

**FAO
STATISTICAL
DEVELOPMENT
SERIES**

1

**FOOD AND
AGRICULTURAL
STATISTICS**
in the context of
a national
information system



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

CORRIGENDA

Page 140,
line 10

Should read:

growth r_T in utilization of C is $.75(4.0) + .25(8.0) = 5$ percent per

Page 190,
line 10

Should read:

$$Y_1 = a_{11}X_1 + a_{21}X_2 + a_{31}X_3$$

Reprinted 2009

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FOREWORD

This is the first issue of a new FAO Statistical Development series of manuals. The Statistical Development Series will provide comprehensive technical manuals for assisting countries in planning, developing and operating the statistical programme component of a national information system for food and agriculture. Although a rather full potential "state of the arts" statistical programme, that even the most advanced country could benefit from, is planned for the series, some of the more advanced programme components, such as a country-wide early crop estimates sampling capability and an operational remote sensing crop monitoring capability, must await future coverage, further technological developments and cost efficiencies. In addition, most of the subjects covered in early issues will be improved upon with additional field experience and subsequent revision. But every country, even the poorest and least developed, both economically and in statistical capability, can initiate the planning and development of a particular programme component after an evaluation of its current capability and needs, with the first generation such component reflecting marginal improvement in the country's current capability and each successive programme development cycle resulting in a larger and more integrated programme.

Because statistics must have a sound conceptual base, with theoretical concepts relevant to real-world problems on the national policy agenda successfully operationalized, with the resulting data interpreted and analysed to become useful information to decision makers, this first manual in the series places statistical programmes in the context of a national information system for food and agriculture. Then, the basic statistical development components, such as the agricultural census, household surveys and community-level statistics, are treated in successive papers, as is the use of administrative records as a source of secondary data. Several issues concerning subject-matter statistics complete the series. Subjects to be covered include: socio-economic indicators of agrarian reform and rural development, natural resources with emphasis on agricultural land, marketing, credit, fertilizers, machinery and other manufactured inputs, farm management, type of farming, enterprise costs and returns, commodity supply and utilization accounts, agricultural input and output prices, food balance sheets, agricultural population and labour force, food consumption and nutrition, economic accounts for agriculture, and other statistical needs for monitoring and evaluating

the economic viability of the agriculture sector, food self-reliance, and other dimensions relevant to a country's food and agricultural complex.

In all areas, from the agricultural census as the cornerstone of the statistical development programme to the use of socio-economic indicators in monitoring agrarian reform and rural development, the emphasis will be on a balanced programme of data collection, processing and analysis as integral and inseparable parts of a national information system for food and agriculture.

Leroy Quance
Director
Statistics Division

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CHAPTER 1

INTRODUCTION

If we could just know where we are and whither we are tending
we could better judge what to do, and how to do it.

Abraham Lincoln

1.1 Background

One of the most basic objectives of FAO is the development and improvement of food and agricultural statistics, particularly in developing countries. Despite an increasing awareness of the importance of statistics in planning social and economic development, most developing countries do not have an adequate statistical organization or trained statistical personnel for collecting, processing and analysing food and agricultural information. In particular, statistical development is slow and agricultural censuses, surveys and other statistical inquiries are often undertaken in isolation from each other and from the uses their results are to serve. Further, there is often a lack of understanding and coordination between statistical agencies and economic analysis, planning and decision-making offices, making it difficult to obtain the necessary cooperation among these important elements of the national information system for food and agriculture.

The collection, processing, analysis, dissemination, and use of data are costly and time consuming processes, requiring trained personnel, organization, transport and related facilities and services. Developing countries, however, have severe financial, human and institutional resource limitations. These problems have been addressed through such technical assistance funds as the United Nations Development Programme (UNDP) (formerly, the Extended Programme of Technical Assistance and the United Nations Special Fund), government cooperative Trust Funds, and the FAO Technical Cooperation Programme. These funding sources have provided developing countries with badly needed technical assistance in the form of resident experts and consultants in food and agricultural statistics, training, data processing and the provision of related equipment. The earliest recorded technical assistance project in a developing country was on crop surveys in 1951. The number of such projects has grown to about

60, including regional statistical advisers on specific subjects, e.g., training and commodity statistics.

The FAO training programme for the 1960 World Census of Agriculture also benefitted from these funds for the organization of training centres at the international, regional and national levels. Due to the UNDP funding crisis in the late 1960s, however, funds for the regional statistical advisers and training centres were discontinued. The number of projects in food and agricultural statistics also declined significantly, recently levelling out at about 40. Further, a large share of the current projects are funded by the FAO Technical Cooperation Programme and are short-term projects designed to fill explicit, critical needs and not lasting more than one year. A few longer-term projects are funded by UNDP and Trust Funds.

Substantial progress has been achieved over the past several decades in improving food and agricultural statistics in developing countries. Approximately 150 countries conducted an agricultural census during the decade of the 1970 World Census of Agriculture Programme (1966-75), and similarly 150 countries will have conducted an agricultural census during the decade of the 1980 World Census of Agriculture (1976-85). In addition, a large number of countries routinely conduct sample surveys in food consumption, household income and expenditures, farm management, marketing, crop yields and production, and many other socio-economic areas of food and agriculture.

Yet, there continue to be problems and need for improvement. Often, field enumeration has been attempted without the development of sufficient statistical infrastructure, i.e., organization, trained manpower, vehicles and other equipment. Further, inadequate attention is often given to data processing and analysis and dissemination. In some statistical projects, the end of the field enumeration is also the end of the census or survey organization, and the material used, e.g., lists, sketches, maps, instructions and worksheets, is discarded without consideration for its possible future use. Also, there is often little or no ex post evaluation of the work done, where the performance of various processes is evaluated in terms of the frequency and types of errors, time spent, and costs in order to improve the conduct of future activities.

To overcome these problems, FAO has periodically promoted the preparation of national, long-term, integrated programmes of food and agricultural statistics in developing countries. For example, about two decades ago, FAO made an effort to facilitate the dialogue between

national statistical agencies, planners and decision makers regarding data needed for agricultural development planning. As a result, for the first time, an integrated, phased programme was prepared for developing statistics geared to agricultural development planning requirements. The programme, specifically targeting countries in the FAO Near East Region (FAO 1968), was meant to be a framework to guide each country in identifying its stage of statistical development and determining its statistical development priorities in light of its own resources and agricultural development planning data needs.

In another effort, J.S. Sarma, a member of the FAO Statistics Advisory Committee of Experts, proposed a multi-year programme of censuses and surveys in food and agriculture (Sarma 1971). Also, training centres in developing countries have promoted the concept and application of long-term, integrated programmes of food and agricultural statistics -- in Kenya in 1970 and at the Statistical Institute for Asia and the Pacific in Japan in 1974. Finally, the first UNDP project to implement a long-term integrated programme was carried out in the five central African countries in 1973 and recently in Ethiopia.

Statistical problems exist in different countries with differing degrees of severity and with emphasis on different causes and effects. Basically, however, in all cases, the roots of the problems are buried in inadequate national efforts of an interdisciplinary, inter-ministerial and continuing nature in the development and operation of an information system to support effective government intervention in the sector.

Information required for planning agricultural development and the methodology for collecting, processing and analysing data on food and agriculture are well summarized in references cited above and elsewhere. Also, most of the essential elements for developing a national information system for food and agriculture have been conceptualized and promoted over the last several decades (e.g., Bonnen 1977). What seems to be lacking is an institutional framework, firmly embedded in an interdisciplinary national effort, which promotes, in a balanced and coordinated way, the major dimension of such a programme -- an approach that provides dynamism through the continuous dialogue between users and producers of information in order to meet the changing demand for information effectively and efficiently -- constantly reviewing the underlying concepts, definitions and methods, and developing and maintaining the necessary human, financial and institutional resources.

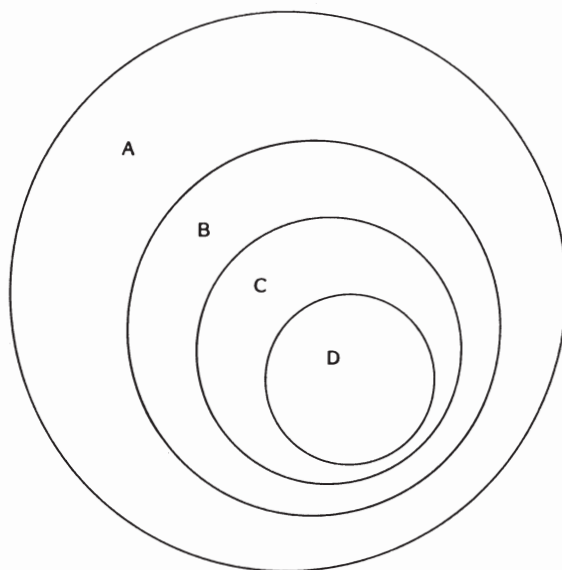
The national information system context for food and agricultural statistics presented herein can provide such a framework for the food and agricultural statistics programme component of such a system. It views the entire national information system, including decision makers, statisticians and analysts, as an integrated whole rather than as a collection of independent and unrelated activities. Each activity in the system, e.g., food and agricultural statistics, is designed to function in complementary interaction with other activities, so that concepts and definitions are harmonized and related activities are linked or coordinated to provide consistent, relevant, timely and reliable information.

The subject-matter scope of the national information system covers all areas relevant to public (and possibly some private) decision making, as indicated in the largest circle (A) in Figure 1.1. The conceptual focus of this manual is the subset of information of interest to food and agricultural decision makers, as indicated by circle B in the diagram, with special emphasis on food and agricultural information (circle C), of which food and agricultural statistics (circle D) comprise a further subset. Examples of information in B but not in C include demographics and national accounts, while examples of information in C but not in D include policy analysis studies and situation and outlook reports.

In the terminology of this manual, the "national information system" refers to the structure of information covered in A and the institutional organization which provides it. Similarly, the "national information system for food and agricultural decision making" corresponds to B, the "food and agricultural information system" to C, and the "food and agricultural statistical programme" to D.

1.2 Objective and Outline

The overall objective of this manual is to provide a general understanding of the structure and operation of a country's national information system for food and agricultural decision making and general guidelines on the planning and implementation of the food and agricultural statistical programme as an integral part of the total system. Such an information system will be: (a) effective and efficient in providing timely, relevant, accurate, accessible, and consistent information to food and agricultural decision makers; (b) able to adapt structurally and conceptually to changing conditions and an evolving policy agenda, thus avoiding conceptual and institutional obsolescence; and (c) consistent with the human, financial and institutional capabilities of the country as those capabilities develop and grow over time.



- A - Information for public decision making
- B - Information for food and agricultural decision making
- C - Food and agricultural information
- D - Food and agricultural statistics

Figure 1.1 – Subject-matter coverage of a national information system from a food and agriculture perspective

Following this brief introduction, food and agricultural decision makers are identified in Chapter 2, and the role of information, and thus of statistics, in decision making is discussed in Chapter 3. In Chapter 4, the system approach, defined as a formalized problem-solving process, is applied to the design of information systems. A general classification scheme for identifying and defining the operational concepts which specify the boundaries of food and agricultural information is detailed in Chapter 5. Chapters 6 and 7, then, focus specifically on features of statistical and analytical programmes, respectively, while programme implementation guidelines are offered in the final chapter, Chapter 8.

Countries following the guidelines contained in this manual will find that the information base supporting economic development and other policy concerns in food and agriculture will be more relevant and useful, that policy efforts will thus be more successful, and that, as a consequence, government intervention in food and agriculture will be more effective and better understood and appreciated.

CHAPTER 2

FOOD AND AGRICULTURAL DECISION MAKING

The aim of this manual is to contribute to the development of improved programmes of agricultural statistics in developing countries. The overriding theme is that many of the statistical development problems encountered heretofore can be overcome by (a) improving the communication and coordination between providers and users of agricultural statistics, (b) recognizing statistical needs in the context of information for food and agricultural decision making, and (c) designing and implementing statistical programmes to fill those needs. Issues related to these tasks are addressed in the remaining chapters of the manual. The present chapter identifies the ultimate information users - food and agricultural decision makers -- while Chapter 3 describes the role information plays in their decision making.

A country's food and agricultural decision makers are defined, in the context of this manual, as those public, and possibly private, decision makers responsible for guiding and managing the development and performance of its food and agricultural system. The first section of this chapter, therefore, outlines the domain of "food and agriculture" in general terms, recognizing that detailed specifications will need to be made on a case-by-case basis to conform to the conditions and needs of particular countries. Section 2.2., then, elaborates the scope of national decision making in terms of its goals and performance objectives and its various subject areas and policy instruments.

2.1 The Domain of Food and Agriculture

The domain of food and agriculture encompasses the complex interactions of physical, climatic, biological, economic and social processes in the production, processing, distribution and utilization of food and agricultural commodities. These processes are carried out, given climatic conditions and soil and water resource endowments, by governments, households and production units. A general overview of these processes and agents is given below, followed by a more precise identification of the economic sectors and activities relevant to food and agriculture using the International Standard Industrial Classification.

2.1.1 Processes and Agents

In Figure 2.1, the rectangles represent the five principal agents, or categories of agents, involved in food and agricultural processes:

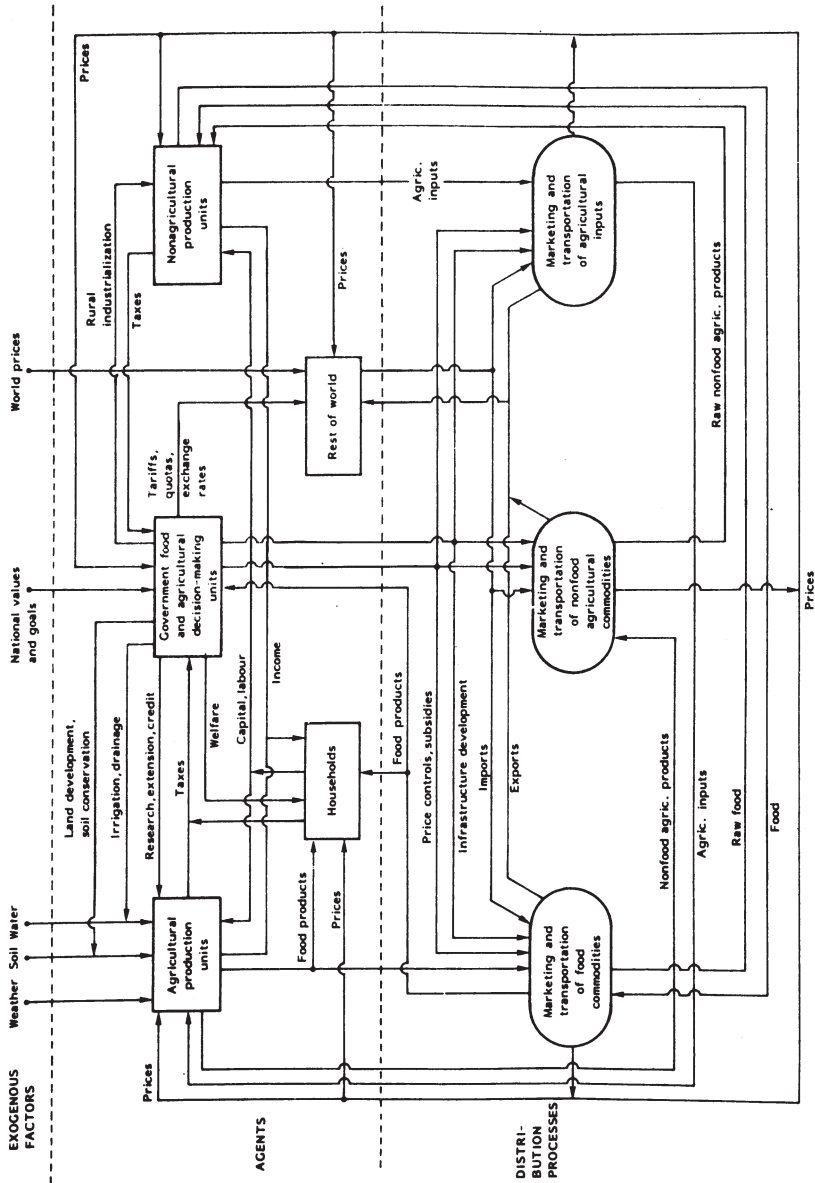
- (a) local, regional and national government agencies;
- (b) households, both farming and non-farming;
- (c) agricultural production units, i.e., holdings and agricultural service establishments;
- (d) non-agricultural production units, i.e., agents active in fisheries, forestry, food processing, and the production of all other goods and services, including marketing and transportation; and
- (e) the rest of the world, as both a source of supplies and a destination of products and sometimes as a source of inputs.

Although the agents of the marketing and transportation processes are included with other non-agricultural production units, the processes themselves are indicated explicitly at the bottom of the diagram (represented by ovals) in order to clarify the flows of commodities and price information among the five groups of agents. In addition, monetary flows are implicit in the commodity flows through the distribution processes, although in the reverse direction.

Five key exogenous factors influence a nation's food and agriculture, as identified at the top of Figure 2.1: (a) weather, (b) soil, (c) water, (d) national values and goals, and (e) world prices. Of these factors, soil and water quantity and quality are partly controllable by government actions. In addition, national values and goals, while endogenous to the nation, can be considered exogenous to food and agriculture.

It is worth noting that Figure 2.1 is a simplified model of the domain of food and agriculture. Enhancements could be made, e.g., by distinguishing between farming and non-farming households, separating fishery and food processing establishments from all other non-agricultural production units, and identifying the inputs produced and used by agricultural production units. However, the simplicity of Figure 2.1 is adequate for this discussion.

The flows originating from the government decision-making units are the policies, programmes, and projects implemented to guide and manage the food and agricultural system. Decisions are made in light of national values and goals and relative prices, and are financed, at least in part, by business and personal taxes. Agricultural production units benefit from public investments in land and water development;



Source: Adapted from Carroll and Rossmiller (1978).

Figure 2.1 - Agents and processes in food and agriculture

research to develop new crop varieties and animal breeds and to improve cropping and livestock management practices; extension to disseminate information on research results; and credit programmes to facilitate the acquisition of modern inputs. Rural industrialization efforts, although directly concerned with non-agricultural production, are generally intended to keep labour and capital on farms and in rural areas by providing employment opportunities to reduce rural-urban migration and to increase income available to farm households which may be reinvested in agriculture. The welfare of households is enhanced by government programmes in health and nutrition, education, housing, family planning and direct income transfers. Interventions in the marketing and transportation processes, aimed at reducing food costs, include direct price controls and subsidies and investments in infrastructure to improve roads, bridges, and market and storage facilities. Finally, foreign trade is influenced by such trade policies as tariffs, exchange rates and quotas.

Households provide capital and labour to the production of agricultural and non-agricultural goods and services, in return for which they receive income. They are also the final consumers of food products, either directly from the farm, in the case of subsistence farming, or through market channels. Price information is used in both consumption decisions and in allocating labour and capital.

Agricultural production units purchase inputs and allocate land, water, capital and labour resources to the production of food and non-food agricultural commodities based on relative prices and the available resource supplies. Section 2.1.2 identifies the specific economic activities carried out by these agents.

Non-agricultural production unit are engaged in economic activities other than agriculture, although some of them are considered to be within the domain of food and agriculture, as indicated in Section 2.1.3. For example, fishery and food processing establishments are included in non-agriculture, as are the manufacturing of machinery, chemical fertilizers and other agricultural inputs and the marketing and transportation of food and agricultural commodities.

Finally, the rest of the world is the source of imports and the destination of exports, in response to world and domestic prices and government trade policies.

2.1.2 Economic Activities of Agriculture

The essential features of the economic activities carried out by agricultural production units can be outlined with reference to the ISIC, the United Nations' International Standard Industrial Classification of all Economic Activities (UN 1971), which provides a framework of the international comparison of national statistics. Major Division 1 of the ISIC, includes agriculture, forestry and fisheries and has the following structure:

Major Division 1	Agriculture, Hunting, Forestry and Fishing
Division 11	Agriculture and hunting
Major Group 111	Agricultural and livestock production
Major Group 112	Agricultural services
Major Group 113	Hunting, trapping and game propagation
Division 12	Forestry and logging
Major Group 121	Forestry
Major Group 122	Logging
Division 13	Fishing
Major Group 130	Fishing

Although the ISIC generally subdivides the three-digit Major Groups into four-digit Groups to obtain more homogeneous economic activity classes, no such Groups are identified for the Major Groups in Major Division 1, except fishing.

Major Groups 111 and 112 cover the activities of agricultural production units. (Note that the ISIC appears to limit the term "agriculture" to crop production alone, while in this manual it refers to both crop and livestock production). Although there are no Groups defined for agriculture, the ISIC provides a description of the contents of the Major Groups (UN 1971, p. 27):

111 Agricultural and livestock production

Growing of field crops, fruits, grapes, nuts, seeds, tree nurseries, except those of forest trees, bulbs, vegetables, flowers both in the open and under glass; tea, coffee, cocoa and rubber plantations; raising of livestock, poultry, rabbits, bees, fur-bearing or other animals; the production of milk, wool, fur, eggs, honey; and silkworm egg and cocoon raising. Also included are establishments primarily engaged in landscape gardening, e.g., the planting and care of lawns, flower gardens, shade and ornamental trees. The processing of agricultural products on farms and plantations is covered

in this group if it is not feasible to report separately on the production of agricultural products, e.g., grapes, rubber, tea leaves, olive oil, nuts, milk, and the processing of these commodities.

112 Agricultural services

Agricultural, animal husbandry and horticultural services on a fee or contract basis, such as harvesting, baling, threshing, husking and shelling; preparing of tobacco for auctioning; animal shearing; pest destroying and spraying; seeding and spraying by aircraft; pruning; picking of fruits and vegetables and packing on the farm and on the account of the producers elsewhere; and the operation of irrigation systems. The provision, on a fee or contract basis, of agricultural equipment along with the services of drivers and other attendants of the equipment, is covered in this group, but the letting of agricultural equipment solely is classified in major group 833 (Machinery rental and leasing). Veterinary services on a fee or contract basis are classified in group 9322 (Veterinary services); establishments primarily engaged in the transportation of farm products are classified in the appropriate group of division 71 (Transport and storage); and the operation of horse and dog racing stables are classified in group 9490 (Amusement and recreation services, not elsewhere classified).

Further clarification of the economic activities of agricultural production units (holdings) is needed for national accounts purposes, particularly in cases where the holdings are also engaged in non-agricultural activities. Two types of non-agricultural activity of holdings are distinguished: secondary activities and ancillary activities. Generally, ancillary activities are considered part of agriculture in national accounts.

Non-agricultural activities for which separate information can be obtained on inputs and outputs are considered to be "secondary activities" carried out by establishments apart from holdings; otherwise, they are "ancillary activities" of the holdings. Examples of secondary activities include own-account construction, retail shops of holders, and transport units which provide services for hire. Examples of ancillary activities include garages, repair shops, warehouses and the harvesting of forestry and fisheries products from forests and waters on the holding.

Two other criteria may also be used in differentiating between secondary and ancillary activities of agricultural production units: the size of the activity and its purpose. As a general rule, non-agricultural activities which are of small scale or which are mainly for the use of the holding rather than for sale in the market are considered ancillary.

2.1.3 Other Economic Activities Related to Food and Agriculture

The domain of food and agriculture includes many other economic activities besides those of agricultural production units. Some have already been mentioned above, such as food processing, fisheries, veterinary services, and marketing and transportation. These and others are listed below, by ISIC classification, with comments indicating their relevance to food and agricultural decision making.

Forestry and Logging (Major Group 12) -- in so far as food products are harvested and income is provided to agricultural households and holdings as ancillary activities.

Fishing, particularly Group 1302 (Fishing not elsewhere classified), which includes inland waters fishing -- as a producer of food commodities and in so far as income is provided to agricultural households and holdings.

Manufacture of food, beverages and tobacco (Division 31) -- of importance in food and nutrition and as a market for agricultural products; where economically feasible, also a target of government promotions of rural industrialization and import substitution.

Manufacture of textiles (Major Group 321) and Manufacture of leather and products of leather (Major Group 323) -- as a major market for non-food agricultural products, policies promoting the development of these industries can be an important stimulus to agricultural holdings and their income.

Manufacture of fertilizers and pesticides (Group 3512) and Manufacture of fertilizers and pesticides (Group 3822) -- where economically feasible, developing these industries can improve the availability of these important agricultural inputs while reducing foreign exchange costs.

Construction (Major Division 5) -- includes the construction of irrigation and drainage facilities and major infrastructural development to improve the efficiency of the marketing and transportation of food and agricultural products, e.g., roads, bridges, railroads and seaport facilities.

Wholesale trade (Division 61), Retail trade (Division 62) and Transport and storage (Division 71) -- government programmes to develop and improve the efficiency of these services can be an important factor in reducing food costs.

Financial institutions (Division 81) -- as targets of policies to improve the availability of credit to agricultural producers.

Machinery and equipment rental and leasing (Major Group 833) -- making these services available in rural areas can be a means of facilitating farm mechanization.

Education services (Major Group 931) and Medical, dental, and other health services (Group 9331) -- in rural areas, in so far as rural development programmes and human capital formation in agriculture are of concern to food and agricultural decision makers.

Research and scientific institutes (Major Group 932) -- with respect to public and private institutes engaged in research in technical agriculture, agricultural economics and farm management, and rural sociology.

Veterinary services (Group 9332) -- services to livestock producers on a fee or contract basis.

Business, professional and labour associations (Major Group 935) -- with respect to farmers' cooperatives and other associations and agricultural workers' unions; development of such associations many be part of agricultural and rural development efforts.

2.2 The Scope of Public Food and Agricultural Decision Making

The public decision-making (i.e., policy-making) process, applies policy instruments to the target world (the food and agricultural sector, as delimited in Section 2.1) in order to achieve performance objectives and, ultimately, national policy goals. These elements of public policy are elaborated in the following sections, and the general relationships among them are indicated in Figure 2.2. Note in particular the feedback relationship whereby policy makers use information on the degree of attainment of performance objectives, i.e., performance indicators, in allocating resources to, and otherwise adjusting, the application of policy instruments to the target world.

2.2.1 General Policy Goals

In a very general way, policy goals may be viewed in terms of their relative emphasis on (a) growth, including the efficient allocation of existing resources in food and agricultural production and investment in improving the productivity of those resources and creating additional resources; (b) equity, encompassing the distribution, among nations, groups within nations and individuals within groups, of agricultural resources, products and income; and (c) stability, which adds a time dimension to the other two goals in terms of reducing year-to-year fluctuations along the time path of progress towards their attainment.

The goal setting performed in the policy-making process establishes the relative importance of these three general goals, and thus the weights for evaluating trade-offs among them when they are in conflict with one another. For example, reducing tax rates on high-income individuals in order to induce additional investment amounts to a decision to promote a growth objective at the expense of increasing the inequality of income distribution.

Goal setting is a dynamic process which is affected not only by the feedback from performance indicators but also by factors outside the food and agricultural sector. In the early stages of development, public decision-making goals are not apt to be well specified. Therefore, information on the trade-offs among performance indicators, gained by experience with different policy instruments, will affect the weights assigned to the growth, equity and stability goals, i.e., improved knowledge of what is achievable influences the goal structure generated by the policy process.

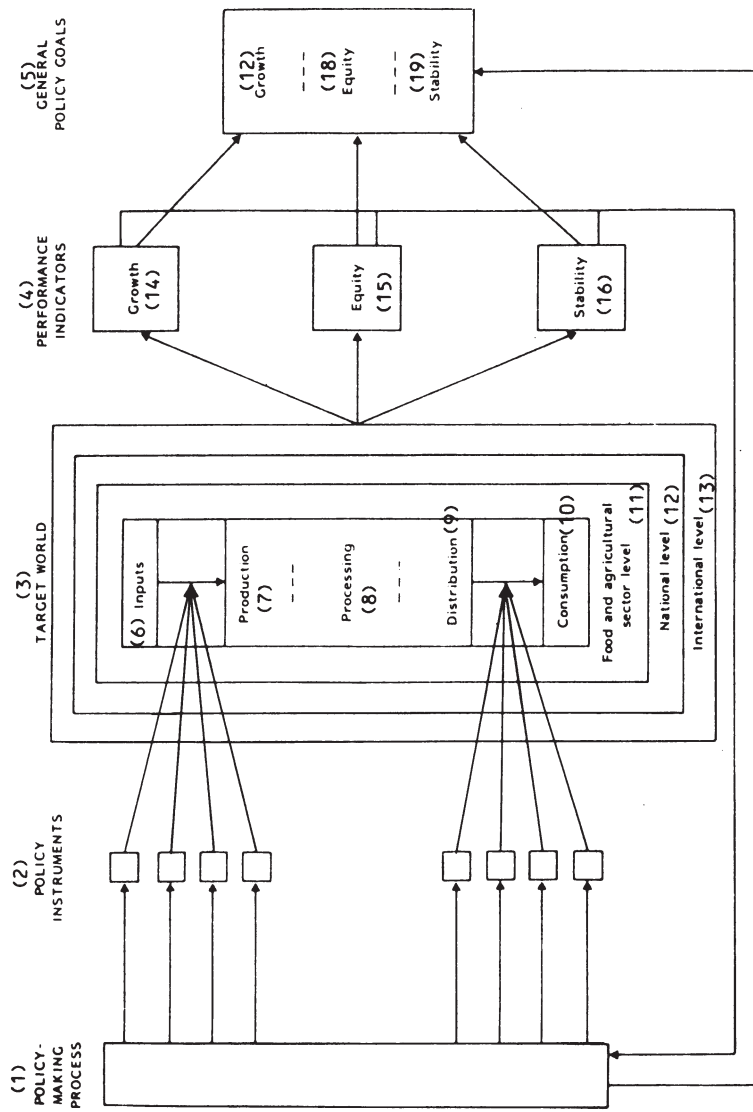


Figure 2.2 - Food and agricultural policy

2.2.2 Performance Indicators and Objectives

Performance indicators are specific variables in the target world which are observed and measured to gauge the success of the policy instruments in achieving policy goals. Policy objectives are desired values which the instruments are to attain, usually by some specified point in time. Attainment of these objectives, then, indicates satisfactory progress toward the general goals. The indicators, along with other information, serve as inputs to the policy process for adjusting the instruments and objectives and the relative importance of the goals.

Examples of typical indicators associated with each of the three general goals are:

- (a) growth: agricultural production and value added, labour efficiency, crop yields, rate of return on investment, meat or milk yield of feed, cost of food, and input costs;
- (b) equity: farm/non-farm income ratio, nutritional status of socio-economic groups, size distributions of land holdings and income, unemployment rate, and cost of agricultural subsidies; and
- (c) stability: year-to-year fluctuations in grain production, livestock production, food prices, and income, measured with, for example, means and standard deviations or frequencies and amplitudes.

2.2.3 Policy Instruments and Subject Areas

The means available to public decision makers to achieve policy goals and objectives are many and varied. Typically, a particular policy instrument, although intended to affect primarily either growth, equity or stability, also has some impact on the other goals. Thus, national food and agricultural policies, which are generally composed of combinations of instruments, can have both complementary and conflicting elements, and both desired and undesired results. The two approaches presented below for classifying instruments illustrate these combinations and the range of subject areas of concern to food and agricultural decision makers.

First, although nations vary widely in their reliance on market mechanisms to allocate food and agricultural resources and products, the separation of policy instruments into those that deal with (1) prices and quantities in the factor market and (2) prices and quantities in the product market is useful (Figure 2.2). A few examples of instruments in each of these four sets are given in Table 2.1.

A second way to organize policy instruments is hierarchically, where lower level instruments represent implementations of higher level instruments. That is, instruments can be considered to range from broad policies (higher level) to programmes for implementing those policies (middle level) to projects for implementing the programmes (lower level). Figures 2.3-2.5 illustrate this arrangement for, respectively, three broad policies: (1) improving food and nutrition, (2) improving the quality of rural life, and (3) promoting the contributions of agriculture to the national economy.

These broad policies are shown at the left of each figure. To the right are listed areas of policy action available for implementing policies. For example, alternative ways of improving food and nutrition, one or more of which may be pursued, include (4) increasing the food supply, (5) influencing the per capita demand for food, and (6) decreasing the population growth rate. Alternative ways of achieving each of these instrumental objectives are identified next, and so on, moving further to the right, until more narrowly focused policy instruments, e.g., at the project level, are reached.

Since a given instrument may serve to implement more than one higher level instrument or objective, duplication of the hierarchical progression from that point onward is avoided by showing the progression only the first time the instrument appears and then cross-referencing (with box numbers) back to that point for later occurrences. For example, population control (box 13 in Figure 2.4) is one means of achieving a smaller number of farmers (box 33) and also of achieving a decreased population growth rate (box 6 in Figure 2.3); it is from the latter point that the hierarchical implementation of a population control programme is continued, to boxes 25 and 26 and so on.

Policy instruments for achieving policy objectives and goals are numerous, cover a wide range of subject areas, and are related to one another in both complementary and conflicting ways, as indicated above. Thus, it is uncertain to what degree policy actions will have their intended direct effects without undesired side effects. It may not even always be clear what the appropriate goals and objectives are

Table 2.1
Categories of Food and Agricultural Policy Instruments, by Market

1. Factor Market

a. Price Instruments

1. Tax incentives to increase investment in agricultural resources
2. Interest rate subsidies
3. Payments to farmers to withdraw land from production
4. Export and import tariffs and subsidies on fertilizer, fuel, machinery and other inputs
5. Property taxes on machinery, livestock, and real estate
6. Minimum wages for agricultural workers

b. Quantity Instruments

1. Collectivization of farms into larger units
2. Land redistribution with upper limits on farm size
3. Government-operated vocational training and extension programmes
4. Government-sponsored agricultural research and technology development
5. Public investment in land and water development
6. Export and import quotas on fertilizer, fuel, machinery and other inputs

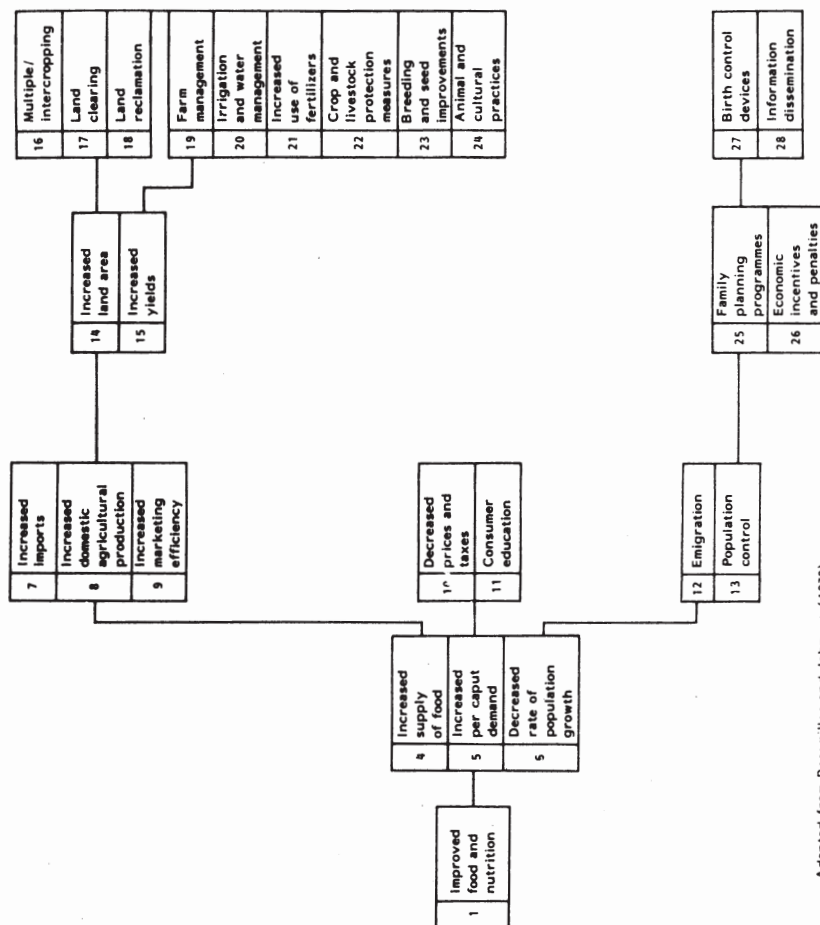
2. Product Markets

a. Price Instruments

1. Price supports for farm products
2. Government-sponsored crop insurance
3. Consumer price subsidies or ceilings for food products
4. Export and import tariffs and subsidies on agricultural products
5. Differential taxation of certain agricultural products (e.g., tobacco and alcohol)

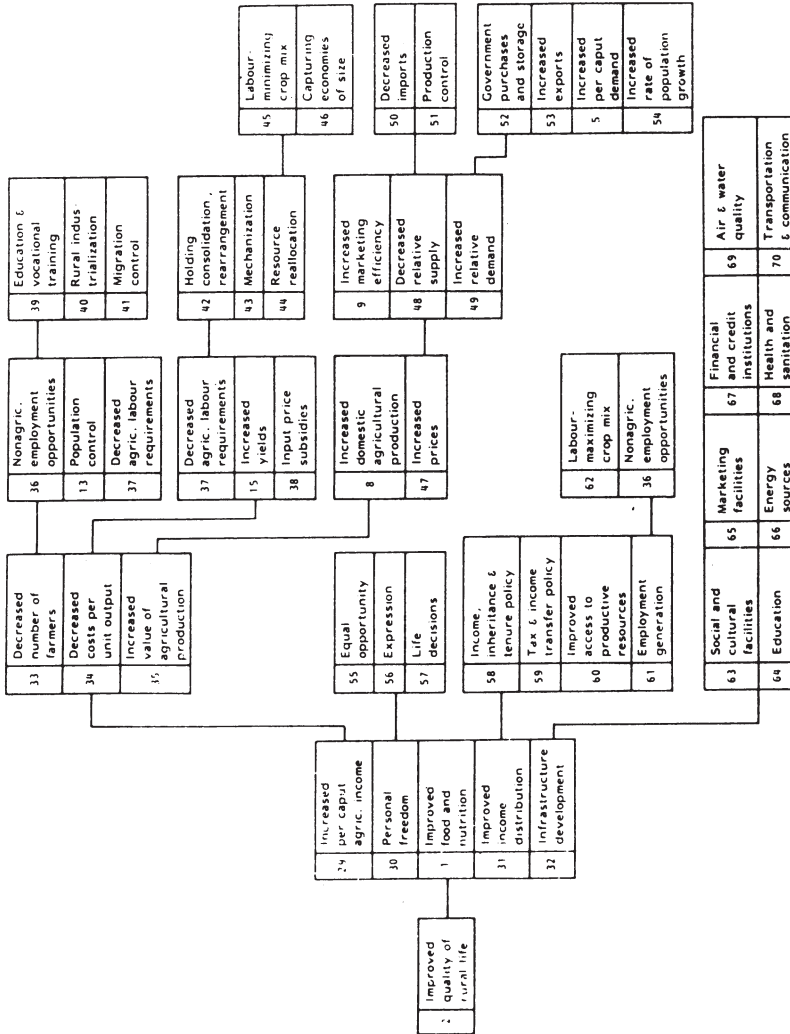
b. Quantity Instruments

1. Assignment of production quotas to production units
2. Government food purchases and sales to selected population groups
3. Export and import quotas on agricultural commodities
4. Government operation of buffer stocks of agricultural commodities
5. Quantity-oriented trade agreements at world market prices



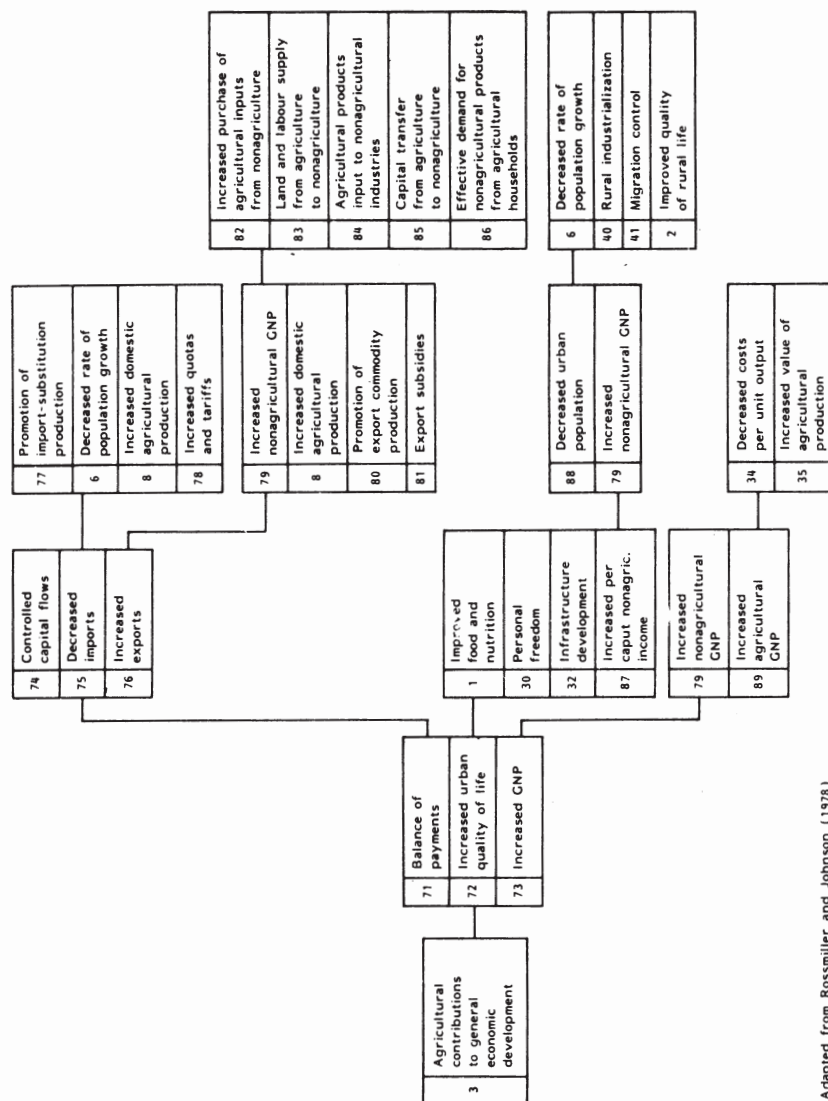
Adapted from Rossmiller and Johnson (1978)

Figure 2.3 - Policy areas relevant to improved food and nutrition



Adapted from Rossmiller and Johnson (1978)

Figure 2.4 - Policy areas relevant to improved quality of rural life



Adapted from Rossmiller and Johnson (1978)

Figure 2.5 - Policy areas relevant to agricultural contributions to general economic development

or should be, in that they emerge through the complex and dynamic political process in which various individuals and groups of the national society manoeuvre for power to promote their interests. These problems are addressed in the next chapter.

One of the most difficult tasks in developing an adequate information system for policy purposes is to identify and measure (or estimate) statistical indicators of the performance of these policy instruments. This issue is addressed in a general way in this manual. However, the selection and measurement of specific performance measures -- such as socio-economic indicators to monitor and evaluate agrarian reform and rural development programmes -- are the subject of other manuals in this Statistical Development Series.

CHAPTER 3

INFORMATION AND DECISION MAKING

The success of a statistical programme depends on how well it contributes to meeting the information needs of the users of its service -- i.e., public and private decision makers with interest in, and responsibility for, food and agriculture. Therefore, the design and implementation of a statistical programme must be based on an understanding and appreciation of those needs in the context of the information system of which it is part.

The scope of food and agricultural decision making is identified in Chapter 2, and the information system concept is defined in Chapter 4. The present chapter establishes the link between information and decision making. It begins with a discussion of the uncertainty and other problems of decision making arising from the complexity of the food and agricultural world to be managed, and it considers the role of information in addressing these problems. Next, some of the major sources of information and the primary ways decision makers use it are outlined. The final section describes the nature of information as a commodity.

3.1 Problems of Food and Agricultural Decision Making

Decision making to formulate and implement policies, programmes, and projects for the development of a nation's food and agricultural capabilities is beset by problems arising from complexity and uncertainty. Unfortunately, these are not problems that can ever be fully solved -- the future will always be uncertain, and socio-economic systems will always be complex. The best we can hope for is to reduce the inherent uncertainty by increasing our understanding of the complex processes we are trying to manage.

3.1.1 Complexity

Bonnen (1983, p. 4) asserts that a

"fundamental change is taking place in the nature of the government demand for statistics. The growing complexity of industrial societies has changed the agenda and processes of policy making and, thus, ultimately also of statistics. Since World War II the society and economy of the United

States have become very much more complex, specialized, and interdependent. Various sectors interact, each sector creating many kinds of conflicts and effects external to itself. This in turn has led to a major transformation of the role of government in society. . . . Federal policy decision making has become far more extensive, interactive, and complex. The distinction between public and private sectors has become blurred. As a result of this greater complexity and interdependence, national policy decisions today are decisively dependent on quantitative measures to identify and understand complex problems, problems that have gotten beyond the capacity of "seat-of the pants" decision making."

While Bonnen's observations refer to the United States and other developed countries, they apply equally well, if not more so, to developing countries, which are attempting to accomplish in years what developed countries did over centuries. Developing countries, moreover, are making this attempt in the presence of modern transportation and communications technologies, which have contributed greatly to the complexity and interdependence of socio-economic relationships within and among nations.

A major source of complexity in food and agricultural decision making is its concern with human systems. This complexity is particularly evident since agricultural development, which generally has an economic focus, is frequently implemented as an integral part of broader rural development programmes, which are concerned with all aspects of rural life and welfare. An understanding of the complex relationships involved is important, because efforts directed at one aspect, such as health, may and probably will affect others in both desired and undesired ways.

Rural life can be viewed in two dimensions. First, human processes and activities take place at several hierarchical levels. At the core is the rural individual -- man, woman, child, aged, disabled, landless, landlord, farmer -- whose welfare is a principal target of rural development. The individual lives within the social context of a family or, more generally, a household. Several such households form a rural community or region, which, along with other rural and urban communities, is part of the nation. Finally, the nation interacts with other nations at the world level.

Activities and processes at one level influence and place constraints on those at higher and lower levels. For example, the rural household communicates its needs and wants and supplies its

labour to the community, while the community, in trying to fulfill those needs, place constraints on the household and the individual with respect to acceptable behaviour (criminal and civil laws, social norms). Similar mutual relationships exist between community and nation and between nation and world.

An understanding of these hierarchical relationships is important for the design and evaluation of rural development programmes and projects, with corresponding implications for data and information needs. For example, rural development efforts are typically nationally directed, frequently with assistance and encouragement from international donor agencies and other national governments. While the improved welfare of rural people and communities is generally stated as a prime objective, the nation as a whole and the donor agencies will have other objectives as well, e.g., contributions to the national economy, food self-sufficiency, national security, political stability, and foreign alliances and trade relations.

The second dimension of rural life is the complex overlay of spheres, or areas, of human activity: economic, psycho-social, political, biological and ecological (Figure 3.1). Rural development, by definition, addresses itself to improvement in all these spheres at the levels of the rural individual, household, community, and region.

Economic activities and processes, which encompass the production and allocation of resources, goods, and services, are typically the major focus of agricultural and rural development efforts. Within the economic sphere, decisions are made to convert the basic biological and psycho-social needs into effective demand, to provide supplies to be converted into need fulfillments, and to convert population resources into labour, entrepreneurial talent, and consumers. The biological sphere represents people's efforts to maintain themselves and function as living organisms, while their mutual interactions with the natural ecosystem (of which they are part) comprise the ecological sphere of human activity. The political sphere, which is a special application of the economic process, is where people, through their participation in organizations and decision-making processes, interact in allocating and using power as a resource to influence group decisions to the best advantage of themselves, their constituents, their community, or their country. Finally, people's needs as introspective and social beings are expressed and satisfied through their social and psychological activities and processes. In fact, it is the psycho-social sphere that generates the system of values which motivates and guides activities in the other spheres.

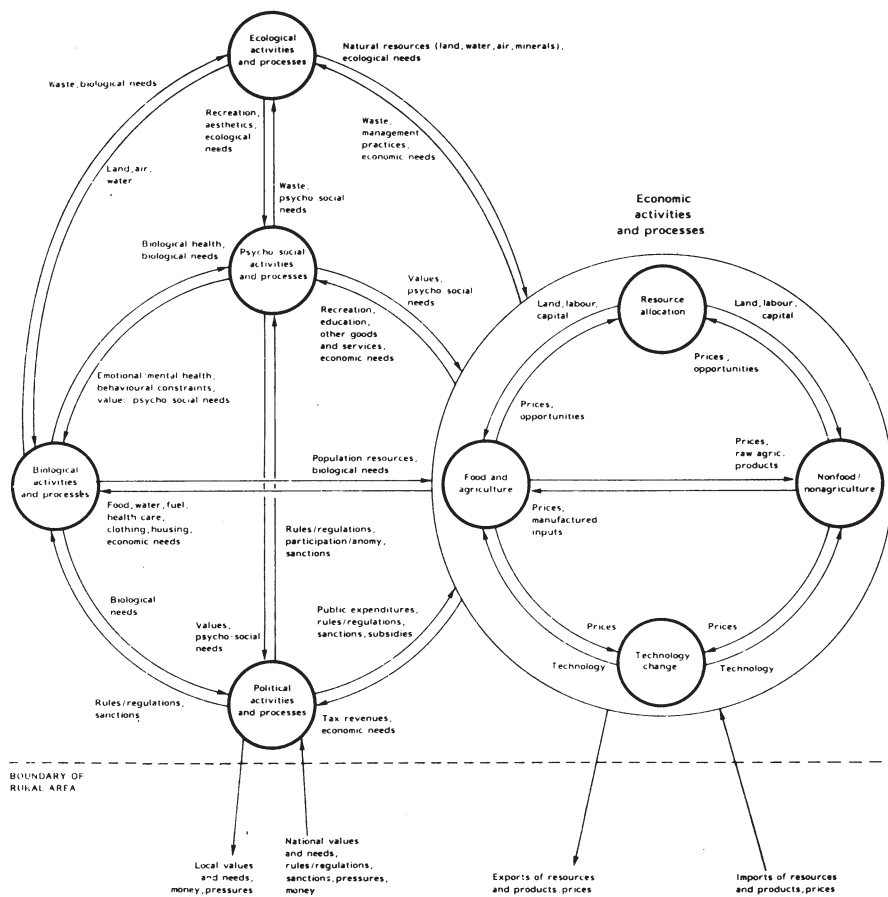


Figure 3.1 - Interactions among spheres of human activity in a rural area

At any level, people participate in the various spheres of activity virtually simultaneously. Indeed, the boundaries between the spheres are ill defined: at any point in time, a given activity or action (of an individual, a household, a community, or a nation) may contain motivations and characteristics which would classify it in more than one sphere, e.g., economic, political, and social. Figure 3.1 indicates the major interactions among the five spheres at the level of a rural community or region. These interactions are not exhaustive, but they are representative of some key relationships. While most are self-explanatory, some observations are worth noting.

Rural development programmes have major impacts in the economic sphere through land and water development projects, land tenure reform, rural industrialization efforts, promotions of cooperatives and modern inputs and production practices, price subsidies etc. It is important to recognize that they also have major long-term effects on the political and psycho-social spheres as well. Changing patterns of income distribution and ownership of productive resources also redefine social and cultural relationships among people (e.g., former landlords and landless), which may cause some transitional psychological and public order problems. Politically, increasing participation will have similar effects in that the redistribution of power is the political counterpart of the redistribution of economic resources.

Two distinctive features of agricultural production add to the complexity of decision making for agricultural development. First, crop and livestock production are closely linked with natural biological and ecological processes. Indeed, agriculture is the manipulation of those processes to serve human values and purposes. The second complicating feature of agriculture, and one which contributes to uncertainty, is its sensitivity to weather influences.

The complexity of the food and agricultural (and rural) system of concern to decision makers creates three classes of problems for them: uncertainty, compression of time and space, and the need for "multi" perspectives. These problem areas and the consequent role of information are discussed in the following sections.

3.1.2 Uncertainty

As all decision makers know and experience, uncertainty is an unavoidable fact of life. For food and agricultural decision makers, there are three broad areas of uncertainty to contend with.

First, there is uncertainty regarding the present condition and trends of the food and agricultural system. Certainly, because of its complexity, knowing everything about that system is impossible, and knowing the state and direction of only the relevant aspects of the system (i.e., the relevant performance measures) is very difficult or unfeasible. Indeed, even the identification of what is relevant is uncertain, for that depends on the values held by the society and the nature of the problems or policy issues.

Statistical programmes, working as part of research and analysis efforts, can help in assessing the values of various segments of society, e.g., through the conduct of attitude surveys and opinion polls and observations of revealed preference. Then, through careful needs analysis and problem definition, the relevant policy issues and performance measures can be identified. Even then, however, some uncertainty will remain because of statistical measurement problems (e.g., the adequacy of questionnaire designs, sampling errors and the accuracy of responses), and also simply because values change over time.

Once the relevant variables have been identified with some degree of confidence, adequately measuring or observing all of them is still difficult or impossible. For example, the World Conference on Agrarian Reform and Rural Development (FAO 1979), and the process which followed up on its recommendations, identified three broad, interrelated areas of concern: growth, with equity, through people's participation. These areas encompass 15 more specific areas of concern, such as access to rural resources, employment, income growth and distribution, health, nutrition and education. Fifty-two socio-economic indicators were initially defined for monitoring and evaluating progress in these areas, and pilot studies were conducted in over 20 countries in the four developing regions of the world to assess the relevance and feasibility of those indicators (FAO 1983). Results of the pilot studies are summarized in Table 3.1. In general, relevance depended on the adequacy with which a set of indicators, designed for international comparability, met a country's own particular situation. Also, feasibility ratings by a country were closely related to the level of development of its statistical programmes.

In addition to uncertainty concerning the actual state of affairs, there is a second area of uncertainty which pertains to desired conditions. Here, again, information is necessary on values held by various segments of society in order to increase knowledge of what the state of society should be. Some information may be obtained through statistical surveys measuring attitudes, opinions, and preferences. A more important source, however, is the continuous

political and economic process of give and take and compromise among competing interests, each making trade-offs among its own conflicting goals and with those of other interests. As the knowledge of values improves over time, and as values themselves change, the desired conditions, and the policies implemented to attain those conditions, adjust accordingly.

Table 3.1
Relevance and Feasibility of 52 Socio-Economic Indicators for
Monitoring and Evaluating Agrarian Reform and Rural Development
 (percent of responses)

Region	Number of Responses*	Appropriate	Feasible as Defined	Feasible Modified	Feasible Disaggreg.
Africa	177	84%	42%	57%	19%
Asia and Pacific	208	78%	61%	77%	58%
Latin America	228	80%	48%	68%	40%
Near East	119	94%	80%	91%	43%

*By country and indicator.

Source: FAO 1983

Just as there is uncertainty about where the system is at any point in time and about where it should be, there is also uncertainty concerning how best to progress from one to the other. This third area of uncertainty has two categories: (1) future events beyond the control of the country's decision makers but which are likely to influence its food and agricultural system; and (2) the future impacts on the system of those influences and of current policy actions. Outside influences not controllable by a country's decision makers include, for example, weather; diseases of people, livestock, and crops; and world prices. If the focus is solely on the food and agricultural sector, the behaviour of other national factors (e.g., interest rates, prices and markets of non-food commodities, and political and social movements) must also be considered for their

potential impacts on food and agriculture. Information is also needed on the likely consequences of those outside influences and of decision makers' own actions -- i.e., what will happen, where will it happen, when, and to whom.

Statistical monitoring and analysis of past trends and cycles of outside factors, combined with appropriate social and economic research and analysis (e.g., of foreign markets), provide useful information for anticipating their probable behaviour in some relevant future time period. Decision makers can then design policies, programmes, and projects which will ameliorate, compensate for, or reinforce the effects of outside influences, rather than be taken by surprise by them.

Likewise, uncertainty arising from the complexity of the socio-economic, biological, and ecological processes which comprise the domain of food and agriculture can be reduced by an increased understanding of the structure of relevant cause-and-effect relationships. Again, statistical and other research and analysis provide the information needed both for improved understanding of the system and for projection of the likely consequences of policy actions and exogenous influences. The use of models and the role of statistics in this process are discussed in Chapter 7.

3.1.3 Compression of Time and Space

Bonnen (1983) notes that, associated with interdependence and other aspects of complexity,

"another challenging and fundamental change in the nature of the decision process arises out of the technological and institutional innovations in transportation, communication, and data processing. Before World War II there often was time for reflection, thoughtful analysis and even data collection, when faced with a policy issue. Today the technological and institutional compression of time and space turns a higher proportion of national decisions into immediate crises of varying importance, simply because all the policy variables interact much more quickly, whether the problem is economic, political or military." (Bonnen 1983, p.5)

The compression of time is evident in two respects. First, because of modern communications and transportation, public knowledge of new policies and other decisions is almost instantaneous, and their impacts are transmitted and felt more quickly than in the past. A major consequence of this is that decision makers have little time, if any, to change their minds about a course of action taken, whether to withdraw it or merely to modify it, before its impacts are widespread. Secondly, for similar reasons, decision makers must respond to emergent situations much more rapidly than formerly, lest those situations get out of hand. There is frequently not the luxury of time to consider options carefully or to try them out on a trial basis.

The same phenomena - modern transportation and communications in a world of complex national and international social and economic interdependencies -- also create two types of spatial compression for decision makers: geographic and sectoral. First, the knowledge and impacts of a decision are apt to be much more widely distributed geographically than in the past. Also, by design or by accident, they tend to reach beyond the boundaries of a particular decision maker's immediate area of responsibility. It's as if the world has become smaller, i.e., been compressed into a "global village".

The compression of time and space for decision making has important implications for the accuracy, timeliness, and relevance of information in general and of statistics in particular. Bonnen's conclusion is that "the growing complexity of decision [making] places a higher premium on relevance, not just in some general subject matter sense, but in terms of adaptation of information to the needs of a particular decision maker faced at a specific time with a specific decision" (Bonnen 1983, p. 14). In the face of the reduced time available to make decisions, the same statement can equally be applied to timeliness. The wider and faster impacts of decisions also place greater importance on the accuracy of the information supporting them, simply because much more is at risk with each decision.

From the point of view of the decision maker, however, timeliness and relevance must take priority over accuracy. Relevant information which is on hand when it is needed will be used, and the more accurate it is, the better. Information which arrives too late or which is irrelevant to the problem at hand, no matter how much greater its degree of accuracy, is useless. It is up to the professional standards of statisticians and analysts and the integrity of national statistical programmes and information systems to make the technical and institutional adjustments necessary to provide the information which is needed, when it is needed, and with a suitable degree of accuracy.

As a consequence, although there will always be a need for regular censuses, surveys, and statistical reports, it is increasingly essential for statisticians, economists, and other analysts to work together as a team to tailor statistics and information, derived from standard sources and formats, to the requirements of particular decision situations while ensuring accuracy. In addition, because of the increasing social, economic, and geographic interdependencies within and among nations, there is a growing need to incorporate appropriate information from other domains into food and agricultural decision making, as is discussed next.

3.1.4 "Multi" Perspectives

Another implication of the complexities of food and agricultural decision making is the need for information, and for an information system to provide it, which has what can be called "multi" perspectives -- i.e., information which is multidisciplinary, multidimensional, and multitemporal (and intertemporal).

As we have seen, disciplinary specialists working alone, whether statisticians, economists, or others, are not sufficient for tailoring information for a specific decision situation. Data, theories, and methodologies from many disciplines are needed as ingredients to a particular decision. For food and agriculture, appropriate multidisciplinary information may be drawn from economics and other social sciences, biological sciences, statistics and engineering, depending on the problem at hand.

The socio-economic indicators for monitoring and evaluating agrarian reform and rural development programmes (FAO 1984) are an example of meeting the need for a multidimensional perspective in an important area of food and agricultural decision making. In general, the interdependencies and complexities of the domain of food and agriculture and its relationships to other domains of human existence create a demand for information disaggregated along several dimensions -- e.g., by economic sector, geographic area, income class, rural/urban, population age-sex cohort, and commodity.

Impacts of a decision taken today will be felt over several future time periods. In addition, conditions in one period, which may be due to past decisions, will affect performance in later periods. Thus, information is necessary on what those impacts are likely to be and when they are likely to occur -- a multitemporal and intertemporal perspective. The former means it is important to consider impacts at several points in time, and the latter means it is important to

consider cause-and-effect linkages between time periods. A snapshot picture of the situation at the end of a five-year plan period or a one-year budget cycle is not sufficient. A time path of performance during that period and beyond will show the direction of progress and illuminate potential bottlenecks and trouble spots along the way.

3.1.5 Rationality of Decision Making

The presumption underlying this manual, indeed underlying all statistical, research, and analysis programmes, is that decision makers want and use information as a basis for making decisions. The use of information to identify decision options and their likely consequences is an essential component of rational decisions. Rationality also requires that decisions be consistent with maximization of the decision maker's objective function.

Cynics, however, say that government decisions are basically irrational and that, therefore, sophisticated statistics and complicated models are useless and a waste of resources better spent elsewhere. Too often, they say, decisions are based on the whim or mood of the decision maker, to save his face or win him political support, or to favour family and friends or punish enemies. What such cynics are really saying, however, is that the decision makers' implicit objective functions are different than their own or than what they feel society's objective function should be.

But society as a whole does not have an objective function; rather, decisions are made by people, each with his or her own objective function. Political considerations and the political process, then, rather than being irrational, are the means by which information on the implicit objective functions of interested parties is transmitted to decision makers. Politics, therefore, like economics, improves the rationality of decisions by reducing uncertainty concerning the values held by various segments of society.

A more serious limitation to the usefulness of information in, and thus the rationality of, decision making is the fact that human beings are limited in their capacity to acquire and process information. In theory, perfect rationality implies perfect knowledge; in practice, however, we live in an inherently uncertain world and therefore must make do with bounded rationality (Simon 1957).

One implication of bounded rationality is that true maximization of objective functions is impossible, or at least a matter of highly improbable chance. There is uncertainty about the nature of the objective functions, the identity of the feasible decision options, the future consequences over time of those options, and the constraints and outside factors that may influence them -- all of which must be known for true maximization. Even if all that information existed, bounded rationality says that human decision makers would be able to assimilate and use only a small part of it.

Thus, we cannot know the true best way to go from actual conditions to desired ones. As a consequence, instead of maximizing, decision makers satisfice (Simon 1957), i.e., they investigate options until one is found that is "good enough", or satisfactory, using information that is available or that can be acquired at a reasonable cost in terms of time, manpower, and money. (The economics of information, including its cost effectiveness, is discussed in Section 3.3.)

Although the bounds on rationality cannot be removed, there are ways they can be relaxed. The responsibility falls to the statisticians, analysts, and other providers of information to ensure that the limited information processing capacity of the human mind is not cluttered with inaccurate or irrelevant information. Also, information providers have control over the manner in which the information is presented. Thus, through the definition of measures, aggregates and composite indicators, and the design of tables, charts, graphs, textual analyses and other formats, they can influence the quality and content of the information provided and, hence, its effectiveness.

The role of statisticians and other information providers in easing the bounds on rationality requires a close interactive relationship with decision makers. The importance of this interaction cannot be overemphasized. It is the only means by which the information providers can know what information content is relevant and what presentation formats are most effective in communicating that content.

3.2 Sources and Uses of Information

The previous section establishes the increasing importance and reliance placed on information to enable decision makers to better comprehend and manage the complexity and uncertainty of the modern world. This section briefly identifies the major providers of food

and agricultural information and the principal ways that information is used in decision making.

3.2.1 Information Sources

Most of the data needed for government decision making are supplied through the censuses and surveys of the official statistical programmes. Site visits and administrative reports are also useful official sources of qualitative as well as quantitative observations. With basic data and information gathered from these sources (and from the unofficial sources discussed below), governmental research and analysis units provide further interpretations and analyses to meet the information needs of decision makers. Such units include research institutes, planning offices, and staff groups.

There are also a number of unofficial channels which should not be overlooked as legitimate sources of information. In particular, they frequently offer different perspectives on current situations and trends, including qualitative information on values and goals of various interest groups and other segments of society. These perspectives are useful as a supplement to official sources, as a check on official sources, or merely as an indication that there is a communication problem to overcome. In many countries, the public press is one such source. Another source is direct communications from interested parties, e.g., peasant organizations, farmer cooperatives, landowners, retailers, consumer groups and exporters. These communications, whether in support or in protest, may range from private letters or office visits, to participation in political campaigns or public demonstrations. Finally, research and analyses conducted by universities, private corporations, and other non-governmental organizations are important supplements to those of governmental units.

3.2.2 Information in the Decision Cycle

Decision making can be viewed as a continuous, cyclic process of identifying problems, formulating alternative solutions, analysing options, deciding, implementing decisions, observing the results, evaluating the situation, and then continuing to deal with new or ongoing problems. Information is used in all stages, and the process is iterative in that some stages may be repeated based on information gained at later stages.

By observing the real world, qualitative and quantitative information on actual conditions are obtained and made available to other stages of the process, which, in turn, help determine additional observations needed. Observations are accomplished through regular surveys, censuses and administrative records, or through special studies and surveys designed to fill particular information needs.

Referring to specific stages of the decision cycle, for example, in evaluating ongoing agrarian reform and rural development programmes, observations are needed on a whole range of socio-economic indicators (FAO 1984), e.g., specific measures of nutrition, health, income growth and distribution, education, access to resources and community services, and participation in decision making. Or, to analyse options for farm price supports, decision makers need information on farm management practices, farm family consumption and savings patterns, market price determination processes, government budget and foreign trade implications, and other factors that may affect or be affected by the proposed alternatives. In a final example, the implementation of an irrigation project will require the monitoring of the cost and timely supply and use of workers, equipment and materials, and also of the impacts of the project on agricultural production, farm income, and water availability and quality.

Government decision makers are not the only users of information gathered from public sources. Private decision makers have similar problems with the complexities and uncertainties of the modern world, and thus also need timely and reliable information to improve the efficiency and effectiveness of private production, investment, marketing, consumption, and research and development decisions. The government is in a unique position to provide reliable information that may not otherwise be available. This is particularly true for the smaller, more atomistic economic actors, such as farmers, retailers, and consumers. Riemenschneider and Bonnen (1979) make this case based on information's characteristics as a public good, as discussed in the next section.

3.3 The Nature of Information

The above sections have examined the role and importance of information for food and agricultural decision making. This section offers a formal definition of "information" and describes its characteristics as a commodity with economic value.

3.3.1 Information and Data

The terms "information" and "data" are often used interchangeably. It is useful for our purposes, however, to distinguish between them. (See the Glossary for summary definitions of these and other terms used in this manual.)

Information is instrumental in nature. In general, information is knowledge used for a purpose; in our particular context, the purpose is to reduce uncertainty and otherwise support decision making. To be useful, information must be timely, accurate, consistent and relevant to the problem or decision at hand, where information to support a particular decision may be drawn and adapted from the existing body of knowledge, or it may be acquired specifically for the current situation.

Data are defined, for our purposes, as the subset of information which encompasses measured facts. Data may be logically derived facts or empirical facts, and they may be quantitative or qualitative in nature. For example, the name and address of the respondent to a political opinion poll are qualitative data, as are his opinions on how well the government is performing and what the national priorities should be. Empirical data are the product of observing and measuring real-world phenomena, and hence are the primary output of national statistical programmes, where data may be collected either as part of an information-gathering process to support specific decisions or in the general process of increasing knowledge..

Types of information which are not data, and are also necessary for decision making, include principles and the knowledge and skills for perceiving relations and implications, formulating concepts, making evaluations, and drawing conclusions.

Data, as the factual subset of information, are a base from which new, more complex and more useful information may be produced. Basic, or raw, data are direct measurements of concepts relevant to various aspects of problems. As such, they are based on both logic and experience, but they are rarely useful on their own for decision making. Statistical, economic and other analytical methods are used to transform basic data into information readily usable by decision makers. In a sense, raw data can be considered the lowest level of information, and successive interpretations and analyses of data and information transform them into more useful, higher levels of information.

Three types of information are relevant to the decision-making process: normative, positive, and prescriptive. Normative information concerns the goodness or badness of conditions, situations, and things, and thus reflects the underlying relevant set of values. Preferences of farmers, consumers, and other interest groups are an example of normative information useful for setting food and agricultural policy goals and targets. Positive information, on the other hand, concerns the status and behaviour of conditions, situations, and things independent of their goodness or badness. Examples include data on daily temperature and precipitation, amount of land allocated to various crops, and number of children born into a household.

The distinction between positive and normative information is not always clear, however. Positive information on cropland allocations, for example, also has a large normative content, since it results from decisions based on farmers' objective functions. Similarly, market prices reflect the relative values society places on consuming and producing various goods and services and on the risks associated with uncertainty. Even a simple count of births in a household contains normative information on the personal, social, and economic value the family places on family size and children as well as positive information on the effectiveness of birth control methods and family planning programmes and on numbers of future consumers and labour force participants.

Finally, prescriptive information, which depends on both normative and positive information, concerns concepts and relationships about what the goals should be and what courses of action should be taken. Typically, it involves compromises among possibly conflicting goods and bads. For example, the achievement of one good, such as cheap food for consumers, may hamper the achievement of other goods, such as food self-sufficiency or improved farm incomes. It may even worsen some bads, such as foreign exchange costs or government budget deficits. Also, different segments of society will generally have different concepts of what is good and bad.

The process of arriving at a prescription, that is, of making a decision, utilizes another type of information -- decision rules. One type of decision rule, voting, is found in constitutions and by-laws. For example, a constitution may specify that it takes a majority vote of a legislative body to pass a law but a two-thirds vote to amend the constitution itself. Other types of decision rules include compromise, consensus, and physical force. Theories of human behaviour also contain information on decision rules. Ultimately, however, it is in practical decision-making settings that the

behaviour is exhibited which the theories attempt to explain, where prescriptive information is generated through the interplay of conflicting goals, values, and interests in the presence of imperfect positive and normative information.

Positive and normative information on situations, trends and values are generated by the statistical and analytical components of a food and agricultural information system. Conceptually, however, decision rule information resides within the political, decision-making system of the country and would not be considered part of the food and agricultural information system. Prescriptive information for solving problems is created through the iterative interaction between decision makers, with their decision rules, statisticians and analysts in the food and agricultural information system and other sources of relevant positive and normative information.

3.3.2 Information as a Commodity

The information system described in the next chapter can be considered a production process. The commodity it produces is information, an essential input to the decision process, much as sunlight is an essential input to the plant growth process. Riemenschneider and Bonnen (1979) discuss information's characteristics as a commodity, particularly as public good, and the implications for the design of information systems. Indeed, they assert (p. 152) that "information only becomes an economically valuable commodity in the context of decision-making" and that its value "depends on the types of decisions for which it is used" and the value of those decisions.

In discussing the provision of information for decision making in the private sector, Riemenschneider and Bonnen (1979) show that the market structure of a particular industry influences whether information, as a public good, is supplied by specialty firms, by industry or trade associations, or by the government. They conclude "that government intervention might be appropriate to achieve a desired level of information production as an industry becomes more atomistic" (p. 156). Agriculture, particularly in developing countries, tends to be such an atomistic industry, thus justifying the importance, for the development and operation of the private sector, of government-supplied information.

There is a paradox associated with the dependence of the value of information on its use in decision making, a paradox that has implications for statistical work. It is that a

"decision-maker or purchaser of information does not know the exact value of the information until it is acquired and used, but to determine precisely its value prior to buying it, the purchaser must in effect obtain the information without cost...."

"The importance of credibility and reliability of sources of data and information is stressed by this paradox. When the purchaser of the information is forced to estimate its value prior to receipt, the value is often determined from previous experience with the same supplier. Another common way to judge reliability, especially of statistical data, is through the methodology used in the data collection. This accentuates the critical role of documentation of statistical procedures in operating information systems." (Riemenschneider and Bonnen 1979, p. 154)

On the demand side, the value of information is related to its use in reducing uncertainty in decision making. As the uncertainty of a situation and/or the stakes at risk in a decision increase, the value of information increases correspondingly. Collecting data and producing information are expensive processes, however. Personnel requirements include statisticians, enumerators, coders, programmers, and economic and other analysts. Computers are frequently needed to process and store the data. Dissemination of the data may also be costly. The aggregation of all such expenses incurred in producing the information may be considered to be its direct cost. It is not so simple to attribute a value to the benefits derived from the use of information, however. Efforts devoted to obtaining information are rewarded in improved decision making, i.e., decisions that are more likely to produce desired results and avoid or reduce undesired ones. Therefore, the value of information is a function of the reduction in decision-making risk attributable to its use.

As such, the benefits of information depend on its relevance, accuracy, and timeliness. The collection of data and creation of information not relevant to current or future decisions waste resources; i.e., they incur costs without returning any value in terms of reduced decision-making uncertainty. Furthermore, although perfect accuracy is as impossible to attain as perfect certainty, the greater the accuracy, the greater the reduction in uncertainty and, hence, decision-making risk. Finally, information must be made available promptly; it loses its value within the decision-making process if presented after the decision has already been made.

Resources which may be devoted to data and other types of information are limited, particularly in developing countries. Therefore, resource allocation decisions must be made with respect to providing only that information which is relevant in the context of the particular problem or class of problems faced by the client set of decision makers. Furthermore, since perfect accuracy is impossible, these decisions must determine the point at which the value of an additional unit of accuracy, in terms of reduced decision-making uncertainty, is not worth the cost of obtaining it.

This chapter has defined the concept of information and its role in reducing uncertainty and otherwise supporting decision making. With this background, the next chapter outlines what is meant by an information system and applies the systems approach to designing information systems.

CHAPTER 4

THE INFORMATION SYSTEM

Earlier chapters discuss the scope and problems of food and agricultural decision making and the essential role of information. Indeed, information is defined as having meaning and economic value only when it is used in decision making. This utilitarian perspective is important for understanding and solving the problems of national statistical programmes in developed and developing countries alike. Therefore, with this manual, FAO is recommending an approach to statistical development which places statistical programmes and their design within the larger context of information systems.

This chapter defines and applies the systems approach to the design of information systems. The systems approach is a formalized problem-solving process, where a problem is defined as a situation in which a decision must be made among a set of feasible alternatives in order to achieve some objective. Section 4.1 discusses a distinctive feature of the approach, i.e., its systems view of the world, where the portion of the world relevant to a particular problem is looked at as a system. These concepts are applied in Section 4.2 in describing an information system as a process. Section 4.3, then, gives a broad overview of the systems approach and applies it to the problem of designing information systems, while Section 4.4 addresses organizational considerations.

4.1 The Systems View: General Concepts

This section discusses the meanings of "system" and related concepts, including the important system characteristics of feedback and stability, and their usefulness for decision making.

4.1.1. System Definition

A SYSTEM is a collection of objects or processes, called COMPONENTS, which interact to perform a given function or functions. The interactions, which are the linkages connecting the components, take place through the paths or mechanisms of material, energy, and information flow among the components. The STRUCTURE of a system is uniquely defined by the system's components and linkages, a change in either of which signifies a change in the system. The ENVIRONMENT of the system includes all aspects of the world not explicitly part of

the system, and the system's BOUNDARY divides the system from its environment. The system interacts with its environment through flows, across its boundary, of material, energy, and information, called INPUTS and OUTPUTS. Figure 4.1 shows the relationships among these concepts for a generalized system of three components, four linkages, two inputs and two outputs.

The portion of the world comprising the domain of food and agriculture is described in Chapter 2 as a system (Figure 2.1). For simplicity in illustrating the concepts, let's consider a small part of that system as a system relevant to decision makers concerned with agricultural supply and demand. Thus, Figure 4.2 represents some components important to the agricultural sector of one region of a country, i.e., agricultural production, rural households, urban households and food markets. The key interactions linking these components are also indicated in the figure. The system as we have defined it does not have components for other regions within its boundary; therefore, other regions are considered part of the system's environment. Thus, for example, our system definition does not specify whether imports from the "environment" come from foreign trade or other regions of the country.

There are two observations to make here. First, a system, like beauty, is in the eye of the beholder. That is, we select the components and linkages according to what is relevant to our purposes for considering the agricultural sector (or any system) in the first place. This selection also partly depends, of course, on who "we" are: the farmer, the extension agent, the government planner, the input supplier and the food processor will all see the same agricultural system differently. Likewise, the selection of relevant interactions between system and environment (i.e., inputs and outputs) depends on who is doing the selecting and for what reason.

The system can also be defined at different levels of organization, again depending on our objectives. Thus, what we might consider to be a system in one context could be but one component of a broader system for other purposes. Conversely, a system component could also be viewed as a system with components of its own. For example, the regional agricultural sector might be just one component of a regional or national socio-economy. Other components of this broader system could represent household demographics, health, education or non-agricultural production. For other purposes, the decision maker might need to view the agricultural production component as a system in its own right, including components of crop production, livestock production and resource allocation, with appropriate interactions among them.

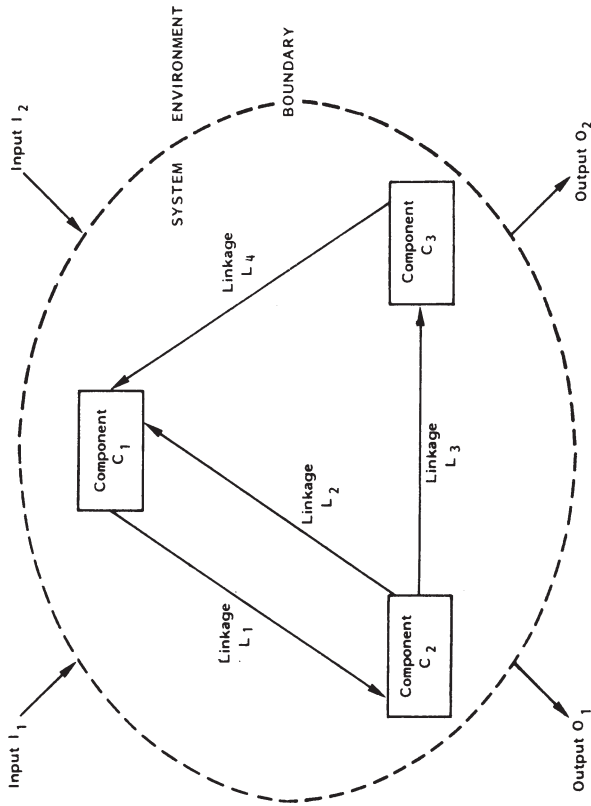


Figure 4.1 – System concepts

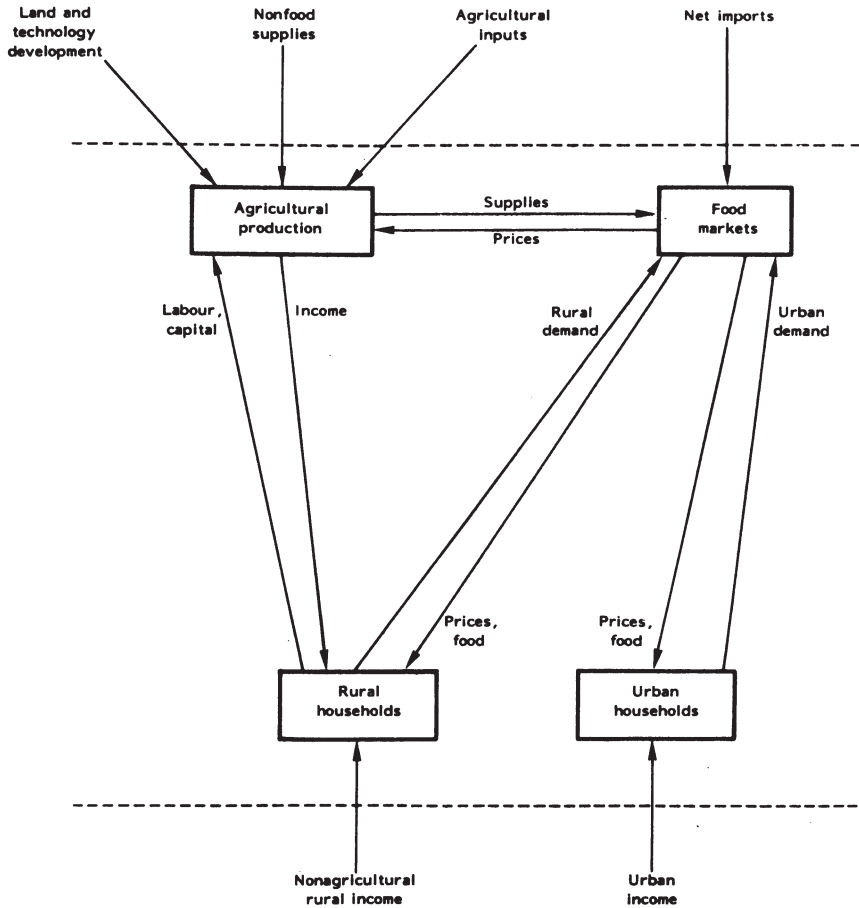


Figure 4.2 - An agricultural supply-demand system

The second observation is that systems and system components can be physical or abstract and refer to objects or processes -- again, depending on what suits our purposes. In agricultural production, for example, biomass growth (if that level of detail is needed) is a physical process, marketing is an abstract process, and the agricultural sector itself is an abstract object. A livestock housing component could be viewed as a physical object, if the physical characteristics of temperature, insulating properties, space, etc., are of interest, such as in a chicken coop design problem. It could also be considered a physical process, if we are concerned only with its function of providing shelter, warmth, and space. Section 4.2 of this chapter describes an information system as an abstract process, while Section 4.4 views it as an organization, i.e., an abstract object.

4.1.2 Feedback and Stability

The FEEDBACK LOOP is a linkage of a system component with itself, generally through a sequence of linkages with other components. It is a special, and very important, kind of linkage. The sequences $L_1 - L_3 - L_4$ and $L_1 - L_2$ in Figure 4.1 are feedback loops through which component C influences its own behaviour. In the agricultural system the agricultural production and food market components have an impact on one another. For example, agricultural production, if it increases faster than demand, will make prices fall, which, in turn, will reduce production in later periods.

This food example illustrates a very important feature of feedback loops. In particular, the supply-price interaction is not simultaneous; i.e., a change in price will not simultaneously affect supply. It is true of feedback interactions in general that they occur with time lags, i.e., feedback processes are time consuming and their impacts are distributed over time. Thus, feedback loops are at the core of what gives systems their dynamic behaviour (Forrester 1968), i.e., how the condition of a system at one point in time depends on its past history and influences its future. The importance for decision making of considering the dynamics of systems is discussed in Section 3.1.4 in terms of the need for multitemporal and intertemporal information.

While definition of the relevant system, including placement of the system boundary, is somewhat arbitrary, guided only by what is needed to consider the problem at hand, there is a general rule related to the feedback concept which reduces the arbitrariness and makes the ultimate system definition more useful. It is that the system should not have a feedback relationship with its environment;

i.e., those parts of the world which both affect the system and are affected by the system should be included within its boundary as part of the system. In the agricultural sector case, for example, if the problem involves the efficient allocation of rural resources and if the regional economy has a non-agricultural production activity which competes with agriculture for capital and labour and also produces inputs for agricultural production (a feedback loop), then non-agricultural production should be included as a system component and not left in the environment.

There are two basic kinds of feedback loops: positive and negative. It is important for decision makers to understand and appreciate them because of their implications for the stability of the system of interest and its ability to achieve behavioural goals. A couple of illustrations will serve to explain them.

Suppose Figure 4.3 represents our relevant system of interest and that a land reclamation project results, over time, in greater agricultural production. This begins a sequence of reactions: increased agricultural employment, increased rural income, increased investment in agriculture, further increases in agricultural production, and so on. The plus signs (+) next to each arrowhead mean that a change in one component causes a change in the next one in the same direction -- all increases in this case. Since the loop is reinforcing, i.e., since a change in agricultural production eventually leads to a further change in itself in the same direction, this is a POSITIVE FEEDBACK loop, as indicated by the (+) in the center of the loop.

It is clear that this is an example of an exponential growth process, and, hence, positive feedbacks are often called growth-inducing loops. Population growth is a common example, where births make more people which make more births and so on. If the growth were considered undesirable, such as in an escalation of conflict, we might call it a "vicious-circle" loop.

The loop does not have to reinforce increases, or growth, for it to be positive. The key is that the sequence of changes be in the same direction, whether they are increases or decreases, leading to growth or collapse. For example, suppose, instead of new land being developed, urban growth results in cropland losses. The resulting reduction in agricultural production reduces employment, which reduces income, which reduces investment, which further reduces production, and so on. All the impacts are in the same direction, so the loop is still positive, although, unless other steps are taken, it leads to accelerating collapse. One of these other steps might be a land development program to compensate for the losses to urbanization.

If the loop closes by counteracting or offsetting, rather than reinforcing, the initial change, it is a NEGATIVE FEEDBACK loop -- frequently called goal-seeking or self-equilibrating or self-correcting. A common example is a thermostat controlling the temperature in a home or a chicken coop: if the temperature is low, the heater comes on, raising the temperature until the heater shuts off, thus allowing the temperature to fall until the heater comes on again, and so on -- constantly correcting the temperature in search of the goal set at the thermostat.

Loosely speaking, a system is STABLE if its response to an external shock or influence stays within reasonable bounds and eventually diminishes and damps out. In the price-demand-supply example of Figure 4.2, suppose supply is lowered, e.g., through some catastrophic loss of land, causing an increase in the equilibrium price (Figure 4.4). If the demand and supply adjust to bring the actual price up to the new equilibrium, perhaps with some oscillations, the system is stable. If, on the other hand, the price leaves the old equilibrium, continues to fluctuate wildly, and never stays close to the new equilibrium level, the system is unstable. The only way an unstable system can be managed, short of modifying the system structure to make it stable, is for outside influences to force it to behave in the desired way.

As suggested by this example, the stability of a system is associated with negative feedback. The growth of a system, as we have seen, is associated with positive feedback -- and so, unfortunately, is instability. A socio-economic system contains innumerable feedback loops, both positive and negative, and the net effect on any given component of the system, unemployment, for example, depends on the relative strengths of the various loops it is in. This is what makes the management of such a system so difficult: inducing growth through the stimulation of positive loops while maintaining stability by working with the negative loops.

The next section uses these concepts to identify the food and agricultural information system as a process.

4.2 A Systems View of the Information Process

An information system is defined as a dynamic process whose function is the provision of information to support decision making in a specific subject area by a specific set of decision makers. It can also be described as an organization, with its associated structure, statistical and analytical programmes, personnel, budgets and support

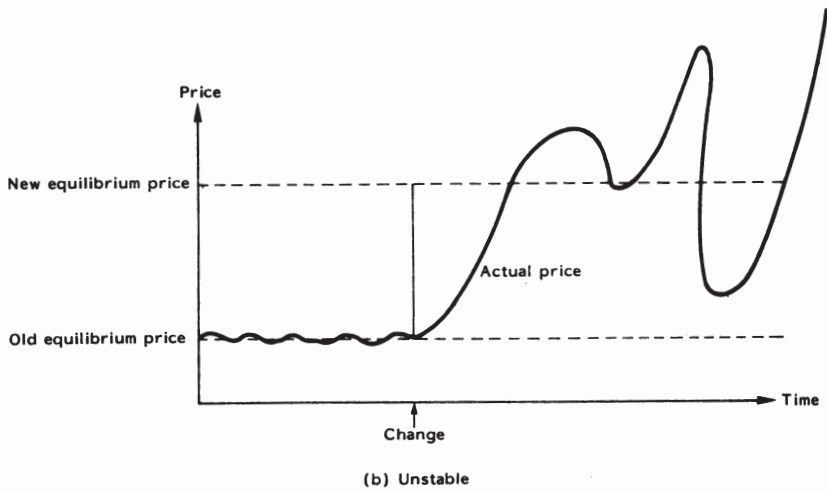
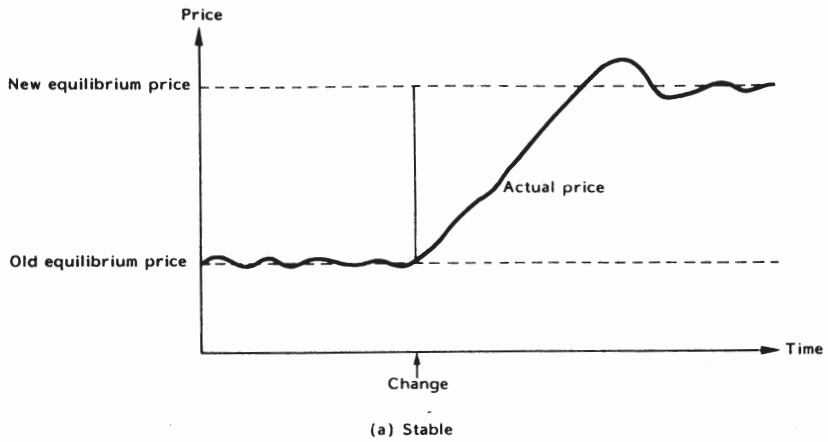


Figure 4.4 - Stability of a price-demand-supply system

services. This section focuses on the process description, and points out the importance of feedback in preventing the information system from becoming obsolete. Organizational considerations are addressed in Section 4.4.

4.2.1 Component Processes

The system has five principal components, each of which is also a process (shown as rectangular boxes in Figure 4.5): (a) conceptualization, (b) operational definition of concepts, (c) observation and measurement, (d) interpretation and analysis, and (e) decision making and implementation. These processes interact and take place continuously, as indicated in the figure by the solid double-headed arrows. The target world, which lies outside the information system, includes those parts of the real world relevant to the specific subject area encompassed by the information system -- food and agriculture in this case.

By definition, empirical awareness and knowledge of the target world can only come through the process of observation and measurement -- one of the components of the system. However, it is virtually impossible to know or comprehend every detail of the real world in all its complexity, or even of only the target subset of the real world. Therefore, all empirical perceptions of the world must, of necessity, pass through an observational filter which essentially defines and delimits what is observed and how it is observed. Thus, the adequacy and accuracy of observations and measurements are constrained, in the first instance, by the adequacy and accuracy of the filter.

The filter is the product of two other component processes of the information system: conceptualization and the operational definition of concepts. Conceptualization is the primitive, often subconscious, way people formulate notions of the real world. The resulting concepts tend to be vague and ill-defined. To gather information useful for decision making -- in particular, to design and carry out statistical activities and conduct meaningful analyses -- the vague concepts must be operationally defined. For example, what precisely is a farm, a holding, a parcel? How are they to be measured and in what units? The primitive concepts together with their operational definition, then, become the conceptual framework which is the observational filter.

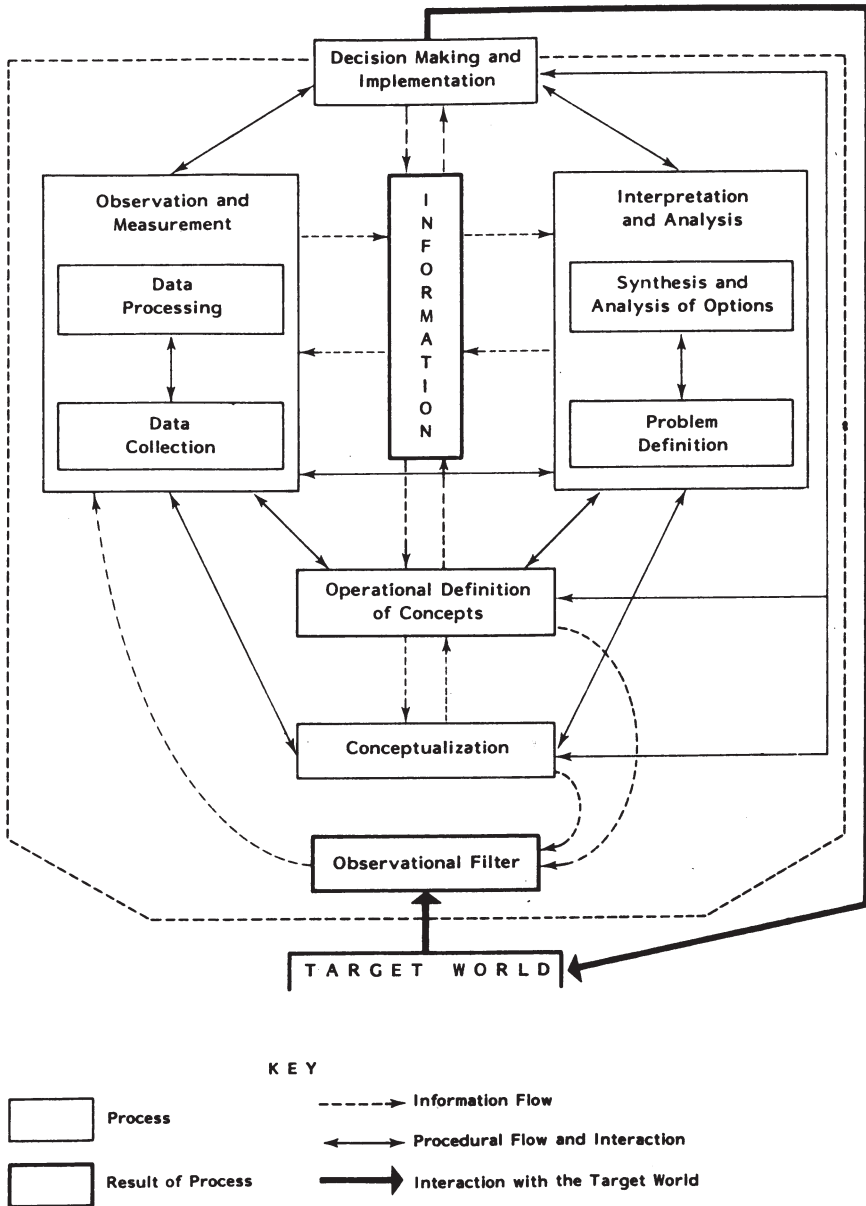


Figure 4.5 - A dynamic information system

Chapter 5 presents a detailed, comprehensive classification scheme which operationalizes concepts needed to produce information for food and agricultural decision making. In designing its information system, each country will tailor this general scheme to its own particular needs, depending on its socio-economic system, policy agenda and capabilities.

Given the observational filter, all awareness of the real world, at least of the target world, comes through the process of observation and measurement, with its subprocesses of data collection and data processing. Data collection may be either formal or informal, i.e., through the carrying out of formal censuses, surveys and other statistical activities, or simply by casual, informal observations of the target world. Data processing validates what has been collected and tabulates and stores data in forms for effective presentation and use in interpretation and analysis and in decision making.

There are five principal criteria by which the observation and measurement process may be evaluated: relevance, accuracy, timeliness, consistency and accessibility. The structure and quality of data collection particularly influence the accuracy, consistency and timeliness of the data, while data processing contributes to timeliness and accessibility. The relevance of data, however, depends on how well integrated the 'conceptualization and operational definition processes are with observation and measurement. The most accurate, consistent, timely, and accessible data may yet be useless if the observation and measurement process is not kept up to date with current data needs as reflected in the observational filter, or if the filter itself is obsolete' (Bonnen 1977).

The primary product of observation and measurement is data, i.e., measured facts (see the discussion in Section 3.3.1), which flow into the pool of information available for decision making. The usefulness of such data is generally limited, however, without first passing through the interpretation and analysis process, with its two subprocesses of problem definition and synthesis and analysis of options. Data coming from the target world are evaluated in light of other information on national values and policy goals from the decision-making process. The awareness of any discrepancies between actual and desired conditions is the beginning of problem definition, wherein the boundaries and requirements of specific policy issues are explicitly identified. Decision options are then formulated and analysed in terms of potential direct and indirect, good and bad consequences, with the analytical results becoming useful information for decision making.

Part of the analysis process is the specification, testing, and use of analytical frameworks, or models. These models may range in sophistication and complexity from informal mental constructs to computerized, mathematical simulation models. To be consistent with the data being observed in the target world, however, all models, whatever their level of formality or sophistication, must be based on the same set of concepts and operational definitions as those forming the observational filters and directing the design of measurement instruments. Thus, interaction between actors in the observation and measurement process and those in the interpretation and analysis process is essential.

The decision-making and implementation process is shown in Figure 4.5 as straddling the information system boundary (the dashed line around the diagram). The implication is that decision making (including implementation as a level of decision making) lies only partly within the information system. The interaction among decision making, interpretation and analysis, and observation and measurement is so close and so essential to the effective supply of useful information that at least that part of decision making involved in the interactive generation of information must be considered part of the information system. Aspects of decision making which lie outside the information system include the decision rules which determine the selection among options, the exercise of authority, and the bearing of responsibility for the results. The incidence of decisions on the target world, indicated by the double arrow linking decision making to the target world, is also outside the information system.

There is yet another part of decision making, and an information-gathering one at that, that is outside the realm of a particular information system. Remember, an information system is defined to be limited in scope to a specific subject area, such as food and agriculture, relevant to the target world. Practical public decision making, however, typically requires information from other sources and subject areas as well. Examples include information on national values and goals, of a political or national security nature, and from related socio-economic sectors. Thus, the acquisition and use of such other information are not part of the information system under consideration (e.g., food and agriculture).

So far, the discussion has described a national information system in general, defined to cover a specific subject to support a specific set of decision makers. For a national information system for food and agriculture, then, the subject is whatever the nation defines its domain of food and agriculture to be, and the set of decision makers is those government officials responsible for food and

agriculture. The information system services some information needs of private-sector food and agricultural decision makers as well.

4.2.2 Obsolescence and Feedback

As changes occur in the target world, national values and the policy agenda, it is necessary for actors in both the observation and measurement and the interpretation and analysis components to interact with decision makers in revising the operational definitions, or the basic concepts themselves, which are the foundation of their perceptions of the target world. It is this conceptual self-adaptation which makes the information system dynamic. Without it, the concepts, and hence the observational filter, become obsolete, severely diminishing the accuracy and relevance of the information.

As Bonnnen(1977) has pointed out, such conceptual obsolescence and consequent policy difficulties are all too often the rule rather than the exception in government information systems. He cites as one example the situation of poultry production in the United States. The concept of a farm-gate poultry price no longer exists in an industry that has become vertically integrated, i.e., where there is no distinction between the farmer, the processor, and the distributor. It would thus be operationally impossible to define and measure such a price. Yet, a farm-gate price continues to be reported by the statistical system although this number has become meaningless.

A second type of obsolescence Bonnen identifies, institutional obsolescence, arises when the organization of the information system itself, including the statistical, analytical and decision-making units, does not or cannot adjust as necessary to meet changing data and information needs. For example, the system may not be able to adequately produce new types of surveys, censuses or analytical studies or to present them at the times and places needed. The feedbacks indicated in Figure 4.5 can correct for both types of obsolescence, and it is the task of those designing and managing the information system to ensure that these feedbacks are in place and effective.

4.3 The Design Problem

The problem, or task, facing government decision makers is to design and implement an information system organization, including statistical and analytical components (or programmes), which will effectively and efficiently carry out the process described above.

This section applies the formalized problem-solving process of the systems approach to analysing the needs the organization must satisfy and to identifying the relevant system inputs, outputs, and constraints it will face, i.e., defining the problem. Design of the system organization itself is discussed in Section 4.4.

4.3.1 Information System Needs

The needs analysis stage of problem definition determines who has what needs with respect to the problem or task at hand. This is essential in order to provide a suitable context for the evaluation of decision options. That is, what individuals and groups, or classes of individuals and groups, have an interest at stake in, or are directly or indirectly affected by, the food and agricultural information system to be designed? What are the interests and needs of these affected parties with respect to the information system? Once these questions are answered, the specific decision goal or goals can be stated in terms of satisfying those needs and interests.

Some of the observed problems of statistical programmes include lack of trained personnel, one-shot or independent censuses and surveys, long delays in completing censuses and surveys, inadequate data processing capability, and a combination of inaccurate relevant statistics and irrelevant accurate statistics. These problems can be attributed to such higher-level problems as statisticians being left out of policy planning, disciplinary isolation, and, consequently, lack of budgetary support and of a long-term statistical development strategy. Many of these statistical problems also arise in a still higher-level information system context, as a result of conceptual and institutional obsolescence, as discussed in Section 4.2.2 -- i.e., the concept of what is to be measured no longer has any reference in today's world or is no longer relevant to today's decision problems, and/or the organizational structure of statistical systems has been outmoded by changes in the way decisions are made and information is used.

So, given these perceptions, who has what needs? A general outline for some of the major participants is given, but these considerations must be analysed in greater depth to identify each country's particular needs.

(a) Public food and agriculture decision makers need information, as discussed in Chapter 3, on the current domestic and international state of affairs and trends in food and agriculture and the likely consequences of their policy actions to manage those affairs. They also need similar information on other socio-economic sectors which

have a bearing on food and agriculture, such as transportation, rural infrastructure (e.g., roads and electrification), and demographics.

(b) Public decision makers in other sectors closely related to food and agriculture need similar information.

(c) Private decision makers with a stake in food and agriculture, e.g., food producers, marketers, processors and consumers, need information of a similar nature as well as on the likely actions of public decision makers.

(d) Professional statisticians, economists and other analysts in government need a work environment which offers security and professional integrity along with opportunities for professional rewards and growth.

(e) Public administrators and tax payers need an efficient information system, one which is affordable and worth the cost.

To satisfy these needs, a general goal could be stated as: Provide relevant, accurate, and timely food and agricultural information for decision making in a manner consistent with national social and political values and with available human and financial resources, given the country's level of development. As stated above, detailed needs and goals must be identified and stated for each country on a case-by-case basis. Once this has been done, the boundary conditions of alternative information systems to achieve the goals can be specified.

4.3.2 Information System Boundary

In designing a public-sector information system, consideration must be given to what it is expected to produce and to the measures by which it is to be evaluated -- i.e., the outputs of the system, both desired and undesired. In addition, the resources available and necessary to operate the system, as well as the feasible and allowable decision actions for managing it -- i.e., the purposeful inputs of the system -- need to be specified. Any outside influences within which the system must survive -- i.e., the environmental inputs -- must also be identified. Finally, any constraints (minima and maxima) that may be imposed on these variables should be indicated.

Obviously, the primary product, or desired output, of an information system is information for both public and, to some extent, private decision making. Information is a very general concept, however, and difficult to measure, either quantitatively or qualitatively. To be more specific, the nature of the information and how it is presented should be explicitly identified, i.e., the

content, format, and timing of various statistical and analytical presentations, both regular and special, should be specified. These could include, for example, statistical yearbooks, annual household survey reports, periodic situation and outlook reports for commodity groups, special staff studies and analyses of emergent policy issues, planning analyses, public and closed-door briefings on current situations and trends, and census reports. The exact mix of these and other types and formats of information to be produced by the system will depend on the country's own needs and capabilities -- essentially determined by the country's food and agricultural decision makers and the domain of their concern. Chapter 6 presents some general recommendations in this regard with respect to statistical programmes.

Important measures of the quality of these outputs are their relevance, consistency, timeliness, accuracy and accessibility, and the system design must give attention to all of them. Accuracy is a function of the technical competence of the human resources employed and of the adequacy of the financial, staff, and computing support provided them. Timeliness and accessibility are functions of organizational structure and procedures as well as staff and computing support. They can be measured in such ways as the frequency with which periodic reports or announcements are published on time and the opinion of decision makers about whether information from special analyses and studies reaches them in a usable form and in time for the decision to be made. Finally, relevance and consistency depend on the effectiveness of the communication among statisticians, analysts, and decision makers and on the flexibility of the system to adapt to changing conditions and concepts in avoiding the conceptual and institutional obsolescence discussed in Section 4.2.

In addition to identifying the desired system outputs, consideration should be given to any undesired products or consequences, whether direct or indirect, that may result from operation of the system. The objective here is not to argue against system implementation but rather to anticipate potential negative results and to build into the design means for reducing them or at least compensating for them. Expenditures to operate the system although necessary, are one obvious "negative". Indeed, cost relative to the value of the product, including consideration of the quality and usefulness of that product, is an important variable measuring efficiency of the system.

Another possible negative may be, depending on the degree of openness of the society, the release of information that embarrasses the government or certain parts of it or becomes ammunition in the hands of opposition parties. Of course, from the point of view of the opposition and possibly of long-term national well-being, this may be a valid and desirable, rather than undesirable, result.

A negative that cannot be escaped, since there cannot be perfect certainty about present or future conditions or reactions to policy actions, is that some of the information output used as the basis for decisions may not be accurate. The objective is to design the information system so that such occurrences are reduced in comparison with decisions made without it.

There may also be some negatives, which must be anticipated and dealt with, resulting from building flexibility into the system to avoid obsolescence and maintain relevance of the data and information. In particular, reorganizations or job reassignments can cause reduced efficiencies (at least temporarily) and feelings of insecurity and resentment on the part of professional and other staff who have become used to certain routines. Also, the usefulness of the product for certain purposes may suffer in the trade-off made between the desirability of time series which are consistent over time and the need to redefine or drop certain ones or add new ones.

The design of the system should also accomodate the purposeful inputs that will be available and applied to it. Important considerations here are the human and financial resources which the country, depending on its level of development, can allocate to providing food and agricultural information. The system should not require more than is available, and yet it should be able to be expanded or enhanced along with the country's capabilities. The allocation of resources is also a major way public decision makers and administrators can control or manage the information system. Such control is essential if the sytem is to remain relevant and credible in the eyes of its primary users. At the same time, however, the system should also be designed to protect its technical and professional integrity, also important for credibility, from bowing to political expediency. These resource considerations will be discussed further in the next section.

Demands from public and private users for various types of information products are a very important category of input to the information system. Again, to maintain relevance and credibility and avoid obsolescence, the system must be able to make the adjustments necessary to respond effectively and efficiently to changes in these demands arising from changing conditions in the real world -- be they changes in format, content, or timing.

The environment in which the system must operate may also influence the system in ways not controllable by decision makers. A major category of environmental input to consider in the information system design comes from the socio-economic system it is observing and

analysing. Examples here include social norms which influence the attitude, whether cooperative or resistant, of people and businesses toward surveys and censuses; weather, civil disturbances, and other factors which may impede data collection; and employment opportunities elsewhere in the economy or abroad that may attract trained manpower away from the food and agricultural information system.

4.3.3 Summary Problem Statement

The output of the problem definition stage for each country can be thought of as a clear, explicit statement of the information system design problem for that country. In general, it could take this form:

to design and implement an information system that will provide timely, relevant, accurate, accessible and consistent information to food and agricultural decision makers in an effective and efficient manner; that will be able to adapt structurally and conceptually to changing conditions in the target world and to evolving policy agendas, thus avoiding conceptual and institutional obsolescence; and that will be consistent with the human, financial, and institutional capabilities of the country as those capabilities develop and grow over time.

This section has described, in general terms, the definition of the boundary of an information system in terms of its inputs and outputs and the needs of affected parties. The next section examines some of the internal design characteristics that should be considered in the organizational structure of the system.

4.4 The Information System as an Organization

The discussion in Section 4.1 points out that a system may be either a process or an organization. Many systems, such as an information system, may be both, depending on how one wants to look at them and for what purpose. Section 4.2 describes a food and agricultural information system as a process whose components perform various functions in the production of information for decision making (Figure 4.5). This section describes the information system as an organization for carrying out this process. The discussion focuses first on the structure of the system and then considers the requirements for human and other resources. Finally, other topics considered include organizational flexibility and adaptability, politicization, and implementing the transition from the existing system.

4.4.1 Structural Considerations

The organizational units of a public information system for food and agricultural decision making can be grouped in three interacting categories: statistical programmes, analytical programmes and decision-making units. Detailed organizational design options must be specified on a country-by-country basis. They will, for example, depend on such political and administrative characteristics as centralized versus decentralized decision making and administration, the relationship between the government and private sectors, and human, financial, technical and administrative capabilities. Nevertheless, some general statements can be made along functional lines.

A statistical programme is defined (see the Glossary) as the complex of government agencies, personnel, budgets, support services and schedule of statistical activities, with internal and external institutional linkages, whose primary responsibility is the observation and measurement component of the information system. The statistical programme is not equivalent to the observation and measurement process, however, in that other actors, particularly researchers, analysts and decision makers, also conduct at least informal data collection and processing activities. At times, the analytical programme may also supplement the statistical programme's formal statistical activities with small-scale special surveys and studies, although, ideally, such formal activities should be coordinated with the statistical programme.

The statistical programme has responsibilities in other information system components as well. In particular, it supports the analytical programme in statistical aspects of interpretation and analysis. As a minimum, the very act of aggregating, tabulating and cross-tabulating data is a form of interpretation creating higher-level information that can be communicated to decision makers. Beyond that, statistical analyses can illuminate meanings and implications hidden within the explicit data. Thus, statisticians are an invaluable component, along with economists and other researchers and analysts, of teams performing planning and policy analyses. The units and functions of the statistical programme are discussed further in Chapter 6.

An analytical programme is defined as the complex of government agencies and institutes, personnel, budgets, and support services, with internal and external institutional linkages, whose primary responsibility is the interpretation and analysis component of the information system. The analytical programme is not equivalent to the

interpretation and analysis process, however. As noted above, it also participates, in coordination with the statistical programme, in observation and measurement -- both in carrying out informal and some formal data collection and processing activities and, with decision-making units, in helping identify data collection and processing needs and priorities. In addition, the models used by the analytical programme provide valuable consistency checks on data generated by the observation and measurement process. The structure and functions of the analytical programme are outlined more fully in Chapter 7.

Computer services are a very important component of both statistical and analytical programmes. Reference here is both to mainframe computer services provided from a central site and to microcomputers. Central computers, with suitable hardware and software configurations, are necessary to maintain the large data bases and computer models growth generated and used by the statistical and analytical units. In addition, the on-going growth in the use of microcomputers for personalized data and word processing has implications for the conduct of statistical and analytical activities and also for the use of central site services. In particular, it adds a new dimension to the demands placed on mainframe computers, expanding from primarily batch production jobs to interactive use via communication links and networks. For example, data and computer programmes may be loaded from the mainframe into the microcomputer for local processing, with results being loaded back into the mainframe for storage and larger processing tasks.

A variety of supporting units, in and out of government, provide services critical to the effective operation of the statistical and analytical programmes. With respect to universities, technical agricultural research units, and other research institutes, Jones and Rossmiller (1978, p. 341) point out that

"through these linkages a continuous flow of information, research and analytical results, and trained personnel from relevant disciplines can be maintained. Since much of the trained intellectual capacity of a country normally resides in these types of institutions, much can be gained through establishment of close working relationships with them. One means of facilitating a working linkage is through governmental support to these institutions (funding for special studies, grants, contracts, consulting) to carry out research and analytical efforts of mutual interest and of use to the government."

Finally, decision-making units include those agencies of government, with associated personnel, budgets, support services, and internal and external institutional linkages, responsible for formulating and executing plans, policies, programmes, and projects to carry out national values and goals. In fulfilling these responsibilities, they interact with the statistical and analytical programmes in all component processes of the information system in order to develop the information they need to support their decision making. Interactions include receiving the data and information they need on real-world situations and trends and projected consequences of decision options. In the other direction, decision makers communicate their policy agenda and information needs to the statistical and analytical programmes and participate in problem definition and the synthesis and analysis of policy options. They also manage the system and establish priorities through the allocation of personnel and budgetary resources.

In a sense, the adequacy of the organizational structure is a resource available to the information system. Other key resources are discussed next.

4.4.2 Resource Considerations

In addition to the institutional resources discussed above, two essential resource categories are personnel and budgets. Each of the organizational units requires a staff with the appropriate mix of skills and skill levels and the budget necessary to maintain that staff and carry out operations.

It is important that both budget and staff resources be stable over time and be maintained at levels that will ensure effective and efficient operations and results. An overworked staff will perform less effectively and less efficiently, so that any cost savings will come only at the expense of staff morale, the quality of the information product, and, hence, the quality of the decisions based on it -- possibly proving self-defeating in the end.

Typically in developing countries,, budgetary and other institutional constraints are more limiting than the availability of trained personnel. Nationals trained in the latest statistical and analytical methods and techniques, either at home or abroad, immediately become too valuable for government employment to compete with opportunities in the private sector, again either at home or abroad. The result is a high turnover rate of people who have gained experience and expertise, leaving those with less experience or

capability to fulfill the information needs of government decision makers.

This is due both to overall budget limits and to civil service job categories and salary scales which do not recognize the special situations of technical and scientific professionals. Solutions to such problems -- whether they involve civil service reform or giving the improvement of information a higher priority over other pressing needs -- do not come easily to countries struggling with the myriad and complex demands of social, political, and economic development. Nevertheless, the problem should be recognized and the information system designed with the flexibility to live within these constraints and to adopt improvements as the constraints are eased over time.

In putting together statistical and analytical teams, the system design should give careful consideration to the combination of skills and skill levels necessary to carry out the required functions. These are outlined for the statistical and analytical programmes in Chapters 6 and 7, respectively.

4.4.3 Other Considerations

Three additional factors to consider in designing an information system for public food and agricultural decision making are: conceptual and institutional obsolescence, the politicization of data and information, and the transition from the existing information system.

Conceptual and institutional obsolescence are defined and discussed in Section 4.2.2. In designing an improved information system, means should be built in to avoid these problems. Subject-matter researchers and analysts -- such as agricultural economists, statisticians, and rural sociologists -- in the analytical and statistical programmes or in university or other research institutions are perhaps in the best position to become aware of concepts or operational definitions which are about to become obsolete or irrelevant to the current and evolving policy agenda. Such people should be prominently involved, along with decision makers and others in the political process, in regular reviews of the current concept definitions (such as those derived from the classification scheme suggested in Chapter 5) and, when necessary, in the redefinition process. In addition, provisions should be made to minimize any technical problems, such as discontinuous time series, which may arise as a consequence.

It may happen that redefining old measures or defining new ones will require new instruments or methods of data collection and analysis. These in turn may require job reassignments or bureaucratic reorganizations in order to continue to be effective in providing timely, relevant, accurate, and consistent data and information. Another possible source of institutional obsolescence in the information system is reorganization at the level of the decision-making units, e.g., increased or decreased centralization, or a realignment of ministerial functions. The information system design, therefore, particularly of the statistical and analytical programmes, should anticipate the need for appropriate reorganizations. Associated problems, such as the morale and cooperation of personnel who have come to feel secure in their assignments, and potential solutions should also be anticipated.

The problem of politicization is a serious one for the integrity and credibility of data and information, particularly when used as performance measures or justifications for (or against) public policies. Further, if long-standing policies and, therefore, special interests are founded on and have a stake in certain measures, the problem of redefining them if and when they become obsolete becomes that much more difficult. Riemenschneider and Bonnen (1979, p. 157-158) recognize that

"in designing a government information system, various efforts to guard against politicization of data should be considered. Some of the important means of avoiding politicization of data include: the complete documentation of methodologies used in obtaining data; the encouragement of ties between government statisticians, economists and other analysts and academic and other non-governmental professionals in these fields; the selection of leaders of statistical agencies on merit not political acceptability; and an attempt to maintain appropriate distance between policy formulation and evaluation and the collection of statistics."

Finally, in planning for the implementation of an improved information system, it must be recognized that every country has an existing one to begin with. Therefore, implementation is not a question of scrapping what already exists but rather one of a transition from one system to the other.

The next stage in designing an information system is to synthesize, or formulate, options for fulfilling the specifications discussed thus far. This process begins in Chapter 5, where a general classification scheme is recommended for identifying and defining

operational concepts which can be used as performance indicators of the food and agricultural system. Each country will then tailor this general scheme to its own situation and capabilities. Chapters 6 and 7 focus specifically on features of the statistical and analytical programmes, respectively, while Chapter 8 offers implementation and transition guidelines.

CHAPTER 5

OPERATIONAL CONCEPTS FOR MEASUREMENT AND ANALYSIS

Information for decision making is provided by the information system's processes of (a) observation and measurement and (b) interpretation and analysis, in iterative interaction with the decision-making process, as discussed in Chapter 4 (Figure 4.5). Both information-providing processes are ideally founded on a common set of basic concepts and operational definitions of those concepts, which also defines the observational filter governing how we look at the target world and what we see there. This chapter defines and classifies specific items of information needed to operationalize key concepts covering the domain of food and agricultural decision making (described in Chapter 2). A standard, comprehensive classification scheme of information items is presented in Section 5.1, while Section 5.2 indicates how the items are used in various decision-making contexts. Detailed definitions of the main items in each category are given in Section 5.3.

The standard classification and definitions offered here are intended to facilitate international comparisons (e.g., in agricultural censuses, commodity supply and utilization accounts, and economic accounts for agriculture) and to help national statistical programmes organize and manage data collection and processing activities within their countries, although individual countries may need to add or delete items, or modify item definitions, in order to better describe their own unique situations. The items are called information items because they are also the subject of activities of analytical programmes, i.e., they refer to measured facts (data -- see the Glossary) about the target world and also to hypotheses, projections, implications and conclusions about that world.

5.1 Standard Classification Scheme

The complete classification scheme, with code numbers, is presented in Appendix I. The items classified are defined as specific pieces of information on particular aspects of the target world and relate both to subject-matter areas, covering the entire domain of interest to food and agriculture decision makers, and to participants in those areas, e.g., such economic agents as farmers, input suppliers, wholesalers and food processors. For statistical programmes, the classification and definitions provide guidance in

specifying the scope and frequency of measurement instruments and the practical problems associated with each instrument. The right-hand column in Appendix I indicates, for each item, appropriate data sources and measurement instruments, which are discussed further in Chapter 6. For analytical programmes, the classification and definitions provide a firm basis for identifying relevant variables to model and analyse, enabling analysts to trace, for example, the flow of a commodity from production through processing and distribution to final consumption, together with information on the economic agents involved at each stage. The policy analysis process and the use of models are described in Chapter 7.

The subject-matter categories, while emphasizing agricultural production, cover the entire domain of food and agriculture. Category 01 identifies the economic agents associated with the agricultural production units described in category 02, and category 03 provides information on household members. Labour force and employment information is covered in category 04, while category 05 describes the availability, tenure, use and development of land and water resources for agricultural production. Categories 06-08 provide commodity-specific information on crop and livestock production and the use of inputs, while categories 09 and 10 cover the capital stocks of, respectively, machinery and equipment, and buildings and other structures. Forestry and fisheries activities which are ancillary to the activities of agricultural holdings are included in category 11. Credit, marketing and stocks are the subject of category 12; price information is provided in category 13; and post-harvest losses are described in category 14. Category 15 provides information on household incomes and expenditures. Finally, categories 16 and 17 include other relevant information, e.g., foreign trade, national accounts, and agricultural research and extension.

The major categories are subdivided in three additional levels of increasing specificity, called divisions, sections and subsections, respectively. Code numbers are constructed by assigning two digits to the categories and one digit each to the lower levels of the hierarchy. If a hierarchical level is missing, e.g., if there is no disaggregation of a division into sections or of a section into subsections, the corresponding digit for that level is zero. At the bottom of the hierarchy, individual information items within the subsections are assigned a sixth digit. Some items are further disaggregated by various dimensions of interest, indicated by a seventh digit in parentheses, e.g., age classes (1) under 1 year of age, (2) 1 year to under 2 years of age, and so on.

Since all items are, to some degree, related to one another, it is inevitable that any classification scheme such as this will scatter the items of interest to a particular subject among several

categories. For example, elements of "income" can be found in such categories as employment, crops and livestock in addition to category 15 (Income and Outlay). The analyst investigating a particular subject, therefore, needs to look through all categories in order to locate all items relevant to the topic of interest. Also, the list of items includes prices, values (e.g., of production or of consumption expenditures) and quantities. While given any two of these items for a commodity the third can be computed, all three are listed in order to provide a choice for data collection activities, since in certain cases it may be more practical to collect data on values, for example, than on prices.

Table 5.1 shows the structure and code numbers (to four digits) for the categories, divisions and sections of the generalized classification scheme. The complete list of subsections and items (to six digits) is given in Appendix I. This selection of items is motivated by the general information needs of food and agricultural decision making, as illustrated in the next section. Since those needs will vary with each country's particular situation, the item list should be modified accordingly for implementation on a country-by-country basis.

5.2 Use of Information Items in Food and Agricultural Decision Making

The broad goals of food and agricultural decision making are identified in Chapter 2: growth, equity and stability. Chapter 2 also discusses how these goals are pursued through the formulation, implementation, monitoring and evaluation of a hierarchy of policy instruments -- plans, policies, programmes and projects -- spanning the domain of food and agriculture. The details of the concepts and operational definitions embodied in the classification scheme presented here may seem far removed from these broad goals. As explained in Chapter 3, however, the connection results from the need for data and other information at every stage and level of decision making in order to deal with the complexities of the target world and reduce the inherent uncertainties.

With respect to agrarian reform and rural development, there is a need to identify indicators of people's participation. Some items included in Table 5.1, such as category 03 items relating to household members and 04 items relating to the labour force and employment, are relevant for monitoring and evaluating people's participation. However, a more adequate conceptualization of people's participation must be accomplished before items for this important dimension of agrarian reform and rural development can be encoded.

Table 5.1
General Classification of Food and Agricultural Information

Code Number*	Description*
01	<u>Identification</u>
011	Holding, holder, respondent
0111	Holding
0112	Holder
0113	Respondent for holding
012	Household, head of household, respondent
0121	Household
0122	Head of Household
0123	Respondent for household
013	Agricultural service establishments
014	Locality
015	Other units (to be specified)
02	<u>General Characteristics</u>
021	Holding
0211	Holder
0212	Hired manager
0213	Economic activities of an enterprise
022	Agricultural service establishments
023	Cooperatives
03	<u>Demographic and Anthropometric Characteristics</u>
031	General Information
0311	Household
0312	Household members
032	Guests
033	In-migration and out-migration
034	Anthropometric characteristics of household members
04	<u>Employment</u>
041	For each household member
0411	Status of labour force participation
0412	Occupation
0413	Employment status
042	Employment on holding
0421	For each member of holder's household (including holder) -- for holdings whose holders are real persons
0422	Agricultural workers, other than members of holder's household

Table 5.1 (continued)

Code Number*	Description*
043	Employment in agricultural service establishments
0431	Unpaid family workers
0432	Permanent agricultural workers
044	Cost of labour (for holdings and agricultural service establishments)
0441	Wages paid
0442	Cost of insurance and other fringe benefits
045	For each agricultural worker -- permanent and occasional (for holdings and agricultural service establishments)
0451	Identification
0452	Time worked
0453	Wages earned
046	Participants in cooperatives, collectives or communal holdings
047	Employment outside holding (for households of which at least one member is a holder)
0471	For each member of household (including holder)
05	<u>Land and Water</u>
051	For entire holding
0511	Number of parcels and total area
0512	Rental of land
0513	Land purchased or sold
0514	Shifting cultivation
0515	Use of soil conditioners
0516	New cropland
0517	New permanent meadows and pastures
0518	Irrigation
0519	Drainage
052	For each parcel
0521	Location, area and distance
0522	Area by tenure
0523	Rent
0524	Land use
0525	Irrigation and drainage
0526	Shifting cultivation
06	<u>Crops</u>
061	For entire holding
0611	Temporary crops
0612	Permanent crops
0613	Fertilizers
0614	Pesticides

Table 5.1 (continued)

Code Number*	Description*
0615	Seeds and young plants
0616	Animal power
0617	Machinery
0618	Crop insurance
062	For each parcel
0621	Crop stand
0622	Temporary crops - rotation and intensity
0623	Temporary crops - inputs used
0624	Temporary crops - outputs
0625	Permanent crops - plantation characteristics for each crop
0626	Permanent crops - inputs used during year - non-productive age
0627	Permanent crops - inputs used during year - productive age
0628	Permanent crops - output
0629	Permanent crops - nurseries
07-08	<u>Livestock</u>
071	Management and population
0711	Livestock production system
0712-0713	Total number of livestock kept - present population
072	Cattle
0721	Herd structure and management
0722	Veterinary
0723	Feed
0724	Labour
0725	Other inputs
0726	Production - meat
0727	Production - milk
0728	Production - other
073	Buffaloes
0731	(same as 0721-0728 for cattle)
074	Sheep
0741-0746	(same as 0721-0726 for cattle)
0747	Production - wool
0748	Production - milk
0749	Production - other
075	Goats
0751-0756	(same as 0721-0726 for cattle)
0757	Production - wool
0758	Production - milk
0759	Production - other
076	Pigs
0761-0766	(same as 0721-0726 for cattle)

Table 5.1 (continued)

Code Number*	Description*
077	Horses and camels
0771	Horses
0772	Camels
0773	Sales and purchases during year
078	Chickens
0781	Population
0782	Inputs
0783	Production
079	Other poultry
0791	Population
0792	Inputs
0793	Production
081	Other domesticated animals
0811	Bees
0812	Others (including deer)
09	<u>Machinery and Equipment</u>
091	For holdings
0911	Indication of use, by type of machinery and equipment
0912	Number used and source
0913	Rentals paid
092	For holdings and agricultural service establishments
0921	For machinery owned solely or jointly
10	<u>Buildings and Other Structures</u>
101	Living quarters
1011	General characteristics and agricultural use
1012	Tenure
102	Non-residential buildings
1021	Use and tenure
1022	Physical properties of buildings
1023	Purchases and sales
1024	Construction costs during past year
103	Other structures
1031	Construction costs during past year
11	<u>Ancillary Activities</u>
111	Forestry
1111	Existence of forest trees on holding
1112	Number of forest trees
1113	Area under forest trees
1114	Inputs used during year
1115	Production during year
1116	Sales
1117	Own consumption

Table 5.1 (continued)

Code Number*	Description*
112	Fisheries
1121	Existence of fisheries activities on holding
1122	Cultural installation
1123	Inputs used during year
1124	Production during year
1125	Sales
1126	Own consumption
12	<u>Credit, Marketing, Stocks</u>
121	Credit
1211	Credit activities
1212	Credit received, for each transaction
122	Marketing
1221	Timeliness and sources of inputs
1222	Disposal of products
123	Stocks
1231	Of agricultural products, by product
1232	Of agricultural inputs, by input
13	<u>Prices</u>
131	Prices received and prices paid by farmers
1311	Prices received by farmers, by product sold
1312	Wholesale prices, by product sold
1313	Retail prices, by product sold
1314	Export prices, by product exported
1315	Prices paid by farmers at point of purchase
132	Prices of household consumer goods and services
133	World prices for agricultural products and inputs
14	<u>Post-Harvest Foodgrain Losses</u>
141	At holding
1411	Losses at harvest
1412	Losses at threshing/shelling
1413	Losses at cleaning/winnowing
1414	Losses at drying
1415	Losses in storage
1416	Losses in transport
1417	Losses in processing
1418	Losses in packing and handling
142	By intermediaries
143	At warehouses

Table 5.1 (continued)

Code Number*	Description*
15	<u>Income and Outlay</u>
151	Revenues not covered elsewhere
1511	Rentals received
1512	Receipts for agricultural services rendered
152	Outlays not covered elsewhere
153	Income of household
1531	From the holding
1532	From the agricultural service establishment
1533	From employment outside the holding
1534	From other sources
154	Sales of household property by household during past year
1541	Sale of living quarters
1542	Sale of second-hand durable household goods
155	Miscellaneous household receipts
1551	Inheritance
1552	Other
156	Household expenditures during past year, value and quantity
1561-1562	Food, beverages, tobacco and intoxicants
1563	Fuel and light
1564	Housing and household furnishings and services
1565	Clothing and bedding
1566-1567	Miscellaneous expenditures
1568	Savings
16-17	<u>Other</u>
161	Foreign trade of agricultural inputs and products
1611	Exports
1612	Imports
1613	Foreign exchange
162	National accounts and budget
1621	National accounts
1622	Annual national budget
163	Government land and water development and crop improvement projects
1631	Total cost
1632	Benefits
164	Government-held stocks of agricultural products
165	Domestic manufacturing
1651	Agricultural inputs
1652	Other manufacturing
166	Climatic data, by region
167	Community services available at village level

Table 5.1 (continued)

Code Number*	Description*
168	Technological research information
169	Quality of irrigation water
171	Soil characteristics
172	Agricultural extension
173	Agricultural education
174	Miscellaneous

* The classification hierarchy is indicated for both code numbers and descriptions by levels of indentation as follows:

Category (2 digits)
 Division (3 digits)
 Section (4 digits)

Figures 2.3 to 2.5 in Chapter 2 elaborate the hierarchical structure of policy goals, objectives and instruments. Figure 2.3 is augmented here as Figure 5.1 in order to illustrate how specific items of information are related to support decision making in specific areas, e.g., improved food and nutrition. Similar relationships can be made for the other policy areas shown in Figures 2.4 and 2.5 for Improved Quality of Rural Life and Agricultural Contributions to General Economic Development, respectively.

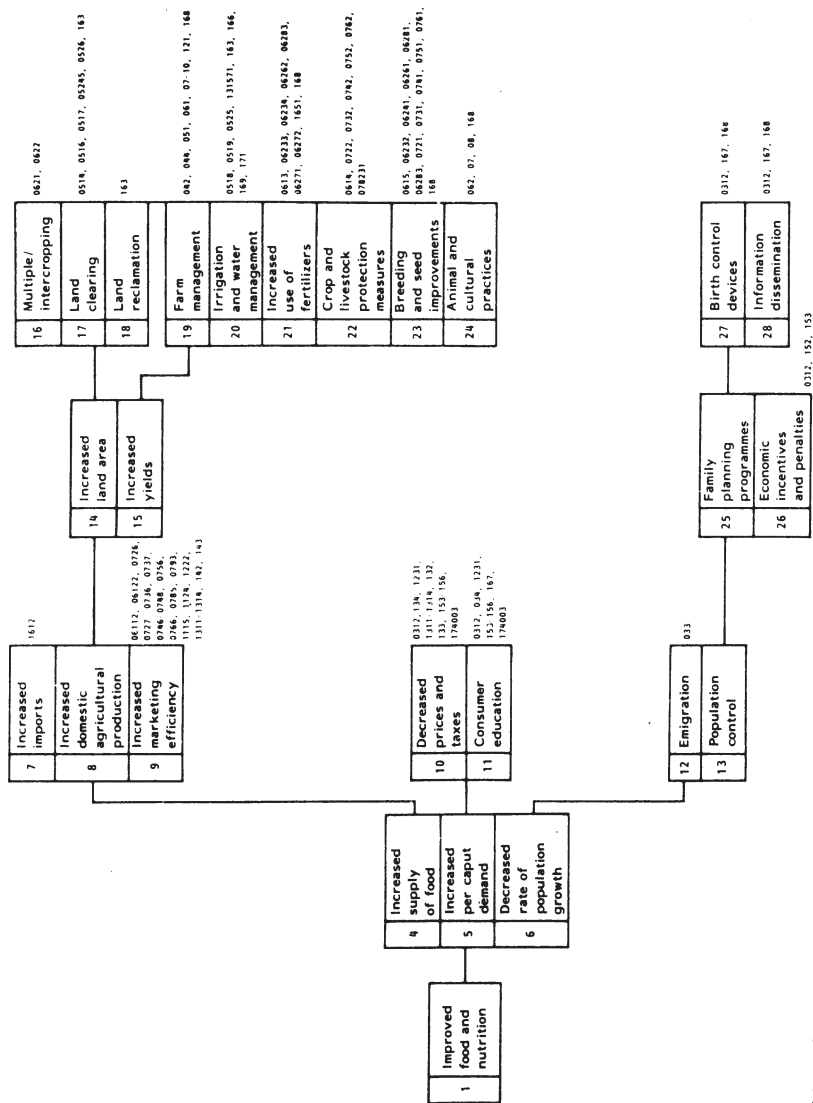
Code numbers of information items relevant to the analysis of a policy area are indicated at the right side of the figure, following the lowest level of policy instrument indicated for that area. If fewer than six digits are shown, then all items subsumed under the two-, three-, four- or five-digit level indicated are considered to be relevant. Descriptions of items corresponding to the code numbers are given in Appendix I. For data collection purposes, appropriate sources and measurement instruments for each item are also indicated in Appendix I and discussed in Chapter 6. Operational definition of key items are given in the next section.

5.3 Operational Definitions

As discussed in Chapter 4, all our observations and, hence, empirical knowledge of the world, or of a relevant part of it called the target world, are filtered by our concepts of that world. To provide useful information for decision making, however, vague and primitive concepts need to be carefully and explicitly defined so that statisticians, analysts and decision makers can be assured of using the same filter to view the same world. The classification scheme presented in Section 5.1 is one important step in achieving a common view and understanding. Another essential component is the operational definition of the information items so classified, i.e., for each item, the identification of exactly what is to be observed and analysed and how it is to be measured. In principle and in practice, these definitions need to be made by and for each country in light of its own situation and policy agenda. In addition, there is also a need for some international comparability and consistency for cross-country analyses and interpretations. This section makes some suggestions along these lines for key concepts and items in each of the major (two-digit) classification categories.

5.3.1 Category 01: Identification

Category 01 identifies the entities in the target world which are the subject of both data collection activities (i.e., observation) and



Adapted from Rossmiller and Johnson (1978)

Figure 5.1 - Policy areas and information relevant to improved food and nutrition

analysis. Following the recommendations of the United Nations Statistical Office (UN 1968b), three types of units are distinguished:

- (a) the statistical unit -- the entity for which items are measured, i.e., for which data are gathered;
- (b) the reporting unit -- the entity making the measurement, i.e., from which the data are gathered; and
- (c) the tabulating unit -- the entity measured.

In general, these units are different for different statistical and analytical activities, e.g., the statistical unit for the agricultural census is the agricultural holding, while for the household income-expenditure survey it is the household. Even for a particular activity, it is not always possible for all three types of units to refer to the same entity. For example, in a census of agriculture, in tabulating the age distribution of cattle for an agricultural holding which is part of an enterprise engaged in both agriculture and manufacturing, the statistical unit is the agricultural holding, the reporting unit is the enterprise, and the tabulating unit is the cattle.

0111 Holding

An agricultural holding is an economic unit of agricultural production under single management and comprising all land and livestock kept wholly or partly for agricultural production purposes, without regard to title, legal form or size. The management may be exercised by an individual, a household, jointly by two or more individuals or households, a clan or tribe, or a legal person, e.g., a corporation, collective, cooperative or government agency. The holding's land may consist of one or more parcels located in one or more areas, provided all the parcels share the same management and the same pool of factors of production, e.g., labour, farm buildings, machinery and draught animals available to and utilized by the holding as a whole.

The following points should be observed in identifying a holding:

- (a) Economic units engaged solely in hunting and trapping, forestry and logging, and fishing are not agricultural holdings, because they are not considered to be agricultural production activities.
- (b) Economic units engaged in agricultural services are considered to be establishments (see the definition of "establishment", below) rather than holdings.

- (c) Some holdings, for which land is not an essential factor of production, may have little or no significant amount of land, e.g., poultry hatcheries or certain other livestock production activities.
- (d) In some countries, there are holdings, called tree holdings, whose operators have no rights to the use of the land on which the trees are grown.
- (e) Agricultural production units under the same ownership or general direction are considered to be separate holdings if they are operated by different persons.
- (f) A given household may have more than one holding.
- (g) Holdings may be operated by part-time holders (see the definition of "part-time holder", below).
- (h) Open rangeland is not considered a holding. If, however, a specified area is delimited by fencing or other form of boundary demarcation, and if its use is supervised, such land may be considered a "communal grazing land holding" as a special category.

0112 Holder

The holder is a person who exercises management control over the operations of the agricultural holding and takes the major decisions regarding the use of available resources. He has technical and economic responsibility for the holding. He may undertake all of his responsibilities directly or delegate the day-to-day management of the work to a hired manager.

0121 Household

The concept of a household is one of the basic elements of observation and analysis in national information systems. The most recent United Nations definition of a household is (UN 1980, p. 50):

"The concept of household is based on the arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living. A household may be either (a) a one-person household, that is, a person who makes provision for his or her own food or other essentials for living without combining with any other person to form part of a multiperson household, or (b) a multiperson household, that is, a group of two or more persons living

together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and have a common budget to a greater or lesser extent; they may be related or unrelated persons or a combination of both. Households usually occupy the whole, part of, or more than one housing unit but they may also be found living in camps, boarding houses or hotels or as administrative personnel in institutions, or they may be homeless. Households consisting of extended families that make common provision for food or of potentially separate households with a common head, resulting from polygamous unions, or households with vacation or other second homes may occupy more than one housing unit. Homeless households are defined as those households without a shelter that would fall within the scope of living quarters."

Explaining various types of households, particularly the extended household, is needed because of the possibility of having more than one holding in one household. The United Nations has recommended a classification of households based on the "family nucleus" concept. The family refers to "those members of the household who are related, to a specified degree, through blood, adoption or marriage" (UN 1980, p. 72). A household may be comprised of more than one family, where a family nucleus consists of one of the following types, each of which must consist of persons living in the same household:

- (a) a married couple without children;
- (b) a married couple with one or more never-married children;
- (c) a father with one or more never-married children; or
- (d) a mother with one or more never-married children.

The following types of household are identified (UN 1980, pp. 73-74):

- (a) one-person household;
- (b) nuclear household, consisting entirely of a single family nucleus;
- (c) extended household, defined as consisting of either:
 - (i) a single family nucleus, and other persons related to the nucleus;
 - (ii) two or more family nuclei related to each other, without any other persons;
 - (iii) two or more family nuclei related to each other, plus other persons related to at least one of the nuclei; or
 - (iv) two or more persons related to each other but none of whom comprises a family nucleus;

(d) composite household, defined as a household consisting of either:

- (i) a single family nucleus plus other persons, some of whom are related to the nucleus and some of whom are not;
- (ii) a single family nucleus plus other persons, none of whom is related to the nucleus;
- (iii) two or more family nuclei related to each other plus other persons, some of whom are related to at least one of the nuclei;
- (iv) two or more family nuclei related to each other plus other persons, none of whom is related to any of the nuclei;
- (v) two or more family nuclei not related to each other, with or without any other persons;
- (vi) two or more persons related to each other but none of whom comprises a family nucleus, plus other unrelated persons;
or
- (vii) unrelated persons only.

It should be noted that in rural areas, particularly in developing countries, a one-to-one correspondence between a household and a holding is quite common. In fact, households whose members operate separate holdings, and holdings operated by two or more persons belonging to different households, while they exist, are few in number. Thus, households may serve as efficient vehicles to identify holdings. The important point to keep in mind in considering the relationship between a household and a holding is that a household is a complex socio-economic unit, whereas a holding is solely an economic unit. Thus, when studying an agricultural holding whose holder is the head of a rural household, the holding should be considered as the economic unit engaged in agricultural production; the members of the household who participate in the work of the holding as members of the labour force used by the holding; and other members of the household as not directly related to the holding. When studying the household, however, the scope of the investigation may extend beyond the economic activities covered in the study of the holding.

0122 Head of household

The head of the household is defined as that person in the household who is acknowledged as such by the other members. The head has the primary authority and responsibility for household affairs. However, in cases where such authority and responsibility are not vested in one person, special rules may be needed to identify the head of household (UN 1980, p.70).

0113 and 0123 Respondent

The respondent is the person from whom the information about the statistical unit is collected.

013 Establishment

The establishment is the main statistical unit of industrial censuses and surveys. According to the United Nations definition (UN 1968a, p. 12), the basic features of an establishment are:

- (a) it is under single control;
- (b) it is engaged in one, or predominantly one, kind of economic activity; and
- (c) it operates at a single location.

In practice, it is not always possible to meet all three of these criteria. Therefore, for operational purposes, some flexibility is introduced (UN 1968b, p. 13), particularly with respect to the third criterion, by defining the establishment as the combination of activities and resources directed by a single owning or controlling entity toward the production of most homogeneous group of goods and services, usually at one location, but sometimes over a wider area, for which separate records are available that can provide data concerning the production of these goods and services and the materials, labour and physical resources, both direct and indirect, used in that production. Below are some examples of flexibilities introduced by this definition, which emphasizes the need for an establishment's keeping of separate records.

- (a) An establishment may have units at more than one location. The ancillary units of an establishment, if they serve only that establishment, e.g., warehouses, garages, repair shops, and research laboratories, may be considered integral parts of the main establishment even if they are located in different areas.
- (b) For mining, the establishment includes all wells or pits and ore processing plants located in a single mining field. Individual wells or pits are not treated as separate establishments as long as they are in the same mining field.
- (c) For electricity and gas, the establishment includes both the main producing plant and its distribution system, which may extend over many areas.

The economic units engaged in agricultural services conform to this definition of an establishment. Although an agricultural holding is not considered to be an establishment, it does share some common features:

- (a) both refer to a unit of production;
- (b) both require a single management; and
- (c) both encompass predominantly one kind of economic activity.

Indeed, at the present disaggregation level of the ISIC, all plant and livestock production is considered a single economic activity group (code 1110).

Geographic characteristics differentiate holdings and establishments. An establishment operates essentially at a single location. It may have ancillary units at locations other than its main site, but it cannot carry out its economic activity at more than one location. If it does, it is called a "kind-of-activity unit" rather than an establishment. It is necessary to have a single location for the statistical unit in industrial statistics in order to derive and publish the results by geographically identifiable regions.

Although agricultural statistics have a similar need, it is not possible to restrict a holding to a single location, since land, which may exist in widely separated parcels, constitutes an essential factor of production for the holding. However, the present definition of a holding does provide a framework for tabulating regional information. In particular, information on a parcel in one territorial or administrative division may yet be included in a holding located in another division as long as it is under the management of that holding and the means of production used on that parcel, e.g., labour force, machinery and animals, are the same as those used on other parcels.

014 Locality

The United Nations defines a locality as "a distinct population cluster (also designated as inhabited place, populated centre, settlement, etc.) in which the inhabitants live in neighbouring living quarters and which has a name or locally recognized status" (UN 1980, p. 68). This definition embraces population clusters of all sizes, including fishing hamlets, mining camps, farms, ranches, market centres, villages, towns and cities. For locality statistics in agriculture, it may be more practical to exclude localities larger than rural towns.

015 Other units

It may be necessary to identify still other units for purposes of special rural and agricultural inquiries. Such units may include, for example, well defined areas for an agricultural production survey

based on an area frame, schools for a food consumption survey of school children, and hospitals and clinics for a study of the availability and quality of rural health care.

5.3.2 Category 02: General Characteristics

This category describes the legal status and other organizational characteristics of agricultural holdings, their holders, enterprises, agricultural service establishments and cooperatives.

0211 Legal status of holder

Two broad categories of legal status of holders are identified: private and government. While government holdings are operated by a central or local government, directly or through a special body, there are several types of private holders.

In most cases, the private holder is an individual. There may be more than one holder in a given household, each operating a separate holding. If, however, the agricultural operations carried out and commodities produced by different members of the same household are sufficiently pooled, then it may be more practical to treat them as only one holding, as may be the case under the conditions of traditional agriculture prevailing in some parts of the world. In extended households and composite households, on the other hand, it may be more convenient to distinguish the existence of several holders and holdings. In cases where two or more members of the same household operate jointly the same holding, the holder is considered to be the household. Finally, when two or more individuals of different households share jointly the operation of a holding, each of them should be identified as a joint holder.

Because of the seasonality of agriculture, many countries are seeing increasing numbers of holders engaged in other economic activities in addition to agriculture. A full-time holder may have secondary, temporary occupations, e.g., in transport or trade or as an occasional worker during the slack season.

Legal persons, such as corporations and cooperatives may also be private holders of agricultural holdings. In most countries, joint stock companies are a typical example of corporations, while cooperatives include several kinds of organizations characterized by various combinations of individual and joint ownership or leasehold.

Finally, there may be private holders who do not fall into any of the categories described above (and listed in classification items 021101 and 022001 in Appendix I), e.g., tribes, clans or private schools.

0212 Hired manager

A hired manager is a civil or legal person who takes the technical and administrative responsibility of managing a holding on behalf of a holder. His or her responsibilities are limited to making day-to-day decisions in operating the holding, including the management and supervision of hired labour. If, however, the hired manager has or shares economic and financial responsibilities and rewards in addition to managing the holding, he or she should be considered a holder or a joint holder.

0213 Economic activities of an enterprise

An enterprise is a legal entity or family of legal entities which may own or control a number of establishments, where by definition (see discussion above for item 013 in Section 5.3.1) an establishment is engaged in predominantly one kind of economic activity. In many countries, there are enterprises engaged in agriculture together with other economic activities, as identified in this classification section.

5.3.3 Category 03: Demographic and Anthropometric Characteristics

Demographic and anthropometric characteristics of household members constitute an essential component of many studies, particularly those concerning employment, food consumption and nutrition.

031204 Educational attainment

"Educational attainment refers primarily to the highest grade completed within the most advanced level attended in the educational system of the country where the education was received, but it should also take into account any adult education measurable in levels and grades, or their equivalent, even if it was provided outside of the regular school and university system" (UN 1980, p. 86). In rural areas information on literacy is of particular importance for developing countries. "Literacy is the ability both to read and to write. . . . The language or languages in which a person can read and write is not a factor in determining literacy" (UN 1980, p. 88).

5.3.4 Category 04: Employment

This category covers (a) employment of household members and hired labour on holdings and in agricultural service establishments and (b) other employment of the members of a holder's household. It is important to note that information items pertinent to particular data collection and analytical activities should be made consistent with the statistical unit chosen. For example, employment may be an appropriate focus of a survey where the holding is the statistical unit, but in a labour force survey the interest would focus on individuals.

0411 Labour force participation

Economically active persons are those who furnish labour for the production of economic goods and services during the reference period. For persons to be included in the economically active population, a minimum age, e.g., 15 years, should be determined by each country, taking its own conditions into account. Since children usually participate in agricultural work in most developing countries, a lower minimum age will frequently be desirable. To facilitate international comparisons, however, tabulations should distinguish between persons under 15 years of age and those aged 15 years or more. A separate tabulation for persons under 10 years of age is also recommended if the country's minimum age is less than that. No upper age limit is recommended for persons to be considered economically active.

Non-economically active persons fall into the following categories:

- (a) Homemakers -- persons of either sex who are engaged in household duties in their own homes, e.g., housewives and other relatives responsible for the care of the home and children.
- (b) Students -- persons of either sex who attend any regular educational institution, public or private, for systematic instruction at any level of education.
- (c) Income recipients -- persons of either sex who receive income solely from property or other investments, royalties, or pensions from former economic activities.
- (d) Others -- persons of either sex who are receiving public aid or private support and are not otherwise employed or seeking employment, and all other persons not falling into any of the above categories, e.g., children not attending school and disabled and retired members of the household.

In determining a household member's participation in the labour force, economic activity has precedence over non-economic activity, e.g., employed and unemployed persons should be considered economically active even though they may also be students or homemakers.

The economically active population includes the civilian labour force and the armed forces. The civilian labour force is further divided into employed and unemployed persons.

As defined by the International Labour Office (ILO 1959, pp. 44-45), the employed include all persons who worked during some reference period or who had a job in which they had been working but from which they were temporarily absent, e.g., because of illness, injury, labour dispute, vacation, or bad weather. The unemployed consist of all persons who were not working during the reference period but who were seeking work for pay or profit, including those who had never worked before. Also included are persons who were not seeking work during the reference period because of temporary illness, because they were awaiting the start of a new job subsequent to the reference period, because they were on temporary or indefinite lay-off without pay, or, in areas of limited employment opportunities, because they believed no jobs to be available. For members of an agricultural holder's household, the criterion of pay or profit does not apply, since such people may not be paid.

0412 Occupation

The occupation of an economically active person, whether employed or unemployed, refers to the kind of work done during the reference period. For persons with more than one occupation, the main occupation is the one representing the largest proportion of working time during the reference period. Occupations are classified by the International Labour Office (ILO 1969) into the following "major groups":

- 0,1 Professional, technical and related workers
- 2 Administrative and managerial workers
- 3 Clerical and related workers
- 4 Sales workers
- 5 Service workers
- 6 Agricultural, animal husbandry and forestry workers, fishermen, and hunters
- 7, 8, 9 Production and related workers, transport equipment operators, and labourers
- X Workers not classifiable by occupation

These major groups are further divided and subdivided successively into "minor groups", "unit groups", and "occupational categories". Most rural people have occupations in major group 6, which has five minor groups:

- (a) Farm managers and supervisors
- (b) Farmers
- (c) Agricultural and animal husbandry workers
- (d) Forestry workers
- (e) Fishermen, hunters and related workers

The minor group farmers is defined as "workers conducting mixed farms to produce a variety of agricultural and animal husbandry products, or specialized farms to produce a particular type of agricultural or animal husbandry product, on their own behalf or in partnership" (ILO 1969, p. 138). The word "worker" in this definition is understood to refer to real persons in general, to the exclusion of legal persons. For our purposes, it is useful to restrict the use of the term "worker" to the sense of "agricultural worker", as described below, leaving "farmer" to refer to agricultural holders who are real persons.

The main occupation of a hired manager who is not the holder or a joint holder of the holding he or she manages or of any other holding is within the minor group farm managers and supervisors.

The minor group agricultural and animal husbandry workers includes all workers, who are not holders or managers but including members of holders' households, performing a variety of tasks in growing crops, breeding and raising livestock, maintaining farm structures and equipment, and assisting generally on farms by carrying out simple farming tasks (ILO 1969, p. 144). The term "agricultural workers" is preferred here to "agricultural and animal husbandry workers" in keeping with the definition of agriculture given in Chapter 2, which covers both crop and livestock production.

Two classes of agricultural worker are identified: permanent and occasional. A permanent agricultural worker is one whose services are utilized on a regular and continuing basis during the agricultural year, although he or she may engage in other work during a slack season. The total number of days worked (normally six months or more) has been used in some countries to distinguish between permanent and occasional workers. However, a permanent worker may actually work less than six months, especially in countries which have only one crop season. Therefore, countries need to determine the minimum number of working days or months which is to distinguish between permanent and

occasional workers in accordance with their own agricultural and other relevant conditions. Generally, an occasional worker is not expected to work on a regular, continuing basis, even though he or she may be hired on several occasions during the agricultural year.

0413 Employment status

Persons engaged in the occupations described above are further classified by their employment status in those occupations, e.g., an agricultural worker may be an employee or an unpaid family worker. The United Nations recommends the following classes of employment status (UN 1980, pp. 96-97):

- (a) Employer
- (b) Own-account worker
- (c) Employee
- (d) Unpaid family worker
- (e) Member of a producer cooperative or a collective
- (f) Persons not classifiable by status

An employer is a person, including an individual or joint agricultural holder, who operates his or her own economic enterprise, engages independently in a profession or trade, and hires one or more employees on a permanent or occasional basis. An own account worker, on the other hand, operates his or her own economic enterprise, or engages independently in a profession or trade, but hires no employees. An employee is an individual who works for an employer, on a permanent or occasional basis, and receives remuneration in wages, salary, commission, tips, piece rates, or payment in kind. For example, a hired manager whose main occupation is classified in the minor group of "farm managers and supervisors" has the employment status of "employee". Finally, an unpaid family worker works a specified minimum amount of time (e.g., at least one-third of normal working hours), without pay, on the holding or other enterprise operated by another member of his or her household. Although unpaid family workers receive room and board, these benefits should not be considered pay, since they are not dependent on the work performed.

0441 Wages paid

Wages paid include payments in both cash and kind. Wages in kind should include the cost of goods and services furnished to employees free of charge or at substantially reduced prices, such as clothing, food, beverages and dwellings.

5.3.5 Category 05: Land and Water

Information on agricultural land and water resources is classified in two divisions: 051 relating to holdings, and 052 relating to parcels.

051101 and 052 Parcels

A parcel of a holding is any piece of land entirely surrounded by land, water, road, forest or other boundary which is not part of the holding. It may consist of one or more cadastral units, plots or fields adjacent to each other. By definition, any two parcels of the same holding are non-contiguous. The term parcel as used here should not be confused with the same term in cadastral work.

051102 and 052101 Total area

The total area of a holding is the combined area of all its parcels, including the farmyard and land occupied by farm buildings, but excluding land rented to others by the holder and the holder's share of communal grazing land. The land area of the holder's residence is also counted in the total area of the holding if it is not located off the holding, e.g., in a residential area of a nearby village or town, and if it is not used solely for residential purposes. The total area of a holding practising shifting cultivation should include the area under crops during the reference period and the area prepared for cultivation but not sown or planted at the time of enumeration; it should exclude land abandoned prior to the reference period. For consistency, the total area of the holding should also equal the total area of its land in various use classes (described below for section 0524).

0513 Land purchased or sold

The total amount paid for land purchased and the total amount received for land sold include any transfer costs incurred, e.g., for legal fees, title searches, and brokers' commissions. Any such transfer costs should also be reported separately for national accounts purposes.

0514 and 0526 Shifting cultivation

Under shifting cultivation practices, a piece of land is first cleared with simple tools, with useful trees left standing and other trees and shrubs pruned down to stumps and debris burned. Land thus

cleared is cultivated for a number of years, using no fertilizers, until yields fall rapidly and weeds grow rampant, at which time the farmer abandons the land and allows it to restore itself through the natural growth of vegetation, which may take several years, before clearing and cultivating it again.

051813 Area actually irrigated

This item refers to the gross area of land purposely and actually provided with water, other than by rain, for improving the production of crops or pastures. The uncontrolled flooding of land by the overflow of rivers or streams should not be considered irrigation. However, rain water or water from uncontrolled overflow of rivers and streams may be collected and later used for irrigation. Land irrigated more than once during the agricultural year should be counted only once for this item, so that the total of irrigated and non-irrigated areas equals the total area in all land uses.

05152, 05162, 05172, 05183 and 05192 Costs incurred

Costs incurred for soil conditioners, cropland additions, pasture establishment, and irrigation and drainage facilities are classified as own account or contracted items. Own-account costs are for materials and hired labour used by the holding itself for these purposes, where the value of labour for unpaid family workers is imputed. Such own-account activities are considered to be ancillary activities of holdings and thus constitute part of agricultural production. The same activities, if contracted out to others, such as construction firm, are then not considered production of the agricultural sector but rather of construction.

0522 Area by tenure

Land tenure refers to the arrangements or rights under which the holder holds or uses the land of the holding. A holding may be operated under one or more forms of tenure, as described in the following subsections.

05221 Owned or held in ownerlike possession

Area owned is the area of a holding for which the holder possesses title of ownership and, consequently, the right to determine the nature and extent of its use. It does not include area owned but rented to others. Areas held in ownerlike possession include land for which the holder does not have title of ownership but which may be

operated as if he or she did, excluding land so held but rented to others. Some common types of ownerlike possession are:

- (a) land operated under perpetual and long-term lease and hereditary tenure;
- (b) land peacefully and uninterruptedly operated by the holder without legal title of ownership or long-term lease, for a long period of time, and without payment of rent; and
- (c) land granted to the holder, rent free, from tribal or other communal land, to be retained by the holder as long as it is kept under cultivation by his or her own labour and that of household members, but which cannot be sold or mortgaged.

05222 Rented from others

Rental or lease arrangements may take different forms. Some common examples include:

- (a) Land rented to the holder, for a pre-agreed amount of money and/or produce. In general, the administration, management and operation of the land are the responsibility of the holder.
- (b) Land rented for a pre-agreed proportional share of the produce or, in exceptional cases, the cash equivalent. The responsibility for management of the holding may be exclusively the holder's or may be shared to a limited degree with the landlord if the latter contributes tools, fertilizers, or other inputs. The economic risks, however, as far as income is concerned, are always shared by the holder and the landlord.
- (c) Land rented in exchange for services, in which the usufruct is granted to the holder instead of wages, e.g., in return for a certain number of days of work as an agricultural labourer on the landlord's holding or for other services rendered to the landlord (e.g., a religious organization or government).

05223 Operated on a squatter basis

Land occupied and used by squatters may be public or private property and is land for which the holder lacks title of ownership and for which rent is not paid but which the holder operates to his or her benefit without the consent of the owner.

05224 Operated under tribal or traditional communal forms of tenure

Individuals have certain rights in the joint exploitation of land held on a tribal, village, kindred, or family basis, by virtue of their membership in the social unit. Title to the land, often vested

in the chief of the tribe, is communal in character but is only usufructuary, not absolute.

05225 Operated under other forms of tenure

Examples of other forms of tenure which may exist in some countries include (a) land operated by a trustee, (b) communal land received by members of a collective for their individual use, and (c) land under inheritance proceedings.

0524 Land use

The total area of a holding consists of land in the following classification:

- (1) Agricultural land
 - a) Cropland
 - i) Arable land
 - ii) Land under protective cover
 - iii) Land under permanent crops - in open air
 - b) Land under permanent meadows and pastures
 - i) Cultivated
 - ii) Naturally grown
- (2) Woodland or forest
- (3) All other land
 - a) Unused and undeveloped potentially productive land
 - b) Land in the holding not elsewhere specified

Land in each land use class should be measured in terms of gross area, where gross area includes, and net area excludes, uncultivated patches, bunds, footpaths, ditches, headlands, shoulders and shelterbelts.

Some countries utilize the concept of "cultivated land", which is the total cropland and the cultivated part of land in permanent meadows and pastures. For the international comparability of statistics, such countries should clarify their definition of this concept.

05241 Arable land

Arable land is defined here to include the area in the classes described in the following items: (a) land under temporary crops in the open air, (b) land under temporary meadows, (c) land temporarily

fallow, and (d) all other arable land. In some countries, however, the term "arable land" may also include land in permanent crops or be used in some other sense. Therefore, each country should clarify its own definition of arable land so that international comparisons based on the definition given here can be made.

052411 and 052421 Land under temporary crops - in open air

Temporary crops are those with a growing cycle of under one year, which need to be newly sown or planted for further production after the harvest. Crops remaining in the field for more than one year but destroyed when harvested (e.g., cassava and yams) and crops grown in rotation and destroyed when the land is ploughed (e.g., alfalfa and clover) should also be considered temporary crops. Some crops (e.g., asparagus, strawberries, pineapples, bananas and sugar cane) may be classified as either temporary or permanent, depending on how they are grown in a particular area.

052412 Land under temporary meadows

To distinguish temporary and permanent meadows and pastures, it is suggested that a period of less than five years be considered temporary. Some countries may use different criteria and a few do not make the distinction, so countries should clarify their own definitions in their censuses and surveys.

052413 Land temporarily fallow

A maximum period of idleness, probably less than five years, should be specified. Otherwise, if land remains fallow too long, it might acquire characteristics which would place it in another category, such as permanent meadows and pastures (if it could be used for grazing), or wood or forestland (if it has become overgrown with trees that could be used as timber or firewood), or wasteland. On the other hand, land should not be considered temporarily fallow unless it has been, or is intended to be, kept at rest for at least one agricultural year.

052414 All other arable land

This category includes, for example, arable land temporarily damaged by floods, land prepared for cultivation but not sown because of unforeseen circumstances, and abandoned land.

052422 and 05243 Land under permanent crops - in open air

Permanent crops are those which occupy the land for a long period of time and do not have to be planted for several years after each harvest. Included is land in trees, flower-producing shrubs, and nurseries; excluded are permanent meadows and pastures.

05244 Land under permanent meadows and pastures

Land used for five or more years for growing herbaceous forage crops, either through cultivation or naturally (wild prairie or grazing land), is considered to be permanent meadows and pastures.

05245 Woodland and forest

Included in this subsection are all tracts of timber, natural or planted, which have or will have value as wood, timber, or other forest products or for protection, e.g., scattered trees, trees in rows, belts and small clumps, nurseries of forest trees, and bamboo and other woody vegetation. Excluded are woodlands or forests used for recreational purposes only, which should be counted under "land in the holding not elsewhere specified".

052461 Unused and undeveloped potentially productive land

This item includes uncultivated land which is either producing some kind of utilizable vegetable product -- e.g., reeds and rushes for matting and livestock bedding, and wild berries and fruits -- or could be brought into crop production at relatively little additional expenditure.

052462 Land in the holding not elsewhere specified

Included, for example, is land occupied by buildings, parks and ornamental gardens, roads and lanes, wasteland, and land under water.

5.3.6 Category 06: Crops

This category covers the basic features of crop cultivation, including items on inputs used and outputs obtained. The information is classified in two divisions, one pertaining to the holding as a whole and the other to each parcel.

New orchards, rubber plantations, vineyards and other fruit-bearing and sap-bearing plants take more than a year after planting to become productive. The United Nations, in its System of National Accounts, considers expenditures on clearing, planting and tending permanent crops in their non-productive stage to be fixed capital formation (UN 1968a, p. 113). Therefore, such input costs are classified in a separate section (0626) in order to distinguish between fixed capital formation and intermediate consumption. The following is a suggested classification scheme, based on end use, for temporary and permanent crops. Since most crops may undergo different degrees of processing depending on their end use, countries may modify the classification of crops in accordance with their own national situation.

A. Temporary crops

1. Cereals harvested for grain
2. Tuber, root and bulb crops
3. Leguminous plant mainly for grain (excluding soybeans and groundnuts)
4. Crops mainly for food processing and industrial purposes (sugars, oilseeds, fibres, and spices and condiments)
5. Vegetables
6. Special horticultural cultivation (flowers ornamentals, mushrooms and greenhouse vegetables)
7. Fodder crops (for grazing or cut for hay, green feed or silage)
8. Seed crops
9. Other temporary crops not elsewhere specified

B. Permanent crops

1. Fruits and nuts
2. Permanent industrial crops (e.g., beverages, oils, spices, rubber and fibres)
3. Nurseries
4. Other permanent crops not elsewhere specified

0613 Fertilizers

In general, fertilizers refer to anything added to the soil to increase the amount of plant nutrients available for crop growth and are here classified into inorganic fertilizers, organic manures, and other fertilizers. The four types of inorganic fertilizers are: nitrogenous; phosphates; potash; and mixed, compound and complex fertilizers. There are also four types of organic manures: (a) farmyard manure, which refers to faeces and urine of farm animals mixed with litter (mainly straw); (b) compost, which is derived from decomposed plant remains, usually with lime, nitrogen and water added; (c) green manure, which provides humus to the soil when crops specifically grown for the purpose (e.g., Italian rye grass and

mustard) are ploughed under; and (d) kelp, which is seaweed applied as a source of potash. Finally, other fertilizers include, for example, guano, fish manure, fish guano, bone meal and wood ashes.

0614 Pesticides

Materials useful for the mitigation, control or elimination of pests which are troublesome or harmful to crops or livestock include insecticides, fungicides, fumigants, herbicides and rodenticides.

0618 Crop insurance

Included are insurance schemes against such natural calamities as hail, snow or rain storms, floods and droughts.

0621 Crop stand

A pure stand is a single crop, temporary or permanent, cultivated alone in a field. Different crops may also be cultivated simultaneously on the same piece of land so that it is difficult to measure how much area is allocated to each crop. There are two types of such cropping combinations: mixed and associated crops.

Mixed crops are two or more different temporary or permanent crops (but not both temporary and permanent crops) grown simultaneously on the same field or plot. The number, kinds and proportions of crops in the mixture will generally vary according to prevailing practices, meteorological conditions and other factors. In some countries, certain temporary crops, particularly grains, are grown and harvested as mixtures. It is recommended that such mixtures be treated as a single crop, without attempting to estimate the area under each crop, although the names of the constituent crops should be indicated. For other types of crop mixtures, however, it may be practicable and desirable to estimate the area covered by each crop. Methods for making such estimates commonly range from the informal -- e.g., relative quantities of seed used, densities in the mixture compared to common densities in pure stands, and eye estimates -- to statistical sampling procedures.

Interplanted crops, a special type of mixture, occur in the situation where one crop is planted between rows of another crop, e.g., sorghum and groundnuts between rows of cotton, or groundnuts between rows of maize or sorghum. It is generally desirable to assign areas to each of the interplanted crops in proportion to the areas occupied by each crop, even when favourable interactions may result in

higher yields than in pure stands, so that the total of individual crop areas equals the total mixed area.

When both temporary and permanent crops are grown simultaneously in the same field, each of the crops is referred to as an associated crop. In assigning areas to the associated crops, net harvested areas should be used for temporary crops and gross areas for permanent crops. If the permanent crop is in a compact plantation, the whole gross area should be assigned to it for purposes of estimating land use in category 05; however, it is still important to estimate the net area equivalents under the associated temporary crops for purposes of calculating total area harvested for those crops.

062202 Cropping intensity

Intensity refers to the frequency with which a given piece of land is cultivated. In countries with more than one cropping season, successive cropping is of great importance where the same or different crops are grown and harvested on the same land several times during the agricultural year. The field, or parts of it, may also be left fallow during one or more of the cropping seasons. The area of successive crops is to be counted for each crop separately each time the area is sown or planted during the year. Thus, since such areas are counted more than once a year, the total harvested or sown areas for the year may be larger than the total physical areas of the holding.

06231 Area sown or planted, and harvested

The area sown for a temporary crop includes the areas (preferably net areas) for growing that crop as many times as they are used during the agricultural year. The area planted for permanent crops is the gross area of the stand regardless of how many times produce is harvested from the stand.

The area harvested for a particular crop is the total area from which the crop is gathered. In the case of successive cropping, a piece of land is counted as many times as the crop is harvested from it. As for area sown or planted, net areas should be used, if possible, for temporary crops and gross areas for permanent crops. For crops producing more than one product, such as cotton fibre and cottonseed, duplication should be avoided by assigning the harvested area to the principal product.

06251 Permanent crops plantation characteristics

Most tree crops and some other permanent crops must reach a certain age before they become productive. Crops at that stage should be counted as " of productive age" even if they have not yet yielded a harvest because of poor weather or other abnormal conditions. Old trees or other trees of productive age but no longer producing, if they can be identified, should not be counted.

Compact plantations are plants, trees or shrubs planted in a regular or systematic manner. Irregularly planted land may be considered compact if it is planted densely enough to permit the collection of data regarding the area planted; otherwise, the plantation is said to be scattered. Areas under scattered trees may be estimated by assigning a standard area to each tree and multiplying by the number of trees.

5.3.7 Category 07-08: Livestock

This category consists of a division containing information on livestock production management systems and population numbers and separate divisions for each of nine classes of animal. The animal divisions contain sections on demographic characteristics of the herds, the use of inputs, and outputs produced. The category also contains information on the manufacturing of milk products, which is considered an ancillary activity of agricultural holdings, and on the slaughtering of animals at slaughterhouses, which is a non-agricultural economic activity.

0711 Livestock production system

Four production systems are identified:

- (a) Nomadic or totally pastoral -- where livestock is kept by households that neither have a permanent place of residence nor practise regular cultivation.
- (b) Semi-nomadic or semi-pastoral -- where livestock is kept by households that establish a permanent place of residence. Crops are cultivated as a supplementary food source, but the herds are moved on transhumance to assure sufficient forage and water.
- (c) Sedentary pastoral -- where livestock raising and the cultivation of crops are carried out by households that have a permanent residence.
- (d) Ranching -- where livestock are kept on ranches.

0721, 0731, 0741, 0751 and 0761 Herd structure and management

For each major livestock type, a herd model, in the form of a table, shows the population structure of the herd at the beginning of the year (by age, sex, breed and purpose), and management practices during the year in terms of births, deaths, purchases and sales. The herd model is especially useful in computing the number of animals fed and cared for during the year.

5.3.8 Category 09: Machinery and Equipment

Information on machinery and equipment used wholly or partly for agricultural production is classified in two divisions, the first referring to holdings and the second to both holdings and agricultural service establishments. Machinery and equipment used on holdings will generally be among the following types:

- 1 Stationary power-producing machinery
 - 11 Prime movers
 - 12 Electric generators and motors
- 2 Agricultural machinery
 - 21 Tractors
 - 22 Tillage, planting and cultivating equipment
 - 23 Harvesting and threshing equipment
 - 24 Livestock and food and feed processing equipment
 - 25 Other agricultural machinery and equipment
- 3 Transport equipment
 - 31 Trucks
 - 32 Cars, jeeps and station wagons
 - 33 Carts and wagons (animal drawn)
 - 34 Wheelbarrows
 - 35 Others
- 4 Office machinery and equipment
 - 41 Fixed capital
 - 42 Others

092121 Horsepower

It is recommended that the nameplate horsepower (hp) rating be used as the capacity measure for power equipment, even though this rating may not represent the actual effective power output for older equipment. The kilowatt (kw) is another power measure frequently used, with the relationship of 1 hp = .7457 kw.

09213 and 09214 Purchases and sales

For national accounts purposes, it is necessary to distinguish between purchases of new and used machinery and equipment. For new purchases, the total cost is the amount paid to the seller, while for used purchases it is that plus such transfer costs as brokers' commissions, legal fees and title searches. The total amount received for the sale of machinery and equipment may also include transfer costs.

092151 and 092152 Repairs

Expenditures on repairs are divided into current and capital repairs. Current repairs are made on machinery and equipment to keep them in proper working order. Capital repairs, on the other hand, lengthen the expected normal lifetime of machinery and equipment or significantly increase their productivity, e.g., major alterations and additions or replacements, and are considered fixed capital formation in the national accounts. For example, the replacement of the tyres on a truck is a current repair, while the replacement of the engine in the truck is a capital repair (UN 1968a, p. 113).

09216 Own-account production

For the national accounts, the value of machinery and equipment with an expected useful life of one year or more and manufactured by the holding for its own use is considered part of fixed capital formation (UN 1968a, p. 96).

5.3.9 Category 10: Buildings and Other Structures

The three divisions of this category describe living quarters, agricultural buildings and other structures, respectively, mostly in keeping with United Nations recommendations for housing censuses (UN 1980).

The United Nations defines a building as:

"any independent free-standing structure comprising one or more rooms or other spaces, covered by a roof and usually enclosed within external walls or dividing walls which extend from the foundations to the roof. However, in tropical areas, a building may consist of a roof with supports only, that is, without constructed walls; in some cases, a roofless structure consisting of a space enclosed by walls may be considered a building." (UN 1980, p. 232)

101 Living quarters

Living quarters are defined as "structurally separate and independent places of abode" (UN 1980, p. 236) and may be inhabited by only one household or, as in the case of collective living quarters, house large groups of individuals or several households.

10111 Structural type

Several structural types of living quarter are identified (UN 1980, pp. 238-241):

- (a) Conventional dwelling -- a room or suite of rooms in a permanent building (expected life of 10 or more years) or structurally separated part thereof, which is intended for habitation by one household, e.g., houses, flats, suites of rooms, and apartments.
- (b) Semi-permanent dwelling -- typical and traditional in many tropical rural areas; constructed with locally available crude materials, e.g., bamboo, palm or straw, and often with mud walls and/or thatched roofs; and expected to last for only a limited time (from a few months to 10 years).
- (c) Mobile housing unit -- any type of housing unit made to be transported (e.g., a tent) or mobile (e.g., a boat, barge, railroad car or trailer).
- (d) Marginal housing unit -- makeshift shelters constructed of waste materials or otherwise generally considered unfit or unintended for human habitation, e.g., squatters' huts, stables, warehouses and caves.

102 Non-residential buildings

This division includes information on buildings and structures entirely or primarily intended for agricultural purposes, e.g., warehouses, stables and office buildings. Information on irrigation and drainage facilities is classified in category 05, Land and Water.

1023 Purchases and sales

For the purchase or sale of buildings, the total cost includes the amount paid to the seller and any transfer costs. Transfer costs need to be considered separately for national accounts purposes.

1024 Construction costs

Expenditures for constructing new non-residential buildings and other structures and for major alterations in existing ones --

including the installation, alteration and improvement of fixtures, facilities and equipment which are integral and fixed parts of structures -- constitute part of agricultural fixed capital formation. The cost of materials and labour, including the imputed value of the labour of unpaid household members, used in construction activities carried out by a holding itself are considered own-account costs and hence part of the agricultural production activity. Construction contracted to others, on the other hand, constitutes production of the construction industry of the non-agricultural sector of the economy.

103 Other structures

Other structures include, for example, roads, bridges and railroad sidings.

5.3.10 Category 11: Ancillary Activities

As defined in Chapter 2, agriculture includes certain non-agricultural ancillary activities, most of which are classified in appropriate subject-matter categories, as follows:

- (a) Land and water improvements -- category 05
- (b) Provision of veterinary services and processing of livestock products -- category 07-08
- (c) Machinery and equipment manufacture - category 09
- (d) Construction of non-residential buildings and other structures -- category 10
- (e) Transport to the first point of sale or storage -- category 12

The remaining ancillary activities, forestry and fisheries, are covered in category 11.

1112 Number of forest trees

Forest trees are grown for wood, fuel, forage, and protection (e.g., shelter, shade or soil conservation) purposes; excluded are trees grown for crop production (covered in category 06) and included are bamboo and other woody vegetation.

113 Area under forest trees

Compact areas are those planted in a regular or systematic manner, or, if irregular, dense enough to permit estimation of the area covered. Nurseries cover land where young forest trees are cultivated for sale or transplanting.

1122 Cultural installation for fisheries

Holdings having more than one type of water environment used for fishery activities, should be classified by the most important installation.

1124 Fisheries production

Landings refer to the weight of fish as taken from the water before gutting or other treatment. Other aquatic products may include frogs, crabs and their products.

5.3.11 Category 12: Credit, Marketing, Stocks

The three divisions of category 12 cover credit, marketing and stocks, respectively, with marketing and stocks including separate sections for inputs and products.

121 Credit

Credit refers to the borrowing and repayment of financial resources, in cash or in kind, in order to facilitate the production, storage, processing and marketing of agricultural products.

121211 Sources of credit

Credit sources vary from country to country, depending on local conditions and institutions. Commonly observed sources of credit are money lenders, cooperatives and banks. Other possible sources include merchants selling goods on credit, insurance companies, and relatives and friends.

121212 Terms of credit

Short-term credit, which is to be paid back within a year, is generally used to pay for fertilizers, seeds, labour and other inputs for ongoing production activities; medium-term credit, with a period of one to five years, is mainly for purchasing livestock and important machinery items; and long-term credit, advanced for over five years, serves for the purchase of land and the construction of buildings and irrigation facilities.

12122 Amount of credit

The amount of credit includes the principal of the loan, i.e., the money actually taken by the borrower, or the cash equivalent if credit in kind. The amount to be repaid will thus exceed the principal amount by the amounts of service and interest charges. Data is needed on these items separately for national accounts purposes.

5.3.12 Category 13: Prices

Information on prices is contained in three divisions. The first division (131) includes prices for agricultural products and inputs, for which further information can be found in FAO (1980a). Divisions 132 and 133, then, cover retail prices for household goods and services and world prices for agricultural products and inputs, respectively. Disaggregations of these two divisions are not given here, because the items tend to be numerous and very detailed, and, in any case, these areas are generally readily available from components of the national information system other than food and agriculture. Category 15, sections 1561-1567, illustrates a possible commodity breakdown for retail prices, and Appendix II suggests one possible classification of consumer food items.

1311-1314 Agricultural product prices

Farm-gate prices are prices actually, or conceptually, received by farmers for products leaving the farm, thus excluding transportation costs to, and selling costs at, the first point of wholesale or retail sale off the farm. If the costs of such activities, which are considered to be non-agricultural, are included in the prices actually received by the farmer, they should be subtracted to arrive at the conceptual farm-gate price.

Agricultural products are not usually purchased directly by final consumers at the farm gate but rather through one or more wholesale markets and middlemen. At the first wholesale market in the chain, called a primary wholesale market, producer-sellers or their agents assemble their products and offer them for sale in bulk quantities to wholesalers, who then resell them to local or nearby retailers, to exporters, or to other wholesalers who transport the products to other locations and markets for resale there. Secondary wholesale markets, then, are distribution markets, where retailers, exporters and bulk consumers buy from wholesalers and, to a lesser degree, directly from producer-sellers. Finally, retail markets sell to final consumers.

1315 Agricultural input prices

These prices should also be considered prices at the farm gate. If an input is bought off the farm, except from local or village craftsmen or tradesmen, then marketing charges, taxes and transport expenses should be added to the price paid at the point of purchase to arrive at the conceptual price paid at the farm gate. If subsidies are provided to farmers to induce or enable them to buy sufficient quantities of certain agricultural inputs, and if these subsidies effectively reduce the price actually paid, then the farm-gate price paid by farmers should be the reduced, subsidized price.

5.3.13 Category 14: Post-Harvest Foodgrain Losses

Foodgrain losses are defined as the reduction in weight of edible grain available for human consumption, except the weight of moisture lost in drying. There are three stages at which losses are reported in this category, each of which is a classification division: on holdings, by intermediaries, and at warehouses. Only the first division is further disaggregated here, where losses on the holding may occur at several stages of on-farm processing, some of which are described below.

Harvesting refers to the cutting, gathering, bundling and stacking of a crop, whether done manually or mechanically. Losses, principally due to shedding, depend on the time of harvesting, where later harvests yield greater losses. In the threshing process, the grains are beaten, either manually or mechanically, to separate them from the husk, as for rice, or from the plant to which they are attached, as for maize. Losses in this operation arise from damage to the grains or grains escaping collection after threshing. Then, in winnowing, some of the grain may be blown away with the chaff. Drying losses can occur in two ways. First, when grain is spread out for sun drying, such as on a road or yard, part will be eaten by birds, rodents, insects and other pests; secondly, inadequate drying may lead to fungal damage or increased milling losses. Finally, storage losses, mostly due to pests, humidity and temperature, account for more on-farm post-harvest losses than at any other stage.

5.3.14 Category 15: Income and Outlay

Income and outlays of holdings and households are covered in the six divisions of this category. Since most of the items determining revenues and outlays of holdings and agricultural service establishments, as well as off-farm employment earnings, are included

in appropriate classifications in categories 04-12, only items not covered elsewhere are itemized in this category. Also, a separate division contains information of household income from sales of personal property and miscellaneous sources. The division on household consumption (156) is disaggregated only to the subsection level because of the potentially large number of country-specific items involved. The countries are therefore recommended to prepare item lists reflecting their own culturally and economically determined consumption patterns. (See Appendix II for one possible detailed classification of consumer food items). Countries should also clearly specify whether their income and outlay data are determined by the accrual or cash method of accounting.

5.3.15 Category 16-17: Other

The final category includes miscellaneous information generated by a food and agricultural information system -- e.g., climatic and agricultural extension data -- and information available from other components of a national information system or from other countries -- e.g., foreign trade accounts and national budgets and accounts.

5.4 Refinement and Standardization

The classification scheme and operational definitions presented in this chapter and in Appendix I are intended to serve as a prototype of a comprehensive, consistent design of the content of an information system for food and agricultural decision making. As a prototype, much will be learned in applying it to actual statistical and analytical work in developing countries, e.g., in the 1990 World Census of Agriculture and the design of other national food and agricultural censuses and surveys and policy analysis models (see Chapters 6 and 7, respectively).

In particular, individual countries will adapt specific classification items and definitions to their own unique situation through additions, deletions and modifications. This practical experience will assist in refining the general classification to better meet national needs while maintaining a high degree of international comparability. In addition, exposure to a wider review will ensure a standardization consistent with other classification schemes of the UN and its specialized agencies, particularly in subject areas where the scheme proposed here overlaps similar areas of other classifications.

CHAPTER 6

THE STATISTICAL PROGRAMME

Two major components of an information system for food and agricultural decision making are the statistical programme and the analytical programme. As explained in Section 4.4, the analytical programme concentrates chiefly on interpreting and analysing data and other information in light of existing knowledge and communicating the results to decision makers. The statistical programme, on the other hand, is primarily responsible for (a) producing data by observing and measuring the target world, i.e., the components of the socio-economic system pertaining to food and agriculture; (b) processing data; and (c) contributing to the upgrading of data by performing statistical analyses as part of the interpretation and analysis process.

This chapter discusses the functional, technical, and organizational issues surrounding the development of statistical programmes in developing countries. The next chapter performs a similar task for analytical programmes. Section 6.1 summarizes means available for measuring the information items classified in Chapter 5, while Section 6.2 outlines the technical aspects of statistical observation and measurement, including the quality of data. Finally, organizational infrastructure is discussed in Section 6.3.

6.1 Measurement Instruments and Data Sources

A classification scheme for the items of information useful for food and agricultural decision making is discussed in Chapter 5, with a detailed itemization presented in Appendix I. For each item, Appendix I also suggests what are, from the point of view of enumerators and statisticians, suitable statistical instruments for measuring that item in the target world. For users of the resulting data, on the other hand, e.g., statisticians, economists, decision makers and other analysts, the measurement instruments -- or more appropriately the reports of their findings, such as census reports, survey reports, and statistical summaries and yearbooks -- represent data sources. Table 6.1 summarizes the correspondence between the 21 instruments and sources and the major categories of information.

Operationally, the measurement instruments numbered 1 through 17 in Table 6.1 can be considered censuses and surveys, which are the main generators of data in most countries. While there are areas where censuses or surveys constitute the only sources of accurate

Table 6.1

Data Sources and Measurement Instruments for
Categories of Food and Agricultural Information

Categ.	Description	Data Sources/Instruments*																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
01	Identification	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
02	General Characteristics	X	X				X													X	X	
03	Demographic Characteristics	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
04	Employment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
05	Land and Water	X	X	X	X	X	X													X	X	X
06	Crops	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
07-08	Livestock	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
09	Machinery and Equipment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	Buildings and Other Structures	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	Ancillary Activities	X	X	X	X	X									X							
12	Credit, Marketing, Stock	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
13	Prices						X															
14	Post-Harvest Losses						X															
15	Income and Outlay						X															
16-17	Other	X	X	X	X									X								

The data sources and measurement instruments are as follows:

- 1 Census of agriculture
- 2 Periodic agricultural production survey
- 3 Farm management survey
- 4 Rural household income and expenditure survey
- 5 Food consumption survey
- 6 Survey of post-harvest losses
- 7 Survey of agricultural service establishments
- 8 Rural labour force survey
- 9 Soil survey
- 10 Livestock
- 11 Special agricultural censuses and surveys on particular subjects
- 12 Census of population and housing
- 13 Demographic survey
- 14 Census of industrial establishments
- 15 Survey of rural household industries
- 16 Urban household income and expenditure survey
- 17 Other non-agricultural censuses and surveys
- 18 Administrative records
- 19 Locality
- 20 International statistical publications
- 21 Technological research

data, this is not always the case and in almost all countries budgetary allocations for statistical purposes are nevertheless limited. Therefore, administrative and locality records, which are much less costly, should be used to supplement or replace censuses and surveys wherever feasible.

The sources/instruments for which FAO is responsible, plus those numbered 18 to 21 in Table 6.1, are briefly described in the following sections. Later volumes in this Statistical Development Series treat them at greater length.

6.1.1 The Agricultural Census and Production Survey

Censuses and surveys are statistical activities undertaken to collect data from units of interest by direct observation and measurement, interview or mail, or respondent record keeping. Although some surveys are designed to study the same selected units continuously over time, censuses and surveys are generally conducted at intervals to obtain data on a statistical population for a specific point in time.

The statistical unit for the census of agriculture is the operational agricultural holding. In the statistical literature, "census" refers to a complete enumeration of all statistical units in the population, while a survey collects data only from a selected number of statistical units, called a sample. Thus, a census of agriculture implies that data is collected from all holdings in the population. However, in many countries, it has been found impractical to conduct a complete enumeration of all holdings in a census of agriculture with a large scope. Therefore, census-of-agriculture data are collected in such countries only from a sample of holdings. While such an enumeration is, strictly speaking, a survey, it is nevertheless generally referred to as a "sample census of agriculture".

The purposes of the agricultural census are to: (a) collect data on the structure of agriculture, including a limited inventory of durable factors of production, the tenure rights of holders with respect to the factors of production, and the availability of agricultural inputs (goods and services); and (b) provide a frame for agricultural surveys. These purposes are limited, since it is assumed that countries supplement the census with other measurement instruments to meet their data needs. Thus, data collected in the agricultural census are limited to those aspects of agriculture which change relatively slowly over time under normal conditions.

The periodic agricultural production survey serves as the source of current statistics on agricultural production, with crop forecasting considered to be a complementary activity. Since the agricultural census does not include data on agricultural production, the production survey should be conducted every year, including the year of an agricultural census. The statistical unit for the production survey is the agricultural holding, and the population from which the sample is drawn should, if possible, cover all holdings in the country.

6.1.2 Other Food and Agricultural Censuses and Surveys

The main purpose of the farm management survey is to provide detailed data on all aspects of decision making on holdings, e.g., investment and disinvestment, assets, organizational structure, the allocation of resources, and input-output relations. Thus, the agricultural holding is the statistical unit for farm management surveys. Since agro-climatic conditions may vary greatly from one region to another, the survey sample should include regions representing the various conditions in the country. With a large scope covering the whole country, the survey should be conducted at five- to eight-year intervals.

The aim of the rural household income and expenditures survey is to obtain data on the income of rural households derived from all sources and on the expenditure patterns of these households. Thus, the statistical unit is the household, and, with a large scope, the survey should be repeated every five to ten years, depending on the rate at which changes are taking place in the conditions of rural life.

Emphasis in the food consumption survey is on the nutrition of individuals. Thus, with the individual as the statistical unit, the objective is to obtain data on the intake of food and its nutritive value. For technical reasons, the household is the statistical unit of a food consumption survey. Since food expenditures are one of the subjects covered in household income-expenditure surveys, countries may prefer to combine the two surveys by adding food purchases to the scope of the income-expenditure survey. Subsample surveys may be directed at the food intake of individuals and anthropometric measurements within the family unit.

An important aspect of the food problem in many countries is the waste and spoilage of agricultural products between field and table. The survey on post-harvest losses aims to measure these losses,

particularly for foodgrains, the major part of agricultural production destined for human consumption. Since the survey covers losses at various stages of marketing, transportation and storage, the statistical units for the corresponding phases of the survey are agricultural holdings, intermediaries, and warehouses respectively. Similarly, a survey on pre-harvest losses of foodgrains due to pests and diseases provides data for planning a programme to reduce foodgrain losses.

The survey of agricultural service establishments, for which the statistical unit is the agricultural service establishment, collects data on these important contributors to agricultural gross domestic product.

The soil survey, which is not normally the responsibility of the agricultural statistical agency, is a systematic study of soil classifications, property mappings, crop adaptation, and the distribution of various soil types. Statistical units for the survey are areas with well defined boundaries.

The livestock census or survey collects data, on both animals and holdings with livestock, necessary to evaluate animal husbandry practices. Its scope should be broad enough to include all animal husbandry systems practised in the country, including nomadic ones. The agricultural holding is the statistical unit for this survey. Countries may want to conduct a livestock census, at eight- to ten-year intervals, in addition to more frequent (at least annual) livestock surveys.

Price statistics are generally collected through specialized price surveys but may also be collected through other agricultural surveys. Agricultural and food prices derive their meaning and significance from the stage of marketing they relate to, i.e., prices received by farmers, wholesale prices, retail prices, export prices, import prices and prices paid by farmers.

The statistical unit for collecting price statistics varies according to the type of price and to the prevailing marketing systems in the country. Thus, the statistical unit might be the holding or the agricultural household or the wholesale market in the case of prices received by farmers. The wholesale market and the terminal market are the primary sampling units for wholesale and export prices, respectively, while the transactions themselves or the outlets are the secondary sampling units. The retail outlet, holding or agricultural household may be the sampling unit for prices paid by farmers for agricultural production inputs.

Special agricultural censuses and surveys on particular subjects include all agriculturally related censuses and surveys not specifically mentioned above. Examples include: number and type of fruit trees, fishery and forestry as ancillary activities of agricultural holdings, non-agricultural uses of machinery and equipment, credit, stocks, and marketing. There are also small-scale surveys required, for example, to develop conversion factors between greasy and clean fleece weights for wool and goat hair, and between carcass weight and liveweight of livestock.

As has been pointed out, food and agricultural information is but a subsystem of a national information system. A food and agricultural statistical programme, however, depending on the organizational structure of statistical institutions in the country, does not necessarily provide all the statistical information needed by food and agricultural decision makers. These decision makers also typically need data on the target world -- e.g., on population, prices, labour force, income and expenditure, and rural industrial establishments -- measured by other censuses and surveys (outside the responsibility of FAO) such as those numbered 4, 8, and 12 through 17 in Table 6.1. Indeed, a similar role is played by agricultural censuses and surveys, providing agriculturally related data needed by decision makers in other sectors.

6.1.3 Administrative Records

Some records kept by administrative agencies for internal use may advantageously serve more general purposes if made available to the public in statistical form. For example, measurements done by cadastral offices to establish cadastral maps are administrative records, and, as such, they are legal documents. However, such records may also be used to identify the parcels of a holding and thus to find the total area of the holding or the distribution of its land by class of use. Similarly, for example, records of prices at wholesale markets, of imports and exports, of livestock slaughtered at slaughterhouses, and of the implementation of irrigation schemes and other government projects are all useful sources of data.

Such administrative records, once established, should not be revised very often. Therefore, extreme care should be exercised in identifying the data to be recorded and in determining the definitions of concepts to be adopted and the format of the forms to be used for recording. A control scheme, at least on a sample basis, should be built into the record-keeping activity to improve the quality of data.

6.1.4 Locality Records

Locality records are kept by the inhabitants of a locality on a voluntary basis. They differ from administrative records in that they are not the by-products of government agencies but constitute a form of people's participation in rural development.

Such records may contain a variety of agricultural and non-agricultural facts about the locality -- e.g., relating to households, livestock, land, markets, cottage industries, extension services, and irrigation facilities -- not found in any other source of data, thus constituting an important component of community-level statistics. If this data is to be aggregated to higher geographic or functional levels, however, the definition of concepts and the forms used for record keeping should be standardized.

6.1.5 International Statistical Publications and Data Banks

The statistical publications and data banks of other countries and of international agencies are useful in cross-country comparative studies and in checking export statistics against the import statistics of other countries, forecasting exports, and monitoring world prices. Such sources have a further important use for a country which, lacking statistics of its own on a particular topic, e.g., capital-output ratios or demographic vital rates, adapts the statistics of other countries having similar conditions with respect to that topic.

The usefulness of international statistics is highly dependent on the uniformity of the concept definitions used and the classification schemes adopted. Although much has been accomplished in securing such uniformity among countries, there is still room for further improvement. Countries have been urged to provide, in their statistical publications, detailed definitions of concepts which differ from those given in international recommendations.

6.1.6 Technological Research in Food and Agriculture

Technological research is generally performed in laboratories, universities and research institutes and involves experiments with food crops, animals and agricultural inputs. It aims mainly at discovering causal relations, in contrast to other data sources which collect primarily descriptive data. Indeed, it is this difference

that makes technological research and other data sources complementary to one another. That is, the descriptive statistics obtained from censuses and surveys may aid the formulation of hypotheses to be tested by technological research; similarly, research results may suggest, for example for confirmation purposes, additional information to be obtained through censuses or surveys.

6.1.7 Relationships among Measurement Instruments

In order to optimize the allocation of data collection resources and the quality of the data collected, linkages among the above measurement instruments and data sources need to be clearly identified. There are two dimensions to the linkages, or relationships: design and organization. The design of an instrument refers to such technical considerations as scope, coverage, methodology, timing, publication programme and data storage, while organizational considerations include institutional structure, human resources and supporting infrastructure. These topics are discussed in the following sections.

6.2 Technical Considerations

There are many technical aspects to consider in designing and conducting agricultural censuses and surveys, e.g., sample design, questionnaire design, enumeration, data processing, publication, statistical analysis and data quality. Many of these and other considerations will be treated fully in subsidiary manuals to be published in this Statistical Development Series. This section considers the following implications and advantages of linkages among measurement instruments: conceptual definitions, timing, master frame and data storage.

6.2.1 Conceptual Definitions

One objective of linking measurement instruments through their design is to make it possible to combine data from various sources as needed for particular analyses. Therefore, the need for uniformity in conceptual definitions and classification schemes cannot be over-emphasized. For example, an agricultural holding should be defined identically for farm management surveys and agricultural censuses, and size classes of holdings should be the same or mutually convertible for all measurement instruments and data sources. The classification scheme and definitions presented in Chapter 5 and Appendix I are an attempt to promote this conceptual consistency.

6.2.2 Timing

Equally important is the timing of the various censuses and surveys. That is, proper scheduling enables the information collected in one instrument to be used in the design of another. A particularly important example is that, if possible, the census of agriculture should be undertaken just after completion of the population census (discussed further below). Information on who is engaged in agricultural activities, acquired while listing households in the population census, is of utmost importance in preparing the frame of the census of agriculture. In many countries, urban areas are inadequately covered, if at all, in censuses of agriculture. In such cases, subjective guesses must be made regarding agricultural production in urban areas in order to estimate national production for use in the national accounts. Therefore, it is recommended that the population census include items indicating whether any household members, even in urban areas, are engaged in agricultural activities.

Table 6.2 illustrates a simplified outline of a ten-year cycle of data collection activities and serves as a guide in the timing of various measurement instruments, as indicated by the X in the appropriate year. Table 6.2 omits items 17-21 from Table 6.1, because these represent data sources not subject to design and timing decisions of food and agricultural statistics. Furthermore, such data collection activities as 4, 8 and 12-17 are the responsibility of other UN agencies, which may suggest timings other than those indicated in Table 6.2. For the rest, three censuses are to be undertaken once every ten years: population, agriculture and industry; one survey is to be conducted annually: the periodic agricultural production survey; and six surveys and one census are to be carried out every five years: farm management, rural and urban household income and expenditure, food consumption, agricultural service establishments, rural labour force, and livestock. A soil survey may be taken once every ten years. In addition, special agricultural surveys (number 11) may be conducted in any year.

A population census is important for the national food and agricultural information system in two respects: (a) to establish the statistical frame for food and agricultural surveys, and (b) to identify the socio-economic groups at which level agrarian reform and rural development programmes are to be monitored and evaluated. It is not certain that traditional population censuses adequately enumerate a country's socio-economic groups for the latter purpose.

Table 6.2
A Ten-Year Cycle of Data Collection Activities

Instruments and Sources	Year (ending in digit)									
	0	1	2	3	4	5	6	7	8	9
1 Census of agriculture				X						
2 Periodic agricultural production survey	X	X	X	X	X	X	X	X	X	X
3 Farm management survey				X					X	
4 Rural household income-expenditure survey			X						X	
5 Food consumption survey	X					X				
6 Survey of post-harvest losses							X			
7 Survey of agric. service establishments			X					X		
8 Rural labour force survey					X					X
9 Soil survey	X									
10 Livestock census					X					X
11 Special agricultural censuses and surveys	X	X	X	X	X	X	X	X	X	X
12 Census of population and housing	X									
13 Demographic survey			X							
14 Census of industrial establishments				X						
15 Survey of rural household industries					X					
16 Urban household income-expenditure survey				X					X	

The network in Figure 6.1 outlines an approach to satisfying both needs, with the hypothesis that most of such information could, in many developing countries, be provided by population censuses. Figure 6.1 disaggregates a population into nine levels, with the total population of a country at level 1 and the rural/urban disaggregation at level 2. Population censuses traditionally identify the geographic location of the population, e.g., by state, province, region, city, town, etc., at the third level, as illustrated on the urban side of Figure 6.1. For an ideal agricultural statistical frame, one that could be fully stratified by socio-economic group within agro-ecological zones, the rural side of Figure 6.1 identifies the agro-ecological or other land or resource zone at level 3.

At level 4, the household is identified, including whether it has a male or female head. An institutional category is also designated at this level. In the traditional sense, this institutional designation could include schools, hospitals, military installations and other organizations providing institutional food and housing. With respect to the rural population, state and collective farms of socialist countries are identified.

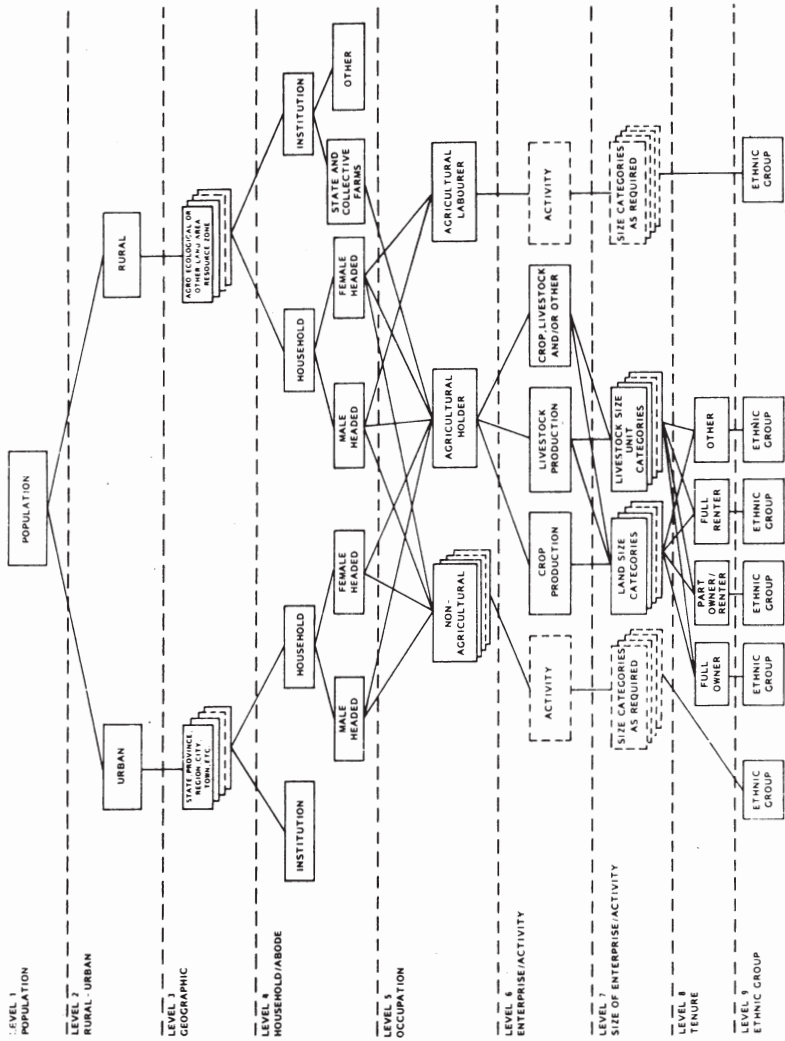


Figure 6.1

Delineation of socio-economic groups and agricultural holders by agro-ecological zone or other geo-political area

The agricultural holder or labourer within each household is identified at the occupational level, level 5. There is also an opportunity at this level to record rural households as non-agricultural and urban households as containing agricultural holders.

Level 6 identifies the basic type of agricultural enterprise, such as crop production, livestock production, or some combination of crop, livestock and other agricultural enterprises. Levels 6, 7 and 8 in Figure 6.1 may not be essential in the traditional sense for providing a statistical frame in food and agriculture. However, access to land is an indicator of a dominant socio-economic group, and is thus important for monitoring and evaluating agrarian reform and rural development programmes, as is the designation of ethnic group at level 9.

At level 5 and in Figure 6.1, the designated information begins to exceed what is normally included in a population census. However, the goal of providing both a statistical frame and an identification of socio-economic groups could be extended to other non-agricultural statistical areas. For this purpose, much more detail would be needed than is provided in Figure 6.1. Thus, the dotted lines indicate areas possibly needing further development for such purposes. With very limited resources available for statistical frames in developing countries, there is often competition for carrying out not just the population and agricultural censuses but also censuses in other important areas, e.g., housing. However, if the population census could provide agriculture and other important sectors with the information outlined in Figure 6.1, multi-year schedules of sample surveys could be developed to collect, in a much more timely and cost-effective manner than otherwise, most of the statistics necessary beyond those derived from the population census itself.

6.2.3 Programme Coordination and Integration

Adequate coordination is a prerequisite for the successful implementation of a national statistical programme for food and agriculture. A national coordination committee will be useful in reviewing and monitoring the implementation programme. It is important to review the plan periodically, for possible changes in priority and timing necessitated by such unforeseen factors as delays caused by shortages of funds.

A long-term integrated programme of data collection activities can increase the efficiency and timeliness of statistical activities and the accuracy and consistency of statistical information. Such a programme is comprised of (a) a well specified and detailed description of the data instruments to be undertaken; and (b) a realistic schedule of collection, processing, analysis and dissemination of quantitative information. The data instruments are programmed in advance for each year and over a period of, say, 10 years in such a way that maximum use is made of the common or interrelated aspects of the data requirements and statistical operations to achieve economy and efficiency and to enable the accumulation of experience for improving future data collection activities. Such a programme must, of course, take into consideration the limitations imposed by the availability of human and financial resources and supporting infrastructure.

6.2.4 Frame

The success of any census or survey depends to a large extent on the quality of the frame (list, map or other means) used to identify the statistical units in the population. The ideal would be to have a complete list of all statistical units, with prior information for each of them on particular characteristics of interest, before starting the census or survey. Registers of statistical units (e.g., agricultural holdings, agricultural service establishments, or households) are not generally available in most countries. Consequently, many surveys are based on multi-stage sampling schemes due to insufficient prior information on sampling units, resulting in the need for large, costly samples. A population census should provide a frame of agricultural households for the agricultural census. In turn, an agricultural census should provide a sound frame for other agricultural surveys whose statistical units are agricultural holdings.

6.2.5 Sampling Techniques

Sampling techniques are increasingly being used in agricultural censuses and surveys, especially in developing countries, to (a) allocate limited human and financial resources effectively; (b) publish important results rapidly; carry out quality control checks on collected data; and (c) better control field operations.

The sampling design depends on available resources, the accuracy desired in the estimates of principal items, and the control of field activities. Many sampling designs have been used, the most common

being multi-stage stratified sampling. In agricultural censuses and surveys, multiphase and successive sampling designs are also used.

The proper sample size to use in a given situation depends on the purpose and the desired accuracy of information. For example, if data are needed for planning at the smallest administrative level in the country, a much larger sample is needed, proportionally, than for larger units. A critical examination of the sample size should be made at the time of the pilot survey.

6.2.6 Questionnaires and Tabulation

The success of agricultural censuses and surveys depends on the proper design of the questionnaire. The framing and wording of questionnaires should take into consideration the calibre of enumerators and respondents and should be simple and clear. Before designing a questionnaire, data requirements of different users must be ascertained and the extent to which they can be accommodated in the questionnaire or covered by separate surveys should be determined. The advice of a data processing expert in designing a questionnaire can be of immense value in facilitating later tabulation of the results. In fact, the tabulation plan should be drawn up along with the design of the questionnaire to ensure that items of information needed in the tabulation programme are included in the enquiry.

6.2.7 Data processing

Data processing is currently one of the most limiting factors in the statistical programme of most developing countries. The data processing capability should be planned, implemented and tested before field enumeration is begun and, generally, data should be recorded in machine readable form early in the development cycle.

The organization of computer data processing activities depends on the computer facilities available. There are, however, certain operations to be conducted before computer work can begin. One very important operation, which will help rectify omissions and other errors, is checking the completeness of the census and survey enumeration and questionnaires. In addition, field supervision will reduce the burden of checking at the central office. Other important operations are coding, punching and verification, for which it is important to establish appropriate quality control procedures.

A comprehensive, consistent data base management system is also necessary to check, update, store, and retrieve data from various sources and measurement instruments. For statistical purposes, such a system is important to generate additional tabulations not published initially, for cross-section analyses based on data at the level of the statistical unit, and for later analysis of the data. Access to data from different sources so they may be combined in various ways is needed for policy analysis. The computer programmes and equipment which house the data and operate the data base management system must be designed to be as easy or easier to use for non-computer people as traditional desktop calculators and printed publications.

6.2.8 Quality Checks and Post-Enumeration Surveys

Various factors affect the quality of data in different ways. Errors always exist in data whether based on a complete enumeration census or a sample survey. It is therefore necessary to check the quality of data collected. In the case of a sample survey, results are accompanied by what are known as sampling errors, which can be controlled to any desired degree by using proper techniques and by enlarging the sample size. However, there are other errors, called non-sampling errors, which are difficult to eliminate. The technique practised most often for checking the quality of census data is the comparison of that data with information available from independent sources. Another useful technique in many cases involves examining the consistency of data with respect to a priori knowledge. Post-enumeration checks through sample surveys are also a very common method of assessing the accuracy of survey and census results.

6.2.9 Dissemination

A publication programme for disseminating the results of agricultural censuses and surveys is the traditional link between producers and users of statistical information. Census and survey results and analyses need to be properly organized, tabulated and published in a report or series of reports and made available to users as soon as possible. Therefore, at a minimum, it is essential that a programme of publications be carefully planned and implemented with adequate resources.

The utility of statistical information decreases in direct proportion to the time it takes to become available to users. As a consequence, on-line data bases are growing in importance relative to statistical publications, thus increasing the importance of an efficient data processing and data base management capability.

6.3 Organizational Considerations

Three classes of organizational issues important to food and agricultural statistical programmes are discussed in this section: institutional structure, human resources, and supporting infrastructure.

6.3.1 Institutional Structure

There is wide variation among countries in the structure of government agencies responsible for food and agricultural statistics (FAO 1974/75). Typically, several agencies, often even more than one ministry, may be involved. For example, administrative record keeping and technological research are carried out by many different agencies. Two types of organizational set-ups can be distinguished for censuses and surveys. In some countries, all censuses and surveys are centralized, i.e., under the responsibility of a single, centrally located statistical office, while in others they are decentralized. In a decentralized system, coordination among statistical agencies -- possibly through the establishment of a central statistical coordination office or an interministerial or interagency committee with effective executive authority and responsibility -- is essential to maintain consistency with respect to conceptual definitions, timing, data processing and other technical and analytical aspects of the information system.

6.3.2 Human Resources

Personnel requirements to execute the various measurement instruments should be considered in light of the types of activities to be carried out, which, in broad terms, can be distinguished as follows: (a) administration, (b) planning, (c) data collection, (d) data processing, and (e) support services. Administration refers to the overall management of a census or survey, while planning involves its design. The design of a census or survey describes the scope and coverage and includes the forms and questionnaires to be used, definitions of concepts, sampling plan (if one is to be used) and instruction manuals for data collection and processing. Data collection, then, is the actual conduct of interviews, measurements or record keeping, as the case may be, while data processing involves the editing, coding, classification, publication and storing of data and is generally computerized. Finally, services necessary to support the statistical personnel in the conduct of their activities include transport, maintenance, data entry, computer programming and secretarial and office services.

For each type of activity, personnel may be required, both full time and part time, at various levels of professional experience, training and competence. Proper personnel coordination and scheduling among activities and among data sources/measurement instruments will avoid problems of some areas being overstaffed while other areas may be short. This is particularly important for professional statisticians and data processing experts whose supply is limited in most developing countries and also in the case of a decentralized statistical programme. Cooperation among agencies in the utilization of available manpower will not only be cost effective from the standpoint of the national statistical budget but also promote the consistency of the data being generated by the various instruments and sources.

Since the institutional structure of statistical programmes varies widely from country to country, it is not possible to formulate detailed personnel requirements which would be appropriate for all of them. The following list does indicate, however, general personnel requirements which are relevant to all countries:

- (a) high-level government administrators of statistical activities;
- (b) experts trained in statistical theory and practice;
- (c) experts trained in computer operations, programming and data base management;
- (d) junior staff capable of supervising enumerators; and
- (e) sufficient numbers of enumerators and data processing clerks.

Some countries employ full-time field enumerators, but many developing countries may prefer to reduce costs by utilizing part-time and temporary enumerators. For example, agricultural extension workers are frequently assigned data collection duties during what would otherwise be slack seasons for them. In practice, however, the training and experience of the enumerators and supervisory staff and the smooth functioning of the field organization in general are critical to the success of statistical activities --signalling the importance of a stable, permanent staff (at least a small cadre) and organization.

Training of statistical personnel should be organized in a planned and coordinated way for all data collection activities. Different types of training programmes should be devised so that the training is appropriate to the trainee's level as well as the task the trainee is expected to perform in the statistical operation. Training may have to be organized at international or regional centres for senior staff, at national training centres for middle-level staff, and at various places within the country for field staff. The requirements for training professional and supporting statistical and data processing

personnel could be determined as part of the pre-programme planning phase of a long-term statistical programme (see Chapter 8, Section 8.2.1).

With respect to staffing statistical projects, it is increasingly recognized that resident foreign experts should be utilized only when absolutely necessary. Rather, limited project funds are better used for formal training of country personnel and for temporary technical backstopping by consultants and staff of international organizations.

6.3.3 Supporting Infrastructure

As mentioned above, a number of services and facilities are necessary to support the direct statistical activities. Among these are computer, printing, transportation, maintenance, secretarial and office services and equipment. Transportation and data processing equipment require particularly close coordination with the various statistical activities, especially in developing countries where they are in short supply. Transportation equipment is also important in situations where reliable public transport is not available, especially for field work. The sharing of data processing facilities is another area where economies of scale can be gained. Data processing requirements should be carefully planned and coordinated to avoid underutilization of expensive equipment while still processing the data in a timely manner.

With careful planning, advantage can also be taken of linkages between the statistical and analytical programmes not only for supporting staff, facilities and equipment but also with respect to institutional structure in order to facilitate and ensure the necessary working relationships between the two programmes.

Basic data development, data processing and statistical analysis are three equally important cornerstones of a successful national programme of food and agricultural statistics. With respect to analysis, it is essential for an effective analytical programme that statisticians and economists work together along with appropriate technical subject-matter scientists and decision makers. The analytical programme component of an information system is described in the next chapter, Chapter 7.

CHAPTER 7

THE ANALYTICAL PROGRAMME

The statistical and analytical programmes are the two major components of an information system for food and agriculture decision making. The statistical programme is primarily responsible for planning and conducting field enumeration of basic data, data processing and statistical analyses. The analytical programme, while also performing some observation and measurement, concentrates chiefly on interpreting and analysing data and on communicating results to decision makers. However, the distinction between data processing for statistical as opposed to analytical purposes and the border between statistical and economic analysis is somewhat arbitrary.

Policy analysis is typically carried out, frequently on an ad hoc basis, by staff analysts located in various ministries, divisions, and bureaux; by government or semi-autonomous research institutes; and with contributions from universities, consultants, and other sources of subject-matter expertise.

This chapter begins with a description of the policy analysis process and its role in decision making. Remaining sections define and discuss models and the modelling process and their roles in support of both analytical and statistical programmes.

7.1 The Policy Analysis Process

Policy analysis is the process of producing information to improve policy decisions. Policy analysis is oriented to some objective. The ultimate value of analysis may be to improve well-being of people but the proximate objective or end-in-view for the analyst is to provide information to managers and policy makers to help them make better decisions in allocating scarce resources to meet objectives.

Section 3.2.2 described the seven stages of the decision cycle: problem definition, synthesis of options, analysis of options, decision, implementation, observation of results, and evaluation. Here, the discussion focuses on application of the cycle to solving problems at the policy, programme, and project levels of decision making to guide the food and agricultural socio-economy.

The analytical programme is intimately involved with all stages of the decision cycle but especially in problem definition and synthesis and analysis of options. The analytical programme may entail ex post evaluation of on-going programmes and projects, such as agrarian reform and rural development efforts (FAO, 1985b). In other cases, the analytical programme may emphasize ex ante feasibility of a price intervention policy or an infrastructure project.

The analysis to support a decision will be made within a specific time frame. Decisions made in the course of policy implementation tend to have short-term focus, while policy formulation typically takes a longer-term view. For example, adjustments in on-going measures to regulate rice prices may only be concerned with programme performance over the next few days or weeks. On the other hand, investments in crop improvement research and irrigation infrastructure will need to consider a much wider range of consequences distributed over several years.

In the synthesis of options stage, analysts and decision makers work together closely to formulate alternatives which can fill needs. The analysis stage then projects the likely consequences of the options and evaluates them in terms of feasibility and relative desirability. Close interaction and effective communication is essential between decision makers and analysts to determine economic feasibility, social desirability, and political acceptability of policy options.

7.2 Models and Modelling

Grasping the totality of a country's food and agricultural system is impossible for anyone who would monitor and evaluate the current situation and analyse policy options. Models are a necessary abstraction of the real system. Analytical models serve as filters to screen out non-essential elements and to retain elements essential for food and agricultural decision making. A formal model often integrates statistical data with a conceptual framework (theory), assumptions, and objectives. These elements may come together in an algorithm such as simulation, linear programming, or other mathematical device to provide a framework for generating predictive or prescriptive information of value to decision makers.

7.2.1 Classification of Models

Analysis ranges from informal or intuitive judgement taking little time to highly complete and complex plans laying out a detailed

blueprint for the course of an entire economy. Analysis may be predictive, forecasting the likely future course of one or more variables of interest in the absence of new policy interventions, or it may be prescriptive, showing the implications for producers, consumers, taxpayers, and society of seeking alternative objectives that decision makers have or could prescribe.

Informal or formal mental models existing in the modeller/analyst's mind tend to be vague, implicit, and even subconscious images or concepts of how the world works. A decision maker deriving most or all of his analysis from his own mental models is said, in colloquial English, to be making "seat-of-one's-pants" or "intuitive" decisions. In the face of severe constraints and analytical resource time, such judgements by an informed and experienced analyst can be appropriate and useful.

This chapter mainly deals with formal models. Formal models exist in concrete, explicit form outside the modeller's mind. Being explicit, they are available for critical scrutiny and evaluation and thus for conscious improvement and modification.

Mathematical models can never be the sole information source for complex socio-economic decision making. Informal and formal models, including mathematical models, are used in combination with each other to generate information needed to support decision making. Mathematical models can increase the information quality (in terms of consistency and precision) and the quantity of information as the measured capacity for analysing a number of complex policy options.

Mathematical models frequently require data which do not exist, are expensive to acquire, or are of questionable reliability, especially in developing countries. The quality of information generated by quantitative models is critically dependent on structure (variables and relationships). Poor data with good structure may yield more useful information than good data with poor structure. A model with a reasonably valid structure is a valuable aid in checking data consistency and setting priorities for data collection. Such a model can be used to make estimations to fill gaps in published data. While mathematical models can handle more complex structures more consistently than can verbal or mental models, there are, nevertheless, limits on the feasibility of finding general mathematical solutions.

7.2.2 Some issues for models

A presentation of analytical models is incomplete without placing them in the context of issues which they address. Issues addressed in policy analysis are numerous but policy analysis tools illustrated in this chapter relate mainly to three prominent issues:

- (1) Economic efficiency. Obtaining maximum useful output or real national income from given resources is a major policy objective. Issues of economic efficiency arise when policy makers decide whether to rely on the private market or to supplement or replace it by public interventions. Taxes, subsidies, exchange controls, import quotas, price supports, regulations, and other means are often used to intervene in markets. At issue is whether they raise or lower the real volume of goods and services available to society. Policy makers are concerned with economic growth, and economic growth depends on how efficiently output and resources, including savings and investments, are allocated.
- (2) Distribution. Policy makers are concerned not only with the size of national or sector income but also with how it is distributed. To make decisions, they frequently desire information on the distribution of costs (and benefits) of programmes among producers, consumers, and taxpayers by level of income.

Poverty, underemployment, and access to means for generating a livelihood are policy issues in nearly all countries. Policies to promote more equal income and resource distribution frequently reduce economic efficiency and hence aggregate income and economic growth. The policy analysis can provide information not only on distribution of costs and benefits but also on the trade-off between equity and efficiency. Price ceilings and targeted food assistance influence not only income and nutrition of the poor, they also influence other income groups and sectors by changing producers' prices and government costs. Policy makers can make better decisions if they are aware of these impacts.

- (3) Stability. Food supply and price stability is often of major concern to policy makers. A policy that increases average income and distributes it more equitably may be undesirable if it subjects producers and consumers to high risk of low income or short food supplies in some years. Price controls, commodity stocks, or a cash reserve fund are examples of policy options to reduce instability. The policy analyst can provide useful information to policy makers regarding the likelihood and magnitude of food shortfalls and the economic costs and benefits of policy options to reduce instability, including the option of relying on the private market versus public interventions to reduce instability.

Some governments pursue policies to achieve self-sufficiency in staple commodities. Sometimes such policies reduce food security because they increase reliance on uncertain domestic output, reduce efficiency, and reduce national income to purchase food supplies from abroad when domestic production falls because of unfavourable weather, pests or diseases. In some instances, food security and economic efficiency can be simultaneously improved by raising income through producing commodities in which a country has a comparative advantage. The higher income permits purchase of commodities from abroad as necessary when domestic supplies are short.

In the following sections, specific analytical tools addressing the above and other issues, are presented and discussed. No one tool is applicable to all situations and any tool must be tailored to the needs of the specific situation. The tools presented have been proven through wide use. References are listed for analysts who wish to obtain more background in the theory and application of the various procedures. It is assumed that the statistical programme has provided needed information for the analytical programme. However, it must be recognized that the analytical programme provides feedback to the statistical programme regarding data needed.

7.3 Simple Tools for Analysing Trends

The commodity balance equation provides a useful initial framework to illustrate simple policy analysis tools. The balance identity for a commodity in year t is

$$(7.3.1) \quad S_{t-1} + O_t + M_t = C_t + X_t + S_t.$$

Carrying of stocks from last year S_{t-1} plus output (production) O_t plus imports M_t equal consumption (including waste) C_t plus exports X_t plus carryout of stocks at the end of the year S_t .

An experienced analyst can make many inferences of value to decision makers simply by observing trends in the commodity balance sheet over time. And more formal policy analysis tools can extract even more information from the statistics. A graph of each of the variables, easily constructed with high quality microcomputers, can vividly illustrate trends in data and alert decision makers to emerging developments which they may judge warrant a policy response.

Regression analysis, using statistical procedures now possible at low cost and with precision by computer, can provide additional information. Policy makers may wish to predict production and consumption for next year or further into the future. The analyst might use a ruler and pencil to extend a line from the past into the future, but the result would depend on the analyst's judgement: any two analysts would not draw the same line to predict future values of O and C.

A more systematic and objective procedure is to estimate an ordinary least squares regression equation from the time series of past data. One of several possible forms might be appropriate to predict output O_t :

$$(7.3.2) \quad O_t = a + bT$$

$$(7.3.3) \quad O_t = aT^b \quad \text{or} \quad \ln O_t = \ln a + b \ln T$$

$$(7.3.4) \quad O_t = ae^{bT} \quad \text{or} \quad \ln O_t = \ln a + bT$$

$$(7.3.5) \quad O_t = a + bT + cT^2$$

$$(7.3.6) \quad O_t = a + bT + cT^5$$

where T is a time trend variable arbitrarily constructed as the last two digits of the current year, e is the base of natural logarithms and ln refers to variables coded in natural logarithms. Each equation provides a different trend line; the statistical results can help to decide which equation to select. Equation 7.3.2 assumes that output increases by the same quantity b each year. Equation 7.3.3 assumes that a 1 percent increase in T always results in a given percentage increase b in production. Equation 7.3.4 forces production predictions to increase by the same percentage b each year. Equation 7.3.5 allows the production to follow a "U" shape, either upright or inverted. Equation 7.3.6 allows production to increase (or decrease) at a decreasing rate. If all b and c coefficients in the above prediction equations are not statistically different from zero, the analyst may conclude that the best prediction is a simple average of past production.

Functional forms such as a linear, log-log, semilog, square root, or quadratic equations might be fitted and one selected for prediction based on the proportion of variation explained (R^2), the sign and statistical significance of coefficients, and consistency with the conceptual framework (an equation predicting negative or infinite future values might be ruled out). The standard deviation of the estimate could be used to define the range within which O or C would be

expected to fall in any particular future year with specified probability.

Other statistical techniques could be employed to analyse commodity balance sheet data. A simple correlation coefficient could be used to express the degree of linear association between production and consumption if policy makers are concerned whether food consumption is influenced by variation in food production. Simple correlation coefficients of production 0 between crops would indicate whether production is highly correlated and hence similarly influenced by weather (positive correlation) or whether low production of one staple tends to be offset by high production of another staple (negative correlation).

The standard deviation provides a measure of variability, and may estimate dispersion around the mean or around a trend. If the distribution is normal, two-thirds of the outcomes are expected to fall within one standard deviation above and below the mean (or trend).

In general, the standard deviation increases as average production increases. A measure of relative variation is the coefficient of variation, the standard deviation expressed as a percent of the mean. Coefficients of variation are often used to compare relative variability among crops. Policy makers may wish to explore means to reduce variability in production of a staple crop, and it may be useful to compute coefficients of variation for yield as well as area to determine which is contributing most to variation in output.

Commodity consumption trends may be predicted from population trends and the income elasticity of demand E_y . If the population growth rate is expected to be r_n percent per year, if consumption per caput is expected to be constant (except for the influence of income), if the annual percentage rate of growth in real income per caput is expected to be r_y , and if the income elasticity of demand (percentage growth in consumption C associated with each 1 percent growth in real income per caput) is E_y , then the annual percentage rate of growth in consumption r_c can be expressed as

$$(7.3.7) \quad r_c = r_n + E_y r_y.$$

Thus, if the population growth rate r_n is 3.0 percent per year, the income elasticity of demand E_y is .5, and real income annual growth rate per caput r_y is 2.0 percent, then demand for commodity C is expected to grow $r_c = 4.0$ percent per year.

If some of C is exported and equation 7.3.7 expresses growth only in domestic consumption, the total rate of growth in C from all sources r_T may be expressed as

$$(7.3.8) \quad r_T = w_c r_c + w_x r_x$$

where w_c is the proportion of C consumed domestically, w_x is the proportion of C exported, and r_x is the predicted rate of growth in exports. If three-fourths of C is consumed domestically so w_c is .75 and w_x is .25, if r_c is 4 percent per year, and if the expected rate of growth in exports r_x is 8 percent per year, then the total rate of growth r_T in utilization of C is $.74(4.0) + .25(8.0) = 5$ percent per year. The weights will change over time if r_c differs from r_x so the formula in 7.3.8 with fixed weights is only valid for short periods.

7.4 Demand and Supply Models

In market economies, it is useful to supplement less sophisticated analysis described above with a more complete accounting for variables that influence consumption and production. The supply curve is a schedule of relationships between real prices of a commodity and quantities supplied by producers at each price for a given market per unit of time, other things equal. The demand curve is a schedule of relationships between real prices of a commodity and quantities taken by consumers for a given market per unit of time. The supply curve and demand curve together determine market price and quantity and can be used by analysts to study a wide range of policies as noted in this section.

7.4.1 Supply and production analysis

Many variables such as technology, weather, investment in infrastructure, and prices of related commodities and of inputs shift the supply curve. A supply function contains all of these variables and can be used to estimate the supply curve and sources of shifts in the supply curve.

Earlier, production O was viewed as a function of only a time trend variable. The supply function expresses supply quantity as a function of several variables:

$$(7.4.1) \quad O_{it} = f\left(\frac{P_i}{PP}, \frac{P_j}{PP}, I, T, G, W\right).$$

O_i is production of commodity i ; P_i is own-price of i ; P_j is the price of competing or complementary commodities (which may be represented by an index of prices received by producers or by separate price variables for each commodity); PP is prices paid for inputs (which may be represented by an index of prices paid for all inputs or by separate prices of fertilizer, machinery, labour, pesticides, and other inputs); I is fixed capital inputs or infrastructure such as public irrigation capacity; T is technology such as high-yielding varieties or productivity which is often represented by a time trend; G is government programmes such as extension education or supply controls; and W is weather and other factors such as pests over which the producer has little or no control in the short run. Other variables such as the variation in past prices may also influence the supply quantity.

Elasticities are frequently used for convenience to express the supply response to price. The elasticity E shows the percentage change in one variable associated with the percentage change in another variable and hence is independent of the units of measurement. For example, the own-price elasticity of supply response is

$$E_{ii} = \frac{\Delta O_i}{O_i} / \frac{\Delta P_i}{P_i} = \frac{dO_i}{dP_i} \frac{P_i}{O_i} = \frac{d \ln O_i}{d \ln P_i},$$

the cross-price elasticity for related commodities is

$$E_{ij} = \frac{\Delta O_i}{O_i} / \frac{\Delta P_j}{P_j} = \frac{dO_i}{dP_j} \frac{P_j}{O_i} = \frac{d \ln O_i}{d \ln P_j},$$

and the elasticity of response to input prices is

$$E_{ip} = \frac{\Delta O_i}{O_i} / \frac{\Delta PP}{PP} = \frac{dO_i}{dPP} \frac{PP}{O_i} = \frac{d \ln O_i}{d \ln PP},$$

where Δ is the change in price or quantity and d refers to a very small change. In theory, the sum of these elasticities is zero. That is, a proportional increase in all prices does not change output if farmers react to real (relative) prices as shown in equation 7.4.1 rather than to absolute (nominal) prices.

Supply response elasticities can be estimated empirically by multiple regression statistical analysis utilizing data over time on the variables in equation 7.4.1. In doing so, it is important to recognize that when producers plant they ordinarily do not know what actual price will be when they sell their commodity. They plan based on expected prices. Producers' expectations of price in year t may be formed from a weighted average of prices in previous years. For example, the expected real own-price $(P_i/PP)^*$ for commodity i may be represented by

$$(7.4.2) \quad (P_i/PP)_t^* = .50(P_i/PP)_{t-1} + .33(P_i/PP)_{t-2} + .17(P_i/PP)_{t-3}$$

which can be constructed from time series of past prices. Once producers are subjectively certain of price, they may adjust output slowly because of caution, inertia, or costs of making adjustments. The actual adjustment of supply quantity in one time period may be some proportion g of intended full adjustment to O_{it}^* as expressed below (Nerlove, 1958):

$$(7.4.3) \quad O_{it} - O_{it-1} = g(O_{it}^* - O_{it-1}).$$

A typical linear equation of long-run supply is of the form

$$(7.4.4) \quad O_{it}^* = a + b(P_i/PP)_t^* + cH_t + eT$$

where H is high-yielding varieties and the expected price is from equation 7.4.2. Substituting equation 7.4.4 into equation 7.4.3 yields the Nerlovian short-run supply equation.

$$(7.4.5) \quad O_{it} = ag + bg(P_i/PP)_t^* + cgH_t + geT + (1-g)O_{it-1}.$$

This equation can be estimated by the ordinary least squares multiple regression procedure from time series data. The adjustment rate g is calculated from the coefficient $1-g$ on the lagged variable O_{it-1} . The short-run supply response to P_{it-1} is .5 times the short-run coefficient of bg from equation 7.4.5. The long-run response b to price is the short-run coefficient bg in 7.4.5 divided by the adjustment rate g . If the equations are in original values, the marginal response to price can be converted into elasticities by multiplying them by the appropriate ratios of price to quantity. If the variables are in logarithms, the coefficients in equation 7.4.5 will be elasticities. A typical empirical supply elasticity is .1 in the short run and 1.0 in many years if the price increase is maintained. Supply elasticities have been estimated and reported for a number of commodities and countries (Nerlove 1958; Askari and Cummings 1976).

Figure 7.1 illustrates the use of a supply curve for policy analysis. Output initially is q_s and price is p . An increase in the price to p_1 from an increase in demand, an increase in support price, termination of a tax, or from other sources raises the supply quantity to q_{s1} . If the increase in price is 10 percent and the supply elasticity is .1 in the short run and 1.0 in the long run, supply quantity is predicted to increase by 1.0 percent in the short run and by 10 percent in the long run if the higher price is maintained. If the original quantity q_s is 150 kilos and the original price p is 20 rupees, the long-run elasticity implies that a price increase of 2 rupees increases quantity 15 kilos if the price increase is maintained for several years.

If the price is decreased to p_2 from the initial price p , the quantity supplied falls to q_{s2} . If the real price decrease from p is 20 percent and price is held at that lower level with the supply elasticity as above, the quantity supplied is expected to fall 2.0 percent in one year and 20 percent in many years.

Frequently, the analyst desires more information than just the supply response to price. Suppose it is useful to know the contributions of specific resources and of yield and area components to supply response. Supply response to price is a function of the physical response of output to use of inputs and the behavioural response of input use to price, the latter represented by the input elasticity of demand. The physical response of output to inputs is expressed by the production function.

$$(7.4.6) \quad O_i = f(X_1, X_2, \dots, X_n)$$

where $X_1, X_2, \dots, X_n$ refer to inputs such as fertilizer, pesticides, irrigation water, land, labour, and other inputs. The production elasticity of output O_i with respect to any input X_k is

$$E_{ik} = \frac{\Delta O_i}{O_i} / \frac{\Delta X_k}{X_k} = \frac{dO_i}{dX_k} \frac{X_k}{O_i} = \frac{d \ln O_i}{d \ln X_k}$$

and the elasticity of input demand with respect to product price is

$$E_{ki} = \frac{\Delta X_k}{X_k} / \frac{\Delta P_i}{P_i} = \frac{dX_k}{dP_i} \frac{P_i}{X_k} = \frac{d \ln X_k}{d \ln P_i}$$

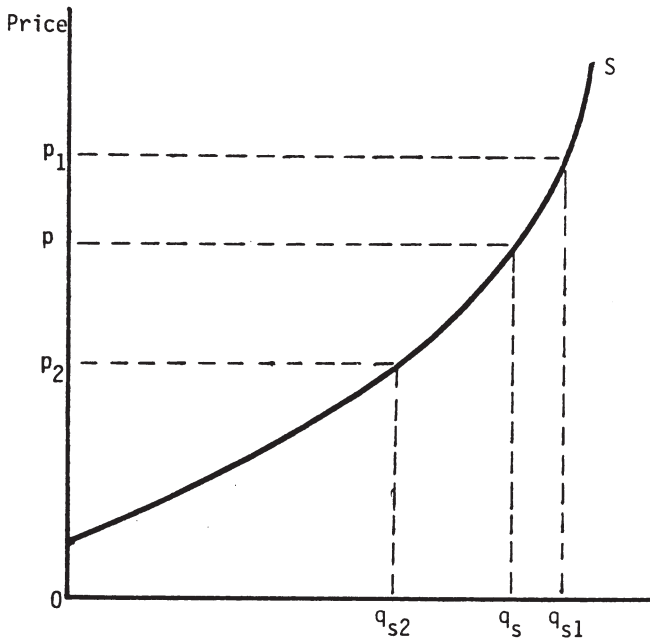


Figure 7.1 - Illustration of supply curve S

It has been^{1/} shown (Tweeten and Quance, 1969) that under specified assumptions^{1/}:

$$E_{ii} = \sum_k E_{ik} E_{ki}.$$

The elasticity of output supply is the input demand elasticity multiplied by production elasticity summed over all inputs. The contribution of input k to the elasticity of supply is $E_{ik}E_{ki}$.

Various methods can be used to estimate the production function. One method is ordinary least squares. A typical formulation is

$$(7.4.7) \ln O_i = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + \dots + b_n \ln X_n$$

where coefficients $b_1, b_2, \dots, b_n$ are elasticities of production. Taking antilogarithms, equation 7.4.7 is the Cobb-Douglas production function.

$$(7.4.8) O_i = b_0 X_1^{b_1} X_2^{b_2} \dots X_n^{b_n}.$$

Because input quantities tend to move together through time, the high correlation among inputs often causes statistical problems in estimating equation 7.4.7 directly from time series. Indirect methods such as the "dual" are sometimes used^{2/}.

In theory, the marginal product of input k is equal to the ratio of input price to product price

$$\frac{dO_i}{dX_k} = \frac{P_k}{P_i}.$$

Multiplying both sides by the ratio of input quantity X_k to output, it is apparent that in competitive equilibrium

$$\frac{dO_i}{dX_k} \frac{X_k}{O_i} = \frac{P_k X_k}{P_i O_i}$$

^{1/} See Gardner (1979) for calculations with interdependent markets.

^{2/} Extensive literature reports the theory and application of the so called "dual" method of indirect estimates of input demand and output supply elasticities. See Lau and Yotopoulos (1972), Binswanger (1974), and Beatti and Taylor (1985).

and the elasticity of production can be measured by the factor share, the right-hand side, which can be computed directly from secondary data sources. Because the elasticity of production equals the factor share only in competitive equilibrium, methods have been devised to estimate the elasticity of production from factor shares in an economy in disequilibrium (Tyner and Tweeten, 1965).

Input demand equations may be specified in a form similar to that for the supply equation 7.4.1 but with input quantity the dependent variable. Technology may be a less prominent variable in the input demand equation. Suppose that the input elasticity of demand has been calculated and that the price elasticity of demand for input with respect to input price P_k is equal (sign reversed) to the elasticity of demand with respect to output price P_i . The contribution to supply elasticity of O_i is shown as:

Input	Elasticity of production	Short Run		Long Run	
		Elas. of input dem.	Cont. to sup. elas.	Elas. of input dem.	Cont. to sup. elas.
Fertilizer	.1	.5	.05	2.0	.20
Land	.3	.0	.00	.3	.09
Labour	.3	.1	.03	.5	.15
Machinery	.1	.0	.00	3.0	.30
Irrigation	.2	.1	.02	1.5	.30
	<u>1.0</u>		<u>.10</u>		<u>1.04</u>

A 1 percent increase in the price of commodity i increases fertilizer use by .5 percent in the short run and by 2.0 percent in the long run. Because fertilizer is a small proportion of all inputs, its elasticity of production is not large. But because demand for fertilizer is responsive to price, fertilizer contributes more to the supply elasticity for O_i than does labour which has a larger elasticity of production.

Analysts may also find it useful to disaggregate supply response into area and yield components. It can be shown (Tweeten and Quance, 1969, p.349) that the total supply elasticity E_{ii} can be expressed as

$$(7.4.9) \quad E_{ii} = E_{yi} + E_{ai}(1 + E_{ya})$$

where E_{yi} is the elasticity of yield with respect to product price P_i , E_{ai} is the elasticity of crop area with respect to P_i , and E_{ya} is the elasticity of yield with respect to area. If crop area is expanded on marginal lands, E_{ya} is negative; if area is expanded on superior lands (say recently irrigated), E_{ya} is positive. If yield and area are independent, then the total supply elasticity of O_i is a simple sum of the yield and area elasticities.

7.4.2 Demand and utilization analysis

Graphs, moving averages, simple linear regression, or other procedures can be used to analyse past trends or predict future trends in consumption or exports. Because the latter two variables are influenced by prices and other factors, a more comprehensive analysis may be desired.

The demand function for a good i may be expressed as

$$(7.4.10) \quad C_i = f\left(\frac{P_i}{PG}, \frac{P_j}{PG}, \frac{Y}{PG}, G, T\right)$$

where C_i is quantity demanded, P_i is the price of good i , P_j is the price of related commodities, PG is the general price level, Y is income, G represents government interventions such as provision of food stamps, and T is a trend variable measuring such factors as changes in tastes and preferences. If demand is measured on a per caput basis, C_i and Y_i are expressed per person. If total demand is measured, then C_i and Y are for the total population and a variable N for population must be added to the right-hand side of equation 7.4.10.

The demand equation may be estimated from time series, sometimes with price rather than quantity dependent. The function may be estimated by an ordinary least squares multiple regression equation (see Tweeten, 1967) or an interdependent system of demand equations for related commodities using two-stage least squares or other simultaneous equation system. In other instances, analysts estimate price and income responses from food consumption data obtained from a cross-sectional survey of consumers.

The quantity C_i may be expressed at the retail level or farmgate level. The quantity may be traditional physical units or a nutrient such as protein or total calories. Measures of protein or total calorie demand are particularly useful to examine the impact of public policies on nutrition by income or occupational groups in the population.

As in the case of supply analysis, it is often convenient to express the response of quantity to price or income as elasticities. The elasticity of demand is the percentage increase in consumption associated with a 1 percent increase in price or income. Own-price elasticity is

$$E_{ii} = \frac{\Delta C_i}{C_i} / \frac{\Delta P_i}{P_i} = \frac{dC_i}{dP_i} \frac{P_i}{C_i} = \frac{d \ln C_i}{d \ln P_i}.$$

Cross-price elasticity is

$$E_{ij} = \frac{\Delta C_i}{C_i} / \frac{\Delta P_j}{P_j} = \frac{dC_i}{dP_j} \frac{P_j}{C_i} = \frac{d \ln C_i}{d \ln P_j}$$

and income elasticity is

$$E_{iY} = \frac{\Delta C_i}{C_i} / \frac{\Delta Y}{Y} = \frac{dC_i}{dY} \frac{Y}{C_i} = \frac{d \ln C_i}{d \ln Y_i}$$

where Δ refers to the change in a variable and d refers to a very small change. If consumers react to real prices and incomes, it can be shown that the sum of the price and income elasticities theoretically is zero. For normal goods, the own-price elasticity is negative and the income elasticity is positive. The cross-price elasticity E_{ij} may be divided into responses for several related commodities, some of which are substitutes for i and have positive elasticities and some of which are complements and have negative elasticities. Analysts have devised procedures to specify an entire matrix of own-price and cross-price elasticities of demand for food in a country (Brandow, 1961: George and King, 1971). Ordinarily, the distinction between short run and long run is not as important for demand as for supply because consumers tend to adjust purchases fairly rapidly to a change in price or income.

Income elasticities vary with income levels. For example, the income elasticity for the poorest 10 percent of the population in India and Indonesia has been found to be .8 and for the richest 10 percent to be .3 (Knudsen and Scandizzo, 1979). Thus a 10 percent increase in real income is predicted to increase food consumption by 8 percent among the

very poor and by 3 percent among the very rich in these countries. If food has few substitutes so that the cross-price elasticity of demand is zero, then the income elasticity is also a measure of the own-price elasticity for food but with the sign reversed. If this were the case in India and Bangladesh, a 10 percent increase in real food price would be expected to reduce food intake by 8 percent for the very poor and by 3 percent for the very rich in these countries. The analyst equipped with estimates of income and price elasticities for total food, for individual food items such as grains and root crops, for calories, and for protein could examine and predict the likely consequences for various segments of the population of government programmes to influence nutrition with a subsidy to producers, a price ceiling to consumers, or with targeted food assistance. The latter might be through food stamps or through direct distribution of a food consumed largely by the poor and made available in fair-price shops.

7.4.2.1 Marketing margins

Governments face a food price dilemma in that to benefit producers, many of whom are poor, they want high supply prices but to benefit consumers, many of whom also are poor, they want low food prices (Timmer et al, 1983). The marketing margin, which is the difference between the farm and retail price of food, ideally is kept low to reduce the food price dilemma. Those who market food from producer to consumer incur costs for procurement, processing, transportation, storage, wastage, and selling which must be covered by receipts or the place, form, and time utility created by marketing activities will not be forthcoming. Consumers and/or producers may be worse off from either too high or too low marketing margins.

Policy analysts can help to inform policy makers by using information from surveys to estimate total and components of marketing margins. These estimates help identify inefficiencies in the marketing system. Marketing margins in the private sector can be compared to marketing costs estimated for an alternative system of marketing such as a state-run agency or a parastatal corporation. For comparison, it is important to estimate not how efficiently a state agency would operate in theory but in practice. Governments which have taken over some or all marketing activities frequently have experienced actual marketing costs (paid for partly out of taxes) that are higher than the "inefficient" private sector they replace.

Marketing margins appropriately vary spatially because of transportation cost and seasonally because of storage costs. These elements need to be included when determining the marketing margin for a specific location and season.

7.4.2.2 Export demand

Exports may be an important component of demand and need to be accounted for in demand analysis of the impact of price on total quantity demanded or the impact on quantity demanded of a change in price. Domestic demand tends to be inelastic so that a given percentage change in price results in a smaller percentage change in quantity (in opposite direction), hence revenue is greater with a lower quantity and higher price. Export demand for any one country tends to be elastic in that a given percentage increase in price induces a larger percentage decrease in quantity. Hence export revenue is less with a higher price.

The total demand quantity q_d for a commodity is domestic demand quantity q_c plus export demand quantity q_x or $q_d = q_c + q_x$. The total demand elasticity is

$$(7.4.11) \quad \frac{dq_d}{dp} \frac{p}{q_d} = \frac{dq_c}{dp} \frac{p}{q_c} \left(\frac{q_c}{q_d} \right) + \frac{dq_x}{dp} \frac{p}{q_x} \left(\frac{q_x}{q_d} \right).$$

It is apparent that the total demand elasticity is a weighted sum of domestic and export elasticities with the respective weights equal to the domestic share and export share of total demand quantity.

Figure 7.2 illustrates demand curves for domestic consumption C and for exports X. Total demand CaD is the horizontal summation of the demand curves for C and X. If price is p , domestic demand quantity is q_c , exports q_x , and total demand is $q_d = q_c + q_x$. If the government intervenes to raise price to p_1 above the world price, the export market is lost. The domestic demand quantity and total demand quantity are q_{d1} . If decision makers wish to retain the export market when price is increased to p_1 , then subsidies could be used to hold the export price to p .

7.4.3 Joining Demand and Supply Analysis

Neither supply alone nor demand alone is adequate to analyse many actual or prospective policies. Joint use of demand and supply to analyse policies is illustrated with Figure 7.3. The domestic demand is D and domestic supply is S. The import supply M is horizontal (perfectly elastic for a small country), implying that the country can import all it desires of the commodity at Price P_e . The supply curve,

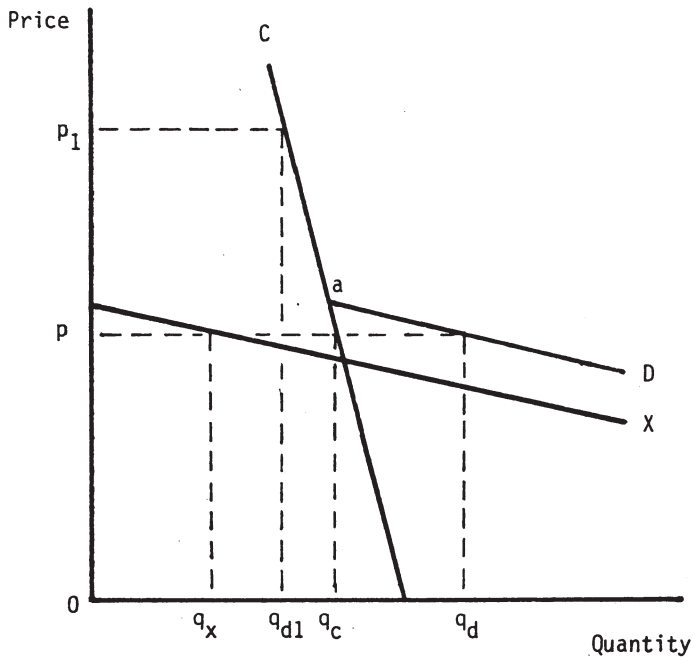


Figure 7.2 - Illustration of demand curves for domestic consumption C , exports X , and total demand CaD

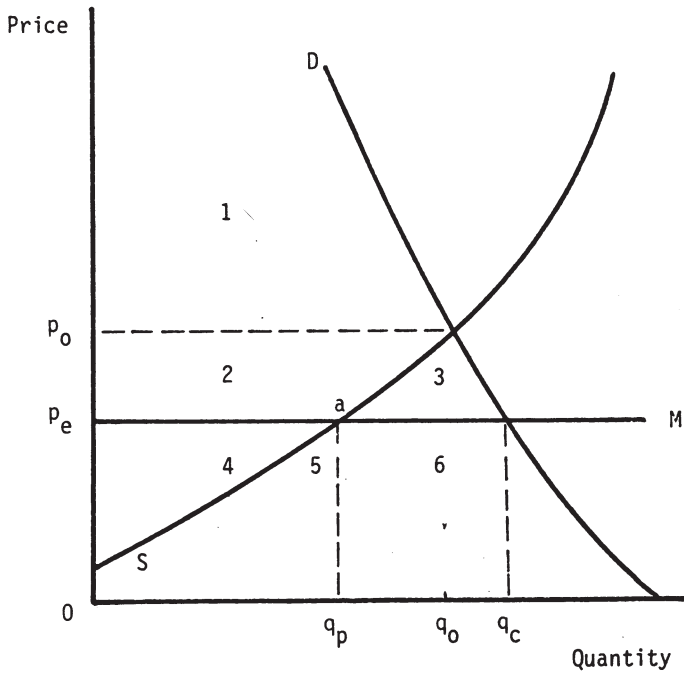


Figure 7.3 - Illustration of domestic demand curve **D**, domestic supply curve **S**, import supply curve **M**, and total supply **SaM**

showing the schedule of prices and quantities that will be supplied at the lowest price, is S_d and the total demand curve is D . Equilibrium in an open market is at the price where supply quantity just equals demand quantity and is at price p_e and quantity q_c in Figure 7.3. Of the total quantity, q_p is from domestic production and $q_c - q_p$ is imported.

Suppose that policy makers decide to pursue a policy of self-sufficiency by eliminating imports and raising the domestic price to p_o . The new quantity supplied and demanded is q_o . It is less by $q_c - q_o$ than the former quantity demanded because consumers cut back purchases along the demand curve D . The new domestic quantity supplied q_o exceeds the former quantity q_p by the amount $q_o - q_p$ which is the domestic supply response along S to the increase in price from p_e to p_o .

Implications of numerous other policies such as taxes, subsidies, or quotas could be examined using demand and supply curves. Simulation (to be discussed in a later section) of an entire system of demand and supply equations provides even greater information, permitting the analyst to measure the impact of a policy change for many commodities whose markets interact.

7.4.4 Classical Welfare Analysis

Analysis thus far has provided little insight into the merits of a particular policy as measured by its impact on producers, consumers, taxpayers, and on national income. The analyst is rarely if ever in a position to designate one best policy because decision makers' objectives tend to be numerous and sometimes obscure. But various analytical tools have been devised to help identify effects on national income and the distribution of that income among producers, consumers, taxpayers, and society. The procedure is called classical welfare analysis^{3/}.

^{3/} For additional discussion of classical welfare analysis, see Timmer et al. (1983, pp.190-94) and Tweeten (1979, ch.16)

The demand curve shows the maximum price consumers would pay for various quantities of a commodity. The benefit of an incremental unit of output is measured by its demand price. If the maximum price were charged for each quantity, the area beneath the demand curve D in Figure 7.3 to the left of q traces out the total revenue available from consuming q .

The supply curve shows the minimum price at which producers are willing to supply the various quantities of a commodity. They will tend to supply additional output if incremental variable costs are covered. The opportunity cost (benefit foregone by not consuming other goods and services) of an incremental unit of output to a competitive supplier is measured by the supply price. If the minimum price were paid for each possible quantity in Figure 7.3, it follows that the total variable cost (benefit foregone of other goods and services) of producing any given quantity q is the area beneath the supply curve in Figure 7.3 to the left of q .

Net revenue or net benefit is the difference between total revenue and total cost. Given that potential total revenue from consuming q_c is area 1 to 6 in Figure 7.3 and total variable cost is area 5 + 6, it follows that the maximum net revenue from producing (or importing) and consuming the commodity is area 1 + 2 + 3 + 4. Any other quantity reduces net revenue and national income. For example, termination of imports to pursue a policy of self-sufficiency at quantity q_o would raise costs of production and reduce gross revenue so that net revenue would be only area 1 + 2 + 4 -- a loss of net revenue indicated by area 3. If a subsidy or other policy were successful in increasing quantity supplied and demanded above q_c , net revenue would be reduced because the incremental cost M of additional supplies exceeds the incremental benefits (along curve D to the right of q_c) of additional consumption. Thus consumption q_c , domestic production q_p , and imports of $q_c - q_p$ provide greatest economic efficiency as measured by net revenue, the contribution of a commodity to national income.

For the supply and demand curves in Figure 7.3 to be valid efficiency measures, they must measure incremental costs and revenues for society^{4/}. Private incremental costs (supply curve) and benefits

^{4/} Classical welfare analysis has been criticised because the marginal utility of income is not constant over the range of the supply and demand curves being considered, the curves are inaccurate outside the range of historical data, and because producers surplus based

(demand curve) will suffice if private firms and individuals respond to incentives and if there are not externalities in the form of social cost (benefits) diverging from private costs (benefits). This assumption will not hold in the case of environmental impacts - costs to society of soil erosion or pesticide contamination of food for example tend to exceed costs paid by the individuals and firms. Net social costs are appropriately measured by areas bounded by social supply and demand curves between the social equilibrium quantity and the actual quantity.

Demand and supply curves in Figure 7.3 are also useful to show the distribution of net revenue. If price is p_e , gross revenue to producers is area 4 + 5. Variable costs equal to area 5 are incurred by producers so their net revenue (return to fixed inputs) is area 4 which is defined as producers surplus.

Consumers would be willing to incur outlays equal to area 1 to 6 for quantity q_c but only have to pay the value in area 4 + 5 + 6, hence they have net benefits called consumers surplus equal to area 1 + 2 + 3 when price is p_e and quantity is q_c . It is apparent that total net revenue is producers surplus plus consumers surplus.

A change in supply-demand quantity from q_c influences not only net revenue but how it is divided. For example, a policy realizing self-sufficiency at price p_0 and quantity q_0 raises net revenue to producers by area 2 and reduces net benefits to consumers by area 2 + 3. Thus consumers lose and producers gain from self-sufficiency. Area 3, the net revenue loss to the country, is the consumers' loss in excess of producers' gain.

on a behavioural supply relationship is an inexact measure of returns to fixed factors (net producer income). These criticisms do not invalidate classical welfare analysis if options considered are within or close to the range of historical data experience, do not entail a major change in income, and if separate estimates (often available) of variable costs and receipts are available to verify and, if necessary, adjust estimates of producers surplus.

It is often convenient to include a third group of gainers or losers from public policy - taxpayers. With taxpayers included, the net gain (loss) to society is the sum of net gains (losses) to producers, consumers, and taxpayers. It is frequently convenient to consider only deviations from the most efficient allocation so that extreme values of demand and supply curves outside the range of historical experience (and which are likely to be inaccurate) do not influence measures of inefficiency.

Figure 7.4 illustrates the impact of subsidies to reduce the food price dilemma by lowering food prices to consumers and raising prices to producers. The domestic demand and supply curves are respectively D and S and the horizontal (small country) export demand curve is X . Without intervention in markets, total demand $D+X$ intersects supply S at equilibrium price p_e and quantity q_p . Of this quantity, q_c goes to consumers and $q_p - q_c$ to exports.

A subsidy of $p_e - p_c$ per unit to domestic consumers raises consumption from q_c to q_c' . The cost of the subsidy to taxpayers is $q_c'(p_e - p_c)$ or area 1 + 2 in Figure 7.4. Compared to equilibrium without intervention at p_e and q_c , the net gain to consumers (consumers surplus) is area 1. Thus the net social cost in foregone national income is area 2 from the subsidy to consumers.

A subsidy of $p_p - p_e$ per unit raises the price to producers to p_p and increases their output to q_p' from q_p . The cost to taxpayers of the subsidy is $q_p'(p_p - p_e)$ or area 3 + 4 + 5 in Figure 7.4. Compared to equilibrium at p_e and q_p , the gain in net income (producers surplus) is area 3 + 4, hence the subsidy to producers reduces national income by area 5. The cost to taxpayers of combined subsidies to producers and consumers is area 1 + 2 + 3 + 4 + 5 in figure 7.4. The results measured as gains and losses compared to no intervention are summarized as follows:

Gain to consumers	1
Gain to producers	3 + 4
<u>Loss to taxpayers</u>	<u>1 + 2 + 3 + 4 + 5</u>
Net loss to society	2 + 5

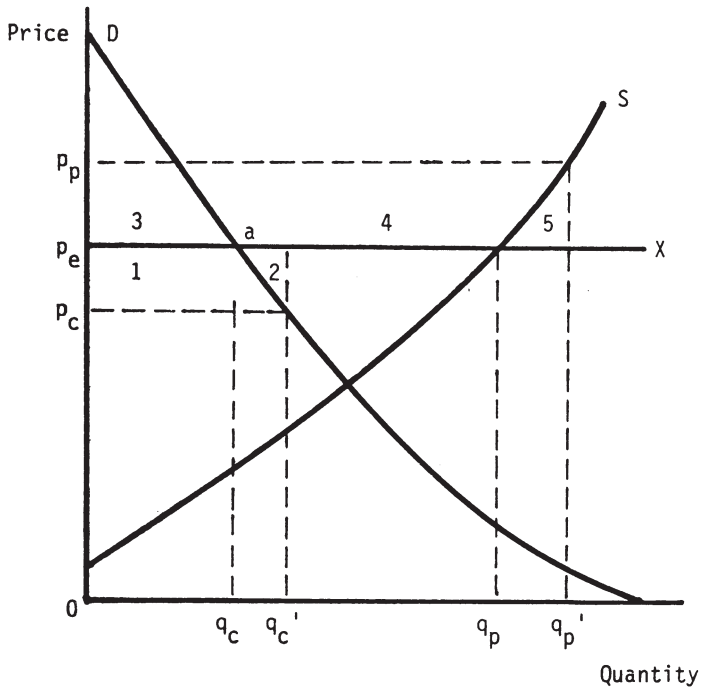


Figure 7.4 - Illustration of domestic supply curve S , domestic demand curve D , export demand curve X , and total demand DaX

Classical welfare analysis is suitable for evaluating impacts not only of taxes and subsidies but also of other distortions such as quotas and exchange rate interventions. An overvalued exchange rate is equivalent to an export tax and an import subsidy; an undervalued exchange rate is equivalent to an export subsidy and an import tax.

The efficiency of the transfer to consumers can be measured by the ratio of area 1 to the transfer cost 1 + 2, to producers by the ratio of area 3 + 4 to transfer cost 3 + 4 + 5, and to consumers plus producers by the ratio of area 1 + 3 + 4 to area 1 + 2 + 3 + 4 + 5. Administrative costs also need to be included in net social costs. An efficient transfer may reduce national income by 4 percent of the income transferred; transfer costs through taxes or subsidies on agricultural output in developing countries tend to be much larger.

If per caput income is sharply different between producers, consumers, and taxpayers (of course any one individual can be all three), efficiency measures may need to be adjusted for the marginal utility of money (see later section on project analysis). If producers have low incomes and taxpayers have high incomes, a transfer of income from taxpayers to producers may be appropriate to raise well being. A cash transfer is often more efficient than price interventions or input subsidies, but cash transfers are often difficult to administer in developing countries. Also food assistance targeted to the poor may be a more efficient transfer than general food subsidies to consumers.

7.4.5 Stabilizing Prices and Consumption

In concluding this section which has dealt with use of demand and supply in policy analysis, it is well to consider briefly an analysis of stabilization of prices and consumption through a buffer stock reserve. Supply and utilization data from the commodity balance equation 7.3.1 can be used to determine statistically appropriate buffer stocks to stabilize consumption given the variability in domestic production, exports, and imports. If the commodity is utilized only for exports and domestic consumption, the change in stock from year to year is $C_t + X_t - O_t$ from equation 7.3.1. The estimated variance in exports is

$$(7.4.12) \quad S_x^2 = \sum_{t=1}^n \frac{(X_t - \bar{X})^2}{n - 1}$$

where $\bar{X}$ is the mean of exports from sample year 1 to year n. The estimated variance in domestic production is

$$(7.4.13) S_o^2 = \sum_{t=1}^n \frac{(O_t - \bar{O})^2}{n-1}$$

where $\bar{O}$ is the mean of production from year 1 to year n. Given a normal distribution, the estimated variance in stocks S_s^2 given that C_t is constant is

$$(7.4.14) S_s^2 = S_x^2 + S_o^2 - 2rS_xS_o$$

where r is the simple correlation coefficient between exports and production.

Given empirical estimates of S_s^2 , stocks required to avoid consumption shortfalls with specified probability can be readily calculated. Buffer stocks of quantity S_s (one standard deviation) will be sufficient to avoid a shortfall in consumption in all but one of six years and buffer stocks of $2S_s$ (two standard deviations) will be sufficient to avoid a shortfall in consumption in all but one of 50 years on the average over the long run. (If trends in exports and production can be predicted, then the values of S_x^2 and S_o^2 can be computed from dispersion around their respective trends rather than around their respective means).

If S_x^2 is 100,000 tonnes, S_o^2 is 1,000,000 tonnes and the correlation^x between X and O is .1, then the estimated variance in stocks S_s^2 from equation 7.4.14 is [100,000 + 1,000,000 - 2(.1)(316)(1,000)] or 1,036,800 tonnes and S_s is 1,018 tonnes. Thus buffer stocks held as carryover from one crop year to the next of $2S_s$ or 2,036 tonnes are adequate to cover a shortfall in production due to unfavourable weather or other shocks to production or exports in 49 out of 50 years. Pipeline stocks needed to fill normal distribution channels and seasonal stocks drawn down from harvest to the end of the marketing season supplement buffer stocks.

It may be noted that the foregoing analysis is to determine statistically appropriate stocks rather than economically optimal stocks. Simulation analysis discussed later has been used to determine economically optimal buffer stock policies to stabilize consumption (see Eaton and Steele 1976).

7.5 Index Numbers, Composite Prices, and Productivity

In empirical estimates of demand and supply, composite measures of prices paid or prices received are sometimes necessary because the price of each commodity or of each resource cannot be included in statistical equations. Analysts frequently wish to measure trends in composite food prices or in the general price level. Also analysts sometimes wish to measure composite farm input and output to gauge productivity gains (ratio of aggregate output to input) and trends in total food production and consumption. In short, aggregation of individual prices or quantities is basic to policy analysis. At issue is how to form meaningful aggregates.

7.5.1 Index Number Formulation

Physical quantities or prices for individual commodities cannot merely be added together but must be weighted properly to form meaningful indices. To construct a quantity index, quantities of individual items are weighted by prices. To construct a price index, individual price components are weighted by quantities. Aggregate input is real resource costs measured in actual quantities of components multiplied by constant prices of inputs; aggregate output is real revenue measured by actual quantities multiplied by constant prices of products. Indices in any given year are expressed as a percentage of the index in some base year.

7.5.1.1 Laspeyres Index

The most widely used aggregation procedure is to weight prices (quantities) by base period quantities (prices) to form a Laspeyres Index. The procedure is illustrated with a simple example where the commodities (inputs or outputs) are Z and Y and p is price and q is quantity (Table 7.1).

The conventional notation is to designate price or quantity in the base year by the subscript zero (0) and in any given year other than the base by the subscript one (1). The Laspeyres quantity index $L(q)$ for the data in Table 7.1 is

$$L(q) = \frac{p_{0Z}q_{1Z} + p_{0Y}q_{1Y}}{p_{0Z}q_{0Z} + p_{0Y}q_{0Y}} = \frac{\sum p_0 q_1}{\sum p_0 q_0}$$

Table 7.1

Data to be Aggregated to Illustrate Index Number Formulas

Year	Commodity Z		Commodity Y		Gross Value (\$)
	Price p(\$/unit)	Quantity q(units)	Price p(\$/unit)	Quantity q(\$/unit)	
1965	.60	1,161	60	60	4,296.60
1975	1.20	725	80	85	7,670.00
1985	2.50	249	120	110	13,822.50

or					L(q)
	1965	(.60 X 1,161) + (60 X 60) = 4,296.60			100
	1975	(.60 X 725) + (60 X 85) = 5,535.00			129
	1985	(.60 X 249) + (60 X 110) = 6,749.40			157.

These values expressed as percent of the base year (1965) constitute the Laspeyres Index and indicate that the aggregate quantity of X and Z increased to 129 percent of the 1965 level in 1975 and to 157 percent of the 1965 level in 1985.

The Laspeyres price index L(p) is defined as

$$L(p) = \frac{P_{1Z}^q q_{0Z} + P_{1Y}^q q_{0Y}}{P_{0Z}^q q_{0Z} + P_{0Y}^q q_{0Y}} = \frac{\sum P_1 q_0}{\sum P_0 q_0}$$

or					L(p)
	1965	(.60 X 1,161) + (60 X 60) = 4,296.60			100
	1975	(1.20 X 1,161) + (80 X 60) = 6,193.20			144
	1985	(2.50 X 1,161) + (120 X 60) = 10,102.50			235.

The Laspeyres Index of price increased from 100 in the base year (1965) to 144 in 1975 and to 235 in 1985.

7.5.1.2 Paasche Index

In contrast to the Laspeyres Index which uses base year weights, the Paasche Index uses weights of the given or "current" year. The Paasche formula for a quantity index P(q) is

$$P(q) = \frac{p_{1Z}^q q_{1Z} + p_{1Y}^q q_{1Y}}{p_{1Z}^q q_{0Z} + p_{1Y}^q q_{0Y}} = \frac{\sum p_1^q q_1}{\sum p_1^q q_0}$$

or

	$P(q)$
1965 $\frac{(.60 \times 1,161) + (.60 \times 60)}{(.60 \times 1,161) + (.60 \times 60)} = \frac{4,296.60}{4,296.60}$	100
1975 $\frac{(1.20 \times 725) + (.80 \times 85)}{(1.20 \times 1,161) + (.80 \times 60)} = \frac{7,670.00}{6,193.20}$	124
1985 $\frac{(2.50 \times 249) + (1.20 \times 110)}{(2.50 \times 1,161) + (1.20 \times 60)} = \frac{13,822.50}{10,102.50}$	137.

The Paasche Index for price is

$$P(p) = \frac{p_{1Z}^q q_{1Z} + p_{1Y}^q q_{1Y}}{p_{0Z}^q q_{1Z} + p_{0Y}^q q_{1Y}} = \frac{\sum p_1^q q_1}{\sum p_0^q q_1}$$

or

	$P(p)$
1965 $\frac{(.60 \times 1,161) + (.60 \times 60)}{(.60 \times 1,161) + (.60 \times 60)} = \frac{4,296.60}{4,296.60}$	100
1975 $\frac{(1.20 \times 725) + (.80 \times 85)}{(.60 \times 725) + (.60 \times 85)} = \frac{7,670.00}{5,335.00}$	139
1985 $\frac{(2.50 \times 249) + (1.20 \times 110)}{(.60 \times 249) + (.60 \times 110)} = \frac{13,822.50}{6,749.40}$	205.

7.5.1.3 Fisher Ideal Index

It is apparent that the Laspeyres Index and Paasche Index do not give the same measures of the composite quantity or price indices. The advantage of the Laspeyres Index and a reason it is most widely used is its convenience. Only base period prices are needed to compute the quantity index and only base period quantities are needed to compute the price index. This saves expenses of gathering data. In this example, the Laspeyres Index gave the higher estimate of the composite price and quantity changes. The Paasche Index gave lower estimates of the composite price and quantity changes for 1965 to 1985. The two indices give the upper and lower bounds of changes in price and quantity but there is no resolution to the issue of which is more accurate.

Although the index number problem has no solution, the Fisher Ideal Index has been proposed as a compromise between the extreme results from the base period weighting under the Laspeyres Index and given period weighting under the Paasche Index. The Fisher Ideal is the geometric mean of the Laspeyres and Paasche Indices. The Fisher Ideal Index is $F(p) = \sqrt{L(p)P(p)}$ for price and $F(q) = \sqrt{L(q)P(q)}$ for quantity. The Fisher Ideal not only gives results between the Laspeyres Index and the Paasche Index, it also meets the so called factor reversibility test. That is, the Fisher Index for price multiplied by the Index for quantity gives the actual exact index for the value computed directly from the price and quantity data in Table 7.1.

Results are summarized for the example in Table 7.2. The Fisher Ideal Index is preferred conceptually but requires more data than the Laspeyres Index. The three index number formulas do not exhaust the possibilities - other index number formulas have been proposed and utilized (see Tomek and Robinson, 1981, pp.204-269; Yamane 1967, ch.11, for further discussion of formulations). The actual choice of formulas will depend on the data and computational resources available. A common approach is a combination of the Paasche and Laspeyres formulations by using base period weights but updating them periodically to better represent current price or quantity weights.

7.5.2 Index Number Uses

Examples of composite series useful in the analytical programme are indices of prices received and paid by producers and indices of factor or multifactor productivity.

7.5.2.1 Price Indices

An index of prices received by producers measures trends in a composite of commodities produced by farmers. The composite may be for commodity groups such as coarse grains, foodgrains, all crops, all live-stock and livestock products, or for crops and livestock combined. Trends in such series may be of interest directly or indirectly for inclusion in supply analysis discussed earlier.

An index of prices paid by producers measures trends in a composite of inputs. The composite may be for an input group such as purchased inputs, production inputs, purchases for consumption, farm produced inputs, or for all inputs. An input price index may be used to adjust commodity support prices or to deflate prices in supply analysis.

Table 7.2
Summary of Quantity, Price, and Value Indices
Computed from Laspeyres, Paasche, and Fisher Ideal Formulas

Year	Quantity	Price	Value	Actual Value
Laspeyres				
	L(q)	L(p)	L(q)L(p)	
1965	100	100	100	100
1975	129	144	186	179
1985	157	235	369	322
Paasche				
	P(q)	P(p)	P(q)P(p)	
1965	100	100	100	100
1975	124	139	172	179
1985	137	205	281	322
Fisher Ideal				
	$\sqrt{L(q)P(p)}$	$\sqrt{L(p)P(p)}$	F(q)F(p)	
1965	100	100	100	100
1975	126	142	179	179
1985	147	219	322	322

The ratio of the index of prices received by producers to the index of prices paid by producers measures the terms of trade for agriculture. Changes in terms of trade can measure changes in farm economic well-being or incentives to produce. It is important to note, however, that the well-being of persons in agriculture depends on productivity, off-farm income, and other factors as well as on terms of trade.

7.5.2.2 Productivity

Productivity generally refers to ratios of input to output (US Department of Agriculture, 1980). If only one input and one output are involved, productivity can be measured by technical efficiency. With more than one input or output, economic efficiency is involved because aggregation is necessary using price-weight procedures described above.

Productivity does not necessarily measure economic efficiency (Tweeten 1979, ch.5). The divergence between the two concepts is greatest for partial productivity measures. Common partial productivity measures include gross farm output per unit of farm labour, persons supplied per farm worker, or crop yield per hectare. Improving economic efficiency entails substitution of profitable and productive conventional inputs such as farm labour and land. In the process, output per unit of labour increases as output expands or as less efficiency labour resources are released to other uses. Thus increased labour productivity as measured by gross output per unit of labour may be a sign of labour inefficiency - economically inefficient labour in a sector is replaced by improved capital inputs.

Measuring the economic efficiency of agriculture requires both static and dynamic measures. Static measures of efficiency were listed in earlier sections and include rates of return on resources, benefit-cost ratios, and net social loss or gain. A traditional farming economy characterized by a closed set of technologies for decades is likely to have made resource adjustments eliminating economic disequilibrium. That is, resources are allocated to their highest and best use. Lack of profitable alternatives that would reward producers for foregoing consumption to invest for the future retards economic progress. Dynamic efficiency is unlikely to be evident despite presence of static efficiency.

Multifactor productivity as measured by total input relative to total output over time is a useful measure of dynamic efficiency. As productive and profitable improved inputs are made available from agricultural research, extension, and education in a traditional economy, economic disequilibrium will become apparent in higher rates of return on new inputs such as high-yielding varieties. As producers adopt these new inputs, total inputs will be reduced or output expanded to increase multifactor productivity. Thus a dynamic agriculture may show static inefficiency but does not necessarily indicate static efficiency - static measures of efficiency may show disequilibrium over a period of multi-factor productivity growth.

Static measures of efficiency are useful to show opportunities for allocating resources and products in ways that reduce real costs or increase real output, and to show the social costs of not seizing such opportunities. An economy that creates static disequilibrium through improved inputs from agricultural research and extension and has producers who quickly allocate resources to reduce static disequilibrium will display much dynamic efficiency apparent in productivity gains and national income growth. Human resource investments can be decisive in increasing capabilities of producers to respond appropriately to disequilibrium. If producers respond and static disequilibrium is reduced, the result will be apparent in increased multifactor productivity and

national income. But in a truly dynamic economy, agricultural disequilibrium will constantly be generated from a continuing flow of improved capital inputs, technology, management, marketing, and product mixes. Disequilibrium is unlikely to be fully eliminated even if producers are responsive to continuing incentives for change in a growing economy.

Multifactor productivity ideally is measured by total output divided by total inputs including conventional farm labour, management, and capital (including land) as well as non-conventional inputs such as general and vocational education and agricultural research extension. In the case of durable resources the input is measured by the service flow cost - interest, depreciation, repairs, and maintenance.

Non-conventional inputs are not easily measured and a common procedure is to estimate productivity as real farm output per unit of conventional farm inputs. This series has the advantage of showing shifts in the aggregate farm supply curve over time and hence for predicting future supply-demand balance and real price trends. But it has the disadvantage of any partial productivity measure. That is, the way to increase efficiency of conventional resources is to use non-conventional resources to the point where their marginal productivity is zero. Because these non-conventional resources have an opportunity cost (resources used for research, education, and extension have value elsewhere), it is inefficient to drive their marginal product to zero. It follows that an analytical programme must consider the efficient use of both conventional and non-conventional resources^{5/}. Rates of return on conventional inputs or non-conventional inputs (see Ruttan 1982) above or below rates of return elsewhere (adjusted for risk) imply static inefficiency which eventually will be apparent in dynamic efficiency.

5/ Sometimes it is useful to measure sources of output gains over time. Using terminology from section 7.4 and given the elasticity of production E_{ik} of input k with respect to output i , the percentage increase in output i , O_i , is

$$O_i = \sum_k E_{ik} X_k$$

where X_k is the percentage increase in input k . The formula enables the analyst to estimate the contribution of each input k to output over time.

7.6 Economic Accounts for Agriculture

Agricultural analysis, formulation of economic policy and development planning generally require comprehensive and coherent information on all aspects of agricultural activity. Traditional agricultural statistics provide a wide range of data on crops, livestock, prices, etc. Such data are usually presented as separate and independent information, and it is necessary to have a coherent framework in which such data can be described and presented for analysis. The economic accounts for agriculture (FAO 1985a) provide such a framework for recording data relating to agricultural production and other activities in agriculture. Since agriculture is only a part of the total economy, these accounts are designed to fit the general scheme of accounts for the economy as a whole consisting of a system of national accounts, and they provide background information necessary to assess agricultural activities and developments against the performance of the other sectors.

The economic accounts consist of three basic accounts - production, income and outlay, and capital formation - and a number of supporting tables and worksheets. The main accounts match total agricultural production against the inputs used in production, capital formation against its finance; and income received by agricultural holdings against their expenditure. The supporting tables and worksheets provide detailed information from which the aggregates presented in main accounts are computed. As these accounts are compiled using alternative sources of information such as the agricultural census, farm management reports and household expenditure surveys, the economic accounts are also useful in checking the internal consistency of all the data relating to the sector.

The production account can provide a detailed picture of the structure of the industry - the composition of total agricultural output, the inputs used in producing these goods and their cost, the value added generated in the sector and its distribution among the population engaged in agriculture. When built up into time series with production accounts spanning a number of accounting periods, expressed in constant prices using index number methods discussed in Section 7.5, trends in pattern of production, sales, and shifts in emphasis from one type of farming to another become apparent. Such series also facilitate analysis of the inter-active effects of prices, production, sales and costs, ex post evaluation of on-going programmes, and observation of the effects of agricultural policies.

These accounts, as part of a system of national accounts, show the contribution of agricultural sector to the total gross domestic product of a country reflecting the importance of the sector to the total economy. The production account aggregates can be combined with figures for the number of persons engaged in agriculture to measure labour productivity in agriculture and such measures are necessary to make comparisons of inter-sectoral efficiency. It is possible to account for the dualistic nature of agriculture in many developing countries, and prepare separate economic accounts that are suitable for comparing income of traditional agricultural sector with income of the more advanced agricultural sector. Further, information contained in the worksheets and supplementary tables can be used in the computation of volume indices for inter-regional and inter-country comparisons of output and productivity.

The information on input use and output mix contained in these accounts can be used in the construction of input-output tables which provide a useful aid to answering questions about how the economy will respond to particular changes and what are the repercussions of changes in the final demand requirements on other industries.

Extensive analysis of the material presented in these accounts can be undertaken to throw light on many facets of the sector and assist in decision making processes connected with the planning and future development of agriculture, but only a few major aspects were highlighted in this section.

7.7 Project Analysis

Many agricultural policies entail investment, production, and income streams spread over many years. Analysts frequently are called upon to evaluate the net payoff from past projects or to determine the economic feasibility of prospective projects. Numerous such analyses have been made for human resource investments in general education (Hansen 1963) and vocation-technical training (Shallah and Tweeten 1970); in irrigation, roads, bridges, and transportation (Adler 1971); and in agricultural research and extension (Ruttan 1982). The theory and application of project analysis is detailed in a number of sources (see Little and Mirrlees 1969; Squire and Van der Tak 1975; Gittinger 1982).

7.7.1 Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return

Conceptually, the requirement for project analysis is to determine the stream of costs of the project $C_0, C_1, \dots, C_n$ and benefits $B_0, B_1, \dots, B_n$ over the n -year life of the project (until C_{n+1} and $B_{n+1} = 0$). The streams of costs and benefits are discounted or compounded to a common point in time. If the discount rate (to be discussed later) on funds for the project is r , the net present value (NPV) of the project is

$$(7.7.1) \text{ NPV} = B_0 - C_0 + \frac{B_1 - C_1}{1 + r} + \frac{B_2 - C_2}{(1 + r)^2} + \dots + \frac{B_n - C_n}{(1 + r)^n}$$

where the subscript 0 refers to the first day of the project, subscript 1 refers to the end of the first year, and so forth. Of course, some of the B s and C s may be zero in the above formula. If the net present value is positive, the project is attractive to decision makers.

Other formulations are also used to measure economic payoff from projects. Sometimes a benefit-cost ratio is computed from the same data as in equation 7.7.1. The benefit-cost ratio is calculated as

$$(7.7.2) \text{ B/C} = \frac{B_0 + B_1/(1 + r) + B_2/(1 + r)^2 + \dots + B_n/(1 + r)^n}{C_0 + C_1/(1 + r) + C_2/(1 + r)^2 + \dots + C_n/(1 + r)^n}$$

Other things equal, projects with high B-C ratios are favoured over those with low ratios. If only one project can be undertaken, the project with the highest NPV may be selected. In other instances, a choice must be made among several projects, any one or more of which are potentially fundable. Two or more projects funded simultaneously may provide a higher net present value than one large project. If projects are not mutually exclusive, they may be ranked by B-C ratios. But the ranking of projects depends heavily on the discount rate chosen to compute NPV or the B-C ratio, a rate that decision makers may wish to vary for purpose of comparison but which tends to be inflexible and hidden in benefit-cost analysis.

If projects are not mutually exclusive, decision makers may desire to judge projects on the basis of the internal rate of return, choosing projects offering the highest internal rate of return. The internal rate of return is found by solving for the value of the discount rate r that makes the NPV equal to zero:

$$(7.7.3) \quad B_0 - C_0 + \frac{B_1 - C_1}{1+r} + \frac{B_2 - C_2}{(1+r)^2} + \dots + \frac{B_n - C_n}{(1+r)^n} = 0.$$

Given values for B_s and C_s , the internal rate of return r is calculated with ease using business calculators or programmes available for main-frame computers or microcomputers.

Even if economic benefit and cost streams are accurately measured, the resulting NPV, B-C ratio, or internal rate of return do not provide all the information often needed by those who make decisions. The analyst may also be called upon to provide measures of the riskiness of the project, whether it might be undertaken by the private sector rather than by the public sector, and the distribution of costs and benefits among groups arrayed by income level.

7.7.2 Choice of Discount Rate

The discount rate used to calculate a benefit-cost ratio or net present value may be the rate at which consumers discount future versus present consumption or may be the rate of return on funds invested in alternative projects. Consumers on the whole prefer present to future consumption. The poorer the consumers, the higher the premium placed on present consumption. In a well-functioning economy, the consumption rate of discount will equal the return on savings and investment which will equal the interest rate with appropriate adjustment for risk among investments. A typical discount rate or real rate of interest (market rate of interest less the inflation rate) is 10 percent in developing countries. A higher discount rate implies a greater premium on current consumption, greater incentive to save, and emphasis on investments that promise early payoffs. A common procedure in project analysis is to compute NPV and the B-C ratio using alternative discount rates so that the decision maker can compare results and determine sensitivity of results to alternative choices of discount rates.

7.7.3 Estimating Benefit and Cost Streams

The greatest challenge in project feasibility analysis is to determine the flow of benefits and costs. The principles of estimating costs and benefits are similar to those for classical welfare analysis discussed earlier. The area beneath the long-run social demand (long-run marginal revenue) curve is benefit B_1 and the area beneath the long-run supply (long-run marginal cost) curve is cost C_1 . The difference between benefits with and without the project estimated for each year of

the project traces the benefit stream. A similar procedure for costs (variable costs with and without the project each year) traces out the cost stream.

Principles of determining benefits and costs are illustrated further using the Policy Analysis Matrix (PAM) in Table 7.3. The table lists the accounting matrix for one year. Investments with a longer duration require comparable calculations for each year of the life of costs and benefits, a task made manageable by systematic trends in data. Calculations need to be in constant (inflation corrected) prices if real rather than nominal rates of return are at issue. Net costs (benefits) are from the differences calculated with and without the project.

The first row in Table 7.3 measures profits based on actual market prices, costs, and receipts, hence is applicable to a private firm. Changes in the first row can indicate the impact on private firms of changes in price supports, taxes, subsidies, research, or other public projects and policies.

Table 7.3

Accounting Matrix for Static Efficiency and Policy Analysis

	Receipts	Costs		Receipts
		Tradeable Inputs	Domestic Factors	Less Costs Profits
Private prices	A	B	C	D ¹
Efficiency on social prices	E	F	G	H ²
Effects of policy and market failures	I ³	J ⁴	K ⁵	L ⁶

Source: Hillman and Monke (1985, p.8); and Pearson (1985).

1. Private profit, $D = (A-B-C)$
2. Social profit, $H = (E-F-G)$
3. Output transfers, $I = (A-E)$
4. Input transfers, $J = (B-F)$
5. Factor transfers, $K = (C-G)$
6. Net policy transfers, $L = (D-H) = (I-J-K)$

Evaluation of payoffs in efficiency prices or social prices in the second row in Table 7.3 is appropriate to determine net benefits of a project or policy for society as a whole. Efficiency prices are appropriate if the objective of public policy is to increase real national income. Appropriate efficiency prices for commodities that are internationally traded are world border prices - expected cif import prices for importables and expected fob export prices for exportables. That is, efficiency prices reflect the opportunity cost of importing to meet domestic needs using foreign exchange or selling abroad to earn foreign exchange.

World prices for domestic factors of production (labour and capital) tend to be inappropriate or unavailable. Hence these factors are valued according to their social opportunity cost as measured by national income foregone by removing the factors from their next best alternative. These factor costs must be adjusted to correct for market failure such as environmental degradation and for distortions introduced by taxes, exchange rates, subsidies, interest rate ceilings, union wage scales, or other public or private interventions that reduce efficiency allocations.

Tradeable commodities and inputs are defined as those which are traded internationally. Non-tradeable commodities and inputs are neither imported nor exported because it does not pay to do so, so that prices are determined by the domestic market. Prices of non-tradeables are influenced by distortions in prices of tradeables. Hence prices of non-tradeables must be adjusted if market prices of tradeables are adjusted. The preferred adjustment is to compute the value of non-tradeables from the corrected value of tradeable inputs, capital, and labour used in the non-tradeable items. This requires complex input-output tables measuring inputs by source to produce non-tradeables. Such information may be unavailable or highly inaccurate in developing countries. An alternate procedure is to use domestic prices of non-tradeables adjusted for distortions such as subsidies or taxes causing deviations of prices from those of a well-functioning market. (It may also be noted that receipts in Table 7.3 may need to be divided into those for tradeable and non-tradeable commodities.) Durable capital costs are expressed as the flow of inputs necessary to maintain output. The flow includes depreciation, interest, maintenance, and operating costs. Land may be costed in the same manner or by its rental value.

The last row in Table 7.3, the difference between the first and second rows, measures the effects of policy and market failure. In the absence of market failure or policy distortions, all entries in the final row will be zero, and what is profitable for private firms will also raise national income.

In the case of a project with benefits (receipts) and costs spread over several years, the difference between benefits (costs) with and without the project for each year can be entered in equation 7.7.1 and the net present value calculated and compared with other projects. The data are from the first row of Table 7.3 for a private firm and from the second row for a public project.

If an internal rate of return is calculated, an iterative procedure is required because the cost of durable inputs must include interest charged at the internal rate of return. After solving for the internal rate of return, that return is then used to charge for durable capital. The procedure is repeated until the calculated internal rate of return is also the interest rate on durable capital - a procedure made manageable on a microcomputer or mainframe computer.

As indicated earlier, the second row in Table 7.3 determined from efficiency prices indicates the influence of a project on national income. An alternative is to measure costs, benefits, and net benefits at social prices to account for the value of a more equitable distribution of income. One approach is to adjust the efficiency measures by the marginal utility of income. To do so, those who will pay costs (taxpayers, investors, etc.) and who will receive benefits (consumers of a public project) may be divided into income quintiles or other grouping based on total income per family. The cost incurred and benefits received by each income group can be assigned a marginal utility of income based on weights (1) given by policy makers or (2) from a utility function derived from socio-psychological measures of well-being (see Harper and Tweeten 1977; Tweeten, Mylay, and Dellenbarger 1986). Multiplying efficiency benefits and costs for each income group by the marginal utility of income (for convenience, the middle income quintile can be normalized to a marginal utility of 1.0) and summing over all income groups forms the social benefit-cost ratio to be compared among projects.

Data may not be available or reliable to convert efficiency measures of row 2 into social well-being measures or even to show the distribution of costs and benefits among income groups. In such cases, decision makers will use ad hoc judgements to adjust efficiency measures of project appraisal for social and political factors that influence the choice of projects. In some instances, both equity and efficiency are enhanced by making investments solely based on efficiency and using direct transfers to raise incomes of the poor (see Harberger 1984).

Finally, social net benefits might be adjusted for riskiness of each of several projects in determining the net social benefits among several projects whose social feasibility is being estimated.

7.8 Simulation Analysis

Simulation attempts to reproduce on a small scale the actual essential elements of an operating market, socio-economic system, or other unit of inquiry. By allowing the analyst to observe and experiment with the working of the system in the "laboratory" of a computer model, simulation is a powerful tool of policy analysis. Because of computational requirements of simulation models, it is not coincidental that their popularity has been closely correlated with the use of computers.

Simulation may be simple or complex. Trade-offs are inevitable: large models provide greater realism but are costly to build and maintain; small models are less costly but may lack essential realism. There is merit in keeping simulation models as simple as possible consistent with meeting needs of policy analysts.

7.8.1 System Simulation Models

System simulation emphasizes accounting for all components in the system that bear significantly on the analysis and solutions to problems. System simulation models offer a broad and flexible means of dealing with the complexities of monitoring and evaluating food and agricultural policies, programmes, and projects. Their flexibility rests in their building-block organization, allowing for the development and incorporation of new components and the substitution of complex components for simpler ones as necessary to suit the particular analysis. They also allow for the use of a wide range of modelling techniques from different disciplines, depending on the needs at hand. Simulation is adaptive in that improved knowledge about data and structural relations can be progressively incorporated into the models.

A simulation model can incorporate one or more of several models discussed in this report including supply, demand, and balance sheet components; linear programming and other optimizing procedures; and behavioural equations. It can predict real world behaviour or show the impact of policy experiments including alternative tax rates, quotas, price controls, investments in land and water development projects, land reform, and population planning.

Because any model is only an approximation of reality, there will always be errors in its absolute predictions. Relative consequences, however, while still subject to error, tend to be more reliable in that data and structural inaccuracies usually affect the results of different

experiments in the same ways. For example, if simulation of Policy A results in \$100 million of additional farm income by 1990 while Policy B yields \$150 million, the fact that Policy B gave 50 percent more income relative to A may be a more accurate piece of information than the absolute numbers of \$100 million and \$150 million.

7.8.2 Selection of Model Type and Modelling Approach

Simulation models can have numerous forms including (Manetsch 1978):

- (1) a microscopic (individual or firm) versus macroscopic view (sector or national);
- (2) static versus dynamic behaviour, where dynamic models are generally characterized by feedback loops and time lags;
- (3) deterministic versus stochastic behaviour, where stochastic models explicitly include probability distributions to treat data series and parameters as random variables;
- (4) linear versus non-linear behaviour, where an example of a linear model is a doubling of fertilizer application causing a doubling of rice yield, and where a non-linear model allows for diminishing returns, thresholds, saturation points, and other types of constraints;
- (5) optimizing versus non-optimizing behaviour, where an optimizing model attempts to identify decisions which maximize profits, security, happiness, or efficiency or which minimize costs, poverty, malnourishment, or trade deficits; and
- (6) structural versus predictive, where predictive models emphasize ability to forecast future outcomes whereas structural approaches emphasize causal relationships among important variables of the system. These structural relationships are deduced using appropriate theory from disciplines such as economics, sociology, biology, and physics. The structure of the model, once specified, determines what data and statistical analyses will be needed to estimate parameter values and test the model's validity.

Emphasis in structural models is on the theoretical and logical validity of the causal relationships in order to understand why certain behaviour occurs in response to past and proposed policy conditions. For this reason, structural models are typically better at predicting and explaining qualitative behaviour and responses than at making forecasts of absolute numbers.

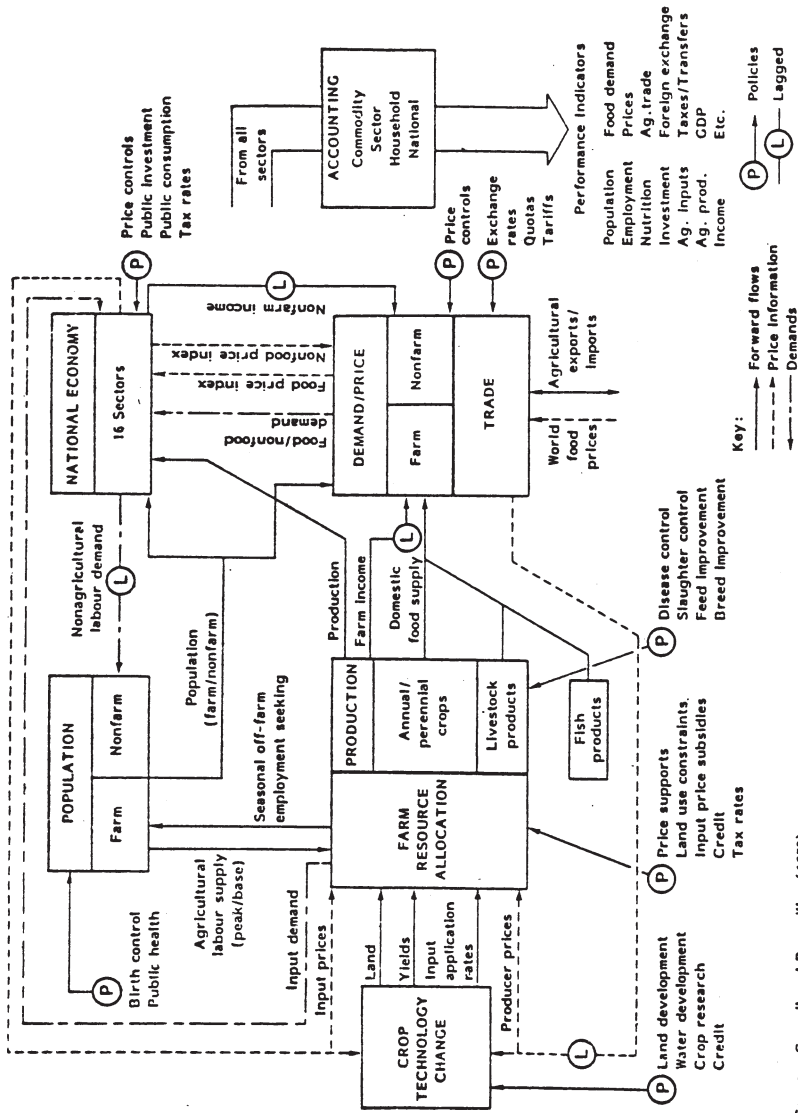
By contrast, behavioural predictive models are developed through an inductive process. Beginning with empirical data on the behaviour of variables of interest, relationships are chosen according to some criterion such as a least-squares fit. These statistical relationships will be a satisfactory predictor of what behaviour may occur under conditions similar to those used to estimate them in the first place. However, an understanding of how or why that behaviour occurs (i.e., causal relationships) is important in making decisions about the future under conditions which may never have existed before - a common situation in development planning. Because structural and predictive modelling have their own respective strengths and weaknesses, it is not surprising that practical models for policy analysis are hybrids typically falling somewhere between the two extremes.

Some general statements can be made about the requirements of developing and operating various types of models (Manetsch 1978):

- (1) Dynamic models are usually more costly to develop than static models. However, they usually provide decision makers with significantly more useful information.
- (2) Stochastic models usually are not much more expensive to build than deterministic models, but they are much more expensive to operate on computers.
- (3) Optimizing models are usually more expensive to operate than non-optimizing models.
- (4) Model development costs tend to go up much faster than the model size.

7.8.3 Model Specification

The building-block approach is most suitable for construction of system simulation models. For example, Figure 7.5 is a diagram of a complex simulation model developed for agricultural sector policy analysis which uses a variety of modelling approaches: the national economy component uses a 16-sector input-output model; the population component utilizes a cohort-survival model; the crop technology change component follows a production function approach; the resource allocation component is based on a recursive linear programming model; and the demand/price/trade component operates as a simultaneous-equation, market-clearing model. The interested reader is referred to Chapters 5-10 in Rossmiller (1978) for further background and descriptions of the overall system model and its components.



Source: Carroll and Rossmiller (1978).

Figure 7.5 - A five-component agricultural sector simulation model

7.8.4 Data Sources and Requirements

In general, the aggregation levels decided upon in the model specification stage for commodities, population groups, or geographic regions heavily influence a model's specific data requirements, data sources, and procedures for estimation. For example, depending on the country and the purposes for the model, it might be important to treat rice, corn, wheat, beef, and milk as separate commodities (although even these products are aggregates of components with different characteristics), while grouping other commodities, such as fruits, vegetables, and industrial crops.

As an illustration, Table 7.4 shows a few of the data requirements of the agricultural sector simulation model described above and in Figure 7.5. The sources used to fulfill these requirements (also indicated in the table) include measurement instruments discussed in Chapters 5 and 6, results of separate analyses, and experimental assumptions. For each of the five component models, selected data requirements are listed in three major categories:

- (1) initial conditions of internally computer variables;
- (2) values of parameters measuring the strengths of technical, institutional, and behavioural relationships; and
- (3) values, for each time period to be simulated, of exogenous variables such as government decisions.

Sensitivity testing is an important method for determining how much the outputs of the model are influenced by possible errors in the model's data series and parameter values. It involves making systematic changes in appropriate data and parameters, based on the degree of uncertainty regarding their accuracy, and then examining the effects of those changes in one or more model outputs. Sensitivity testing helps set priorities on efforts to improve the parameter estimates and data in the model, thereby allocating scarce resources for data collection and analysis in a cost-effective manner.

7.8.5 Computer Implementation

Solving a model refers to the process of determining the behaviour of the endogenous variables over time, given particular initial conditions of those variables and values of input variables (e.g., policies, weather conditions) over time. In the case of simple models, it may be possible to apply mathematical techniques such as calculus and

algebra to arrive at a general solution to equations of the endogenous variables as functions of the input variables. However, such solutions are generally impossible for large, complex, non-linear, socio-economic models. In such cases, it is necessary to use numerical analysis techniques, the basis of simulation, in which solutions are found by stepping the model through time in small increments to generate a particular time series of numerical values for the endogenous variables.

7.8.6 Model Testing and Credibility

The credibility of a model is tested every time it is used for policy analysis. Credibility testing involves checking:

- (1) the logical structure, defined as the conceptual validity and internal consistency of the model's structure;
- (2) the predictive capability, defined as the model's ability to predict the real world. Failure of the model to track historical values within some acceptable range indicates problems in the structure of the model, in estimated parameter values, or in the time-series data supporting it;
- (3) the clarity of the model, i.e., that it be unambiguous and easily communicated to analysts and decision makers; and
- (4) the workability both of the model, in terms of its utility in operation, and of the policy recommendations resulting from its use in policy analysis.

Finally, decision makers themselves make judgements about the utility of a model in terms of (1) the value of the information received as compared to the cost of acquiring it, and (2) the workability of the policies which have been implemented partly on the basis of the results of the modelling exercise. Ultimately, this may be the most important test, for it concerns the usefulness of the information for decision making - the overall objective of the information system as a whole.

Simulation models formulated for various developing countries are described elsewhere (see Thorbecke and Hall 1982; Rossmiller 1978). Such models are highly diverse and are capable of addressing issues of efficiency, equity, and variability. Some stochastic models are suited to analyse commodity stock operations and other programmes to reduce variation in food supplies and prices.

7.9 Mathematical Programming

Econometric and simulation models have obvious advantages when based on statistical relationships which extract maximum information from historic data and with measures of statistical reliability of estimates based on probabilities. However, econometric techniques alone are not well suited for analysing policies outside the range of past experience, do not adequately handle detailed constraints such as seasonal land and labour restrictions, and have limited ability to provide detail on land and other shadow prices, export earnings, and impacts on farms of specific type, size, and location. Mathematical programming or activity analysis is an analytical tool that has been used to overcome these shortcomings, although the tool itself also has shortcomings described later.

Governments have multiple and conflicting objectives including economic efficiency, equity in income distribution, low unemployment and underemployment, low and stable food prices, high and stable farm prices, improved nutrition, protection of the environment, positive trade balance, and self-sufficiency in staple foods. Mathematical programming, which potentially can account for a wide range of objectives and constraints, offers promise for policy analysis in such situations. Rarely if ever can one best solution be obtained; the major contribution to policy decisions is to show the trade-offs among the various objectives and constraints.

7.9.1 Basic Programming Model

The linear programming model is of the form

$$(1) \text{ Maximize } C_1 X_1 + C_2 X_2 + \dots + C_n X_n$$

$$(2) \text{ Subject to } AX' \leq b$$

$$(3) \text{ and } X_1, X_2, \dots, \geq 0$$

where (1), the objective function, may be net returns (gross returns above expenses), net social gain (consumers surplus plus producers surplus) as defined earlier, or other policy objectives specified by decision makers (see Heady and Candler 1958; Norton and Schiefer 1980; Kutcher and Norton 1982). The $C_1, C_2, \dots, C_n$ are respective net contributions per unit of activities $X_1, X_2, \dots, X_n$ to the objective function. (Alternatively, the objective function may be minimized as in the case of risks or costs of production or transportation). The column vector b refers to constraints $b_1, b_2, \dots, b_m$ such as seasonal

availability of land, labour, capital, and other resources, and may include policy restraints such as quotas or minimum production targets that are forced to be met. X' is a column vector of $X_1, X_2, \dots, X_n$ and A is an $m \times n$ matrix of technical coefficients. Each coefficient a_{ij} indicates the requirement of b_i per unit of activity X_j .

Analysts have been ingenious in adapting activity analysis to a wide range of policy issues (see Thorbecke and Hall 1982; Norton and Schiefer 1980). Programming to maximize net income on a farm firm depicting representative or typical resource and marketing situations can provide policy makers with information on cost of production, economies of size, or the impact of a change in price supports or other policies on farm firm output and income. Programming of representative farms using border (world) prices (with adjustment of prices to correct for overvalued or undervalued exchange rates, for input or output taxes and subsidies, and for other price distortions) can give useful insight into comparative advantage. In Liberia, for example, analysts (Epplin and Musah 1985) found that the opportunity cost or shadow price of rice production was 27 cents per pound in terms of foregone income from tree crops (coffee, cocoa, rubber, and palm products). The border price of rice was 9 cents per pound. Thus a government policy promoting self-sufficiency in rice could reduce national income and potentially confront individual producers with loss of food in that they could have three times as much rice by producing tree crops for the market than by using their limited resources to produce rice. Analysis can show costs in foregone national income and trade-offs between income and food security from pursuing policies of self-sufficiency in staple or other commodities.

Modifications have been made in programming models to depart from the assumption of instantaneous profit maximizing and to more closely model the real world. Constraints have been modified in recursive programming to limit the adjustment producers can make in any one period so that equilibrium can be attained only after several periods. The purpose is to better predict behaviour of producers than do instantaneous adjustment models. In reality, production functions are not linear but diminishing returns can easily be approximated in programming models by dividing the production function into several linear segments with successively less favourable output-input ratios. Other modifications include incorporating in the objective function the disutility of risk and downward sloping demand curves. Sector-wide or regional programming models have accounted for costs of transportation and for aggregate supply-demand equilibrium. Models have been modified to show the impact of government restrictions to improve functioning of the market by reducing soil erosion and ground water contamination from commercial fertilizers and saline irrigation water (see English et al 1982).

Dynamic programming models allowing for several time periods can accommodate technical and behaviour conditions characterizing long-term investments and the impact of taxes or subsidies which influence the use of durable capital. Myoung and Schreiner (1984) used linear programming to determine economically optimal capacity rural water systems recognizing price-sensitive demand.

As with other models, programming models can be validated by comparing model predictions with actual observations, or parameters estimated by programming with those estimated by positivistic models such as ordinary least squares (OLS). Quance and Tweeten (1971) found that linear programming models tended to substantially overestimate supply and input demand elasticities compared to OLS, but Shumway and Chang (1977) and Norton and Schiefer (1980) reported much more favourable results regarding fidelity of programming predictions to observed behaviour of producers.

Sector, regional, or national programming models require substantial data. One of the most successful agricultural sector models for a developing country is the CHAC model for Mexico (Norton 1974; Norton and Solis 1981). That Mexican model describes 29 different producing locations, 31 different crops, and has over 2,500 different production technology vectors. The sector models draw heavily on data from secondary sources including the agricultural and population census as well as from primary sources including surveys specifically designed for such purposes. Policy instruments in the CHAC model are investment in irrigation facilities, research, and extension; factor and product market pricing policies; tariff and export incentive policies; selected factor allocations such as financial credit to crops and areas; and land tenure and farm-size distribution policies. The model generates data on agricultural income, production, employment, exports, individual commodity prices, the index of prices received by farmers, elasticities of supply for commodities and demand for inputs, and marginal rates of substitution among inputs and among outputs.

In short, programming models are important tools for the analytical programme of policy analysts. They answer questions not easily addressed using other tools but require considerable data and are subject to the usual limitations of any optimizing model.

7.10 Agrarian Reform and Rural Development (ARRD)

Most of the preceding treatment of the analytical programme deals with economic growth and general social benefit/cost concerns. But accumulated evidence from many countries during the 1970s led some to

rejection of the "trickledown" theory of economic development which held that aggregate economic growth would benefit the poor. Despite sustained overall economic growth in many countries, the relative share of the poor in real income diminished and the incidence of poverty increased.

Changes in development thinking followed, resulting in the "Basic Needs Approach". The objective was to provide opportunities for full physical, mental, and social development of the human personality by stressing development strategies such as self-reliance, improvements of essential public services, economic growth with equity, and people's participation. More importantly, this approach emphasized the need to direct development efforts toward the needs and concerns of large, often rural, disadvantaged socio-economic groups.

United Nations (UN) resolutions in the 1970s reflected the above shifts in development thinking. UN resolutions passed on 1 May 1974 by the Declaration and Programme of Action on the Establishment of a New Economic Order and on 12 December 1974 by the Charter of Economic Rights and Duties of States underlined the responsibility of states to... "fully mobilize and use its resources to implement progressive economic and social reforms and to ensure the full participation of its people in the process and benefits of development". The call for a New International Economic Order, by establishing the principles of equitable international economic relations between countries, paved the way for the World Conference on Agrarian Reform and Rural Development (WCARRD) in 1979 (see FAO 1979).

The 1979 World Conference on Agrarian Reform and Rural development implicitly identified several areas of concern relating to the general societal goals of economic efficiency, equity, and stability in resource allocation, production, and distribution processes in developing countries.

The first group of concerns relate to the traditional concept of growth, including the natural resource base; population; total output of goods and services; agricultural production, trade, and food supply; and rural non-farm activity. Agrarian reform may be needed where conventional growth, although necessary, is not sufficient to meet the needs of society. Traditional economic progress benefits society most when socio-economic groups have equitable access to natural and man-made resources and services. Equitable access to education, health, and other social services helps otherwise disadvantaged groups make the best use of access to productive resources made available by agrarian reform.

The second major area of concern, equity, encompasses access to opportunity. It includes concerns of poverty, nutrition, health, housing, education, and access to other community services as well as to land, water, and other production resources and services.

The third major area of concern, people's participation, involves means to facilitate and preserve growth with equity. It includes such means as rural organizations, communication, involvement in public decisions, devolution of governmental power, and community self-reliance.

The overall goal of agrarian reform and rural development is thus growth with equity through people's participation.

7.10.1 Socio-Economic Indicators

Socio-economic indicators for ARRD may be subjective or objective. Subjective indicators range from informal observation to carefully formulated and tested attitudinal scales devised by sociologists and psychologists relating to overall personal happiness, satisfactions with various domains of life such as family and community, and confidence in institutions and persons in authority (see Tweeten, Mylay, and Dellenbarger, 1986).

Objective indicators measure income, wealth, education, housing, availability of health facilities, and other factors that contribute to well-being. Selected areas of concern and indicators suggested by the World Conference on Agrarian Reform and Rural development are listed in Table 7.5.

It is clear from the table that ARRD indicators place heavy demands on the statistical and analytical programmes. An appropriate approach is to select a few key indicators consistent with available, reliable statistics and an appropriate analytical framework for analysis. Additional indicators and analyses may be added as resources become available to collect and process such series.

The conceptual framework needs to be fully developed in conjunction with the indicators so that interrelationships among indicators and the impacts of policy incentives identified and understood and most indicators relating to equity must be collected and analysed at the socio-economic group level. Socio-economic group delineations include rural/urban, male/female, agricultural holder/labourer, landless and

Table 7.5

WCARRD Areas of Concern and Possible Indicators

Areas of Concern	Indicators
Growth with equity	1.1 Per capita income 1.2 Percentage of income accruing to each of the lowest four deciles of the population
Nutrition	2.1 Per capita calorie consumption 2.2 Percentage of undernourished population 2.3 Percentage of children (ages 1-5) in a group less than specified percent weight-for-age
Health	3.1 Infant mortality (below 1) 3.2 Child death rate (ages 1-4)
Housing	4.1 Percentage of households dwelling in good condition and built of durable materials
Literacy and education	5.1 Adult literates as percent of total population of age 15 and over 5.2 Primary school enrolment ratio
Distribution of land yield	6.1 Arable land and land under permanent crops per agricultural population 6.2 Percentage of area in holdings held by each of the lowest four deciles of holdings 6.3 Yield of the major cereal crops

Access to community services

Percentage of population living in villages or communities with easy access to:

- 7.1 potable water supply;
- 7.2 primary schools;
- 7.3 primary health centres;
- 7.4 primary market(s);
- 7.5 electricity;
- 7.6 roads.

Wages and labour

- 8.1 Agricultural labourers as percentage of active population in agriculture
- 8.2 Average daily wage rate of agricultural labour

Rural Industrialization and employment

- 9.1 Unemployed man-days as percentage of total available man-days among agricultural labourers
- 9.2 Percentage of non-agricultural workers in total number of workers

regional/national differences. In the case of planning and delivery of public services, the appropriate spatial unit of indicators may be a trade and service area comprised of a town and surrounding rural holdings.

Given the indicators, the challenge for the analytical programme is to test conceptual hypotheses concerning the interrelationships and to quantify trade-offs among indicators so that decision makers can make informed judgements regarding ways to set and reach reasonable development targets and objectives.

In studying the process of development, in addition to individual indicators, need may exist for a summary measure to bring together the individual indicators, some of which show changes at different rates or even in opposite directions. Such summary measures are called composite indicators. There are various statistical techniques that can be used to calculate composite indicators. Certain problems are to be faced when calculating composite indicators. The first problem is the number of indicators to be included in the composite indicator. No consensus of opinion exists on this issue. This is partly due to differences in emphasis attributed to various aspects of the subject, and partly due to the constraints imposed by the non-availability of relevant basic data. For example, Adelman and Morris (1967) used 41 indicators; Chenery and Syrquin's study (1975) was based on three variables and ten development processes; M.D. Morris (1979) constructed the well-known physical quality of life index with three indicators; the United Nations Committee for Development Planning (1971) utilized three indicators to identify the least developed countries; Harbison et al. (1970) studied 40 indicators; and Mc Granahan et al. (1972) employed 18 indicators.

Other problems involved in calculating composite indicators are related to scale of measurement, unit of measurement and weighing. The individual indicators may have different scales, but the composite indicator, being a collection of different species, will have its own scale. Generally, various indicators are expressed in different units. This necessitates finding a common unit to bring these indicators together. Standardization or arbitrary conversion techniques are utilized to express original indicator values in common units. Weighing is the identification of the relative importance of each indicator in the composite indicator. Different weighing methods have been used in various studies.

Principal component analysis is one of the most commonly used techniques to calculate composite indicators. The technique tries to find certain basic factors which are hidden behind the observed indicators. These basic factors are called components and their values

are called scores. The important assumption of this technique is that the components are linear functions of the original variables and the analysis yields as many components as there are original indicators. For example:

X_1 : life expectancy at birth

X_2 : infant mortality rate

X_3 : adult literacy rate

the component analysis will yield three components (Y_1 , Y_2 , Y_3) which will be in the following form:

$$Y_1 = a_{11} X_1 + a_{21} X_2 + a_{31} X_3$$

$$Y_2 = a_{12} X_1 + a_{22} X_2 + a_{32} X_3$$

$$Y_3 = a_{13} X_1 + a_{23} X_2 + a_{33} X_3$$

The (a) values are the coefficients which are estimated by the component analysis. As is seen, each component is a weighted sum of the original variables, the weights being the coefficients. If the observed values of the three original variables belonging to a unit (country) (i) are plugged in these equations the, Y_1 , Y_2 , and Y_3 scores are obtained. In fact, what the component analysis does is to transfer the dispersion of units in the original indicators into a dispersion in the components.

The utility of this transfer of dispersion comes from the fact that there is the following relationship between the variances of components:

$$V(C_1) > V(C_2) > V(C_3)$$

The success of the component analysis is partly measured by the relative size of the variance of the first component which is mostly referred to as the percentage of total variance explained by the first component. If the variance of the first component is large, say 80% of the total variance, then the remaining components can be neglected. So, the comparison between units can be based on their scores of this first component.

7.10.2 Monitoring, Evaluation, and Analysis

Agrarian reform and rural development are ongoing processes which must be regularly monitored, evaluated, and analysed. The results are useful to those who implement ARRD programmes. It is often necessary to modify plans, programmes, and even goal-related targets in light of new

information provided by monitoring and new insights obtained from successive evaluations and analysis.

Monitoring is the continuous observing of movements in the indicators of the degree to which action programmes, as policy instruments, are succeeding in achieving the policy goals. Monitoring utilizes benchmark information collected during the preparation of action programmes. It records levels of indicators at appropriate intervals through programme implementation. It provides the information necessary for evaluative analysis.

Evaluation is the periodic analysis conducted during programme implementation. Evaluation attempts to determine the relevance and effectiveness of action programmes relative to costs, targets, and objectives. Evaluation results can improve activities in progress and aid in future planning, programming, and decision making.

In the case of land reform, for example, monitoring may focus on the extent to which land is distributed to landless agricultural labourers and tenants and the extent to which landless, female, aged, and other possible disadvantaged heads of rural households have equal access to land as compared to non-disadvantaged groups. In the case of rural development, evaluation (and monitoring) can determine the extent to which small farmers are being given access to, and are using, agricultural credit made available through an integrated rural development programme; female heads of farm households are gaining access to credit; landless men or women are gaining access to paid employment (farm and non-farm); the changing incidence of malnutrition among children; progress in increasing primary school attendance by boys and girls in small farm and landless households; and increasing participation of disadvantaged rural groups in people's organizations. Monitoring also can indicate the causes of deviations from desired courses and, thus, suggest corrective measures. Although evaluation may be distinguished conceptually from monitoring, the two activities overlap considerably and both represent important components of regular follow-up of new or adjusted policies and programmes.

Analysis overlaps with evaluation but here refers to more in-depth study of causal and behavioural relationships among areas of concern and indicators. Analysis, in contrast to monitoring and evaluation, examines not only current programmes and policies but also alternatives for change. Given the indicators, the challenge for the analytical programme is to test conceptual hypotheses concerning the inter-relationships and to quantify trade-offs among indicators so that decision makers can make informed judgements regarding ways to reach development targets and objectives.

The ARRD analytical programme can encompass virtually all tools discussed in foregoing sections along with selected other techniques mentioned in this section. Analytical studies help in understanding and predicting processes of rural development and poverty alleviation. Such studies identify costs and benefits of alternative means to reach AARD objectives. Interrelationships among several indicators may be of special interest and may be estimated using various techniques of analysis such as cross tabulations, regression, factor analysis, and principal components analysis. Results can help to identify policy instruments that have the most impact on levels of living variables at the national or subnational levels. Principal component or related factor analysis can supplement a conceptual model by qualifying statistical relationships among variables - grouping those variables with high intercorrelations into clusters (factors) while minimizing correlation among clusters.

Gini coefficients and Lorenz curves showing the percentage of the population receiving specified percentages of income, nutritional deficiencies, or health care services depict distributional relationships at a point in time or changes over time. Regression analysis can be used to quantify the impact of programmes and policies on such distributions. Multiple regression analysis could be used to relate infant mortality rate, for example, to income, education, access to health care facilities, and the quantity and quality of those health care facilities. ARRD indicators may be part of an overall causal framework which can be modelled by linear programming, simulation, or by an interdependent econometric system. Less sophisticated analysis may also be useful including simple correlation coefficients among indicators.

The most challenging aspect is to quantify complementarity and competitiveness among indicators and the underlying causal elements. Agricultural price supports may be judged to benefit a disadvantaged group but how much national economic growth is sacrificed by redirecting public spending away from agricultural research and extension, from education, from rural road and bridge construction, and from irrigation investment? Formation of a labour union among low-paid workers may be deemed necessary for equity but will higher wages generated thereby force the firm to sharply curtail output or result in bankruptcy? How much does an overvalued exchange rate intended to benefit low income consumers reduce exports and employment opportunities for the poor in export industries? Land reform may be much needed, but will a specific plan for implementation result in parcels too small to provide minimal living standards or create rigidities that inhibit able operators from expanding output to meet national needs for food?

The analytical tools presented herein can help to answer some of these questions. Ideally, reducing or removing arbitrary barriers to opportunity for disadvantaged groups and individuals will both raise and more equitably distribute income and other benefits of socio-economic progress. In other instances, income growth may be sacrificed to obtain a more equitable distribution of income. Decision makers will be in a better position to determine which strategy is superior when facing difficult trade-offs if analysts provide reliable information on the choices faced.

Some developing countries strongly emphasizing policies for equity in the 1970s subsequently shifted to policies emphasizing growth through privatization and open market incentives in the 1980s. This retreat from former policies in no way implies that equity is unimportant. It only illustrates that overemphasis on equity can sacrifice growth to the point where the income growth dividend is inadequate to finance educational, infrastructure, health, and nutrition services for the disadvantaged. Land reform efforts have frequently been disappointing, not because land reform was not needed to raise well-being for the disadvantaged and to promote social stability, but because land reform was poorly planned and implemented. Examples are abundant where subsidized credit and other programmes to benefit the poor in fact did not target the intended group, but instead were both inequitable and inefficient.

Lessons of the 1970s and 1980s are that too much emphasis either on growth alone or on equity alone can detract from well-being. The challenge for the analytical programme at its best is to identify trade-offs and predict outcomes so that decision makers can avoid policies which subsequently must be reversed because they failed to meet objectives. In short, ARRD is the result of the totality of government intervention in food and agriculture and its goals and objectives. Monitoring, evaluating, and analysing ARRD are applications of the comprehensive food and agricultural information system serving national decision makers.

7.11 Conclusions

Modern microcomputer hardware and software has placed low-cost but powerful computational capabilities within reach of policy analysts in developing countries. The major restraint on policy analysts seeking to provide the very best analytical programme and information system for decision makers is no longer computational capacity but is the availability of statistical data systems along with the resources and ingenuity of the analyst. Analyst's time and analytical capabilities as well as data limitations will continue to be restraints, but careful allocation of these limited resources can go far to improve information systems for policy decisions.

Certain parameters provide basic inputs for a wide variety of analytical models including simple supply-demand analysis, classical welfare analysis, and simulation modelling. Central to almost any type of market policy analysis programme is a complete set of own-price and cross-price elasticities of supply and demand in the short run and long run for major farm and food commodities. Income elasticities of demand and production elasticities are also basic.

Such parameters cannot be estimated or utilized without a strong statistical programme featuring time series of balance sheets for farm and food commodities, of resources (such as fertilizer, labour, pesticides, irrigation, fuel, and credit), commodity yield and area, marketing margins, and prices. Policy inputs regarding exchange rates, investment in research and education, price supports and ceilings, quotas, subsidies, and taxes, also are often critical for policy analysis. Data on population and on income growth and distribution among segments of the population, and on use of high-yielding varieties and other aspects of technology are also important. Only by joining the statistical programme with the analytical programme to answer real questions posed or potentially posed by policy makers can an information system make the maximum contribution to improve policy decisions.

CHAPTER 8

PROGRAMME IMPLEMENTATION

Food and agriculture encompass complex interactions of physical, climatic, biological, economic and social processes in (a) the production, processing, distribution and utilization of food and agricultural commodities, (b) rural development and agrarian reform, and (c) the nutritional status of a country's population. Given a country's endowment of soil and water resources and climate, these processes are carried out by individuals, households and other production and consumer units with some degree of government intervention (Chapter 2).

Each country is unique in its stage of social, economic and technical development, the extent to which its government intervenes in the above spheres of activity, and in its progress in developing an information system to aid both private and public decision making. The national information system for decision making in food and agriculture must be carefully pursued in the context of the country situation. Thus, specific activities presented in this chapter on programme implementation are not recommended for all or for any specific country. Such details do, however, illustrate the kind of activities most countries will want to consider. And, taken together, the selection and organization of such activities illustrate the systematic planning, monitoring, development, evaluation and improvement process that every country needs.

This manual is directed at the statistical programme component of a national information system for food and agriculture. However, this purpose is pursued within the broad structure of the more general information system within which the successful national statistical programme must be planned and implemented. General programme implementation guidelines are provided. For planning and conducting a specific statistical activity - such as developing socio-economic indicators for monitoring and evaluating agrarian reform and rural development, conducting an agricultural census or food consumption survey, constructing commodity supply/utilization accounts, or deriving economic accounts for agriculture - additional, more specific programme development guidelines should also be used. FAO either has, or plans to issue, Programme Development Guidelines manuals in these and other important areas.

There are a large amount of both agricultural and non-agricultural data and information not dealt with in this manual. For example, non-agricultural information relating to such areas as urban development and national defence, agricultural extension and market news services are not covered. The sub-domain of information toward which this manual is directed is generally limited to aggregate and, as appropriate, per capita data series in the farm production sector; agricultural trade; agricultural inputs and services; agrarian reform and rural development; food supplies, prices, and distribution; consumption and nutrition; fisheries and forestry as they relate to food supplies and land use; and related population, national income and general price level information.

Although much of the statistics and analyses produced by the information system dealt with in this manual are useful to private decision makers, the programme described is directed primarily at the information needs of public decision making in food and agriculture.

8.1 Summary of the Information System Approach

Information in general, and statistics in particular, have extrinsic value. That is, they are useful only as a means of analysis and decision making. This utilitarian perspective calls for the national statistical programme in food and agriculture to be developed within the larger context of national decision making. Decision making with respect to managing governmental intervention in food and agriculture is a continuous, cyclic process of indentifying problems, formulating and analysing alternative solutions, making decisions, observing and evaluating results, and then identifying the new problem situation. The process is iterative in that any of the several stages may be repeated based on information gained at later stages (Chapters 3 and 4). Thus, the national information system is basically a macro application of the individual problem-solving or managerial process.

Chapter 2 presents an approach to conceptualizing the complex technical, economic and social interrelationships in food and agriculture, while Chapter 3 discusses many of the complexities of decision making with respect to policy goals, instruments and performance indicators. These important dimensions of decision making in food and agriculture are placed in an information system context in Chapter 4, and operational concepts for measurement and analysis are categorized in Chapter 5. Some important points can be summarized as follows:

1. The scope of food and agriculture encompasses such a wide range of complex phenomena and interacting forces that most policy concerns are multi-perspective and multi-objective.
2. To adequately serve national decision making in food and agriculture, therefore, an information system must provide statistics on the technical, economic and social dimensions of policy instruments and their performance indicators.
3. Policy makers, planners, statisticians and economists should cooperate in developing the same conceptual understanding of the food and agricultural complex to use as a basis for defining operational concepts for data collection and analysis.
4. The statistical programme should be a timely and efficient integration of censuses, surveys, and use of administrative records and community level statistics, giving balanced attention to basic data collection, data processing and statistical analysis.
5. The analytical programme must be capable of projecting, over time, the behaviour of the technical, economic and social variables in food and agriculture as well as the impact on these same variables and other performance indicators of policy instruments relative to policy goals and objectives, where objectives are defined as quantitative future target values of performance indicators.
6. Although statistical and analytical activities based on aggregate data series, available at the national level on both a total and per capita basis, are adequate for many policy concerns relating to growth, adjustment and stability, most policy concerns relating to equity require data series and analyses disaggregated by socio-economic group and, often, geographic region.
7. Once concepts, definitions and procedures are institutionalized in a national statistical programme, they tend to become static, whereas the real-world phenomena they represent are usually constantly changing. Thus, the conceptualization of food and agriculture and the operational definitions and concepts used to quantify or represent real-world phenomena, and consequently the statistical and analytical programmes, must be continually monitored, evaluated and revised.
8. Since most national governments are decentralized - with ministries, bureaus, agencies, departments and/or divisions separated according to disciplinary, programmatic or

regional concerns while the technical, social and economic phenomena in the target world to be managed are interdependent - coordinating the information system for decision making in food and agriculture across governmental organizations is a difficult task requiring special and continuing attention at the highest policy level.

8.2 Implementation Guidelines

The information system is conceptualized in Chapter 4 as having five interdependent component processes: (a) conceptualization, (b) operational definition of concepts, (c) observation and measurement, (d) interpretation and analysis, and (e) decision making and implementation. These processes, along with the more basic steps of problem solving, translate into the following five programme implementation phases:

- A. Policy and programme setting
 1. Policy concerns
 2. Evaluation of alternatives
 3. Decision making
 4. Programme implementation
 5. Monitoring and evaluation
- B. Conceptualizing and operationalizing an understanding of food and agriculture
- C. Integrated statistical programme
- D. Analytical programme
- E. Reporting

As with problem solving and the phases of the information system, the programme implementation phases are interrelated and iterative. Before policy decisions are made, iterations through conceptualization of concepts, statistical and other information development, processing, analysis and reporting, as contained in Phases B through E, are necessary based on a statement of policy concerns resulting from previous such cycles. The monitoring and evaluation sub-phase of the Policy and Programme Setting phase is concerned with the information system itself as well as the real-world policy concerns. Thus, the Policy and Programme Setting phase is actually an "executive level" decision-making cycle within the larger information system cycle.

Whereas the programme implementation phases are listed vertically above, in actual practice various time lags exist between related activities across phases, as illustrated in Figure 8.1. With respect to the processing of any single policy concern (I in Figure 8.1), the various time lags between target completion dates t_i , $i=1, 2, \dots, 5$, can vary from a few hours, to weeks, months, and even years. Further, a very large number of policy concerns are being worked through the information system at any given point in time. Thus, the real, complete and detailed programme implementation programme for any country is probably too complex to picture as in Figure 8.1 for any significant time period. Yet, it is useful for a country to develop a written programme implementation plan for the major activities of the information system and to continually revise it at periodic intervals, not to exceed one year.

Table 8.1 (at the end of this chapter) illustrates how a multi-year plan for developing and operating an integrated programme of food and agricultural statistics in the context of a national information system can be constructed. In general, such a programme involves several annual or biennial repetitive cycles of the above five programme phases, but a pre-programme planning phase is also required. For purposes of these guidelines, a ten-year programme covering the period 1986-1995, divided into five biennial cycles, is presented. Some people may prefer a more formal programme evaluation and review technique (PERT) or critical path analysis approach over the simple presentation of Table 8.1.

8.2.1 Pre-Programme Planning

A pre-programme planning period is required, consisting of the following five steps.

- (1) Establish, review, and/or strengthen the government co-ordinating mechanism, including the participation of both data users and producers, for overseeing the planning and implementation of the multi-year programme of work.
- (2) Assemble, organize and disseminate to appropriate participants all relevant material on the country's food and agricultural complex and on the government's role in it.
- (3) Organize and conduct a national workshop, or series of workshops, to:

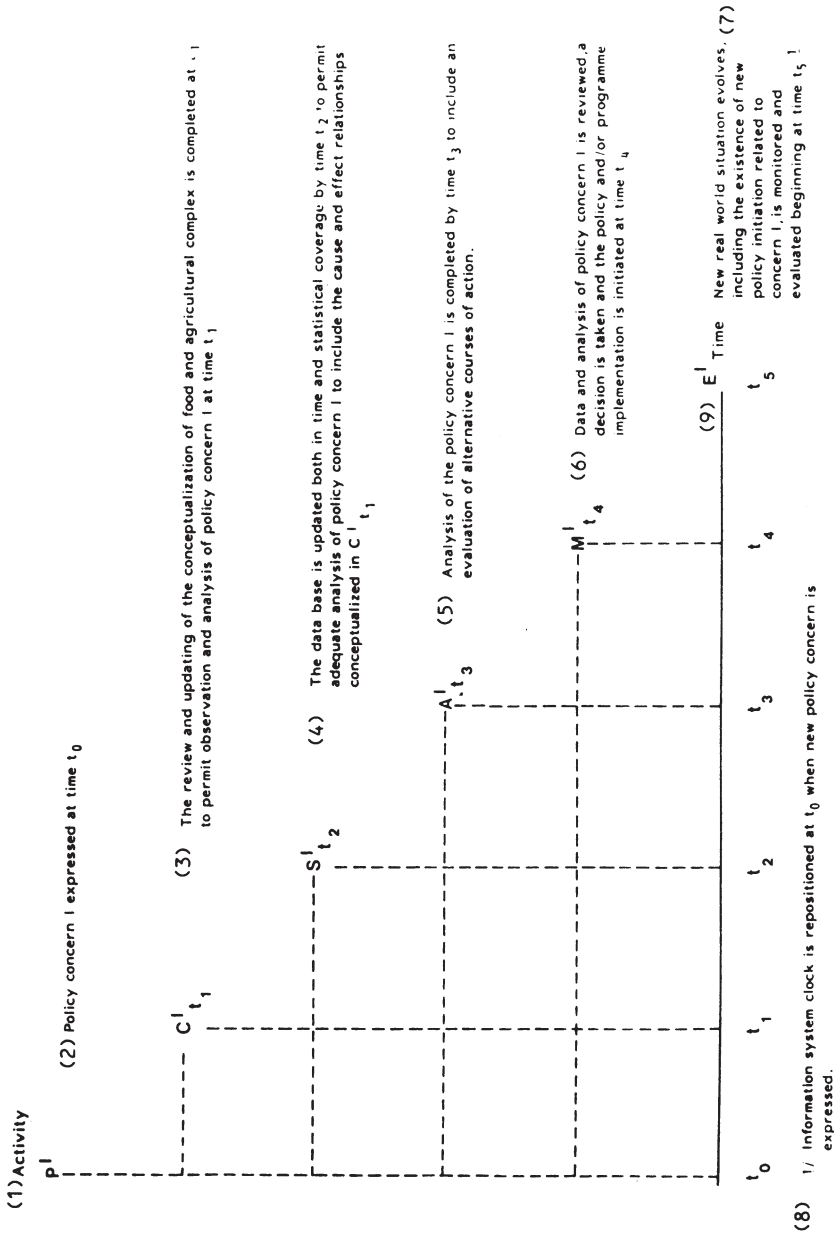


Figure 8.1 - Illustration of time lagged programme implementation cycle with respect to a single policy concern

- a) Review the material from (2).
 - b) Conceptualize the relevant variables and relationships at work in the country's food and agricultural complex and the government's role in it, including an explicit statement of policy concerns, objectives and possible instruments that are or could be used to achieve policy goals and objectives.
 - c) Develop operational definitions for every variable identified in (b).
 - d) Identify statistical and analytical activities required to develop a simulation of the technical, economic and social relationships conceptualized in b), using the statistics operationally defined in c). This can be a very simple model at the beginning (see Section 8.2.3 below and Chapter 7).
- (4) Develop a long-term plan (up to 10 years) that will produce the statistical and analytical activities identified in d) according to a time schedule and with adequate detail and specifications to satisfy the policy needs identified in (3) b). This plan should include estimates of staff and training requirements; needs for office space, vehicles, computer services, survey equipment and other fixed overhead or infrastructure costs, as well as annual operating expenses; and necessary changes in institutional organization. The programme budget should indicate that part of the financial needs to be borne by the sponsoring governmental unit and that part for which outside donor assistance will be needed.
- 5) The coordinating body established in (1) meets to approve the long-term development plan formulated in (4).

8.2.2 Policy and Programme Setting

We assume that the major policy concerns in food and agriculture centre around food security, agricultural adjustment and agrarian reform and rural development. Food security is a continuing concern across all programme cycles and implicitly includes desires for continued and efficient growth of agricultural, and especially food, output and the economic viability of the farm production sector. Concerns relating to agricultural adjustment are in keeping with the guidelines and targets for international agricultural adjustment adopted at the 1983 FAO Conference. Major government emphasis on agrarian reform and rural development is programmed in such a way as

to not only meet national concerns but also to conform to the recommendations of the World Conference on Agrarian Reform and Rural Development and to the FAO's reporting of progress in agrarian reform and rural development at every other biennial FAO Conference, beginning in 1983 (FAO 1981; FAO 1983, pp.21-25). During each programme cycle, specific areas of concern relating to agrarian reform and rural development - such as nutrition, poverty alleviation, landlessness and the quality of life in rural areas - receive special attention.

Considerable time, staff and budgetary resources are required to develop basic data and statistical and analytical capabilities and to conduct analyses of government programme options and their potential impacts. It is important, therefore, that the national policy agenda be projected a considerable number of years into the future so that pre-requisite statistical and analytical activities can evolve in a timely and efficient manner.

8.2.3 Conceptualizing and Operationalizing an Understanding of Food and Agriculture

This is perhaps one of the most overlooked aspects of developing statistical and analytical programmes to support government policy needs in food and agriculture. Each year, appropriate staff activities are developed and planned to review and update the conceptualization and operational definitions of food and agriculture. For example, a standing national review committee may be created, with representation from agricultural, planning and other interested government agencies. Such a committee would be charged with reviewing the adequacy of concepts and operational definitions with respect to current and anticipated situations and policy needs. It would also have the power to implement necessary changes.

Conceptualization should include explicit attempts to develop causal loop flow diagrams and cross-impact matrices of all important technical, economic and social relationships at work in food and agriculture. This, in turn, can provide a consistent, sector-wide blueprint for guiding development of basic data collection, processing and statistical analysis activities and for the gradual building up of a simulation capability for the food and agricultural sector. Although, initially, such simulation activities will very likely be informal and, when quantified, of an extremely partial nature, they will, over time, add up to an internally consistent simulation of the food and agricultural sector which contributes to the information and analysis required for policy making and planning.

8.2.4 Integrated Statistical Programme

It is important that the national statistical programme in food and agriculture gives a balanced emphasis over time to basic data development, such as capabilities for agricultural censuses and surveys, data processing and statistical analysis. A schedule of censuses and surveys should be established consistent with recommendations in Chapter 6 (Table 6.2). In addition, a programme of activities should be formulated to develop administrative and locality records and to identify needs for international publications and sources of technical research information.

One of the earliest and most efficient activities is to establish and/or update an agricultural sample survey frame from the population and/or agricultural census. Thus, if the population census provides an adequate identification of agricultural holders, a country may elect to replace the agricultural census with a sample survey of the structure of the agriculture production sector. Further, the population census should be conducted in such a way as to provide estimates of the size of the country's various socio-economic population groups, information which is especially critical for monitoring and evaluating agrarian reform and rural development. When a country has advanced beyond the most rudimentary statistical capability in food and agriculture, it should consider the feasibility of constructing an aerial frame sample survey capability.

The agricultural census or agricultural structure sample survey should provide estimates of the number and size distribution of agricultural holdings by type of enterprise. This is especially important for analysing the causal relationships between the structures of the farm production sector and policy goals relating to agricultural adjustment, food security and such agrarian reform and rural development concerns as landlessness and poverty.

The annual sample survey programmes in the various cycles illustrated in Table 8.1 thus provide the more current food and agricultural statistics. In keeping with the primary policy concern of food security, agricultural production surveys are conducted annually.

The second priority area for sample survey data collection is food consumption, with two food consumption surveys being scheduled in the first and fourth programme cycles. Here it should be possible to link food consumption and household income and expenditure surveys

with smaller sample segments covering other, more costly, data collection in such areas as anthropometrics. It is most important that sample surveys on food and agricultural data relating to consumption and other household centred activities be coordinated and made an integral part of the country's UN Household Survey Capability Programme.

Other subjects for which data is collected through surveys include soil, farm management, agricultural service establishments, rural labour force, demographics and livestock, as well as agricultural prices and other special subjects.

It is essential that the basic data collection, processing and early statistical analysis activities be completed in an efficient and timely manner to facilitate use of the data in more comprehensive analytical programmes in support of policy deliberations. Capabilities for data processing and statistical analysis should be planned, developed and tested before field enumeration is begun. Data should become machine readable as early in the collection and processing stage as possible, and the data bank should allow for both statistical report writing and, later, a more detailed analytical use of the data.

8.2.5 Analytical Programme

The various analytical activities illustrated in the five programme cycles of Table 8.1 are only a small subset of the many such activities needed to fully exploit the data that should flow out of the integrated statistical programme and that is needed to support the several important policy concerns. Here again, an important aspect of scheduling analytical programmes is that they are timed to take advantage of current agricultural censuses and surveys and are completed in a timely manner with respect to policy needs.

The analytical activities outlined in Table 8.1 illustrate the strategy of beginning with simple analytical activities, such as looking at trends and percentage changes in statistics over time relative to both base periods and target values. Then, moving on to basic correlation and regression analysis, price and income elasticities of demand and price elasticities of supply should be estimated when the prerequisite data on production, consumption and prices become available. At this point, composite indicators of agrarian reform and rural development may be derived. These quantitatively oriented activities should gradually combine and evolve into a more comprehensive simulation model of the technical and economic relationships at work in the food and agricultural

complex. Initially, such simulations can be partial commodity or subsector studies, but should eventually represent a comprehensive model of the food and agricultural sector with important linkages to the general country and world economies. Some additional intermediate steps include the development and annual updating of commodity supply and utilization accounts, food balance sheets and economic accounts for agriculture.

8.2.6 Reporting

Generally, two types of reports are recommended in Table 8.1. After initial data processing, analysis and dissemination are completed, it is useful to issue staff reports on the various policy concerns. This provides for early and continuous interactions of the social scientist with policy makers and sets the scene for issuing national reports depicting the government's concern, role and impact on effecting improvements in the food and agricultural complex. Further, reports should be scheduled to both capitalize on recent statistical and analytical developments as well as provide for policy needs. Two special staff reports are scheduled in programme cycles I, III and V to facilitate the monitoring and evaluation of progress and problems in agrarian reform and rural development, including reporting at the 1987, 1991 and 1995 FAO biennial Conferences.

8.3 Conclusion

In conclusion, the concepts and guidelines presented in this manual are applicable to any country, at any stage of development, from the least developed to the most industrialized. All that is required is an interest in, and commitment to, ensuring that the information available to public decision makers in food and agriculture, including its statistical and analytical components: a) is relevant to current policy issues, b) accurately reflects the current state and direction of the target world system, and c) reaches its users when and where needed. The path is the same, but different countries will enter that path at different places depending on their own unique needs and resource endowments.

The first step for a country is to assess its current human, institutional, natural and financial resources with respect to food and agricultural decision-making capacity. Then, it should identify its needs and goals in that regard and plan a programme of activities to reach those goals and satisfy those needs. Finally, there remains only to implement the plan and evaluate its progress.

We close where we began, by asserting that countries following the guidelines contained in this manual will find that the information base supporting economic development and other policy concerns in food and agriculture will be more relevant and useful, that policy efforts will thus be more successful, and that, as a consequence, government intervention in food and agriculture will be more effective and better understood and appreciated.

Table 8.1

A Hypothetical National Ten-Year Plan for Developing
an Integrated Statistical Programme for
Policy Needs in Food and Agriculture

Programme Phase	Programme Cycle I (1986-87)
A. Policy and Programme Setting	1. Food security (1986-87) 2. Agrarian reform and rural development, general (1986-87) 3. Coordinating group meetings to review progress and plans (1986-87)
B. Conceptualizing and Operationalizing an Understanding of Food and Agriculture	1. The conceptualization and operational definitions of food and agriculture are reviewed and updated as necessary (1986)
C. Integrated Statistics Programme	1. Define and estimate population Programme in selected socio-economic groups from most recent population census (1986) 2. Update agricultural sample survey frame (1986) 3. Conduct sample surveys on i) agricultural production (1986-87); ii) food consumption (1986); iii) soil (1986-87); iv) farm management (1987); and v) agricultural service establishments (1987)

D. Analytical Programme

1. Select socio-economic indicators, estimate benchmarks and set targets based on policy statements in A.2 (1986)
2. Estimate number of people below the poverty line, by socio-economic group, based on C.1 and C.3 (1987)
3. Initiate or improve system of price and production index numbers (1987)
4. Initiate or improve system of commodity supply/ utilization accounts and food balance sheets (1987)

E. Reporting

1. Develop staff report for policy considerations based on completed statistical and analytical activities (as needed and appropriate)
 2. Provide FAO with a progress report on agrarian reform and rural development for use at the 1987 FAO Conference (1986)
 3. Issue national report on agrarian reform and rural development (1987)
-

Table 8.1 (continued)

Programme Phase		Programme Cycle II (1988-89)
A. Policy and Programme Setting	1. Food security (1988-89)	
	2. Nutrition (1989)	
	3. Comprehensive agricultural legislation or 5-year plan (1989)	
	4. Coordinating group meets to review progress and plans (1988-89)	
B. Conceptualizing and Operationalizing an Understanding of Food and Agriculture	1. The conceptualization and operational definitions of food and agriculture are reviewed and updated as necessary (1988)	
C. Integrated Statistics Programme	1. Conduct surveys on	
	(i) agricultural production (1988-89); (ii) income and expenditures (1988); (iii) soil (1988-89); (iv) rural labour force (1989); (v) livestock (1988)	

D. Analytical Programme

1. Estimate per capita food consumption relative to requirements, by socio-economic group (1988)
2. Estimate relationships between food consumption, nutrition and income, by socio-economic group (1989)
3. Develop 5- to 10-year commodity, aggregate farm output, price, and income projections (1988)

E. Reporting

1. Develop staff report on nutrition for policy considerations (1988)
 2. Issue national report on nutrition (1989)
 3. Issue staff report on comprehensive food and agricultural legislation or five-year plan (1988)
 4. Issue national report on comprehensive food and agricultural legislation or five-year plan (1988)
-

Table 8.1 (continued)

Programme Phase	Programme Cycle III (1990-91)
A. Policy and Programme Setting	1. Food security (1990-91) 2. Poverty alleviation (1990) 3. Agrarian reform and rural development, general (1991)
B. Conceptualizing and Operationalizing an Understanding of Food and Agriculture	1. The conceptualization and operational definitions of food and agriculture are reviewed and updated as necessary (1990-91)
C. Integrated Statistics Programme	1. Conduct population census (1990) 2. Conduct agricultural census or farm structure survey (1991) 3. Conduct sample surveys on (i) agricultural production (1990-91); (ii) soil (1990-91); (iii) demographics (1990-91)
D. Analytical Programme	1. Estimate matrices of price elasticities of demand and supply (1990) 2. Estimate income elasticities of demand (1990) 3. Establish a system of economic accounts for agriculture (1991)

E. Reporting

1. Provide FAO with a progress report on agrarian reform and rural development for the 1991 FAO Conference (1990)
 2. Issue national report on agrarian reform and rural development (1991)
 3. Issue staff report on poverty for policy considerations (1990)
 4. Issue national report on poverty alleviation (1991)
-

Table 8.1 (continued)

Programme Phase		Programme Cycle IV (1992-93)
A. Policy and Programme Setting	1. Food security (1992-93)	
	2. Structure of the farm production sector and landlessness (1992)	
B. Conceptualizing and Operationalizing an Understanding of Food and Agriculture	1. The conceptualization and operational definitions of food and agriculture are reviewed and updated as necessary (1992)	
C. Integrated Statistics Programme	1. Conduct sample surveys on (i) agricultural production (1992-93); (ii) farm management (1993); (iii) agricultural service establishments (1992); (iv) soil (1992-93); (v) household income and expenditures (1993) (vi) rural household industries (1993)	
	2. Review agricultural sample frame and establish area frame sampling programme if appropriate (1992-93)	

D. Analytical Programme

1. Analyse food supply/requirements situation, including production, carry-over stocks, expected imports, vulnerable socio-economic groups and contingency plans to meet possible shortfalls; update quarterly (1992-93)
2. Estimate individual causal relationships required of a rather complete food and agricultural sector simulation model (1992)
3. Update 5- to 10-year commodity, aggregate farm output, price, and income projections (1993)

E. Reporting

1. Issue staff report on the structure of the farm production sector, including a special chapter on landlessness for policy considerations (1992)
 2. Issue national report on the structure of the agricultural production sector, with special attention to landlessness (1993)
-

Table 8.1 (continued)

Programme Phase	Programme Cycle V (1994-95)
A. Policy and Programme Setting	1. Food security (1994-95) 2. Rural infrastructure, inputs, marketing and level of living in rural areas (1994) 3. Comprehensive agricultural legislation or 5-year plan (1995) 4. Agrarian reform and rural development, general (1995)
B. Conceptualizing and Operationalizing an Understanding of Food and Agriculture	1. The conceptualization and operational definitions of food and agriculture are reviewed and updated as necessary (1994-95)
C. Integrated Statistics Programme	1. Conduct sample surveys on (i) agricultural production (1994-95); (ii) food consumption (1994); (iii) special subjects (1995)
D. Analytical Programme	1. Combine individual causal relationships within the food and agricultural sector into a simulation model, test and revise (1994-95)

E. Reporting

1. Issue background report to FAO on agrarian reform and rural development for the 1995 FAO Conference (1994)
 2. Issue national report on agrarian reform and rural development (1995)
 3. Issue staff report on food security (1994)
 4. Issue national report on food security (1995)
 5. Issue staff report on comprehensive food and agricultural legislation or five-year plan (1994)
 6. Issue national report on comprehensive food and agricultural legislation or five-year plan (1995)
-

APPENDIX I

CLASSIFICATION OF ITEMS AND MEASUREMENT INSTRUMENTS

The classification scheme organizes items for a food and agricultural information system into the following hierarchy of generality:

Category
Division
Section
Subsection
Item

Each item is represented by a six-digit code, where the first two digits refer to the category, the third digit to the division, the fourth digit to the section, and the fifth digit to the subsection. If there is no disaggregation of a division into sections or of a section into subsections, the corresponding digit for that level is zero. Some items are further disaggregated by various dimensions of interest, indicated by a seventh digit in parentheses, e.g., age classes (1) under 1 year of age, (2) 1 year to under 2 years of age, and so on. This selection of items is motivated by the general information needs of food and agricultural decision making. Since those needs will vary with each country's particular situation, the item list should be modified accordingly for implementation on a country-by-country basis.

The right-hand column in the following table indicates, for each item, the appropriate data sources and instruments for measuring it. These 21 instruments and data sources, which are discussed in Chapter 6, are identified as follows:

- 1 Census of agriculture
- 2 Periodic agricultural production survey
- 3 Farm management survey
- 4 Rural household income and expenditure survey
- 5 Food consumption survey
- 6 Survey of post-harvest losses
- 7 Survey of agricultural service establishments
- 8 Rural labour force survey
- 9 Soil survey
- 10 Livestock census

- 11 Special agricultural censuses and surveys on particular subjects
- 12 Census of population and housing
- 13 Demographic survey
- 14 Census of industrial establishments
- 15 Survey of rural household industries
- 16 Urban household income and expenditure survey
- 17 Other non-agricultural censuses and surveys
- 18 Administrative records
- 19 Locality records
- 20 International statistical publications
- 21 Technological research

Code Number	Description	Data Sources and Measurement Instruments
01	<u>Identification</u>	
011	Holding, holder, respondent	
0111	Holding	
011101	Address	1,2,3,4,6,10,11,16
0112	Holder	
011201	Name	1,2,3,4,6,10,11,16
011202	Address, if different from holding	1,2,3,4,6,10,11,16
0113	Respondent for holding	
011301	Whether respondent is holder	1,2,3,6,10,11
011302	Name, if not holder	1,2,3,6,10,11
012	Household, head of household, respondent	
0121	Household	
012101	Address	1,4,5,8,12,13,15,16
0122	Head of Household	
012201	Name	1,4,5,8,12,13,15,16
012202	Address	1,4,5,8,12,13,15,16
0123	Respondent for household	
012301	Whether respondent is head of household	4,5,8,12,13,15,16
012302	Name, if not head of household	4,5,8,12,13,15,16
013	Agricultural service establishments	
013001	Title	7,18
013002	Address	7,18
014	Locality	
014001	Name	18,19
014002	Address	18,19

015	Other units (to be specified)	
02	<u>General Characteristics</u>	
021	Holding	
0211	Holder	
021101	Legal status of holder	
	(a) Private	1,3
	- An individual	
	- A household	
	- Two or more individuals of different households or two or more households	
	- Corporation	
	- Cooperative	
	- Collective	
	- Other	
	(b) Government	
0212	Hired manager	
021201	Whether there is a hired manager	1,3
021202	Name	1,3
021203	Address, if different from holding	1,3
021204	Whether has fixed wage or shares economic and financial responsibility of holding	1,3
0213	Economic Activities of an enterprise	
021301	Whether holding part of enterprise with other economic activities	1
021302	Other economic activities of enterprise	1
	(a) Agricultural services	
	(b) Hunting, trapping and game propagation	
	(c) Forestry and logging	
	(d) Fishing	
	(e) Manufacturing	
	(f) Other (to be specified)	
022	Agricultural service establishments	

Code Number	Description	Data Sources and Measurement Instruments
022001	Type of legal organization (a) Private - Individual proprietorship - Corporation - Cooperative - Other (e.g., partnership) (b) Government	7, 18, 19
023	Cooperatives (for holdings and agricultural service establishments)	
023001	Number of members	7, 18, 19
023002	Number of male members	7, 18, 19
023003	Number of female members	7, 18, 19
03	<u>Demographic and Anthropometric Characteristics</u>	
031	General information	
0311	Household	
031101	Number of household members	1, 3, 4, 5, 8, 12, 13, 16
0312	Household members	
031201	Name	1, 3, 4, 5, 8, 12, 13, 16
031202	Age	1, 3, 4, 5, 8, 12, 13, 16
031203	Sex	1, 3, 4, 5, 8, 12, 13, 16
031204	Educational attainment	1, 4, 5, 8, 12, 13, 16
031205	Marital status	1, 4, 5, 8, 12, 13, 16
031206	Relationship to head of household	1, 4, 5, 8, 12, 13, 16

032	Guests	
032001	Name	4, 5, 12, 13, 16
032002	Age	4, 5, 12, 13, 16
032003	Sex	4, 5, 12, 13, 16
032004	Duration of stay with household	4, 5, 12, 13, 16
033	In-migration and out-migration	
034	Anthropometric characteristics of household members	
034001	Height	5, 13
034002	Weight	5, 13
034003	Other anthropometric measures	5, 13
04	<u>Employment</u>	
041	For each household member	
0411	Status of labour force participation	
041101	Whether economically active	1, 3, 4, 5, 8, 12, 13, 15, 16
0412	Occupation	
041201	Whether has more than one occupation	1, 3, 4, 5, 8, 12, 13, 15, 16
041202	Main occupation	1, 3, 4, 5, 8, 12, 13, 15, 16
041203	Whether "farmer" is secondary or tertiary occupation, if not main	1, 3, 8, 12
0413	Employment status	
041301	Employment status in main occupation	1, 3, 4, 5, 8, 12, 13, 15, 16
041302	Employment status in secondary or tertiary occupation, if "farmer"	1, 3, 8, 12
042	Employment on holding	
0421	For each member of holder's household (including holder) -- for holdings whose holders are real persons	
042101	Whether any work done on holding during year	1, 3, 8
042102	Whether permanent or occasional agricultural worker on holding	1, 3, 8

Code Number	Description	Data Sources and Measurement Instruments
042103	Number of days worked on holding during past month	3,8
042104	Allocation of time among activities	3,8
042105	Whether remuneration received for work during year	1,3,8
042106	Total wages received from holding during year	3,8
0422	Agricultural workers, other than members of holder's household	
04221	Indication of use	
042211	Whether permanent agricultural workers employed during year	1,3,8
042212	Whether occasional agricultural workers employed during year	1,3,8
04222	Number of permanent agricultural workers	
042221	Male	3,8
042222	Female	3,8
043	Employment in agricultural service establishments	
0431	Unpaid family workers	
043101	Number used during year	7,8
0432	Permanent agricultural workers	
043201	Number of males used during year	7,8
043202	Number of females used during year	7,8
044	Cost of labour (for holdings and agricultural service establishments)	
0441	Wages paid	
04411	To hired manager	3,4,5,7,8
044111	In cash	3,4,5,7,8
044112	In kind	3,4,5,7,8
04412	To permanent agricultural workers	
044121	In cash	3,4,5,7,8
044122	In kind	3,4,5,7,8
04413	To occasional agricultural workers	

044131	In cash	3,4,5,7,8
044132	In kind	3,4,5,7,8
0442	Cost of insurance and other fringe benefits	
044201	Whether agricultural workers covered by social or private schemes	3,7,8
044202	Employer's share of premiums paid	3,4,5,7,8
045	For each agricultural worker -- permanent and occasional (for holdings and agricultural service establishments)	
0451	Identification	
045101	Name	3,7,8
045102	Age	3,7,8
045103	Sex	3,7,8
0452	Time worked	
045201	Number of days worked	3,7,8
045202	Allocation of time among activities	3,7,8
0453	Wages earned	
04531	Daily wage	
045311	In cash	3,7,8
045312	In kind	3,7,8
04532	Annual earnings	
045321	In cash	3,7,8
045322	In kind	3,7,8
046	Participants in cooperatives, collectives or communal holdings	
046001	Name	8,18
046002	Age	8,18
046003	Sex	8,18
047	Employment outside holding (for households of which at least one member is a holder)	
0471	For each member of household (including holder)	
047101	Whether employed outside holding during year	3,8
047102	Whether employed outside holding permanently or occasionally	3,8
047103	Number of man-days worked	8

Code Number	Description	Data Sources and Measurement Instruments
047104	Occupation	8
047105	Earnings for year	3, 4, 5, 8
047106	Location of work	8
	(a) Within locality of household	
	(b) Outside locality of household	
05	<u>Land and Water</u>	
051	For entire holding	
0511	Number of parcels	1, 2, 3, 6, 19
051101	Number of parcels	
051102	Total area	1, 2, 3, 6, 19
0512	Rental of land	
05121	Land rented to others	
051211	Whether land rented to other during year	1, 3
051212	Area of land rented to others during year	3
05122	Land rented from others	
051221	Whether land rented from others during year	1, 3
051222	Rent paid in cash for land rented during year	3
051223	Rent paid in kind for land rented during year	3
0513	Land purchased or sold	
05131	Land purchased	
051311	Whether land purchased during year	3, 18
051312	Total cost of land purchased	3, 4
051313	Transfer cost of purchase transactions borne by holding	3
05132	Land sold	
051321	Whether land sold from holding during year	3, 18
051322	Total sales receipts	3, 4

051323	Transfer cost of sales transaction borne by holding	3
0514	Shifting cultivation	
051401	Whether shifting cultivation practised	1,3
051402	Area abandoned at beginning of year, if any	3
0515	Use of soil conditioners	
05151	Indication and area of use	
051511	Whether soil conditioners applied to holding land during year	1,3
051512	Area of application, if any	1,3
05152	Costs of soil conditioner applications during year	
051521	Own account	3,4
051522	Contracted	3,4
0516	New cropland	
05161	Indication and area of additions during year	
051611	Whether additions made to cropland from other land in holding	1,3
051612	Area added to cropland during year	
05162	Costs of cropland additions during year	
051621	Own account	3,4
051622	Contracted	3,4
0517	New permanent meadows and pastures	
05171	Indication and area of additions during year	
051711	Whether additions made to permanent meadows and pastures during year	1,3
051712	Area added to permanent meadows and pastures during year	1,3
05172	Costs of permanent meadow and pasture additions during year	
051721	Own account	3,4
051722	Contracted	3,4
0518	Irrigation	
05181	Indication and area of normal irrigation	
051811	Whether any land in holding irrigable with existing equipment	1,3
051812	Whether any land in holding actually irrigated during year	1,3
051813	Total area actually irrigated	1,3
05182	Source of irrigation water	
051821	Belonging to holding	
	(a) Natural spring	1,3

Code Number	Description	Data Sources and Measurement Instruments
	(b) Well	
051822	(c) Others (e.g., reservoirs filled by rainfall) Not belonging to holding	1,3
	(a) Government-built irrigation canal	
	(b) Rivers and creeks	
05183	(c) Others (e.g., from neighbours' sources Costs of irrigation during year	
051831	Own-account construction of irrigation facilities	3,4,7
051832	Contracted construction of irrigation facilities	3,4
051833	Payments to outside sources for irrigation water used	3,4
0519	Drainage	
05191	Indication, area and type of drainage	
051911	Whether any land of holding has drainage facilities	1,3
051912	Total area having drainage facilities	1,3
051913	Type of drainage facilities	3
	(a) Pumping through open drains	
	(b) Pumping through covered drains	
	(c) Gravity flow through open drains	
	(d) Gravity flow through covered drains	
05192	Costs of building drainage facilities during year	
051921	Own account	3,4
051922	Contracted	3,4
052	For each parcel	
0521	Location, area and distance	
052101	Location	1,2,3,6
052102	Total area	1,2,3,6
052103	Distance to residence	3,6
0522	Area by tenure	

05221	Owned or held in owner-like possession	1,3
052211	Area owned or held in owner-like possession	
05222	Rented from others	1,3
052221	Area rented for an agreed amount of money and/or produce	1,3
052222	Area rented for a share of produce	1,3
052223	Area rented in exchange for services	1,3
052224	Area rented under other arrangements	1,3
05223	Squatter basis	
052231	Area operated on a squatter basis	1,3
05224	Tribal or traditional communal forms of tenure	
052241	Area operated under tribal or traditional communal forms of tenure	1,3
05225	Other forms of tenure	
052251	Area operated under other forms of tenure	1,3
0523	Rent	
05231	Rent paid during the year	
052311	In cash	3,4
052312	In kind	3,4
0524	Land use	
05241	Arable land	
052411	Land under temporary crops - in open air	1,2,3
052412	Land under temporary meadows	1,2,3
052413	Land temporarily fallow	1,2,3
052414	All other arable land	1,2,3
05242	Land under protective cover	
052421	Land under protective cover - temporary crops	1,2,3
052422	Land under protective cover - permanent crops	1,2,3
05243	Land under permanent crops	
052431	Land under permanent crops	1,2,3
05244	Land under permanent meadows and pastures	
052441	Cultivated	1,2,3
052442	Naturally grown	1,2,3
05245	Woodland or forest	1,2,3
052451	Woodland or forest	
05246	All other land	1,2,3

Code Number	Description	Data Sources and Measurement Instruments
052461	Unused and undeveloped potentially productive land	1,2,3
052462	Land in holdings not elsewhere specified	1,2,3
0525	Irrigation and drainage	
052501	Whether normally irrigated	1,3
052502	Whether drainage facilities used	1,3
0526	Shifting cultivation	
052601	Area cleared for cultivation	1,3
06	<u>Crops</u>	
061	For entire holdings	
0611	Temporary crops	
06111	Crops grown during year	
061111	Name of crops grown	1,2,3
06112	Quantity produced of each crop grown during year	
061121	Early forecast	2,3
061122	Final estimate	2,3,18
06113	Value of production of each crop grown during year	
061131	Value of production	2,3,4
06114	Area harvested of each crop grown during year	
061141	Area harvested	1,2,3,18
0612	Permanent crops	
06121	Crops grown	
061211	Name of crops grown	1,2,3,11
06122	Quantity produced of each crop during year	
061221	Early forecast	2,3
061222	Final estimate	2,3
06123	Value of production of each crop during year	
061231	Value of production	2,3,4

06124	Plantation features and ages of trees for each crop	
061241	Number of scattered trees	1,2,3,11
061242	Number of trees of productive age in compact plantations	1,2,3,11
061243	Area under trees of productive age in compact plantations	1,2,3,11
061244	Number of trees of non-productive area in compact plantations	1,2,3,11
061245	Area under trees of non-productive age in compact plantations	1,2,3,11
0613	Fertilizers	
06131	Use and cost of chemical inorganic fertilizers during year	1,2,3
061311	Whether chemical inorganic fertilizers applied	3,4
061312	Cost of chemical inorganic fertilizers applied	
06132	Quantity of chemical inorganic fertilizers applied during year	
061321	Nitrogenous fertilizers	2,3,18
061322	Phosphate fertilizers	2,3,18
061323	Potash fertilizers	2,3,18
061324	Mixed, compound and complex fertilizers	2,3,18
06133	Organic manure and other fertilizers applied during year	
061331	Whether organic manure or other fertilizers applied	1,2,3
061332	Type of organic manure applied	1,2,3
	(a) Farmyard manure	
	(b) Compost	
	(c) Green manure	
	(d) Kelp	
061333	Cost of organic manure applied	3,4
061334	Type of other fertilizers applied	3,4
	(a) Guano	
	(b) Fish manure	
	(c) Fish guano	
	(d) Bone meal	
	(e) Wood ashes	
	(f) Others (to be specified)	
061335	Cost of other fertilizers applied	3,4
0614	Pesticides	
061401	Whether pesticides applied during year	1,2,3

Code Number	Description	Data Sources and Measurement Instruments
061402	Type of pesticides applied during year	1, 2, 3
	(a) Insecticides	
	(b) Fungicides	
	(c) Fumigants	
	(d) Herbicides	
	(e) Rodenticides	
	(f) Other pesticides	
061403	Cost of pesticides applied	
0615	Seeds and young plants	3, 4
061501	Whether high-yield variety seeds used during year for each crop	
061502	Quantity of seed used during year for each crop	1, 2, 3
061503	Cost of seed from outside holding used for each crop	2, 3
061504	Cost of young plants acquired from outside holding	2, 3, 4
0616	Animal power	2, 3, 4
061601	Cost of animal power used during year	3, 4
0617	Machinery	
061701	Cost of machinery use during year for each machine used	3, 4
0618	Crop insurance	
061801	Whether any crops insured during year	1, 3
061802	Cost of crop insurance for year	3, 4
062	For each parcel	
0621	Crop stand	
062101	Indication of crop stand	1, 2, 3
	(a) Pure stand - temporary crop	
	(b) Pure stand - permanent crop	
	(c) Mixed - temporary crops	
	(d) Mixed - permanent crops	

0622	(e) Associated crops	
062201	Temporary crops - rotation and intensity	1,3
062202	Crop rotation	1,2,3
	Cropping intensity	
	(a) Two or more years of fallow after each cropping year	
	(b) One year cropping followed by one year fallow	
	(c) Two years cropping followed by one year fallow	
	(d) Cultivated once each year	
	(e) Cultivated twice each year	
	(f) Cultivated three times each year	
	(g) Other (to be specified)	
062203	Holder's intended use of parcel during next year	2,3
0623	Temporary crops - inputs used	
06231	Area	
062311	Area sown for each crop	1,2,3
062312	Area harvested for each crop	1,2,3
06232	Seed	
062321	Type of seed for each crop	1,2,3
	(a) High yielding	
	(b) Other	
062322	Quantity of seed used for each crop	2,3
062323	Cost of seed used for each crop	3
06233	Quantity of chemical inorganic fertilizers	
062331	Nitrogenous fertilizers	3
062332	Phosphate fertilizers	3
062333	Potash fertilizers	3
06234	Cost of fertilizers and pesticides	
062341	Cost of chemical fertilizers	3
062342	Cost of all other types of fertilizers	3
062343	Cost of pesticides	3
06235	Animal power	
062351	Days of use of animals to cultivate parcel, for each animal used	3
062352	Cost of animal power used	3
06236	Machinery	
062361	Days of use of machinery to cultivate parcel, for each machine used	3

Code Number	Description	Data Sources and Measurement Instruments
062362	Cost of use of machinery	3
06237	Labour	
062371	Unpaid family workers' time used	3
062372	Other workers' time used	3
06238	Insurance	
062381	Cost of crop insurance	3
0624	Temporary crops - outputs	
06241	Yield	
062411	Yield per unit area for each crop	3
06242	Quantity of production for each crop	
062421	Early forecast	3
062422	Final estimate	3
0625	Permanent crops - plantation characteristics for each crop	
06251	Plantation features and ages of trees	
062511	Number of scattered trees	1,2,3
062512	Number of trees of productive age in compact plantations	1,2,3
062513	Area under trees of productive age in compact plantations	1,2,3
062514	Number of trees of non-productive age in compact plantations	1,2,3
062515	Area under trees of non-productive age in compact plantations	1,2,3
0626	Permanent crops - inputs used during year - nonproductive age	
06261	Young plants	
062611	Source of young plants planted	3
	(a) Own nursery	
	(b) Outside holding	
062612	Cost of young plants from outside holding	3
06262	Quantity of chemical inorganic fertilizers applied	
062621	Nitrogenous fertilizers	3
062622	Phosphate fertilizers	3
062623	Potash fertilizers	3

062624	Mixed, compound and complex fertilizers	3
06263	Cost of fertilizers and pesticides applied	
062631	Cost of chemical fertilizers	3
062632	Cost of all other types of fertilizers	3
062633	Cost of pesticides	3
06264	Animal power	
062641	Days of use of animals to cultivate parcel, for each animal used	3
062642	Cost of animal power used	3
06265	Machinery	
062651	Days of use of machinery to cultivate parcel, for each machine used	3
062652	Cost of use of machinery	3
06266	Labour	
062661	Unpaid family workers' time used	3
062662	Other workers' time used	3
0627	Permanent crops - inputs used during year - productive age	
06271	Quantity of chemical inorganic fertilizers applied	
062711	Nitrogenous fertilizers	3
062712	Phosphate fertilizers	3
062713	Potash fertilizers	
062714	Mixed, compound and complex fertilizers	3
06272	Cost of fertilizers and pesticides applied	
062721	Cost of chemical fertilizers	3
062722	Cost of all other types of fertilizers	3
062723	Cost of pesticides	3
06273	Animal power	
062731	Days of use of animals to cultivate parcel, for each animal used	3
062732	Cost of animal power used	3
06274	Machinery	
062741	Days of use of machinery to cultivate parcel, for each machine used	3
062742	Cost of use of machinery	3
06275	Labour	

Code Number	Description	Data Sources and Measurement Instruments
062751	Unpaid family workers' time used	3
062752	Other workers' time used	3
06276	Insurance	
062761	Cost of crop insurance	3
0628	Permanent crops - output	
06281	Yield	
062811	Yield per unit area for each crop	3
06282	Quantity produced for each crop	
062821	Early forecast	3
062822	Final estimate	3
06283	Young plants	
062831	Number grown in nurseries and sold	3
062832	Number grown in nurseries and used on holding	3
0629	Permanent crops - nurseries	
062901	Cost of chemical fertilizers applied	3
062902	Cost of pesticides applied	3
062903	Unpaid family workers' time used	3
062904	Other workers' time used	3
07-08	<u>Livestock</u>	
071	Management and population	
0711	Livestock production system	
071101	Type of production system	1,3,10
	(a) Nomadic or totally pastoral	
	(b) Semi-nomadic or semi-pastoral	
	(c) Sedentary pastoral	
	(d) Ranching	
0712-0713	Animal numbers, by animal type	

071201	Cattle	1,2,3,10,18,19
071202	Buffaloes	1,2,3,10,18,19
071203	Sheep	1,2,3,10,18,19
071204	Goats	1,2,3,10,18,19
071205	Pigs	1,2,3,10,18,19
071206	Horses	1,2,3,10,18,19
071207	Asses	1,2,3,10,18,19
071208	Mules and hinnies	1,2,3,10,18,19
071209	Camels	1,2,3,10,18,19
071301	Chickens	1,2,3,10,18,19
071302	Beehives	1,2,3,10
071303	Deer	1,2,3,10
071304	Others (e.g., other poultry, rabbits, llamas, elephants, ostriches, silkworms, fur-bearing animals reared in captivity, etc.)	1,2,3,10,18 1,10,11,18

072

Cattle

0721	Herd structure and management	
07211	Cattle population, by age, sex and main purpose	
072111	Present population	2,3,10
	Age classes:	
	(1) Under 1 year of age	
	(2) 1 year of age and under two years	
	(3) 3 years of age and over	
	Main purpose classes:	
	(1) For breeding	
	(2) For draught	
	(3) For milk	
	(4) For meat	
072112	Maximum population	10
072113	Minimum population	10
07212	Sales and purchases during year	
072121	Number of cattle sold, by age, sex and main purpose	2,3,10
072122	Total value of sales	2,3,4,10
072123	Number of cattle purchased, by age, sex and main purpose	2,3,10

Code Number	Description	Data Sources and Measurement Instruments
072124	Total cost of purchases	2, 3, 4, 10
07213	Births and deaths during year	
072131	Number of live births, by sex	2, 3, 10
072132	Number of natural deaths, by age, sex and main purpose	2, 3, 10
07214	Breed	
072141	Present population of cattle, by race	3, 10
07215	Weight	
072151	Present population of cattle, by weight class: (1) Less than 225 kg. (2) 225 kg. and over	3, 10
0722	Veterinary services	
072201	Number of presently diseased cattle, by type of disease	3, 10
072202	Number of sick cattle treated during year	3, 10, 18
072203	Number of cattle vaccinated during year, by type of vaccine	3, 10, 18
072204	Cost of veterinary services during year	3, 4, 10
0723	Feed	
072301	Quantity consumed, type	3, 10
072302	Cost of feed	3, 4, 10
0724	Labour	
072401	Unpaid household members' time	3, 10
072402	Other workers' time	3, 10
0725	Other inputs	
072501	Other inputs (to be specified)	3, 10
072502	Cost of other inputs	3, 4, 10
0726	Production - meat	
072601	Number slaughtered by household during year, by age, sex and purpose	2, 3, 4, 10
072602	Liveweight of cattle slaughtered by household during year	2, 3, 4, 10, 11

072603	Number slaughtered at slaughterhouses during year, by origin (indigenous, foreign)	10,11,18
072604	Liveweight of cattle slaughtered at slaughterhouses during year	10,11,18
072605	Carcass weight of cattle slaughtered at slaughterhouses during year	10,11,18
072606	Value of cattle slaughtered at slaughterhouses during year	10,11,18
0727	Production - milk	
07271	Milk products	
072711	Quantity of milk produced	2,3,4,10
072712	Value of milk produced	2,3,4,10
072713	Quantity of milk used for milk products	3,4,10
07272	Milk products	
072721	Quantity of butter produced	3,4,10
072722	Quantity of cheese produced	3,4,10
072723	Quantity of yoghurt produced	3,4,10
072724	Quantity of other milk products produced (to be specified)	3,4,10
072725	Value of milk products produced	3,4,10
0728	Production - other	
072801	Number of hides	3,10,18
072802	Other (to be specified)	3,10,18
072803	Value of other cattle products produced	3,4,10,18
073	Buffaloes	
0731	Herd structure and management	
07311	Buffalo population, by age, sex and main purpose	
073111	Present population	
	Age classes:	
	(1) Under 1 year of age	
	(2) 1 year of age and under 3 years	
	(3) 3 years of age and over	
	Main purpose classes:	
	(1) For breeding	
	(2) For draught	
	(3) For milk	
	(4) For meat	
		2,3,10

Code Number	Description	Data Sources and Measurement Instruments
073112	Maximum population	10
073113	Minimum population	10
07312	Sales and purchases during year	
073121	Number of buffaloes sold, by age, sex and main purpose	2,3,10
073122	Total value of sales	2,3,4,10
073123	Number of buffaloes purchased, by age, sex and main purpose	2,3,10
073124	Total cost of purchases	2,3,4,10
07313	Births and deaths during year	
073131	Number of live births, by sex	2,3,10
073132	Number of natural deaths, by age, sex and main purpose	2,3,10
0732	Veterinary services	
073201	Number of presently diseased buffaloes, by type of disease	3,10
073202	Number of sick buffaloes treated during year	3,10,18
073203	Number of buffaloes vaccinated during year, by type of vaccine	3,10,18
073204	Cost of veterinary services during year	3,4,10
0733	Feed	
073301	Quantity consumed, by type	3,10
073302	Cost of feed	3,4,10
0734	Labour	
073401	Unpaid household members' time	3,10
073402	Other workers' time	3,10
0735	Other inputs	
073501	Other inputs (to be specified)	3,10
073502	Cost of other inputs	3,4,10
0736	Production - meat	
073601	Number slaughtered by household during year, by age, sex and purpose	2,3,4,10
073602	Liveweight of buffaloes slaughtered by household during year	2,3,4,10,11

073603	Number slaughtered at slaughterhouses during year, by origin (indigenous, foreign)	10, 11, 18
073604	Liveweight of buffaloes slaughtered at slaughterhouses during year	10, 11, 18
073605	Carcass weight of buffaloes slaughtered at slaughterhouses during year	10, 11, 18
073606	Value of buffaloes slaughtered at slaughterhouses during year	10, 11, 18
0737	Production - milk	
07371	Milk products	
073711	Quantity of milk produced	2, 3, 4, 10
073712	Value of milk produced	2, 3, 4, 10
073713	Quantity of milk used for milk products	3, 4, 10
07372	Milk products	
073721	Quantity of butter produced	3, 4, 10
073722	Quantity of cheese produced	3, 4, 10
073723	Quantity of yoghurt produced	3, 4, 10
073724	Quantity of other milk products produced (to be specified)	3, 4, 10
073725	Value of milk products produced	3, 4, 10
0738	Production - other	
073801	Number of hides	3, 10, 18
073802	Other (to be specified)	3, 10, 18
073803	Value of other buffalo products produced	3, 4, 10, 18
074	Sheep	
0741	Herd structure and management	
07411	Sheep population, by age, sex and main purpose	
074111	Present population	2, 3, 10
	Age classes:	
	(1) Under 1 year of age	
	(2) 1 year of age and over	
	Main purpose classes:	
	(1) For breeding	
	(2) For wool	
	(3) For milk	
	(4) For meat	

Code Number	Description	Data Sources and Measurement Instruments
074112	Maximum population	10
074113	Minimum population	10
07412	Sales and purchases during year	
074121	Number of sheep sold, by age, sex and main purpose	2,3,10
074122	Total value of sales	2,3,4,10
074123	Number of sheep purchased, by age, sex and main purpose	2,3,10
074124	Total cost of purchases	2,3,4,10
07413	Births and deaths during year	
074131	Number of live births, by sex	2,3,10
074132	Number of natural deaths, by age, sex and main purpose	2,3,10
07414	Breed	
074141	Present population, by breed	3,10
0742	Veterinary services	
074201	Number of presently diseased sheep, by type of disease	3,10
074202	Number of sick sheep treated during year	3,10,18
074203	Number of sheep vaccinated during year, by type of vaccine	3,10,18
074204	Cost of veterinary services during year	3,4,10
0743	Feed	
074301	Quantity consumed, type	3,10
074302	Cost of feed	3,4,10
0744	Labour	
074401	Unpaid household members' time	3,10
074402	Other workers' time	3,10
0745	Other inputs	
074501	Other inputs (to be specified)	3,10
074502	Cost of other inputs	3,4,10
0746	Production - meat	
074601	Number slaughtered by household during year, by age, sex and purpose	2,3,4,10

074602	Liveweight of sheep slaughtered by household during year	2,3,4,10,11
074603	Number slaughtered at slaughterhouses during year, by origin (indigenous, foreign)	10,11,18
074604	Liveweight of sheep slaughtered at slaughterhouses during year	10,11,18
074605	Carcass weight of sheep slaughtered at slaughterhouses during year	10,11,18 10,11,18
074606	Value of sheep slaughtered at slaughterhouses during year	10,11,18 10,11,18
0747	Production - wool	
07471	Number of sheep clipped	2,3,10
074711	Number of sheep clipped	
07472	Wool produced	2,3,10
074721	Greasy fleece weight	11
074722	Clean fleece weight	2,3,4,10
074723	Value of wool produced	
0748	Production - milk	
07481	Milk products	
074811	Quantity of milk produced	2,3,4,10
074812	Value of milk produced	2,3,4,10
074813	Quantity of milk used for milk products	3,4,10
07482	Milk products	
074821	Quantity of butter produced	3,4,10
074822	Quantity of cheese produced	3,4,10
074823	Quantity of yoghurt produced	3,4,10
074824	Quantity of other milk products produced (to be specified)	3,4,10
074825	Value of milk products produced	3,4,10
0749	Production - other	
074901	Number of hides	3,10,18
074902	Other (to be specified)	3,10,18
074903	Value of other sheep products produced	3,4,10,18
075	Goats	
0751	Herd structure and management	
07511	Goat population, by age, sex and main purpose	

Code Number	Description	Data Sources and Measurement Instruments
075111	Present population	2,3,10
	Age classes:	
	(1) Under 1 year of age	
	(2) 1 year of age and over	
	Main purpose classes:	
	(1) For breeding	
	(2) For goat hair	
	(3) For milk	
	(4) For meat	
075112	Maximum population	10
075113	Minimum population	10
07512	Sales and purchases during year	
075121	Number of goats sold, by age, sex and main purpose	2,3,10
075122	Total value of sales	2,3,4,10
075123	Number of goats purchased, by age, sex and main purpose	2,3,10
075124	Total cost of purchases	2,3,4,10
07513	Births and deaths during year	
075131	Number of live births, by sex	2,3,10
075132	Number of natural deaths, by age, sex and main purpose	2,3,10
07514	Breed	
075141	Present population, by breed	3,10
0752	Veterinary services	
075201	Number of presently diseased goats by type of disease	3,10
075202	Number of sick goats treated during year	3,10,18
075203	Number of goats vaccinated during year, by type of vaccine	3,10,18
075204	Cost of veterinary services during year	3,4,10
0753	Feed	
075301	Quantity consumed, by type	3,10
075302	Cost of feed	3,4,5,10

0754	Labour		
075401	Unpaid household members' time		3,10
075402	Other workers' time		3,10
0755	Other inputs		
075501	Other inputs (to be specified)		3,10
075502	Cost of other inputs		3,4,10
0756	Production - meat		
075601	Number slaughtered by household during year, by age, sex and purpose		2,3,4,10
075602	Liveweight of goats slaughtered by household during year		2,3,4,10,11
075603	Number slaughtered at slaughterhouses during year, by origin (indigenous, foreign)		10,11,18
075604	Liveweight of goats slaughtered at slaughterhouses during year		10,11,18
075605	Carcass weight of goats slaughtered at slaughterhouses during year		10,11,18
075606	Value of goats slaughtered at slaughterhouses during year		10,11,18
0757	Production - goat hair		
07571	Number of goats clipped		2,3
075711	Number of goats clipped		
07572	Goat hair produced		2,3
075721	Greasy fleece weight		11
075722	Clean fleece weight		2,3,4,10
075723	Value of goat hair produced		
0758	Production - milk		
07581	Milk products		
075811	Quantity of milk produced		2,3,4,10
075812	Value of milk produced		2,3,4,10
075813	Quantity of milk used for milk products		3,4,10
07582	Milk products		
075821	Quantity of butter produced		3,4,10
075822	Quantity of cheese produced		3,4,10
075823	Quantity of yoghurt produced		3,4,10
075824	Quantity of other milk products produced (to be specified)		3,4,10

Code Number	Description	Data Sources and Measurement Instruments
075825	Value of milk products produced	3,4,10
0759	Production - other	
075901	Number of hides	3,10,18
075902	Other (to be specified)	3,10,18
075903	Value of other goat products produced	3,4,10,18
076	Pigs	
0761	Herd structure and management	
07611	Pig population, by age, sex and main purpose	2,3,10
076111	Present population	
	Age classes:	
	(1) Under 6 months of age	
	(2) 6 months of age and over	
	Main purpose classes:	
	(1) For breeding	
	(2) For other purposes	
	Maximum population	10
	Minimum population	10
076112	Sales and purchases during year	
076113	Number of pigs sold, by age, sex and main purpose	2,3,10
076121	Total value of sales	2,3,4,10
076122	Number of pigs purchased, by age, sex and main purpose	2,3,10
076123	Total cost of purchases	2,3,4,10
076124	Births and deaths during year	
07613	Number of live births, by sex	
076131	Number of natural deaths, by age, sex and main purpose	2,3,10
076132	Weight	2,3,10
07614	Present population, by weight class	3,10
076141	(1) Less than 20 kg.	

	(2) 20 kg. and less than 50 kg.	
	(3) 50 kg. and less than 80 kg.	
	(4) 80 kg. and less than 110 kg.	
	(5) 110 kg. and over	
0762	Veterinary services	
076201	Number of presently diseased pigs, by type of disease	3,10
076202	Number of sick pigs treated during year	3,10,18
076203	Number of pigs vaccinated during year, by type of vaccine	3,10,18
076204	Cost of veterinary services during year	3,4,10
0763	Feed	
076301	Quantity consumed, type	3,10
076302	Cost of feed	3,4,10
0764	Labour	
076401	Unpaid household members' time	3,10
076402	Other workers' time	3,10
0765	Other inputs	
076501	Other inputs (to be specified)	3,10
076502	Cost of other inputs	3,4,10
0766	Production	
076601	Number slaughtered by household during year, by age, sex and purpose	2,3,4,10
076602	Liveweight of pigs slaughtered by household during year	2,3,4,10,11
076603	Number slaughtered at slaughterhouses during year, by origin (indigenous, foreign)	10,11,18
076604	Liveweight of pigs slaughtered at slaughterhouses during year	10,11,18
076605	Carcass weight of pigs slaughtered at slaughterhouses during year	10,11,18
076606	Value of pigs slaughtered at slaughterhouses during year	10,11,18
076607	Other production (to be specified)	3,10,18
076608	Value of other production	3,4,10,18
077	Horses and camels	
0771	Horses	

Code Number	Description	Data Sources and Measurement Instruments
077101	Number of horses, by age and sex	2, 3, 10
	Age classes:	
	(1) Under 3 years of age	
	(2) 3 years of age and over	
0772	Camels	
077201	Number of camels, by age and sex	2, 3, 10
	Age classes:	
	(1) Under 4 years of age	
	(2) 4 years of age and over	
0773	Sales and purchases during year	
077301	Total value of sales	2, 3, 4, 10
077302	Total cost of purchases	2, 3, 4, 10
078	Chickens	
0781	Population	
07811	Number of chickens for breeding	
078111	Hens and pullets for producing hatching eggs	3, 10
078112	Cocks and cockerels	3, 10
07812	Number of chickens for egg production	
078121	Growing pullets	3, 10
078122	Laying hens and pullets	3, 10
07813	Number of chickens for meat production	
078131	Broilers	3, 10
078132	Other (e.g., capons)	3, 10
07814	Other chickens (multi-purpose mixed stock)	
078141	Growing pullets	3, 10
078142	Laying hens and pullets	3, 10
078143	Other	3, 10
0782	Inputs	

07821	Feed	
078211	Quantity consumed, by type	3,10
078212	Cost of feed	3,4,10
07822	Labour	
078221	Unpaid household members' time	3,10
078222	Other workers' time	3,10
07823	Other inputs	
078231	Cost of veterinary services	3,4,10
078232	Cost of other inputs (to be specified)	3,4,10
0783	Production	
07831	Chickens	
078311	Number slaughtered by household during year	3,4,10
078312	Number sold during year	3,10
078313	Liveweight of chickens sold	3,11
078314	Ready-to-cook (oven-ready) weight of chickens sold	3,11
078315	Receipts from sales of chickens	3,10
07832	Eggs	
078321	Number of eggs produced	3,4,10
078322	Weight of eggs produced	3,11
079	Other poultry	
0791	Population	
079101	Ducks	3,10
079102	Geese	3,10
079103	Turkeys	3,10
079104	Guinea fowl	3,10
079105	Pigeons	3,10
079106	Others (to be specified)	3,10
0792	Inputs	
079201	Cost of feed	3,4,10
079202	Unpaid household members' time	3,10
079203	Other workers' time	3,10
079204	Cost of other inputs	3,4,10
0793	Production	
079301	Number slaughtered by households during year, by type	3,4,10

Code Number	Description	Data Sources and Measurement Instruments
079302	Number sold during year, by type	3,10
079303	Receipts from sales of other poultry	3,4,10
081	Other domesticated animals	
0811	Bees	
081101	Quantity of honey produced	2,3,4,10
0812	Others (including deer)	
081201	Cost of inputs	4,10,11
081202	Quantity of production (to be specified)	4,10,11
09	<u>Machinery and Equipment</u>	
091	For holdings	
0911	Indication of use, by type of machinery and equipment	
091101	Whether used on holding during past year	1,2,3,10
0912	Number and source	
091201	Number used on holding, by source and type of machine or equipment	1,2,3,10
	Source classes:	
	(1) Owned solely by holder	
	(2) Owned jointly by holder and others	
	(3) Provided by landlord	
	(4) Provided by other private holders (excluding cooperatives and collectives)	
	(5) Provided by cooperative or collective	
	(6) Provided by a private agricultural service establishment	
	(7) Provided by a government agency	
0913	Rentals paid	

091301	Amount paid during year for rental of machinery and equipment	3,4
092	For holdings and agricultural service establishments	
0921	For machinery owned solely or jointly	
09211	Age	
092111	Age of each piece of machinery and equipment	1,3
09212	Tractor power	
092121	Horsepower (or kilowatts) of each tractor	1,3
09213	Purchases during past year	
092131	Cost of new machinery and equipment	3,4,14
092132	Cost of used machinery and equipment	3,4
092133	Transfer costs of used purchases borne by purchaser	3
09214	Sales during past year	
092141	Receipts from sale of used machinery and equipment	3,4
092142	Transfer costs of sales borne by seller	3
09215	Operating costs during past year	
092151	Current repairs	3,4,14
092152	Capital repairs	3,4,14
092153	Cost of fuel and oil	3,4
092154	Depreciation	3
092155	Insurance premiums	3,4
09216	Own-account production	
092161	Value of equipment manufactured on holding	3,4
09217	Non-agricultural use	
092171	Days used for non-agricultural purposes, for each type of machinery and equipment	11
09218	Machinery and equipment in unusable condition	
092181	Number unusable, for each type of machinery and equipment	3

10 Buildings and Other Structures

101	Living quarters	
1011	General characteristics and agricultural use	
10111	Structural type	

Code Number	Description	Data Sources and Measurement Instruments
101111	Indication of structural type (a) Conventional dwelling (b) Semi-permanent dwelling (c) Mobile housing unit (d) Marginal housing unit Outer walls (for each building)	3, 4, 12, 16
101112	Type of construction material of outer walls (a) Concrete (b) Brick (c) Adobe (d) Wood (e) Other (to be specified)	3, 4, 12, 16
101113	Water and electricity	
101131	Indication of source of drinking water (a) Piped water (b) Own well (c) Other (to be specified)	3, 4, 12, 16
101132	Whether electricity available within living quarters	3, 4, 12, 16
10114	Area	
101141	Total area of living quarters	3, 4, 12, 16
10115	Agricultural use of living quarters	
101151	Whether living quarters used partially for agricultural purposes	1, 3, 6, 10 3, 6, 10
101152	Area or volume allocated to agricultural uses, if any (a) Keeping livestock (area) (b) Storing agricultural products (volume) (c) Storing agricultural inputs (volume) (d) Keeping agricultural machinery and equipment (area) (e) Other (to be specified)	

1012	Tenure		
101201	Indication of type of tenure of living quarters		1,3,4,12,16
	(a) Owned		
	(b) Rented		
	(c) Other (to be specified)		
102	Non-residential buildings		
1021	Use and tenure		
10211	Indication of use		
102111	Whether any non-residential buildings used		1,3,6,10,12
10212	Tenure (for each non-residential building used)		
102121	Indication of type of tenure		1,3,10,12
	(a) Owned		
	(b) Rented		
	(c) Other (to be specified)		
102122	Rent paid during year, if any		3,4,16
1022	Physical properties of buildings		
10221	Area or volume		
102211	For keeping livestock other than poultry (area)		1,3,10
102212	For keeping poultry (area)		1,3,10
102213	For storing agricultural products (volume)		1,3,6
102214	For keeping agricultural machinery and equipment (area)		1,3
102215	As office (area)		1,3
102216	For mixed or other purposes (area)		1,3
10222	Outer walls (for each building)		
102221	Type of construction material of outer walls		1,3,6,12
	(a) Concrete		
	(b) Brick		
	(c) Adobe		
	(d) Wood		
	(e) Other (to be specified)		
1023	Purchases and sales		
10231	Purchases		
102311	Cost of buildings purchased during past year		3,4
102312	Transfer cost borne by purchaser		3

Code Number	Description	Data Sources and Measurement Instruments
10232	Sales	
102321	Total receipts from sale of buildings during past year	3,4
102322	Transfer cost borne by seller	3
1024	Construction costs during past year	
102401	Own account	3,4
102402	Contracted	3,4,17
103	Other structures	
1031	Construction costs during past year	
103101	Own account	3,4
103102	Contracted	3,4,17
11	<u>Ancillary Activities</u>	
111	Forestry	
1111	Existence of forest trees on holding	
111101	Whether forest trees exist on holding	1,2,3,11
1112	Number of forest trees	
11121	Total number	
111211	Total number of forest trees	1,2,3,11
11122	Number of trees, by purpose	
111221	For fuelwood	1,2,3,11
111222	For industrial wood	1,2,3,11
111223	For forage	1,2,3,11
111224	For protection	1,2,3,11
111225	For other purposes	1,2,3,11
11123	Number of trees planted during year	
111231	Number of trees planted during year	1,3,11

1113	Area under forest trees	
111301	Compact woodland and forest area	1,3,11
111302	Forest tree nurseries	1,3,11
111303	Other area	1,3,11
1114	Inputs used during year	
111401	Cost of young plants acquired outside holding	3,4,5,11
111402	Unpaid household members' time	3,11,15
111403	Other workers' time	3,11,15
111404	Cost of other inputs (to be specified)	3,4,5,11,15
1115	Production during year	
111501	Fuelwood	2,3,11
111502	Wood for industrial use	2,3,11,15
111503	Forage from trees	2,3,11
111504	Other	2,3,11
1116	Sales	
111601	Quantity sold	2,3,11,15
111602	Receipts from sales	2,3,4,5,11,15
1117	Own consumption	
111701	Value of produce consumed by holding	2,3,4,5,11,15
111702	Value of produce consumed by household	2,3,4,5,11,15
112	Fisheries	
1121	Existence of fisheries activities on holding	
112101	Whether fish or other aquatic animals and plants harvested	1,2,3,11
1122	Cultural installation	
112201	Indication of type of cultural installation used for fisheries	1,2,3,11
	(a) Pond	
	(b) Rice fields	
	(c) Other (to be specified)	
112202	Number of each type of cultural installation	2,3,11
112203	Area of each type of cultural installation	2,3,11
1123	Inputs used during year	
112301	Unpaid household members' time	3,11

Code Number	Description	Data Sources and Measurement Instruments
112302	Other workers' time	3, 11
112303	Cost of other inputs (to be specified)	3, 4, 5, 11
1124	Production during year	
112401	Fish taken from waters on holding (landings)	2, 3, 11
112402	Other aquatic animals and plants (to be specified)	
	Taken from waters on holding	2, 3, 11
1125	Sales	
112501	Quantity sold	2, 3, 11
112502	Receipts from sales	2, 3, 4, 5, 11
1126	Own consumption	
112601	Value of produce consumed by household	2, 3, 4, 5, 11
12	<u>Credit, Marketing, Stocks</u>	
121	Credit	
1211	Credit activities of holding and agricultural service establishment	
12111	Indication of credit received during year	
121111	Whether money borrowed	1, 3, 11
121112	Whether services or fixed assets purchased on credit	1, 3, 11
12112	Indication of credit given to others during year	
121121	Whether credit provided to others	3, 11
1212	Credit received, for each transaction	
12121	Source and term	
121211	Indication of source of credit:	1, 3, 11
	(a) Money-lender	
	(b) Cooperative	
	(c) Bank	
	(d) Other	

121212	Indication of term of credit	3,11
	(a) Short-term	
	(b) Medium-term	
	(c) Long-term	
12122	Amount of credit	
121221	Amount of principal	
121222	Service charges	
121223	Interest charges	
12123	Use	
121231	Amount used for holding or agricultural service establishment	3,4,11
121232	Amount used for other purposes	3,4,11
12124	Repayment	
121241	Amount paid back during year	3,4,11
122	Marketing	
1221	Timeliness and sources of inputs	
12211	Indication of timeliness of obtaining inputs	3,11
122111	Whether chemical inorganic fertilizers obtained on time	3,11
122112	Whether pesticides obtained on time	3,11
122113	Whether other inputs (to be specified) obtained on time	3,11
12212	Indication of sources of inputs	
122121	Source of chemical inorganic fertilizers:	3,11
	(a) Government agencies	
	(b) Cooperatives	
	(c) Private commercial establishments	
	(d) Other holders	
	(e) Other (to be specified)	
122122	Source of pesticides:	3,11
	(a) Government agencies	
	(b) Cooperatives	
	(c) Private commercial establishments	
	(d) Other holders	
	(e) Other (to be specified)	
122123	Source of other inputs (to be specified):	3,11

(a) Government agencies

Code Number	Description	Data Sources and Measurement Instruments
1222	(b) Cooperatives	
12221	(c) Private commercial establishments	
122211	(d) Other holders	
	(e) Other (to be specified)	
	Disposal of products	
	Production purpose of holding	
	Indication of production purpose of holding:	1,3,11
	(a) For own consumption only	
	(b) Mainly for own consumption	
	(c) Mainly for market	
12222	Allocation of production quantities, for each produce	
122221	Own consumption	3,4,11
122222	Seed for next season	3,11
122223	Animal feed	3,10,11
122224	Sale	3,11
12223	Buyers of quantities sold, for each produce	
122231	Individual consumer	3,11
122232	Tradesmen	3,11
122233	Government agencies	3,11
122234	Other buyers	3,11
12224	Locations of sales, for each produce	
122241	Holding	3,11
122242	Marketplace of locality of holding	3,11
122243	Places outside locality of holding	3,11
12225	Transport of produce to first point of sale, for each produce	
122251	Whether produce transported by holder	3,11
122252	Indication of means of transport:	3,11

	(a) Individuals	
	(b) Animals and animal driven vehicles	
	(c) Tractors	
	(d) Other (to be specified)	
122253	Cost of transport	3,4,11
12226	Time of sale, quantity for each produce	
122261	Before harvest	3,11
122262	Directly from harvest	3,11
122263	After storage	3,11
12227	Value of sales	
122271	Value of sale, for each produce	3,4,11
123	Stocks	
1231	Of agricultural products, by product (for holdings and households)	
12311	Stock at beginning of year	
123111	Total quantity	3,11
123112	Quantity for sale	3,11
123113	Quantity for own consumption	3,4,11
12312	Stock at end of year	
123121	Total quantity	3,11
123122	Quantity for sale	3,11
123123	Quantity for own consumption	3,4,11
1232	Of agricultural inputs, by input (for holdings and agricultural service establishments)	
12321	Stock of chemical inorganic fertilizers at beginning of year	3,11
123211	Quantity of nitrogenous fertilizers	3,11
123212	Quantity of phosphate fertilizers	3,11
123213	Quantity of potash fertilizers	3,11
123214	Quantity of mixed, compound and complex fertilizers	3,11
12322	Stock of chemical inorganic fertilizers at end of year	
123221	Quantity of nitrogenous fertilizers	3,11
123222	Quantity of phosphate fertilizers	3,11
123223	Quantity of potash fertilizers	3,11
123224	Quantity of mixed, compound and complex fertilizers	3,11

Code Number	Description	Data Sources and Measurement Instruments
12323	Stock of pesticides at beginning of year	
123231	Quantity in stock, by type of pesticide	3, 11
12324	Stock of pesticides at end of year	
123241	Quantity in stock, by type of pesticide	3, 11
13	<u>Prices</u>	
131	Prices received and prices paid by farmers	
1311	Prices received by farmers, by product sold	
13111	Sales directly from holding	
131111	Farm-gate prices	3, 10, 11
13112	Products whose farm-gate prices are fixed by government	
131121	Whether farm-gate price of product fixed by government	18
1312	Wholesale prices, by product sold	
13121	Sales by producer-sellers at primary wholesale market	
131211	Prices received by producer-sellers	3, 10, 11
131212	Market entry fees borne by producer-sellers	3, 10, 11
131213	Incidental charges borne by producer-sellers	3, 10, 11
131214	Incidental charges borne by wholesale buyers	11, 17
13122	Sales by wholesalers at primary wholesale market	
131221	Prices received by wholesalers	11, 17
13123	Sales by wholesalers at secondary wholesale market	
131231	Prices received by wholesalers	11, 17
131232	Cost of transport incurred by wholesalers	11, 17
131233	Incidental charges borne by wholesalers	11, 17
131234	Incidental charges borne by buyers (e.g., retailers)	11, 17
13124	Products whose wholesale prices are fixed by government	
131241	Whether wholesale price of product fixed by government	18
1313	Retail prices, by product sold	

13131	Sales by producer-sellers at retail markets	
131311	Prices received by producer-sellers	3,10,11
131312	Incidental charges borne by producer-sellers	3,10,11
13132	Sales by retail traders	
131321	Prices received by retail traders	11,17
131322	Cost of transport borne by retail traders	11,17
131323	Incidental charges borne by retail traders	11,17
13133	Products whose retail prices are fixed by government	
131331	Whether retail price of product is fixed by government	18
1314	Export prices, by product exported	
13141	Exports by producer-sellers	
131411	Prices received by producer-sellers	3,10,11,18
131412	Incidental charges borne by producer-sellers	3,10,11,18
13142	Exports by wholesalers	
131421	Prices received by wholesalers	11,17,18
131422	Incidental charges borne by wholesalers	11,17,18
13143	Products whose export prices are fixed by government	
131431	Whether export price of product is fixed by government	18
1315	Prices paid by farmers at point of purchase	
13151	Seed and seedlings, for each crop	
131511	Seeds	3,11
131512	Seedlings	3,11
13152	Animal feed	
131521	Hay	3,10,11
131522	Others (to be specified)	3,10,11
13153	Fertilizers and pesticides	
131531	Nitrogenous fertilizers	3,11
131532	Phosphate fertilizers	3,11
131533	Potash fertilizers	3,11
131534	Other chemical fertilizers (to be specified)	3,11
131535	Organic fertilizers (to be specified)	3,11
131536	Pesticides (to be specified)	3,11
13154	Machinery and equipment	
131541	For each type of machinery and equipment (to be specified)	3,18
13155	Other materials	

Code Number	Description	Data Sources and Measurement Instruments
131551	Gasoline	18
131552	Oil	18
131553	Bags	3
131554	Rope	3
131555	Others (to be specified)	3
13156	Services	
131561	Wage rate for agricultural workers	3,8
131562	Rates for contract services	3,7
13157	Other inputs	
131571	Irrigation rate	3,18
131572	Electricity for light	18
131573	Electricity for power	18
131574	Land rental	3,11
131575	Others (to be specified)	3,11
13158	Transport	
131581	Cost borne by holder to transport goods and services purchased	3,10,11
13159	Agricultural inputs whose prices are subsidized by government	
131591	Whether price of input is subsidized by government	18
132	Prices of household consumer goods	
(to be itemized)		4,11
133	World prices for agricultural products and inputs	
(to be itemized)		18,20
14	<u>Post-Harvest Foodgrain Losses</u>	
141	At holding	

1411	Losses at harvest	6
141101	Whether harvested manually or mechanically	6
141102	Quantity of grain left in field	6
1412	Losses at threshing/shelling	6
141201	Method of threshing	6
141202	Quantity of grain lost	6
141203	Quantity of grain damaged	6
1413	Losses at cleaning/winnowing	6
141301	Method of cleaning/winnowing	6
141302	Quantity of grain lost	6
1414	Losses at drying	6
141401	Method of drying	6
141402	Quantity of grain lost	6
1415	Losses in storage	6
141501	Quantity of grain damaged by mites	6
141502	Quantity of grain damaged by micro-organisms	6
141503	Quantity lost due to rodents	6
141504	Relative humidity in storage facility	6
141505	Temperature in storage facility	6
1416	Losses in transport	6
141601	Location of transport losses	6
	(1) From field to threshing floor	
	(2) From threshing floor to drying place	
	(3) From threshing floor to cleaning place	
	(4) From farm to storage	
	(5) Other	
1417	Losses in processing	6
141701	Mode of processing	6
141702	Quantity of grain lost	6
1418	Losses in packing and handling	6
141801	Mode of packaging	6
141802	Quantity of grain lost	6
142	By intermediaries	6
	(to be itemized)	

Code Number	Description	Data Sources and Measurement Instruments
143	At warehouses	6
	(to be itemized)	
15	<u>Income and Outlay</u>	
151	Revenues of holdings and agricultural service establishments not covered elsewhere	
1511	Rentals received	
151101	From land rented out to others	3,4,7
151102	From non-residential buildings rented out to others	3,4,7
151103	From machinery and equipment rented out to others	3,4,7
151104	Other rentals received	3,4,7
1512	Receipts for agricultural services rendered	
15121	Services for crop production	
151211	Land clearing and soil preparation	4,7
151212	Planting	4,7
151213	Cultivation	4,7
151214	Pest and disease control	4,7
151215	Mowing and harvesting	4,7
151216	Farm transport and storage	4,7
151217	Finishing, preparation for market	4,7
15122	Services for livestock production	
151221	Breeding, raising and milking	4,7
151222	Feeding and watering	4,7
151223	Indoor and outdoor care	4,7
151224	Training of animals for agricultural purposes	4,7
151225	Preparation for market	4,7
1513	Other receipts	
151301	Interest	3,4,7

151302	Dividends from stocks held	3,4,7
151303	Insurance compensation for crop or property damage	3,4,7
151304	Other	3,4,7
152	Outlays of holdings and agricultural service establishments not covered elsewhere	
152001	Income taxes	3,4,7
152002	Property taxes	3,4,7
152003	Fines	3,4,7
152004	Other	3,4,7
153	Income of household	
1531	From holdings	
1532	From agricultural service establishments	
1533	From employment outside holdings	
1534	From other sources	
15341	Rentals received	
153411	From residential buildings	4,16
153412	Other rentals	4,16
15342	Interest received	
153421	From credit given to others	4,16
153422	From bank accounts	4,16
15343	Other	
154	Sales of household property by household during past year	
1541	Sale of living quarters	
154101	Total receipts from sale	4,16
154102	Transfer costs borne by seller	4,16
1542	Sale of secondhand durable household goods	
154201	Total receipts from sale	4,16
155	Miscellaneous household receipts	
1551	Inheritance	
155101	Value of property inherited (net of costs)	4,16
1552	Other	
155201	Lottery	4,16

Code Number	Description	Data Sources and Measurement Instruments
155202	Insurance compensation for property damage	4, 16
156	Household consumption during past year, value and quantity	
1561-1562	Food, beverages, tobacco and intoxicants	
(all subsections to be itemized)		4, 16
15611	Cereals and related products	
15612	Lentils and other pulses	
15613	Oilseeds, and fats and oils	
15614	Meat, fish and eggs	
15615	Milk and related products	
15616	Condiments and spices	
15617	Vegetables and related products	
15618	Fruits and related products	
15619	Sugar and related products	
15621	Tobacco and related products	
15622	Alcoholic beverages	
15623	Non-alcoholic beverages	
15624	Prepared meals and refreshments	
15625	Other	
1563	Fuel and light	4, 16, 18
(to be itemized)		
1564	Housing and household furnishings and services	
(all subsections to be itemized)		4, 16
15641	House rent and water charges	
15642	House repairs and maintenance	
15643	Furniture and furnishings	
15644	Household appliances, utensils, etc.	
15645	Household services	

15646	Other	
1565	Clothing and bedding	4,16
	(all subsections to be itemized)	
15651	Ready-made clothing	
15652	Material for clothing	
15653	Headwear	
15654	Bedding	
15655	Footwear	
15656	Other	
1566-1567	Miscellaneous expenditures	4,16
	(all subsections to be itemized)	
15661	Medical care	
15662	Personal care, toiletries, etc.	
15663	Education and reading	
15664	Recreation and amusement	
15665	Transport and communication	
15666	Subscriptions and charity	
15667	Personal effects	
15668	Taxes (excluding for holdings and agricultural service establishments)	
15669	Interest (excluding for holdings and agricultural service establishments)	
15671	Legal fees (excluding for holdings and agricultural service establishments)	
15672	Other	
1568	Savings	4,16
	(to be itemized)	
16-17	Other	
161	Foreign trade of agricultural inputs and products	
1611	Exports	
16111	For each commodity, during past year	18,20
161111	Quantity exported, by destination	18,20
161112	Value of exports, by destination	

Code Number	Description	Data Sources and Measurement Instruments
16112	Other information related to exports	
161121	Population of each importing country	20
161122	Industrial demand for exported and exportable commodities in each importing country	20
161123	Production of exported and exportable commodities in each competing country	20
161124	Stocks of exported and exportable commodities in each importing country	20
161125	Means of transport to each destination	17
1612	Imports	
16121	For each commodity, during past year	
161211	Quantity imported, by origin	18,20
161212	Value of imports, by origin	18,20
16122	Other information related to imports, for each imported commodity	
161221	Domestic production of commodity or its substitute	2,11,14,17,18
161222	Quantity used in agriculture	3,11,18
161223	Quantity used in industries other than agriculture	14,17,18
161224	Quantity used for final consumption	4,15,18
1613	Foreign exchange	
161301	Earnings during past year	18
161302	Expenditures during past year	18
162	National accounts and budget	
1621	National accounts	
162101	Gross domestic product, by economic sector	18
162102	Income taxes paid by holdings	18
1622	Annual national budget	
16221	Total budget	
162211	Capital outlays	18

162212	Current expenditures	18
16222	Amount allocated to agriculture	
162221	Capital outlays	18
162222	Current expenditures	18
163	Government land and water development and crop improvement projects	
1631	Total cost	
163101	Internally financed part of cost	18
163102	Externally financed part of cost	18
1632	Benefits	
(to be itemized)		18
164	Government-held stocks of agricultural products	
164001	Capacity of storage facilities	18
164002	Quantity held of each crop	18
165	Domestic manufacturing	
1651	Agricultural inputs (for each input)	
165101	Production capacity of establishments	14,17,18
165102	Actual production during past year	14,17,18
165103	Investment planned for next year	17
1652	Other manufacturing (for each product)	
165201	Quantity of agricultural products used as inputs during past year	14,17
165202	Quantity of food manufactured during past year	14,17
166	Climatic data, by region	
166001	Rainfall	18
166002	Risks of water-related hazards	11
166003	Number of days with sunshine	18
166004	Temperature	18
166005	Number of days with frost	18
166006	Agricultural calendar, for each crop	18,19

Code Number	Description	Data Sources and Measurement Instruments
167	Community services available at village level	
167001	Primary school	18,19
167002	Potable water	18,19
167003	Electricity	18,19
167004	Public health services	18,19
168	Technological research information	
(to be itemized)		21
169	Quality of irrigation water	
(to be itemized)		9,21
171	Soil characteristics	
(to be itemized)		9,21
172	Agricultural extension	
172001	Number of extension workers	18
172002	Number of transport vehicles	18
173	Agricultural education	
173001	Number of students at university-level educational institutions specializing in agriculture	18
173002	Number of students at secondary-school-level educational institutions specializing in agriculture	18
174	Miscellaneous	
174001	Number of land disputes brought to court	18
174002	Length of all-weather roads in rural areas	18
174003	Nutritional composition of agricultural products	21

APPENDIX II

A SUGGESTED CLASSIFICATION OF CONSUMER FOOD ITEMS

Code Number ¹ /	Description
<u>Food</u>	
	Cereals and cereal products
	Grains as whole grain, meal, flour (specify where important: wheat, rice, rye, barley, oats, maize, millet, sorghums, etc.)
	Pastas: macaroni, spaghetti, etc.
	Commercially baked goods (specify where important: bread and other baked goods)
	Other cereals and cereal products (specify where important)
	Starches and starchy roots
	Potatoes (specify form where important: fresh [old, new], canned, dehydrated, flour, etc.)
	Sweet potatoes (specify form where important: fresh, flour, etc.)
	Cassava (specify form where important: fresh, meal, flour, etc.)
	Other starchy roots (specify where important)
	Starches, pure, dry (specify where important: wheat, maize, rice, potato, cassava starches, sago, etc.)
	Sugars and sweets
	Sugars (specify where important: crude, refined, cane, beet, palm, coconut, maple, etc.)
	Syrups and molasses (specify where important: molasses of cane sugar, of sugar beet; cane juice; cane, maple, corn, carob, grape, date syrups, etc.)
	Honey (including honey on the comb, etc.)
	Others (specify where important: jams, marmalades, candy)
	Pulses (dry)
	Beans (specify where important: broad beans, kidney beans, lima beans, mung beans, etc.)
	Peas (specify where important: dry peas, lentils, chick-peas, etc.)
	Soybeans and soybean products (specify where important: whole soybeans; soy sauce, soybean curd, paste, milk, flour; etc.)

Code
Number-1/

Description

Nuts

- Groundnuts (specify form where important: in shell, shelled, salted, in butter, etc.)
- Coconuts (specify form where important: mature nuts, immature nuts, coconut milk, shredded coconut, etc.)
- Other tree nuts (specify where important: almonds, pistacios, cashew nuts, cashews, walnuts, pecans, wild or unspecified, etc.)

Seeds

- Seeds (specify where important: squash, watermelon, sunflower, sesame, etc.)

Vegetables

- Roots, bulbs and tubers (specify where important: beets, carrots, kohlrabi, leeks, mature onions, okra, parsnips, radishes, horseradish, salsify, scorzonera, turnips, rutabaga, etc.)
- Leafy vegetables (specify where important: bean sprouts, beet greens, Brussels sprouts, cabbage, cassava leaves, celery, chicory and endive, kale, lettuce, mustard greens, okra leaves, parsely, spinach, onion leaves, etc.)
- Tomatoes (specify where important: fresh, canned, etc.)
- Other vegetables, edible flowers, stems

Fruits

- Bananas and plantains
- Citrus fruits (specify where important: grapefruit, lemons, limes, oranges, etc.)
- Fat-rich fruits (specify: olives, avocados, etc.)
- Other fresh fruits (specify where important: apples, pears, etc.)
- Dried fruits (specify: dates, figs, raisins, etc.)

Meat and meat products, poultry and insects

- Fresh and frozen meat (specify where important: beef, veal, pork, mutton and lamb, goat, etc.)
- Offal (specify where important: animal and part - liver, kidney, brain, heart, sweetbread, etc.)
- Meat products (specify where important: bacon, ham, dried beef, dried pork, canned beef, canned pork, etc.)
- Insects (specify and distinguish at least between adults and larvae)

Code₁
Number- /

Description

Eggs

Eggs (specify fresh, dried, frozen, etc.: hen, duck, goose, turtle, etc.)

Fish and shellfish

Fish, fresh (specify and distinguish between fat fish [salmon, trout, herring, mackerel, etc.] and low-fat fish [cod, haddock, etc.]

Shellfish (specify: lobster, crawfish, crabs, shrimps, oysters, clams, mussels, etc.)

Fish, salted, smoked or dried (specify fat-rich and fat-poor)

Fish, canned (specify: in oil, not in oil, fat-rich and fat-poor)

Shellfish, canned (specify: lobster, crawfish, crabs, shrimps, oysters, clams, mussels, etc.)

Other aquatic animals (frogs, turtles, etc.)

Milk and dairy products (excluding butter)

Milk, liquid, whole (specify: cow, goat, sheep, buffalo, camel, etc.)

Milk, liquid, skim or buttermilk, partly skimmed

Cream (specify fat content)

Cheese (specify varieties: hard, soft, etc.)

Milk, processed (specify: evaporated, condensed, sweetened, dried, etc.)

Yogurt, other fermented milk and fresh milk products

Ice cream

Oils and fats

Vegetable oils and fats (specify: oils, hardened shortening, etc.)

Animal fats (specify: butter, ghee, lard, etc.)

Marine oils (specify)

Mixed products of vegetable, animal or marine origin (specify)

Other oil and fat products (specify: mayonnaise, dressings, etc.)

Beverages

Alcoholic drinks (specify: beer, wine, spirits, etc.)

Canned or bottled soft drinks (specify)

Other beverages (specify: tea, coffee, etc.)

Code, Number ¹ /	Description
Miscellaneous	Miscellaneous (specify: spices, salt, yeast, condiments, etc.)

- ¹/ When such commodity detail is necessary (see, for example, sections 5.3.12 and 5.3.14 for detail on prices and income and outlay, respectively), the six-digit code should be expanded accordingly. A similar approach is required for machinery and equipment (section 5.3.8).

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GLOSSARY

DEFINITION OF TERMS FOR A NATIONAL INFORMATION SYSTEM
FOR FOOD AND AGRICULTURESYSTEM

A collection of objects or processes, called components, which interact to perform a given function or functions.

MODEL

A system which is an abstraction of another system, called the reference system.

INFORMATION

In general, knowledge used for a purpose: in particular, used to support decision making.

DATA

The subset of information which encompasses quantitative and qualitative measured facts.

INFORMATION SYSTEM

A dynamic process and an organization, with associated statistical and analytical programmes, personnel, budgets and support services, whose function is to provide information in support of decision making in a specific subject area by a specific set of decision makers. The five component processes include: (a) conceptualization, (b) operational definition of concepts of the target world; (c) observation and measurement of the target world; (d) interpretation and analysis; and (e) decision making and implementation.

STATISTICAL PROGRAMME

The complex of government agencies, personnel, budgets, support services and internal and external institutional linkages with primary responsibility for (a) the observation and measurement component of the information system, and (b) in concert with decision makers and the analytical programme, conceptualization and the operational definition of concepts; and secondary responsibility for (c) supporting the analytical programme in statistical interpretation and analysis.

ANALYTICAL PROGRAMME

The complex of government agencies and institutes, personnel, budgets, support services and internal and external institutional linkages with primary responsibility for (a) interpretation and analysis component of the information system, and (b) in concert with decision makers and the statistical programme, conceptualization and the operational definition and redefinition of concepts; and secondary responsibility for (c) supporting and supplementing the statistical programme in observation and measurement through helping to identify data collection and data processing needs and priorities.

SYSTEMS APPROACH

A formalized decision-making process, where (a) a decision must be made among a set of feasible alternatives in order to achieve some objective; and (b) the portion of the world relevant to that particular decision problem is looked at as a system, and the decision options are formulated as systems.

The process has the following stages: (1) observation, (2) problem definition, (3) synthesis and analysis of options, (4) decision, (5) implementation and (6) monitoring results. The process is (a) cyclic in that the sixth stage is the same as the first stage of a new decision-making cycle; (b) iterative in that earlier stages may be repeated or redone based on information gained at later stages; and (c) interactive in that the active involvement of and close interaction with decision makers is a critical and essential element.

In the context of information for food and agricultural decision-making, the systems approach is applied to (a) designing effective information systems, and (b) defining policy issues and formulating and analysing policy options.

NATIONAL INFORMATION SYSTEM FOR FOOD AND AGRICULTURE

An information system operated by a national government to support government, and possible private, decision makers responsible for what that nation defines its domain of food and agriculture to be. This information system does not generally satisfy all the information needs of food and agricultural decision makers. Additional information is typically needed from domains of other socio-economic sectors (including political and national security domains).