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Title: Concepts to Consider in Developing a Microcomputer Simulation
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The purpose of this thesis is to discuss concepts and strategies that
provide a general framework which can be used to develop a microcomputer
simulation model for educating senior public officials on the linkages
between the macroeconomy and agriculture in a developing country.

Tradition has it that agriculture is preeminently microeconomics.
Those working in the agricultural sector usually relegate macroeconomics to
the corner of general economic issues. Yet, it is the macro-management of
the economy that provides the strong environment necessary for development
of both urban and rural sectors. Micro-agricultural policies and programs
succeed generally because of the broader economic environment often pro-
vided by prudent management of the rate of growth of the money supply, by
keeping most interest rates at economic levels, a reasonably open policy to-
ward developing of banking and para-banking institutions, an exchange rate
policy that is liberal, and by trade policies which, although far from ideal,

do not prevent the agricultural sector from deriving stimulation from international markets.

This study, therefore, outlines an educational program specifically to meet the needs of those in policy analysis and decision-making positions in agriculture and related sectors so that they can understand macroeconomic policy and its linkages with agriculture. The program is built around the principle of adult learning theory so that it emphasizes hands-on, practical approach methods. Simulation, case method, and other participatory instructional methods are recommended as likely to be most effective.

Concepts to Consider in Developing a Microcomputer
Simulation Model to Promote Understanding of
Linkages Between the Macroeconomy and
Agriculture in a Developing Country

by

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Table of Contents

Table of Contents (continued)

List of Figures

CONCEPTS TO CONSIDER IN DEVELOPING A MICROCOMPUTER SIMULATION MODEL TO PROMOTE UNDERSTANDING OF LINKAGES BETWEEN THE MACROECONOMY AND AGRICULTURE IN A DEVELOPING COUNTRY

I. INTRODUCTION

Background

Increasingly, changes in the agricultural and non-agricultural sectors of rural economies are influenced by macroeconomic policies at both the national and international levels. The well-being of the agricultural sector is influenced by such factors as fiscal and monetary policies, exchange rates, domestic agricultural programs, domestic and foreign international trade policies, and the overall world economic prosperity.

> Food and agricultural development policy today is carried out in a completely different world from that which prevailed even a decade or so ago. In the past, sectoral approaches were appropriate. Today, the food and agricultural sector can be understood only in the context of the large economy, both national and international. (Schuh, 1987)

Table 1 demonstrates the many factors that affect rural life and which are important in any rural development analysis. Farmers' incomes are more obviously determined by the micro-factors, such as access to resources (land, capital, water, and credit), access to technology (agricultural extension, improved seed, and public research institutions), and choice of strategies (crop mix), as well as a wide range of non-farm activities (health, education, nutrition, and agribusiness development). In addition,

they are also affected by macroeconomic and international variables, which
are usually not as obvious.

Table 1. Factors Influencing Rural Income.

A. MICRO-FACTORS

```
                        ┌ Land ─────────── ┌ Water
                        │                  ┤ Soil Quality
                        │                  └ Size of Holding
                        │
                        │   Labor ──────── ┌ Health
                        │                  ┤ Family Size
                        │                  └ Animals
Farm Income ───────────┤
                        │   Capital ────── ┌ Credit
                        │                  ┤ Markets
                        │                  └ Prices
                        │
                        │   Technology ─── ┌ Seed
                        └                  ┤ Tools
                                           └ Information
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B. MACRO-FACTORS

```
                        ┌ International    ┌ Prices
                        │   Trade ──────── ┤ Commodity
                        │                  │    Speculation
                        │                  └ Quotas
                        │
                        │   International  ┌ Balance of Payments
                        │   Finance ────── │ Stabilization Programs
Farm Income ───────────┤                  ┤ Interest Rates
                        │                  └ Exchange Rates
                        │                  ┌ Price Controls
                        │                  │ Marketing Board
                        │   National       │ Land Reform
                        │   Policies ───── ┤ Agric. Research
                        └                  │ Extension Work
                                           │ Urban Policies
                                           └ Domestic Macro-Policies
```
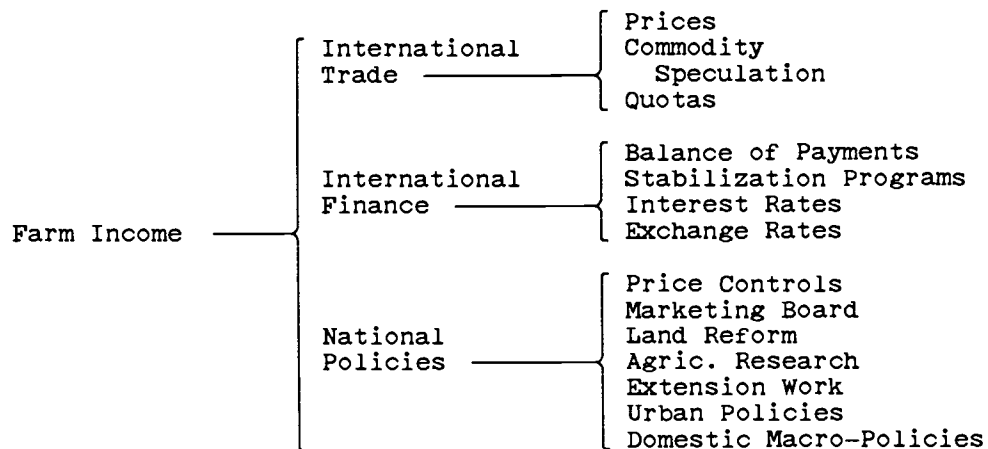
Figure 1 illustrates the interrelatedness of agricultural and food policy to
other policies. It shows the tradeoffs that a policy maker should consider
in establishing priorities for food policy goals and the need for broad un-
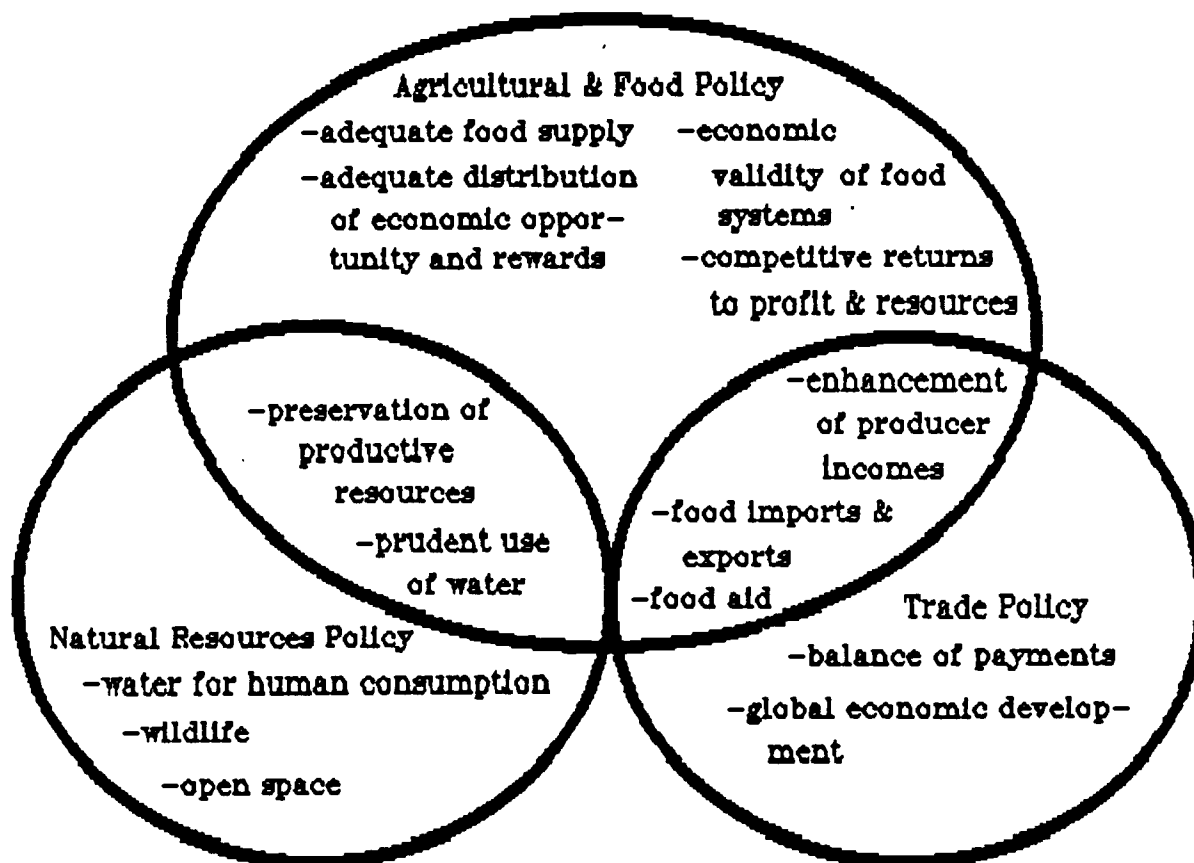derstanding of the interdependence between sectors of the economy.

Figure 1. Interrelatedness of Food Policy to
Other Selected Policies (Lee, 1981).

The increased interdependence between agriculture and the rest of the economy raises a number of important issues: (1) the effect of shocks originating in agriculture, such as price increases due to a shortfall in supply due to weather conditions, those originating in the domestic general economy, and those originating in the international economy; (2) the comparative effectiveness of sector-specific versus general economic policies on

the agricultural sector; and (3) the weight that should be given to the effects of agricultural policies on the general economy, as well as the agricultural sector.

A serious evaluation of these issues requires an understanding of the interrelationships among the agricultural sector, the balance of the economy, and the international economy. Such linkages are crucial in the assessment of direct and indirect effects of various policies--sectoral as well as fiscal and monetary. The ultimate effects of monetary, fiscal, and exchange-rate policies, as well as direct agricultural policies and trade policies, depend on the nature and extent of the direct and indirect causal links among the agricultural sector, the general economy, and the international economy. Unfortunately, macroeconomists have concentrated on strictly aggregate markets, with limited consideration of the roles of the sectors of the economy, especially agriculture.

This neglect of the agricultural sector in the analysis of macroeconomic policy has been paralleled by a general lack of attention to the effects of macroeconomic policy in the study of agricultural economics. Although the importance of macroeconomic policy for agriculture has long been recognized in the special case of the impact of exchange rate policy on earned profits from agricultural exports (Chambers & Just, 1979, 1981; Schuh, 1974), other linkages between macroeconomic policy and the wider agricultural sector have just been recently explored. Sectoral emphasis by agricultural economists has resulted in the neglect of the linkages of agriculture with the rest of the economy.

While some of the factors influencing the agricultural sector are sector-specific, many are determined in important respects by macroeconomic policy. The design and management of macroeconomic policies influ-

ence the environment for growth and development in an economy, but badly distorted policies can destroy incentive structures.

The interaction of commodity price policies and macro policies--fiscal, monetary, and budgetary--are varied and complex. These policies, coupled with those for macro prices--exchange rates, interest rates, and wage rates--may fundamentally change the opportunity cost and hence the mix of production and consumption in the economy. That is, macroeconomic policies and macro prices condition the macro environment in which micro decisions are made by producers, consumers, marketing agents, and others in the economy. Macroeconomic policies affect the cost and effectiveness of specific agricultural policies.

The nonfarm sectors of the rural economy are likewise affected by macroeconomic policies. Rural financial markets are becoming more integrated into national and international capital markets. Small village industries are directly affected by monetary and fiscal policies and by the industrial development policies of foreign countries since they are selling in both the domestic and foreign markets. These macroeconomic impacts on rural industries have substantial effects on rural development.

Specifically, budgetary policy, including the allocation of government budgets, involves the share of overall budgetary allocation going to programs directly affecting various sectors of the economy and how these resources are allocated to various programs--between consumption, production, and investment. The overall level of investment in the country is a determinant of national income growth, an important factor affecting demand for food crops and prices for goods in the country. Subsidies, when used as instruments of policy, are the best example of budgetary policy. Their effect is to force a wedge between domestic prices to consumers, producers, or both,

and the international prices. These directly affect trade. Another example is direct investment in infrastructure and human capital, such as road building and training, which provide long run productive capacity for development in the economy.

Fiscal policy affects government spending, per capita tax revenue, and investment in productivity. Per capita tax revenue is inversely related to per capita food consumption and the external trade balance (balance of current trade account + long-term capital receipts + private and other long-term investment). Investment in productivity varies positively with cash crops production, gross domestic product per capita, and per capita food consumption. This means that attempts to increase investment in productivity will have favorable reverberations in the economy. Government spending is positively related to money supply growth rate and the inflation rate. In developing countries, government budget deficits are often financed by increasing money supply (inflationary) with severe consequences, or by raising per capita tax rates, which further distorts the economy.

Generally, governments in developing countries have shifted the relative burden of public finance to international trade and urban-based economic activities. Agriculture is often burdened by the implicit taxation of agricultural price policy and exchange rates. Collection of either income or sales taxes is impractical in rural areas. Hence, the rural sector bears little overt tax burden and this serves to alleviate, to some degree, the heavy economic burden typically placed on rural sectors.

However, two theories have been put forward to explain persistent inflation in developing countries: monetarism and structuralism. The monetarist position is that increases in money income is a result of increases

in aggregate demand. Inflation is therefore a result of the continued expansion of aggregate demand after real income approaches the capacity or supply constraints of the economy. They argue that inflation is generated by unjustified expansion of both government deficits (financed for the most part by increases in money supply) and in the central banks' loans to the public and to commercial banks. The structuralists position is that inflation is rooted in the bottlenecks of inelastic supply in the agricultural sector. With weak agricultural sectors, economic growth and industrialization increase the demand for food and raw material to the industrial sector, but agricultural output is sluggish and cannot keep pace with the demand at constant prices. This is usually a result of rural socioeconomic structure and the concomitant neglect of rural areas in government development efforts. Prices in the nonfood sectors of the economy are often inflexible downward. The rise in the relative price of food, combined with the rigidity of nonfood prices, results in an increase in the overall level of prices. Government spending is, however, weakly related to gross domestic product per capita and per capita food consumption.

Macro prices also have direct and indirect effects. Exchange rates alter the opportunity cost and affect production/consumption decisions. Exchange rates affect the exchange rate of the local currency in foreign markets and thus the volume of exports and imports. If exchange rates are overvalued, this places an implicit tax on production and provides an implicit subsidy for consumption. It also discriminates against production for export markets. Because domestic products are overpriced in the foreign markets, exports will decline and foreign goods underpriced relative to domestic currency will increase imports. An indirect effect is that production for domestic consumption of non-traded goods tends to increase, while export pro-

duction tends to decline. But since domestic markets would most likely be flooded with surpluses from imports, local non-trade industries experience difficulties.

Interest rates serve two main functions--that of allocating capital (investment) and determining the supply of capital in the form of domestic savings or imported capital. Economic development depends on capital creation, hence a low real interest rate plays a pivotal role. The level of interest rates also has major implications for financial intermediation in the rural areas. The interaction of interest rates and the development of financial institutions (deregulation of the banking system, branch banking) affects development. High interest rates affect cost of production.

Minimum wages influence the choice of production technology, rural-urban migration, and export competitiveness. Thus, general macroeconomic management policies impinge upon or influence the prices and quantities of products produced in the economy. Developing nations rarely have policy instruments which influence agricultural wages directly. If minimum wage policies are at all effective, their impact is urban. Such policies typically service to accentuate the urban-rural wage differential, and as Harris and Todaro (1970) have shown, the rate of rural-urban migration is related to the expected urban wage. The expected urban wage is a function of the rate of unemployment in the urban sector, as well as the level of urban wages paid to those employed. The successful establishment of minimum urban wages will affect the rural sector via the rate of migration. The higher the expected urban wage, the higher will be the rate of rural to urban migration. Insofar as an urban wage policy succeeds in raising urban wages relative to rural, it will increase the rate of migration and thereby

affect the supply of rural labor, which would tend to raise rural wages and affect the rate of growth of agricultural output.

In the current economic environment, developments in world markets and in exchange rates have significance for agricultural prices and input costs and for farm income and asset values. The growing dependence of agriculture on other sectors for inputs and for farm production, as well as for processing, storage, and transportation and distribution of farm products, has resulted in general economy prices directly influencing returns to agriculture.

While the influence of macroeconomic policies on agricultural and rural economy is increasing and is increasingly recognized by policy makers, understanding of the microeconomic implications of these changes is lacking, particularly in developing countries. Macroeconomic policy and its profound effects on the agricultural sector are insufficiently understood and all too frequently inhibit rather than support agricultural development, particularly in developing countries. One should hardly need to emphasize the obvious fact that the agricultural sector in any economy is an integral part of the macroeconomic system. This is particularly so in developing countries, wherein typically one-third to one-half of a nation's aggregate output is generated by the agricultural sector and where an even larger proportion of the labor force is employed. It is not merely a matter of size, of course, but of intersectoral linkages and the impact of macroeconomic policy variables on the incentive patterns and the performance of the agricultural sector. These effects are of such basic importance that a well-managed macroeconomic policy is made a necessary precondition to strong growth performance in the agricultural sector. Johnston and Mellor (1961) defined the role of the agricultural sector by enumerating five functions, any of which could be

vital to developmental success. These functions are: (1) meeting the community's demand for goods, to the extent consistent with the resource endowment and comparative advantage; (2) supplying manpower and materials for non-agricultural producing sectors; (3) providing an internal market for domestic non-agricultural production; (4) providing a source of savings and investment for development; and (5) providing a source of foreign exchange earnings. Merely to enumerate these functions establishes the fundamental macroeconomic importance of the agricultural sector in the development process, and it is also readily evident that each of these functions is sensitive to macroeconomic policy.

It follows as a corollary that the performance of the agricultural sector must be crucially dependent upon the macroeconomic environment. Unfortunately, however, macroeconomic policy is rarely, if ever, made with the interests of the agricultural sector foremost in mind. On the other hand, agricultural policy is usually made by officials whose training and orientation is overwhelmingly directed toward the problems of specific commodities, their production conditions, their markets, their pricing patterns of outputs and inputs, their sociocultural environment, and their technologies. These are not trivial matters in policy making, but preoccupations with micro problems often leads to neglect of essential broader policy considerations..It is, therefore, important to study the linkages of the agricultural sector with the domestic and international economies. It is essential for all concerned with rural development to begin to understand the important relationships between macroeconomic policy and its farm and nonfarm microeconomic impacts.

In developing countries, there is an urgent need to develop basic education to help policy making and implementation processes that take account

of overall linkages in the economy. Development policy often depends on a small set of decision makers who are often quantitatively and qualitatively under-equipped for handling the large task of development programming. This is a complicated problem, with the quality of decision makers depending on many complex variables, such as educational structure of the population in general, recruitment channels into decision making positions, and socialization of new entrants. Many of the people in policy making positions have either worked themselves into their positions through long experience or through accelerated on-the-job training programs. Often these people are subject matter specialists and not well-trained in social and economic disciplines.

There is a need to upgrade top decision making people with new skills. Intensive crash learning courses need to be developed devoted to intensive study of main development issues. Participants in this type of education would include senior and up-coming decision makers and policy shapers of all kinds, such as politicians, civil servants, trade union activists, military officers, mass media commentators, professional policy advisors of various types, and business directors.

Learning methods should fit these audiences, with emphasis on linkages between the macroeconomic system and sectoral and/or individual decision making, aimed at development issues and at overall impact on incentive structures. This can be done with some injection of advanced theoretical knowledge and relevant intellectual disciplines. Development policies try to influence complex social processes through deliberate intervention based collective choice. There is little hope for success in such presumptuous endeavors without some understanding and sense for socio-macroprocesses, together with an appropriate intervention theory. Accordingly, thinking in

terms of historic processes and evaluation options in terms of long-range macro-impacts is the main task facing decision makers.

Statement of the Problem

The purpose of this study is to discuss concepts and strategies to consider in developing a microcomputer simulation model to promote understanding of linkages between the macroeconomy and agriculture that could be used in training decision makers in a developing country. More specifically, the concepts will focus on the macro-linkages, sectoral development policies, and educational strategies, using Botswana as an example.

The Current Situation

Since independence, Botswana has been engaged in a number of policies designed to restructure both rural and urban lives, socially and politically, as well as economically. The efforts include rural development, local government, and local development planning. There is a strong feeling that economic development should grow out from the villages themselves or from local initiatives, with the central government providing counselling and guidance and major infrastructural requirements. There is very little that the government can do unless much of the thought and effort comes from the people. That is, development should come from below. The "development from below" engenders increasing enthusiasm and increasing hopes for local action, participation, and local initiative--rather amorphously defined ideas, but ones that imply a large role for local institutions in planning and administration of developing programs.

In order to understand the whole planning process in Botswana, one has to have an understanding of the relationship between the local community

and the central government. There is a system of district administrative councils and village development committees throughout the country. These systems provide the important link in the chain of political support for members of Parliament. Most government departments have a "point man" in all these committees. Thus, the direct link between central government and local governments is in the hands of elected officials and public servants. These are the people actively involved in the analysis and interpretation of government policy. Most of these people have had some form of education, in some cases beyond high school. However, they are not greatly conversant with overall development policy and in particular inter-sectoral linkages and macroeconomic policy management. They can communicate very well and have good learning skills.

The implicit assumption is that policy makers need more information and analytical results to use in improved public sector interventions. Sometimes lack of good planning and policy analysis is considered to be the key explanation in the poor formulation and implementation of interdependent policies, programs, and projects at the national, sectoral and district levels needed to achieve multiple objectives for economic and social development.

The technical capability to effectively analyze policies and a close relationship to policy makers are essential to any planning success. Also, the linkage of the sectoral planning office to the national planning office is very important since it reflects the many policies that affect agriculture and which are determined outside the sector itself. Such key policy issues as exchange rates, interest rates, investment allocation, tariffs, subsidies, and internal terms of trade are controlled by top economic policy decision makers located elsewhere in the government. In addition, the top-down nature of planning between the national and sectoral levels, in which the national

planning office sets overall objectives on the basis of a macroeconomic analysis and provides targets and forecasts of resources for the agricultural sector, calls for professionals in agricultural planning units to fully understand macro-targets and forecasts.

In some cases, it is the absence of mid-level personnel capable of providing the supporting analysis or policy overview that affects formulation of policy. It is therefore important to have an ongoing training program to upgrade local personnel. In addition, there are often many public organizations dealing with policy, say for example with agriculture, numerous divisions of the Ministry of Agriculture, quasi-governmental marketing organizations and other ministries with independent areas of jurisdiction: lands administration is under the Ministry of Local Government and Land and water is under the Ministry of Minerals and Water Affairs. The problem is that policy makers usually do not think in terms of a general equilibrium framework. It is, therefore, important that a process be established so that ministries affecting agricultural performance--such as agriculture, finance, industry, natural resources, trade, and marketing--collectively participate in agricultural policy-formulation processes. One way to achieve this is to train people in better understanding of intersectoral linkages and the macro-economy.

Objectives of the Study

The general goal of the study is to discuss or review concepts useful in designing a simulation game or similar learning device that could be used in training of mid-level management and policy analysts in skills, knowledge, and attitudes prerequisite to effective development policy planning and administration. Instructional objectives are assumed to represent prerequi-

sites to effective policy planning. These objectives are developed in terms of observable learner behaviors to facilitate a systematic approach to instruction and evaluation. It is hoped that:

1) The participants will develop more favorable attitudes toward the concept of sectoral planning and macrolinkages;

2) The participants will develop more favorable attitudes toward considering the effects of sectoral policies on the balance of the economy;

3) The participants will be able to describe the interaction between sectors and the macroeconomy;

4) The participants will be able to identify the competitive and co-operative relationships among sectors;

5) The participants will be able to differentiate between effective and ineffective sectoral policies;

6) The participants will increase their communication and linkage development skills; and

7) The participants will increase their understanding and use of group dynamics and group process as a method in macropolicy determination.

Overview of the Study

The second chapter is a review of the literature on simulation and the training needs of management in developing countries. It summarizes the use of computer simulation in training managers and policy analysts. Other delivery systems, role playing, and case methods will be briefly reviewed as to their appropriateness in public policy education. The third chapter is a summary of the use of microcomputers as instructional tools,

including discussion of adult learning theory and an educational model to be used. The fourth chapter presents the technical material for instruction and a national economic model, which explains the linkages between macro variables and the agricultural sector. The essential concepts are also presented. A discussion of the feedback linkages between the macroeconomy of agriculture and major macro variables is presented. Finally, the fifth chapter presents summary and evaluation procedures that will be needed to make the program more effective.

II. REVIEW OF RELATED LITERATURE

Over the years, alternative or modified methods of teaching/learning have emerged at all educational levels. Anderson (1975) states that the role of instructors has progressed through a cycle to where most teaching-learning relationships involve more than one teaching strategy. Traditional methods of lecture, discussion, project, and recitation have served the educational process for a long time. These methods have proven successful at meeting educational objectives. However, over the last few years other methods have been developed and utilized to further improve the teaching-learning environment. These include computer-assisted instruction, such as simulation, programmed instruction, inquiry learning methods, discovery learning techniques, and various forms of individualized instruction. Programmed instruction, computer games, and role playing have been widely used in training in recent years. These new techniques, when added to the older methods of lectures, the conference method, films, and the case study method, provide the field of training and education with a number of alternatives to use in a particular situation. While availability of resources in the form of money, time, and personnel, do play a significant part in the choice of training method, another important criterion must be the relative effectiveness of the training methods being considered for a particular training objective. This progress has come as a result of effort and encouragement by educational leaders.

According to Kneller (1967), any approved methodology of teaching/learning should be supported by learning theory, which may be summa-

rized as follows: (1) learning should proceed from the known to the unknown; (2) all things should be taught in due succession and only one thing at a time; (3) teaching should be simple and straight forward; and (4) people should learn by doing. The method that is selected depends often on the target audience, instructional objectives, and the content of the educational program. The method or combination of methods used should maximize the assimilation and retention of the learned material.

In the field of public policy education, Barrows (1983) argues that one of two basic models should be followed. The first is the advocacy model, in which the educator advocates one position or supports one group in the policy debate. The second is the alternative-consequences model, in which the educator helps people analyze the policy alternatives and likely consequences of each, but does not advocate any particular decision. In the advocacy model, the policy analyst examines the issue in light of his/her professional knowledge and his/her own values, identifies the policy alternative he believes is best for society and argues strongly for his/her position on the basis of his/her interpretation of the scientific evidence on the issue. However, Fletcher (1982) points out that policy analysts (planners) are not responsible for policy decisions and management activities to implement policies. He urges that in a broad sense, policy analysis refers to all activities that generate and present information to improve the basis for decisions by policy-makers and implementation actions by executor agencies. He points out that policy analyses can range from informal advice, possibly based on nothing more than experience and opinion, to formal studies and plans requiring extensive data gathering and analytical procedures. Policy analysis, therefore, is the process that produces analytical information for the purpose of improved public policy decision-making and implementation.

Policy analysis has a crucial role in each stage of the planning process (i.e., goal setting, problem identification, formulation of policy alternatives (policy development), choice of optimum alternatives, realization of strategy and evaluation). Its use is most familiar within the formulating stage where the main contribution is to identify and compare policy alternatives. Accordingly, the main product of the planning-policy analysis system is information for use in public and private decision-making. In the public sector this includes identification of alternatives, the likely consequences of those alternatives, and information to support the implementation of selected alternatives. Figure 2 shows the decision-making process in the public sector economy. Decisions are made by the political-administrative system policy decision-makers and managers and also by households, private producers, and public enterprises within the socioeconomic system. Planners, policy analysts, and other advisors gather data and generate information for use in decision-making.
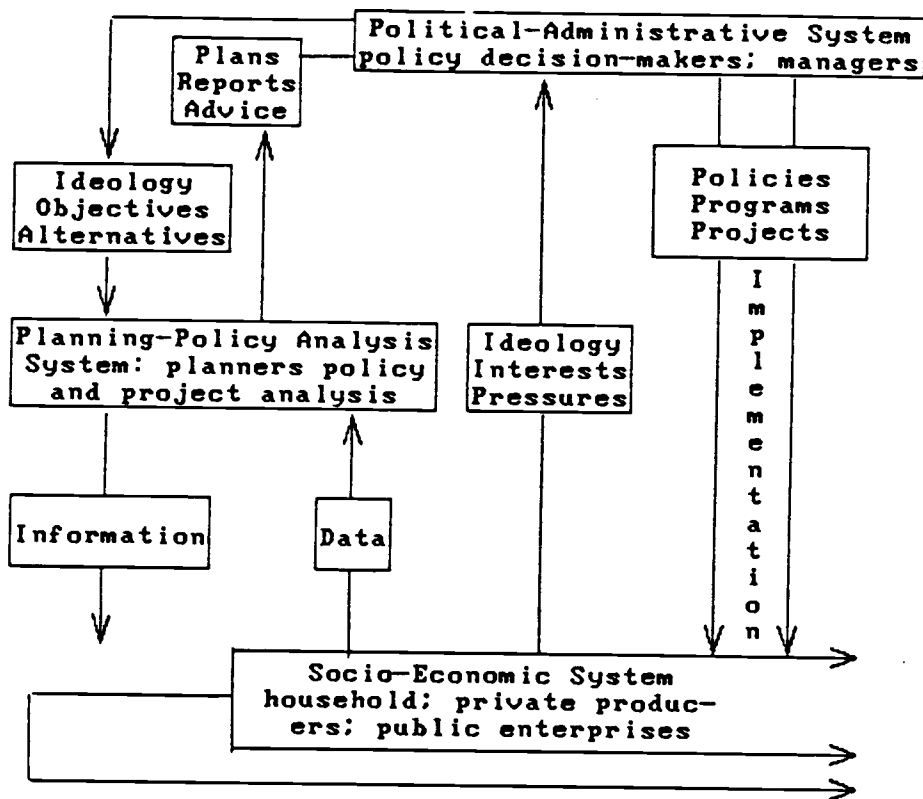
Figure 2. Planning in Relation to Economic Policy Decision-
Making and Public Sector Management (Fletcher, 1982).

Given the above decision-making environment, the alternatives-
consequences model will be ideal for policy education for policy planners or
analysts. There are two variations to this model. One version tries to
help people clarify the problem or issue, outlines the policy alternatives,
presents the likely consequences of each alternative, and leaves the decision
to the people and the democratic process. The second version, sometimes
called the consequences-alternatives model, describes the situation where the
political-administrative system representatives asks policy analysts to help
them identify policy alternative(s) that produce the consequences they desire.
The alternatives-consequences model seems an appropriate teaching method

for public policy analysis for the following reasons: (1) the policy analyst has no right to assume an advocacy position; (2) the policy analyst is not always trained or competent to assume the position of a professional advocate, and (3) the alternative-consequences model is more consistent with a democratic political system (Barrows, 1983).

Cannon (1973) noted that training of public administrators in developing countries should rely increasingly on research, development, and experimentation with participatory methods, i.e., those that emphasize relevant and student involvement. This observation is equally relevant for policy analysts and planners. Any training method which stimulates real life experience is critical to training processes in developing countries. Knowledge is only one factor influencing behavior. Consequently, training programs should use techniques which affect the goals and values, motivations, analytical and decision-making skills, operational abilities, and self-confidence of the participants. Simulation techniques, when used in training, may reproduce in selective and condensed form the beneficial attributes of direct experience.

Training programs should include case studies which require students to recommend and defend administrative and policy decisions generated by a concrete set of circumstances and role playing where students carry out policy positions.

Need for New Training Methods in the Public Services

There is no doubt that foreign universities offer students from developing countries a broadening intercultural experience, valuable information, and disciplinary tools to analyze policy problems and their social and

political context. Nevertheless, few American universities have yet developed specific courses in development administration for developing countries and it is often difficult to relate course work offered to developing countries' real problems. In part, foreign and even local universities have failed to keep pace with the social and economic evolution of developing nations and have made little effort to promote the new provisions needed for accelerating development. Most of the courses offered by universities often do not encourage students to deal critically with the materials given to them. Classroom hours in universities are too often not complemented by relevant observation and outside reading. Courses offer too little opportunity for students to gain an insight into the actual functioning of a government in society and the multi-faceted problems of development administration.

There is a compelling case for participatory training methods for in-service public service training: skills and behavior patterns cannot be learned entirely from lecture methods, but must come also from experience. The "transfer space law" suggests that the amount of learning transferred from a training to a working environment is related to the similarity of the two situations (Williams, 1970). As psychologists are fond of telling us, teaching is more effective where students actively participate in the learning process, receive continuous feedback, and have the opportunity to repeatedly review new ideas in a variety of contexts. People are likely to learn when they enjoy what they are doing; they are happier and more productive when they participate. The premise is that adults enjoy participative forms of learning where they can share their rich life experiences and contribute to the classroom.

The traditional lecture method has been found inappropriate for training decision-makers and policy analysts, who often need supplementary

training designed to develop decision-making and managerial skills. The shortcomings of the lecture method include the following: it is not action-oriented; it is a low-keyed approach which does not necessarily stimulate the attentiveness nor continuously activate the involvement of the audience; it establishes an essentially one-way communication, which prevents the lecturers themselves from being enriched by the stimulus of students; and the lecture method is not efficient for handling intermediate or small-size classes which are usually the class sizes in developing countries for inservice training (Cannon, 1973).

Promising Instructional Methods

The Case Method

The major objective of the case method approach is to help students learn for themselves by independent thinking. A collateral objective is to develop skill in using knowledge. "Knowledge without the skill to use it, is inert and surplus baggage to the practitioner. Skills without the continual infusion of new knowledge leaves its possessor practicing in the grip of unmodified routines" (Bailey, 1961). The case method is effective and feasible for the following reasons: it forces the students to get involved with practical problems and makes them become emotionally committed to producing good solutions. It also helps as students observe improvement in their own analytical abilities during the course of their experience with cases, gaining a confidence which creates an enthusiasm for contending with real problems on the job.

Role Playing

Role playing is a technique which offers an opportunity for practicing skills in doing and implementing. In-basket problems could be used where participants are given a job title and a description of a setting. Then they would be given typical contents of the in-basket for that position. Within some prescribed time they would act upon its contents. Their actions and performance is later analyzed and evaluated. Role playing emphasizes learning by doing, learning through observation and feedback, and learning through imitation (participants can imitate desirable behavior). Role playing calls for active participation and could be used to complement the case method. Role playing is particularly suited for attitude change (Cannon, 1973).

Simulations (Games)

Simulation may be defined as the creation of realistic games to be played by participants in order to provide them with lifelike problem-solving experiences related to their present or future work (Cruikshank, 1966). It is a process of conducting experiments on a model, instead of attempting the experiments with real systems. A simulation of a system is the operation of a model which is a representation of the system. The model is amenable to manipulations which would be impossible, too expensive, or impractical to perform on the entity it portrays. The operation of the model can be studied and, from it, properties concerning the behavior of the actual system or its subsystem can be inferred (Beck & Monroe, 1969).

Beck and Monroe (1969) state that simulation as a training tool has crucial characteristics, such as "analogous circumstances" providing a setting in which a learner can function and which is related to the degree of

fidelity to the real life situation. It allows participants to simulate intricate real world situations. In education for decision-makers it represents an environment in which the learner is to function and is assumed to have enough of the characteristics of the real environment to provide practice in meeting contingencies which could occur in the learner's life. In simulation games, the participants are divided into hypothetical groups. Each group has its own goals. Each group is given the facts of the situation and a definition of the characters and their objectives. Actually, simulation incorporates any techniques which place a learner in a social environment and requires him to respond to game procedures. By doing so the learner discovers for himself the theoretical basis of his actions and is led to conceptualize about the practical consequences of courses of action. The second characteristic is that it ensures tentative or low risk input. The learners can make a response without irrevocable commitment--that is, it has the desirable quality of enabling the learners to manipulate various courses of action and their consequences without the student suffering physically or emotionally for wrong choices. With low risk input and symbolic consequences, the whole simulation exercise is replicable, providing an opportunity for repetitive procedures in arriving at best solutions.

Gaming and simulation are techniques of long-standing use as instructional tools. Modern war-gaming dates from the eighteenth century when military establishments became conscious of the need to revise the training of combat officers. Their applications have ever since spread to other areas. The four main areas of application have been (Mackey & McCarl, 1984):

    1)   education and training;

2)   decision-making and policy formulation;

3)   research; and

4)   operational investigations.

Green and Cotlas (1973) urge that common methods of training and developing managers have many shortcomings. One is lack of active, fruitful involvement by participants during the learning process. Another is the absence of the opportunity for the trainee to have frequent, intense, and meaningful interaction with the kind of environment for which he is being trained. Green and Cotlas have developed a video-audio-participative system which calls on students to play managerial roles, presenting them with the results of successive decisions. The effectiveness of this new method was compared to the traditional methods of lecture-discussion and lecture-discussion-case method. It was found to be superior to the conventional methodologies for the reason that it generated more active participation in the learning process; allowed frequent, intense interaction with the type of environment for which the learner is being trained; and provided an environment in which students could experiment and apply their abstract learning to realistic situations, thus facilitating learning from experience.

Vora (1973), in a study to assess the use of simulated management games as a device for educating managers, concluded that management games had utility for short-term pay-offs in learning and for long-term facilitating of self-education through its motivating elements. He asserted that it provides for a general but controlled environment for learning and experimenting on the part of the participants. Wolfe (1973) carried out a study on the comparative learning effects of management games vs. casework in teaching, finding that management games produce learning outcomes that were equal to cases in fact mastery and superior in principle mastery.

He concluded that games alone are superior to cases alone in teaching business policy principles and are a worthwhile learning environment capable of useful instruction in many policy and decision-making courses. Carol & Petersen (1972) found that for purposes of developing effectiveness in problem solving skills, the training directors rated the case study, games, and role playing as having the most effectiveness. Role playing was found relatively more effective in changing attitudes.

Simulation has been used in many other fields. Many studies have been concerned with the simulation of the firm or business. Charles P. Bonini (1963) developed a model of a hypothetical business firm. His complex model represented a synthesis of some of the important theories from a number of disciplines, among which were economics, accounting, organization theory, and behavioral science. The essential elements of the Bonini hypothetical business organization include: decision centers, information centers, decision rules, information links, information systems, and decision systems. The purpose of the model was to study the effects of three types of changes on the behavior of the firm: changes in the external environment, changes in the information system, and changes in the decision system. Bonini used a factorially designed experiment to study the main effects and the various interactions of eight specific changes in the model, including prices, inventory levels, costs, sales, profits, and organizational pressure.

Cohen (1960) formulated and experimented with two mathematical models describing the behavior of shoe retailers, shoe manufacturers, and cattlehide leather tanners between 1930 and 1940. He found a very close correspondence between the simulated time paths and the actual time paths.

The conclusions expressed by Greene (1961), after simulating a market organization, were that: (1) simulation models can help link economic theory and business practice and (2) simulation models are of great assistance to management when multivariate problems beyond a relatively low level of complexity must be analyzed.

Gensch (1967) developed a computer model to be used in an advertising firm for the selection of media to carry advertisements. His conclusion was that the simulation approach was superior to hand-generated schedules for making effective media selections of specified advertising messages for national magazines and network television.

Walker (1966) formulated a hypothetical computerized model of a manufacturing firm. He integrated production, marketing, administration, and the economic environment of the firm for the purpose of experimentation with operational decisions. He suggested that simulation models for operational planning can be constructed and that the computer has the capability of successfully evaluating these models while effectively searching for more efficient solutions.

Manetsch (1965) simulated the softwood plywood industry on a digital computer. Input variables consisted of the number of mills, jobbers, firms, retailers, users, and also considered demand and market prices. Major industry variables generated by the program were mill market prices, mill production, mill unfilled orders, mill profits, wholesale inventory, and whole sale unfilled order. He concluded that the simulated data bears definite resemblance to data reflecting past industry performance.

Several other studies (Summit, 1966; de Berncastle, 1962) suggest potential for simulation in managerial decision-making. They have indicated

that simulation results in decisions which produce reasonable, consistent, adequate, and stable results as compared to those obtained by human decision-makers operating in a similar environment.

Macroeconomics and the Agricultural Sector

The treatment of macro-linkages to and from the agricultural sector in the agricultural development literature has been largely in an ad hoc fashion, despite the fact that development theory is entirely macroeconomic in nature. In the early 1970s, the agricultural sector was modeled generally as a closed economy with only exogenous influences from the general and international economies (Freebairn, Rausser, & de Gorter, 1984). However, since the mid-1970s a number of models have been constructed which recognize the linkages among sectors. Earlier models, however, such as those of Lewis (1954) and Ranis and Fei (1964), the so-called two sector models, were all grossly aggregrative.

In developed countries, agriculture was not considered that important in the national economy until the 1971 to 1974 grain price explosion which fueled inflation of that period. It was then that large macro models started to integrate the backward/forward linkages between agriculture and the rest of the economy. These models have been extended to include the international sector.

Then, there were the so-called second generation models. In these models, agriculture is affected by a few general economic variables, such as consumer disposable income, interest rates, and level of agricultural exports. Disturbances in agriculture are assumed to have no impact on the rest of the economy. The shortcomings of these models are the lack of

direct linkage of interest rates and liquidity variables to supply or to inventory demand behavior and the lack of explicit variables to represent sector policies (Freebairn, Rausser, & de Gorter, 1982).

Finally, a third generation of models were developed, consisting of a large number of equations which required massive data. These models link the agricultural sector to the government sector, the foreign sector, and the general economy, including the financial markets.

In summary, three generations of policy models are currently in use by policy makers. First generation models represent agriculture as a separate entity influenced by few macroeconomic variables, and they omit the transmission mechanisms through which events in other sectors of the economy are relayed to agriculture. Second generation models forecast events in agriculture in a recursive fashion, taking current period outputs from macroeconomic model solutions. Such models represent the most commonly used policy models. Finally, the third generation models incorporate the desired linkages between agriculture and the rest of the economy, simultaneously solving for desired values.

Models have been identified as approximations of reality. The largest use of models in the policy process has been the study of economic alternatives. They increase the opportunity for the introduction of quantitative analysis into the decision-making process. In examining alternatives, a baseline solution that reproduces the actual economic outcome for a given time period is computed. Then, policy targets are chosen and policy controlled variables within the model are used to move the solution toward policy objectives. By examining various scenarios, the policymaker can examine the impact of a particular policy alternative on all sectors of the economy without actually having to implement the policy.

Policy analysis and planning activities can be divided into two parts: (1) descriptive assessment and analysis and (2) decision-oriented analysis and planning. The first group consists of the most basic initial information gathering and descriptive activities; the second consists of more focused analysis, usually treated in greater depth and complexity. Planning units in most developing countries have not been able to achieve a transition from descriptive-oriented to decision-oriented states of planning. Much of present policy analysis is based on information systems (surveys and other data). These data provide for four types of policy analysis: (1) descriptive analysis, (2) diagnostic analysis, (3) predictive analysis, and (4) prescriptive analysis (Fletcher, 1982).

Descriptive Information and Policy Analysis

This form of policy analysis, in major part, is the development of a descriptive information system, including time series data in production, consumption, exports, and imports, with these data often disaggregated by region. Related macroeconomic and demographic data are sometimes included with these data. This information could be used to change or make new decisions.

Diagnostic Information and Policy Analysis

This type of policy analysis describes "what is wrong." Examples of this type of analysis might include data showing an increasing fraction of imports of a commodity or an increasing expenditure of foreign reserves on food imports. These diagnostic data and analyses help identify and articulate problem areas and point toward alternative measures in order to facilitate better decision-making.

Predictive Analysis

Predictive analysis is the process of examining the future. It creates scenarios based upon "what if" hypotheses and incorporates alternative assumptions about the future.

Prescriptive Analysis

Prescriptive analysis describes what should be done if specific objectives are to be met. It specifies a course of action through the laying out of a plan.

Selected Models for Policy Analysis

Several methods have been used in quantitative analysis of policy questions to provide relevant information for decision processes.

Econometric Analysis

In agricultural policy analysis, econometric analyses are applied in estimation of relationships in the agricultural commodity markets, agricultural economy interactions, and other behavioral relationships. The derived parameters may be used in forecasting demand and supply conditions. They may also be used in an analysis of the impacts of public policies on economic variables.

Agricultural models are built to include multiple regression estimates of consumer demand functions, production functions, cost functions, and Engel curves to show the relationships between incomes and specific types of expenditures and various macroeconomic relationships. Estimates of the elasticity or responsiveness of different economic units are useful in analyzing the impact of existing or contemplated policies on various segments

of the population and on economic activity. Knowing the effects of the interaction of agricultural variables with the macroeconomic variables of income, savings, and investment is useful in analyzing the implications of policies that affect the agricultural sector. Econometric models can be used for the simulation of historic periods, i.e., the simulation over certain time periods with alternative policy variables (fiscal and monetary policies).

Project Analysis

Project analysis is a method of evaluating alternative investments or activities. It assesses the benefits and costs of a project and reduces them to a common yardstick. Project analysis involves both financial and economic analysis; the first considers direct monetary costs and benefits, while the second evaluates social costs and benefits. When capital investment is contemplated, either in demand or supply management, financial analysis must be undertaken; this involves using payback techniques or discounted cash flow methods. All of this information provides valuable inputs in the decision-making process.

Mathematical Programming Models

Mathematical programming models may be developed for policy analysis and may be used for simulating a sector's response to possible policy changes. Usually, mathematical programming models have a stated objective function and set of constraints. Initially, these models are solved for a base solution, after which the procedure is to alter the model in a way that reflects a new policy, or new values of policy instruments, and then to solve the model again, recording the new values of the goal variables. By proceeding in this manner through a series of policy changes, a table can be

built up showing the relationship between policy options and their effects on different goals.

The agricultural sector is frequently expected to fulfill multiple objectives which are conflicting or mutually reinforcing. The dilemma of policy analysis is to show the trade-off between the various objectives. Often stated objectives include more employment, earning foreign exchange, helping to make (or keep) the country self-sufficient in food, increasing farm incomes, and keeping food prices low to consumers. Since these goals are not mutually consistent, the policy analyst can help by showing just which goals are advanced by which particular policies and which are not. By showing the multiple consequences of each policy and by simulating multiple consequences of policy changes, with the aid of the model, the analyst can provide an objective basis on which policy preferences can be debated and the decision process facilitated.

Input-Output Model

An input-output model depicts the structural interdependence, in terms of demand and supply relationships (or inter-industry relationships), of an economy in equilibrium. Such a model has several uses to policy makers and analysts. To the extent that it shows the final demand for goods and services and the inter-industry transactions required to satisfy that demand, an input-output model can be used as a planning and forecasting device. In addition, an up-to-date input-output table can be used by policy makers to project full employment levels of overall demand.

III. MICROCOMPUTERS AS AN INSTRUCTIONAL TOOL

The purpose of this chapter is to review the use of microcomputers as an instructional tool and a decision-making tool in management. Specifically, the question is whether microcomputers as an instructional media can improve the effective learning of adult learners. It has been predicted that the use of microcomputers will revolutionize all education, including adult education. It has been suggested that the microcomputer represents the most complete technological device for instruction that has yet been developed (Gueulette, 1984).

Adult Learning Theory

According to Even (1987), adult learning is a problem-solving process involving attention, differentiation, structuring, integrating, abstraction, and generalization. Learning involves the retention of past and present, as well as future experiences. Two assumptions are often made in the development of the learning process: about the "nature of man" and about learning theory. With regard to the nature of man, it is assumed philosophically that people have the capacity to change, have potential for making correct choices when in an interaction with their interdependent total field of experience, and that people in this interaction can take responsibility for themselves and their own learning. They can make decisions that are correct, good, and appropriate on their own. It is assumed that these beliefs are the very reasons why adults can engage in learning and have it make a difference.

In regard to learning theory and resultant instructional practice, it is assumed that adults learn through an interaction process, must be motivated from within, must have a share in deciding what is to be learned, and must set their own goals. Perceptions are based on former experiences and the interaction with new learning. It is believed that adult learning is a problem-solving process in which a new idea comes into the perception of an adult. The adult interacts with that idea, mentally trying, or deciding not to try, to give the new idea a chance at entry into the memory. The adult makes a conscious decision to accept or reject each perceptual input. Learning is not even all that new, because there must be some way to relate new ideas to prior ideas. A whole new idea still needs to get a foothold in the mind, based upon an old or prior idea.

Instructional Theory

If the teacher begins by responding philosophically and by intent, strategy, and style to the needs of each adult who has voluntarily chosen to learn or acquire new knowledge, the teacher will have begun the process of providing learning in response to individuals. Then, the teacher must get the attention of students by relating to the concrete, practical concerns of the students. This makes content problem-oriented. In addition, the teacher needs to find out specific information about students to use when using examples to explain content. This process will make the content more meaningful. Then, the teacher needs to provide a process whereby students participate in the teaching and learning process. This enables the content to be more relevant.

Teacher strategies and style should permit a climate in which students are free to express their opinions about the content and trust that

their opinions will be considered important, be acceptable, and treated with respect. This produces a climate in which the learner is free to learn. In addition, the teacher's processes should encourage each student to make decisions about what is to be learned. Students should receive some feedback or process in both written and verbal form, which helps the learners determine their individual degree of achievement even if grades are not given.

Contribution of Microcomputers to Adult Learning

There are certain characteristics of microcomputers that make them well-suited for adult learning. Malcolm Knowles (1970) made the following basic assumptions about the characteristics of adult learners:

Self-directivity (self-diagnosis of needs for learning); adults need the freedom to decide for themselves what they need to learn and the freedom to choose from among many learning experiences. Microcomputers are able to fulfill this self-directivity requirement for the following reasons:

1) Microcomputers can provide a flexible source for teaching and learning, in terms of both place and time. Professionals can use the programs at home, at work, or at any given time, day or night. They can use a program at their own pace.

2) Microcomputers can be directed to collect data and provide self-evaluation, which is often helpful in adult learning.

Adults bring a very valuable resource into the teaching/learning process--their own experience. Adult programs are often built around this characteristic. This promotes the use of techniques that require learner involvement and participation: case presentation, simulations, role playing, seminars, and debates. Microcomputers are handy in facilitating the process.

Adult learning is problem-centered: they tend to view educational ac-
tivities from a problem-centered vantage point, mainly because they seek an
immediate application of knowledge and skills they learn, an application that
is usually related to their work or life. This characteristic requires the
use of those teaching/learning techniques that are action-oriented, those that
emphasize problem-solving. Simulations and case presentations lend them-
selves to this task, and microcomputers make their use easier.

Microcomputer programs are most useful where the adult learning
objective is skill development. The microcomputer is probably most useful
in the areas of occupational training, which includes the largest number of
adult learners. They have implications for training in the sub-fields under
occupational training, such as vocational and technical training, managerial
training, and professional training and retraining.

One of the basic principles of learning is that behavior changes pro-
gressively as a function of the number of reinforcements that follow the
occurrence of a given response (Deese, 1958). In the case of food rein-
forcement, for example, a large amount of food results in great strength of
response than a small amount (Grindley, 1929). This fundamental principle,
when applied to educational situations involving adults, raises an important
and interesting question: Is confirmation (knowledge of results) a suffi-
cient reinforcer for maximizing learning or is confirmation plus additional
reinforcement required? Microcomputers are able to provide the feedback
if properly programmed. The adult learner is able to evaluate himself as
he goes on with learning.

The instructional use of microcomputers with adults offers a means
of individualizing instruction and meeting certain other needs. If properly
programmed, a microcomputer approach could provide some of the emotional

support to learning. Repetitive microcomputer instruction provides the humanistic, relevant approach so critical to adult basic education students.

Simulation in Education

Simulation has been used in many aspects of education. Computer simulation has been used to aid in decision-making. Casand and Tirrel (1964) used GASP (Generalized Academic Simulation Program) to plan a new junior college of 4,500 in the St. Louis area. The simulation technique increased the actual utilization of classrooms to 88 percent and laboratories to 66 percent figures, which were far above the design submitted by an architectural firm.

Simulation has also been used in long range planning. The Asian Educational Model, developed by the staff members of UNESCO, serves as a tool by educational planners to demonstrate instantly the implications of any quantifiable change in the educational system or any factor directly affecting it. Examples given include the implications of such decisions as introducing compulsory education, changing a pupil-teacher ratio, altering the level of teachers' qualifications or their salaries, changing a government's manpower needs, or revising the amount of gross national product devoted to education (Computer to aid long-range planning of school system, 1966).

Sissan (1969) developed a simulation model which looked at the problem of education management. His model shows the financial consequences of various management policies carried out under a variety of assumed conditions.

Anderson (1969) experimentally tested whether simulation learning games might be a more effective learning experience than conventional classroom approaches in communicating factual information. Student acqui-

sition of some specifically defined behaviors that might be generalized to a comparable real-life situation were also tested. Scores and ratings between control and experimental groups were tested for significance by analysis of variance and covariance. No significant differences were found, except that the simulation learning game was more effective with males.

Baker (1966) experimentally investigated any differences in cognition and attitude between employing simulation and conventional methods in teaching a junior high school American history course. Students were randomly assigned to two experimental and two control classes. They were both pre- and post-tested with attitude and cognitive instruments. Employing analysis of variance and t-tests, the study indicated that there were significant differences in both cognitive performance and attitudinal change favoring the simulation classes.

Calkins (1970) evaluated the effectiveness of a computer assisted instructional model of exchange as an aid to teaching students in college economics. In a specially constructed test, postscores for control were significantly below the experimental group. Exposure to the computer model seemed to be the best explanation of the superior performance of the experimental group, although there were other variables influencing the results.

Kreplain (1986) argues that simulation is a valuable tool for studying complex material handling systems. Today's companies have complex material handling systems, which are often hard to predict with respect to performance. Companies are spending more millions on installing more complex systems to stay competitive. If improved systems do not perform as expected, it could spell disaster. He argues that one way to minimize the

risk is to simulate the proposed system, building a computer model that attempts to mimic the way a system actually works. These models can be used for a number of tasks: to establish the scope and size of the system, to evaluate different approaches during the design stage, to test and debug components during development, to perform analysis of the system in operation, and to examine alternative operating strategies. There is also the added advantage of training with the people involved in the process since it gives them a much better grasp and an intuitive feel for the system.

Simulation is perhaps one of the most powerful instructional uses of the computer, for it can give the learner an opportunity to manipulate the decision-making process. Learners can make "real life" decisions and suffer the consequences of those decisions and yet avoid real danger.

Management games (simulations) are used extensively in business training, where they help corporate managers develop new business skills, increase productivity, improve communications skills, and build effective negotiating techniques in matters of days and hours. Management games that teach technical skills often employ computers to process data as players vigorously compete against one another to improve profitability. These simulation games give a dose of reality, of what it truly means to run a business.

In agriculture, microcomputers have been used for the following purposes:

1) Arithmetic manipulations; microcomputers can easily add, divide, multiply, subtract, and can handle large amounts of data in seconds. They can be used to calculate farm budgets, feed rations, and all other types of record keeping.

2)   Simulation modeling, using alternative assumptions about the farming business.   Thus, microcomputers can be used to test out ideas before being put to use.

3)   Data storage and retrieval; all computers have memory. Data can be stored and retrieved for reformatting, mathematical calculations, and summarization into reports.

4)   Word processing.

5)   Communication; computers may be connected through an interface to other computers.   One can gather data, transmit data to other places, or communicate interactively with other users.   One common use in agriculture is tracking market prices (Mackey & McCarl, 1984).

Babb (1985) describes four agribusiness simulators which can be processed on microcomputers for use in undergraduate and extension teaching.   He argues that simulators represent an extension of case methods of teaching.   Students normally make a sequence of decisions, market conditions, competitors' behavior, and other factors to be considered.   There is feedback from each set of information from earlier decisions.   Simulators have generally been found to be effective for teaching (Wolfe, 1976).

Baumhardt, Trent and Hayes (1985) developed a soil-loss model for use on microcomputers.   The model was developed to help extension, education, and soil conservation personnel estimate the impact of various treatments and for answering "what if" questions about alternative combinations of soil conservation practices.   The basis of the model is the USLE (Universal Soil Loss Equation).   The model was designed to assist in the application of the USLE by leading the user through a series of questions in an iterative program.

The Educational Model

The process that will be used to provide the educational experience for the clientele combines the social change and problem-centered model of adult education. A social change model focuses on the total environment in which the education occurs, that is it focuses on understanding the broader context—in this case the entire economic system (macroeconomy) within which policy analysts and planners operate. The problem-centered model focuses on a professional context and order of complexity of professional problems. Under this model, learning and change are achieved through active participation of the clientele in the discussion and resolution of the problems they face, rather than through lectures covering specific knowledge.

The desired objectives of the learning process are the same as those stated in Chapter I, emphasizing the understanding of the total environment in which policy decisions are made. The target system includes policy analysts in the Ministry of Agriculture and other sectoral planners in other ministries with formal or informal responsibility in rural development. It is often elements within the participants' professional environment that may encourage or impede efforts to change their behavior. Hence, a multi-disciplinary approach to training may be more fruitful. One is interested in influencing the climate of opinion among specialists practicing in the same ministry or government organizations. In order to get any change program going, we need have a change-inducing system. For this program, either ministerial staff training coordinators could take the responsibility of organizing the program, with the help of outside consultants, or the Institute of

Development Management at the University could be contracted for the training. The leadership in all ministries and/or organizations involved should demonstrate or give steadfast commitment to the proposed program if it is going to be a success at all.

In bringing about change, the change agent is expected to select strategies for effecting the change in the environment or target system within which the change must occur and for gaining support for change. It is often helpful to have the program opened by key cabinet level officials to give legitimacy and importance to the desired change.

Various techniques are likely to be effective in promoting change--lectures for promoting and informing and for stimulating aware-ness, interest, and inquiry. Then, participatory formats, such as hands-on experiences, will be used to move further in changing participants behavior by evaluating and trying out new knowledge.

Evaluation

An evaluation process will be set up as an important ongoing activity of the program to guide development and provide essential monitoring. In evaluation, we consider outcomes and look for indications of consequences imputed to the program by both participants and program planners. We will try to observe or otherwise verify apparent changes. In addition, we will look for indications of how extensive or effective the consequences are. Essentially, we are interested in the question: What impact has the pro-gram had and what is the extent and persistence of the impact? In other words, we are interested in the incidence and extent of the changes that can be attributed to the program.

One recognized evaluation method is that of Bennet (1976), which provides a series of dimensions that must be examined to determine what happens when a program is introduced. He calls this analyzing your extension program through a chain of events: (1) inputs (program personnel and facilities), the resources that are used by the program planners, (2) activities (transactions), (3) people involvement, (4) people's reactions, (5) KASA (Knowledge, Attitudes, Skills, and Aspirations) change, (6) practice change, and (7) end results. Figure 3 shows Bennet's "chain of events" in extension program evaluation.
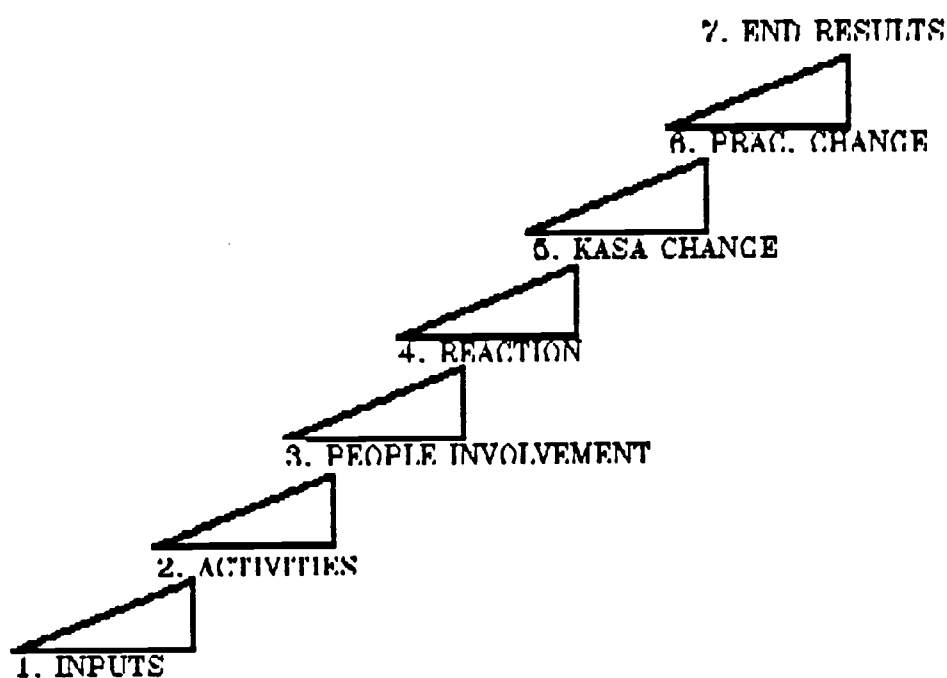

Figure 3. Chain of Events in Extension Programs
(Bennet, 1976).

In program evaluation, both anticipated and unanticipated outcomes can be expected. Judgement on program effectiveness and/or impact can be based on both imputed and verifiable consequences. Imputed consequences are those that participants claim have resulted from their participation in

the program. Verifiable consequences are those for which there is empirical evidence of a written or an observable kind. In a way, these consequences measure participants' personal growth and outside achievement or competence (behavioral change).

In a manner, the proposed program will be evaluated by following Bennet's (1976) "chain of events" method.

Inputs

It is envisaged that a program of this nature will take about a year in its planning phase--design and selling to other ministries and organizations outside government that would be interested in participating. At the end of the planning year, one can evaluate the inputs expended on the program in terms of quality and quantity. The important thing to look for here is the number of days of professional and other staff used, compared to what was anticipated. Also important is the amount of material and facilities that were needed and used during the year and how this compares with projections.

Activities

The program will develop a microcomputer simulation model to be used in training and also develop course content. This will involve data gathering on major macroeconomic variables and agricultural performance variables, such as output, prices, employment, food imports, and consumption data. The actual model will be developed and tested such that it is ready for use in training. This phase of the program can be done and completed within one year. Progress on this phase can be evaluated on a quarterly basis during the first year by holding coordinating committee meetings to

discuss progress. In subsequent years, from year two onward, major activities will be recruitment of participants and conduct of training.

People Involvement

It is hoped that middle level management personnel plus others that influence policy decision processes (civil servants, military officers, politicians, business directors, and professional policy advisors) will participate. The program is designed as a hands-on, problem-centered educational experience so that participants can actively take part in the learning process. During the first six months of the planning year, after interorganizational consultations, an accurate projection of the number and characteristics of potential participants will be available. It is the number out of the potential participants in training that will be used in measuring performance.

Reaction

This asks the question: Do program activities meet participants' expectations? After each training session, participants will be asked to fill out questionnaires to get their reactions to the program or components of the program. In addition to individual training session evaluations, a total program evaluation will be conducted when participants have completed the microcomputer training.

KASA Change

KASA measures changes in participants' Knowledge, Attitude, Skills, and Aspirations. This level involves behavioral changes which often take longer to observe. Participants will be closely monitored by their supervisors and a reporting system will be developed so that after four years, detailed evaluation of the growth or change of behavior of each participant can

be undertaken. During the fourth year, a detailed survey questionnaire will be sent out to get information on knowledge and skills. Attitude change and aspirations are mostly covered at the reaction level.

Practice Change

At this level, we want to know if participatnts practice what they learned. It takes time for people to change and also it depends on whether the institutions they work for will adopt the new practices and technology. It is hoped that a thorough evaluation of this phase can be done by the fourth or fifth year. The first phase will be done by a survey questionnaire whereby participants are asked to rank the effectiveness of the program on their job performance, through a scoring system. The participants will be asked to score the effectiveness of the program on a scale of 1 to 10, the smallest score, 1, being assigned to the poorest performance and 10 to the highest. Since it is assumed that the training will be directed to policy analysts and decision-makers, responses will be collected from both groups through random selection. The data will be generated as follows:

```
Policy Analysts (A)    1    2    3    4    5    6    7    8    9    10
Decision-Makers (B)    1    2    3    4    5    6    7    8    9    10
```

Each respondent will be asked to circle his score and return the questionnaire. On receiving the scores, they will be tabulated as follows:

	A	B
1	3	1
2	2	8
3	5	4
...	...	...
...	...	...
...	...	...
Sum (scores T_i)	Σ	Σ
Mean	X_A	X_B
Number of observations	N_i	N_i

A t-test will then be applied to the data to judge the effectiveness of the educational program.

$$t = \frac{X_i - \mu_0}{S_X}$$

where   t   = test statistic,

X_i = sample mean for i group,

μ_0 = population mean, and

S_X = standard error of each mean.

Then, a hypothesis will be developed and tested, using the above statistic, and based upon probability levels the effectiveness of the program can be conclusively determined. Specifically, the following null hypothesis will be tested.

$$H_0 : \mu_1 = \mu_2 = 0$$

Since this measures only how the participants feel about the program, a second dimension will be added whereby data and reports from the participants' supervisors will be used to judge performance change. A close working relationship between the trainer and the supervisors is necessary if this part of the program is to be successful.

These are the steps that will be undertaken to monitor progress and facilitate adjustment in the development of this and any future programs. Although no instrument is designed for level (7), there may be unanticipated end results that may affect the program. Results, negative or positive, may require program adjustment.

The above seven evaluation levels, if properly and carefully conducted, should ensure the successful evaluation of the program.

In summary, this chapter has described adult learning theory, the basic characteristics of adult learners, how an instructional theory based on adult learning behavior can be developed, and how an instructional tool such as the microcomputer can be used to facilitate learning in an adult learning situation. The use of microcomputers in education and other decision areas is also presented and a procedure for evaluation is explained.

IV. TECHNICAL MATERIAL FOR INSTRUCTION--
ECONOMIC MODEL

Introduction

The purpose of this chapter is to present a model framework for the analysis of macroeconomic policy and linkages to the agricultural sector. A simple monetary model of a developing economy will be constructed. One of the most important characteristics of the model is its emphasis on the role of money in determining prices, real output, and the position of the balance of payments; the model is monetary in that money plays the central role in determining macroeconomic variables of the economy.

The model is adapted from a model constructed by Dorosh (1986). The model differs from the Dorosh model in that only two sectors of the economy (traded and non-traded goods) are specified in both supply and demand. Given the growth and importance of the government sector in producing persistent pressure in domestic goods markets, the government budget is explicitly modeled so as to capture some of the linkages between government fiscal policy and inflation.

The model is characterized by money-determined demand for goods, given a constant velocity of money (velocity being the number of times per unit of time, such as a year, that the typical unit of money turns over). Two goods--traded goods and non-traded goods--are specified in the model. Nominal demand for each of these goods is assumed to be a constant fraction of the money supply (= base money H $\times$ velocity (v)).

$$P_T D_T = a_1 vH \tag{1}$$

$$P_{NT} D_{NT} = a_2 vH \tag{2}$$

where $\quad P_i \quad$ = price,

$\qquad D_i \quad$ = demand,

$\qquad v \quad$ = velocity of money,

$\qquad H \quad$ = base money stock (the liability of the central bank which is central bank credit to the government, plus net foreign assets of the central bank, plus central bank credit to banks, plus other net assets), and

$\qquad a_i \quad$ = constants.

This demand system implies a unitary price elasticity of demand for all classes of goods and unitary expenditure (not income) elasticity of demand.

Supply of traded and non-traded goods is specified to be a function of relative prices,

$$S_T = S_T(P_T/p) \tag{4}$$

$$S_{NT} = S_{NT}(P_{NT}/p) \tag{5}$$

where $\quad S \quad$ = supply of good i, and

$\qquad P \quad$ is a price index defined as

$$P = a_1 P_T + a_2 P_{NT} \tag{6}$$

with the a_i's equal expenditure shares.

It is assumed that most developing countries are price takers. Thus, for traded goods,

$$P_T = eP_T^W \tag{7}$$

where e is the exchange rate expressed as domestic currency/foreign currency and the w superscript indicates "world."

It should be noted here that "traded goods" are defined as those goods for which domestic prices are driven by world prices because the good is

actually exported or imported and no trade policy acts to isolate the domestic market from the world market. By this definition, maize is not a traded good since the Botswana Marketing Board's floor price policies and monopoly of imports serves to break the direct link between world and domestic maize prices. Most developing countries generally try to isolate domestic and international agricultural markets by domestic price controls on food grains that are enforced by quantity adjustments that equilibriate supply and demand in each year.

The domestic market for non-traded goods is assumed to clear through price adjustment equating domestic supply and demand.

$$S_{NT}(P_{NT}/p) = D_{NT} \qquad (8)$$

Changes in money stock drive the model. Money stock can be changed through any of four sources: balance of trade surplus and deficits, foreign borrowing, government domestic borrowing, and private borrowing. In the model, only the balance of trade and government borrowing are endogenous. The balance of trade is determined by supply and demand for traded goods.

$$BT = P_T \cdot S_T - P_T D_T \qquad (9)$$

where BT is the balance of trade.

Government borrowing is that part of the government deficit not financed by foreign borrowing (including foreign aid),

$$DG = GE - T_T \cdot (P_T(S_T - D_T) - KG \qquad (10)$$

where   DG   = nominal government deficit to be financed by domestic borrowing,

   GE   = nominal government expenditure,

   T   is the tax rate, and

   KG   = foreign capital inflows to the government.

Money supply changes are made up as follows:

$$\Delta MS = \Delta H = BT + KG + DG + KP + KPF \qquad (11)$$

where   KP   = private borrowing from the banking system, and

KPF   = private borrowing from overseas sources.

The foreign exchange reserves are denoted as the initial stock of foreign exchange, plus any changes due to the balance of payments (the balance of trade and net capital flows):

$$FE = FE_{t-1} + BT + KG + KPF \qquad (12)$$

where FE = foreign exchange reserves and the subscript t-1 indicates the previous period reserves.

Thus, the complete model consists of 12 equations solved for 11 endogenous variables, D_T, D_{NT}, S_T, S_{NT}, P, P_T, P_{NT}, B_T, DG, FE, and ΔH.

Model Solution

By specifying the supply of traded and non-traded goods in linear form, one is able to get a solution for the model,

$$S_T = c_0 + c_1 P_T/p \qquad (4a)$$

$$S_{NT} = d_0 + d_1 P_{NT}/P \qquad (5a)$$

where c_1 and $d_1 > 0$.

Then, using the market clearing condition Equation (9) for non-traded goods, and making the appropriate substitutions, we obtain

$$S_{NT}(P_{NT}/P) = d_0 + d_1 P_{NT}/P = a_2 vH/P_{NT} = D_{NT} \qquad (13)$$

The price equation of the model is obtained by substituting the expression in Equation (6) for the overall price index and solving for P_{NT}

$$P_{NT} = \frac{a_1 P_T - \dfrac{(S_{NT} - d_0)}{d_1}}{1 - a_2 \left[\dfrac{S_{NT} - d_0}{d_1} \right]} \tag{14}$$

See Appendix 1 for the derivation of Equation (14).

Then, the supply of traded goods can be found from Equation (4a) and the balance of payments, government deficits, and foreign exchange reserves can be obtained from Equations (9), (10), and (12). Equation (12) determines the next period money supply. Equilibrium in the money market is achieved by changes in money stock through surpluses or deficits in the balance of payments and the government budget. Fiscal policy has no direct effect on real output, assuming a stable demand for money and zero interest elasticity and also that the money supply is exogenously set.

National governments in developing countries attempt to manipulate fiscal policy-sources and expenditures of government revenues; monetary policy, essentially central bank policy, regarding the money supply; the interest rate and international policy through exchange rates; and commercial policy to accomplish goals for economic growth, employment, inflation, and balance of payments. However, since the 1970s primary commodity prices have been sluggish, with unanticipated declines in external revenues, and the availability of international credit has also been diminished. This has forced developing nations to finance their expansionary economic policies through fiscal deficits financed by monetary expansion. The net result has been prolonged, persistent inflation in these countries.

There is a clear and urgent need for rapid economic development in most developing countries. Rapid economic development is tied to the rapid rate of capital formation. There are various sources of financing capital

formation. Some of these include personal and corporate savings, revenue from taxation, some other non-tax revenues, and external aid. But in most developing countries, personal savings are low since income levels are also low, and the ability of the government to raise sufficient tax revenue to finance the required high rate of capital formation is drastically restricted by an underdeveloped tax and accounting system. External aid remains inadequate. Thus, it becomes all the more important to mobilize the available domestic resource if an acceptable rate of capital formation and economic development is to be maintained. It is this attempt to mobilize domestic resources, given the inadequacy of tax revenues and personal savings as sources of dometic finance, which leads to the choice of deficit financing or domestic credit creation as a means of financing the level of capital formation required for rapid economic development. In order to show the impact of a policy of deficit financing on domestic price levels, a kind of model is required which establishes theoretical relationships between variables under consideration. This is given by the quantity theory of money, or the basic equation of exchange,

$$MV = PY$$

where   M   = money supply in circulation;

V   = velocity of circulation;

P   = price level; and

Y   = output level.

The equation of exchange tells us that if either the velocity of money (V) increases or the money supply (M) is increased, we may anticipate an increase in the nominal value of annual output (PY). Both P and Y could increase or either Y or P. However, given lags in production, it is P which is likely to respond first.

The model developed above can be used to illustrate the generation of inflation processes in developing countries. The mechanism by which government deficits lead to inflation and balance of payment problems can easily be demonstrated. For example, suppose the economy is in equilibrium initially in both commodity and money markets. If the government desires to increase spending and finances this through domestic credit by borrowing from the central bank, the base money or money stock will increase by ΔH. This action will lead to an initial increase in the budget deficit (DG). The increased money supply induces increased demand, which together with the increased government expenditure places pressure on domestic resources and prices. Prices in the tradable sectors do not adjust since they are set by world market forces, but prices of non-traded goods rise in response to increased demand. Resource allocation shifts to the non-traded sector and supply of non-tradable goods increases. As for tradable goods, their prices may rise because of increased domestic demand and supply may fall due to a fall in their relative price as the price of non-traded goods rises. The result is the worsening of the balance of payments (trade balance). This occurs as a result of the price effects on demand for exports. In summary, increases in government expenditures add to private consumption, thus deteriorating the current account (value of goods produced by domestic residents, plus net transfers from abroad, less the expenditures by domestic residents for goods) and appreciating the real exchange rate (defined as the relative price of traded to non-traded goods). The real appreciation crowds out the foreign demand for domestic output of tradables by making domestic output more expensive (as domestic prices rise above purchasing power par-

ity and produce persistent trade deficits). In the domestic economy, the appreciation shifts resources to the non-traded goods sector by increasing the price of these goods.

Macro-to-Micro Linkages

Inflation Policy

Two macroeconomic variables, the level of inflation and the exchange rate, are often singled out as the major factors shaping economic environments in developing countries. Governments in developing countries are faced with the goals of internal security and political stability and one of the available opportunities to governments to meet these goals is to promote and foster economic development. This has put pressure on those in power to increase expenditures, at times in excess of revenue (deficits). The inflation resulting from the deficit spending, however, has threatened to frustrate the basic goals of these governments--the pace of economic development has slowed and the cost of inflation, especially for urban interest groups, has weakened the political support base of the governments in power. "Many African governments . . . have been overthrown because the people did not have enough to eat, because food was too expensive in the market and the people could not afford it" (Bates, 1981). Two policy variables have been employed to slow down inflation--direct intervention in the markets for food grains and monetary policy to control the quantity of money supply, thereby indirectly altering the direction of overall price-levels. For operational purposes, the definition of inflation is the change in the consumer price index, hence the attempts by developing nations to focus inflation control on the commodities with a major weight in the price index. Food commodities take a large share of consumers' budgets and that is why

governments take active and direct intervention in food-grain markets. There is also the general fear that increases in food prices lead to cost push inflation as wages increase in other sectors to compensate for higher food prices. Other reasons for direct intervention are distributional--to provide food to the poor at a price they can afford in order to assist them in meeting minimum nutritional needs and the political argument that urban consumers (who are often not the poorest) are frequently a source of potential social/political instability. Therefore, governments have an interest in ensuring that urban consumers pay food prices which do not impose hardship or lead to protest against the governments' policies. (This is because grains constitute the bulk of food consumption and are therefore considered wage goods, those upon which wage earners spend a significant portion of their income, which influence the cost of industrial production through wage demands.)

While there are non-monetary factors, such as the weather, which affect the general consumer price index, monetary factors are generally the main culprit. Monetary policies and other macroeconomic policies contribute largely to overall sustenance of inflation--the financing of government deficits by printing money, development projects, growing government payrolls, and increasing military expenditures.

Exchange Rate Policy

Exchange rates often send powerful and pervasive signals. They affect international competitiveness and the real domestic absorption, to the extent that they alter the incentive to produce tradable goods. Output of a product increases when its price, relative to that of other products, goes up

and such an increase can be caused by changes in exchange rates. The exchange rate changes affect the prices of tradable goods (exports and imports) and thus are of immediate relevance to economic agents because price signals have powerful effects on decisions on production, consumption, savings, and investment. Changes in exchange rate policy have significant consequences for a country's domestic relative prices and economic growth through their effect on the real exchange rate. The real rate is a measure of the terms of trade between the traded and non-traded sectors of the economy, which provides the signals for resource movements. Exchange rate policy can affect domestic prices of traded and non-traded goods through its influence on the entire domestic cost structure. Overvaluation of exchange rates by domestic policies or other factors appear to be a common feature of most developing countries and has served as an impediment to producers of export products and as an implicit subsidy for imported goods and services. Hence, exchange rates play a crucial role in development.

Generally, developing countries' currencies are overvalued, with trade controls often used to defend the unrealistic exchange rates. This frequently contributes to the distortion of investment incentives and inefficiency in resource allocation. Exchange rate overvaluation is rarely an overt policy by governments. It is more often the result of expansionary fiscal and monetary policy directed at maximizing economic growth. A side effect of expansionary monetary and fiscal policy is price inflation, which, when more rapid than the price inflation of principal trading partners, causes real exchange rates to appreciate. Additionally, exchange rate overvaluation is often a side effect of a strategy to promote industrial growth as a means to achieve growth and development. Governments pursue industrial growth

by imposing quantitative restrictions (such as duties and quotas) on imports of industrial goods which compete with domestic manufacturers. This serves to increase domestic prices of industrial goods relative to world prices. In these circumstances the official exchange rate will typically overvalue the local currency relative to foreign currency, compared to the real purchasing power of the local currency. This policy has had negative impact on economic growth, particularly in the primary producing sectors, such as agriculture.

Exports are reduced by overvalued exchange rates. The exchange rate determines how much in local currency is received by the exporter in return for foreign currency earnings. If the exchange rate is overvalued, the exporter will receive less in local currency for exported produce than would otherwise be the case. This has a negative effect on incentives to produce in the export sector. The importance of a dynamic export sector in the course of development is well-recognized. Overvalued exchange rates undermine exports' profitability because they reduce other countries' incentive to import from the country with overvalued rates, thus slowing down the engine of the development process. The export sector in some cases does not only represent a large share of output and employment, it is also important because it provides availability of foreign exchange, which is crucial to the overall level of economic activity. The overvalued exchange rate also affects import substituting sectors because imports become relatively cheap as a result of the overvaluation, if overvaluation is not accompanied by quantitative restrictions (such as import quotas and duties). Thus, the production of all traded goods is adversely affected by overvalued exchange rates, thereby undermining export growth and diversification, in turn altogether retarding economic development.

Agriculture, in terms of output and employment, is often character-ized as a leading sector in developing countries, hence the impact of over-valued exchange on this sector is very important. Usually, consumer goods prices, particularly foodstuffs and capital goods, are a primary concern in developing countries. Consequently, agriculture typically receives little or no protection (or even suffers from negative effective protection). Overvalued currencies, then, often discriminate against agriculture. Agricultural im-ports are often duty free. Domestic producers must, therefore, compete with artificially cheapened foreign imports. This puts a downward pres-sure on domestic prices, discouraging local production of the importable products. Ironically, in developing countries the poorest people found in ru-ral areas are dependent on agriculture and discriminating against agriculture impacts heavily on the livelihood of the poorest. Moreover, if the internal terms of trade are biased against agriculture, rural-urban migration is prompted with the result of more need for imported foodstuffs and in-creased pressure on the balance of payments. Through their negative im-pact on agriculture, overvalued exchange rates hurt development. Exchange rates thus influence the development of appropriate domestic technologies. They can also affect employment, particularly labor-intensive employment, if cheaper capital goods imports are encouraged.

There are other adverse effects of overvalued exchange rates. They also stimulate demand for foreign exchange as it makes it relatively cheap-er. This is even more true in developing countries because the public would believe the authorities can not afford and will not tolerate such a situation for a long period. Therefore, people buy more foreign exchange to take advantage of the low prices. As a result, imports and tourism ex-penditures abroad rise. Additional demand for foreign exchange puts pres-

sure on reserves and increases borrowing requirements. Most governments have imposed controls to take care of this problem. The consequence is that distribution shifts toward importers, often people with protected markets who only need cheap inputs. Farmers and exporters are the losers.

Overvalued exchange rates exert pressure on the current account balance of the balance of payments,

CA = X - M

where   CA   = current account (sum of the merchandise trade balance, the service balance, and unilateral transfer balance);

       X   = total domestic currency value of exports of goods and services over a period of time; and

      M   = total domestic currency value of imports of goods and services over the same time period.

It has been established that export competitiveness, as well as the purchasing power of the domestic currency over imported goods is affected by the real exchange rate (R_t).[1] Therefore, the current account flow at any particular time is a function of the real exchange rate at that time, $CA = CA[R)_{(t)}]$. With higher real exchange rates there is a loss of export competitiveness. Few exports and more imports would result, while a lower real exchange rate implies an improvement in export competitiveness, thus leading to more exports and fewer imports. Since most developing countries have overvalued exchange rates they run current account deficits which are temporarily offset through the capital accounts by com-

[1] $R_{(t)} = P_{(t)}/[S_{(t)}P_{(t)}^*]$
where $P_{(t)}$ = current domestic currency price of commodity i;
     $S_{(t)}$ = current exchange rate (domestic currency price of foreign exchange); and
     $P_{(t)}^*$ = foreign currency price of commodity i.

pensatory capital inflows. Often, these governments increase their borrowing to finance additional consumer goods imports. As current account deficits grow, more borrowing takes place, domestic savings declines, and the debt-servicing burden increases and eventually develops into a crisis or the country's foreign assets (reserves) are depleted.

In general, exchange rate policy is not set with primary consideration given to its impact on agriculture, but macroeconomic issues of maintaining adequate foreign reserves, price stabilization, and guarding future export earnings are often the major focus.

Price Formation in Tradable and Non-Tradable Sectors

The impact of government macro-policy on commodity markets depends essentially on the price formation mechanisms in these markets. There are two common types of markets that can be used to demonstrate price formation mechanisms in developing countries. One is the market for tradable goods--goods that are traded on world markets and for which no government policy or market failure acts to separate domestic price movements from world price movements. In other words, the domestic price of tradable goods is determined by the world price converted to domestic currency by the exchange rate and adjusted for fixed taxes (either ad valorem or nominal) and transportation costs. Changes in the world price of a tradable commodity or in the exchange rate affect the domestic price.

The other case is for non-tradables, which are goods that cannot be profitably exported or imported because of high transportation costs (or transfer costs). The price of these goods is not directly affected by changes in the price of these goods in world markets or by changes in the exchange rate.

However, it has been shown that government policy can change the above definitions. Import or export quotas or ceilings, government monopolies on trade, or variable levies and variable taxes can cause a tradable good to be non-traded.

For the sake of clarity, the difference between a tradable and nontradable good is demonstrated by using simple supply and demand diagrams. The analysis is presented in Figure 3. The analysis assumes a small country that is a price taker in world markets. The price at which domestic producer competes is influenced by world price expressed in foreign currency converted to domestic currency by the exchange rate. The world price thus expressed in domestic currency, together with transportation and other transfer costs to or from the world market, determine the width and location of the c.i.f. (cost, insurance, freight)-f.o.b. (free on board) band.
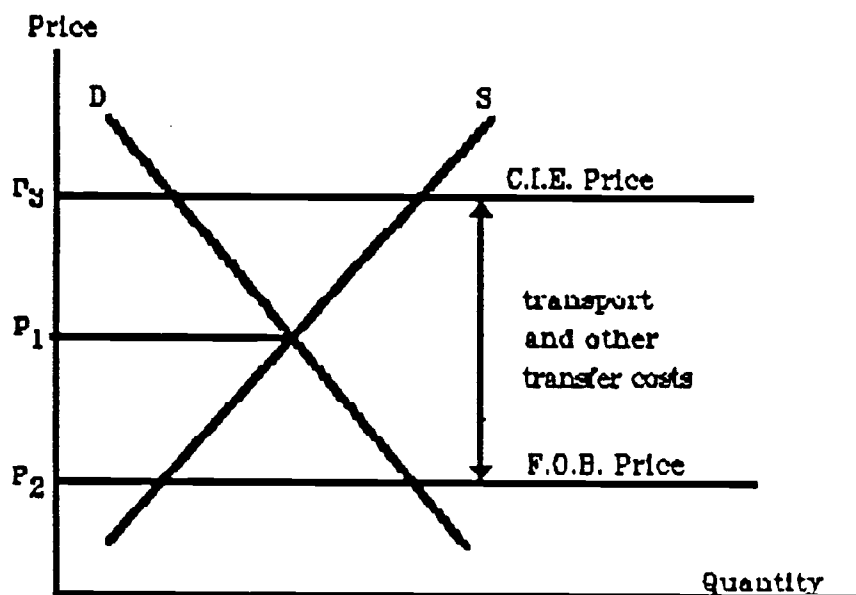
Figure 4. CIF-FOB Band

In Figure 3, P_3 is the world f.o.b. price of an exportable good. For a good to be without a subsidy, domestic supply must exceed domestic demand at world price P_3. If no trade policy acts to break the link between domestic and world prices, the domestic price will be bid up to the world price and will fluctuate with the world export price as long as there exists an exportable surplus at that price. A non-tradable good can be represented as one for which neither imports or exports are profitable. In this case the price is determined by the intersection of supply and demand (P_1).

The effect of government policy interventions that create trade barriers in breaking the link between world and domestic prices is shown in Figure 4. Without the quota the domestic price of a commodity equal to the world price for both producers and consumers (with appropriate allowance made for marketing costs). Domestic production is equal to Q_1 and consumption is equal to Q_2 and supplies of $Q_2 - Q_1$ are imported from the world market at Price P_3 to make up the difference. If an import quota is imposed, reducing imports from $Q_2 - Q_1$ to $Q_4 - Q_3$, the total supply in domestic markets would be domestic supply, plus the import quota (S_2), which will equal demand at the new price, P_2.
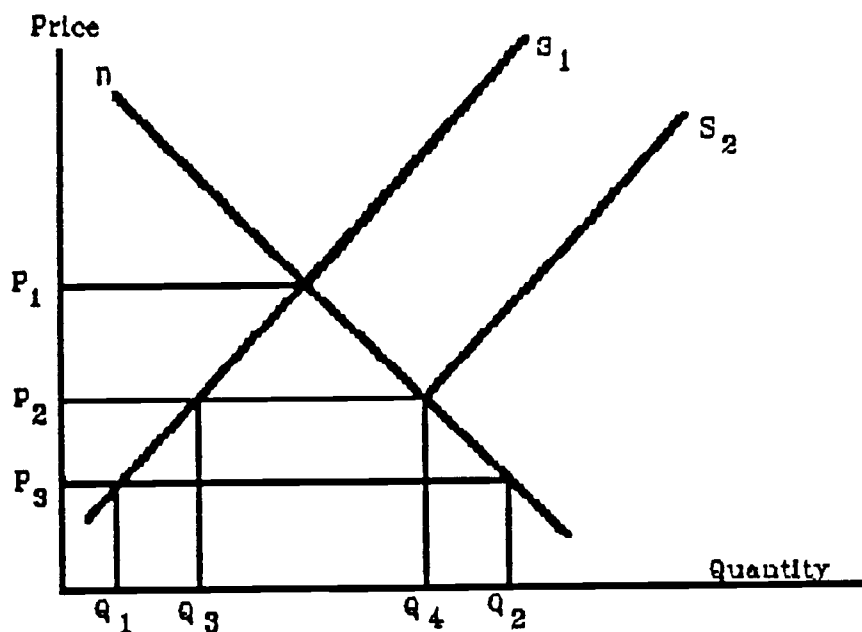
Figure 5. Effect of Import Quotas

The impact of inflation and exchange rate policy on a commodity de-
pends on whether the good is tradable or non-tradable and on the choice of
policy instrument. The price of a non-tradable good, which is not con-
trolled by government, generally will rise with domestic inflation so that the
real price remains unchanged if there are no underlying changes in real
supply or demand. But the real price of a fully tradable good will in gen-
eral follow movements in the real exchange rate if the world market price
of the good remains unchanged in real terms and if there are no binding
quantitative restrictions.

The following relationships illustrate the price formation mechanisms
for tradable goods:

$$P_T = e \cdot P_T^W$$

where $\quad P_T \quad$ is the domestic price of the tradable good,

$\quad\quad\quad\quad$ e $\quad$ is the nominal exchange rate expressed in units of domestic

$\quad\quad\quad\quad\quad\quad$ currency per unit of foreign currency, and

$\quad\quad\quad\quad P_T{}^W \quad$ is the world price of the tradable good expressed in foreign

$\quad\quad\quad\quad\quad\quad$ currency.

A simple measure of the real exchange rate is

$$e^R = P/e \cdot P^W$$

where $\quad e^R \quad$ is the real exchange rate,

$\quad\quad\quad\quad P^W \quad$ is the world price index, and

$\quad\quad\quad\quad P \quad$ is the price index in the domestic economy.

Price Formation in the Grain Market

In Botswana the government is deeply involved in the domestic grain market. The government is active in isolating domestic and international markets by domestic price controls on food grains, enforced by quantity adjustments that equilibriate supply and demand in each year. Three major crops are traded in the domestic market: maize, sorghum, and beans (pulses). The most important policy decision of the government is the annual determination of producer and consumer (release) prices. There are forces mitigating government pricing decisions that are lower than world prices. Bates (1981) has tried to explain government behavior in grain markets by the following arguments. First, that governments are purposive agents for achieving social objectives and can use their power to control markets if it promotes national welfare. Secondly, governments can be seen as responding to the pressures of private interests. Different political groups form coalitions that pressure governments systematically to distort relative prices in their favor. In developing countries, where real incomes

are low and expenditures on food are relatively large, food producers represent a poor coalition partner. More commonly, urban consumer groups and manufacturing interests unite successfully to pressure governments to lower and stabilize domestic food prices. Finally, governments intervene in order to achieve political control. Agricultural policies create resources that politicians can use to build political followings or to nullify political opposition, thereby remaining in power. There are also pressures of another kind that prevent the government from lowering prices too far and which may even cause them to raise prices above world prices. This is the pressure for domestic self-sufficiency in food grain production.

Maize and Sorghum

Because of their role as the most important staple foods, maize and sorghum have been of major concern for government policy makers. These two crops account for a large share of household expenditures, making their prices a major determinant of real income for most urban households. Given the importance of these crops in fulfilling the goals of political stability and the welfare consideration of cheap food supply, the Botswana government is actively involved in these grain markets by setting floor prices to producers and release prices to wholesalers from government storage and by controlling quantities of international trade in these crops through an import/export permit system administered by the Ministry of Agriculture. These government interventions have made these crops non-traded goods-- their prices do not follow changes in world prices. In these markets, one can postulate that with perfect knowledge of past and future events, governments set target producer prices for each food grain, P_t, in relation to the self-sufficiency price SSP_t,

.

$$P_t = \eta + \alpha \bullet SSP_t$$

where η and α are parameters. This formulation allows the self-sufficiency price to influence the long-run target producer price so that the target price may vary from year-to-year as the self-sufficiency price changes.

It is postulated that the government has a long-run target consumer price in relation to the price as follows:

$$CP_t = \kappa + \mu \bullet P_t$$

where κ and μ are parameters. As it is predominantly the government that provides marketing services, implicit in the target consumer price is some degree of subsidy or tax on the operations of the marketing board.

The government holds stocks in order to maintain a regular flow of supplies into consumption and to meet production shortfalls at ruling prices. It is therefore postulated that the government has a long-run target level of carryover stocks, S_t, for the end of each year. This target bears some relationship to the magnitude of random disturbances in the demand and supply. The larger the stocks are, the more the government can accommodate the disturbances in the first instance by building up or drawing down stocks and the less it will need to engage in international trade.

Finally, because the government is assumed to be the only holder of carryover stocks, the social accounting identity is given by

$$M_t \equiv QD_t - QP_t + S_t - S_{t-1}$$

This completes the government involvement in these important grain markets.

Beans/Pulses

These crops are in general freely traded. Since they do not play a major role in the diets of many, particularly the middle and upper income classes, especially in urban areas, and are not a major input in manufacturing, they are generally left to free market forces to determine prices and supply. However, as tradable goods their domestic price is influenced by world prices and exchange rate policy. Given the arguments for self-sufficiency in domestic production of major crops and the desire for foreign exchange, the government has a target price for these crops,

$$P_t = \beta + \gamma \cdot SSP_t + \tau \cdot WP_t$$

where β, γ, and τ are parameters, SSP_t is the self-sufficiency price, and WP_t is the world price. This formulation allows both the self-sufficiency price and the world price to influence the long-run target producer price.

Inputs (Fertilizer)

The government also intervenes in the market for inputs. Since there is no domestic fertilizer industry, and that all imports of fertilizer are handled by a state trading corporation-marketing board, this market, therefore, is completely controlled. Fertilizer is sold to farmers at cost so that the accounts of the marketing board balance. The fertilizer price is

$$P_f = \alpha + \sigma W_t + \rho T + ZH$$

where α, σ, and ρ are parameters, W_t is the world price or import price, T is the handling charge, and H is negative and represents the subsidy per unit of imports. A change in the price of fertilizer, therefore, will affect

producers. It will also affect the balance of payments through imports and government revenue through subsidies.

The Microeconomics of Agriculture

In developing the analytical framework to examine the effects of government macroeconomic policy on both prices and quantities in the food sector, the supply and demand systems for the three major crops will be specified.

Demand System

The per capita demand for each commodity is assumed to be a function of the real prices of maize, sorghum, beans, and real per capita income. The demand equations are:

$$PCQ^d(1,i) = a(i) + b(1,i)^*P_{maize} + b(2,i)^*P_{sorghum}$$
$$+ b(3,i)^*P_{beans} + b(4,i)^*GDP$$

where PCQ^d = the natural logarithm of per capita demand for commodity

i,

P_x = the natural logarithm of the wholesale price of commodity

x deflated by the cost of living index,

GDP = the natural logarithm of the real per capita gross domestic

product, and

i = maize, sorghum, and beans.

The real per capita GDP (equivalent to household income) is assumed to be made up as follows:

$$GDP = R + W + \sum_i A_i \pi_i$$

where   R   is the net return from capital assets,

W   is labor earnings, and

$\sum_i A_i \pi_i$ is total farm profits.

This specification allows a change in food prices to affect demand directly through P and indirectly through GDP because a change in food prices affects farm profits $(\sum A_i \pi_i)$. For example, an increase in the price of maize will reduce the consumption of maize by all households as a result of its effect through P. The same price increase, however, will increase farm profits for those households cultivating maize. The resulting increase in income will tend to increase maize consumption. The b coefficients are elasticities of demand. Own-price elasticities are expected to be negative and cross-price elasticities are expected to be positive since these goods are substitutes in consumption.

Supply System

In deriving the supply equations, it is assumed that the farm has a fixed amount of land on which to allocate the various crops, i.e. maize, sorghum, and beans. The allocation depends on the relative profitability per acre of each crop, which in turn is dependent upon input and output prices and technology. For example, consider maize:

Profit per acre of maize = Value of outputs - Value of inputs

This relationship can be described by a production function (or technology) equation as,

$$\pi_m = \pi_m(\bar{P}_m, T_m)$$

where π_m is the profit per acre of maize,

$\bar{P}_m$ is a vector of input and output prices, and

T_m is technology used in production of maize.

This relationship includes a behavioral assumption of profit maximization. The farmer will only allocate his land to a crop if per acre profits are higher than that expected from competing crops. The farmer constructs similar relationships for other crops. Armed with this information, he will be able to compare relative profitabilities and make his land allocation,

$$A_m = A_m(\pi_m, \pi_s, \pi_b)$$

where A_m is the area allocated to maize,

π_m is the relative profitability of maize, and

π_s and π_b are relative profitabilities for, respectively, sorghum and beans.

Multiplying profit per acre (π_m) by Area (A_m) provides a measure of total profits for maize. Similar calculations for other crops can be made. This allows for the measure of total farm profit as

$$\sum_i A_i \pi_i = \text{Total farm profit}$$

where i = maize, sorghum, and beans. This expression is founded in the microeconomic behavior of farmers and it allows interactions and substitution possibilities in production.

Underlying measures of profitability are physical measures of inputs and outputs. Corresponding to the equation for profits per acre, there is a yield equation:

$$Y_m = Y_m(P_m, T_m) = \text{Maize Yield}$$

where Y_m is the profit-maximizing maize yield. When yield is multiplied by area planted (A_m), we get total supply. Since area planted depends on

the relative profitability of maize and its possible substitutes, total supply

function for any crop will depend on the input and output prices of both

crops as well as technology:

$$Q^S(1i) = c(i) + d(1,i)^*P_{maize} + d(2,i)^*P_{sorghum}$$
$$+ d(3,i)^*P_{beans} + d(4,i)^*P_{t-1\ fert} + d(5,i)t$$

where $Q^S(i)$ is the supply of the commodity,

        P_i is the national logarithm of the deflated price of the com-

            modity,

        t   is a time trend variable (proxy for technical change), and

      P_{t-1} is the national logarithm for the price of fertilizer

        (measures the farmers expected price at planting).

Current real prices of maize, sorghum, and beans are pre-planting, an-

nounced prices by the government. The d coefficients of prices are elas-

ticities of supply. Own-price elasticities are expected to be positive. The

price elasticity for fertilizer is expected to be negative. Cross-price elas-

ticities are less certain.

The basic purpose of the model is to provide the link between

macro-policy variables and the agricultural sector and also to provide an av-

enue to explore the consequences of any of the macro-policy upon agricul-

ture and/or any shocks originating from the agricultural sector into the gen-

eral economy. The goal is not to identify precisely every type of linkage

in the system or to build an elaborate model, although at times this could be

necessary and desirable, but rather to establish a frame of mind for identi-

fying important linkages and judging their importance.

Model Simulations

In order to generate useful information from this prototype model, large amounts of secondary data need to be gathered, such as money supply changes over long periods of time, government budget figures (expenditures, net revenues, budget deficits, balance of payments), and major macroeconomic indicators (e.g., real GNP, inflation, reserves, and purchasing parity exchange and actual exchange rates). These data are necessary in overall description of the economy and its performance, forming the theoretical building blocks for subsequent actual estimation processes. Given the characteristics of the adult learning process, one can also develop pictorial figures which show the relationships between these aggregate variables, particularly money supply/inflation, government expenditures/inflation, and inflation/food prices.

Time data series on annual levels of production and consumption of the major crops, maize, sorghum, and beans, are needed and wholesale market prices for these commodities will also be required. The data is necessary for estimation of supply and demand equations. Elasticities of various coefficients are generated in this context. These elasticities are important in analyzing responsiveness of commodities to specific policy variables.

Estimates from the historical data (base runs) would form the base (point of reference) against which comparisons would be made with alternative policies that would have occurred had they been chosen. For example, given the historical data, and assuming equity is a major policy goal, the model could be used to judge the impact of the pricing policy on real incomes of household groups in both urban and rural areas. The supply and demand equations could be used to yield information about the effects of

pricing policy. If need be, these equations can be disaggregated by income class to better capture the distributional impacts of policy. The supply equation allows for change in both yield and allocation of land among crops, capturing the important substitution effects. If, for instance, the government increases the price of maize, total farm profits would be expected to increase. Reductions in acreages allocated to other crops would also be expected. These could be called first round effects. Increases in farm profits will imply an increase in total household income, or Y, which will in turn increase demand for all food crops. The change in the marketed surplus food crops will depend on both supply response and the demand response. Since it is generally true for both the rural landless and urban classes that their nominal income is not affected by farm profits, any change in consumer prices for basic foods affects them in a real sense. However, there are other effects—since government would have increased maize procurement prices, it would be paying more for its direct purchases. The government, through the marketing board, loses revenues since maize profit margins would be narrowed. Much of the loss results from the potential dramatic increase in formal market maize supply that is not completely offset by increases in formal market demand. The government would have to store or export the excess maize. Usually it is stored at substantial losses or deficits incurred by the marketing board. These losses are covered by budgetary allocations (subsidies) from the treasury. Government wages and salaries often respond positively to an increase in food prices and the resultant fiscal deficit in turn affects the change in the monetary base, through borrowing from the central bank.

One other common policy prescription is currency devaluation to mitigate the effects of overvalued exchange rates upon the economy. Devalua-

tion simulations could be done under two sets of assumptions. The first is that the currency would be devalued, but fixed government prices for maize and sorghum would remain unchanged in domestic currency terms, i.e., the government does not pass on the effects of the devaluation to producers and consumers of domestically produced maize and sorghum. The increase in the price of all tradable goods is passed on. The second assumption is that the government passes on the effects of devaluation so that prices of these crops to producers and consumers remain constant in terms of foreign exchange. For apriori reasons, the passing on of the full effects of devaluation to improve the long-run economic future of food production would be expected. If government food prices are allowed to increase to adjust to devaluation, demand will fall and production will increase. This will be due to the decline in relative prices of non-tradable inputs (such as labor). Similarly, food prices would increase relative to labor rates, therefore demand for food crops would decline. The resulting increase in supply would cut down imports, hence reduce pressure on foreign reserves.

If, however, government procurement prices are kept artificially low relative to the devalued prices, demand for maize and sorghum will increase and production will drop. The government will be forced to import large volumes of maize and sorghum.

Many other policy scenarios can be simulated using this simple model by fixing all variables except one at historical levels and running the model with new values for the changed variable. This type of policy simulation has an advantage over evaluating the effects of alternative economic policies on the behavior of the economy since it does not require or assume prior knowledge of either some form of social welfare function or targets of the policy maker. All the policy analyst needs to know is the output variables

of interest and sets of politically feasible policy variables. With simulation, the analyst can then show the policy maker the consequences of the proposed policies. It is then for the policy maker to select policies that are most compatible with his preference function.

Agriculture makes up a large share of Botswana's economy. Because of the importance of crop production in rural life, crop response to agricultural price and macroeconomic policies can have a significant impact on the economy as a whole. Crop production is the major source of farm income. Sales of agricultural products inject funds for investment in rural areas. Agriculture is also a large employer of labor. Its performance is seen by government as critical in employment generation.

Government expenditures and balance of payments are also affected to a lesser extent by agricultural performance. Expenditures of carryover stocks, subsidies to the producers and consumers, and changes in trade impact the balance of trade. Agricultural prices and the level of production are major determinants of rural incomes.

Food and agricultural policy is seldom considered as part of macroeconomic policy, or vice versa. Central planning agencies, central banks, and ministries of finance and development are responsible for macroeconomic policy, while food agencies and ministries of agriculture design farm and retail price policies. The macro agencies have an input into these deliberations (frequently a veto) because of the consequences of food and agricultural policies for the government budget, but the reverse is seldom true. Few ministries of agriculture contribute to the macro policy debate. It is hoped that a program advocated in this study would greatly help officials from agricultural ministries to have a clear understanding of the total picture of the linkages in the whole economy. It would help participants to

understand why government does what it does and be able to explain that to the general public.

Means to Bring About Change

The first stage of the program will involve a promotional phase whereby all other institutions of government are introduced and briefed about the program. Memoranda will be sent out explaining the goals and objectives of the program and how it fits into the overall manpower and training program of the government. After the initial steps are set in place, the various government ministries and other institutions will be invited and requested to participate in a workshop to discuss the details of the program. A cabinet-level person will be invited to open the seminar to emphasize the importance of the whole initiative.

A national task force, whose functions would include the coordination of the program, its review, and implementation, will also liase with the national university departments and define areas of cooperation. The learning/teaching process will emphasize action-oriented, participatory methods to maximize comprehension, retention, and application. Hence, case studies, simulation games, and role playing will be fully used in the classroom.

A regression analysis approach is advocated for use in the training program called for in this study. It is hoped that the program can provide a group of participants with the capacity for independently conducting or continuing comprehensive policy analysis. Group capability is important in this case because comprehensive policy analysis requires an interdisciplinary and multidisciplinary approach and input from various government agencies. In order that the exercise can be carried out within a reasonable time-frame, including issue identification, model specification, data manipulation,

model calibration, a base scenario, sensitivity studies, interpretation, and policy recommendations, the training program will be divided as follows:

1) Background lectures in technical and policy areas will be given primarily by senior local government and industry officials. The purpose of these lectures will be to make the participants aware of the economic and political analyses that shape policy decision-making. The real objective is to make basic concepts clear. Figure 5 indicates some of the issues involved in policy analysis, which will be covered in background lectures.

ECONOMICS (Economic Science)	POLITICS (Political Science)

FOUNDATION

THE ECONOMIC PROBLEM
(Wants > Resources → Scarcity, i.e.,
our wants exceed available resources
and therefore scarcity exists)

THE POLITICAL PROBLEM
(Conflicts of interest)

THUS

I. Political economy is the study of the methods by which society:

employs its resources (human, capital, natural,
time) productively for the fulfillment of human
wants.

resolves conflicts of interest over the author-
itative allocation of values; thus a study of
power.

Toward these ends

Economics is a study of how a society decides:
  a. What wants to produce (i.e., what wants to
     fulfill) and how much to produce
  b. How to produce most efficiently (i.e., how
     to allocate resources most productively
     to their alternative possible uses)

  c. For whom to produce (i.e., who is to get
     what and how much and how is this to be
     decided)

Politics is a study of how a society decides:
  a. What goal values are to be sought and
     given authority
  b. How societies are to be organized for the
     pursuit and use of power and authority
     (i.e., mechanisms for resolving con-
     flicting values, achieving social
     goals)
  c. For whom the organization exists (i.e.,
     who gets what; whose goals are
     served?)

II. Political economy is the study of social problems relating both to
    the functioning of the organization as a whole and to its parti-
    cular institutions. Both economics and political science usually
    employ a problems approach involving four steps:

    a. Definition of the Problem--What desired goals are believed to
       be inadequately served by existing institutions? How does
       "what is" conflict with what many think "ought to be"?

Economics is concerned with problems relating par-
ticularly to the goals of:
  1. Efficiency and productivity
  2. Growth

  3. Stability (both full employment and general
     price stability)

  4. Security
  5. Equity in the distribution of income

Politics is concerned with problems relating par-
ticularly to the goals of:
  1. Justice in the exercise of power
  2. Equity in the distribution of power (in-
     come, deference, security, influence)
  3. Freedom (both limits on the use of power
     and access to resources needed to rea-
     lize individual potential)
  4. Effectiveness

    b. Understanding of the problem. What concepts, what analytical
       tools, what facts do economics and political science have
       to contribute to an understanding of the problem and its
       proposed solutions?

What do we know about how productively resources
are being employed for the fulfillment of human
wants related to the problem and the consequences
for other values?

What do we know about value conflicts (i.e., con-
flicts of interest) related to the problem, how
they are being resolved, and the resulting allo-
cation and use of power?

(Figure 6: continued next page)

Figure 6 (continued).

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c. <u>Public policy alternatives.</u> What are their economic and poli-
tical implications? How may citizens, as individuals and
groups, influence policy decision-making?

What will be the probable consequences, both in the   Who is proposing what and why? How does private
short run and long run (the seen effects and the   interest relate to public interest? What are the
unseen), for the economic goals stated above?   probable consequences for the political goals
                                                        identified above?

Thus what policy alternatives will bring the greatest net realization of values?

I.e., a more optimal allocation (use) of resources   I.e., resolution of the problem with a minimum
(so that their marginal value products in all al-   value loss to any participant and a maximum value
ternative uses will be equal).   gain to all.

What policy alternative is most compatible with one's economic
philosophy (i.e., one's view of the proper role
of government in relation to the economy)?

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d. <u>Action</u>--How may one implement one's views?

How does one act as consumer, producer, as a member   How may one as a citizen or leader participate in
of an interest group to bring about desired   politics to be most effective in bringing about
changes?   desired changes?

Figure 6. A Frameword for Analysis of Political-Economic Policies
and Issues (Highsmith, Heine, & Bailey, 1983).

2) Methodological lectures on model theory and structure. Mathe-
matical relationships are fully developed and explained with the
aid of graphs, visual aids, and charts. Professional staff from
universities, banks, and government will be called upon to offer
presentations. Other instructional technologies which help adult
learners will be fully exploited. The purpose of the lectures
would be to give the participants considerable insight into the
economy and ensure that development of policy scenarios is not
carried out in isolation from macroeconomic development plans.

3) Analysis with microcomputers and working in groups. There
are always conflicting group interests in any policy issue. In
this case groups could be divided into consumers, agricultural
producers, marketing board members, central bank officials,

and government officials (ministry of finance or treasury). Each group will be required to identify some goals to be achieved; roles of individuals or groups will be clarified and identified; a set of conditions for the players in each group will be articulated; specific goals or objectives for the group are made clear and to begin with each group will be given a simplified base run of the model.

4) Group presentation and discussion. Participants will be given opportunity to discuss their results and how their decisions or recommendations impact on other groups and the general economy. The greatest advantage of this hands-on analysis is that it gives the participants a chance to interact amongst themselves and with experts.

Figure 6 summarizes the procedure for conducting the policy analysis.
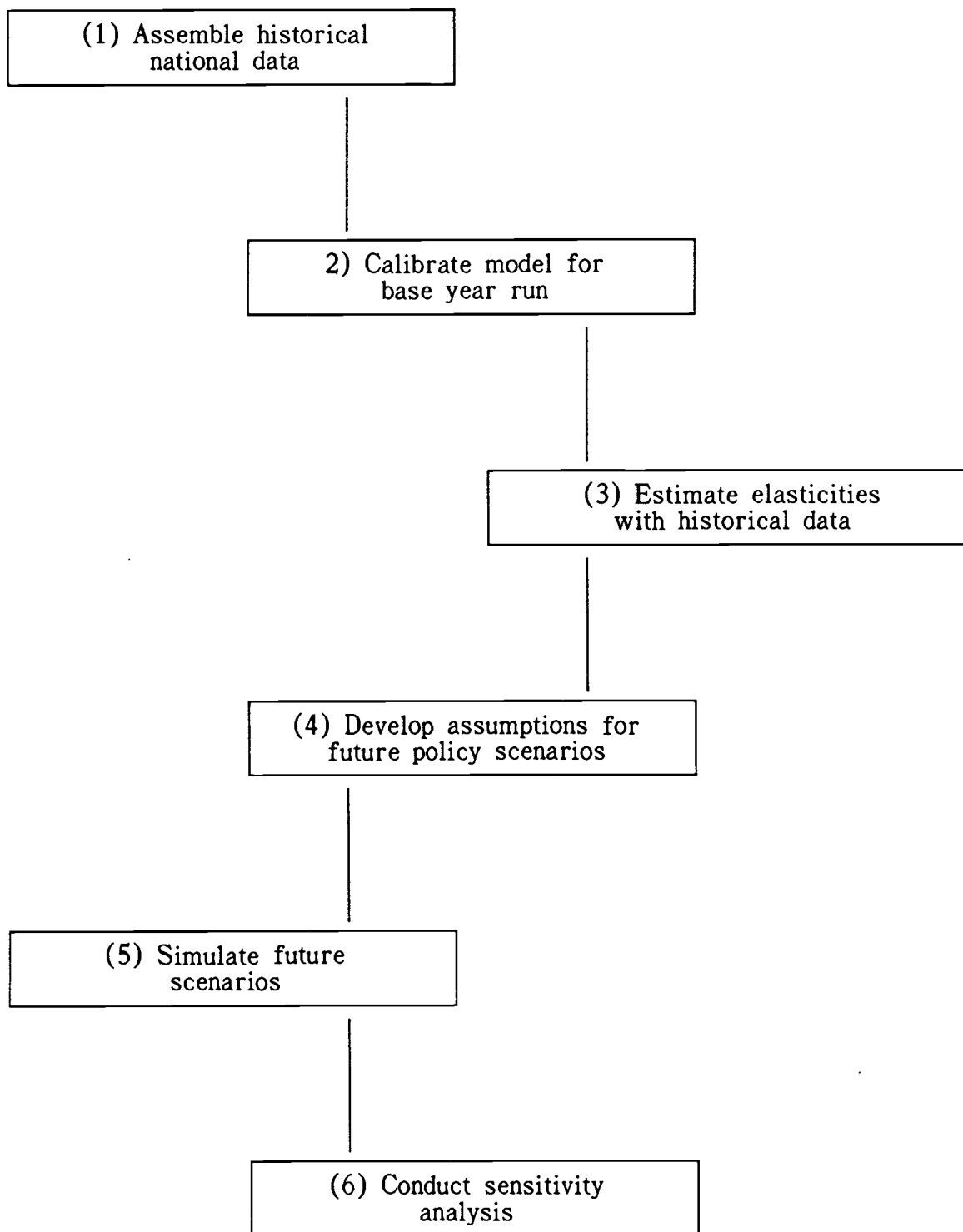
Figure 7. Procedures for Policy Analysis

V. SUMMARY AND CONCLUSION

This study resulted from a desire and interest to incorporate the use of microcomputers in agricultural policy analysis in developing countries and to examine how microcomputers can be used in instructional and decision-making processes.

The review of literature indicated that microcomputers have been used in diverse situations in many disciplines, which is to say that microcomputers can be used to study many types of systems. The environment in which we live and work is continually changing and, therefore, the aim of education is the facilitation of learning. Microcomputers play an essential role in facilitating learning. Since the beginning of the era of microcomputers, policy analysts have been confronted by increasing possibilities of simulating, through smaller systems rather than large-scale models, the likely effects of some existing government programs or weighing the alternative consequences of some proposed changes in policy or in a program. Those who make and evaluate policies increasingly can rely on projections provided by such models as a basis for their work. Models on microcomputers enable their users to produce information that can reduce uncertainty about the future, which in turn gives modelers and analysts personal and organizational power in the form of specialized knowledge.

It has been urged that instruction through microcomputers is experiential in nature, meeting commonly agreed upon applications of adult learning theory. They are performance-oriented, allowing trainees to observe the behavior of others, engage in practice, and receive immediate feedback and

remediation. They are psychologically safe, so the pressure to perform in a real-life setting can be minimized, thus encouraging experimentation and creativity. They encourage risk-taking because the consequence of error is low and the learning potential from the error is high.

In summary, simulation models can be successfully used to assist policymakers in addressing problems related to macroeconomic policy, sectoral development policies, and forward and backward linkages of these policies on the economy, i.e., their socio-economic impacts. They can be useful in evaluating alternative policies, in providing a base of information essential to sound decision-making and in assisting in planning projects or programs. The successful use of these models, however, requires that modelers who use them know how sensitive the results from these models may be to differences in economic assumptions, inadequacies in the model structure, and errors in the underlying data. Analysts should be thoroughly prepared to explain the implications of any given scenario or results of alternative scenarios to decision-makers. In other words, modelers need to work closely with model users, be able to communicate the limitations of these models to potential users, and be prepared to work with model users to assist them in interpreting the results and implications of alternative development scenarios. When properly formulated, these models can facilitate understanding of key causal relationships. Therefore, simulation as a decision aid has considerable promise in education and management settings.

It is necessary to gauge the success of any program. It is also important to keep the evaluation process as simple as possible. It will be necessary to have a continuous evaluation process whereby participants will be monitored at their working environments. Evaluation will also be needed to guide the improvement of the program. It will be necessary to repeat

the seminar/workshop/short course every two or three years, as the persons responsible for making policy change. Prawl, Medlin and Gross (1984) have discussed the major elements of determining program evaluation as appropriateness, effectiveness, and efficiency. Efficiency is concerned with the cost effectiveness of the program. It answers questions such as: Does the program achieve maximum output with minimum input? Is it the least cost method to achieve the program goal? Appropriateness looks at the suitability of the program to the situation or individuals who participate in the program. It provides answers to questions like: Does the program meet the needs of the community? Finally, there is effectiveness, which measures program accomplishment in terms of changes in the behavior of the participants. The evaluation envisaged under this study will focus on program accomplishment, which focuses on how the training program will help participants do their work better or in an improved way (i.e., how it affects their level of knowledge, skills, attitudes, and ground interaction).

In extension education, Bennet (1976) outlined seven events or levels in program evaluation (input, activities, people involvement, reactions, KASA (Knowledge, Attitude, Skills, Aspirations) change, practice change, and end results), which have become standard. In terms of this study, the evaluation will concentrate on the practice change, which tries to measure change in the behavior of clients. Data for evaluation will be generated through direct observation of recommended decision processes over a series of years and through periodic survey data collected from participants on how they rate the effectiveness of the program.

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APPENDIX

APPENDIX 1

Derivation of Equation 14

$$S_{NT} = d_0 + d_1 P_{NT}/p$$

$$\text{where} \quad P = a_1 P_T + a_2 P_{NT}$$

$$S_{NT} = d_0 + d_1 \cdot \frac{P_{NT}}{a_1 P_T + a_2 P_{NT}}$$

$$S_{NT} - d_0 = d_1 \cdot \frac{P_{NT}}{a_1 P_T + a_2 P_{NT}}$$

$$\frac{S_{NT} - d_0}{d_1} = \frac{P_{NT}}{a_1 P_T + a_2 P_{NT}}$$

$$P_{NT} = (a_1 P_T + a_2 P_{NT}) \frac{S_{NT} - d_0}{d_1}$$

$$= (A_1 P_T)\frac{(S_N T - d_0)}{d_1} + (a_2 P_{NT})\frac{(S_{NT} - d_0)}{d_1}$$

$$P_{NT} - a_2 P_{NT}\frac{(S_{NT} - d_0)}{d_1} = a_1 P_T \frac{(S_{NT} - d_0)}{d_1}$$

$$P_{NT}(1 - a_2)\frac{(S_{NT} - d_0)}{d_1} = a_1 P_T \frac{(S_{NT} - d_0)}{d_1}$$

$$P_{NT} = \frac{a_1 P_T \dfrac{(S_{NT} - d_0)}{d_1}}{1 - a_2 \dfrac{(S_{NT} - d_0)}{d_1}}$$