demographic component. Further, it was stressed that additional attention needed to be addressed to building the institutional linkages and to training activities to provide a sound base for continuation of the effort beyond the MSU/AID involvement.

Model Development

During the past year work has continued on further developing various components of the Korean Agricultural Sector Simulation Model. There were two immediate objectives with respect to model development in Korea:

(1) The development of an improved version of the overall sector model which will allow decision-makers to consider alternative strategies of developing the agricultural sector and lead to the formulation of the Fourth Five Year Plan and subsequent updated five year plans.

(2) The development of a detailed sub-sector model to aid government decision-makers in the management of grain policies and programs.

Development of an improved sector model builds on the incomplete computer model (shown in Figure 2 from the technical appendix of the KASS report) which was used to prepare 15-year projections for the main sector report published in 1972[1/]. Figure 2 shows which components of the model

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[1/] G. E. Rossmiller et al., Korean Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985, Joint publication of the Agricultural Economics Research Institute, Ministry of Agriculture and Fisheries, Seoul, Korea, and Department of Agricultural Economics, Michigan State University, East Lansing, MI, 1972.

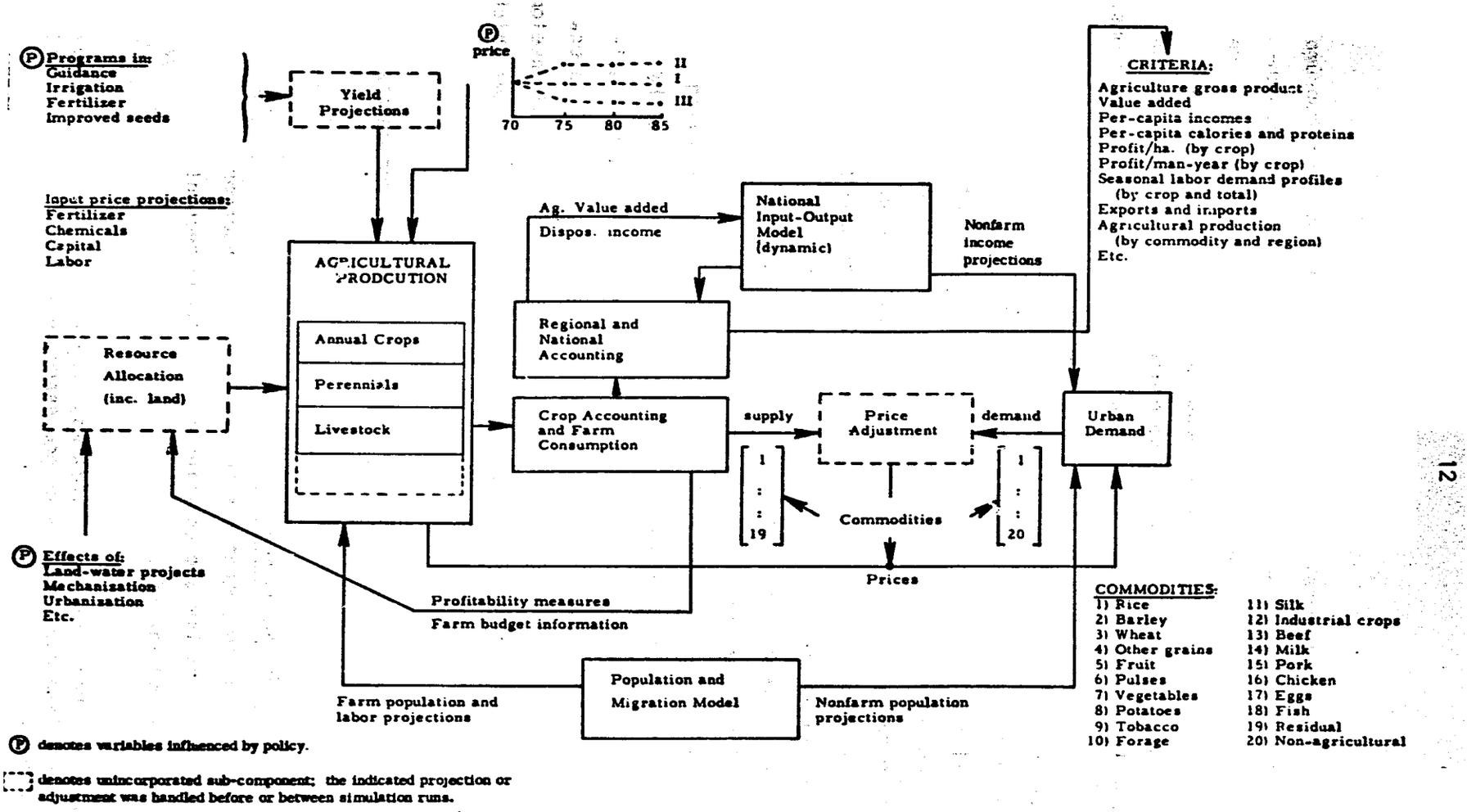


Figure 2. Diagram of iterative operational model of Korean agricultural sector actually used to project consequences of alternative policy strategies.

were operational [agricultural production, crop accounting, farm consumption, regional and national accounting, national input-output (rudimentary), urban demand, and population-migration] and which components were not yet operational (price adjustment mechanism, yield projections, resource allocation) and, thus, had to be handled by off-line projections or by man-machine iterative adjustment of prices and crop area allocations.

The main efforts during the past year have focused on designing, programming, and testing the missing components. Dr. Lloyd Teigen has worked on modifying the urban demand component to incorporate an annual price adjustment mechanism which uses a simultaneous equation approach, and on an international trade mechanism with import and export quotas and tariffs. While on short-term trips to Korea, Dr. Hartwig deHaen and Dr. Friedrich Bauersachs from Bonn University in Germany worked on operationalizing the recursive linear programming resource allocation component. Dr. Tom Carroll carried out preliminary work on updating the population base from the 1966 census to the 1970 census and began incorporating changes in the population component which were recommended during the project evaluation. He also coordinated work on computerizing the rudimentary livestock production and demand model being used by the Livestock Bureau of MAF to make its projection. Mr. Forrest Gibson continued development work on the grain management model and incorporated many changes which were recommended during the evaluation.

Further discussion of development work on the various components follows.

Urban Demand and Price Adjustment Component[1/]

The urban demand component has been modified to incorporate an annual price adjustment mechanism and an international trade mechanism with import and export quotas and tariffs.

[1/] Initial international trade work was supported by the MSU 211d grant. This work identified additional work necessary on the KASS component which is reported here.

The original version of the annual price adjustment mechanism (as described in Appendix D of the User's Manual) was substantially redesigned and reprogrammed during the report period. The original version operated in the manner of a sequential disequilibrium adjuster. The new version (SEAPA, simultaneous equation annual price adjustment component) calculates the endogenous prices which simultaneously satisfy the linear demand equations and the budget constraint taking into account policy-specified prices for certain commodities. The mechanism also includes a provision for reservation prices for all commodities. These reservation prices correspond theoretically to the minimum point on the average variable cost curve for firms producing those commodities.

One version of the pricing mechanism has been uncoupled from the main KASS model in order to operate directly from an interactive computer terminal. In this way the debugging process can be speeded up and policy analysis can be carried out more quickly with the pricing mechanism.

The SEAPA price adjustment component was technically operational at the end of the report period. However, more econometric analysis may be required to obtain a more consistent set of price and income elasticities. Sensitivity analysis is being carried out to test the sensitivity of the price adjustment mechanism to changes in policy-determined prices and quantities marketed.

Another version of a price adjustment routine was also developed which does not explicitly include a simultaneously satisfied budget constraint. This endogenous price gonerator (EPG) first uses a simultaneous equation approach to solve log-linear demand functions and then uses an iterative procedure to determine a budget parameter which will cause the proportion of food expenditure to total income to fall within some specified range of a value estimated using Engel's Law.

If the SEAPA price adjustment component turns out to be too sensitive to quantity/price changes because of parameter estimation problems and the

requirement of the exact satisfaction of the overall budget constraint, the EPG model can be substituted as a back up for SEAPA in KASS model runs.

The world market mechanism interacts with the system by setting the domestic supply plus import target equal to the domestic demand plus export target. If the calculated price is between the export price (f.o.b.) and the import price (C+F+T), it remains unchanged. If it is below the export price, exports of the commodity are increased by an amount necessary to equate domestic with world export price. If it is below the import price, imports of the commodity are decreased up to the amount of the import quota in an effort to keep the domestic price at the import price. If the domestic price exceeds the import price, no adjustment is made. Thus there is a built-in asymmetry in the world market linkage which is biased toward the saving of limited foreign exchange. Both of these trade adjustments (imports or exports) affect all freely determined price in the system, as well as the budget parameter, in a general equilibrium fashion. Dollar prices are used for the world prices of the commodities and for transorporation charges; tariffs and the exchange rate explicitly enter the computations.

RLP Resource Allocation Component

The overall design of the recursive linear programming resource allocation component (RLP-RAC) is outlined first, and then, model development activities during the report period are reviewed.

RLP-RAC Component Design[1/]

The resource allocation component (RLP-RAC) being developed for the KASS model incorporates the recursive linear programming approach to project allocation of resources, principally land and labor, at the aggregate farm enterprise level. The general design of the overall system model provides for dynamic interactions between a general simulation model (SIM) and a linear programming component (LP) as shown in Figure 3. The whole system is a model of a recursive decision system. The LP component represents the farm firms; the other components (SIM) describe the physical and institutional environment in which the firms operate and in which farmers derive their decisions.

In the present version of Korean model the simulated environment (SIM) is represented by (1) a set of policy determined variables, (2) endogenously generated variables and (3) exogenous variables. Policy variables are mainly prices for those products where market intervention for stabilization and price-support take place (food grain management) and for those inputs (e.g. tillers, fertilizer, etc.) which are controlled by the government. Endogenously generated variables include prices which are determined by market mechanisms (currently being incorporated into the KASS model) and the agricultural labor force as projected by the national demographic component. Exogenous variables include crop and livestock yields, technical coefficients, and input prices.

[1/] A full description of the RLP resource allocation component is found in the following project working papers:

Hartwig deHaen and Jeung Han Lee, "Dynamic Model of Farm Resource Allocation for Agricultural Planning in Korea--Application of Recursive Programming within a General System's Simulation Approach," Project Working Paper 72-1, October, 1972.

Hartwig deHaen, "Preliminary User's Guide to the Recursive Linear Programming Resource Allocation Component of the Korean Agricultural Sector Model," KASS Working Paper 73-2, May, 1973.

Hartwig deHaen, "Projection of Resource Allocation and Production in Korean Agriculture with a Microeconomic Model," Paper presented at the Summer Workshop of the Agricultural Economics Research Institute, Seoul, Korea, 30 July - 4 August, 1973.

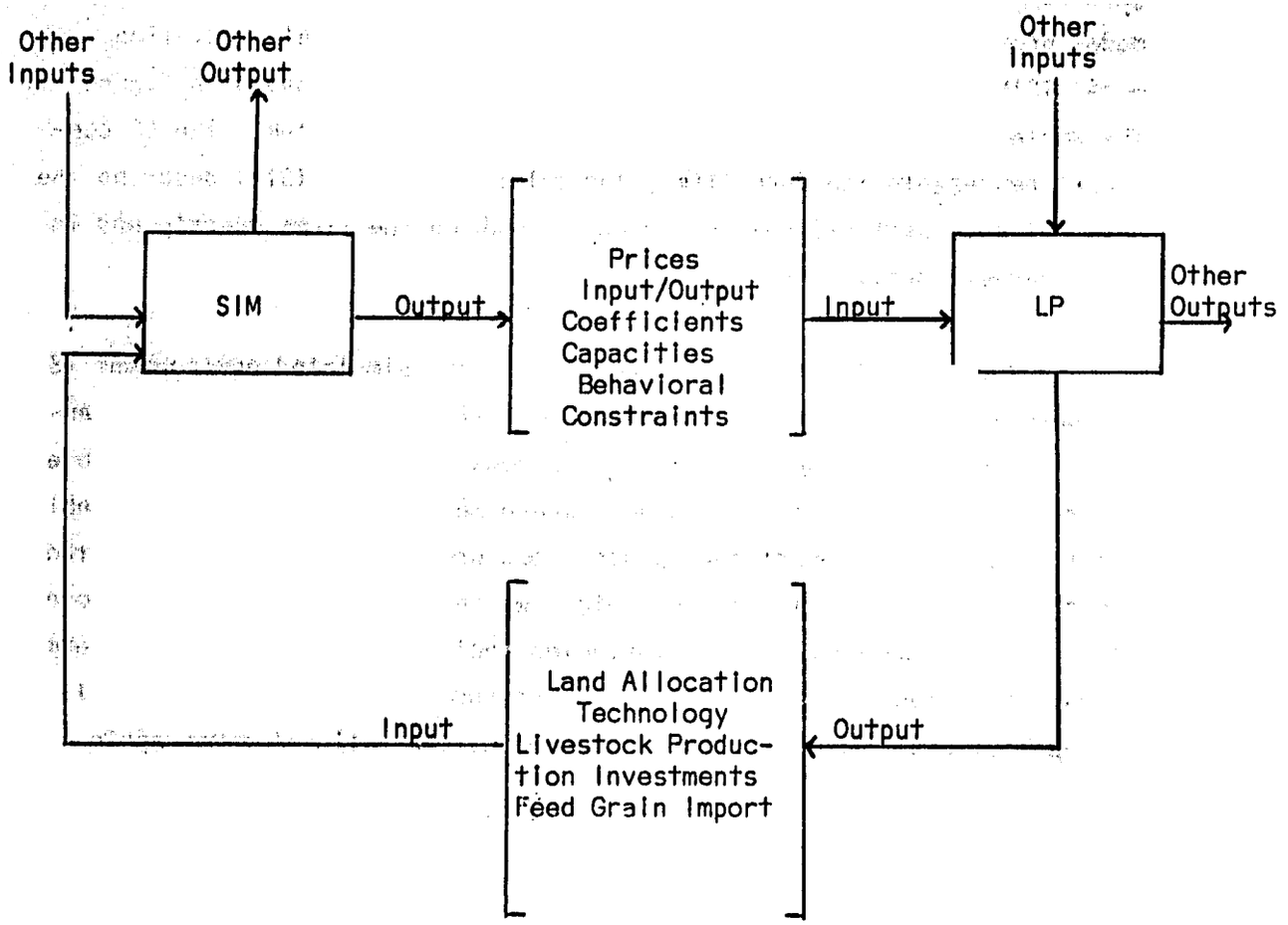
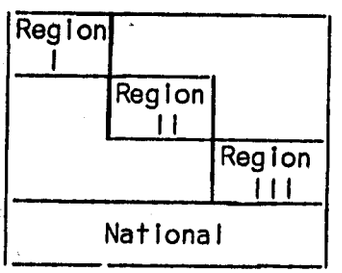


Figure 3. Dynamic Linkage Between Components of the General System's Model (SIM) and a Linear Programming Component (LP)

The main output of the farm firm component (LP), computed once every year, are acreages for field crops, utilization of labor, draft cattle and farm machinery, machinery investment and import requirements for feed grain. Moreover the dual solution provides information about the cost structure of agricultural production computed as shadow prices of various resources.

The total agricultural area of Korea is divided into three quasihomogenous regions. Since farm sizes do not differ significantly so far, no further disaggregation is done within the regions. Each region is treated as if it were one unique decision unit to which principles of individual farm development can be applied. Allocation, production and investment activities for all three regions are computed as the solution to a multiregional activity analysis problem

The LP component for each year is block diagonal with one block for each of the three regions:



This block diagonal matrix structure makes the modeling of inter-regional competition possible. In the current version of the model, there are three overlapping constraints for all three regions. Two stand for the politically fixed national quota of raw silk and tobacco production. The third is a restriction for feed grain imports. All other constraints are repeated in each region.

The activities in the LP analysis include: (1) Production of various field crops, including forage and pasture management, distinguished by type of technology; (2) Production of livestock products; (3) Planting of orchards

and mulberry fields; (4) Investment in farm machinery; (5) Feed grain imports; (6) Various transfer activities. The technology may either be traditional, i.e., using hand and animal tools, or mechanized with a 10 hp-powertiller including the necessary attachments. In the case of rice production there is a third separate technology: transplanting of rice by mechanical rice transplanter. The livestock activities are dairy, Korean cattle, hogs, eggs and broiler production. Cattle can be kept either as draft cattle or for beef production.

The constraints for each region include land capacities for paddy, upland, and double cropping. They include limitations for labor, draft cattle and machinery during two peak seasons, constraints for the current herd size of livestock enterprises, and several balance equations for feed inputs. The model also tries to reflect the "suboptimal" and cautious behavior of farmers by incorporating additional adaptive flexibility constraints on acreages of field crops and livestock production which guarantee that production patterns in any year do not deviate by more than a certain proportion from the patterns during the previous year. Similarly the level of investment in new machinery is restricted to a certain proportion of the existing stock of machines invested in previous years. This reflects the adoption behavior of farmers during the transition process, where learning and diffusion of new ideas are accelerated as the number of previous adopters increases.

The objective function for the model specifies that farmers try, within the limits of the current physical and institutional constraints, to realize those combinations of enterprises and activities which maximize the expected income without running an unbearable risk of losing a basis for family subsistence.

In order to account for the dynamic properties of the sectoral adjustment and growth process, a dynamic feedback operator is defined which relates the values of the objective function coefficients, of constraints and a matrix coefficients to preceding LP solutions, to variables being computed in other parts of the simulation model and to exogenously projected variables.

Obtaining an operational RLP resource allocation component within the general KASS model has been proceeding in two phases:

Phase I: KASM/RLP operating with exogenously projected producer prices.

Phase II: KASM/RLP operating with endogenously determined prices through a market mechanism in the urban demand component, (e.g. SEAPA or EPG components discussed earlier).

RLP-RAC Development Activities

A preliminary version of KASM/RLP with exogenously projected producer price (Phase I) was operational at the beginning of the report period with an earlier version of the KASS Model (Version 1.12). A paper (cited earlier) describing preliminary projections with the model was prepared by deHaen for the Summer Research Workshop held at the Agricultural Economics Research Institute in Seoul during the summer of 1973. Dr. deHaen summarized strengths and weaknesses of the preliminary Phase I version as follows:

> The positive features may be summarized as follows: Projections of resource allocation with the model allow for automatic consistency checks for supply and utilization of resources. They include information about the economic forces underlying growth or decline of resources, measured as shadow prices, that cannot be obtained by non-simultaneous system-models. The model is adaptive in the way that it contains feedback mechanism relating current plans to past experience. The results, although not yet fully acceptable, seem to support the hypothesis of rational behavior under limited information. Finally, the model structure includes explicitly the competition mechanism between human, animal and mechanical power that regulates the process of technical change in agriculture.
>
> The weaknesses of the model are: Some important factors of production so far have been left out; they include mainly investment capital and the skills of people.[1/] The limited availability of both resources may have a considerable impact on production patterns (e.g. restriction of modern vegetable production more than the results indicate) and the speed of the modernization process. Another weakness of the current model lies in the data supply. Too many data do not differ between regions with the consequence that the projected regional production patterns are very similar. This is particularly true for prices, but also for yields and labor requirements. Whether the model

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1/ An incorporation of the capital market was left out (1) for lack of data and (2) assuming that the public sector would supply the required capital at the assumed interest rate.

can be a useful instrument for detailed policy analysis as well as for educational purposes in Korea cannot be answered at this moment. A final answer has to be delayed until this component is endogenously linked to the demand component and the rest of the sector model. However, even at this stage it may give some insight into the manifold interdependencies within the farm sector which finally determine the development process in agriculture.

Phase II development work on the RLP-RAC proceeded slowly during the report period for several reasons. First, Phase II depended on implementation of an urban demand component with a market mechanism. The original version of the annual price adjustment mechanism was discarded. Design and development of the SEAPA component described in the previous section proceeded much more slowly than anticipated because of theoretical, empirical, and programming problems encountered along the way. Second, professional input was reduced to a two-week visit to Korea by Dr. deHaen in March, 1973, and an eight-week visit to Korea by Dr. Friedrich Bauersachs from 25 May 1974 to 22 July 1974. Third, because the KASM/RLP model required 25 minutes to run for 15 simulated years at the National Computer Center and because it was given somewhat lower priority relative to other KASS components by our programmer staff, turnaround time on the KASM/RLP test runs slowed down to more than a week between runs. Finally, when an effort was made to transfer the model the CDC system at the Korean Institute of Science and Technology in order to improve turnaround time, technical problems involving core limitations and the operation of the Wisconsin LP package were encountered.

Nevertheless, in spite of these problems, some progress was made. The preliminary Phase I KASM/RLP version was reworked, errors were uncovered and corrected, and RLP-RAC was updated to link with KASM 1.14, the version of the model documented in the User's Manual.

Perhaps the most significant addition to the program was a preprocessor routine which allow for the flexible alternation of the standard two-dimensional LP matrix structure. The natural indexing system for the elements of the regionalized block diagonal format described earlier is "region" by "constraint" by "activity" plus "national constraints." The preprocessor program converts this three dimensional structure to the two-dimensional structure, which is the input structure required by a standard

LP program. Thus the preprocessor facilitates adding or deleting constraints and activities in 1 to N regions. Equally important as its use by KASS, this generalized routine will be a useful addition to the software library.

During Bauersachs' visit to Korea during the last month of the report period intensive work was carried out on several fronts:

1. At the National Computer Center test runs were made with the KASM-RLP-SEAPA 3-region model. Efforts were being made to eliminate technical problems encountered in trying to link the subcomponents and to achieve results from the larger model which made sense economically. While no successful linked runs were accomplished during the reporting period, it became clear that the linkage would require solution of technical and theoretical problems not earlier anticipated, and that improved estimates of price and income elasticity coefficients were required as well as further sensitivity testing of the behavior of the SEAPA price adjustment mechanism.

2. At the Korea Institute of Science and Technology, advanced development work on the RLP-RAC was started. The main objective of this work is to achieve a version of KASM-RLP-SEAPA operating with a manufacturer's supplied LP package (in the case of the CDC Cyber Computer, OPTIMA or preferably APEX when it becomes available at KIST) operating in a national mode instead of a regional mode (but with the flexibility to operate in 1 to N regions as desired). It was decided to use a manufacturer supplied LP package because most computer manufacturer's are investing significant resources to make their LP packages very efficient with respect to speed and core memory utilization. It was also decided to operate at the national level because as reported earlier little difference was found among the region patterns probably because the data thus far used in the model are very similar across regions. Also, operating at the national level will reduce the computer costs significantly. It will allow researchers to investigate the economic behavior of the national model to determine changes that need to be made in the structure before introducing complexities associated with regionalization. Preliminary consideration has already been given to modifying the LP structure to include constraints on working capital and

investment capital, constraints specifying land where mechanization is possible, constraints on the speed at which double crop paddy can be improved by a drainage program, and other modifications.

In summary, the KASM-RLP-SEAPA model (Phase II) is close to being operational and to producing results useful for policy analysis. Also, basic design work has been done to develop a more flexible version which will make it much easier to introduce changes in the model structure as well as allow for operation at the national level or regional levels.

Livestock Component

A "two-cohort" livestock model was made technically operational early in the report period. This model simulates male and female livestock populations with two age cohorts per sex. In application of the model the first cohort usually corresponds to the "maturation" phase of life and the second to the "productive" phase of life. Distributed delay subroutines modified to handle attrition (deaths, sales, etc.) are used to simulate the "flow" of animals through these two cohorts. The model permits the user to introduce birth and death rates which are functions of per-animal nutritional levels.

Preliminary testing of the model was done using roughly estimated parameters for the Korean native cattle herd in Korea. The model could be extended to dairy herds, beef herds, swine populations and poultry. However, for animals with relatively short reproduction cycles like poultry and swine raised for slaughter, a simpler first-order differential equation formulation may be more appropriate.

It was decided to suspend work on further development on this version he livestock component pending:

1. Further work on the resource allocation component,
2. Clarification of the MAF's objectives and alternative development strategies for livestock production to be considered by the model, particularly in view of the drastically increased international prices for feed grains,

3. Clarification of the impact of the energy crisis on rates of mechanization and the effect on the use of the Korean native cattle herd for draft purposes,
4. Further training of Korean counterpart staff to handle a complicated systems model of the livestock and feed grain subsector.

Instead, work was started on computerizing the methods already developed by the Livestock Bureau in MAF for making the long-range projections for 1973-1981 which were prepared during the most recent government planning exercise. Development of this rudimentary livestock model had several advantages:

1. It provided opportunity for Korean counterparts at NAERI and MAF to gain experience in programming and testing a computer model given relatively well-defined specifications as to the computational procedures to be followed.
2. It minimized the input of scarce MSU personnel resources.
3. It produced a model which required estimates on much fewer parameters than were required for the two-cohort model described above. These parameters were ones already in use at MAF.
4. It provided a model which can be used now by MAF to revise their projections quickly and thus demonstrate the utility of a computerized simulation model.
5. It opened the lines of communication to MAF decision-makers on their terms and through their points of reference. This communication will help the KASS Team to clarify livestock development objectives and to obtain suggestions for areas of improvement in the model in close interaction with the decision makers.

At the end of the report period the MAF Livestock Model is operational. It produces projections of demand and production of beef, pork, chicken, eggs, and milk, herd size for Korean native cattle, imported beef cattle and dairy cattle, swine and poultry; and feed grain requirements. Some of these projections differ from projections produced in the MAF report, because of variations in the methods used to computerize the projections. Interaction with MAF personnel will continue in order to resolve differences, to determine the utility of the present model, and to extend the model's capability to handle relevant economics and policy questions.

Population Component

During the report period two Ph.D. theses on aspects of rural-urban migration were completed by East-West Center Grantees at the University of Hawaii[1/]:

"The Economics and Social Determinations of Rural-Urban Migration in Korea: A Case Study of North Cholla Province" by Seyeul Kim.

"Rural-Urban Labor Migration, Farm Structure, Factor Productivity, and Farm Income in Korean Agriculture" by Kang-Sik Park.

These theses contain useful conceptual information which may influence the design of an improved mechanism for handling off-farm migration and its effects on farm productivity for the KASS model. However, because of the small geographically local sample of farmers interviewed for the study, the theses will probably not be useful for parameterization of the migration mechanism in the model.

The KASS population component was reviewed by John E. Craig, Jr. of International Statistical Program Office, U.S. Bureau of the Census. He concluded:

> In my estimation, KASS has made a commendable first approximation to incorporating demographic and nonagricultural variables into a sector study. In certain respects this first approximation is technically deficient; in others it is simply inadequate. These problems may be traced primarily to simply the inability to do every thing at once in a massive undertaking.

Dr. Tom Carroll has laid the groundwork for development of an improved version of the population component by outlining the changes required in model structure to make it demographically acceptable and by convering to a 1970 census base for data. Dr. Carroll along with John Sloboda, Harvard traveling fellow in Korea, are developing a paper reviewing the literature on rural urban migration as a base for modeling a migration mechanism. The actual modeling will begin during the next report period.

[1/] Their field research in Korea was funded under a sub-contract of this contract.

General Model Updating

The User's Manual (Special Report 9), which was completed during the previous report period, documents version 1.14 of the Korean Agricultural Sector Simulation Model (referred to hereafter as KASM 1.14) which produced the projections presented in the main sector study report (op. cit.).

Early in the current report period extensive work had been done to prepare KASM 1.14 for interfacing with the grain management program (GMP) component and to correct some minor errors in KASM 1.14 which were discovered while the version was being documented. However, half-way through the report period it was decided to give much lower priority to updating KASM 1.14 and to concentrate effort on first getting the GMP component to operate as a self-contained model. This was done for several reasons. First, during much of the report period slow turnaround at the National Computer Center was slowing progress, and it became clear that updating KASM 1.14 was taking too much time away from the development of the GMP model. Second, KASM was designed to address a broad range of agricultural development policies on both a regional and national basis; while the first version of the GMP model is much narrower in scope, looking much more deeply into policy issues at the national level concerned only with the major food grains (rice, barley, and wheat). Thus, it is doubtful that users of the GMP model will have an immediate need to examine outputs of both KASM and GMP simultaneously. Third, an independent GMP model can be made operational much sooner than a larger KASM-GMP model, because it will not be necessary to test both the updated KASM and the linkage between an updated KASM and the GMP component.

During the remainder of the report period work continued on updating KASM 1.14 but at a much lower priority. The effort which was invested is not wasted, however, because an improved KASM remains one of the objectives of the project--not only to facilitate linkage of KASM with new components like the GMP, the RLP resource allocation component, and the livestock component, but also to be used in developing the Fourth Five Year Plan for agriculture. Work will continue on updating KASM 1.14 during the next report period.

Grain Management Program Model

The overall design of the grain management program model (GMP) is outlined first, and then model development activities during the report period are reviewed.

GMP Model Design

The GMP model consists of four subsector models and a market pricing and transaction mechansim which provides the linkage between these subsector models (and in later versions of the GMP, linkage with the larger KASS model);

- Government grain management subsector model
- Private marketing subsector model
- Farm production subsector model
- Urban demand subsector model
- Market pricing and transaction mechanism

The overall design of the GMP model is shown in figure 4.

The government grain management subsector model (GGM), the core of the GMP model, is the instrument through which researchers and decision makers can evaluate proposed alternative grain management policies and programs. This model calculates several variables directly related to government grain management operations. Some of the types of policies which can be addressed to GMP through the GGM mechanism are:

a) policies for controlled market pricing patterns
b) policies for government buying and selling pricing patterns
c) policies (or decision rules) governing the intensity and timing of government domestic purchases and sales for controlling market prices
d) policies governing the desired seasonal levels of reserve stocks of rice and barley
e) policies (or decision rules) governing the intensity and timing of imports to maintain desired stock levels, while at the same time utilizing these same stocks in controlling market grain prices
f) policies related to the amount of government-owned and government-leased warehousing
g) policies regarding warehouse construction and financing

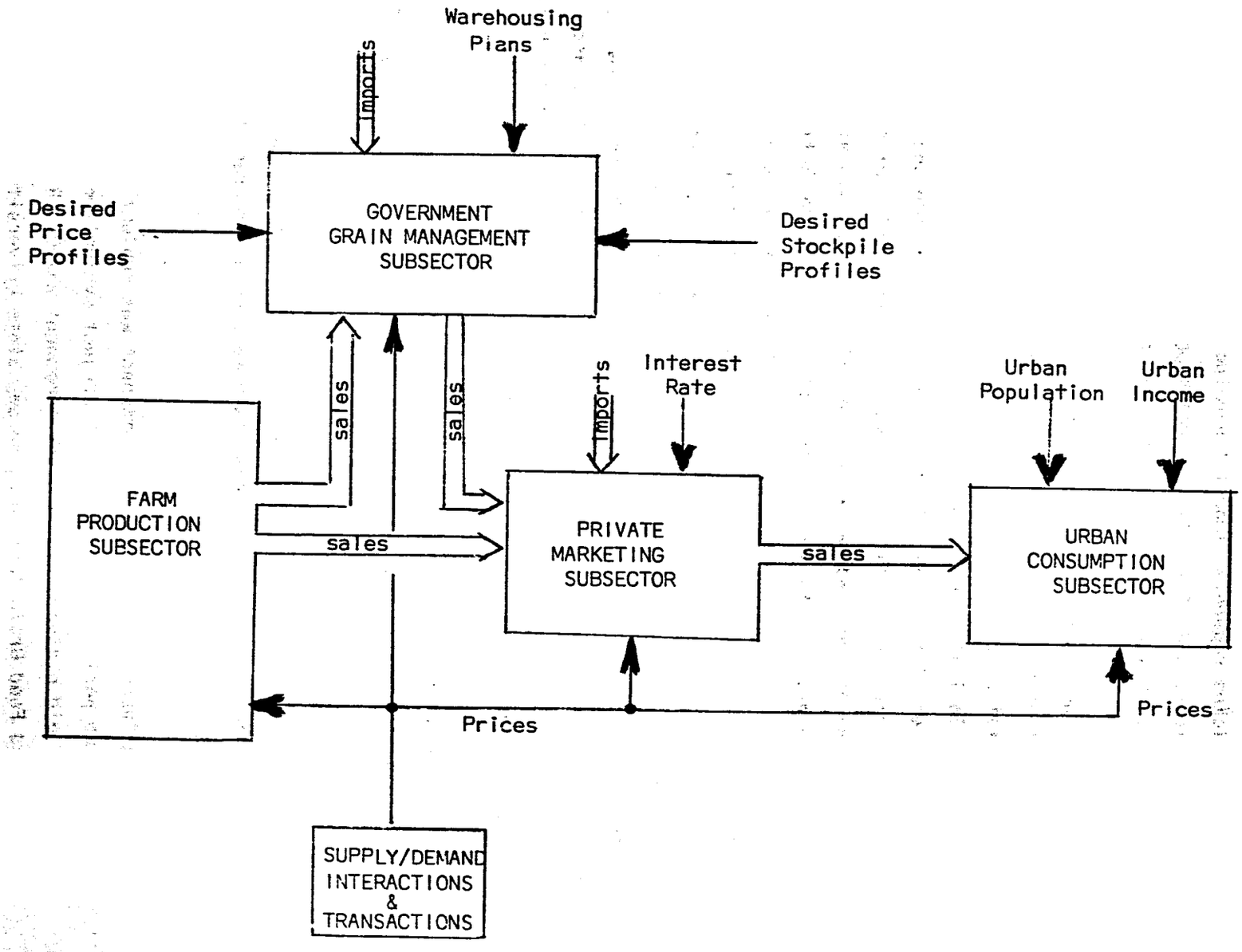

Figure 4. Grain Management Program Simulation Model (General Outline).

h) policies regarding import financing
i) policies specifying import quotas on wheat and feed grains
j) policies imposing tariffs on wheat and feed grains

The GGM subsector model is designed as an automatic feedback control system. Currently, three automatic controllers are incorporated into the model: a market price controller, an import controller, and a warehousing controller. Basically, each controller periodically compares the actual observed values of the 'controlled' variables (e.g., rice and barley prices) with the current desired values. The time-series of differences between actual and desired values are called the "error signals." These error signals are used to generate appropriate corrective action to reduce the amount of error in the controlled variables. In the case of the price controller, the error signals are used to generate government domestic purchasing and sales patterns which would be necessary to maintain the desired market price behavior. There are definite trade-offs between system response (how market price actually responds to desired price signals) and the costs and impacts of various control schemes. These are system design problems which must be worked out through interactions between researchers, decision makers, and the GMP model.

More detailed description of the design of GGM subsector model and other subsector models may be found in KASS Working Paper 73-4 (July, 1973).

GMP Model Development Activities

During the report period the iterative process of designing, testing, and validating subcomponents of the grain management program (GMP) model has continued.

During February 1974, the GMP component was subject to a comprehensive evaluation as part of the overall KASS project evaluation initiated by USAID/W. Field evaluator for the GMP component was Dr. Richard Phillips of the Food and Feed Grain Institute, Kansas State University. As a result of this in-process evaluation, several of the suggested refinements outlined

In section IX of the GMP evaluation report[1/] were undertaken immediately and are currently programmed and included in the GMP component models. These current refinements and others which were already underway are summarized below.

Key market positions and functions are now identified throughout all subsectors of the GMP component. Market positions include farm households, production area assembly and shipping points, consumption area terminal points, port-discharge and storage points, retail sales stores and non-farm consumer households. Transportation between production and consumption areas, as well as between sea ports and consumption areas, is now explicitly modelled in both the private and government marketing channels. Hulling and polishing processes, as well as product and by-product inventories, are now modelled by market position.

The private marketing subsector model now is augmented by an industrial wheat system model to track the progress of wheat imports from original import orders through port arrivals, discharge, port storage, port to mill transit, mill wheat storage, wheat flour production, wheat flour warehousing to wheat flour wholesales. Disaggregation of wheat flour products into major commodities such as noodles, bread and bakery products and other products has not yet been accomplished. Also, now included in this subsector is a private grain storage behavioral mechanism which is responsive to past as well as forecasted seasonal price and storage profitabilities.

The farm production subsector model now identifies non-food uses of food grains (rice, barley and wheat). These uses currently include livestock feed and seed requirements.

A new urban demand subsector model has been designed to handle consumer food grain consumption demands as well as demands for consumer stock

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1/ Evaluation of the Grain Management Program Simulation Model, Richard Phillips and Paul L. Kelly, Food and Food Grain Institute, Kansas State University, February 1974.

level adjustments. Urban demands for food grains respond to relative price levels as well as relative rates of change in food grain prices. Urban consumption of food grains also responds to difference between desired and actual household stock levels. When stock levels are well below desired levels, reflecting an unavailable supply at any price situation, urban consumption is suppressed, reflecting a tightening-of-the-belt syndrome.

By the end of the report period most of the programming on the various subsector models for the first version of the GMP model had been completed. The next several months will be spent debugging and running the model to observe its behavior and its usefulness in answering some of the policy questions raised by the Korean government.

Miscellaneous Activities

KASS Project personnel were involved in several other activities related to model development and application. These included: (1) participating in a grains price policy task force set up in May, 1974, to assist MAF and EPB in determining an optimum grains price policy for the remainder of the rice year, (2) developing a separate model of private storage behavior, (3) developing a 19-sector input-output model focusing on the linkage between the agricultural and nonagricultural sectors, (4) consulting with the Agricultural Production Division of NAERI on how to handle problems encountered in operationalizing a large-scale nine-region linear programming model, and (5) consulting with the FAO advisor at the Institute of Agricultural Sciences on the application of the linear programming method to allocating land areas associated with basic soil classifications to different cropping patterns with the objective of maximizing regional income subject to meeting production targets, (6) giving preliminary thought to the design of an agricultural data base which could be linked to the analytical simulation projection models.

Grains Policy Task Force

In March 1974 when Dr. Kim, Director of NAERI, was in the U.S. attending the evaluation conference, he indicated that a major issue confronting MAF was to determine a conserving grains price policy for implementation until harvest in mid-October and to determine longer term grain policy in

connection with changed world and domestic conditions with respect to world grain prices and availabilities, energy shortages, fertilizer supplies, changed demand conditions and other relevant variables. Dr. Kim indicated that KASS should help in the analysis.

Because of his general knowledge in the world grain policy area, his specific knowledge of the Korean situation and the KASS work through contact as one of the AID evaluators of the project, and his continued interest, Dr. Richard Phillips was asked to consult with KASS on the problem during the last two weeks in May. Dr. G. E. Rossmiller allocated part of his 3-1/2 months in Korea beginning mid-May to this issue as KAPP representative. Mr. Forrest Gibson and Dr. Lloyd Teigen from KASS were asked to participate. Thus, the foreign consultant group consisted of Phillips, Gibson, Teigen, and Rossmiller. A Grain Policy Task Force was formed consisting of Dr. Kim, Dong Hi, NAERI; Dr. Moon, Pal Yong, KDI; Mr. Shin, Food Bureau, MAF; and Mr. Park, EPB. The task force met five times during late May, June, and early July to formulate the short run problem, discuss alternatives, provide data, and to discuss results and form for the short term report. At some of these meetings additional personnel from MAF and EPB were present. In addition Dr. Fred Mangum, KAPP policy analyst, who arrived in late June, was invited to participate and to eventually replace G. E. Rossmiller as a consultant to the Task Force.

The analysis carried out by the task force made use of a simple "front-end" market component developed for the larger Grain Management Program Model described earlier. The simultaneous equation model is set up for only rice, barley, and wheat. It includes price, cross price, and income elasticities, which are estimated for 3 different periods during the year--October thru January, February thru May, and June thru September. These periods coincide with three distinctly different consumption behavior patterns during the year. The policy and solution variables which can be analyzed are the three grain prices and the three grain quantities demanded. The analyst can specify the level of any three of the variables and the model will solve for the other three. The model was used to generate results for the June thru September period.

This model is set up to run interactively from a remote terminal to the KIST computer. This mode of operation speeded up considerably the analytical work of the task force. During meetings of the task force it was also possible to request runs to test different pricing policies and have results back for immediate discussion.

In a meeting of the Task Force representatives with Assistant Vice Minister Bae, MAF, and his Bureau and Division directors, in early August copies of both an English and Korean version of the short run Task Force report were presented and discussed. The Vice Minister was enthusiastic about the report and the approach saying "this is the first time this kind of analysis has been done in MAF." He invited the task force to continue its work with even closer interaction with MAF decision makers, promised full support for data needs, and asked the task force help in determining the rice purchase price to be set this fall. The task force will continue to function and will respond to MAF requests for help as well as initiate work on analysis of intermediate and long term grain policy for Korea.

Model of Private Storage Behavior[1/]

A separate model was developed by L. D. Teigen to analyze private sector storage behavior and price response for two cases: (1) a monopoly or cartel in the storage industry and (2) a competitive equilibrium in the storage industry.

The model is based on a linear demand curve with inventory costs per metric ton stored which are assumed to be the sum of interest costs plus a fixed storage rate per month. In the monopolistic case, the storage level, and hence sales to consumers, is determined in such a way as to maximize year-end profits from private storage activity. In the competitive

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[1/] Work on this model was supported in part by the MSU 211d grant and is written up in KASS Working Paper 73-5, "A Model for Private Storage Behavior under Competition and Monopoly with an Application to Korean Rice Storage" and in KASS Issue Paper 7, "Price Targets and Import Levels on Korean Rice."

case, storage levels and sales to consumers are such that the month-to-month rise in prices is just sufficient to equal the average cost of holding inventories.

The model was modified in order to accommodate government target prices and used to analyze the trade-off between price targets and import levels for rice under the assumption of a market clearing price of 125 ₩ per kilogram.

National Input/Output Model[1/]

A 19-sector input-output model for Korea has been prepared and documented in KASS Working Paper 74-1. This model has been aggregated from the 1970 Bank of Korea 56-sector input-output model.

All of the significant linkages between the agricultural and nonagricultural sector have been maintained. Thus, the model can be used to trace through the consequences of the agricultural-nonagricultural sector interactions for policy analysis.

This version of the model is being used to evaluate the effects of the extrapolation of 1960-1970 demand trends to the year 1975 under several assumptions regarding import substitution.

This version of the model will be used as a basis for developing a dynamic input-output model which will link the nonagricultural sector directly to the KASS Model.

NAERI Interregional LP Model

Project staff consulted with the Agricultural Production Division of NAERI on problems encountered in operationalizing NAERI's regional linear programming model of the Korean agricultural economy in 1961. The model

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1/ Supported in part under the MSU 211-d grant.

consists of nine submodels describing the agricultural production facilities in each province of the Republic of Korea and a demand section which is representing the national market for nearly 60 commodities. The demand section connects all the regional submodels into a homogeneous interregional competition model.

The general recommendation is that both KASS and the Production Division should concentrate on getting national versions of their respective LP resource allocation models operational. This will facilitate making the models operate technically and the running of policy analysis at the national level in order to obtain the technical and economic experience needed before regionalizing the models.

Gimhae Soil Survey Linear Programming Model

Project staff cooperated with Mr. Thomas Day, FAO Soil Survey and Fertility Advisor at the Institute of Agricultural Sciences at the Office of Rural Development, in developing a linear programming method for allocating land areas associated with different soil classification groups among alternative cropping patterns.

The purpose of this program was to establish an example of a method of using the linear programming technique to assist the Government in reaching their established crop production targets and, beyond that, to maximize regional farm income and the efficiency of crop distribution. To do this a rudimentary program was devised to combine the soil survey data available in the reports of the Institute of Agricultural Science (IAS) with information on crop yields, costs and income data available from other sources. The linear programming analyzes miximized regional income based on allocation of land areas for 11 basic soil classification groups in Gimhae Gun, Gyeongsangnam Province, to 134 possible cropping patterns (single, double, or triple cropping) of 18 basic crop commodities subject to land constraints and the necessity to meet minimum production targets for the 18 crop commodities. Constraints on capital and labor were not considered in the analysis. Thus, there is doubt as to the relevance of this particular version to a full economic analysis. However, the purpose of

the project was to demonstrate how linear programming analysis would be extended to include the effect of soil classification data on yield and incomes under different cropping patterns.

Future Work on Data Base Linkages

Work on the KASS model during the past two years has made it clear that the simulation projection models must eventually be linked to an updatable agricultural data base if they are to provide useful up-to-date projections for policy-makers operating in a rapidly changing world environment. The extent of the data base required will depend on the level of detail and regionalization which policy-makers wish to address.

Thus in thinking about the design of a computer-based agricultural data system one must think about the scope of the data base (the kinds, periodicity, and geographical levels at which time series data is to be stored) and the computer software required for manipulating the data base (e.g., updating the data, accessing by general users for a variety of analyses, accessing data to initialize the KASS model at any point in time, aggregating data across commodities and regions, accessing through a user-oriented conversational language, etc.).

Future work must include the design of the basic software required to manage the data base and the storage of basic time series data at the province-level at least in order to test the system. This work must be coordinated with the activities of the Agricultural Statistics consultant under KAPP.

Training Activities

Training activities which were supported under the contract or other AID programs in support of the Korean field operation included presentation of agricultural systems analysis workshop for researchers and decision-makers, formal training of two Koreans in the Development Analysis Study Program at MSU, and informal on-the-job training of counterparts.

Workshop for Agricultural Systems Analysis

During July and August the Agricultural Economics Research Institute in cooperation with Michigan State University Project staff, conducted a Workshop for Agricultural System Analysis for researchers and decision-makers. The Researcher Workshop ran for five full days (30 July - 3 August 1973). Most of the twenty-nine participants considered the workshop to be a valuable contribution to their professional careers. The Decision-Maker Workshop, which ran for four afternoons (6-9 August 1973), was attended by thirty-one participants. Unfortunately, at the end of the second day the Minister and Vice-Minister of Agriculture and Fisheries were suddenly replaced and as a result the thirteen participants from the Ministry were unable to attend the remaining two sessions.

The workshop presentations and the number of participants by organization are given in Appendix C.

Academic Training

In October two Koreans went to Michigan State University to take part in the special non-degree Development Analysis Study Program on agricultural sector simulation methodology. Mr. Dong Min Kim has been associated with the KASS Project since its beginning at the National Agricultural Economics Research Institute and will return to head the new Agricultural Sector Analysis Division which has been set up at NAERI. Dr. Ho Tak Kim is a faculty member of the College of Agriculture, Seoul National University, and will return to train students at the college in the system simulation methodology. Several other Koreans continue their graduate degree programs in agricultural economics at MSU.

Informal Training

Mr. Olson, our field computer programmer from Michigan State University, continues to provide on-the-job training for three Korean programmers. Each by now has completed a formal training course in FORTRAN programming conducted by the Korea Institute of Science and Technology. The programmer-trainees continue to learn about the inner workings of the KASS model and the computer operating systems at both the National Computer Center and

Korea Institute of Science and Technology. One programmer was given the responsibility of designing and programming the MAF Livestock Model described earlier and did an excellent job with the assignment.

On-the-job training of Korean counterparts continues, but this probably has been the least successful part of the training effort during the past year. There are several reasons for this. Approximately one-fourth of the NAERI professional staff was away during the year for further academic training. Since there was no appreciable reduction in the NAERI work load, brush-fire work in the form of special reports and quick translations have interfered with the concentrated effort required by a counterpart if he is to master the skills that come with close interaction with contract personnel. Also, the people who are presently away receiving further training are the people probably best suited to working closely with the KASS contract personnel.

With respect to those who have returned to NAERI after completing training and thus would be better suited to work with the KASS group, it is necessary for the director to distribute them across the five divisions in order to maintain an overall balance of capabilities in the organization

However, in spite of these difficulties, some progress has been made. Mr. Sang Won Lee worked very closely with Mr. Gibson for five months preparing data series for the grain management model and gaining insights into the overall design of the model. He will be attending the 74-75 session of the Development Analysis Study Program and most likely will do a special project on some aspects of the grain management model. Mr. Chang Bok An and Mr. Young Suk Kim worked on the design and development of the MAF Livestock Model under the guidance of Dr. Carroll. Mr. An will also be attending the 74-75 Development Analysis Study Program and will continue work on developing a more sophisticated livestock model.

Computer Operations in the Field

Much effort during the past year was spent improving our computer operations in the field.

Since the beginning of the project most of our computing has been done in batch mode on the Univac 1108 Computer located at the National Computer Center in the Unified Government Building in downtown Seoul. The programmers were located in an office in the Unified Government Building. Computer service was "free" to government agencies; thus neither our contract nor NAERI had to pay directly for computer service used by the project. However, turnaround became slow, averaging only three to four executions per week on any one line of work. By comparison, at Michigan State University it is possible to average at least two to three executions per day in batch mode and more in interactive mode.

In October arrangements were made to begin using the CDC Cyber 70 Computer in batch mode at the Korea Institute of Science and Technology. Project programmers were also allowed access to the remote batch terminal located at the Korea Times Building about three blocks from the programmers' office in the Unified Government Building. Development work on the KASS model was slowly shifted over to the KIST Computer.

From October to December, 1973, computer services at KIST were paid in dollars by the contract. Beginning in January, 1974, computer services were paid in won from the local AID Trust Fund Budget.

On March 12, 1974, a Teletype Model 38 Terminal was installed at NAERI. This brought remote interactive computer service directly into NAERI. Arrangements were made by USAID/Korea with IBM Corporation (Federal Systems Division) to lease an IBM 026 Keypunch on a temporary basis until such time as NAERI could obtain its own keypunch from IBM Korea, Inc. The keypunch became operational April 10, 1974. Shortly after installation of the keypunch, the programmers' office was moved from the Unified Government Building to NAERI.

These changes brought a considerable improvement in our computer operations. Turnaround at KIST has been a factor of about 10 faster than at NCC. As a result the controlling factor on productivity shifted from computer to the programmer staff.

The improved computer operations were obtained only through considerable administrative effort to make the arrangements and through programmer and professional input to convert programs from one computer to the other. Although the costs were relatively high the long run viability of the computer-project interface is greatly enhanced.

KASM 1.14 was the first part of the model to be made operational on the KIST Computer. This was followed by the development work on the GMP model and SEAPA component. The work on the RLP component continued at NCC during deHaen's short-term visit in Korea during March 11-26, 1974, and Bauersach's visit beginning May 25, 1974. Because of the complexity of programming it was deemed best to get the Phase II of RLP development work operational at NCC before transferring it to KIST.

The plan for future computer operations is to do most of the soft-ware development work on the KIST computer as long as the contract maintains a field operation in Korea. Moreover, it is planned that the computer programs also be made operational at NCC so if adequate funds are not available in the NAERI budget to buy time at KIST, then NAERI can use the "free" computer service at NCC for operational activities.

International Data Communication Link

During the past year the Field Project Leader also investigated the feasibility of using the remote terminals located at NAERI and the project offices at MSU for international data communication. The purpose of this arrangement would be to speed the flow of important communications between project headquarters and the field operation. These communications might relate to coordination of the project activities, requests for data and help on theoretical problems, source code for model components and updates,

drafts of work plans and research papers for comment, computer outputs from model runs, etc. The proposed scheme for linking the remote terminals might eventually include the equipment shown in Figure 5.

A similar set-up, although much less elaborate, could be used by a task force preparing a sector analysis using the system simulation methodology in a country without adequate computer facilities. In this case there would be only a central computer center at which the software library resided and was maintained by a central research staff. The central staff would receive instructions and data from the field via the international data communication link, submit runs, and then send computer outputs back to the field task force via the data communication link.

Investigation of the feasibility of an international data communication link revealed the following:

1. Data communication at 100, 300, 1200, 2400 baud is technically feasible now over the international voice-grade channels.
2. An international standard exists for the operation of 2400 baud modems. There is no international standard for 100, 300, or 1200 baud modems. The low-speed modems used by the AT&T Company in the United States cannot communicate with low-speed modems used by most other countries of the world.
3. Member nations of the International Telecommunication Union last year signed a convention allowing for 2400 baud data communication over international voice channels.
4. The tariffs agreed to between the United States and Korea do not yet allow data communication at any speed over the voice channels between the two countries. However, agreements between the U.S. and some of the other LDC's would permit this mode of operation.
5. Between the U.S. and Korea it may be possible to use the U.S. Department of Defense AUTOVON link as an interim measure until such time as data communication becomes legal over the commercial channels.

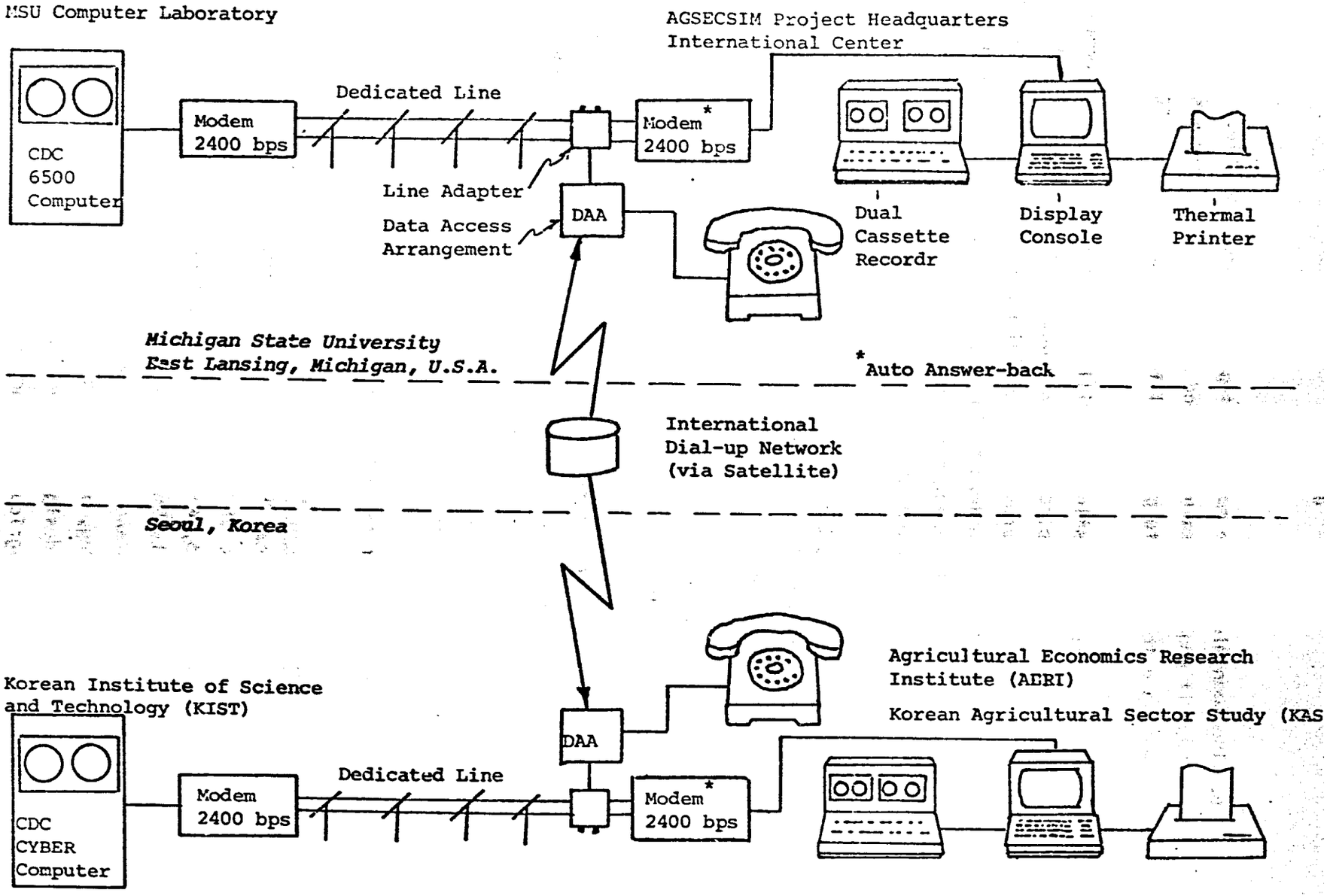

Figure 5. Data Communications Network for Agricultural Analysis and Simulation Project.

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6. The economics of the new technology look very favorable. At 2400 baud it would be possible to send at least a 6000 word message during a three-minute phone call for the same cost as a 50 word cable.
7. Implementing and testing the utility of international data communications is worth pursuing as a project activity because of its implications for improving the efficiency of international research and possible applications by task force who wish to use computer based analysis for evaluating strategies of agricultural development countries without adequate computer facilities.

KASS Relations with Other Projects and Organizations

During the past year the KASS Project has maintained cooperative relations with the Korean Agricultural Planning Project (KAPP), the Korean Development Institute (KDI), the Korean Institute of Science and Technology (KIST), the Institute of Agricultural Sciences (IAS) at the Office of Rural Development (ORD).

During the remainder of the contract period in Korea the KASS Project through NAERI hopes to increase its cooperative relationships with the Korea Advance Institute of Science (KAIS), with the AID-Loan Crop Improvement Project, and with other projects and organizations concerned with agricultural development in Korea.

A brief discussion of the nature of these relationships follows.

Korean Agricultural Planning Project (AID Grant)

The Korean Agricultural Planning Project (KAPP) is a three-year contract between the Republic of Korea Government and Michigan State University funded through a $703,042 AID Grant to the ROKG. The general objective of the KAPP Project is "to increase the capacity of the Ministry of Agriculture and Fisheries and through them the government of the Republic of Korea for sound planning, agricultural policy formulation, program development, and project design and execution toward more rapid and effective development of the agricultural sector." The project staff includes

the following long-term personnel: (1) Policy analyst (agricultural economist) working with the Planning Coordinator's Office in MAF, (2) an agriculture outlook analyst (agricultural economist) working with the appropriate agency in MAF, and (3) a program and project evaluation analyst (agricultural economist) working initially with the Agricultural Development Corporation (ADC, the MAF operational agency responsible for land and water development) and other agencies as appropriate. Provision has also been recently added for a one-year agricultural statistician to work with the MAF Statistics Bureau on the improvement of the present statistics collection and data processing now being done in MAF and on the development of a comprehensive statistics and data system.

Michigan State University agreed to undertake the KAPP Project with the understanding that there would be close cooperation between the KAPP Project and an on-going KASS Project. KAPP Project personnel would help introduce the use of the KASS models into the decision-making structure of MAF and help identify areas where the existing KASS models could be improved in order to be responsive to the needs of decision-makers. The KASS Project would be responsible for extending and improving the models.

The scope of work for the KAPP Project may be found in Appendix D.

Korea Development Institute (KDI)

The Korea Development Institute was established in 1972 as a semi-autonomous research institute to conduct policy-oriented research on strategies of economic development for the Economic Planning Board.

KASS personnel, particularly Mr. Gibson, have consulted with Dr. Pal-Young Moon, Senior Fellow in agricultural economics at KDI, about his econometric analysis of grain prices.

Further contact with KDI is expected during the next year as the KASS begins development of a dynamic input-output model to provide the linkage of the KASS model with the rest of the Korean economy. It is hoped that a mutually cooperative arrangement can be worked out with KDI in the effort to work out the set of national guidelines which will be the basis for the Fourth Five Year Plan.

Korea Institute of Science and Technology (KIST)

During the past year KASS Project personnel have established very good relations with Dr. Ki-Soo Sung, Dr. Yong-Teh Lee, and the staff of the Computer Center at the Korea Institute of Science and Technology (KIST). They have been most helpful in arranging for batch service and interactive service and have maintained an active interest in implementing the data communication proposal described earlier. Discussions have been held on identifying KIST personnel who could serve as programmers on the KASS Project and who might go on for further training in agricultural systems science. Both Dr. Sung and Dr. Lee are actively interested in the substantive content of the KASS Project, not just the KASS Project as a paying customer for computer services at KIST.

ORD Institute of Agricultural Sciences

During the past year contact has been made with the ORD Institute of Agricultural Sciences (IAS) through cooperation with Mr. Thomas Day, the FAO Soil Survey and Fertility Advisor and Mr. E. Boswinkle, advisor on the statistical analysis of yield response trial data. IAS has a new director, Dr. Kee, Jung Haeng, who has expressed interest in the KASS Project and a desire for closer cooperation with NAERI in the economic analysis of IAS-gathered data.

Korea Advanced Institute of Science (KAIS)

The Korea Advanced Institute of Science (KAIS) was established in 1972 as a graduate school to give advance degrees (Master's and Ph.D.'s) in various scientific fields including industrial engineering and computer science. KASS personnel have been in contact with Dr. Chan-Mo Park of the Computer Science Department and Dr. Lee of the Industrial Engineering Department about the possible means of collaboration between KAIS and NAERI.

One means of collaboration would be an arrangement whereby one or more KAIS students, highly qualified in technical areas, could work with KASS personnel on a practical problem application. Ideally this arrangement could lead to a master's thesis for the KAIS student, further experience for KAIS is an important socio-economic area, progress on KASS work, and development of persons with systems expertise who might be able to contribute to further NAERI work in the systems-simulation area. However, such an arrangement probably would succeed only if:

a) All persons engaged in the interdisciplinary project work were sufficiently broad to be able to communicate and interact effectively (many of these kinds of efforts have failed in the past because disciplinary specialists were thrown into a complex multi-disciplinary problem area before they were ready for it).

b) Experienced KASS systems people invest an appreciable amount of time to provide guidance and direction.

A second proposed arrangement would be to send one or more KAIS Industrial Engineering students to MSU to participate in the one-year Development Analysis Study Program. The students would take appropriate course work and write a master's thesis as part of the program. Both alternatives are being explored.

ORD Crop Improvement Project (AID Loan)

The U.S. Agency for International Development has recently made a $5,000,000 loan to support funding for a five-year crop improvement project at the Office of Rural Development (ORD) beginning in 1974. Seventeen international scientists will be in Korea for varying lengths of time to conduct intensive varietal research programs in the genetic improvement of rice, barley, wheat, soybeans, and potatoes.

The project also provides for establishing a Cropping System Team. This team will carry out research of both (1) an "agronomic experimental" nature to see what combinations of crops can be grown under experimental conditions and under farm conditions and (2) what the cost and returns are under various farm cropping systems, and what costs, returns and production could be under different hypothetical cost and price structures.

The KASS Team should cooperate with the Cropping System Team in order to speed the analysis of the impact of proposed cropping systems on overall agricultural productivity. As the KASS effort expands its data base from the national level down to the province and county levels, the KASS model will also be in a position to make recommendations on land allocation to new cropping systems under expected cost/price structures.

A paper on the use of PERT in project implementation included in our contractual obligations will use this project as a demonstration of the use of the PERT technique. Hopefully the result will be useful to the director of the Crop Improvement Project.

IV. FIELD OPERATIONS IN NIGERIA

In the year ending 30 June 1974, the main simulation work on the Nigerian economy was done by Felix Nweke. Mr. Nweke's graduate stipend was paid under MSU's 211d grant; however, considerable assistance was rendered to Felix Nweke by members of the Simulation Project supported by AID/csd-2975.

As a result of the Nigerian Development Seminar held in 1971, Nigerian graduate students at MSU became interested in both the fishery and forestry sectors of the Nigerian economy. Felix Nweke decided to attempt a major effort at modeling the Nigerian forestry sector. To this end he spent considerable time developing a rough model outline of the Nigerian forestry sector including processing and the utilization of round and sawn lumber and plywood. He was given substantial technical assistance in modeling by members of the AID/csd-2975 team and by such 2975 consultants as Dr. Dupe Olatunbosun, then a visiting professor at the University of Michigan and now acting director of Nigerian Institute of Social and Economic Research.

After the rough outline of the overall forestry sector had been developed, it was decided that Nweke should confine his modeling efforts to the domestic demand for round, sawn and plywood. Arrangements were made for Nweke to work in cooperation with Mr. Oseni, Director of the Federal Department of Forestry in the Federal Ministry of Natural Resources in the 1975 fiscal year. At the close of the project year, it was anticipated that Nweke would go to Nigeria to work cooperatively with Mr. Oseni and that appropriate conferences involving AID/csd-2975 personnel and Nigerian personnel would be held as appropriate. It is anticipated that Mr. Nweke will return to MSU with the data which he collects to complete modeling of his part of the Nigerian forestry industry.

The subcontract with the University of Ibadan covering the kola nut industry, research being done by agricultural economics M.S. candidate, Cyril Aja, continues until 30 September 1974. Cyril Aja expects to complete his research on the kola nut industry by that date. We expect preliminary results of that research by early November.

V. CAMPUS ACTIVITIES AND RESEARCH

Several project personnel contributed to project objectives through various activities on campus. Alvaro Posada completed his Ph.D. dissertation research on a simulation of the Colombian beef cattle industry. He focused on the Atlantic Coast of Northern Colombia as the most important of Colombia's five beef producing regions and developed a model in which four alternatives to traditional production could be considered, and in which the system would respond to various policy stimuli such as disease control, taxing policies, development credit policies, government production campaign promotion, and cattle pricing and export policies. A more complete abstract of this work can be found in Appendix F.

Jeung Han Lee is nearing completion of his Ph.D. dissertation research on projections of product supply and factor demand under structural change for Korean agriculture. The primary purpose of this study is to contribute to the model of the production system in Korean agriculture as a component of the MSU/KASS model. Since the acreage response system is already built, this study concentrates on modeling the yield response and factor demand of the various crops in the KASS model for the three regions. Emphasis of the study is to explain how the public policies, programs and projects concerned with technological, institutional, and human change will affect yield response. The results of this model in terms of yield response and other outcomes will be fed into the agricultural resource allocation component (RLP) of the KASS model.

Marc Buchner is also nearing completion of his dissertation research with the project. The purpose of his research is to develop and construct an optimization component that will efficiently assist in solving parameter estimation and policy decision problems in complex simulation models. The approach used is to have a crude pattern recognition capability, numerical optimization methods, and human interaction in a computer program that will provide the user with a procedure to study model behavior and maximize or

minimize various objective functions with respect to possibly constrained variable sets. An investigation of the suitability of different optimization methods for inclusion in the component led to a decision to use a two-level search strategy. These two methods are the Complex and the Powell's algorithms. The complex method is efficient for searching far from an optimum while the Powell's method is efficient for searches close to an optimum. The completion and integration of this research into our Korean models and the software library will greatly enhance the capability of these models to provide analytical inputs to decision makers.

Dr. Ho Tak Kim developed as his special project for the Development Analysis Study Program a model depicting the broad interrelationships between the variables of income distribution, savings, effective demand and economic growth in the Korean economy. The model allows examination of the impact and consequences of alternative policy measures for the redistribution of income on economic growth and other related variables. The model is presently operable and a paper is available which will become a KASS Special Report. Dr. Kim plans to refine and integrate this component into the KASS model system upon his return to Korea.

Dong Min Kim is developing, as a special project for the Development Analysis Study Program, a micro-farm simulator adapted to the Korean situation which may be run in an interactive mode from a teleprinter devise. The study is an attempt to develop a computerized simulation model to investigate the problem areas in exploiting the alternative possibilities of food production at the farm level in Korea. In the long run this individual farm model may become an integral component of the larger KASS model but immediate plans are for it to be independently designed so it can be used as a research and educational devise in its own right. It is likely that this work will also be published as a KASS Special Report.

VI. THE DEVELOPMENT ANALYSIS STUDY PROGRAM

Purpose

In recent years the judicious use of quantitative methods has proven useful in arriving at better planning and management decisions in developing countries. The purpose of this study program is to develop professional capacity needed to effectively apply modern quantitative methods to the problems of project, program, and policy formulation and implementation in developing countries. The program is designed for professionals working in various areas related to developmental planning and emphasizes basic methodology, theory, and techniques; practical experience in developing and maintaining decision-making models; and the use of models in developmental decision-making processes. Due to the nature of past experience of the study program staff, heavy initial emphasis is given to applications of the approach to problems of agricultural and rural development. Another goal of the program, however, is to extend applications into other areas such as education, nutrition and health planning and management. Thus limited numbers of participants can be accepted with interests in such areas.

Overall Description of the Study Program

Due to the diversity of disciplines and functions necessary in the application of the systems analysis approach (or any approach) to the formulation and implementation of projects, programs and policies for development, several types of study programs are needed to produce required personnel. The Development Analysis Study Program proposes three distinct subprograms which can be used singly or in combination to produce a range of capabilities. These are the Basic Study Program primarily for analysts and model builders, an Orientation Study Program for decision makers, administrators, and others who need a broad understanding of the systems analysis approach and its application in decision making, and a Computer Programmer Study Program for personnel needed to process data and program and operate models.

The Basic Study Program

(For Analysts and Model Builders)

The Basic Study Program is designed for professionals who have at least a bachelor's degree in an appropriate field such as agricultural economics, engineering, economics, mathematics or statistics. It can be used as a part of a regular master's or doctoral program in an area such as System Science or Agricultural Economics or it can stand alone as a one-year diploma program. The former option is recommended as a norm but the latter option is available for participants who cannot remain away from their professional positions for more than one year.

Content of the Basic Study Program

The Basic Study Program includes formal course work in systems methodology, system theory, simulation methods, optimization methods, computer-based decision analyses, and computer science. Where needed, it also includes formal course work in essential related areas such as economics, areas of technical agriculture, public administration, sociology, etc. Regular university courses are reinforced by special seminars and tutorials. The Basic Study Program also includes intensive practical experience in the development of decision-making models. The last six months of this one-year program are largely devoted to a model development project in the participant's area of interest. This work is carried out in close interaction with experienced members of the study program staff.

The following courses are considered as an essential technical core for the Basic Study Program (course numbers are those at Michigan State University):

Basic Computer Science (CPS 120 and/or 300)	3-6 hours
Mathematics (Theory of Matrices--MTH 334)	4 hours
System Science	
Linear System Theory (SYS 810)	3 hours
Systems Methodology and Simulation (SYS 811)	3 hours
System Project (SYS 813 or equivalent thesis work)	12 hours
Advanced Systems Methodology and Simulation (SYS 8xx to be developed)	3 hours

Mathematical Programming	
EC 833 or SYS 465 or SYS 828	3 hours
Econometrics (AEC 835)	3 hours
Computer Models in Agricultural Sector Analysis--with Computer Laboratory (AEC 8xx)	3 hours
TOTAL HOURS	34-40 hours

The technical core therefore includes about 37 quarter hours of work. This includes intensive practical project and laboratory work as well as formal course work. A qualified participant can complete this core plus some "broadening" work and/or electives in a period of one year.

A possible time schedule for this program, based on one full year, is as follows:

Fall	Winter	Spring	Summer
SYS 810 (3)	SYS 811 (3)	SYS 813 (5) (Proj.)	SYS 813 (7) (Proj.)
CPS 120 (3)	AEC 8xx (3)	SYS 8xx (3)	AEC 835 (3)
MTH 334 (4)	CPS 300 (3)	AEC 833 (3)	
10 credits	9 credits	11 credits	10 credits

Normally there would be room in this program for "broadening" electives.

Prerequisites for the Basic Study Program

Participants are carefully selected on the basis of the following criteria:

a. Formal training and experience in a relevant discipline--agricultural economics, engineering, an area of technical agriculture, mathematics, statistics, etc.

b. A "flair" for quantitative methods and solid preparation in basic mathematics and statistics which includes:[1]

   I. College Mathematics through differential and integral calculus (at least one year)

   II. A course in probability theory preferably based on the calculus

[1]Candidates essentially qualified but weak in specific quantitative areas could remove deficiencies in a number of ways including spending additional time at M.S.U.

iii. One or more courses in statistics--preferably including regression analysis

c. Participants should be appropriately located in the institutional structure of a country that is seriously interested in the use of models as aids in policy, program and project analysis.

d. There should be high probability that individual participants will be actively involved in analysis, research, teaching or other work related to problems of agricultural sector analysis for a considerable period of time upon return to their home countries.

e. Adequate facility with the English language.

f. Adequate "infrastructure" in participating countries (computers, programmers, data acquisition, etc.).

Status of the Basic Study Program

A "pilot" version of this study program began in the fall of 1973 with 10 participants (three of these full-time) from Korea, Nigeria, Ghana, Sweden and the U. S. If funding for the training program is forthcoming, a regular class will begin in September 1974.

The Orientation Study Program

(For decision makers, administrators)

The purpose of the Orientation Study Program is to provide decision makers, administrators and others with a basic understanding of the systems approach to planning and management and the use of quantitative models in decision making. The program is designed to be useful for decision makers and administrators who need or will need to converse with and understand staff analysts as quantitative techniques are applied to the management issues they face. The Orientation Study Program is also designed for others who need a broad understanding of this area. This program, of two-week duration,[1/] includes formal instruction in systems methodology and the capabilities and limitations of quantitative methods such as linear programming, simulation models, econometric models and critical path analysis. Laboratory

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[1/] This training program would normally be held at Michigan State University though in special cases sessions may be scheduled abroad. Attendees coming to M.S.U. from abroad should allow adequate additional time for "jet shock" adjustment.

sessions will be directed at exploring the use of an interactive approach to decision making involving quantitative models. The Orientation Study Program can be offered on a pilot basis during the 1974-75 academic year. Facility with the English language is required.

The Programmer's Study Program

(For computer programmers)

The Programmer's Study Program is a variable duration program designed to produce computer programmers who can effectively program, maintain and operate decision-making models. The program includes formal training in computer programming and necessary related areas such as mathematics, statistics, and economics. The program also includes intensive practical experience in programming and operating simulation, linear programming and other models as appropriate. Depending upon the background and preparation of participants, the program will involve 3-12 months in residence at Michigan State University. This program could be offered on a pilot basis during the 1974-75 academic year. Normally a bachelor's degree in an appropriate area such as mathematics or statistics is desirable but appropriate experience may substitute for formal education in particular instances. Facility with the English language is required.

Financial Arrangements

Expenses for participant travel, tuition, and maintenance at Michigan State University are borne by participants or their sponsoring agencies.

Training Activities During Report Period

The training program as currently conceived and operated is described in the above. The so-called Basic Study Program was operated for the first time during the 1973-74 academic year. This program offered foreign professionals with advanced degrees in agricultural economics an intensive one-year experience in the theory and application of systems analysis and simulation to problems relating to agricultural sector development. It also offered Ph.D. candidates (mainly Koreans in Agricultural Economics at MSU) more intensive work in systems and simulation than they would normally have received in their regular academic program. In several cases this experience contributed directly to the ability of these doctoral students to do thesis work based on systems analysis and simulation.

The following persons participated in the 1973-74 Basic Study Program:

Person	Status
Kim, Dong Min	Section chief of NAERI[1/] in charge of sector analysis and simulation
Kim, Ho Tak	Post doctoral fellow Assistant Professor of Agricultural Economics, Seoul National University
Lee, Jeung Han	Ph.D. candidate in Agricultural Economics (Korea)
Yoo, Jong Tak	Ph.D. candidate in Agricultural Economics (Korea)
Lee, Seong Woo	Ph.D. candidate in Agricultural Economics (Korea)
Bo Andersson	Ph.D. candidate in Agricultural Economics (Sweden)
Rhee, Seung Yuer	Ph.D. candidate in Economics (Korea)
Felix Nweke	Ph.D. candidate in Agricultural Economics (Nigeria)
Atta Konada	Ph.D. candidate in Agricultural Economics (Ghana)

During this year a number of elements of the training program were developed. These included:

1. A two-term seminar to parallel basic courses participants take in System Science. (The seminar reinforced this basic material and provided more examples directly related to rural development.)
2. A pilot version of a graduate course in simulation-based policy analysis.
3. A pilot version of a course in advanced systems methodology and simulation. (This course was designed specifically for the needs of students developing large scale simulation models such as those encountered in developmental planning.)
4. Development of new teaching materials related to 2) and 3) (see bibliography).

1/ National Agricultural Economics Research Institute, Seoul, Korea

The training program also offered participants consulting services in computer science and system science to aid in assimilating basic material and in acquiring necessary skills.

Two participants completed the one year Basic Study Program and completed model development projects relating to problems of Korean rural development. Kim, Ho Tak developed a simulation model to explore the impacts of income distribution within the rural and urban sectors upon macroeconomic growth. Kim, Dong Min developed an interactive farm simulator that permits users to explore issues in farm management and the impacts of certain public policies upon farmer responses. The training program supported both these projects with computer programming assistance and consulting in model development.

The expected enrollment in the 1974-75 Basic Study Program is eight including three Koreans from the staff of NAERI, two scientists from the International Rice Research Institute (Philippines), one staff member from Agricultural Economics at M.S.U. and two Ph.D. candidates in Agricultural Economics (one a Korean and the other an American research assistant with the Agricultural Sector Analysis and Simulation Projects).

During the year a study was conducted to determine appropriate selection criteria for the Basic Study Program given that the objective of the program is to produce individuals who will be able to make useful contributions to their country's development over a period of years. Results of this study are reported in "Candidate Selection Procedures: Multi-National Program of Study in Systems Analysis for Developmental Planning" by William A. Mehrens and Stephen M. Downing, Michigan State University, 16 April 1974.

VII. SOFTWARE LIBRARY

Background

Under contracts AID/csd-1557 and this contract, in Nigeria and in Korea, the project team has developed and applied the generalized system simulation approach to agricultural development analysis and policy making. As part of that effort, a number of models have been built, assembled and computerized. These include, for example, models of production and processing processes; demand and consumption demographic processes as applied to human, cattle and tree populations; commodity, regional and national accounting; resource allocation decisions; and the diffusion of innovations.

It has become clear that these and other processes are of general interest in the developing (and developed) world and that generalized models of them could be built and then adapted and assembled in various configurations to help analyze particular problems in particular countries. This model structure is capital stock which should be preserved for reinvestment elsewhere where required. The use of a software library of such generalized models can greatly reduce the cost of conducting agricultural sector, subsector, policy, program and project analyses by: (1) facilitating application of the computerized system simulation approach incorporating a broad range of quantitative analytical techniques--e.g., LP models, econometric models, PERT models, state space models, etc.--to the analyses (the approach was shown to be a cost-saver in comparing the KASS and CSNRD experiences); and (2) greatly reducing the likelihood of one team of workers, addressing a particular problem in a particular country, going through the process of developing models which may or could be virtually identical to models already developed or being developed by another team in another place. For such a library to be effective, its prime concerns must include complete and clear documentation of each of its models and programming the models in a language which is acceptable to a wide range of computer models and sizes.

With this rationale, the initiation of development of such a software library--CLASS, the Computer Library for Agricultural Systems Simulation--was written into the first phase of this contract, and a Simulation Library Working Conference was held in March 1973 with representatives from national and international development assistance agencies, LDC's and relevant disciplines to get some idea of the potential demand for such a library and of how best to go about organizing it. The conferees concluded, briefly, that:[1/]

1) there is clearly a need for developing analytical capacity, particularly in LDC's for policy and other decision making in development planning;
2) CLASS can contribute to the satisfaction of that need;
3) the library should be open to any analytical techniques which prove themselves useful;
4) a passive clearinghouse would not be sufficient, but rather complementary inputs, particularly expertise, need to be actively provided to successfully implement library components; and
5) such expertise is a major limiting resource and, therefore, training is a high priority, complementary activity.

With this background, the library and its scope have been defined as follows:

The Computer Library for Agricultural Systems Simulation (CLASS) is viewed as a unit which acquires, catalogs, maintains and distributes computer programs and associated documentation. These computer programs are of generalized simulation models and routines designed specifically for the analysis of agricultural development problems and processes. In particular, the library sets standards of admissibility for programs and documentation; catalogs and indexes programs and documentation so as to facilitate their retrieval by users seeking a set of programs to be used in a specific problem analysis; and distributes programs and documentation to users.

To enhance the effectiveness of the library, its functions also include identifying and soliciting needed models; actively bringing programs and documentation up to the library's standards; and providing limited consultation in identifying and implementing appropriate library programs for a

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[1/] "Summary of the Simulation Library Working Conference, March 29-30, 1973" by Michel Petit.

particular application. A subsidiary function of the library in conjunction with the identification and solicitation of models is to survey and catalog ongoing research in agricultural systems modeling and simulation.

It is essential that CLASS remain closely associated with, if not a part of, one or more organizations charged with model development, research and analysis applications, and training. In the short run these broader functions will be carried out in fulfilling MSU's obligations under its AID contract, AID/csd-2975. In the long run, however, as the library expands and acquires applications experience, it will be desirable, even necessary, that it move from MSU to, or to some association with, one or more national or international development assistance agencies.

Component Generality

In the terminology of the library, the word "component" refers to the unit maintained and distributed by the library, much as a book is the unit of a book library. CLASS stocks two kinds of components: utility routines and models of socioeconomic processes. When a set of such models and routines are linked together, they become, in systems terminology, submodels or components of a larger system model, e.g., the KASS model or the Nigerian simulation model.

Utility routines include programs of mathematical operations and algorithms which have been found to be useful in simulation models. Examples include discrete and continuous time delays, table functions, LP algorithms, gradient search techniques, PERT routines, matrix inversion routines, and the like. The general applicability of such utility routines is obvious, and no further discussion is necessary here.

Models of socioeconomic processes may be general in two dimensions. First, a model can be generalized across applications. For example, a demographic model may be applicable to human, tree, livestock or capital equipment populations; or a processing model may be suitable for the processing of cocoa, oil palm products, rubber or tabacco (as in the Nigerian simulation model). The other dimension of model generality is with respect to geographic and problem areas. For instance, a population model, a demand model or a production model may be applicable to analyses of food production problems in Tanzania, cattle industry problems in Venezuela or Colombia, or agricultural sector problems in Nigeria or Korea.

It is difficult to measure the generality or generalizability of a model. We can say with confidence that complete generality--a model which is all things to all people--is not only impossible but nonsense. We may also assert that extreme generality--less than complete--is undesirable for reasons of model development and application efficiency; likewise, extreme specificity would be inefficient from the point of view of the library's stocking and maintenance of a component with very limited demand potential. The implication is that the library must aim for a middle ground and, hence, a set of models for each process (including different levels of aggregation) so that within the set can be found a model which meets the requirements of a given application. Of particular relevance for the kinds of models to be included in CLASS is the fact that, as models become larger and more problem-oriented they of necessity lose generality. Thus, there will be trade offs to consider.

Component Standards

For CLASS to be of service to, and thereby attract, users, library components must maintain standards in three areas. First components must: 1) meet the test of generality as discussed above; 2) be theoretically and empirically valid, realizing, of course, the limitations of the body of social and economic theory upon which the models must be based; and 3) be mathematically sound, i.e., as to the use of techniques, algorithms and logic.

Perhaps the most crucial aspect of a component from the point of view of user access is its documentation. It is primarily through the documentation that the scope, assumptions, limitations and applications of a component will be communicated to the users. Therefore, strict documentation standards are maintained which specify topics to be discussed (e.g., rationale for the model, mathematical description, sample run) and call for readibility, thoroughness, and the citation of relevant references. Included also is documentation of the component's computer program to enable a programmer to implement it at the local installation.

Finally, the computer program itself is expected to meet a set of standards. A basic requirement is that programs be in the FORTRAN language so that they may be compatible with as wide a range of FORTRAN compilers as possible on a variety of computers around the world. In addition, recognizing the role of the program itself as a vehicle of communication with the user, clarity and readability are also important criteria. Computational efficiency is also a factor, particularly if library components are to be implemented on small computers, and this then means that trade offs must be made with the compatibility and readability considerations.

Simulation Language

To facilitate user access to models constructed from library components, CLASS is developing a FORTRAN-based simulation language. The language is conversational and interactive and allows the policy analyst to sit down at a computer terminal and enter parameter values to "tell" the model what he wants to do with it and how he wants output displayed--without the need of programming skills. For example, he can specify whether he wants to perform a policy experiment or sensitivity tests; if a policy experiment, what policy combinations and levels (e.g., budget levels, tax rates, etc.); what endogenous variables to display at what intervals and in what format (e.g., graphs, histograms, tables, etc.); and the time period to simulate and whether he wants to interact and possibly change policies in the course of simulation or to see results only at the end.

A second phase of the simulation language development will focus on facilitating the job of the model builder/programmer in linking up library components into the particular configuration desired as a model for the specific application at hand.

Field and Training Links

Aside from actual use of the library and its services, there are important two-way links between the CLASS activity and the field applications (i.e., Korea) and training program activities of the total agricultural simulation project.

The field and training activities feed into CLASS by:

1) identifying needed components as a result of field experience and training requirements;
2) testing library components in actual field and training applications;
3) building models which could be generalized and otherwise adapted to serve as CLASS components;
4) testing, and thereby demonstrating the strengths and weaknesses of, the simulation language under actual field and training conditions; and
5) identifying useful output formats and testing output-generating routines in field and training applications.

Likewise CLASS services the field applications and training program by:

1) supplying components to serve a teaching and training function;
2) supplying the field with models and routines either not yet in place or in need of replacement;
3) providing and maintaining the simulation language system to facilitate non-programmer interaction with the models;
4) providing and maintaining output-generating routines; and
5) making the KASS and other field experiences (models, etc.) readily available to other agricultural development researchers, analysts, advisors and consultants in the field. This last contribution relates particularly to the Simulation Library Working Conference's viewing CLASS as a means of conserving, utilizing and disseminating the capital (i.e., models and expertise) created under AID/csd-1557 and the first phase of this contract.

CLASS Advisory Boards

In view of the fact that the library's objective is to provide a service--and a rather unique and novel one at that for the agricultural development field--it is considered essential that potential users and other experienced professionals have an input into its development and operationalization. Formally, this input will be channeled through technical and policy advisory boards whose functions, in general, will be to review, evaluate, advise and recommend.

The specific charge given the Policy Advisory Board (the Technical Advisory Board will be defined at a later date once the Policy Advisory Board has specified its parameters) will be to:

1) Evaluate the quality and coverage of library components, and recommend where existing components should be revised and where further modeling is needed. Coverage here refers both to the modeling of subject matter areas (i.e., socioeconomic processes) and to the incorporation of various analytical techniques, e.g., cost-benefit analysis models, PERT models, optimizing models (linear programming or otherwise), linear-in-the-parameters simultaneous equations systems, stochastic process models, input-output models, etc.

2) Review and evaluate the library's scope and operations as to the level of usage and effectiveness of its components and services, and recommend modifications of services and operating procedures as necessary for improvement.

3) Recommend and evaluate alternative means of disseminating information to users and potential users of CLASS components and services

4) Based on the performance of CLASS during the period of this contract, consider and advise on the library's ultimate geographic and institutional location and means of financial support.

The Ultimate CLASS

The last function of the Policy Advisory Board discussed above arose out of discussions at the Simulation Library Working Conference concerning the ultimate nature of such a library. It was generally recognized that it would be neither appropriate nor efficient for an operation such as CLASS, once it has been established and has become a regular "business," so to speak, to be located at any university. Rather, its proper place will be within a national or, preferably, international agency charged with performing--and developing indigenous capacity to perform--the analysis necessary for development planning and policy making.

CLASS Activities During Report Period

The Computer Library for Agricultural Systems Simulation (CLASS) progressed on four fronts during the reporting period: organizational design, component development, language development and policy advisory board.

On organizational design, refer to a paper by Dennis Pervis[1/] outlining a functional and administrative organization for CLASS and procedures

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1/ "Functions, Procedures and Organization of CLASS," April 8, 1974, by Dennis Pervis.

for component acquisition and development. In addition, the CLASS Standards Manual defines standards for components, for documentations and for computer programs.

Component development concentrated initially on utility routines for two reasons. First, such routines are often necessary components of other models and, secondly, they served as prototypes to test, evaluate and revise the library standards and procedures. Six distributed delay routines and four table look-up routines were defined and are now in the final stages of review and documentation. In addition, a routine for commodity and regional accounting was defined and is in the programming and testing stage.

Development of process models began with two demographic models which, given age-sex-specific birth, death and migration rates, simulate the cohort survival process. One model has fixed age cohorts, and the other has distributed delay age cohorts. These models are in the review stage of development. Table 1 indicates the stage of development of library materials in process. Effort is concentrating toward the "critical mass" recommended by the Policy Advisory Board.

Design and implementation of the simulation analysis language was initiated and has progressed well. A preliminary design was implemented for demonstration purposes at the CLASS Policy Advisory Board meeting in May 1974 (see below). Based on that experience, the design has been improved and expanded to offer the user greater flexibility and ease of use. Implementation is currently underway. A brief description of the language's objectives is found in Tom Manetsch's working paper on the subject.[1/] A statement of language requirements follows.

Two general requirements on the language system are that it: (1) be completely compatible at least with the FORTRAN compilers most commonly

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[1/] T. J. Manetsch, "A Simulation Language to Facilitate the Development and Use of Simulation Models in Policy, Program, and Project Analysis--Preliminary Outline," Project Working Paper 73-1, 1973.

TABLE 1

Library Routines and Componerts in Process as of June 30, 1974

Component Name	Initiated	Developed	Programmed	Documentation Written	Component Reviewed	Component Revised	Admitted to CLASS
DEL	X	X	X	X	X		
DELS	X	X	X	X	X		
DELF	X	X	X	X	X		
DELLF	X	X	X	X	X		
DELVF	X	X	X	X	X		
DELLVF	X	X	X	X	X		
TABELS	X	X	X	X	X		
TABEXS	X	X	X	X	X		
TABULS	X	X	X	X	X		
TABUXS	X	X	X	X	X		
DEMOGC	X	X	X	X	X		
DEMOGD	X	X	X	X	X		
AGACC	X	X	X				
Mini Production Component	X	X					
Maxi Production Component	X						
Price-Quantity Adjustment Component	X	X					
Grain Management Component	X	X					
External Trade Component	X	X					

DEL - Distributed Delay

DELS - Distributed Delay with Storage

DELF - Distributed Delay with Finer Time Increment

DELLF - Distributed Delay with Storage Losses

DELVF - Distributed Delay with Variable Delay Time

DELLVF - Distributed Delay with Storage Losses and Variable Delay Time

TABELS - Table Function with Equal Intervals, Limited Extrapolation and Single Curve

TABEXS - Table Function with Equal Intervals, Extrapolation, and Single Curve

TABULS - Table Function with Unequal Intervals, Limited Extrapolation and Single Curve

TABUXS - Table Function with Unequal Intervals, Extrapolation and Single Curve

DEMOGC - Demography with Distributed Age Cohorts

DEMOGD - Demography with Discrete Age Cohorts

AGACC - Agricultural Accounting

used on CDC 6000 series computers and IBM 360/370 series computers, and with as many additional compilers as practicable; and (2) be scalable to handle various kinds and sizes of problems, e.g., only that part of the system need be loaded which is necessary to execute the particular task at hand at any given moment.

More specifically, based on an initial conceptualization of the simulation language system (Figure 6), top priority is given to development of the FORTRAN-based system executive and the user interpreter, the latter being the software which translates the user-oriented component of the simulation language into FORTRAN. This is not to diminish the importance of the designer interpreter (which translates the designer-oriented component of the system into FORTRAN), particularly the automatic linking of components, but it does recognize the project's preeminent user orientation.

Included in the user-oriented component will be provisions for interactive or batch

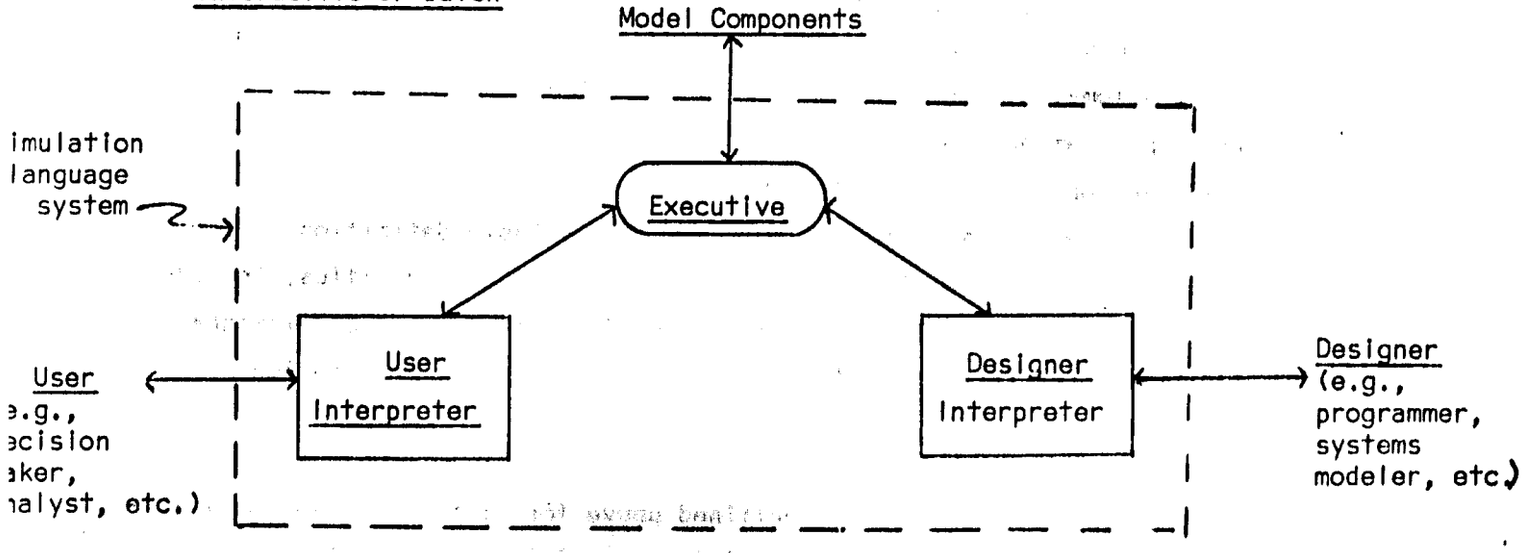

Figure 6.

Simulation Language System

(i) job parameter specification,

(ii) sensitivity testing of any model parameter,

iii) policy experimentation,

(iv) time series tracking (automatic or manual),

(v) optimization mode operation (for either policy experimentation, response surface estimation or parameter estimation),

(vi) Monte Carlo mode analysis, and

(vii) response surface estimation.

Important supportive features here will include alternative output modes and formats capable of accessing, storing and/or printing any specified model variable or set of variables; appropriate error diagnostics; and the ability to specify alternative model initial conditions for various times zero.

As the user interpreter becomes operational, development of the designer interpreter will get under way. The latter will include:

(i) automatic model building, i.e., component interconnections, including linkages of component input and output variables and execution time sequencing,

(ii) automatic overlaying as may be specified,

(iii) program editing,

(iv) appropriate error diagnostics,

(v) program documenting of equations and variable definitions.

Further down the line may be higher level programming capabilities, including modeling directly with block diagrams and/or differential and integral equations, the option of specifying alternative numerical integration methods, etc.

The language specifications outlined above for either the user or the designer are of course subject to revisions, additions or deletions as indicated by experience in the course of language development and, indeed, with the project's activities in general.

The Policy Advisory Board was constituted and held its first meeting in East Lansing on 6-7 May 1974. Official minutes and recommendations of

that meeting are found in Appendix E. While the Board's role is advisory only, the ideas, criticisms encouragement and guidelines offered by its members are of immense value to the project team in development of CLASS toward a working system which can ultimately be transferred to an action agency. Board members are: Art Coutu (Chairman), Derek Byerlee, Doug Caton, Lee Fletcher, Al Halter, George Judge, Henri Quaix, Leroy Quance, and Stephan Tangermann.

Continued work on CLASS will focus as indicated below:

1. Component development will proceed to add to the library a) a simplified production component, b) a generalized LP-simulation interface package, c) an input-output macroeconomic model linking agricultural and nonagricultural sectors, d) an urban demand/simultaneous equations annual price adjustment model, and e) an output display package.

2. Initial implementation of the simulation analysis language will be completed. The language system will be tested and demonstrated at the International conference (see below). The system will be evaluated and revised based on this experience.

3. A Policy Advisory Board meeting will be held in February 1975. Another will possibly be held in fall 1975 in conjunction with the International conference.

4. An International conference will be held per Advisory Board recommendation (see Appendix E) in 1975 to introduce the international professional community to CLASS services.

5. CLASS standards and procedures will be continually reevaluated and revised as indicated by experiences.

6. The library will respond to requests for its services within the limits of its resources.

VIII. DISSEMINATION OF RESULTS

Project activities during the report period included attendance of project personnel at conferences and seminars and publications as listed below.

Conferences and Seminars

1. Glenn Johnson, Tom Manetsch and Ed Rossmiller participated in two Workshops on Agricultural Systems Analysis in Seoul, Korea in July and August 1973.

2. Ed Rossmiller presented a seminar at the Food Institute, East-West Center, Honolulu, Hawaii on "The Korean Agricultural Sector Simulation Project--a Two Year Perspective" in August 1973.

3. Mike Abkin, Glenn Johnson, Tom Manetsch and Ed Rossmiller attended a Simulation Seminar at AID/Washington on 9 July 1973.

4. Ed Rossmiller consulted with AID officials at a meeting in Chicago on alternative methods of financing and administering AID contracts in the future on 11-12 September 1973.

5. Ed Rossmiller presented a seminar in the Department of Agricultural Economics, Michigan State University on "The Korean Project: Reflections of a Team Member" in November 1973.

6. Tom Manetsch and Ed Rossmiller met with AID, IBRD, and USDA personnel in Washington, D. C. to discuss the training program on 8-9 November 1973.

7. Tom Manetsch consulted with AID officials in Washington, D. C. with respect to AID administration of agricultural sector research on 28-30 November 1973.

8. Mike Abkin and Dennis Pervis traveled to Athens, Georgia to consult with Margaret Park and visit the COSMIC Computer Center Library at the University of Georgia on 9-10 January 1974.

9. Glenn Johnson traveled to Bellagio, Italy on a Rockefeller Foundation residency to draft a book on agricultural change in February 1974. This was partially in the furtherance of objectives of AID/csd-2975.

10. Glenn Johnson attended a Ford Foundation conference in Nairobi, Kenya to make available analytical techniques developed under AID/csd-2975 on 23-28 February 1974.

11. Mike Abkin, Tom Carroll, Glenn Johnson, Dong Min Kim, Ho Tak Kim, Tom Manetsch and Ed Rossmiller attended an evaluation conference on Contract AID/csd-2975 and confer with AID personnel and project evaluators on 27-29 March 1974.

12. Ed Rossmiller presented a seminar at the Society for International Development luncheon, Michigan State University, on "Agricultural Sector Analysis: The Korean Case" on 5 April 1974.

13. Mike Abkin attended the Symposium on Global Modeling sponsored by the International Institute for Applied Systems Analysis (IIASA) in Baden, Austria in May 1974. The subject of the Symposium was the Mesarovic-Pestel multiregional world model. Dr. Abkin also held discussions with IIASA Director Howard Raiffa on the possibilities of MSU-IIASA collaborative research.

14. Mike Abkin followed up on the IIASA meeting by attending as an observer a meeting of the National Academy of Sciences Advisory Committee on IIASA in June 1974. The committee is advisory to Harrison Brown, USA representative on IIASA's governing council. Again, the potential for MSU-IIASA collaboration was investigated.

15. Glenn Johnson attended a MUCIA planning meeting in Chicago on sessions design workshops on international aspects of international development on 18 June 1974.

Miscellaneous Reports and Working Papers

Abkin, Michael H., and Manetsch, Thomas J. "Simulation Approach to Development Planning with Nigerian and Korean Applications." East Lansing: Michigan State University, March 1974. (Paper submitted for publication in Automatica.)

de Haen, Hartwig. "Suggestions and Conclusions from a Two Week Stay with the KASS Team, Seoul, Korea." Consulting Report. Seoul, Korea: Korean Agricultural Sector Simulation Project. 22 March 1974.

Gibson, F. J. "A Status Report on the Grain Management Simulation." KASS Working Paper 73-4. Seoul, Korea: Korean Agricultural Sector Simulation Project. July 1973.

Gibson, Forrest and Kim, Sang Gee. "Food Grain Management Program in Korea." Agricultural Economy. Ministry of Agriculture and Fisheries. May 1974. (In Korean)

Kim, Dong Hi and Kim, Sang Gee. "Background Report on Korean Agricultural Sector Study (KASS), 1971.9-1974.1." Korea: National Agricultural Economics Research Institute. January 1974. (In Korean)

Manetsch, Thomas J. "Simulation of Aggregate Loan Repayment Policies Using the Variable Distributed Time Delay." Project Working Paper 74-1. East Lansing: Michigan State University. March 1974.

_____. "Equations for an Urban Consumption Component with Consumer Storage for the Korean Grain Management Model." Project Working Paper 74-2. East Lansing: Michigan State University. 1974.

_____. "Some General Principles of System Modelling." Training Program Paper. East Lansing: Michigan State University. 1974.

_____. "Toward a Learning Cybernetic Model of Farm Production, Consumption, Investment, and Dis-Investment Activities." Training Program Paper. East Lansing: Michigan State University. 1974.

_____. "Use of the VDEL Subroutine to Simulate Project Implementation in Economic Development." Training Program Paper. East Lansing: Michigan State University. 1974.

_____. "Consulting Report on Grain Management Model and Systems Science Training Based on a Field Trip to Seoul, Korea. 16-29 June 1974." Consulting Report. Seoul, Korea: Korean Agricultural Sector Simulation Project. June 1974.

Mehrens, William A. and Downing, Stephen M. "Candidate Selection Procedures: Multi-National Program of Study in Systems Analysis for Developmental Planning." Training Program Paper. East Lansing: Michigan State University. 16 April 1974.

Teigen, L. D. "Report on the Modifications of the KASS Model for International Trade Analysis." KASS Issue Paper 5. Seoul, Korea: Korean Agricultural Sector Simulation Project. 26 November 1973.

_____. "Thoughts on International Prices as Limits to Domestic Price Variation." KASS Issue Paper 6. Seoul, Korea: Korean Agricultural Sector Simulation Project. 7 December 1973.

_____. "A Model for Private Storage Behavior under Completion and Monopoly with an Application to Korean Rice Storage." KASS Working Paper 73-5. Seoul, Korea: Korean Agricultural Sector Simulation Project. December 1973.

_____. "Price Targets and Import Levels on Korean Rice." KASS Issue Paper 7. Seoul, Korea: Korean Agricultural Sector Simulation Project. 15 January 1974.

_____. "The Annual Price Determination Mechanism." KASS Working Paper 74-2. Seoul, Korea: Korean Agricultural Sector Simulation Project. June 1974.

Teigen, L. D. and Suh, H. H. "An Aggregated Input Output Model for Korea Emphasizing Agriculture." KASS Working Paper 74-1. Seoul, Korea: Korean Agricultural Sector Simulation Project. March 1974.

Winer, Claudia and Wolf, Chris. "PAL Syntax." East Lansing: Michigan State University. 6 August 1974.

Wolf, Chris, Manetsch, Thomas J., and Winer, Claudia. "A FORTRAN Executive Program for Continuous Flow Simulation Models--SIMEX1." Training Program Paper. East Lansing: Michigan State University. 1974.

Journal Publications

Abkin, M. H., et al. "System Simulation of Agricultural Development: Some Nigerian Policy Comparisons." American Journal of Agricultural Economics, Vol. 55, No. 3, August 1973.

Ph.D. Dissertations

Kim, Seyeul. "The Economic and Social Determinants of Rural-Urban Migration in Korea: A Case Study of North Cholla Province." Unpublished Ph.D. Dissertation, Department of Agricultural and Resource Economics, University of Hawaii, 1973.

Park, Kang-Sik. "Rural Urban Labor Migration, Farm Structure, Factor Productivity, and Farm Income in Korean Agriculture." Unpublished Ph.D. Dissertation, Department of Agricultural and Resource Economics, University of Hawaii, December 1973.

Posada, Alvaro. "A Simulation Analysis of Policies for the Northern Colombia Beef Cattle Industry." Unpublished Ph.D. Dissertation, Department of Agricultural Economics, Michigan State University, 1974.

KASS Publications Translated Into Korean

Ferris, J. N., Libby, L. W., Seol, I. J., Suh, H. H., and Rossmiller, G. E. "Storage and Movement of Farm Commodities with Emphasis on Storage Requirements" and "Demands on Transportation Facilities and Benefits from Road Improvements," Chapters 10 and 11 from Investment Priorities in the Korean Agricultural Sector, written by the Korean Agricultural Sector Study Team, 1972 (translated into Korean in 1974).

Haley, William J. and Kim, Young Sik. "Land and Water Resource Development." Part II from Investment Priorities in the Korean Agricultural Sector, written by the Korean Agricultural Sector Study Team, 1972 (translated into Korean in 1974).

Papers Presented at Conferences, Seminars, and Meetings

Abkin, Michael H. "Infrastructure to Support Systems Modeling as a Continuous and Transferable Process: The Computer Library for Agricultural Systems Simulation." Paper presented at the Airlie Evaluation Conference 27-28 March 1974.

"An Optimization Component for Large Scale Simulation Models." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. April 1974.

"CLASS Standards Manual, Computer Library for Agricultural Systems Simulation." East Lansing: Michigan State University. 4 April 1974.

de Haen, H. "Projections of Resource Allocation and Production in Korean Agriculture with a Microeconomic Model--A Component of the Korean Agricultural Sector Model." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

Johnson, G. L. "Systems Simulation and Its Application in the KASS Approach." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

_____. "General, Systems, Simulation Models for Sector Analysis." Paper presented at the Airlie Evaluation Conference 27-28 March 1974.

Manetsch, T. J. "Economic Analysis for Agricultural Sector Planning: System Simulation Concepts." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

_____. "An Introduction to the Systems Approach as a Problem Solving Methodology." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

_____. "Basic Systems Theory and Concepts Underlying Construction of the Korean Simulation Model with Implications for Further Work." Paper presented at the Airlie Evaluation Conference 27-28 March 1974.

_____. "A Proposed Development Analysis Study Program." Paper presented at Airlie Evaluation Conference 27-28 March 1974.

Pervis, Dennis W. "An Analysis of the Proposed Agricultural Accounting Component for CLASS." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. 29 April 1974.

_____. "Functions, Procedures, and Organization of CLASS." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. 8 April 1974.

Rahimi, Morteza. "Preliminary Reference Manual Policy Analysis Language PAL." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. May 1974.

"Requirements for the Development of a Simulation Language System." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. 16 July 1973.

Rossmiller, G. E. "Role of Economic Analysis in the Planning and Policy Formulation Process." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

_____. "Utilizing a Systems Model for Policy Analysis." Paper presented at the Airlie Evaluation Conference 27-28 March 1974.

Rossmiller, G. E. and Kim, D. H. "KASS Development Issues." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

_____. "Research Needs for Planning and Policy." Paper presented at Workshop on Agricultural Systems Analysis, Seoul, 30 July - 9 August 1973.

Watt, David and Winer, Claudia. "Using the Software Library: An Example from Michigan Agriculture." Paper prepared for the CLASS Policy Advisory Board Meeting, 6-7 May 1974. East Lansing: Michigan State University. May 1974.

IX. EXPENDITURES AND CONTRACTOR RESOURCES AND WORK PLAN

Personnel

The following individuals were employed during the period 1 July 1973 through 30 June 1974 to carry out the terms of the Contract:

1. Dr. George E. Rossmiller
   Project Director
   Post: U. S. and Seoul, Korea
2. Dr. Tom W Carroll
   Field Project Leader
   Post: Seoul, Korea
3. Dr. Michael H. Abkin
   Regular Staff Member
   Post: U. S.
4. Mr. Bo Andersson
   Graduate Student
   Post: U. S.
5. Mr. Alan Baquet
   Graduate Student
   Post: U. S.
6. Mrs. Herta Bauersachs
   Short-Term Staff Member
   Post: Seoul, Korea
7. Dr. Freidrich Bauersachs
   Short-Term Staff Member
   Post: Seoul, Korea
8. Mr. Marcus Buchner
   Graduate Student
   Post: U. S.
9. Mrs. Kay Cooper
   Secretary
   Post: Seoul, Korea
10. Ms. Patricia H. Cooper
    Secretary
    Post: Seoul, Korea
11. Dr. Hartwig de Haen
    Short-term Staff Member
    Consultant
    Post: U. S. and Seoul, Korea
12. Mr. Steven Downing
    Graduate Student
    Post: U. S.
13. Mr. Forrest Gibson
    Regular Staff Member
    Post: Seoul, Korea
14. Mr. Thomas Hamby
    Graduate Student
    Post: U. S.
15. Mr. Frank Huybrechts
    Graduate Student
    Post: U. S.
16. Mr. Gary Ingvaldson
    Regular Staff Member
    Post: Seoul, Korea
17. Dr. Glenn L. Johnson
    Regular Staff Member
    Post: U. S.
18. Mr. Chung Ho Kim
    Graduate Student
    Post: U. S.
19. Dr. Ho Tak Kim
    Post Doctoral Appointee
    Post: U. S.
20. Mr. Seong Woo Lee
    Graduate Student
    Post: U. S.
21. Dr. Thomas J. Manetsch
    Regular Staff Member
    Post: U. S. and Seoul, Korea
22. Dr. William Mehrens
    Short-Term Staff Member
    Post: U. S.

23. Mr. Keith Olson
Regular Staff Member
Post: Seoul, Korea

24. Miss Judy Pardee
Secretary
Post: U. S.

25. Mr. Dennis Pervis
Regular Staff Member
Post: U. S.

26. Mr. Alvaro Posada
Short-Term Staff Member
Post: U. S.

27. Mr. Bert M. Pulaski
Short-Term Staff Member
Administrative Assistant
Post: U. S.

28. Dr. Morteza Rahimi
Short-Term Staff Member
Post: U. S.

29. Dr. Lloyd Teigen
Regular Staff Member
Post: Seoul, Korea

30. Ms. Claudia Winer
Regular Staff Member
Post: U. S.

31. Mr. Christopher Wolf
Regular Staff Member
Post: U. S.

32. Mr. Carl Wright
Student Labor
Post: U. S.

The personnel listed below, although not employed or paid under the terms of the Contract, contributed significantly to the Contract objectives.

1. Douglas Caton
Agency for International Development
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

2. Apostolos Condos
Food and Agriculture Organization
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

3. Arthur Coutu
North Carolina State University
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

4. Albert N. Halter
Oregon State University
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

5. Dong Min Kim
Development Analysis Training Program
Michigan State University
(KASS Division Chief, NAERI)

6. Jeung Han Lee
Graduate Student
Michigan State University

7. Stan Miller
Oregon State University
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

8. Margaret Park
COSMIC
University of Georgia

9. Leroy Quance
ERS, USDA
Policy Advisory Board
Computer Library for Agricultural Systems Simulation

10. Stefan Tangermann
University of Göttingen
Policy Advisory Board
Computer Library for Agricultural
Systems Simulation

11. David Watt
Graduate Student
Michigan State University

The following personnel from the National Agricultural Economics Research Institute have been associated with the KASS Project in Korea during the past year.

1. Dong Hi Kim
Director
2. Bong Koo Kim
Research Consultant
3. Soon Pyo Chyun, Chief
Agricultural Sector Division
4. Sang Gee Kim
Staff Agricultural Economist
5. Chang Bok An
Staff Agricultural Economist
6. Sun Jeung Lee
Staff Agricultural Economist
7. Han Hyeck Suh
Staff Agricultural Economist
8. Chul Ho Kim
Assistant Agricultural Economist
9. Sang Won Lee
Assistant Agricultural Economist
10. Kong Nam Hyun
Assistant Agricultural Economist
11. Bu Kwan Lee
Computer Programmer
12. Hyo Bok Lee
Assistant Computer Programmer
13. Young Suk Kim
Assistant Researcher
14. Kyong Sook Park
Assistant Researcher
15. Young Sa We
Research Assistant
16. Young Sub Kim
Research Assistant
17. Kyong Soo Kim
Secretary

The following individuals are presently working with the Korean Agricultural Planning Project:

1. Dr. George E. Rossmiller
   Director
   Post: U. S. and Seoul, Korea
2. Dr. Hahm, Man Jun
   Contract Officer
   Post: Seoul, Korea
3. Miss Jeong Suk Cho
   Secretary
   Post: U. S.
4. Dr. David Culver
   Short Term Consultant
   Post: Seoul, Korea
5. Dr. Richard Duvick
   Program and Project
   Evaluation Analyst
   Post: Seoul, Korea
6. Mr. Byung Suk Lee
   Administrative Officer
   Post: Seoul, Korea
7. Dr. Fred Mangum
   Policy Analyst
   Post: Seoul, Korea
8. Ms. Edith Nosow
   Secretary
   Post: U. S.
9. Mr. Bert Pulaski
   Administrative Officer
   Post: U. S. and Seoul, Korea
10. Dr. Karl Wright
    Short Term Consultant
    Post: Seoul, Korea

Budget

The provisions of Amendment 8 to Contract AID/csd-2975 has provided funding for the continuance of the project period to 31 July 1975. This budget currently is scheduled to support a modified full campus and Korean component staff until 31 December 1974 followed by a limited Korean component only to be extended to 31 July 1975. A proposal is being submitted for further extension and funding of the project to: (1) further refine and develop the Korean model, (2) enhance and complete the Software Library as to its use and placement in either an international or privately funded institution, (3) provide support for the training program component, and (4) to provide consultant services and software for use in other countries.

Budget Schedule

Line Item	Actual Expenditures Fm 7/1/71 To 3/31/74	Firm Budget Fm 4/1/74 To 7/31/75	Total Budget Fm 7/1/71 To 7/31/75
Salaries	334,619	202,366	537,985
Consultants	5,865	4,000	9,865
Fringe Benefits	38,696	29,842	68,538
Overhead	171,138	93,946	265,084
Travel	31,535	50,028	81,563
Equipment	750	--	750
Other Direct Costs	50,436	38,360	88,796
Allowances	10,430	--	10,430
Subcontract	6,877	3,400	10,277
TOTAL	$650,346	$421,942	$1,073,288

The last Annual Report covers the activities related to expenditures for period 7/1/71 to 6/30/73. Other sections of the present report describe the activities performed during this reporting period. Under the present terms of the Contract as currently stated, the next annual reporting period would be the final one; however, there is currently a proposal in AID/W

Recapitulation of Actual/Estimated Expenditures
to 30 June 1974

Line Item	Fm 7/1/71 To 6/30/72	Fm 7/1/72 To 6/30/73	Fm 7/1/73 To 6/30/74	Total Expenditures 6/30/74
Salaries	61,154	144,312	189,482	394,948
Consultants	1,700	1,365	200	3,265
Fringe Benefits	5,024	15,446	21,727	42,197
Overhead	32,442	71,291	84,129	187,862
Travel/Transportation	11,859	10,525	21,616	44,000
Equipment	478	272	--	750
Other Direct Costs	12,617	19,533	29,985	62,135
Allowances	--	7,677	2,395	10,072
Subcontract	--	5,382	1,495	6,877
TOTAL	$125,274	$275,803	$351,029	$752,106

for a continuation of the project. The Contract at this time is planning and continuing on to meet the objectives of the Contract as stated in the Plan of Work.

Budget Forecast and Summary

The following projected expenditures and budget for the remainder of the Contract are minimum of what is needed to carry out the terms of the Contract.

Budget Expenditures and Forecast

Line Items	Actual/Estimated Expenditures Fm 7/1/71 To 6/30/74	Actual/Estimated Expenditures Fm 7/1/74 To 7/31/75	Projected Expenditures Fm 7/1/71 To 7/31/75
Salaries	394,948	143,037	537,985
Consultants	3,265	6,600	9,865
Fringe Benefits	42,197	26,341	68,538
Overhead	187,862	77,222	265,084
Travel/Transportation	44,000	37,563	81,563
Equipment	750	--	750
Other Direct Costs	62,135	26,661	88,796
Allowances	10,072	358	10,430
Subcontract	6,877	3,400	10,277
TOTAL	$752,106	$321,182	$1,073,288

The following approved budget summarizes the budget according to Amendment 8 to the Contract.

Approved Budget*

Line Items	Actual/Estimated Expenditures Fm 7/1/71 To 3/31/74	Firm Budget Fm 4/1/74 To 9/30/74	Firm Budget Fm 10/1/74 To 7/31/75	Total Fm 7/1/71 To 7/31/75
Salaries	334,619	132,737	70,629	537,985
Consultants	5,865	2,500	1,500	9,865
Fringe Benefits	38,696	19,248	10,494	68,538
Overhead	171,138	69,831	24,115	265,084
Travel/Transportation	31,535	35,035	14,993	81,563
Equipment	750	--	--	750
Other Direct Costs	50,436	20,680	17,680	88,796
Allowances	10,430	--	--	10,430
Subcontract	6,877	3,400	--	10,277
TOTAL	$650,346	$283,431	$139,511	$1,073,288

*According to Amendment 8 to the Contract.

Administrative Relations With USAID/Korea and AID/Washington

USAID/Korea

The Mission has continued to meet its contractual obligations to the Michigan State University project. The cooperation of the Rural Development Division and the General Services Office, AID/Seoul in providing support and advice in time of need is acknowledged with many thanks. Particular recognition should go to Francis C. Jones and Michael H. B. Adler for their interest and support.

AID/Washington

Contracting Office

The cooperation of Miss Virginia Perelli, Contracting Officer and Mr. Philip Casteel of that office is appreciated. Their advice and full attention given to our many contractual requests and the professional manner in which the contract negotiations, over the past years (extensions, new budgets, etc.) were handled and carried out is certainly a credit to that office.

TAB Office

TAB personnel have taken a keen interest in the project over the reporting period as evidenced by the relatively high proportion of their time devoted to evaluation and contractual discussions. In particular the support of Douglas Caton until his transfer from the Agency is gratefully acknowledged. Lee Fletcher has given freely of his time and energies in carrying out the contractual obligations of his office.

Work Plan for the Period 1 July 1974 - 31 July 1975

The AID evaluation of the project in early 1974 made it impossible to place previously developed proposals for extending AID/csd-2975 before AID/W and its Research Advisory Committee prior to the fall meeting in 1974. Consequently the project has been twice extended by Amendments 7 and 8. Amendment 7 amended the Scope of Work and provided funding through 30 September while Amendment 8 further amended the Scope of Work. In addition, Amendment 8 provided salaries for four workers in Korea for 12 months each in the period 1 July 1974 - 31 July 1975. Amendment 8 presumed that an effort would be made to extend the project on a longer term basis and that such an extension would provide a modified plan of work for the four workers in Korea starting 1 January 1975. That proposal for extension of the Contract to 30 June 1976 is presently in process. Following is the work plan provided for in Amendment 7 and 8 to the Contract:

1. Finalize preparation of the livestock subsector component of the overall agricultural sector model.
2. Formulate an auxiliary model on grain storage and management.
3. Finalize a library procedure to identify, catalog, and record computer software on systems simulation.
4. Prepare technical papers on:
   a. investment-disinvestment theory
   b. use of PERT in project analysis
   c. modeling of rural-urban migration
5. Prepare a substantive proposal on utilization of the experience and advancement in technique in Korea to other LDC's.
6. A 15-sector input-output component with dynamic feedback will be linked to the Korean Agricultural Sector Study (KASS) model. This model will be capable of tracing the agricultural sector income investment and consumption activity and migration behavior in the nonagricultural sector as well as nonagricultural economic activity impact on the agricultural sector and will provide the basis for development of the expanded input-output component.

7. The migration portion of the population component will be linked to the rest of the KASS model and the input-output interface between agricultural/nonagricultural sectors. Base policy runs incorporating these linkages and projecting the consequences of alternative population control and agricultural income and price policy alternatives will be assessed during this period.
8. An operational version of the yield determination component will be completed. This yield determination component will be linked with the KASS model and runs selected jointly with the Korean Agricultural Planning Project (KAPP) workers and Korean decision makers will be made.
9. Work on the grain management component and policy analysis of alternatives will be accomplished in conjunction with the Ministry of Agriculture and Fisheries.
10. Contractor personnel in Korea will:
    a. be responsive to KAPP and Korean decision maker needs for modeling and programming assistance
    b. in the event that a contract extension is not negotiated, prepare for a 31 July 1975 departure with:
        (1) special training and seminars to ease the dislocations which would be caused by their departure
        (2) special documentation work to help insure the continued use of the KASS model
        (3) develop alternative ways of providing assistance in:
            (a) model development
            (b) training
            (c) documentation and library work

APPENDIX A

Introduction to the General System Simulation Approach

This appendix is an introduction to the general system simulation approach. It discusses (1) the distinction between the "systems approach" and "simulation techniques," (2) the relation between the system simulation approach and other analytical techniques, and (3) the application of the approach at non-sector level applications.

First is the distinction between "systems approach" and "simulation techniques." The concept of the systems approach adhered to by the project is described by T. J. Manetsch and G. L. Park in their forthcoming book Systems Analysis and Simulation with Applications to Social and Economic Systems.

In that book, they define the "systems approach" as a problem-solving methodology which begins with a tentatively identified set of needs and has as its result an operating system for efficiently attaining a set of "goods" and avoiding a set of "bads" within the constraints of a system.

> There are two prominent attributes of this approach: 1) it overtly seeks to include all factors which are important in arriving at a ... solution to the given problem and 2) it makes use of quantitative models to assist in making rational decisions at many levels where it is appropriate to use such tools.

To elaborate, we consider the following mathematical statement:

'Systems Approach' > $\sum_{i=1}^{N} x_i$

(read ' includes but is greater than')

x_1 = A methodology for planning/management

x_2 = A multidisciplinary team

x_3 = Organization

x_4 = Mathematical modeling techniques
x_5 = Disciplined non-quantitative thinking
x_6 = Simulation techniques
x_7 = Optimization techniques
x_8 = Application of computers

We see from this statement that we have a number of factors that make up systems analysis but do not completely define it. One of these important factors is a systems planning and management methodology. This is a process that begins with the definition of the needs in the particular situation, moves on to explicit problem definition, synthesis of alternative solution approaches, examination of the feasibility of these alternatives, approach selection, design and optimization of the selected approach, and ends with an operating system which has been implemented in the real world ....

In order to implement the systems approach we usually need a multidisciplinary team which can bring together the many disciplines and talents needed to carry out these diverse functions. We also need organization theory, and organizations to effectively allocate these human and physical resources to the tasks at hand in all phases of activity from planning through operation of the real system.

The fourth factor in the inequality above is the concept of modeling. Much time is devoted to modeling in many systems and technical courses. Our concept of modeling is the construction of an abstract model as representation of 'the real thing'. 'The real thing' here is the real situation or problem that is being studied, and the model is a useful representation of that situation that can be dealt with intellectually and reasonably in terms of mathematics or computer programming .... While mathematical models are gaining in importance as means of studying systems and making decisions that relate to the 'real thing', they can never replace sound non-quantitative thinking using the 'mental models' that come with experience in dealing with reality.

> The sixth factor in our discussion of the systems approach is the concept of simulation. Simulation usually means that we have a computer program or other functioning model of the system on which we can try different design and management strategies ....
>
> Optimization is where we desire to maximize or minimize some criterion of performance of the system while satisfying other constraints due to physical or social environments. Readers who have been exposed to (economics, our insert) linear or nonlinear programming or to optimal control problems have encountered the concept of optimization before. An example of an optimization problem might involve the assignment of transportation links in a system that transfers goods between several factories, several warehouses, and the ultimate consumers. The goal might be to provide the transportation of goods at minimum cost while satisfying constraints on delivery time and other factors.
>
> The eighth significant area in systems analysis is the use of computers. Systems analysis can be done without computers but the computational power of the computer makes many systems analysis tools easier to use, especially in large scale problems where the number of variables and interactions are large. Using modern computers it is now feasible computationally to study complex systems with thousands of variables.

Second, simulation techniques are often used in applying the systems approach to problems. Simply stated, simulation is the tracking or projection of a variable or set of variables over time, under different assumed conditions some of which are and some of which are not controlled by man. An eyeballed line through a scatter diagram on graph paper, using a ruler and pencil, is a simulation if the line projects the horizontal time dimension beyond the known data. A regression equation with time as an independent variable can provide a bit more sophisticated simulation. Time oriented models based on one or more specialized techniques such as input-output, linear programming, simultaneous equations[1/] are more complex but not basically different. They provide the analyst with a technique for estimating the consequences through time of alternative assumptions--i.e., simulations --often in a specialized sense, through optimizing a single objective function

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[1/] Cowles Commission variety with parameters probabilistically estimated, usually from time series data.

and using specialized sources of data. Specific simulation techniques are used to formulate models which display the time path consequences of a specific set of system inputs and estimated values of parameters.

This project uses the generalized, computerized, systems, simulation approach. Theory and techniques from many disciplines are used to build models in a systems context, the domain of the system modeled being defined in such a way as to include the problem being addressed. Specialized theories and techniques are used where appropriate to build components of the overall model. Such specialized components are linked to each other in the model just as the real components which they represent are linked in the real system. Thus, the approach is general with respect to disciplines and their different theories and to techniques. It is also general with respect to sources and types of data, and information. And finally it makes use of the technology of the modern electronic computer as do many of the specialized techniques when used separately. Thus, the approach used in this project is not in any way competitive (or in conflict) with any specialized technique, theory, or discipline. Ideally it encompasses any and all of these techniques and uses them as, when and where appropriate in modeling a system relevant to the study of a particular specific problem or constellation of problems as such it seeks to exploit and develop the opportunities to exploit various techniques by incorporating components based on these techniques into general, systems-science simulation models. There is much research and development work still to be done to constructively use and interface such components. This project can contribute to and benefit from theoretical, methodological, and operational problem solving research efforts in other projects which are using, gaining experience with, and further developing various specialized techniques. The need is for cooperation to exploit the complementarity between the more specialized techniques and the more general approach. Exploitation of these complementarities among various techniques can provide beneficial advances to all concerned. AID, as the funding source for this and other projects, should encourage and be receptive to the building of linkages and mechanisms for exploiting the complementarities among these projects. The MSU team stands ready to cooperate with other projects as mutually satisfactory mechanisms can be devised.

Third, and finally, the approach is useful in many non-sector level applications. This project focuses on modeling the agricultural sector to assist decision makers at the planning, policy, program, and project levels, and at the national and regional, sector and subsector levels. Thus it is not confined to sector analysis.

APPENDIX B

Airlie House Evaluation Conference
27-28 March 1974

Participants

Michael Abkin
Michigan State University

Joel Bernstein
U.S. Agency for Int'l. Development

Daniel Bromley
U.S. Agency for Int'l. Development

Albert Brown
American Technical Assistance Corp.

Wilfred Candler
University of Guelph

Tom Carroll
Michigan State University

Douglas Caton
U.S. Agency for Int'l. Development

Apostolos Condos
Food and Agriculture Organization

Lehman Fletcher
U.S. Agency for Int'l. Development

Hartwig de Haen
University of Bonn

Leon Hesser
U.S. Agency for Int'l. Development

Lane Holdcroft
U.S. Agency for Int'l. Development

Glenn Johnson
Michigan State University

Kim, Dong [illegible]
National Agricultural Economics
Research Institute
Republic of Korea

Kim, Dong Min
National Agricultural Economics
Research Institute
Republic of Korea

Kim, Ho Tak
Seoul National University

Thomas Manetsch
Michigan State University

Donold McClelland
U.S. Agency for Int'l. Development

William Merrill
Iowa State University

Robert Morrow
U.S. Agency for Int'l. Development

Richard Phillips
Kansas State University

Jorgen Randers
Massachusetts Institute of Technology

George Rossmiller
Michigan State University

Inderjit Singh
Ohio State University

Alan Strout
Agricultural Development Council

Richard Suttor
U.S. Agency for Int'l. Development

Formal Presentations

Fletcher	Concept and Practice of Sector Analysis; Purpose of the Evaluation
Johnson	General Systems Simulation Models for Sector Analysis
Manetsch	Theories and Concepts Underlying Construction of the Korean Simulation Model
Rossmiller	Utilizing A Systems Model for Policy Analysis
Strout	Institutionalizing the Systems Simulation Approach: Progress and Problems in Korea
Randers	Design, Output and Validity of the Korean Systems Model
Singh	The Recursive Linear Programming Component
Phillips	The Grain Management Component
Craig	The Population Component
Candler	The Livestock Component
Kim, D. H.	Institutionalizing Systems Models: A Korean Perspective
Panel	Support Systems to Make Systems Simulation Modeling A Continuous and Transferable Process:
Rossmiller	Institution Building
Carroll	Computer Operations in the Field
Manetsch	Training
Abkin	Software Library

APPENDIX C

Researcher Workshop

July 30 - August 3, 1973

Presentations:

Dr. T.J. Manetsch Michigan State University	Systems Analysis Framework; Systems Simulation Concepts; KASS Model
Mr. B.S. Ryu Ministry of Agriculture & Fisheries	A Case for Agricultural Systems Analysis
Mr. S.M. Oh Bank of Korea	Inter-industry Analysis
Dr. Hee Yeon Song Korea Development Institute	Macro Projection Model
Dr. P.Y. Moon Korea Development Institute	Simultaneous Equations
Mr. Chang Economic Planning Board, Bureau of Statistics	Data Collection Problem
Dr. D.H. Kim Agricultural Economics Research Institute	Production Functions
Dr. H.T. Kim Seoul National University	Supply Functions
Dr. T.W. Carroll Michigan State University	KASS Population Component
Mr. S.G. Kim National Agricultural Economics Research Institute	KASS Resource Allocation Component
Dr. S.H. Ban Seoul National University	Agricultural Productivity Growth Analysis
Mr. F.J. Gibson Michigan State University	KASS Grain Management Program Component
Mr. K.S. Chai Ministry of Agriculture & Fisheries	Agricultural Production Policy in Korea

Dr. D.H. Kim, NAERI Dr. G. E. Rossmiller, MSU	Research Needs for Planning and Policy
Dr. G.L. Johnson Michigan State University	Agricultural Development Research Around the World
Dr. J.H. Park Blue House	Relationship between Economic Research and Decision Maker

Participants by Organization:

National Agricultural Economics Research Institute	7
Agricultural Development Corporation	3
Ministry of Agriculture & Fisheries	2
Seoul National University	2
Forestry Experimental Station	2
Agricultural Co-op College	1
Bank of Korea	1
Chun-buk University	1
Chun-nam University	1
Council for Economics and Science	1
Dong Kuk University	1
Kwan-weon University	1
Kyung Sang University	1
National Businessmen's Association	1
Office of Rural Development	1
Seoul National University	1
Sericultural Inspection Office	1
Sericultural Experimental Station	1
Total	29

Decision-Maker Workshop

August 6-9, 1973

Presentations:

Dr. J.H Park Blue House	Problems facing Korean Agriculture - Implication to Decision Maker and Researcher
Dr. G.E. Rossmiller Michigan State University	Role of Economic Analysis in the Planning and Policy Formulation Process
Dr. G.L. Johnson Michigan State University	System Simulation and its Application in the KASS Approach
Dr. D.H. Kim National Agricultural Economics Research Institute	KASS Findings and Their Policy Implications
Dr. D.H. Kim, NAERI Dr. G.E. Rossmiller, MSU	KASS Development Issues

Participants by Organization:

Ministry of Agriculture & Fisheries	13
National Agricultural Economics Research Institute	3
Agricultural Material Inspection Office	2
Agricultural Development Corporation	2
National Agricultural Cooperation Federation	2
Agricultural Product Inspection Office	2
Chonnam University	1
Chonbuk University	1
Extension Service, Seoul City	1
National Businessmen's Association	1
Oggice of Government Administration	1
Office of Rural Development	1
Seoul National University	1
Total	31

APPENDIX D

Michigan State University
Korean Agricultural Planning Project
Scope of Work

Background

Until the inception of the Third Five-Year Plan in 1972, public policy and investment emphasis was directed toward building social infrastructure and expansion and growth of the industrial sector. Agricultural sector development was allowed to lag behind the rest of the economy during that period. With the initiation of the Third Five-Year Plan in 1972, development emphasis shifted to include the agricultural sector. Thus, the Ministry of Agriculture and Fisheries (MAF) has an increased responsibility in planning policy formulation, program development, and project design and execution.

Situation

The Korean government is interested in agricultural sector development for a variety of reasons. Just under 50 percent of the population is in the agricultural sector and the sector contributes just under 30 percent of total gross national product (GNP). Farm household incomes are low relative to nonfarm household incomes. Rural to urban migration is straining the limits of the absorptive capacity of the industrial sector for labor. Agricultural productivity increases are not keeping pace with the increased demand for agricultural commodities, thus increasing amounts of scarce foreign exchange are required for agricultural imports. Recent shortages of grains in world markets and resultant world price increases have caused these imports to become even more costly.

The various functions related to planning and development activities are located in numerous agencies and offices within and outside of MAF. The relatively low capacity of personnel within many of these scattered agencies for using modern analytical techniques and an organizational structure which precludes adequate coordination of the various functions makes effective planning and development activities extremely difficult.

Recommendations by the Korean Agricultural Sector Study Team (KASS) for an agricultural sector development strategy included implementation of "a policy of improving agricultural policy formulation procedures, programs, project design, and public administration and execution."[1/] These recommendations also call for reorganization of MAF along functional lines and organization for more effective and coordinated statistical and agricultural economics work. Hathaway and Rossmiller, in their KASS paper provided the basis for the broad KASS recommendations.[2/] They went into somewhat greater detail in their recommendations concerning various aspects of the statistics collection and processing system and the economic analysis system to include the functions of policy, program, and project analysis, agricultural outlook, and long run structural economic research.

[1/] Rossmiller, G. E., et al., Korean Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985. Ministry of Agriculture and Fisheries, Seoul, Korea; and Department of Agricultural Economics, Michigan State University, East Lansing, Michigan. 1972. (Also translated into Korean.)

[2/] Hathaway, Dale E. and Rossmiller, G. E., "Organization of the Ministry of Agriculture and Forestry," Republic of Korea, Michigan State University, June 1972.

MAF is now prepared to proceed with more precisely defining operational activities for implementation of many of these recommendations. They are prepared to receive and accommodate technical assistance in three major areas of economic analysis--policy analysis, agricultural outlook, and program and project evaluation--and in the related area of agricultural statistics.

Technical Assistance Required Under the Korean Agricultural Planning Project (KAPP)

This technical assistance should include the following long term personnel: Policy analyst (agricultural economist) working with the Planning Coordinators Office MAF, (2) an agriculture outlook analyst (agricultural economist) working with the appropriate agency in MAF, probably the Statistics Bureau, and (3) a program and project evaluation analyst (agricultural economist) working initially with the Agricultural Development Corporation (ADC) (MAF operational agency responsible for land and water development) but also available to work with other MAF agencies as appropriate. The planning horizon for this project should be a three year period with a review at the end of each year to assess progress and to determine specific project emphases and work plan for the following year. In addition to the above designated personnel, provision should be included in the project for bringing in short term project personnel and consultants as determined appropriate as the project unfolds and in interaction between the long term KAPP personnel and ROK Government personnel with whom they are

working. Finally, coordination is required among project personnel and other international agencies working in related areas.

The KAPP and KASS personnel must coordinate and work closely together in order to exploit the complementarities of the two projects. To assure this coordination between projects a single field project leader will be designated to handle the administrative and personnel details with the back-stopping office at Michigan State University, and the internal policy liaise and coordination functions between the two projects.

In order to accomplish their individual and combined KAPP project objectives KAPP personnel must closely coordinate and integrate their activities. Thus a chief of party will be designated within KAPP to handle internal coordination and project policy issues. Initially this person will be the policy analyst but will be subject to later redesignation by MSU in agreement with MAF.

In addition, an agricultural economist within the KASS team has been designated as operational liaison between KASS and KAPP. This individual (an agricultural economist) will be responsible through his close work relationship with the KAPP personnel, for developing, testing, and integrating components into the KASS model which will be of use to KAPP personnel and MAF in the areas of agricultural outlook and program and project evaluation as well as providing specific additional detail required in the model for policy analysis.

Objectives

The general objective of KAPP is to increase the capacity of the Ministry of Agriculture and Fisheries and through them the government of the Republic of Korea for sound planning, agricultural policy formulation,

program development, and project design and execution toward more rapid and effective development of the agricultural sector. General project working objectives include: (1) to understand the organizational structure and the operational processes presently used by MAF in planning and developmental activities and to identify the constraints in these systems leading to ineffective, inefficient and operationally unsound outcomes; (2) to advise on organizational and functional means to eradicate the constraints identified in (1) above; and (3) to do substantive work on current issues, within the scope of the project, to relieve current problems and to provide on the job training in the use of modern analytical techniques and processes for Korean personnel of the Ministry of Agriculture and Fisheries.

Specific Scope of Work for Long Term Personnel

The following details the specific work plans for the agriculture policy analyst, the agricultural outlook analyst, and the program and project evaluation analyst for the three years of the project with particular emphasis on the first year. Short term personnel and consultant help will be brought in as needs are identified and as the long term personnel working in each area along with their Korean colleagues determine program criteria, specific needs, and scopes of work.

The agricultural policy analyst will:

A. In the first year:

1. Identify, define, and describe (a) the institutional structure within which and (b) the operational process through which planning, policy formulation, program development, and project design and execution take place with respect to the agricultural sector within the Korean Government. Particular

emphasis will be placed on the Ministry of Agriculture and Fisheries. From this descriptive base the policy analyst will identify specific structural and process constraints to effectively carry out the above functions and recommend organizational and institutional changes which will facilitate removal of the identified constraints.

2. Analyze and evaluate the MAF long range projections for the agricultural sector for the period 1973-1981, using modern analytical techniques and recommend changes and alternatives, with particular emphasis on increasing and extending the capability of Korean personnel working in this area.

3. Begin to work with Korean counterpart personnel on economic analysis of specific policy issues of importance to the current planning and policy efforts of the Ministry. Advise policy decision makers in the Ministry on request on policy matters and issues, and help them understand the consequences of alternative courses of action.

4. Coordinate own activities and those of Korean counterparts with the operational activities of the KASS team and recommend extensions and the development of new components to the KASS model which will contribute to the planning and policy analysis functions.

B. In the second and third years the work plan is to be determined in light of the first year activities and in interaction between MAF, MSU, and USAID.

The official counterpart for the policy analyst is the Planning Coordinator, MAF. Operational counterparts are the Director, Planning and Budget Bureau,

MAF and Director, National Agricultural Economics Research Institute. Additional assistance will be provided by the Chief, Planning Division, MAF and the Chief, International Cooperation Office, MAF.

The Agricultural outlook analyst will:

A. In the first year:

1. Identify, define, and describe the specific agricultural outlook needs of the public and private sectors. Plan and begin implementation (with Korean colleagues) of an agricultural outlook analysis system, paying particular attention to the priorities and timing of implementation, additional data needs, and program costs.

2. Plan and begin implementation and improvement of the agricultural statistics collection and processing for the development of an agricultural outlook system. This will involve work with a short term statistical analyst consultant on improvement of statistical collection and processing.

3. Further extend the analytical capability of Korean personnel working in the statistical collection and processing system and the agricultural outlook system by actively working with these counterpart personnel.

4. Assist the policy analyst to analyze and evaluate the MAF long range projections for the agricultural sector for the period 1973-1981 as outlined in point A-2, page 6 under duties of the policy analyst.

5. Coordinate activities with the KASS team to exploit to the fullest the KASS model and through the KASS team liaison person, guide the development of changes in the KASS model to better serve the agricultural outlook function.

B. In the second and third years the work plan is to be determined in light of the first year activities and in interaction between MAF, MSU, and USAID.

The official counterpart for the Agricultural Outlook Analyst is the Director, Agricultural Development Bureau, MAF. Operational counterparts are the Chief, Sae Maul Income Division, MAF, the Chief, Farm Economy Division, MAF and the Chief, Marketing and Economic Analysis Division, NAERI.

The program and project evaluation analyst will:

A. In the first year:

- Work with the Agricultural Development Corporation and the Farmland Bureau, MAF, to extend the capability of those agencies in the use of modern analytical techniques to design programs of land and water development consistent with MAF policy objectives and the third five year development plan, to develop guidelines and rules for choosing among projects of a similar nature and between heterogeneous projects designed to accomplish similar program objectives, and to advise and improve the capability of these agencies in development of project proposals and presentations to funding agencies. Also this analyst will on request review and evaluate existing land and water development program and project proposals.

2. Be available for consultation and active participation in program development and project design and evaluation as requested by

other agencies of the MAF, on domestically funded investment and for loan applications to international financing sources.

3. Work with the KASS team liaison to use the existing KASS model in these analyses and to conceptualize, devise, test, and implement, new components in the KASS model, useful in program and project analysis functions.

B. In the second and third years the work plan is to be determined in light of first year activities and in interaction between MAF, MSU, and USAID.

The official counterpart for the Program and Project Evaluation Analyst is the Director, Farmland Bureau, MAF. Operational counterparts are the Chief, Special Area Development Division, MAF and the Director, Project Design Department, ADC.

General

Within the framework of the scope of work outlined above in each of the three work areas, the official Korean counterparts may ask the respective MSU analysts to perform specific work assignments. Final arbitration of work schedule priorities will be done if necessary by the Vice Minister, MAF in consultation with the KAPP Chief of Party.

Project Personnel

Personnel involved in the Planning Project will be mature individuals with the experience, training, and background necessary for them to provide the technical assistance required and to interact effectively with top level decision makers in the Korean Government.

Rossmiller
Draft II
8 May 1974

Scope of Work
for
Korean Agricultural Statistics and Data System Study Team

Situation

The original plan under KAPP was to provide long term technical assistance in policy analysis, agricultural outlook, and program and project evaluation. Short term assistance was to be provided as needs were identified with respect to statistics collection and data processing in the agricultural sector. During March 1974, however, Mr. Lee, Byung Suk, Chief, International Cooperation Office, MAF and Dr. Kim, Dong Hi, Director, National Agricultural Economics Research Institute, during their respective stopovers at MSU, provided information which changes that original plan. In December 1973 when KAPP was being finalized it appeared that MAF was ready to move toward the direction of the agricultural outlook work presently being done for MAF by NACF and installing the agricultural outlook function as a responsibility of the Agricultural Development Division in MAF. Operational coordination and responsibility would fall in part to both the Statistics Bureau, MAF and the National Agricultural Economics Research Institute. Subsequently, however, it appears that MAF has had some second thoughts as to whether this specific action is the most appropriate way to handle the agricultural outlook function. Indications by both Mr. Lee and Dr. Kim were that it would be appropriate to delay actual technical assistance work on agricultural outlook until MAF has come closer to resolving this issue. In the meantime, however, the increased pressure for better and more useful agricultural sector data has brought to the

forefront the need for concentration on improvement in the statistics and data system. Thus, to the degree possible KAPP should decrease the immediate priority on agricultural outlook and increase the immediate priority on the statistics and data system.

General Plan

In line with these changed priorities during the month of June 1974, KAPP will field a study team to develop a specific and detailed work plan for MAF and KAPP personnel to carry out by June 1975 for the improvement of the present statistics collection and data processing work now being done in MAF and for the development of a comprehensive agricultural statistics and data system. This team will consist of David Culver, agricultural outlook specialist from USDA who is committed to become the agricultural outlook analyst on the KAPP project beginning in June 1975; Karl Wright, agricultural economist, MSU, formerly provided about six months input into KASS and has worked intensively with agricultural data and census data from both the U. S. and Michigan; Tom Carroll, systems scientist with KASS and present field project leader KASS; Lloyd Teigen, KASS/KAPP liaison; and G. E. Rossmiller project director and team leader for this effort. Recruitment is under way for an additional team member from SRS-USDA.

Objectives

The objective of this one month effort is to develop a plan and a design for plan implementation for the rationalization and expanded scope of the statistics collection and data systems for the Korean agricultural sector. To carry out this objective the following steps must be taken:

1. Carry out a comprehensive review of the present MAF statistics collection and data processing activities including: a) means of collection, b) type of statistics collected, c) definition of terms, d) series processed, e) means and frequency of reporting series, f) logical consistency among series, g) identification of present users.
2. Ascertain the relevance of statistics presently collected and processed, and determine collection and processed data gaps which would be potentially useful to the statistics and data users which MAF is interested in serving.
3. Conceptualize and make recommendations as to the institutional and operational design of a statistics collection and data processing system for MAF which uses modern collection, processing, storage, and retrieval technology and which services the multiple needs of the wide array of users of agricultural data.
4. Develop a specific and detailed work plan to implement the recommendations in such a way that the major portion of the newly conceptualized system can be functional by June 1975.

APPENDIX E

COMPUTER LIBRARY FOR AGRICULTURAL SYSTEMS SIMULATION
MINUTES AND RECOMMENDATIONS
FROM THE MEETING OF THE
POLICY ADVISORY BOARD
6-7 MAY 1974
EAST LANSING, MICHIGAN

Review of First Year's Activities

The members of the CLASS project team presented to the PAB the results of the previous year's work. The standards that have been developed for components, documentation, and programming were discussed. Among the examples supplied were several utility programs and component routines. Under development is an optimization package for parameter estimation and development of policy recommendations. The concept of a language to ease the task of model building and policy analysis was discussed and a demonstration given of the policy analyst's language using a model of the state of Michigan constructed with CLASS components generalized from the Nigerian and Korean models. The Michigan model was used to demonstrate the versatility of the language and the library in moving components from the Nigerian and Korean experiences to an entirely new application.

Component Acquisition

There is a definite need for obtaining more components, both from members of the MSU project team and from outside sources. We need to identify problem areas by relating to decision makers. A loose structure exists at present for assimilating outside components into the library, but the process needs to be given more structure. Once these areas are specified, we must show that specific questions can be answered by use of the library's simulation models. We should consider who are our potential customers in deciding upon the inclusion of particular components

in the library. It would be a good idea to take components from an externa model such as one from ERS and run them through the component acquisition process. We would then have "real world" acquisitions which would also be useful for demonstration purposes.

Again, it is important for the CLASS team to be looking at what others are doing along these same lines. We want to see how other librarie operate, though it is agreed that CLASS should be more of an active rather than a passive library.

The Ultimate Location

The library has to begin preparing for eventual transfer to one or more outside locations. To this end, the CLASS team must begin building up a critical mass of components to make the library viable. At least one domestic and one international center should be considered. At the various locations, the library could take on different forms suitable to its users. Possible locations include USDA, IIASA, AID/W, IBRD and FAO.

Documentation

Since we will be addressing a diverse audience, several different types of documentation will be needed. Three classes of potential users emerge, each with its own specific needs--(1) the decision maker, (2) the systems analyst, and (3) the programmer.

The documentation must serve two purposes: (1) that of publicity, to generate an interest in CLASS, and (2) as a means of conveying how to make use of the library.

The first function can best be served by the use of abstracts of which two different types are needed: one for the decision maker in nontechnical language and one aimed at the analyst. The abstracts aimed at the decision makers should focus on problem areas that they may actually confront. Two types of documentation are needed to serve the second function. First, there is the component documentation, directed primarily at the analyst. It should explain the component in disciplinary terms and should contain an example of its possible use. Also included here would be the mathematical description of the component. Secondly, there is the program documentation, which contains the necessary information for implementing the program on a machine. Thus, the three types of documentation, the abstract, the component documentation, and the program documentation provide varying degrees of involvement to the user, as he progresses through the successive steps of utilization.

It was also recognized that within academic circles there is a certain stigma attached to "borrowing" someone else's work. Thus, an attempt should be made to overcome this attitude through the documentation wherever possible; some suggestions were: (1) emphasizing the cost savings, especially in the use of scarce researcher time; (2) pointing out that confidence can be placed in these components since they have been used elsewhere; and (3) emphasizing that the art is in building the model, rather than in programming it.

Symposium

It was recommended that an international symposium be held aimed at the potential users of CLASS. The symposium's purpose would be to make possible users aware of the library and its capabilities and to get

feedback from them. The symposium will serve as a vehicle for "market development." One important feature of the symposium would be a demonstration of interaction with a model using the policy analyst language. The model should be one that all people would agree is a useful problem-solving model, rather than one built for the purpose of demonstration only. Some possible choices were the Korean grain management model, the Venezuelan livestock model, or a model provided by ERS. In order to provide a meaningful interaction, the number of people attending should be kept below 50. A conference committee was chosen consisting of Art Coutu, Leroy Quance, Doug Caton, and possibly Henri Qualx. The question of funding for the conference was discussed. It was recommended that funds be sought from AID, but with responsibility for the symposium remaining with the project team. The PAB and perhaps some outside agency should make recommendations as to who should attend. The conference can also serve a training function for those who attend.

After the conference, the demonstration should be given to other professional meetings. This will allow for an interchange of ideas with others engaged in similar work.

PAB Operations

Due to the anticipated transfer of the library, the PAB should become progressively independent of MSU. One of the important considerations of the Board should be planning for this eventual move. To that end, members of organizations that could possibly become a home for the library should be invited to PAB meetings as observers. In addition, other people involved in work of a similar nature, particularly from other disciplines should be invited to observe.

Subjects that the Board felt needed further consideration were: (1) how much emphasis should there be in the development of components versus further development of the language (the general feelings leaning toward a heavier push for component development), (2) who would provide funding for further language development, (3) what priorities should be used in selecting the types of components, (4) who should finance user service costs, (5) should CLASS provide user training, (6) should the library provide a data bank and management system, and (7) is there a need for a Technical Advisory Committee.

The subject of Board membership was considered and it was felt that the group should not grow much larger, although it should be well rounded in its composition. Some members felt they would prefer to be on the Board as a representative of their particular organization, while others preferred to act as individuals. Thus, each person will act in whichever role he/she prefers.

Subsequent Meetings and a Chairman

Another meeting of the Board was recommended to be held in about six months. Art Coutu was elected chairman of the PAB.

Recommendations

1. There is a need to keep the MSU group intact with activities continued at or above the present level for at least another year. More library routines must be acquired and a nucleus of components must be generated to enable a transfer of activities intact during the next two years to an as yet undetermined location(s).

2. A symposium should be planned for the spring of 1975 in order to make potential users aware of the library and to generate an interest in it. The conference should be aimed at decision makers, with the emphasis on the role of the library in helping them solve the real world problems they face. Although

primary responsibility for the conference should rest with the CLASS staff, extra funding should be sought from AID.

3. A need exists for an interchange of ideas with the professional community. Following the conference, some of the material presented there should be taken to professional meetings so that others may see what the CLASS team is working on.

4. At the same time a survey should be made of other libraries, in private industry as well as in public institutions and universities, to see if there is anything that would be of benefit to CLASS and if there are important duplications to be avoided and/or regarded as complementary to CLASS.

5. Further work should be done to see that the documentation conforms in practice to the theory set forth in the documentation standards, as suggested above on pages 2 and 3. The language will need continued development with some consideration given to what direction it will take.

6. The Board should remain a small group in order to continue to function effectively. However, it is felt that more representation, particularly from other disciplines is needed. Some persons should be invited to attend, not as members of the Board, but as observers.

7. Another meeting of the Policy Advisory Board should be scheduled for October 1974.

Arthur Coutu, Chairman
Policy Advisory Board

George E. Rossmiller

George E. Rossmiller, Director
Agricultural Sector Analysis
and Simulation Projects

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APPENDIX F

ABSTRACT

A SIMULATION ANALYSIS OF POLICIES FOR THE NORTHERN COLOMBIA BEEF CATTLE INDUSTRY

By

Alvaro Posada

The Atlantic Coast of northern Colombia (known as the Costa) supports between 40 and 50 percent of Colombia's cattle population and, with easy access to domestic and world markets, is the most important of Colombia's five beef-producing regions. Because cattle raising is the main economic activity in the Costa and is an extensive operation with low technical efficiency, the region has been a priority target for cattle development programs. In the mid-1960s, with the financial and technical assistance of several international agencies, the Colombian government started a cattle development program aimed at increasing beef production mainly on the Atlantic Coast. In the early 1970s this program was reinforced with a disease control program and then revised and issued as a national cattle development plan. The main instruments of this plan are credit, technical assistance, export subsidies and improved marketing and slaughtering facilities. Its long-term objectives are to increase the protein supply to the Colombian population and to generate foreign exchange earnings.

Alvaro Posada

The primary purpose of this study was to develop a system simulation model to (1) analyze the effects of production incentives on the decision of farmers to adopt new production methods, and (2) estimate the effects of the expanded regional production on the income of farmers, government revenues, Colombian beef consumption and sustained level of exports.

Four alternatives to traditional production were considered. Alternative 1 considered the improvement of native and artificia grasses; alternative 2 considered the improvement of artificial grasses and the substitution of artificial for native grasses; alternatives 3 and 4 added the production of forages and silage to the improvement of range lands in alternatives 1 and 2 respectively. At the present stage of the study, however, alternative 2 was the only one comprehensively tested and used as a base run for policy experimentation. The cattle system simulation model has five major components (including a cattle demography model) which (1) allocate land use according to the farmer's perceived profitabilities of cattle and crops subject to land and capital constraints; (2) calculate yield and output of cattle and crops and their respective producer and market prices; (3) provide the instrumental linkages for government revenue, export trade policies, and production campaign policies; and (4) generate the performance criteria necessary to evaluate the impacts of alternative programs on the cattle economy through time.

The five major sets of assumptions investigated were (1) disease control in the traditional herd, (2) alternative cattle industry taxing policies, (3) alternative development credit policies, (4) alternative levels of government productic campaign promotion, and (5) alternative cattle pricing and export policies. The results of the cattle policy experiments were discussed in terms of the projected time paths (from 1966 to 1985) of five of the most important performance indices incorporated in the model: (1) regional cattle population, (2) Colombian beef consumption per capita, (3) regional farm income from cattle, (4) capitalized grazing land value per hectare, and (5) annual regional government revenue from cattle. Experiments with disease control and export promotion policies each used two indices instead of the above five: regional cattle population and extraction ratio for the disease control policies and domestic market price of finished males and export margin for the export policies.

In general, the study demonstrated that (1) the projected outcomes with the government disease control campaign were greater than under precampaign practices in the traditional herd; (2) the projected outcomes with government programs easing development loan terms were in all cases greater than the base run which assumed current credit policies; (3) the projected area in improved land and the modern cattle population with government policies benefiting both the traditional and modern operations were in all cases lower than under policies benefiting only the modern

operation; (4) the projected area in improved land with the increased land tax rate was greater than the base run which assumed current land tax rates; (5) the projected outcomes with the removal of special taxes on cattle were lower than the base run which assumed no removal of these taxes; (6) given the assumptions on farmers' decisions and accounting mechanisms in the model, availability of credit for land improvement does not seem to be a serious constraint to land modernization; and (7) the projected outcomes with a flexible exchange rate suggest that this is an effective incentive to export without involving large transfers from public revenues to exporters in the form of subsidies.

The study indicated areas where more research and regional data are needed to improve the model's performance, and discussed possible extensions that could help analyze more fully alternative policy strategies for the Costa's overall development. Finally, the study demonstrated that the system simulation approach with a computerized model of the cattle economy which incorporated information from diverse sources and accounted explicitly for the dynamic interactions and feedbacks that might occur can be a very useful methodological tool for policy analysis.