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is not kept up to date with current data needs as reflected in the observational filter, or if the filter itself is obsolete (Bonnen 1977).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 then 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 obsolecence 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 responsiblities 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.