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IMPROVING INFORMATION ON AGRICULTURE AND RURAL LIFE*

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"It is a capital mistake to theorize before one has data."

Sir Arthur Conan Doyle

"The discovery of facts, ...depends at least in part on concepts,
assumptions and inferences
which can only be defended with reference to normative presumptions."

Marc J. Roberts

"If there is no 'given' in experience,
then there is no difference between deduction and induction."

C. W. Churchman, p. 145

I should like to share with you a growing problem in the information base from which this profession works. Over the past five years it has become for me an absorbing challenge and a learning process that in many ways is only just begun. It is an experience which has already been rich in intellectual excitement and filled with implications for the future growth and social usefulness of agricultural economics.

What follows evolved out of the experience of having chaired this Association's Committee on Economic Statistics, which was organized in 1970 and was charged to examine the growing claims that various agricultural

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data were deteriorating. We found that certain of the older food and fiber statistics were indeed performing less well in some long-time repeated uses (AAEA). However, we also found that the statistician, at whose door the complaints were usually placed, was not responsible for this situation so much as was the agricultural economist. This follows from our discovery that it is not in measurement of data where we were failing but in the adequacy of the concepts underlying the data.

I want to explore the meaning of this and related discoveries for the individual agricultural economist as well as the profession. I shall argue that the problems of agriculture and of rural society, indeed, societal problems generally, are best understood as fundamentally problems of information processing. Thus, if we wish to solve the problems of society, we must first solve the implicit information system problem. To the extent that agricultural economics is able to master the information problems within its preview, it establishes its analytical capacity and its social usefulness. Finally, I shall argue that successful information processing is in turn primarily a problem of the appropriate design of the information systems within which data are collected, analyzed, and acted upon by decision-makers.

1) I will first comment briefly on the current state of our data base and analytical capability in contending with the problems we face in agriculture and rural society.

2) Secondly, I want to present what I believe is the most useful way of defining and viewing the nature of data and its relationship to analysis and to information. This paradigm of an information system

I believe expands one's understanding of the problems we face as a profession and suggests some characteristics which must be recognized in the design of any improved data collection and analysis process.

3) Third, I will briefly describe some exciting parallel developments which come to similar conclusions and provide important further insights into the design of information systems and, thus, our capability of managing the problems of a rapidly changing world.

4) Finally, I will comment on the implications of this for us as professional agricultural economists.

OBSERVATIONS ON THE CURRENT STATE OF OUR INFORMATION SYSTEMS

The AAEA Economic Statistics Committee concluded that in those instances where long-collected agricultural data was not performing as well as it had in earlier years, the problem most frequently was a growing obsolescence in the concepts which the data system attempted to measure. Some of these concepts, such as the idea of a farm, are so old and so much a part of our historical tradition that we hardly think of them as concepts at all. But the "family farm," with all its value and organizational assumptions constitutes the central concept around which three-quarters of our food and fiber statistics are designed and collected. Yet it has become an increasingly obsolete representation of the reality of the food and fiber sector. The concept is more than fifty years old, and the structure of the food and fiber industry today only vaguely resembles the structure that prevailed at the time the concept was created. The world has changed and the concept has not.[1]

Conceptual Obsolescence

Let us examine the problem of conceptual obsolescence in more detail. Some agricultural data are more accurate today than before. Most of these data are based on concepts that are biological or physical and have not changed or have changed little in nature. Examples would be the number of cattle and pigs and the acreage and pounds of potatoes or cotton produced. The great improvement in accounting, measurement, and data processing capability over the last 30 years has combined with conceptual stability to increase the quality of some data. Thus, crop and livestock production estimates, with their biological and physical concept base, tend to be far better statistics today than they were 50 or even 10 years ago, despite the criticism they receive.

Even certain statistics based on social science concepts have retained most of their reliability and in some cases have actually been improved. This tends to be the case in those food and fiber statistics where technological and organizational changes have not been rapid. For example, measures of farm production and yields of wheat and most cereals appear to have lost relatively little in conceptual reliability while gaining much in reliability of measurement. Grain prices are another matter. At the other end of the spectrum, where change in the food and fiber sector has been most extreme, statistics on farm gate broiler production are weak and broiler prices have become nearly impossible to collect or interpret. In poultry and eggs, and in many fruit and vegetable products, contracting and vertical integration of both inputs and outputs have undermined, if not destroyed, the traditional concept of the farm which underlies production and marketing statistics. Even the discovery of beef prices has grown more difficult and the data ambiguous. Data on other livestock, cotton, tobacco, peanuts, and other commodities fall in between these two extremes.

Conceptual obsolescence in data is of two types. It can occur not only 1) because of changes in the organization and nature of the food and fiber industry, as I have just described, but also 2) because the agenda of food and fiber policy (public and private) shifts drastically, as it has recently, changing the questions which the information system is expected to answer. When the questions change, it will almost always be found that 1) the conceptual base of some data, especially secondary data, are not fully appropriate representations; and, also, 2) some data critical to the new questions are not even being collected. When normative or positive change occurs either in the object being represented by data or in the environment of the object, conceptual obsolescence is almost certain to follow.

Recent major examples of conceptual obsolescence of data arising from changes in the environment of agriculture can be seen in the entirely new questions which agricultural economists are asked to answer today, as a consequence of new values held and new positive knowledge about the environment, the energy economy, and the world food situation. The overall agenda of urgent agricultural policy issues has changed almost completely since the Great Depression, when the better part of our present data system was designed and built. While some older data have been conceptually redesigned to respond to new questions, by and large we have "made-do," fiddling with different definitions of the same concept. Thus, for example, we have redefined the farm in almost all recent agricultural censuses, while the concept itself has slowly become so obsolete that no matter how sensible the new definition, we still end up measuring something that in some major degree no longer exists.

Farm income is a prime example of both types of conceptual obsolescence. While some improvements have been made, the concept still fails to net out certain expenses and assets and misses some income flows entirely. The design of the farm income concept is still distorted by the political imperative of the parity income calculation and is grossly inconsistent with the conceptual design of national income accounting (AAEA). These are not easy problems to resolve. Eldon Weeks and his associates in the Economic Research Service (ERS) have examined the major deficiencies in the design of farm income numbers and have proposed some original and practical solutions for certain of these deficiencies (Weeks, 1971, 1974; Carlin, et al., 1973, 1974; Simunek).

One might ask what difference it makes whether one does anything about any of these problems. Even the most casual look through the recent Report of the Task Force on Farm Income Estimates should give pause to any user of farm income numbers (Hildreth). It was estimated recently that improving the measurement and moving the beef and dairy cattle inventory changes from current income (where most of it is now accounted for) to a capital account (where it should be) would have had the effect of subtracting about 7.5 billion dollars from 1973 net farm income of 32 billion dollars (Dyer). Hardly a minor impact!

Both farm input and output measures have long exhibited many conceptual deficiencies, even though some improvements have periodically been made. As the American farm industrialized, specialization has separated many production, processing, and marketing functions from the farm to agricultural business firms. As a consequence, agriculture long ago ceased to be just farms. While some of our colleagues are at work on it, we still lack an adequate paradigm with which to describe and categorize the structure of a modern food and fiber industry and to provide a general conceptual basis for sector statistics. There is, for example, presently no accurate basis for describing the character and for measuring the size or productivity of the sector or its social performance.

In the case of social and economic statistics for rural society, the overpowering problem, as the AAEA Economic Statistics Committee pointed out, is the lack of data. This often is because there has been no demand to finance their collection. But even in areas of increasing public concern, as in rural development and in the various dimensions of human welfare, little coherent data and few well-developed information systems exist. The primary reason is found in the absence of any coherent conceptual or theoretical base for either data collection or analysis. We cannot even define adequately what we mean by economic or rural development.

Institutional Obsolescence

Rapid or steady long-term technological, organizational, and associated value change not only create obsolescence and mismatching in the conceptual base but also in the institutional structure of statistical systems. This is often compounded by the reorganization or development of new administrative structures without adequate care for the integrity or capability of involved data systems. Changes in basic statistical measurement techniques (e.g., shifting the agricultural census from a complete enumeration to list frame surveys) which are unmatched by an implementing organizational adjustment also can create another form of institutional obsolescence and inefficiency (American). As a result of institutional obsolescence or reorganization, current administrative structures often do not bring the necessary information together at the time and places in the structure where it is most needed by decision-makers.

Empiric Failure in Design and Collection of Data

Let me turn to a different though related problem: the increasing tendency of economists to propagate endless theories, concepts, and models of unknown value because they fail to design and collect data for an adequate empirical test. In his 1970 presidential address to the American Economic Association, Harvard professor and Nobel Laureate Wassily Leontief indicted economists for this failing. Leontief faults economists for being satisfied with secondary data which does not match and thus cannot adequately test their theoretical concepts. His point is that theory will never be improved without empirical test; and, in its absence, economists are playing sterile games.

Variations on Leontief's criticism have been voiced in many presidential addresses of economists (Bergmann, Blackman, Hahn, Phelps Brown, Maisel, Worswick). In one of the most recent, Bergmann (p. 7) has argued that it is worse than Leontief imagines, since:

> These days the best economists don't even look at second-hand data; they get them on magnetic tape and let the computer look at them. Economists have voluntarily set for themselves the limits on data collection faced by students of ancient history.

Just this year in the annual Richard T. Ely lecture, Alice Rivlin (p. 4) of Brookings lamented that:

> Disdain for data collection is built into the value and reward structure of our discipline. Ingenious efforts to tease bits of information from unsuitable data are much applauded; designing instruments for collecting more appropriate information is generally considered hack work.

Leontief pays a high complement to this profession by explicitly exempting agricultural economics from his indictment. He describes us as "an exceptional example of a healthy balance between theoretical and empirical analysis and of the readiness of 'professional economists' to cooperate with experts in neighboring disciplines..." However, the AAEA Economic Statistics Committee argued in 1972 that the honor Leontief accords us "properly belongs to an earlier generation..." and that agricultural economists are now falling into the same errors which Leontief ascribes to the economics profession.

The capacity and reputation of agricultural economics was built around a balanced investment in the theoretic and empiric. We have lost much of our early interest in the design and collection of data and now often fail to collect needed data or to respect those who do. There is evidence that we are failing also to update our conceptual base at a pace sufficient to keep up with major changes in agriculture. Notice that conceptual failure directly undermines the deductive processes of knowing, while empiric failure directly undermines the inductive processes of knowing. Thus, these are two different kinds of failure. Either long pursued could be fatal. I am sure we will not let this happen.

Property Rights and Vested Interests in Data

Some data problems arise because information always involves property rights, some of which are privately held. As we attempt to redesign or create new data responding to the public interest in problems of international trade with the Soviet Union or China or in public policy issues involving the behavior and performance of the food and fiber sector, we find absolutely essential information is often held by a few firms whose immediate interests are often not served by releasing that information. As industrial concentration continues to grow in food and fiber markets, the issue of private ownership of information versus the public's right to know will become more and more critical and heated. Giant firms acquire with their great size not only an impact on markets but a major responsibility for public information. Where the data on a market are collected from and distributed to firms by a trade association, the tendency to monopolize data is even greater (Stigler, p. 220).

Similarly, bureaucracies and various user groups develop substantial vested interests in existing concepts and measurement procedures. Thus, they behave as if they had a property right in certain data or data systems and often politically are able to enforce their interests. Any change in the design of data must face this problem as a cost of replacing an old statistic with newly designed data. Arrow rightly characterizes this problem as one of human capital made obsolete by change (pp. 40-41).

The Economics of Information

My objective here precludes an adequate discussion of the complex and important problems of the economics of information. But it is worth noting that the further an economy departs from the assumptions of the Neoclassical model (where information is a free good), and the greater the level of uncertainty (up to a limit), the higher will be the value of information. Appropriately designed information allows one to reduce uncertainty and to manage its undesired consequences. But uncertainty is inherent in the human condition. While "sufficient expenditure" on information will keep the effects of uncertainty "upon people...within tolerable or even comfortable bounds,...it would be wholly uneconomic to eliminate all its effects (Stigler, p. 224).

American food and fiber production has in recent years been released from the protective custody of U. S. farm program controls into an internationally interdependent market and an accompanying sea of uncertainty. The value of information has increased many times over, thus exposing more clearly the many weaknesses in our information systems. During the past several decades of shelter from market uncertainty, we so undervalued the major agricultural information systems constructed during and just after the Great Depression that we have allowed them to decay seriously. Improvements are traceable primarily to remedial action following various policy failures and to a few examples of outstanding individual leadership.

Information is an expensive commodity as well as being valuable. Returns to careful decisions about data and information are high. The cost of poor decisions and subsequent lack of appropriate information is extremely high (Bonnen, 1973). The foundation of effective information management is careful design of data and information.

DATA, ANALYSIS, AND INFORMATION: A PARADIGM

One of the first problems encountered by the AAEA Economic Statistics Committee was a confused but common vocabulary which erroneously equates data with information and fails to distinguish the distinctive steps in the process by which data and information are produced. We also seem to lack a clear understanding of how the analytical process or system of inquiry over which the agricultural economist presides relates to data collection and to the information system. Let me share with you a paradigm or useful way of viewing an information system which was developed out of a struggle with these questions.

The Nature of Data and a Data System

Every data system involves the attempt to represent reality by describing empirical phenomen in some system of categories, usually in quantified form. Data are the result of measurement or counting; but when one sets out to quantify anything, the first question that must be answered is, "What is to be counted or measured?"[2] If the configuration of data produced is to be internally consistent and have some correspondence with reality, the ideas quantified must bear a meaningful relationship to each other and to the reality of the world being described. In other words, there must be some concept of the reality of the world that is to be measured. We know that reality is nearly infinite in its variation and configuration and must be simplified or categorized if man's mind is to handle it in a systematic way. Thus, in producing accurate data, one either implicitly or explicitly develops a set of concepts which in some significant degree is capable of portraying and reducing the nearly infinite complexity of the real world in a manner that can be grasped by the human mind. Data are a symbolic representation of those concepts. If the concepts are not reasonably accurate reflections of that real world, then no amount of sophisticated statistical technique or dollars invested in data will produce useful numbers (see data system components in fig. 1).

While data presuppose a concept, concepts cannot be measured directly (or in a strictly logical sense measured at all). Rather, we operationalize the concepts by establishing (defining) categories of empirical phenomena (variables) which are as highly correlated as possible with (i.e., represent) the reality of the object of our inquiry.

Thus, there are three distinct steps or actions which must be performed before one can produce data which purport to represent any reality. These are 1) conceptualization; 2) operationalization of concept (definition of empirical variables); and, finally, 3) measurement. This is what I understand a data system to be (see fig. 1).

The failures and limitations of any one of these data system components constrain and limit the quality and characteristics of the data produced. An inadequacy at any stage can be offset only to a very limited extent by improvements or manipulations at the other stages. Thus, the great

AN AGRICULTURAL INFORMATION SYSTEM

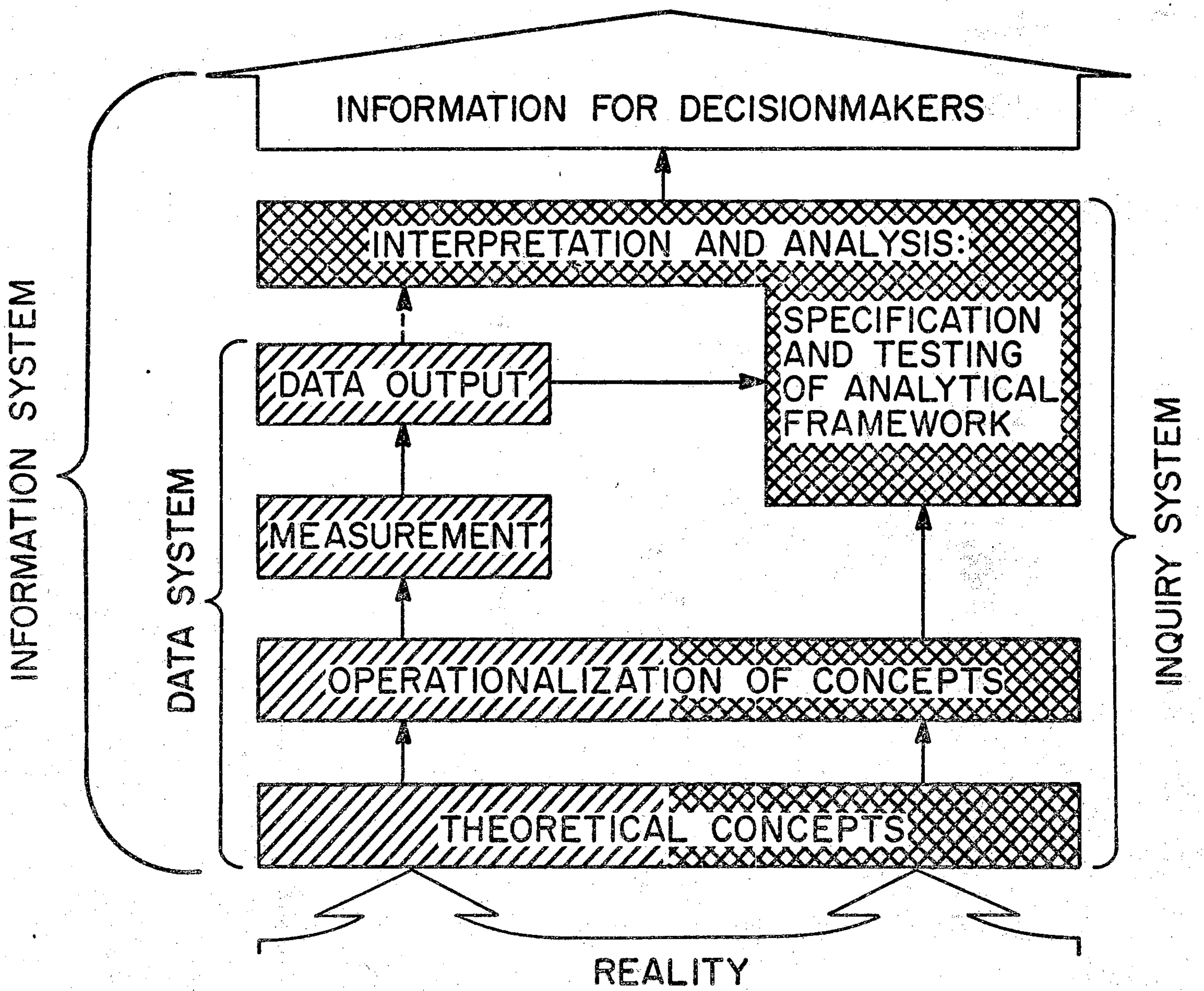

Figure I.

improvements in statistical methodology and data processing techniques over the last generation cannot offset failures at the conceptual level; for no matter how well one manipulates the numbers, one may still be measuring the wrong thing. For example, the parity price concept, no matter how well measured, is a poor representation today of farmer welfare. The "cost of production" concept central to the operation of the Agriculture Act of 1973 is so inadequate as a representation of the complexities of farm cost structures that no amount of genius in operationalizing or measuring it can redeem its inadequacy as a concept.

It is worth noting that the term reliability of data has three different possible meanings in this paradigm: 1) reliability of measurement, which is the way the statistician normally uses the term; 2) reliability of operationalization; and 3) conceptual reliability.

The Nature of Information

Data are not information (Eisgruber, Dunn). An information system includes not only the production of data but also analysis and interpretation of these data in some purposeful policy decision or problem solution context. The demand for data is generated by the need to make decisions on problems. But decision-makers rarely use raw data. Rather, there are intervening acts of interpretation, through statistical and economic analysis, policy staff and political evaluation, etc., which transform data into information by placing them in a specific problem context to give the data meaning and form for a particular decision-maker (see fig. 1). Symbolic data acquire most of their "meaning" and value from the context and design of the information system in which they appear. Thus, I understand an information system to include not only a data system but the analytical and other capability necessary to interpret data.

Analysis as a Function of Information

What does the agricultural economist do when he plays the role of analyst? In our training we all acquired much the same epistemological sense of how we analyze and solve problems. That is, we learned that there is a base of theoretical concepts, a body of theory purporting to represent reality which we 2) operationalize through definition of various variables, often specified formally in a model which 3) must be matched with data or measured representations of these same variables. The model or analytical framework is then tested against the data and conclusions drawn. Thus, in these three steps in analysis, we find two of the same components observed in a data system: 1) theoretical concepts and 2) operationalization of those concepts.

Thus, in our data systems (left side of fig. 1) and in our analytical systems of inquiry (right side of fig. 1), we are operating from the same set of theoretical concepts and, ideally, the same set of definitions which operationalize those concepts. Unless economic theory and economic statistics meet on a common conceptual ground, there can be no mesh between empirical analysis and theory.

The agricultural economist is clearly responsible not only for the design and maintenance of the profession's analytical framework but also for the design of the conceptual base of the data systems which provide the empirical content for that analysis. The commonplace notion held by economists that statisticians alone are responsible for the design and production of data is a grave distortion of our professional responsibilities (Bonnen, 1974). It not only reflects an epistemological weakness but also a lack of understanding of the historical development of data systems. From earliest times data systems have been conceived to solve problems, and professionals whose knowledge was relevant to the problem were involved in design of the data system.

Let me state clearly the implications of this paradigm.

1. Data are not information. They are symbolic objects. Information is a process which imposes form and gives meaning. Data acquire meaning only in the problem context of some information process.

2. All information systems have a purpose because they are subsets or components of social systems which are designed for some problem-solving purpose. Thus, data collection and analysis always has a purpose and can only be understood fully in a social system context.

3. Data collected for societal decision-making must have a social theory base. No matter how ad hoc the collection of data may seem, every measurement act is guided explicitly or implicitly by conceptual and value structures which exist prior to the act of measurement. Data and information are never value free or theory free. Conversely, all concepts or theories have an explicit or experiential prior empiric basis. Theory and data are epistomologically interdependent.

4. Thus, you do not know anything until, as a necessary condition, a deductive, analytic mode of inquiry (see right side of fig. 1) is combined

with an inductive, empiric mode of inquiry (see left side of fig. 1). What is known from such a process grows in extent and reliability by a repetition of interaction between the deductive and the inductive modes, in which both the analytic and empiric contents of the process are reformulated and improved on the basis of what is learned from each prior iteration.

5. An analytical hypothesis or model and the data for its empirical test must have the same conceptual and definitional base. This is perhaps too logical and obvious to mention, yet a failure to appreciate this fact lies at the heart of our apparent inability to understand and deal with the problem of the accuracy of information provided in agricultural economics. It also lies at the heart of the progressive deterioration in the economists' sense of professional responsibility for the design of the data which they use.

Thus, these last three points are implicit in Leontief's insistence on the necessity for empirical testing of all theoretical formulations with data which are designed around the proper concepts. They are also implicit in the AAEA Economic Statistics Committee's insistence that accurate and useful data can be collected only in a conceptual frame which is an accurate representation of the reality which the data attempt to reflect.

6. Data are symbolic of some phenomena which they are designed to represent. The quality of that representation is only as good as the adequacy of the conceptual base, or its operationalization, or its measurement.

7. When the phenomenon that is being represented changes rapidly, as it has in the food and fiber industry, the conceptual base of the information

system must be redesigned frequently to keep up with the change in the reality being represented and the problems being studied. If the rate of change is high enough, the need for conceptual redesign becomes nearly continuous. This is the fundamental problem we face today in the design of information for agriculture. Failure to keep up with the changes in problems and in reality leads to significant conceptual obsolescence, and the system begins to lose its capacity as an accurate guide for problem identification and solution or management. This paradigm of the constituent processes of an information system provides a conceptual template with institutional analogues for the design of data and information systems.

SOCIAL CHANGE AND THE DESIGN OF INFORMATION SYSTEMS

Let me turn to several exciting parallel developments. The first of these are found in the work of Edgar S. Dunn, Jr., who in mid-1974 published a book entitled Social Information Processing and Statistical Systems: Change and Reform. This is an exciting and stimulating volume. Anyone starting out to examine problems of the design of data or information systems should begin with Dunn. For years Dunn has been involved in the management or study of the problems of statistical and analytical systems. Dunn's ideas and those of the Economic Statistics Committee were both well developed by the time we encountered each other in late 1971 and 1972. We were both struck by the similarity of a number of our ideas, though Dunn was reasoning at a far more general level of information system theory and his ideas were more highly developed. He reinforced and encouraged the Committee in its convictions and contributed many stimulating new ideas. Let me point to three ideas out of a dozen exciting insights in Dunn.

We all understand that industrialization and development increases the demand for information. Development leads to specialization of function and organization. This greatly increases the need for coordination and, thus, the social returns to, and the demand for, information. However, it also brings about a change in the kind of information demanded, which we are failing to recognize in dealing with the design of information systems.

The earliest U. S. data systems were usually built around administrative and management needs. The data required can be described as primarily static and descriptive in nature and involving clear, relatively fixed goals and simple or low levels of information processing.

As society has grown more complex and specialized, the demands are not just for more data and greater accuracy in the articulation of detail. Increasingly the demand is for data in a "learning or developmental mode" (Dunn, pp. 32-33), in which the goals of decision-making are not completely specified; and one purpose of the information system is to assist the decision-maker in specifying the goals in a progressively more complete form. In a developmental mode goals and problems may continue to change as learning takes place and thus may never be completely specified. It is obvious that one is not well served in this situation by data which are basically static.

Secondly, in the learning or developmental mode, the information system which perceives and acts on data is itself changing in structure and behavior in response to the information input. Thus, the information system must be capable of perceiving changes not only in the environment but in itself, even under conditions in which such changes themselves become goals (Dunn, pp. 77-85).

As if this were not demanding enough, when the reality of the world, as in agriculture, continues changing rapidly, the need to redesign the system eventually becomes continuous; and it follows that the capacity for redesign must be a normal function of the information system. If the designer does not become part of the system in this situation, the system's capacity to produce useful information will deteriorate.

Another very significant observation can be made about the design of information systems. Any system designed to solve problems will inevitably combine and use different fields of knowledge. Therefore, the concepts underlying the information system will be derived from different disciplines. Agricultural information systems are an excellent example. If such a system is to produce useful data and, in the process, manage its own continuing redesign, a general "theory of social information processing" or, if you prefer, a theory of theories, or a "meta-theory," is needed. In other words, we must have a means of synthesizing concepts from different bodies of knowledge into a meaningful relationship to each other (Dunn, p. 22).

A meta-theory for information system design may well be an impossible goal. But the logic of its necessity is valid and has the virtue of keeping in front of us as designers of information the true complexity of our task. The design of data and information systems is not a job we can assign to any but the best minds.

It is quite clear that the more difficult and abstract system design problems are central concerns of the philosophy of science and, ultimately, are epistemological in nature. In this literature there is a piece of work which is startling in the clarity of insight into the problems of the design of information systems. Even more remarkable, from an entirely different vantage point or literature, it comes to many of the same conclusions as Dunn. It also reinforces the logic of, and provides further insights into, the information system paradigm presented in this paper. The work is C. W. Churchman's volume, The Design of Inquiring Systems. It is not possible here to explore his complex insights adequately. But I can promise anyone who examines Churchman's book an exciting experience.

It is quite clear that in accommodating or attempting to resolve most of society's problems, we create social systems which are really information processing devices for managing those problems. While we are keenly aware of our difficulties in society, we seem almost completely unaware that at the base of these problems are a set of information processing problems that must be dealt with before the urgent needs of society can be served. Much of our difficulty in dealing with these problems arises from our lack of understanding of the information problem. In turn, behind the information processing problem lies the equally unperceived problem of the design of information systems. It is also quite clear to me that despite conventional wisdom, our most important information problems cannot be seen as merely a matter of inadequate measurement techniques. The inadequacy lies in the design and conceptual base of the information processing structures that form our social systems.

I am certain much of my difficulty and slowness in beginning to comprehend this problem can be traced to an inadequate understanding of the methods of social science and their epistemological basis. It is this I believe which lies behind the widespread lack of awareness of the true nature of "the data problem."

In any field at any specific time, one is drilled as a student in a received tradition of scholarship or inquiry which, because it is consensual, remains generally unexamined. Churchman does a great service in forcing much of that unexamined intellectual baggage into a conscious perspective.

I am sure that the striking similarities between the information system paradigm presented here and that of Dunn and Churchman's more sophisticated treatment not only tend to validate my limited insights but suggest a far more generalized framework within which our work on the problems of the design of agricultural information systems should proceed. Dunn and Churchman also establish clearly the significance which this task of improving our information systems has for the society and for a profession such as agricultural economics.

FINAL REMARKS AND RECOMMENDATIONS

In the period from the turn of the century to World War II, the researcher not only designed the analytical framework but typically designed and collected the data for any test of that framework. Communication distances were limited and methodological perspective easier to maintain. Since World War II specialization has progressively separated the data collection function from analysis and interpretation, and we now need to be very much more conscious of the necessity for maintaining a common conceptual base for both data and analysis. In addition, some of our "specialists" in inductive inquiry need to become more conscious of their dependence on the deductive. Many more of us who "specialize" in deductive inquiry need to become much more conscious of our dependence on the inductive.

Agricultural economists have a tradition of inquiry that prevents innocence of the empiric. Even we, however, are increasingly failing in individual and institutional research to do the hard, unglamorous slogging in data collection that often is the most productive of new knowledge.

The agricultural data base in government agencies, in private firms, and universities, at the state as well as national level, is a capital stock, the scope and quality of which governs and limits our capacity to perform as professionals. We must endeavor to deepen our investment in both conceptual respecification and in empirical measures to evaluate that specification. We must work to assure ourselves that we have an appropriate balance between the theoretic and the empiric.

We can approach this respecification or design problem by attacking at one end through the identification of problems in current data and information systems and at the other end of the information process by identifying more clearly the questions that need answers now or will need answers in the future and working back toward the specification of data needed to answer such questions. This would in itself be both a useful and no small task, for few if any of us understand our existing data systems as systems. In the process we should learn a great deal from identification of system problems, particularly failures of the current system. It then is only a step to modeling the systems in terms of various assumptions as to organizational structure, environment, objectives, and other dimensions in the process of specifying what data are needed to answer what questions. All of these efforts would help us toward the urgent objective of identification and conscious management of our data systems as systems and as part of a still more comprehensive set of information systems.

I have argued that one of the essential elements of an ideal data system is an internal capability for renewal or redesign of the data system itself. How to construct this critical component is not at all clear. The capacity for renewing any system must involve feedback or learning loops within the information system itself. This suggests that at a minimum any major data system should have a group of professionals working continuously on the conceptual base, definitions, measurement, and quality of data. This might be characterized as a statistical system design and quality control shop. There would have to be a similar organization at the information system level. Such organizations would monitor, stimulate, and perhaps contribute to conceptual development in the disciplines upon which the data and information systems are dependent. Perhaps these same groups could maintain close relationships with the users of their data. They also would provide a place in the system which could be the common ground on which information and data users, statistical methodologists and disciplinary methodologists met. This is quite critical, since any conceptual deficiency in data also represents a conceptual deficiency for the analytical frames within which the data must be analyzed.

I believe we all need to become more conscious of these problems in all of our data collection and analysis or research. We need to teach research methods at a philosophy of science level of epistemological consciousness, This Association should, I believe, continue to provide a forum for the debate on this problem in its Journal and at professional meetings. The AAEA Economic Statistics Committee under Jim Hildreth's chairmanship is already moving on to the study of problems of specific data and analytical systems in agriculture. The Committee's proposed list of projects holds great promise (Report).

Despite substantial recent efforts, I believe the U. S. Department of Agriculture still needs to expand greatly its efforts at reexamination and redesign of the various analytical and data collection processes over which it presides. The action agencies of the Department are so oblivious of the problem, they are part of the problem. The Economic Research Service (ERS), on the other hand, has in recent years made an excellent beginning and is now quite conscious of, and is working on, many of the problems of information and data system design. ERS has given unstinted support to the activities of the AAEA Economic Statistics Committee.

Political decision-makers as a general rule, however, distracted by the political pressures of the moment, continue as they have for at least 20 years to be unaware or thoughtless of the problems they create for future policy makers. The costs of failure to invest in redesign of data and analytical capability is imposed on other decision-makers and the public of ten and fifteen years later. I understand a political decision-maker's reluctance to have to explain the impact of a change in the parity ratio or farm income concept to Jamie Whitten and other Congressmen. They have my sympathy, but they must support far more effort in redesigning their information systems or the analytical capacity and adaptability of much of the data base of the USDA will continue to decline. There are some interests in the food and fiber sector that would just as soon see this happen; but farmers, consumers, and the nation would be ill served.

The Statistical Reporting Service (SRS) is one of the great strengths of the Federal Statistical System and of the USDA. It was the professional statistician, in agriculture and out, who responded with the greatest interest and understanding to the Economic Statistics Committee's 1972 report to this Association describing the agricultural data problem. It was Harry Trelogan and his colleagues who realized early that there were fundamental difficulties in our data systems. They were largely responsible for the efforts that led to the creation of the AAEA Economic Statistics Committee.

Many are not aware that Harry Trelogan and a core of fine statistical leadership in SRS began over ten years ago to redesign the data base for which they are responsible. In the process they transformed an old system into one of the highest capacity, most efficient, and competent statistical agencies in Washington. That is not easy to do in the face of the lack of support for statistical budgets that has historically prevailed in government.

Harry Trelogan is retiring as Administrator of SRS. If I may be permitted a personal note, it will not be as much fun fighting the data wars without him. A great teacher is always missed. The qualities of his leadership are rare. From Harry Trelogan I learned what integrity in statistics means and what it costs those who maintain it.

I have tried to share with you my own excitement at the discovery of the real implications of the questions raised about the quality of the data upon which we depend as a profession. The significance of these implications for society and for the capacity and social usefulness of this profession is difficult to exaggerate. I hope you too are a little excited. I hope you are able to see the prospect in which at one and the same time we face a major problem in the redesign of agricultural information systems and share in a great opportunity again to contribute to agriculture and the social sciences in a fundamental way, much as agricultural economists did in the early days of econometrics and, in the late 1920's through 1940, development of major information systems to manage and ameliorate the problems of a Great Depression and a World War. We have but to grasp the opportunity. If you chose to work on these problems, I can assure you of an intellectual challenge as great as any you have experienced.

FOOTNOTES

*Presidential Address to the American Agricultural Economics Association, Columbus, Ohio, August 11, 1975. This address was abridged for oral presentation. I am indebted to the faculties at Purdue, Clemson, and the University of Illinois, where I presented seminars on this topic. I also profited from an informal weekly seminar on information systems during the spring term at Michigan State University with Alan Baquet, Tim Baker, Bo Andersson, and Glenn Johnson. An early version of this presentation was reviewed by more colleagues at Michigan State University than can be listed. I am especially indebted to Peter Asquith, C. B. Baker, L. V. Manderscheid, Harry Trelogan, and Jim Hildreth. Any errors, of course, are mine.

[1]Conceptual obsolescence is not limited to agricultural statistics. All of our older social and economic statistics share in this problem. It is also obviously a difficulty that will continue to plague all data systems involving social and economic behavior where change is rapid in a modern society.

[2]Data, strictly speaking, are not limited to quantified forms; but this discussion will be confined to statistical data. Implicit in the question of "what is to be measured" is also the question of "why."

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