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seminar report

Minimum Information Systems for Agricultural Development in Low-Income Countries[1]

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INTRODUCTION

Information Systems for agricultural development in low-income countries has been an area of concern and interest to the Council for some time. In December 1976, a group of individuals experienced in this area met in Oxford to discuss problems and approaches in the development of more adequate information systems. The group included individuals on both the supply and demand side. Some have had long experience in data generation while others, in their roles as public officials or planners, confront the problem of securing required information.

This Seminar Report summarizes major points in the papers presented, and the discussions that ensued.

Papers presented at the seminar are now being edited with a view to their publication as a monograph. Single copies of this report are available without charge from the Agricultural Development Council.

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Sound decisions depend on accurate information. Yet every low income country faces severe competing demands for the financial and human resources it would need to staff an information system equal to its decision-making requirements for agricultural development

Three steps are essential if a low income country is to develop information wisely in support of its development efforts. It must be able to:

1. Identify the information required for the most important private and public decisions and specify the kinds of information that deserve highest priority.
2. Utilize methods of collecting, processing, and analyzing data that meet reasonable standards of accuracy, timeliness, and coverage while at the same time minimize financial and human costs.
3. Do this within an institutional structure which brings *users* and *suppliers* of information together in a continuous dialog and which is able to adapt, as the economy changes, to changing demands for information and new methodologies for generating it.

The purposes of this paper are to identify the principal users of agricultural information and the types of information they need: to identify the principal suppliers of agricultural information and the types of information they can provide; to review some of the more critical methodological issues in supplying information; to discuss institutional arrangements for collecting, processing, and analyzing information; and to identify some critical areas for future atten-

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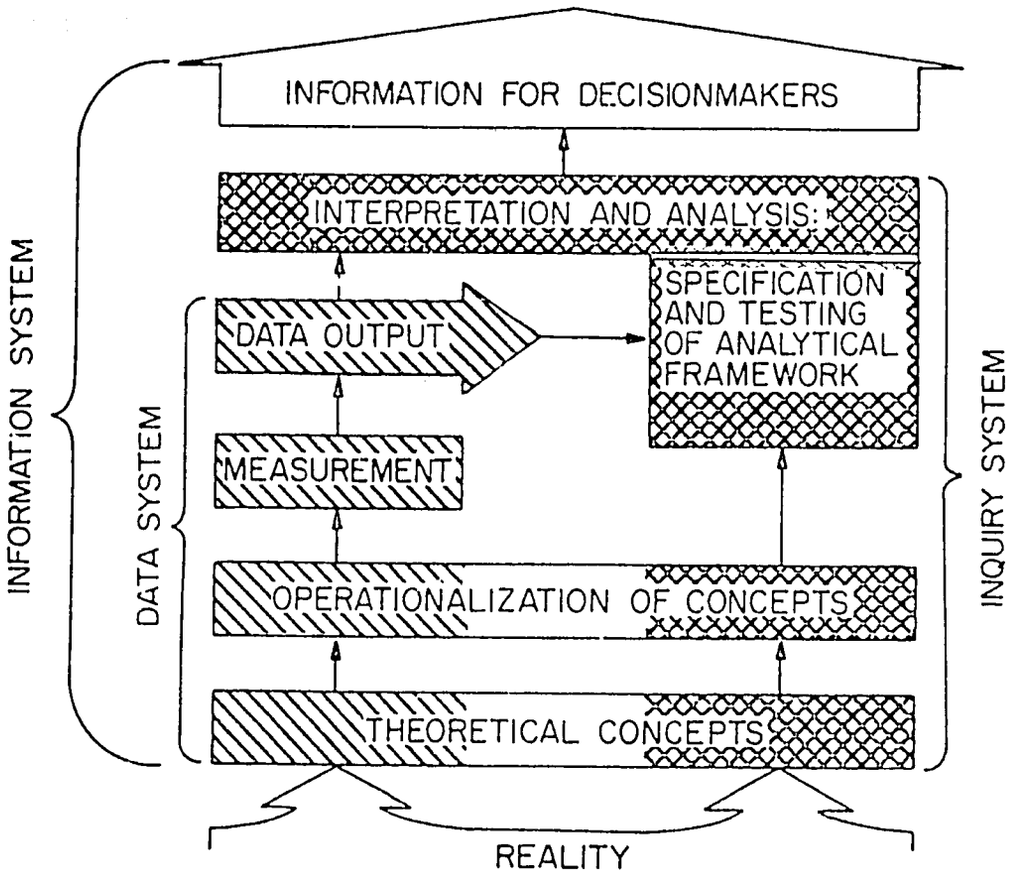
[1]This paper has benefited substantially from suggestions, and in some cases substantial redrafting, by Bryant Kearl, Harry C. Trelogan, Dale Hathaway, James Bonnen, Ken Bachman, and Abe Weisblat.

FIGURE 1

AN AGRICULTURAL INFORMATION SYSTEM



tion. The discussion will focus on the supply of information about agricultural commodities which can be generated within the agricultural sector. Many of the components of demand for agricultural commodities such as population growth and per capita income are outside the direct influence of the agricultural sector. Information on these categories, which are of interest to all economic sectors, is usually provided by the national statistical system.

DEFINITION

The information system is a subset of the social system: the process by which information describing the social system is organized for decision-making. The degree to which it accurately reflects reality in providing useful information for decision-making depends on the degree to which measurement and data, on the one hand, are compatible with specification and testing of the analytical framework, on the other. Thus suppliers of data must be in effective, continuous communication with the users of information (see Figure 1). Both political and objective processes must validate the information if it is to be truly useful in decision-making.

While information can be valuable, it also is expensive. Costs of poor decisions and subsequent lack of appropriate information can be large. Returns to effective decisions about data and information can also be high. Careful system design, followed by prompt and widespread distribution of information to those who effectively make or facilitate decisions is, therefore, the foundation of effective information management.

USERS OF AGRICULTURAL INFORMATION

Who uses agricultural information? In a country with a private agricultural sector, the most important decision makers are the primary producing units (farm families) and the merchants and traders. In the public sector, the most important are those government officials most directly concerned with agricultural policy and those concerned with agriculture as it

relates to the overall economy (for example, the planning commission and central bankers). International organizations constitute a fifth category of users.

Each decision-maker's information needs depend upon the kind of options open to him—the number and nature of activities he can manipulate. His needs are affected by:

1. The nature and state of development of the economy.
2. The other parties involved in his decisions.
3. What each party wants to achieve.
4. Each party's level of knowledge about economic units and how each responds.
5. The governmental philosophy as to what kinds of intervention are appropriate and effective.

In most countries there is a tendency to overestimate the utility of information to public policy makers and to underestimate what it might do for private decision makers. As a result, data-gathering tends to be organized for the public official's benefit and the potentially large payoff from better informed private decision makers is not fully exploited.

Primary Producing Units

Goals of the primary producing units (farmers/producers and also cooperatives) depend on their degree of market orientation. In a subsistence setting, a farm family strives to produce enough to satisfy its own needs. As productivity increases, the farmer has more opportunity to maximize the well-being of his family by profits from sales.

The non-commercial farmer often operates in an environment as complex as that of the commercial producer. He has the same types of decisions to make as does the commercial producer, e.g., what crops to grow, what inputs to utilize, what final use to make of this production. However, he buys little and sells little, and neither the government nor the market has much opportunity to influence his actions in the short run.

Uncertainty is an important consideration in agricultural decisions at all levels of agricultural activity but it is especially important at low levels of production when the farmer has little reserve on which to rely in case of crop failure due to unfavorable weather, attacks of disease and insects, or other causes.[2] The function of information for the poor farmer, as for all other users, is to equip him better to respond to this uncertainty

As his production increases, the farmer buys a greater proportion of his production inputs and sells more of his output. He does not necessarily need *more information* at this stage. However, he does use a *different kind of information* on alternative varieties, fertilizer prices, credit rates, labor availability, commodity prices, etc. This necessitates a greater amount of quantitative data.

The concept of a "moving minimum" (the idea that minimum information needs change with economic circumstances) applies at this level of decision-making as at all others. The agricultural sector is not made up of homogeneous farming units. Not all farm families take advantage of their opportunities in the same way, and the sector does not develop uniformly.

Trade centers are often a major source of information for farm families; markets convey messages rapidly. But governments must consider what special steps they need to take to make sure that all categories of farmers/producers, and especially the smaller operators, have an equal chance to respond to new opportunities as they arise. If all primary producing units are to benefit from information, the form in which data are released may be as important as the kinds of data gathered; i.e., information must be intelligible to the least sophisticated of its potential users.

Merchant/Traders

Merchants and traders seek to maximize money profits. In a free enterprise economy the objectives they pursue may not always be in the broader public interest, i.e., they seek to gain access to special information or to retain or suppress public information from others.

Merchants and traders usually maintain informal exchanges with other traders regarding commodity prices and volumes including anticipated supplies and stocks. Enforcement of a competitive market structure, including steps to make information more accessible and to improve the accuracy and timeliness of volumes, with values standardized by unit and quality, will generally benefit:

1. Sellers (farmers/producers), by giving them better opportunities to choose when, where, and how to buy production inputs and to sell their outputs;
2. Smaller and newer traders, by easing their entry into the market and thereby presumably increasing its competitiveness; and
3. Consumers, by lowering costs of distribution and creating more awareness of when, where, and how to purchase commodities.

Agricultural Policy Makers

The goals of government agricultural policy makers cover a wide range: maximizing food production in the whole country or, in certain regions, maximizing the supply (and controlling the cost) of food for

[2] Information becomes economically valuable *only* in the context of uncertainty. The theory of resource allocation under perfect competition assumes instantly available information. When uncertainty is introduced, information acquires the characteristics of a commodity, i.e., those firms which possess relevant information can expect to obtain higher profits because of it. The use to which the information is put determines its value.

urban areas, increasing rural incomes, establishing more equitable land tenure, improving nutrition, and protecting foreign exchange reserves. Often the unstated goals of these officials are at least as important as their explicit, publicly announced goals.

Agricultural policy makers need a range of information to assist them in achieving these goals. However, information collected by government agencies must have, as its central purpose, service of public needs. Much of this same information is of interest to private bodies. Allowing private interests to dictate public needs—as opposed to sharing in them—invites the potential of corruption into public decision-making.

The more commercial the economy, the more ways the government has of intervening. Correspondingly, its needs for information grow and change. But even in an advanced economy, the government can effectively manipulate only a limited number of policy variables. Government analysts and policy makers must identify, therefore, the limited number of points at which decisions can be made and then specify the kinds of information, including levels of aggregation, they must have to act intelligently.

Generally, the activities which government can influence fall into two categories. First are discrete projects which the government has a direct role in designing and operating and in which sound information is necessary in order to establish reasonable targets and to implement mechanisms to achieve the desired results. Low-income countries often utilize projects as their main means of influencing economic development. Second are matters such as commodity prices, fertilizer prices, or credit eligibility requirements in which the government may intervene and through which it may exercise a more indirect influence on economic behavior. For both types of government interventions, basic questions must be asked about information needs. Which pieces of data are essential, which are only interesting? Which relate directly to the effectiveness of policy variables?

In rapidly developing countries discontinuities in technology and institutions require that there be constant review of information, information-gathering strategies, and information categories. Otherwise, resources are wasted getting information no longer needed and producing results that may actually be misleading. Recent experience has demonstrated that this observation is equally true in advanced economies which are undergoing change.

Agricultural policy makers generally need six main types of data and information organized either for discrete projects or for more generalized policies:

1. *Benchmark data* every five to ten years, covering:
   (a) Physical resources such as land utilization, soil types, ground and surface water supplies, forest and range resources, topography, climate, and transportation facilities.
   (b) Human resources, including the age and sex composition, skills, income levels, etc., of the population.
   (c) Economic activities such as alternative employment opportunities or other productive endeavors, the nature of the farming systems, the available technology, and the transportation system.

   These data can aid in identifying the resources to be utilized, the target groups on which to focus, and the targets to be achieved and in establishing benchmarks against which to measure change at periodic intervals.
2. *Farmer/producer behavior information*, including farm management studies and examination of input/output prices to learn how producers react to policy variables. Lacking this information, policy makers are bound to make errors. A market system, with all its imperfections, often operates better than publicly administered attempts to preempt the market. But intensive analysis of the socio-economic system, including farm management studies based on sound surveys and in-depth interviews, is necessary to inform the policy-maker of probable convergences of interest among different groups, lessons from previous experiences involving change, and formal and informal rules of the relevant social subsystems.
   Certain farmer behavior information can be brought up to date every year or so, once a basic understanding based on several cropping seasons has been established. Agriculture is both complex and changing. New studies will be needed whenever a new technology is introduced which might lead to new input/output responses.
3. *Agronomic data* from different locations and at different times of year showing how major crops respond to such management inputs as fertilizer, irrigation, plant density, weed control, and other cultivation practices.
4. *Current supply data*, including production, area, and yields for the most important crops, supply and prices of fertilizers, interest rates and availablility of credit, and storage stocks held by government and private traders. Good crop data are particularly essential in countries where weather and other forces produce wide variations in yield from year to year.
5. Market news, including volumes of all major commodities traded or available in the market place, including imports exports, with values (prices) standardized on unit and quality.
6. *Other analysis and data* that will permit planners to look ahead. For example, perennial crops have different policy implications than annual crops: policy makers need price outlook information and data on areas, number of trees or plants, ages of plantings, new plantings, and wage rates as a basis for establishing policies for perennial crops.

National Planning Bodies

Public officials interested in agriculture as it relates to the overall economy have many of the same information needs as agricultural officials, but will be more concerned with interrelationships among sectors, the foreign exchange position of the economy, the relative costs of domestic production to import prices, and the general price level.

International Organizations

International organizations undertake programs of financial and technical cooperation. They understandably need information on the general economy as well as the agricultural sector. However, they do not necessarily need any more or better information than do the national governments. There is need to codify, standardize, and build into national information systems the kind of data both needed for internal policy formulation and needed by external agencies for project development. The point of reference should, however, be each country's information needs, not a spurious or unjustified uniformity set up for external convenience.

SUPPLIERS OF AGRICULTURAL INFORMATION

Commonly, there are four categories of data suppliers:

> Central statistical agencies collect numerical data on the general economy as well as agriculture. Ministries of agriculture usually confine themselves to agricultural data.
>
> At the state or province level, two separate, and often uncoordinated statistical gathering units may also operate, one working within agriculture and the other dealing with broader needs.
>
> Specific projects often have their own information gathering sections to gather benchmark data and to evaluate and monitor progress.
>
> Finally, information is gathered by a range of nongovernmental agencies—local businesses, traders, universities, and external assistance agencies.

Each of these categories—specializing in different types of information—can gain from using methods which are simple, inexpensive, accurate, timely, and give adequate coverage.

A modernized agriculture can satisfy most of its private and public information needs within the framework of a continuing collection of statistics organized as a time series. Continuity permits economies by spreading the costs of sampling, training, equipment, etc. It also permits experience to feed improvements into the system. But unless it has good built-in devices to adapt itself to changing needs, a continuing system is best adapted to a relatively static economy.

In a developing country, other kinds of basic and related data are needed before a continuing statistical series has meaning. To make reasonable agricultural policies, policy makers will find themselves wanting information on such questions as soil potential, relative prices and production costs for different crops or commodities, water availability, alternative crop possibilities, acreages and plantings, hired labor costs, fertilizer availability, and weather and climatic variability. A minimum information system for a developing country must provide for such data, perhaps on a one-shot or periodic up-dating basis.

Experience with agricultural development reveals that we often take too narrow a view of the relevant variables. Sound policies demand current information on many variables that are outside the traditional scope of agricultural economics—job opportunities (especially for women) outside the farming sector, the health status of family members who make up the work force, mother's non-agricultural and non-market time uses, children's educational costs and opportunities, and so on. In a peasant agriculture, "family" variables are crucially interwined with the "firm" variables to which we have customarily limited ourselves. More often the unit of observation should be the family, rather than the farm.

Keeping in mind these general comments, a few methods provide the bulk of information. They include censuses, sample surveys, agronomic trials, field reporting, and government reporting.

Censuses

A full-count census provides basic information for benchmark purposes as well as a frame on which to base samples. For small areas, complete enumeration may be the only way to collect information with reasonable accuracy.

The full-count census faces several problems. It is costly in manpower and finances. Difficulties in training and motivating the large numbers of people who collect and process the data are compounded by the intermittent nature of censuses. In addition, there often is a long time lag between collection and publication of the information. These problems notwithstanding, there are situations in which it is difficult to avoid a full-count census.

Most developing countries have now converted the full count census of agriculture into a periodic large scale comprehensive sample survey of agriculture. Problems of delay and accuracy of data remain, however, because of the wide variety of benchmark data needs and the noncontinuous nature of these operations. Often speed and accuracy can be promoted by developing instead a planned program of surveys that rely on large but carefully drawn samples, in some cases combined with satellite imagery and other forms of remote sensing (about which more will be said later), or by continuous large sample surveys concentrating on a limited number of key factors.

Sample Surveys

Sample surveys have considerable value in establishing and updating benchmark data and in collecting specialized information on such topics as the

factors which limit increased farm production (e.g., labor shortages as peak periods).[3]

One issue is how much data should be collected in a given sample survey; some persons favor using integrated, continuous rural surveys, possibly continuing a core set of questions in each survey but emphasizing special topics each time. From the standpoint of costs, multi-purpose surveys that serve the whole economic planning process have advantages over separate information gathering for agricultural, demographic, industrial, and other planning groups. By using common sampling frames and linking the results, ministries of health and education and agriculture and other agencies can get more information at less cost and mutually support one another's work. However, trying to derive too much information from a single interview schedule may introduce weaknesses. For example, collecting crop data along with social data may work to the disadvantage of both; farmers who hesitate to give information on one category may therefore give incorrect information on the other or none at all.

Understanding basic behavioral patterns and monitoring production or trade transactions are each quite complex: separate groups should probably be assigned to each, otherwise both will be done badly. Efficiency in gathering agricultural data can be enhanced by finding ways to involve data users from the beginning. Producer panels and research by social scientists offer alternative, possibly useful, ways to learn about farmers' intentions.

In the subsistence sector, there is a question whether male interviewers are able to describe properly, especially in some cultures, the important contribution of the rural women to the family enterprise. More must be done to get male and female researchers working together in teams to get reliable data not now accessible.

Agronomic Data

The first step in producing agronomic data is to know the technology already being used by the farmers in the area and the readily available materials and technologies not being used which might be introduced with minimum modifications in the local system. Existing technology should be analyzed for modifications that are most likely to produce increases in output and net incomes. Technological questions for further investigation should then be listed in order of priority. Field trials (i.e., fairly simple but well designed experiments on farmers' fields distributed over representative agro-climatic zones of the region) can test such variables as plant population, data and rate of planting, amount, kind and timing of fertilizers, etc., including measurement of economic return.[4]

The risks farmers face in using different levels of inputs should be estimated using the information that is available on climatic variability and fluctuations in prices.[5] Recommendations then can be developed for different levels of inputs (perhaps initially at two levels, full capital and limited capital) and for different ecological conditions taking into account the expected risks in production and marketing.[6]

Tests should continue until they have covered adequately the range of climatic conditions which farmers experience most of the time. In general, the amount of agronomic research required before recommendations are made is proportional to the ecological variability in the area. In regions of irrigated farming or with dependable rainfall, recommendations derived after one year of research may be acceptable. For rainfed regions with frequent or intense droughts, continued agronomic research for several years will be necessary. New varieties have to be evaluated in an experimental environment year by year as they become available, as well as in succeeding years.

Current Supply

Viewing agricultural data from the standpoint of policy makers' needs, supply data are of the highest importance. This is true for a food exporting country, where supply estimates determine how much can safely be exported, as well as for importing countries.

Some supply relationships are unusually complex, and the data analyst must pay attention to the indirect linkages involved. For example, the world price of fish meal may interact with the supply and price of feed grain within a country to determine the urban consumer's meat price—which in turn has potentially great political consequences. Grain yield and production estimates for the country's own agriculture do not in this case give enough information for policy-making.

What national planners need ahead of everything else is a continuing estimate of food supplies and disappearance—current estimates of production, stocks on hand, and expected consumption. Estimates of area sown to specific crops as a proxy for expected production do not begin to give as much information as is needed. Research to relate meteorological data with biometric data should help to improve capacity

[3]Some of the practical issues in making such surveys are discussed in *Field Data Collection in the Social Sciences: Experiences in Africa and the Middle East* (New York: The Agricultural Development Council, Inc. 1976), Bryant Kearl, ed.

[4]The credibility of the farm trials will be increased if farmers, scientists, and technical assistance workers jointly discuss plans for this research.

[5]The benchmark and farmer behavior surveys should make important contributions, such as identifying the competing demands for labor, to determine which varieties and practices are eventually recommended.

[6]Richard K. Perrin, Donald L. Winkelmann, Edgardo R. Moscardi, and Jock R. Anderson, *From Agronomic Data to Farmer Recommendations: An Economics Training Manual.* Mexico: Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Information Bulletin 27, 1976.

to predict production. Thus far, the predictive power of analysis of this subject is weak.

Commodity data should be confined to the crops and animals which are most important in local consumption, enter in largest volumes into the market economy, figure prominently in foreign trade, and for which reasonably accurate data can be collected. Fruits and vegetables which are grown largely in family yards are rarely reported accurately and therefore the "official" figures are often meaningless.

Data on area sown to various crops can be collected, after a suitable frame has been established from sample surveys. Accurate data on yields will require crop cuttings on a sample basis. Production of crops which are almost entirely marketed (e.g., cocoa) can be estimated from market sales. Oral enquiries are usually deficient when farmers do not know the hectarage of their various plots. Aerial photography and remote sensing have potentially useful roles in cooperation with ground estimates if a number of conditions can be met, such as if the day is cloudless and if altitude can be maintained relatively uniformly.

Animal counts, especially when grazing is under nomadic conditions, are difficult. Sample surveys can be utilized in some circumstances. Aerial photography has so far seldom been effective.

Major difficulties can arise from linking area or yield reports to the revenue system; e.g., there may be incentives for a local official to classify land under a low revenue category and then pocket a fee from the farmer for this "service."

Data on commodity stocks held by the government should be part of a regular monthly reporting system. This should be done on a week during periods of large purchases or heavy consumption. Figures on private stocks held by dealers are important for decision-making but should be collected only if an effective reporting system can be implemented which does not interfere with the normal operation of the private trade. Data on stocks held by farmers/producers or consumers are practically impossible to estimate with accuracy. On the other hand, it may be worth considerable effort to estimate the direction of change in private stocks, especially in relation to changes in public stocks. Periodic sample surveys at all four levels—government, private traders, farmers/producers, and consumers—should be taken to estimate losses and wastes in storage.

Sample surveys will often be the best way to learn about input consumption on farms. Aggregate sales and stocks of fertilizers, pesticides, herbicides, tractors, and implements can be obtained from dealers. These reports can be confirmed periodically by systematic on-site inventory inspection in order to correct cumulative underreporting which can lead to overestimates of stocks. Sales and stock information should be collected on a monthly basis during the off-season and on a weekly basis with minimum time lag in reporting and processing just before and during the peak marketing period.

Market News

Data on volumes and prices of major commodities sold in markets should be collected from correspondents in terminal markets or such other markets where farmers can find ready sale for their products at wholesale, and also similar information on assembly or retail markets. These data have the greatest influence on the disposition of the available supplies and their distribution over time, space, and among uses. Price data, and to a lesser extent, volume data are most readily accessible, but the problems of collecting, assimilating, and disseminating the relevant information to be useful for the growers (sellers) and the consumers (buyers) in helping them arrive at intelligent decisions is difficult. In developing countries, especially, it frequently requires the adoption of more universally understood measures of quantities and qualities of products to facilitate meaningful communications. Average prices have little meaning; instead, opening and closing and high and low prices for all the standardized grades should be reported by telephone or cable each day during peak periods and by postcard each week during periods of lower volume.

Planning Ahead

Change itself creates a need for information on variables which previously had not been given attention by policy makers. Somehow the agricultural data system has to foresee the place of such variables, not confining its data gathering to variables which have had historic importance in policy issues.

Governments do not live in the "long term"; their effectiveness is absolutely limited by how well they make the short term decisions that assure their survival. Thus the goal of collecting data useful for analysis of long term policy decisions, which some professionals might prefer, will not usually satisfy the most urgent needs of the policy maker. The value of data of long term relevance may not even be recognized, or at best may be viewed as a luxury. Policy makers necessarily take into account political as well as economic considerations in a socio-economic decision. The political climate, political forces, the politician's sense of timing, and his sensitivity to the pressures of society dictate his readiness to seek data on a policy issue. The economic advisor has a duty to call important issues and alternatives to the attention of political leadership, and to continue doing so while awaiting the time when there will be a readiness to pay attention.

Effective managers of information systems learn to take advantage of adversity. During crises, politicians realize that they need adequate information. The effective manager must anticipate such situations,

noting the difference between short run and long range needs, collecting some kinds of data which, while not useful under existing circumstances, will be valuable for decision-making when circumstances change. At that time he has the information available and can show its value, making a strong case for more and better information on other fronts.

External Events

Information on such external events as world commodity production, trade, and prices is important to policymakers. Individual countries find it hard to collect and maintain these data. Costs are high and several major countries (for example, China and the U.S.S.R.) have been unwilling or unable to join in international exchanges of current data.

The only two sources of world data are the Food and Agriculture Organization of the United Nations (FAO) and the United States Department of Agriculture (USDA).[7] Because FAO is an international organization which consists of member governments, FAO statistics are limited to those reported by member governments; their unity is reduced by this constraint. The USDA makes its own estimates of other nations' production.

The International Food Policy Research Institute (IFPRI) will attempt, as one of its objectives, to improve world agricultural data collection and analysis. IFPRI does not have a capacity to carry out its own collection, but it will attempt to identify and communicate areas of weakness in information collection in each country. Furthermore, it will attempt to anticipate the influence of major external events on international production, trade, and prices so that the world is not caught short on analytical information as it was in 1972.

METHODOLOGICAL ISSUES

Several issues relevant to supplying information deserve special mention.

Censuses vs. surveys

The numerous difficulties associated with a census, including inflexibility, suggest that low-income countries seek ways to reduce their reliance on this approach and pay more attention to developing and implementing suitable sampling techniques to produce accurate, timely data.

Remote Sensing

Remote sensing is a new technique whose potential is not yet clearly defined. It presently can do some things, but not everything, well; even for those things that it can do well, it must be supplemented by traditional methods.

At present, the LANDSAT satellite has resolution which makes it effective for large areas. Encouraging results in accurately estimating area sown to major crops such as wheat and maize grown on large farms has been demonstrated in the U.S.

On the other hand, there are still weaknesses in estimating crop area under conditions which characterize agriculture in the developing countries, particularly Asia and much of Africa, in which there are small, fragmented farms, often standing water in fields, and partial to full cloud cover. It is difficult to distinguish among major crops, i.e., wheat from barley. Mixed crops are difficult to identify. As a result, ground "truth" is required to supplement the atmospheric reconnaissance for area estimates. Yield estimates must still be made from the ground. The real potential of remote sensing is now, and probably will continue to be in the future, in interfacing with traditional methods to improve accuracy and, especially, timeliness of area estimates.

Remote sensing is being explored for such other uses as mapping of topography and major soil types to aid agricultural planning; reporting range conditions to aid in animal grazing management; reporting snow pack coverage for estimates of spring and summer irrigation availability; reporting relative water deficit areas in canal systems to help redirect irrigation supplies; noting the appearance and spread of pests and diseases; and recording changes in forestry conditions.[8]

The U.S. lead in remote sensing technology is now great. The information from the LANDSAT and succeeding satellites will be made available, at cost, to any requesting body, including nations. Receiving stations in individual countries can be constructed and equipped for an investment of $2 to 5 million. Some regional installations are already being initiated.

Advance Productions Estimates

The ability to obtain advance estimates of production when the crop is still in the field remains in an unsatisfactory state. The current method is to measure crop progress at a given time and then project growth based on normal weather for the remainder of the growing season. Yet the seasons when weather is not normal are most critical for policy-makers; these are the times when advance projections of production fail.

Major problems still exist in predicting weather for any significant time into the future—particularly uncertain is the interval between one week and one year

[7] *Food Information System: Summary and Analysis*, Office of Technology Assessment, United States Congress, August 1976.

[8] *Applications of Landsat Imagery*, The World Bank, Washington, D. C., 1976.

away. Furthermore, substantial work remains to be done in relating weather conditions to plant growth. Reports to the contrary, neither of these categories of information has been developed with any high level of predictability.

One question as yet unanswered is, "At what stage in the crop season can one attach a given level of reliability (e.g., ± 5% of the final figure) to a given estimate?" Beyond some point in the growing season, the contribution of favorable weather to increase a yield is generally minimized. Unfavorable weather (e.g., hail or heavy rains) can, however, reduce production right up to the time that the crop is harvested (or processed, if the crop must be sundried). Freezing terminates growth.

Accuracy

Low-income countries may not be able to fine-tune estimates to the accuracy levels demanded in the U.S. system. Yet if errors result in serious food shortages, the costs in terms of human suffering, expenditures for imports, and probable political instability can be high. This is an especially serious problem in low-income countries with marginal or deficit food supply conditions; when crops fail, there is little to fall back on. Until there is successful completion of a world buffer stock scheme, low income countries bear the full impact of the uncertainties of the international commercial market to supplement their domestic production. On the other hand, most low-income countries are located in the tropics and subtropics where continuous growing seasons permit greater opportunity to respond to a single poor crop season. A large amount of storage is done on farms, and experience indicates that a substantial private buffer is usually available for one poor production year, although not for two poor years in a row.

Breadth of coverage involves tradeoffs. With a fixed budget for agricultural information, the more items that are reported, the less accuracy can be attached to each. Therefore, the best advice seems to be to concentrate on the few items most important in policy-making. If the information analyst must err in reporting, it is better to err on the conservative side.

Release of Information

Access to information is a crucial policy issue. Significant economic advantage accrues to those bodies which get accurate information earliest. Some countries restrict release of public information when crops are disappointing or government stocks are low, with the justification that this practice minimizes speculation and hoarding. They argue that when storage stocks are high, little harm can be done (and perhaps some good achieved) by wide publicity. However, they contend that when stocks are low, an official government report confirming shortage encourages market dislocations, i.e., while rumors of shortages are damaging, their bad effects are only intensified by official verification that they are true. In dealing with international organizations, most countries use some discretion in deciding what information to supply and when.

Large grain companies and other international trade bodies have reporting systems that supply information for their own purposes regardless of whether the government releases official data. Withholding public information therefore gives such companies a large market advantage. This practice may also create suspicions which a government wishes to avoid. It is generally assumed that information is withheld when conditions are unfavorable but freely available when favorable. The U.S. practice of not allowing any degree of discretion as to the timing or nature of information released was conscientiously developed to avoid abuse. Reports are made to all parties, public and private, at pre-established times. This practice virtually eliminates political pressures for special favors. The private sector may put out its own figures in an effort to influence the market (e.g., report a large harvest in order to induce farmers to unload stocks at low prices), but a resolute government policy does much to negate these efforts.

Countries that have an elaborate mass media system, supplemented by a network of organized communications channels, circulate current crop and livestock estimates widely. When printed media are not as well developed, the circulation is more limited. Agricultural statistics do not lend themselves easily to the oral or visual media. The practical minded user wants to make comparisons over time or between categories, and to draw from a large body of data those items of special interest to him. For these purposes a printed report is essential. When literacy is low and specialized printed media do not circulate widely, this means that agricultural data tends to come to the attention of the government planner and the highly centralized agricultural business firm more easily.

When agricultural data have economic value, this differential availability has consequences in terms of equal economic opportunity. The individual small farmer or small merchant may be disadvantaged in two ways. The information used by larger entrepreneurs is not as available to him; he lacks access to the sources they have. Moreover, he has less chance to influence those sources and the kinds of data they gather and make available. Users define the data to be gathered. Unless we are prepared to see agricultural data collection contribute to greater economic inequality, someone must assure that small and dispersed potential users get the kinds of information in the form they need, not simply the rich and powerful.

While it is difficult to make general rules to cover all situations, the following seem to hold:

1. What to release?—aggregations of all information collected.

2. When?—at set, predetermined times.
3. In what form?—as simply as possible, i.e., understandable to the least sophisticated user.

The Role of Models

Some government planners and policy makers err in thinking they must rely on sophisticated econometric models. Such an attitude does a positive disservice if it guides information collection away from the important task of learning what the farmer is capable of doing, what he needs, and what policies will bring the desired responses. There is always a risk that models will result in premature assumptions about which variables will prove most important to decision-making. Indirect economic interventions are often much more effective in guiding the progress of agriculture than are top-down administrative interventions by government. But either approach requires price data and micro-data on the individual farmer's use of inputs and responses to changing price and changing risk. Redoing a scheme of national accounts is likely to be a great deal less useful to agricultural development than making soil surveys, obtaining some idea of cash flows, getting data on response to fertilizers, describing the marketing system, and obtaining other usable first-hand information on what actually happens in the market, on the farm, and in the farm family.

Formal econometric models, which are typically estimated from time series data for analysis at the national level, are also often too aggregative to be of much use for sector policy or for exploring important distributional questions. This is not an essential property of econometric models, however, and substantial improvements are possible by a revision of data coverage if historical data are inadequate or missing. The models most often used in the past have applied most appropriately to long run changes, and have been of much less value in guiding what is to happen in the immediate future. However, much of their data requirement can be generated simultaneously with good single-purpose studies. The high data costs for which modelling approaches are sometimes criticized may in part be explained as a misallocation of the data overhead costs that would otherwise be committed in single purpose studies. Without a larger model to provide context, a single purpose studies may in fact add up to little as a source of constant and dependable input on policies and programs.

Good models can crystallize the essence of economic theory. Models (even very aggregate ones) are often useful and sometimes essential if one is to identify the nature of trade-offs between modern and traditional sectors of the economy. They may be a vehicle for communicating the importance of a lagging sector. A multiplicity of village studies can document a host of goals and problems, but the integrating power of a model may be needed to identify the policy variables that will move the system toward desired objectives.

It must be remembered that econometric models are only one member of a family of formal models. Numerical projections and simulations are other formal approaches. The greater disaggregative capabilities of models which can be developed from cross-section data (especially linear programming models) can be useful in examining many distributional and allocational questions, both sectoral and interregional. The type of data they require is typically generated by almost any kind of study that goes beyond simple *ad hoc* treatment. For example, single purpose studies of income and employment, farmer price response, demand and supply analysis, and intranational production and trade relationships can provide data essential for developing larger models.

A good rule for analysis at any level is to seek the simplest method of analysis that will accomplish a given task. Econometric models can help expose questions relevant in policy decisions and make explicit the data required to produce answers. At this stage in their development, however, they must be viewed as a valuable supporting resource for experienced judgment rather than a substitute for it.

Qualitative Non-Statistical Data

Numerical data are only a small part of the total data in an information system. Substantial benefits could undoubtedly result from greater use of non-numerical, qualitative, description data in the information system. Often the most effective way to present analysis to policy makers is to use precise qualitative judgments with modest quantitative data. For example, it may be more accurate to estimate *changes* in crop production levels as opposed to *absolute levels* of crop production each year, i.e., when one cannot get good statistical data, qualitative evaluation of whether crops are greater or less than normal may be as useful. The use of Crop Reporting Boards in the U.S. illustrate that subjective judgment is still an important ingredient even in a highly developed information system. Particularly when the system has technical shortcomings, the wisdom of well-informed persons can play a key role in improving estimates.

But if qualitative data are often the most useful kind, they are also the most easily challenged and the most likely to be suspect. In the search for "objectivity," consequently, useful and necessary data are often thrown away or ignored. This loss can be minimized if a special effort is made to use highly organized and objective methods of collection and analysis when dealing with qualitative data.

INSTITUTIONAL ARRANGEMENTS FOR INFORMATION COLLECTION, PROCESSING, AND ANALYSIS

Essential Elements

An effective information system must satisfy four conditions:

1. It must be able to *anticipate or respond to changes in priorities.* Users of information are subject to political priorities. For example, at one time policymakers may not wish to focus on questions of equity. Yet the situation and their priorities can change quickly and the information system must adjust quickly in order to service the new needs. If anything, it must be even more flexible in a less developed country than in a developed one. A complete census of resources and people may be required initially as a baseline stock of information flows. However, recurrent dependence on censuses builds inflexibility into the information system.
2. There must be *continual evaluation of concepts and methods* to provide a dynamic framework for the flow of information. The organization of U.S. agriculture has changed, but the concepts on which the statistics on U.S. agriculture are based have not kept up with the realities of the current situation. As a result, statistics may give a misleading picture of what is actually happening.
3. *A competent and balanced sustained package of human and nonhuman (hardware) resources* must be built into the system and maintained. Methodologies and equipment for collecting data must be kept up-to-date and appropriate to the situation which is being measured. The information system must remain de-politicized even though the decisions for which the information will be used are political.
4. *Communication of information will need to flow both ways in the system.* It takes a great deal of effort to get information out to potential users in low-income countries where there are only sketchy formal communications networks, especially if this includes an effort to give equal access to less advantaged members of the economy. Likewise, because many of the economic units are less organized than in the developed countries, they offer less opportunity for the users, especially small farmers, to define the content of the information they need. Government and people often see things through different eyes. There is need to bridge these levels.

Alternative Organizational Situations for National Agricultural Statistical Systems

Countries have followed different paths in designing their national agricultural statistical systems. Approximately two-fifths of the low-income countries gather agricultural data as part of a centralized statitical service. One-third have ad hoc systems. The rest rely on their ministries of agriculture for their information needs.

It is not possible to generalize about the best form of organization. A centralized statistical system makes best use of limited human resources, especially when high technology methods (e.g., computers, LANDSAT) are employed. It also does a better job of measuring the intersectoral relationship. However, statistical systems based in the ministry of Agriculture generally bring users and suppliers of information closer together (unless, as in many countries, the Central Planning Agency is the major agricultural decision-maker). Ad hoc systems are generally weak, representing compromises which result in duplication and low quality.

Coordinating the different elements in the information system is a difficult task. One must go beyond admonishing users and suppliers that they do not communicate enough. Ways of reconciling shared collection systems, e.g., national and provincial agencies, must be worked out. Committees, a frequent choice, are not the answer. Finally, responsibility for adequate information must be fixed in a single organization and often in a single individual within that organization.

Balance of Collection and Analysis

It is difficult enough to use data when one cannot have confidence in the magnitude of change reported; no kind of analysis offers much promise when one cannot have confidence in the direction of change. Nor can better statistical methods and data processing techniques offset failures at the conceptual level. No matter how well one manipulates numbers, one may still be measuring the wrong thing.

However, a good analyst often can overcome some weaknesses in reported numbers. Trained field observers may be able to produce more accurate estimates of yield than statistical crop-cutters. Economists using price analysis may be able to improve gross production estimates.

This argues for a balance between the analytical and data gathering capacities of the information system. Furthermore, the type of analysis utilized must be consistent with the quality and type of information available. In many cases, inadequate information is more an indictment of the analysis (and the type of training that analysts receive) than of the data collection.

Steps in Designing a New System

The dilemma of survival in any effective information system arises with the production of data which threaten powerful forces in the society, e.g., land reform or equity, but at the same time to anticipate when such data might be needed and appreciated so

that it is available at that time. For this reason, it is much more difficult to restructure and improve an existing entrenched system than to build a system from the beginning. Redesigning an existing system means reassigning property rights which poses large problems in any society. If one could design the information system from the beginning, it should begin with an identification of problems which private and public policy-makers conceive to be most important. Initial perceptions are not always accurate. Users and suppliers must work together to:

1. understand how the decisions process is organized and how decisions are made;
2. begin to accumulate facts
   a. starting with categories of information considered to be most important, including natural and human resource inventories and basic data series which are commonly necessary; and
   b. adding other information categories once credibility is established.

Technical Assistance

Whether data collection and analysis are adequate in a country ultimately depends upon the ability of the institutions charged with that task in that country. Often they are understaffed and underequipped for their tasks. Outside agencies can train personnel, conduct analytical studies themselves, and provide equipment. This is a valuable contribution if it is not used as an excuse to delay strengthening local institutions and if it does not inadvertently set as a model for a kind of information system that is inappropriate for the low-income country.

SUMMING UP

The strategic part of agricultural decision-making is the careful design of information systems as part of the overall social system. The function of the minimum information system is to produce information to respond to uncertainty, to promote positive change.

Analysts and policy makers must support and encourage statisticians in their work; often statisticians do not get enought credit. They are essential to an agricultural information system. Professionals at all levels must be objective in giving advice—including, importantly, adequate information upon which to base decisions. If they do not play this role, there is little hope to implement a rational decision-making system on a politically sustainable basis.

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