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GENERAL, SYSTEMS, SIMULATION MODELS FOR SECTOR ANALYSIS

by

Glenn L. Johnson

Presented at a Seminar on the

EVALUATION OF THE KOREAN AGRICULTURAL SECTOR SIMULATION MODEL

Arlie House
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GENERAL, SYSTEMS, SIMULATION MODELS FOR SECTOR ANALYSIS

Glenn L. Johnson

The original title for my presentation included the phrase "the case for simulation." I asked Lee to drop the phrase--it sounded too much like an argument in a court of law by a defense attorney--what we need is constructive discussion as to what needs to be done, how, and why.

Last month, I spent three weeks at Bellagio with four topnotch European and U.S. colleagues discussing and writing about methods for studying problems of agrarian change. It was three weeks of hard, intense, objective work on theories, techniques, philosophic orientation and descriptive information concerning problems of agrarian change. I hope these days at Airlie House can be equally constructive because there is so much to be better understood, more completely developed, and more effectively used in connection with general, systems, simulation models to study problems of agrarian change.

I believe I can be most helpful in opening up such a discussion by indicating what we have been trying to do, how we have been doing it, and why we have been doing it that way.

In discussing the "whats," "hows," and "why" of our Korean work, it will be important to recognize that these three are so interrelated that we have to discuss them iteratively and interactively. Thus, I will start out with some whys before discussing whats and hows; however, I will keep going back to the whys as I discuss the whats and hows.

I should also note at the outset that I have set much of the pattern for the Nigerian and Korean studies starting way back when I was director of the Economic Development Institute at the University of Nigeria under a contract which reported to Joel Bernstein when he was Country Director in Lagos. Hence, I bear considerable responsiblity for the Korean work and my own experiences are particularly relevant. Much of what, how and why we have done in Korea is based on the shortcomings of earlier work. It seems constructive to illustrate the dangers involved with shortcoming of my own work rather than with the work of others. Thus, I hope that I may be forgiven for the personal references in the pages to follow. I also hope that you will join me in objective mutual self-criticism when my examples involve efforts similar to ones you have made.

Disciplinary vs. Practical Problem-Solving Research

For the next two days we are going to discuss a piece of practical research. The discussion will be carried out mainly by disciplinarians and, among disciplinarians, mainly by economists.

A. The Distinction:--In these two days we will be in continual danger of evaluating practical problem-solving research with criteria appropriate for disciplinary research unless we distinguish carefully between the two.

Problem-solving research is directed toward finding or helping to find solution to problems faced by real world decision makers. The object is to find a solution to prescribe; hence, the purpose is to produce information which has prescriptive value.

Disciplinary research, on the other hand, increases the stock of knowledge in a discipline such as economics by increasing its theoretical and descriptive base. While not all disciplinary research is of known practical relevance, much disciplinary research is relevant to the solution of practical problems. Some disciplines are primarily positive and seek positive information. Others, such as esthetics, seek normative information. Some disciplines seek information on how to define optima and, hence, deal abstractly with solutions to use as prescriptions to problems yet are not necessarily practical, economics being an example of such a discipline.

The criteria for evaluating practical problem-solving research are not the criteria academic disciplinarians use in evaluating disciplinary research as any one knows who has served in both a staff capacity to decision makers and as a member of a disciplinary department in a university where the objectives are to enhance and provide for intergenerational transfer of knowledge. In practical research, the evaluative criteria are closely related to the values involved in defining the problem under consideration. The important criterion for problem-solving research is whether of not the problem under study is actually solved. Of course, solving practical problems involves the criteria of objectivity, honesty, etc. in the pursuit of truth the same as disciplinary research for without these there are no solutions.

B. The real world, problem definition, conceptualization, mathematical models and computer models:--Doing practical research involves studying that part of the real world in which the problem is located. The process can be viewed something as in Figure 1 below. Evaluation of a

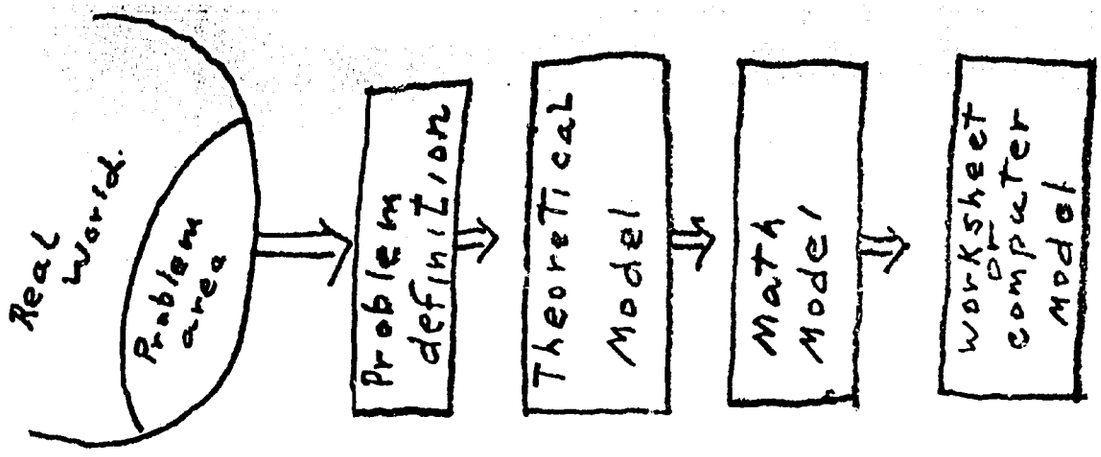

Figure 1.

problem solving effort such as that made for Korean agriculture involves determining how well each of these steps have been carried out in reaching or in helping to reach solutions to the problem or problems at hand.

It takes time to define a problem properly. That part of the real world in which the problem is located must be understood in its institutional, technological and human complexity. Values are important in this connection in order to comprehend what "there is too much and too little of," as the popular song goes. Knowledge is required about the problem in its real world context; usually, such knowledge is tentative and subject to further iterations. At some stage in the accumulation of knowledge, it is possible to begin to conceptualize a theoretical model of that part of the real world in which the problem is located. As problems ordinarily have technical, institutional and human dimensions, practical problem-solving models are generally multidisciplinary.

Once conceptualized, the model needs to be quantified. The first step in doing this is to express the conceptual model mathematically.

This ordinarly involves cooperative effort among highly competent disciplinarians. After such a model is developed and checked out for internal consistency and correspondence with the problematic situation, it must be further simplified so that it can be handled with the computational facilities available whether those be pencil worksheets and tabulation paper, a large scale computer, or something in between. If a computer is to be used, simplification involves creating a computer model capable of approximating the more ideal conceptualizations previously expressed mathematically.

C. Right, wrong, decision rules and prematurity:--Because we are concerned at this conference, with practical, problem-solving, we must consider decision rules for determining what to prescribe as a solution to a problem. We and the decision makers we seek to help are trying to distinguish right from wrong actions. Determining a right action to serve as a goal requires the use of decision rules to process both normative and positive information into decisions. The normative information deals with values--both monetary and non-monetary. In this connection we need to make a sharp distinction between good and bad, on one hand, and right and wrong, on the other.[1/] Good and bad are adjectives (probably primitive terms) describing conditions, situations, and things according to whether they do or do not contribute to attainment of human interest and purposes. Right and wrong on the other hand

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[1/] The distinction between right and wrong, on one hand, and good and bad, on the other is that of C. I. Lewis, The Ground and Nature of the Right, Columbia University Press, New York, 1955. G. L. Johnson and L. K. Zerby, What Economists Do About Values, Dept. Agric. Econ., MSU, East Lansing, 1973.

are adjectives describing actions or goals in terms of whether or not they best or would best attain human interests and purpose in view of the existing situation--as such they are prescriptive and depend on both normative knowledge of good and bad and positive or non-normative knowledge of the real world with all of its technical, institutional and human constraints and possibilities. It is often wrong to do that which is good because something better (more good) can be done. Conversely, it is often right to do that which is bad because it is the least bad which can be done. Thus, decision rules and information on both monetary and non-monetary values are crucial and must be modeled formally or informally.[1/]

Decision rules attempt to maximize human interests. As such they require establishment of preconditions before use. These preconditions include:

(1) the existence of a common denominator among the values involved,

(2) interpersonal validity of that common denominator if the alternatives involves damaging some persons in order to benefit others,

(3) the establishment of the second-order conditions mathematically necessary if a maximum is to exist to be found and,

(4) finally, agreement on which decision rules to use.

Solutions to agricultural development problems typically involve adjustments and changes in institutions, technology and people. Some of the changes can be handled with free, uncoerced trades by the market but the less tractable ones wind up in the hands of public decision makers. This is true because many solutions involve imposing damages on some persons in order to confer benefits on others. Ordinarily the

1/ See the section on the total model beginning on p. 31. Also see Boulding, K. E., The Image, U. of M. Press, 1956. p. 11 "...I shall argue that the process by which we obtain an image of values is not very different from the process whereby we obtain an image of fact, there is clearly a certain difference between them."

force or power of government is required to execute decisions to take such actions. Solving such problems requires an interpersonally valid common denominator. Further in making institutional, technological and human changes, questions of order arise within projects, among projects within programs, and among programs within policies; in order to locate optima actions need to be arranged in the order of their descending net advantage per unit of sacrifices value. Also, an "agreed on" decision rule is required before we (the complex of researchers and decision makers) can select a course of action to prescribe as a solution.[1/]

As economists we have to guard carefully against premature use of the maximizing techniques and computations (which are our strength) while neglecting the processes of establishing the preconditions for using them. Disciplinary excellence, as an economist, requires that one know when not to use maximization techniques as well as ability to use such techniques.

D. Behavioral models and decision rules. Models to predict the consequences of changes in technology, institutions and people have to predict the behavior of consumers, producers and public officials. In considerable part, this involves predicting their attempts to attain monetary and non-monetary values and to avoid monetary and non-monetary "bads." As economists we are quick to use behavorial models based on assumptions of perfect knowledge and foresight,

[1/] We are, of course, involved with the question Pareto raised and the works of Hicks and Arrow become relevant. For persons not comprehending the significance of the work done by these three, the literature on the "Theory of Second Best" may play a useful role. In this connection see Johnson, Harry G., "The Cost of Protection and the Scientific Tariff," Journal of Political Economics, 68:327-45, August, 1960. Lipsy, R. G., and Kevin Lancaster, "The General Theory of Second Best," Rev. Econ. Studies, 24: 11-32, 1956-1957, and Fishlow, Albert and Paul A. David, "Optimal Resource Allocation in an Imperfect Market Setting," J. Polit. Econ., 69:529-546, December, 1961.

and atomistic competition. Under these assumptions, profit and utility maximization without risk discounts and premiums and without entrepreneurial learning and adaptive behavior make sense. However, imperfect knowledge and imperfect competition are integral parts of most problematic situations. This makes it essential to consider decision rules and normative information in an open way. As economists we have to be careful about using behavioral models which ignore the adaptive processes by which consumers and producers establish the preconditions listed above for using our "pet" decision rules.

E. Lessons about the "whats" from the above:--It is clear that practical, problem-solving research must deal (1) with the subject matter of many disciplines in specific problematic contexts, (2) normative as well as positive information, (3) establishing the preconditions for maximization was well as maximization, (4) prescriptive information.

Relevant Experiences

The previous section looked at the distinctions between disciplinary and practical research and outlined, in a rather abstract way, the important "whats" involved in doing practical research. This section is less abstract and concentrates upon experiences relevant to doing problem-solving research. Such an empirical examination of past experiences has the value of casting light on the "hows" and "whys" of practical research. Though less abstract, this section will have to be brief as there is not enough space here or time at this conference to develop in an adequate way the lessons of previous research experiences.

Persons satisfied with the KASS approach may want to skip or merely speedread this section; others should read it to understand the reasons for our approach which, in its generality, may offend some of you as disciplinarians and experts on specific subjects, sources of information and techniques.

My own experiences and those of my colleagues go back to farm management work in the early depression and include a considerable amount of work as U.S. Department of Agriculture civil servants making paper and pennil projections for members of congress and administrators in the U.S. government. They also include a substantial amount of disciplinary research some of which has been recognized as outstanding research with national awards from the American Agricultural Economics Association. Other research is of a more practical nature in both domestic and foreign settings. I will run through this research briefly in order to draw conclusions at the end of this section concerning how to go about doing practical problem-solving research and to see some of the "whys" involved.

For as long as there has been a subject called agricultural economics, farm management workers have worked at micro levels helping farmers plan their businesses so as to take advantage of technological change, new credit arrangements, institutional changes and the changes which have been occurring in the human agent. This micro farm management work attains its greatest credibility with farmers when it is simple enough to be dealt with interactively between the farmer and his wife, on one hand, and the person offering research or extension assistance, on the other. These efforts have had to be multi-disciplinary including technological, institutional and human change. In this work, premaxi-

mization investigations are and continue to be crucial; without them practical farm management research looses its credibility and with good reason for the results are irrelevant. Farmers are interested in seeing the consequences through time of following alternative courses of action. If they can envision these consequences they may be able to find the common denominators among the various monetary and non-monetary values involved and settle questions involving order (or sequence) and decision rules. Attempts on my part and on the part of my colleagues to introduce sophisticated maximization models and procedures at the expense of reducing attention to information from the technical, institutional and humanistic disciplines have met with a lack of credibility among farm decision makers.[1/]

At the outbreak of World War II, the entire free world was interested in the capacity of American agriculture to produce. Large scale projects were set up to make projections concerning that capacity on the basis on information drawn from a wide variety of technical, institutional and human disciplines. They were made with paper and pencil. Maximization models were not used very much and only rather incidental attention was paid to maximizing behavior in predicting the output of American agriculture. The projections gained credibility among public decision makers and, by and large, were quite

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[1/] Glenn L. Johnson, "Agricultural Economics, Production Economics and the Field of Farm Management," Journal of Farm Economics, Vol. 39, May 1957, pp. 441ff. "Stress on Production Economics," Australian Journal of Agricultural Economics, Vol. 7, No. 1, June 1963, pp. 12-26. Mawby, Russell G., and Cecil B. Haver, "Types and Sources of Information Used by Farmers," Chapter 2 in A Study of Managerial Processes of Midwestern Farmers, edited by G. L. Johnson, A. N. Halter, Harald W. Jensen, D. W. Thomas, see Table 7, p. 27, Table 8, p. 28. The Iowa State University Press, Ames, Iowa, 1961.

accurate. Similar conclusions can be drawn with respect to our attempts in the U.S. Department of Agriculture efforts to predict the consequences of changing the parity index and hence the levels of price supports and price ceilings which were maintained in the World War II period.

At the end of World War II there was an international wheat shortage. Again projections concerning the consequences of alternative courses of action were needed. A great deal of information was required in order to make these projections. Much of the information required was institutional in nature, other kinds were technical, and there were deep fundamental normative questions to be answered. There were also questions on the human side as there are strong preferences in the world among different kinds of wheat and rice. Again the projections attained credibility and again there was only minimal attention paid to maximizing procedures and technique although they were not ignored.

At that time in my life, I was an associate of Meyer Girshick, an outstanding econometrician whose life was terminated by an early heart attack. At that time, Meyer's mission was to improve the statistical analysis of data and to improve the projections being made in the Department of Agriculture. His assistant, Selma Swietzer who later became Mrs. Kenneth Arrow and I worked with him. He encouraged us to go to the University of Chicago for our doctorates and to work in the Cowles Commission there. We had great hopes that the simultaneous equations technique being developed there at that time would introduce order and more objectivity into the rather ad hoc, apparently unorganized projection methods being used in the Department of Agriculture. Thus, a short time later, I found myself taking courses from such members of the Cowles Commission as Jacob Marachak,

and Tjallings Koopmans. I had great hopes that their formal techniques would be the more effective equivalents of the less formal projections methods used in the USDA and that great forward strides could be made. I beefed up my mathematics and statistics and studied what they had to offer with considerable care. While doing this I developed a model of the burley tobacco industry. After leaving the University of Chicago I did the empirical work for that model and published an econometric bulletin on it.[1/] The bulletin was not problem oriented; instead it was disciplinary oriented. Worse yet, it was a result of looking for an opportunity to apply the simultaneous equations technique. Fortunately for me it won a prize. After I left the University of Kentucky, I went to Michigan State University where I helped Dale Hathaway develop a similar bulletin on dry edible beans and for similar purposes.[2/] It, too, won a prize. Recently one of my graduate students evaluated both models. Neither remained valid for more than a few months after it was completed. As far as I know neither was ever used by decision makers. Both studies suffered from being narrowly focused on a single source of information--time series data--and on the economic aspects of the two industries involved. Thus, neither study was general enough with respect to types and sources of information to deal with the problems attendant to the institutional and technological changes then taking place in the two industries.

At about the same time, John D. Black and my colleague James Bonnen were making projections concerning American agriculture. They took a less complicated simpler

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[1/] Johnson, Glenn L., "Burley Tobacco Control Programs," Kentucky Agricultural Experiment Station, University of Kentucky, Lexington, Feb. 1952.

[2/] Hathaway, Dale E., "Effects of Price Support Program on the Dry Bean Industry in Michigan," Michigan State University Agricultural Experiment Station Technical Bulletin 250, East Lansing, May, 1955.

approach but were general with respect to types and sources of information used. Their paper and pencil projection techniques did not involve extensive use of maximization models. They attained a relatively high level of accuracy in the projections they made and attained considerable credibility with decision makers. Their experience contrasted rather sharply with that of William Cromarty, one of my graduate students, who developed a Ph.D. thesis in cooperation with Lawrence Klein then at the University of Michigan. In effect, Cromarty helped develop part of the agricultural component of the Klein-Goldberger model of the United States. We all know that that model has not proven to be highly reliable and that it has not attained a great deal of credibility; in fact, I know of no instance in which the econometric component for agriculture has been taken seriously by public decision makers. I believe that the difficulty was a result of concentrating mainly on the information available in time series data to which probablistic estimating techniques can be applied. I believe that had I made Cromarty's work more general with respect to kinds and sources of data and information used, his model would have been substantially improved and might have attained credibility comparable to that attained by the Bonnen-Black effort.

As I indicated later, I took part in the post World War II effort to introduce a great deal more economics into the field of farm management. Others helping in this effort included Earl Heady from Iowa State, Harald Jensen now at the University of Minnesota and a host of then young Turks who felt that they could greatly improve the more ad hoc informal methods of pre World War II farm management men. In two different articles I have since

tried to evaluate as objectively as possible the effects of our effort. One of these articles is entitled, "Economics, Production Economics and Farm Management."[1/] The other one is entitled "Stress on Production Economics."[2/] The general conclusion is that practical problem-solving research in farm management was not greatly improved by our very substantial effort. While, in some way, it was damaged. Though we did not realize it then, we were trying to compress a relatively productive multidisciplinary, problem-solving field of work into production economics which is, itself, a subpart of economics rather at the expense of destroying its technological, institutional and humanistic breadth.[3/] As a result, we lost credibility with private decision makers who quickly saw the inadequacies of our work. Our efforts also had a deleterious effect on premaximization investigations which have to be done before applying the maximization techniques of production economics in solving farmer's problems. Farm decision makers seemed to sense intuitively that we were neglecting agricultural technology, institutional change and the activities of farmers and others.

The attempt to introduce more economics into farm management tended to flounder in the 50's and was diverted to an attempt by agricultural production economists to improve supply and demand analysis for agricultural industries and sectors. The argument was that supply and demand responses depended upon the behavior of individual producers and that such behavior could be predicted from micro-maximizing models. The maximizing technique which was concentrated upon was linear programming. A substantial number of

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1/ Op. cit. p. 10.

2/ Op. cit. p. 10.

3/ Op. cit. "A study of....", p. 10. See Table 7, p. 27 and Table 8, p. 28.

regional research efforts were carried out. I participated in a study of the responses of the Lake State dairy industry to price changes, a similar study of the cotton sector in the south,[1/] a feed-grain livestock study in the Midwest, and a number of other similar efforts. By-and-large these studies were not productive and attained very little credibility with public decision makers concerned with problems of these subsectors of the U.S. agricultural sector. Again the difficulty appears to have been one of concentrating too much upon the economics of these industries without defining the problems which were plaguing these subsectors. Had the problems been more carefully defined, the necessity of doing multidisciplinary work and of using a wider range of sources of information would have been clear. The dangers of concentrating on one specialized technique, linear programming, from only one discipline should have been apparent; they were so real and important they wrecked the studies. The objective functions in the L.P.s lacked normative relevance; the decision rules built into the models did not correspond well with those used by the people whose behavior was being predicted; the investments, investment and user cost theory behind the models was incomplete; institutional considerations were neglected, the constraints used in the L.P.s were incapable of confining the results within bounds known before the research to contain the truth; and, finally, the problem of aggregating L.P. results for representative farms was not solved.

After World War II, the United States entered the international economic development effort in a major way. General economists began to expand and evolve theories of economic development. Most of these greatly over-simplified the role which agriculture plays in the development of a

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[1/] As a consultant only.

Country. Simple two-sector models were developed and planning ministries followed their lead. The result was undue concentration upon the more naive economic aspects of agriculture and neglect of the problems of agriculture in their multidisciplinary complexity. Another result was conflict in AID missions around the world between program and agricultural officers. My first real experience with this was as a member of a mission sent to Thailand in 1961 to evaluate the economic and military assistance programs to that country. At that time Thailand was about five-sixth agrarian; inversely, I was the only agriculturalist on a six man team! Later, general economists perceived the error of their ways, repented and tried to make amends by rediscoverning and stressing agriculture! Their efforts however remain oversimplified, too macro and, often, naive. Even today planning ministries are woefully short of problem-solving research results from studies which tackle specific agrarian problems in their full multidisciplinary complexity at micro, sectoraland macro levels. Further, it is still to be regretted that many economists really work as disciplinarians even when in planning ministries and, hence, do not grasp the institutional, technical and human dimensions of many problems.

In the early 60's, I accepted a research grant for Resources of the Future to study the history of American agriculture from 1917 to the 1960's. With the unfortunate experiences of the regional research efforts on supply and demand behind and around me and with a keen awareness of the effectiveness of less formal more ad hoc projections, it was decided that we would not concentrate on over-simplified, specialized techniques in analyzing the operations of the U.S. agricultural economy. Instead, we returned to procedures more similar to those followed by Bonnen, Black and the projectionists who estimated the capacity of U.S. agriculture to

produce products in support of the World War II effort. The research which was developed drew upon a wide range of sources and types of information rather than being limited to time series data. Maximizing models were used but not exclusively.[1/] I believe that the book growing out of this project to be a far more comprehensive analysis of agricultural policy than could have possibly resulted from using an econometric model type Cromarty developed for Klein from using linear programming models of the type used in, say, the Lake States Dairy Study.[2/]

One of my first assignments under an AID contract was to become director of the Economic Development Institute at the University of Nigeria under Joel Bernstein who was chief of the Nigerian mission at that time. At this point in my career it was clear that practical problem solving research was necessarily problem specific and multi-disciplinary. Therefore, as its first director, I set up the EDI so that it could draw upon the various disciplinary excellencies of the entire University in accordance with the dictates of the problems at hand. Furthermore I benefitted from the above described unfortunate experiences in regional agricultural economic research in the United States and kept the EDI unspecialized on any source or type of information or any computational technique. We were prepared at the EDI to use maximizing models and did; however, we did not use them where we thought them

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1/ Glenn L. Johnson and C. Leroy Quance, The Overproduction Trap In U.S. Agriculture, Resources for the Future, Inc., The Johns Hopkins University Press, Baltimore, 1972. See the technical appendix for a special treatment of profit maximization and loss minimization.

2/ Ibid.

inappropriate and we were concerned with establishing the preconditions for their use.

On returning to the United States and partly as a result of the EDI's success in relating its research to the problems of Nigerian decision makers, I was asked by AID to head up the Consortium for the Study of Nigerian Rural Development (CSNRD). This Consortium was supported by and AID contract to the University of Wisconsin, Colorado State University and Kansas State University. It was governed by a Council including representatives of those universities and the U.S. Departments of Interior and Agriculture, and the Research Triangle Institute in the the Carolinas. Our contractual responsibility was to evaluate the USAID agricultural programs and projects in Nigeria and to make recommendations for their improvement. As the project progressed, the objectives were widened to include making recommendations to the Nigerian government on the improvement of Nigerian agricultural programs and projects whether or not financed by AID. Later the decision was made to carry out an agricultural sector analysis as the basis for reaching such evaluations. Thus the CSNRD research effort was a practical one. CSNRD personnel were immediately impressed with the technological, institutional and human dimensions of Nigeria's agricultural development problems which AID/Lagos had correctly recognized with a variety of projects dealing with these dimensions. It was difficult, initially, to establish the preconditions for using maximizing models. Thus a wide range of kinds and sources of information was used in trying to develop an understanding of the Nigerain agricultural economy. It is significant that 32 descriptive working papers weredeveloped. Before long, it became clear that we had to make projections. Because of the multiplicity of problems

existing in the agricultural economy, we focused the problems into three broad policy alternatives which were under discussion by Nigerian and international agencies at that point in time. In effect, the problem of choosing among these three broad policy alternatives defined that part of the Nigerain real world which had to be studied. We handled the consortium's research program in a general way not specializing it on econometric analyses, input/output analyses or linear programming though all three were used to a greater or lesser degree at some stage in the project. Eventually projections were developed at three points in time for the three broad policy alternatives. These were done on a paper and pencil basis. Substantial interaction with Nigerian and AID decision makers led to the inclusion of additional positive and normative information. Despite the emotions associated with the Biafran secession, a set of policy recommendations was reached which was presented in the final report of the Consortium. This report and FAO's earlier analysis of Nigerian agriculture served as the two basic documents for Nigeria's Agricultural Development Committee which spent six months preparing for a 10 day seminar. Two hundred of Nigeria's leading agriculturalists participated. There work became an input into Nigeria's perspective agricultural development plan.

Part way through the Consortium project I became aware of system-science simulation and was impressed with its generality concerning types and sources of information, the possibility of using specialized techniques if and when appropriate, and with its freedom from necessity to use maximizing components. At my request, Michigan State University

administrators financed a conference or a selected group of people from all over the United States to examine the question of developing a computerized system-science simulation model of the Nigerian economy. Douglas Caton attended the conference and was a prime contributor. The conclusion of this very constructive conference was that the software was not well enough developed to justify computerization of the Consortium study. Thus, the Consortium went forward on a paper and pencil basis using large amounts of expensive professorial time to construct projections on essentially the basis used to project capacity of U.S. agriculture to produce products in support of World War II.

However the high level of expenditures required to support the Consortium effort provided constant motivation to both MSU researchers and AID to find a cheaper way of carrying out an agricultural sector analysis. This motivation resulted in AID/csd/1557, a contract let by AID to MSU to develop the simulation approach to agricultural sector analysis. The need for this contract was perceived as an outgrowth of the conference discussed above.[1/] Under this contract a computerized simulation model was developed for Nigerian agriculture not because we had a contractural obligation to do practical work in Nigeria but, instead, because we needed something in the real world to practice on and we knew quite a bit about the real world in Nigeria.

[1/] This contract did not call for practical, problem-solving work--it called instead for an effort to develop the systems science simulation approach.

The simulation work in Nigeria did not involve sufficient interaction with Nigerian decision makers as it was a centrally funded project given to MSU for the purposes of developing an approach. However, the model which was developed has been used rather extensively by Nigerians and has played an important role in the development of Nigeria's present "perspective development plan," a classified document which can be discussed in detail here.[1/]

For the past three years I have been participating in a running seminar labeled under the name of "TransAtlantic Committee on Agricultural Change" (TACAC). The other four members of the seminar group are Richard Day at the University of Wisconsin; Ulf Renborg, University Uppsala, Sweden; Theodor Heidhues, University of Gottingen; and Michel Petit, University of Dijon. Our seminars and deliberations are resulting in a publication of a book on agrarian change. These seminars have involved intensive discussion of modeling and analytical efforts to solve the problems of agrarian change both in the developed and the less developed countries.

Lessons for Sector Analysis:--At this point I will try to summarize very briefly, the lessons I derived from the above experiences for doing agricultural sector analysis. These experiences indicate:

(1) The advisability of remaining problem oriented in determining what part of the real world will be studied and modeled.

[1/] Alan Strout refers to the effort as "abortive." We think this terminology is unfortunate on two counts. First, the contract did not call for pregnancy in any practical sense. Second, the project did produce twin products by (1) contributing to the development of the approach as required by the contract and (2) being of considerable practical value in Nigeria. (See S. O. Olayide, M. H. Abkin and G. L. Johnson,"Agriculture and the Growth of the Nigerian Economy; Results of Policy Simulation Experiments" Nigerian Journal of Economics and Social Studies, March, 1973.)

if research is to be practical as contrasted to disciplinary.

(2) The advisability of making projections, either with paper and pencil or a computer, to show the consequences of through time of alternative courses of action to solve problems.

(3) The necessity of modeling technical, institutional and human change as appropriate in specific problematic contexts--this implies a need to be flexible with respect to disciplines (kinds of information), sources of information and techniques.

(4) The advisability of being flexible with respect to the use of maximizing models to prescribe solutions and in modeling the behavior of producers and consumers.

(5) The importance of doing premaximization work on questions of the orders in which to do different things within projects, different projects within programs and different programs within projects.

(6) The advisability of being general with respect to developing normative and prescriptive information as well as positive information--this implies avoiding metaphysical presuppositions which would prevent work on any of these three kinds of information.

(7) The necessity of including informal as well as formal components in a total modeling effort.

(8) That credibility with decision makers depends on using at least as many techniques and kinds and sources of data and information as they do--this implies partially abandoning the disciplinarianism of the university and engaging in the multidisciplinary, problem solving activity--it also implies a balancing of crudities, in a study, among disciplines which should be expected to be equally unsatisfactory to almost all disciplinarians involved.

(9) That disciplinary excellence is required in multidisciplinary problem solving efforts--this implies a willingness of disciplinarians to work as team members without trying to preempt the project for their discipline.

(10) That the conflicts which often arise between disciplinarians from academia and practical men from civil services are, to use the current jargon, counterproductive.

The Problematic Situation in Korea

The paper and pencil projections done in Nigeria under Director Adler attained acceptability and credibility with him, Francis Labeau and Francis Jones, then in the African Bureau. Thus when Director Adler and Francis Jones went to Korea and Francis Labeau went to the Asian Bureau, we were asked to come to Korea to consider doing an agricultural sector study for Korea of the type done by CSNRD. Director Adler was counting on us to apply the lessons summarized above with respect to the "hows" and "whats". The orientation had to be practical. Dr. Adler and his RDD officer wanted us to study the Korean agriculture sector in such a way as to contribute to the solution of the important agricultural development problems of the country. The study was to be sponsored jointly by the Korean and U.S. governments; hence, we were to be concerned with the problems of both governments in the country. By combining TAB funding, Mission and country funding, and university expertise we were implementing the ideal arrangement which Joel Berstein, Erven Long and also, importantly, Francis Labeau shared.

Both governments wanted quick results and we were pressed to contract to produce a first draft <u>within seven months</u> after arrival of our regular staff in Korea. It should be noted that all highly developed, quantitative, disciplinary work was in low repute among AID/W and AID/Seoul administrators. This included I/O, L.P., RLP, B/C analyses and econometric models based on time series data. Simulation was identified with quantitative techniques. Though quantitative work was in low repute and the word simulation could not be used freely eithin in the contract or in cable correspondence, we contracted to produce results obtainable within seven months on the small budget provided only by using computerized "simulations." The contract was for roughly one-fifth the money which supported the CSNRD paper and pencil projections.

There were other sharp restraints within which we had to operate. This included poorly organized computational facilities, location of the project in a Korean institute which had not yet found a firm place for itself in the Korean establishment, and a shortage of Koreans capable of doing systems simulation work. These restrictions were so limiting that all evaluations of the Korean effort must be made in the light of them and in view of the fact that we agreed to do the best we could, in such a short period of time, on a limited budget because we understood the practical needs of the Korean and U.S. government. Academic desires had to give way to the problems and necessities of the real world.

A. Defining the domain to be modeled. The number of problems in Korea agriculture of interest to both the Korean and U.S. governments turned out on investigation to be almost infinite. Three people from MSU spent a total of over two man-months just trying to get a grasp of the problems before the work program and contract proposal were submitted. After a very general program of work and the contract proposal had been developed and approved, we still faced the problem of redefining the problems more specifically in order to establish more precisely the domain to be studied and modeled within Korean agriculture. As in the Nigerian consortium study, we reduced the complexity of the problems to be considered by grouping the problems into three broad policy alternatives about which Koreans were debating. One policy alternative was a continuation of the agricultural policies and rural development strategies laid down in Korea's third five-year plan. A second alternative was to modify the third five-year plan to

include higher agricultural product and food prices, increased investment and research in rural guidance (extension), improvement in guidance efficiency, concentration on high payoff land and water development projects, increased investments in rural infrastructure to eliminate transportation and marketing bottlenecks, and a more effective planning program. The third alternative was to place greater reliance on international sources of agricultural products and on private domestic market mechanisms.

Once the problem of Korean rural development was stated in terms of choosing among these three alternatives, the domain to be modeled within Korean agricultural sector was more clearly established. A comforting additional reason for modeling this part of Korean agriculture was the faith that the resultant model would also be capable of being easily modified to handle much more specific problems such as that of alternatives investments in the Korean agriculture research program.

B. Exploring the positive in the institutional, technological and human dimensions of the problem domain. Once the three broad policy alternatives have been defined, it was time to amass descriptive data concerning the part of Korea's real world agricultural sector which was to be modeled. This was done with a large number of working parties composed of both Korean and American personnel. The working parties were multidisciplinary as it was necessary to understand the institutional, technical and human dimensions of the domain. MSU team members included an industrial psychologist, an expert in extension personnel training, a student of public administration, a systems scientist, the director of the agricultural experiment station (a horticulturalist), a sociologist and demographer, an animal husbandryman and a number of

agricultural economists several of whom had technical training in the agricultural physical sciences, mathematics and statistics as well as in sociology, political science and the humanities. On the Korean side considerable technical and institutional expertise was provided. AID, itself, was in a position to provide technical expertise with respect to forage crops, vegetables and fisheries as well as some expertise in livestock production.

In substantial part, the priorities assigned to different components, subjects, etc. with the project grew out of the descriptive work done by the forty or more people who made up the working parties. Evaluators concerned about the priorities assigned within the project would do well to base their criticism on a thorough reading of the working papers and on empirical checks of their descriptive validity.

C. Exploring the normative. In order to outline the three broad policy alternatives which defined the domain modeled, considerable attention had to be given to both monetary and non-monetary values. Early in the experience, we were fortunate enough to be able to attend a seminar based upon the research which the University of Chicago's George Tolley did on managing the rice sub-sector. That seminar included substantial interaction with the leaders of Korean agriculture. This interaction revealed the importance of such non-monetary values as the goodness of nutrition, the goodness of self-sufficiency on the edge of unsettled Asia, the need for a more equitable distribution of real incomes, and conflicts between traditional and rural values and those of the modern, urban Korea.

As modeling of the Korean agricultural sector proceeded, decisions had to be made concerning which parts of the agricultural sector would be modeled in greater or lesser detail. The working parties revealed that significant values were attached to development in the different regions. It was the values associated with crops and regions which made it advisable to disaggregate the model into three regions and to disaggregate agricultural production into 19 different commodity groups. Perhaps as many man-months went into the decision to disaggregate into three regions and 19 commodity groups as have been spent by the evaluators present at this conference.

Other interaction between investigators and decision makers was extremely important in revealing the crucial monetary and non-monetary values for Korea. Such interactions helped establish the three broad policy alternatives. As the model was developed meetings were held with the vice-minister Rhee, with Park, Jin Hwan (economic advisor to the president) and with the minister of agriculture to help clarify the important value constellations in Korean agriculture.

The final report on the Korean study is fairly unique among economic development reports in presenting a methodology for handling normative information explicitly and, hopefully, objectively. It is also unique in the sense that it includes Chapter V on values and public choices. That chapter examines four constellations of values involving food supplies, rural life, overall development, and administrative and political processes. We believe that the normative information contained in Chapter V is at least as basic to modeling Korean agriculture as the positive information used. The processes whereby such information is accumulated are interactive and iterative. Problems are defined tentatively. Further accumulation of positive and normative information leads to redefinitions of the problem.

In turn these are checked with decision makers and other informed people Sometimes they like the changes, sometimes they do not. In any event their reactions indicate what is important and what is not important. Thus, their reactions are a source of normative information. As soon as a model permits even rough, tentative projections into the future these projections can be displayed to decision makers. The result is more interaction and more information about what is valued and what is not valued. It should also be pointed out that this iterative interactive process is productive of positive as well as normative information. Often times administrators, decision makers and others are able to point out important kinds and sources of information which have been neglected that they would not point out if not challenged with projections which they do not believe. An advantage of including this source of information is that it insures against lost credibility with decision makers as a result of reporting less than the decision makers know!

This conference at Airlie House is regarded by us as a continuation of this interactive, iterative process. We have a fine set of papers from Craig, Randers, Singh, Strout and Candler to provide an excellent basis for such interactions and which should lead to superior iterations.

Philosophically the interactive, iterative process which is described here is close to the pragmatic philosophy which undergirds institutional economics and is much stressed by such econometricians as Georgescu-Roegen.[1/]

[1/] Georgescu-Roegen, Nicholas, The Entropy Law and the Economic Process, Harvard University Press, Cambridge, Massachusetts, 1971

This interactive iterative process is one which is regarded with suspicion by people with positivistic metaphysical predispositions as such predispositions preclude the possibility of objective knowledge of the normative. This brings up the problem of philosophic positions and metaphysical presuppositions. We elected to free ourselves from specialized metaphysical presuppositions enough to be able to deal with values explicitly.[1/] Basically we had to do this in order to define Korea's agrarian problems in a non-arbitary, objective way and hence the domains which we were to model. Before the Korean project can be seriously criticized as to the domains modeled or the emphasis placed upon different kinds and sources of information and different analytical techniques, critics must familiarize themselves with the value systems important in Korea. Once they are familiar with those value systems, we are prepared to discuss the appropriateness of the domains which we have modeled; however, for such a discussion to be objective it must be agreed that there is some possibility of having objective norma ve knowledge to use in defining problems and assigning priorities.

D. The importance of premaximization. Exploration of the normative discussed above is important in establishing trade-offs among alternative monetary and non-monetary values.

[1/] Johnson, Glenn L. and Lewis K. Zerby, What Economists Do About Values: Case Studies of Their Answers to Questions They Don't Dare Ask, Department of Agricultural Economics, Michigan State University, East Lansing, MI, 1972. Johnson, Glenn L., "The Role of the University in Economic Development," J. S. McLean Professorship Lecture, Guelph University, March 23, 1970.

Finding the trade-offs among such values is tantamount to establishing the first precondition for maximization--a common denominator among the various multiple values being sought and avoided.

Interpersonally valid common denominators are difficult to find when dealing with technological, institutional and human changes which impose damages on some in order to confer benefits on others. Such changes are involved when one considers changing the general level of food prices which benefit rural people at the expense of farm people. Similar needs for a common denominator arise in deciding to tip the terms of exchange for or against farmers in order to keep labor in or drive it out of agriculture. Technological advances involving the introduction of power tillers influence adversely farmers with land which can only be handled manually or with oxen while conferring benefits on farmers with land amenable to mechanized cultivation. While it is probably impossible to attain a universally applicable, interpersonally valid common denominator of values, substantial progress can be made at least within value constellations and we feel that we did make some such progress.

There are also extremely important questions concerning sequences in which to start projects within programs and programs within policies. These arise in connection with both general and vocational education, in creating new biological and chemical technologies, and in changing institutional structures and especially in controlling demographic processes. Thus, a great deal of premaximization work is required before enough is known about optimal sequences in which various projects should be executed within programs and various programs should be executed within policies to be able to maximize.

Other premaximization work to be done involves reaching agreement on what kind of decision rule to use. Often times maximization of the net present value of expected future costs and benfits is not acceptable and a safer strategy of maximizing the worst that can happen is more appropriate.

In my judgement well over 75 percent of the work involved in reaching evaluative conclusions of the type reached in the Korean agricultural sector study report involves premaximization. The economists heading the project had to be continually on their guard against the premature use of pet maximization techniques and computations without spending enough time on technological, institutional and humanistic details to attain even a somewhat interpersonally valid common denominator, even rough ideas about optimum sequences to follow, and even tentative appropriate decision rules to use.

E. The relatively minor roles of straight forward maximization computations from economics. The economist is almost dismayed at how long he has to wait in the process of studying an agricultural sector for an opportunity to apply his maximizing techniques. Furthermore he is also dismayed when he sees the relatively minor role such techniques play in modeling that part of an agricultural sector containing the problems typically investigated. This was true for the Korean project and may be true for some of the consultants here.

The Total Korean Model

The total Korean model includes far more than that formal part which was conceptionalized, expressed mathematically and converted into operating computer programs.[1/] The formal part which has been programmed onto the

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[1/] See Figure 1, p. 4.

computer is in some ways less important than the informal part. The informal component and others which provided for interaction among investigators (both within KASS and outside of KASS as here at Airlie House) and between investigators and the decision makers of the Korean and U.S. governments. Informal components feeding the formal components are or were the components which generate data on land usage, yields and prices. These are identified in various diagrams describing the Korean model with dotted lines. See Figure 2. Probably still more important than these informal, data-generating components are the informal components providing for interaction between investigators and decision makers. These are not indicated with dotted lines on any of the diagrams describing the total model. However, their importance is readily apparent from the above discussions of the role of interactions with decision makers in the iterative defining and redefining of problems and, hence, the domain to model. A full scale evaluation of the Korean research effort has to take into account both the formal and the informal components. The discussions at Bellagio which I referred to at the beginning of this paper involved a considerable amount of attention to the need to formalize these informal, iterative, adaptive processes whereby investigators and decision makers interact.

The total Korean project is, of course, incomplete and inadequate in many, many ways. It is inadequate with respect to many subjects, techniques and procedures of particular interest to economists; however, the inadequacies and incompletenesses with respect to economics are no less important than those with respect to such other disciplines as political science, sociology, demography and particularly, the agricultural technical

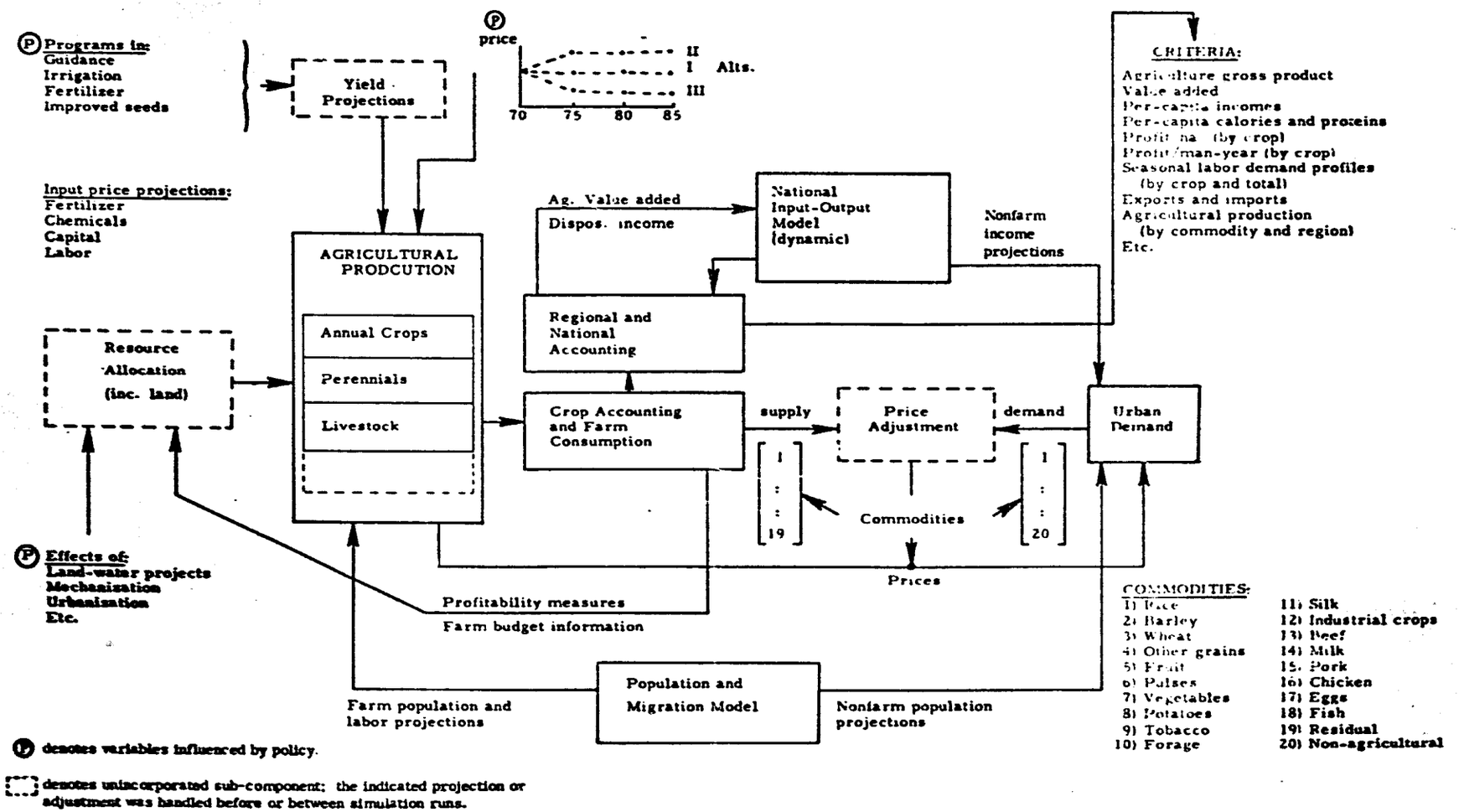

FIGURE II. Diagram of iterative operational model of Korean agricultural sector actually used to project consequences of alternative policy strategies.

sciences. I hope that in the two days ahead we can discuss these inadequacies and incompletenesses in a straight forward objective way in the context of both Korean agrarian development problems and the more general objectives of AID/csd/2975.

In carrying out such discussions it seems to me that we should be oriented to both the problems of Korea and the needs of practical sector analysts. In this connection, we should not forget the economic principle of equating marginal returns to dollars spent on remedying the numerous different crudities. Though there are not many non-economists present at this session in Airlie House, there are a considerable number of civil servants present who are well aware of the institutional, technological and human dimensions of the problems of Korean agricultural development. Even if we can do little to critique the models shortcomings from the standpoint of the technological, institutional and humanistic disciplines, I am sure that the inadequacies and incompletenesses of the model with respect to economics can keep us fully occupied for the next two days. It must be pointed out, though, that irregardless of how thoroughly we criticize the model and make suggestions for its improvement from the standpoint of economics, our evaluations and suggestions for improvement will be incomplete and inadequate until the model is thoroughly critiqued from the standpoint of the theories and techniques of other relevant disciplines in the context of Korea's agrarian development problems.

Some Suggestions With Respect to the Contents of Paper by the Consultants

We did not obtain copies of the consultant's papers until last Friday. This left us short of both reading and writing time. Hence, the following comments are somewhat off the cuff:

1. First, the papers are well done and reflect hard competent work. They provide an excellent basis for constructive discussion the next two days.

2. The Singh paper on L.P. contains many useful suggestions and criticisms. These are based on substantial part on the Day, Singh, Mudahar, Heidhuis, De Haen work with which we are familiar. There are three questions on which we would like constructive interaction at this conference among Singh, DeHaen, Candler, Manetsch and myself (unfortunately Lee, Jung Han could not be present). The three questions are:

    a. How do we interface RLP components into the overall model without using too much computer capacity and computing time. It is possible to run the L.P., say, every five years extrapolating ahead and then iteratively interpolating across the five year gap once it is crossed? With a 1/4 year Δt this could save 18 matrix inversions every five years at the cost of six runs (without matrix inversion). Or would it be better to forget L.P. as a technique and use other methods more closely akin to those followed by the land allocation committee?

    b. The next question is highly theoretical yet extremely

relevant to modeling. Opportunity costs for the unit or part of an economy under consideration are bounded by acquisition prices and salvage values. These bounds are in terms of stock values. Opportunity costs are in terms of the MVPs of services in alternative uses. This creates a stock/flow conversion problem which must be solved in order to model investment (which occurs when value in use exceeds acquisition price) and disinvestment (which occurs when value in use falls below salvage price.) Growth takes place when investment exceeds disinvestment. When investment exceeds disinvestment deterioration occurs. When modeling disinvestment and investment stock/flow conversions are required; but these depend on the rate at which services are extracted from durables and hence, on user costs. Keynes reorganized the importance of user cost when dealing with investment and production at macro levels in General Theory. Arthur Lewis formulated 3 alternative ways of looking at user costs, none of which was acceptable to him. Day and his students including our consultant, Singh, have not solved the problem. Nor have I and my students though we have made some progress at both micro- and macro-levels.[1/] The Day, Singh, et al.

[1/] Petit, Michel J., "Econometric Analysis of the Feed Grain Livestock Economy," a Ph.D. thesis, Michigan State University, East Lansing, 1965. Lard, Curtis F., "Profitable Reorganizations of Representative Farms in Lower Michigan and Northeastern Indiana With Special Emphasis on Feed Grains and Livestock," a Ph.D. thesis, Michigan State University, 1959. Johnson, Glenn L., and C. LeRoy Quance, The Overproduction Trap in U.S. Agriculture, Resources for the Future, Inc., The Johns Hopkins University Press, Baltimore. A Nigerian, Francis Idachaba has made some significant progress in a tentative paper entitled, "Investment and Disinvestment."

treatment of L.P. does not handle user cost adequately. Perhaps handling user cost adequately would destroy independence among LP activities making it necessary to go to non LP techniques. The credit activities and constraints which Singh correctly notes are neglected cannot be "properly" handled until user cost and subsequently investment and disinvestment theory are more completely developed. The question to be asked is this: In view of these theoretical difficulties and in view of the importance of interfacing specialized LP components, should we spend more time "improving" LP constraints, activities and components along the well known Day/Heidhues/Singh lines. Personally, I would opt for interfacing in the Korean effort and for theoretical work of the type indicated above, as part of the 2975 effort,[1/] while postponing substantial additional work on LP constraints, activities and components until theoretical progress is made and more is learned about interfacing.

c. The third question is normative in nature and deals with both objective functions and decision rules in LP's. In forming objective functions for problems involving non-Pareto better changes in technology, institutions and people, numerous different values and objectives are involved. Further, knowledge about such changes is imperfect. Our questions is concerned with potential roles of lexicography ordering, managerial learning activities and "adaptive behavior" decision rules in RLP's?

[1/] Incidentally, it is assumed that all consultants have read, the MSU statement on the relationships of AID/csd/1557, AID/csd/2975 and AID/SA/PROC-184. If not see Appendix A.

3. The Craig paper is well done and has many important suggestions. We liked the attempt to distinguish between empirically and theoretically important questions. We also liked his suggestions for obtaining greater internal consistency at low cost and will exploit such opportunities.

We are painfully aware of the shortcomings he noted of the model with respect to the economics and sociology of migration. Until usercost/investment/disinvestment theory is straightened out, our models and the work of others (economists and demographers alike) on migration, underemployment and employment generation will be poor. So will attempts to model intersectoral and interregional trade of which migration is but one form.

In view of the apparent empirical validity of many KASS population estimates, we ask for advice on whether or not attempts to improve the demographic components directly in the Korean model should have higher priority than attempts to straighten out investment and disinvestment theory under AID/csd 2975.

How to model feminine participation in the labor force as determined by the economics and sociology of child bearing is also an important question. The recent University of Chicago conference on the economics of human fertility provides provocative leads[1/] which

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[1/] Journal of Political Economy, Vol. 81, No. 2, Part II, March/April 1973.

might be worthwhile following up under 2975 if not in Korea, given time and resource contraints for Korea. Should this be done and, if so, in Korea or as part of 2975?

4. The Randers paper is an interesting one containing a very worthwhile statement of his priors. We will be interested in agreements and disagreements among consultants about Randers "priors."

The following quotes should be useful to other consultants in understanding work under AID/csd/2975, in general, and in Korea, in particular.

a. "Simulation models should focus on a problematic phenomenon observed in the real world, and aim at devising improved policies to handle the problem."

b. "Only sharp focus on a particular phenomenon makes it possible to choose among the myriad of real world relationships those that should be included in the model."

c. "We can easily build models that are more consistent and complete than the mental models normally used, and derive the consequences of assumptions speedily and without flaws."

d. "To generate useful structure-determine conclusions, a model must be sufficiently rich and flexible to be capable of generating surprising behavior, that is, modes that vary from the initial problematic one."

e. "All practically useful models have to be made faster (more quickly) than one would like in order for the insights to reach the decision maker before he has moved on to new problems. In this situation I believe the efficient approach is to start by constructing a rather shallow model with a sufficiently wide scope (i.e., including all aspects of reality that are relevant to the problem) and then keep on deepening (i.e., increasing the amount of detail) the model uniformly until time or money runs out."

f. "Is the Computer Library for Agricultural Sector Simulation (CLASS) a useful concept?

Yes, absolutely. A library of service routines (e.g., delays) will be handy and much used by modelers. Social process models (e.g., aging) also have sufficient general applicability to become used if they are well documented.

The following pairs of quotes are interesting and raise fundamental questions for research of the type being evaluated at this conference.

1. "The initial collection of selected relationships in a model should be done with one main objective: To create a structure capable of regenerating the

problematic behavior. Preferably it (the model) should be a small structure where all pieces are equally significant."

2. "To generate useful structure-determined conclusions, a model must be sufficiently rich and flexible to be capable of generating surprising behavior, that is, modes that vary from the initial problematic one."

With respect to these two quotes we ask what is meant by "equally significant" and how large a structure is required before a model is "sufficiently rich and flexible to generate surprising behavior."

3. "In building a simulation model of a social system, the objective should be twofold: To discover the structure underlying an observed problem...."

4. "I believe one can usefully distinguish between parameter-determined and structure-determined conslusions in simulation studies, and that one should solely aim for the structure-determined conclusions because they are very much more reliable. (See Figure 1.) Structure-determined conclusions (e.g., regarding the behavior mode of a system) remain valid as long as the model structure contains the important, relevant feedback loops. Wide variations

of parameter-values and detailed formulations will not change a structure-determined conclusion. On the other hand, for a parameter-determined conclusion (e.g., regarding the size of the demand at a specified future point of time) to be reliable not only must the model structure be sound but in addition, all parameters, functional relationships and the future behavior of exogenous perturbations must be correctly estimated and included."

With respect to quotes 3 and 4 above, we would like reactions of other consultants to the following questions. Randers' opinion may be his response to criticisms of the MIT limits growth studies. Those studies were not done for a world government with responsibility for making decisions on growth. By contrast the KASS work was done for decision making units. Can decision makers get along without both parameters and structurally determined systems? Part of our concern is with whether or not there are structurally determined systems whose structural dominance is not determined by parameters. Even identities and accounting equations have parameters of one and zero both as coefficients for terms and as powers for variables. How can feed back loop be modeled without parameters? An who chooses the functional forms for those loops, with what parameters and on what empirical basis?

5. A social system model cannot be validated (i.e., proven to be correct), it can only be evaluated: one can indicate the extent to which the model passes certain tests.

(6) "I believe the [further] testing should not be restricted to some narrow specialized (possibly quantitative) test. Rather all aspects of the model (the completeness of the structure relative to the phenomenon under study, the realisticness (realism) of the individual mechanisms included, the reasonableness of past and future behavior of the total model, etc.) should be scrutinized against all available knowledge about the simuland (descriptive knowledge contained in peoples minds and in the literature, quantitative measurements, applicable rules of logic and consistency, etc)."

Our question with respect to quotes (5) and (6) is on the difference between validation and evaluation. Is it ever possible to validate any part of any kind of empirical model as unconditionally true? Or do we merely accept it because it has survived a "sufficient" number of sufficiently rigorous tests? In this connection we quote the KASS report here.

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

1. consistency with observed and recorded experience,
2. logical internal consistency of the concepts,

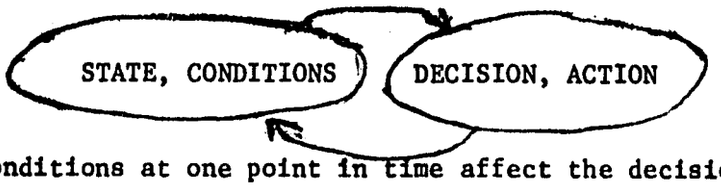
3. interpersonal transmissability of concepts (including estimates and forecasts), and
4. workability when used to solve problems, this being a special case of the first

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

Perhaps Randers' distinction between validation and evaluation can be drawn out by other related questions: Can we validate or verify or evaluate the truth of the normative content of our models? Does Randers' distinction between "social" and "non-social" models depend on the presence of normative as contrasted to positive variables? Answers to such questions are relevant in deciding whether or not problems and, hence, domains can be objectively defined and solutions to problems recognized. If they cannot then objective prescriptive (problem solving) research cannot be done. This seems to be fundamental to recognizing, in social models, the structure Randers wants us to recognize in the following quote.

7. "I believe any social system (i.e., one involving human

actors) develops as the result of the following structure:



The conditions at one point in time affect the decisions taken at that time which in turn affect the future conditions of the system, changing the basis for future decisions and so on ad infinitum. I prefer to see that structure recognized in social models."

We have never been satisfied with cybernetics on this point which seems to be somewhat too positivistic to deal with normative feedback loops. In Korea, these normative feedbacks were studied informally in iterative interaction with decision makers. In doing the MIT limits of growth study, there was no decision-making group with which to interact. In the absence of a relevant decision making unit, did the MIT workers try to build formal models of the normative feedback loops? If so, we would appreciate hearing about their experience as a basis for formalizing the informal components of our model.

5. Strout was charged with evaluating the capacity and utilization of the model in Korea. Overall he has done an excellent job of pointing out the progress to date, the deficiencies remaining, and making recommendations for the continued work in the areas of institutionalization, training and linkages with other Korean agencies, institutions and decision making points.

There is erroneous information on 2 points which should be clarified. On the first page he notes "following up preliminary but abortive simulation studies of Nigerian agriculture..." He should understand that the work in Nigeria was contracted to be strictly developmental and that it was

carried to a successful conclusion. In addition substantial follow-up work took place in Nigeria. Use of the model by Nigerian decision makers has taken place despite the difficulties in foreigners obtaining access to the country. The second point of clarification is on the budget figures he uses on page two and refers to again on page nineteen. He says, "the MSU team through March 1974 will have invested about 14 man years of short and long term research effort and about U.S. $1 millions of AID funds." This includes the approximate $300,000 under contract AID/ead-184 and approximately $700,000 expended under contract AID/csd-2975, the latter expenditures including work at MSU on the training program, the software library, thesis owrk by MSU graduate students on Nigerian and Colombian problems, consultancies both domestically and internationally. We estimate that out of the $700,000 expenditure on contract 2975 perhaps percent has in fact gone to Korea. In this connection, we wish to draw attention again to appendix A of this paper which clarifies the relationships among various contracts at MSU. Confusion among the purposes of AID/csd 2975 and AID/ead 184 needs to be reduced so that we can see clearly the roles to be played by MSU in East Lansing and in non-Korean locations versus the roles to be played in Korea.

6. From Phillips' paper, it is obvious that he knew a good deal about Korea and its agricultural sector before working on this evaluation, spent a good deal of very productive time in Korea on the evaluation, and viewed his role as one of becoming familiar enough with the grain management component to be a constructive critic of its conceptualization and development. From both reading the paper and the comments made by Forrest Gibson about the Phillips visit to Korea, it is clear that Gibson and the KASS team has

already gained considerably through interaction with Phillips.

Apart from the technical recommendations for improvement of the model itself (of which there are many and which for the most part appear to be well conceived and thought out) he gives Forrest Gibson high marks for his conceptual job and his ambitious undertaking. However, he also sees as one of the main problems that of conveying an understanding of the model, its usefulness and its limitations to the variety of decision makers who can benefit from using it. He sees the model as useful to not only decision makers within MAF but also those in EPB, the Blue House, quasi-governmental agencies such as NACF, and the grain trade itself both domestic and those engaged in import and export. He stresses the point that Dr. Kim and his staff will need to make a heroic and consciencious effort to build the linkages and liaison with these external agencies since it will not come about automatically.

With respect to the question of potential application of the grain management component in other countries, he is enthused about its applicability, but somewhat pesimistic about wide transference. The component itself should have wide adaptability in other countries but the problem of interfacing with the other subsectors of agriculture and other sectors of the economy without another full blown sector simulation model in each country is difficult. Other constraints include the problem of input requirements and data which he feels may be difficult to obtain in many countries. Another point he makes is the need for trained personnel to build and utilize such a model and that the trained personnel must be indigenous since it would be too costly to invest in model development for a one

shot application such as the development of a five year plan. He also alludes to the fact that administrators and decision makers must have a proper attitude toward such a model if it is to make any headway in another country. He winds up by recommending that priority be given to complete development and application of the grain management program component in Korea before attempting to face the question of transferability.

7. And, lastly, the Candler paper. Because I was in East Lansing during his short visit there I anticipated a great deal of what he would have to say. Thus, the first part of my own paper deals with:

a. the danger of overstressing the economics of a problematic situation at the expense of neglecting contributions from other disciplines

b. the necessity of doing premaximization work with technological, institutional and human charge and variables

c. the necessity of being general with respect to technique, types and sources of data, and philosophic orientation as well as disciplines

I hope we can have discussion of the relative emphasis to be placed on forage and livestock technology (including disease and parasite protection), institutional changes and the human factor as well as "economic modeling" in studying the livestock sector. And, in discussing economic modeling of the livestock sector, I hope we will consider the questions about investment, disinvestment, user cost, lexiographic ordering, adaptive behavior which were raised earlier in connection with Singh's and Craig's papers.

8. There are three major questions which we would like to keep before the

group.

a. Randers has recommended that we confine ourselves to smaller, more general models. Others have asked us to include great amounts of specific detail, much of it disciplinary in nature, with respect to demography, land allocations, interrelationships among sectors and regions, the economic aspects of livestock production, etc. Our question and I am sure the question of AID/W is - Which of these two conflicting routes do we take?

b. The second question is also one raised by Randers. Is there a concensus that we should move in the direction of structurally dominated as contrasted to parametrically dominated models?

c. The third question involves the basic nature of AID/csd 2975. That contract provides support to both:

   1. develop and extend the general systems simulation approach by developing components (this implies improving underlying theories and data), software library, and training

   2. make applications in countries in response to AID requests.

We are being urged to make fundamental developments in demography, economics, and systems science. Had we had consultants from education, public administration, sociology, political science, statistics, geography and the technical agricultural science, we can be assured that over 90 percent of them would have recommended detailed fundamental developments with respect to their own disciplines and interests. And, to make the question more intriguing, the developments they would seek (like those of the consultants we have) <u>would be relevant</u>. Our question is how much of this sort of work should be in 2975 and how much of it should be directly attached to either (1) the Korean effort or (2) applications work in other locations.

APPENDIX A

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AGRICULTURAL SECTOR ANALYSIS AND SIMULATION PROJECTS
DEPARTMENT OF AGRICULTURAL ECONOMICS
CENTER FOR INTERNATIONAL PROGRAMS

MEMORANDUM

TO: All MSU Project Evaluators

FROM: The MSU Sector Analysis and Simulation Project Team

SUBJECT: The Evaluation

DATE: 21 January 1974

The MSU team is concerned that the project evaluators understand the administrative relationships and operational environment within which the MSU Agricultural Sector Analysis and Simulation Project has performed over the past two and one half years. It is to that end that this memo is addressed.

The Agricultural Sector Analysis and Simulation activity at MSU is a project administratively under the Department of Agricultural Economics and through which the resources and personnel have been mobilized to carry out the activities and objectives of the AID/MSU contracts as described below. The core source of funding for the project is Contract AID/csd-2975 which began in June 1971 and followed the successful completion of Contract AID/csd-1557. Contract AID/csd-2975 is funded and monitored by the Technical Assistance Bureau, AID/W. The objectives under this contract are attached as Appendix A.

As part of the decision to carry on Korean activities under AID/csd-2975, another Contract AID/ead-184 was negotiated with the Asia Bureau AID/W and and the USAID/Korea Mission. AID/ead-184 was funded from Mission sources and is monitored by the Mission. This contract had a different set of objectives from those to be carried out under AID/csd-2975 as can be seen in Appendix B. Contract AID/ead-184 required the MSU team to: (1) produce a broad comprehensive agricultural sector analysis report within seven (7) months after arrival of the first regular staff in Korea; (2) to produce an investment priorities study report within twelve (12) months; and (3) in the longer range, to improve and develop program evaluation, analytical program development, and policy formulation capabilities of the Ministry of Agriculture and Fisheries, ROK. Though simulation is not an integral part of AID/ead-184, that contract was fulfillable within the time and cost constraints of AID/ead-184 only through the use of computers guided systematically by models involving the use of simple (even crude) components and a wide variety of information from many sources and of varying quality.

Evaluators should recognize that Contract AID/csd-2975 activities and objectives in Korea are only part of the Korean project since activities and objectives under Contract AID/ead-184 were also involved. Evaluators should further note that the Contract AID/csd-2975 portion of the Korean project is in turn only a part of the activities under this contract. Major additional activities include those carried out at MSU on the software library and on the training program. In addition, work has been carried out under AID/csd-2975 for Nigeria and Colombia. Further, project personnel have consulted and participated in meetings, seminars, and conferences with a number of international, foreign country, and domestic agencies and institutions.

Chapter 4 of the Korean Agricultural Sector Analysis Report spells out the Korean project (KASS) approach, while the attached Appendix C indicates the definition of system simulation which is integral to both the contract and the project. The extremely strict time pressures and cost constraints imposed by both AID and the Korean government on fulfilling the objectives of Contract AID/ead-184 had, for the most part, positive consequences. The KASS team viewed the activities under Contracts 184 and 2975 in Korea as highly complementary and operated from the beginning of the KASS project with an intent to fully capitalize upon those complementarities. The normative and qualitative non-normative information collected by the short term personnel under Contract 184 was extremely useful in conceptualizing the simulation model components for the Korean Agricultural Sector under Contract 2975. Conversely the conceptualization of the model on the basis of AID/csd-2975 work was useful in determining the hard data and information to require short term personnel to collect under Contract 184. Contract 184 personnel were able to spend more of their valuable time in collecting data and information and in doing qualitative analysis since the required projections were made with computers rather than by short termers using paper and pencil and desk calculator. The time pressures and costs constraints imposed on 2975 to support Contract 184 objectives and be crude but balanced in such a way as to provide the broad array of results necessary to satisfy Contract 184 objectives. Individual components had to be such that the marginal returns per dollar, and time unit spent in refining them were equal among components; to permit great refinement of components based on special techniques at the cost of neglecting more important crudities would have been inefficient.

Since completion of the Contract 184 objectives at the end of the first year of the Korean project a substantial amount of personnel time and resources have gone into: (1) improving existing model components, (2) making the model more user-oriented, and (3) building new components. In addition a substantial amount of effort has gone into concentrated training of Korean

personnel in the systems approach and the use of simulation techniques. These activities received relatively less priority during the first year because of the time pressures imposed upon the activities under Contract 184. This concentrated training effort is making heavy use of the training program and software library components of Contract 2975 at MSU.

The MSU team feels that a complete and comprehensive evaluation cannot be made of either AID/csd-2975 or AID/ead-184 without taking the activities of the total project into consideration since the various activities carried out under both contracts and in East Lansing and in other parts of the world as well as Korea have complemented or competed in such a way that no distinct clear-cut, evaluative lines can be drawn around single activities or subsets of activities to view them as totally separate entities. We urge each evaluator to maintain a broad perspective and to attempt to understand how the individual project pieces for which each evaluator is responsible fits into the totality of the project as constrained by the time and cost limits of the relevant contracts. Only seven months were available and the budget was modest, yet results were produced on time and within the budget.

jmp