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CONTRIBUTIONS OF THE RURAL SOCIAL SCIENCES TO IMPROVEMENTS IN THE FOOD FIBER AND FORESTRY SYSTEMS: RURAL DEVELOPMENT AND RELATED ASPECTS OF GENERAL WELFARE

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In developing my topic, I plan first to gain geographic and historical perspective by mentioning briefly what I regard to be instructive instances in which the contributions of the rural social sciences have made a difference or would have made a difference. Following this I intend to examine instances in which research priorities have been established for agriculture to the neglect of important contributions the rural social sciences are capable of making to the improvement of food, fiber and forestry systems; rural development; and related aspects of general welfare. From these two perspectives I will then identify the four main forces important in bringing about the improvements of concern to me in this paper. After these four main forces are identified, I give attention to the interactions among them as they bring about the improvements with which we are concerned. After this, I distinguish among three broad categories of research and related activities conducted in the agricultural establishment. Then, building on these distinctions, I outline first the multidisciplinary subject-matter contributions the rural social sciences can make, followed by attention to the relevant disciplinary contributions of the social sciences and lastly, I look at the potential contributions of the rural social sciences to problem solving activities in both the public and private sectors.

GEOGRAPHIC AND HISTORICAL PERSPECTIVES

Much valuable perspective can be gained with respect to the possible contributions of the rural social sciences by examining examples from different parts of the world at different points in time with attention to roles played by the presence or lack of improvements in technology; policies, programs, institutions; and the development of human skills and capacities.

One important example involves the new improved varieties of oil palm developed at the West African Institute for Oil Palm Research later renamed Nigerian Institute for Oil Palm Research (NIFOR). These varieties are capable of out-producing wild varieties six to one under experimental conditions and three to one under farm conditions. Nigeria, then the number one palm oil exporter in the world, had exploitive tax policies carried out by parastatal marketing boards. Malaysia, on the other hand, did not have such exploitive policies and institutions. Nigeria failed in her attempts to intorduce the improved varieties because of this important institutional constraint. On the

other hand, Malaysia carefully avoided such constraints and developed a very significant plantation and small holder of palm oil industry to replace Nigeria as the number one palm oil exporter. The difference in institutional variables was crucial for the difference in success between the efforts of these two countries to develop a modern palm oil industry.

In the centrally controlled economies of Eastern Europe, Hungary provides another instructive example. For years the Hungarian agricultural sector suffered from unwise detailed central administration of its state and cooperative farms and, even of its private sector, small holder farms. After the cause of Hungary's poor agricultural performance was identified by several scientists at the Karl Marx University Hungarian policies, programs and institutions were modified to permit: decentralized planning of state and cooperative state and cooperative farms, much more latitude for managers, better rewards for competent management and incentives for state farm employees while terms of exchange between agriculture and non-agriculture were tipped in favour of agriculture. The output response was extremely gratifying. With more income in the countryside, Hungarian rural development improved. General welfare increased with greater availability of food. As one Hungarian agricultural leader put it, "Before the change in policies, consumers had ration stamps, but stores had little food with which to honour the stamps. After the change, ration stamps were not needed and the stores had food to sell without stamps." In Hungary, the requisite technology and human skills had been available; what had remained to be added was better policies and institutions.

A similar development in the People's Republic of China took place at the end of the cultural revolution at the time mainland Chinese leaders shifted to the so-called "responsibility system" for their agriculture. Under the new scheme, planning was decentralized, and family and individual incentives for exceeding governmental productoin quotas were increased. Food production has gone up markedly since the change. In turn, marketing problems developed as production exceeded the capacity of the marketing system. Consequently, elements of the new "responsibility system" had to be introduced into the agricultural marketing sector in order to get the farm commodities moved on to consumers. As in the case of Hungary, the technology had been available. There were also large numbers of skilled, capable people to produce products and to manage the agricultural production and marketing system. The constraint was poor institutions and policies. Withoug proper institutions and policies, adequate technology and skilled, resourceful people were ineffective.

There are also instructive instances in US history. Before the Civil War, southern agriculture depended on the labour of unskilled slaves. The availability of such cheap labour prevented the development of labour saving technology for southern agriculture, the main exception to this statement being the invention of the cotton gin. Farm production grew under the antebellum southern system and, in one sense, rural development reached very high levels under the pre-Civil War system -- for the favoured few who owned the plantations but not for the slaves and poor whites. In Dudley Seer's terms (1970), growth in production took place without development. As there were constraints on increasing the general welfare of the slave and "poor white" populations, the welfare of plantation and slave-owners

increased rapidly while the lots of slaves and the white smallholders improved very little. Andrew Johnson, Lincoln's successor and a southerner opposed to the southern aristocracy, drew political support from disadvantaged white voters in the parts of the South with land unsuited to plantation agriculture.

For at least a century after the Civil War, southern US agriculture suffered from inadequate investments in human skills and capacities. Investments in both poor blacks and poor whites were neglected. Southern agriculture continued to rely heavily on "cheap" unskilled labour, kept in place by lack of saleable skills and ignorance of opportunities open elsewhere. The post-Civil War availability of this cheap labour in the South continued to prevent the creation of labour-saving technologies for southern agriculture. Later, slightly in the World War I period, and then, in a major way in the World War II period, cheap southern labour migrated from southern agriculture to industry. As the labour left, labour-saving agricultural technologies had to be developed for the South and used. The cotton picker was developed. Tractors were introduced. After almost a century of discrimination against blacks and poor whites on the part of the south's residual rural aristocracy and the even more damaging discrimination of the rest of the country against the South, the South and the nation began to invest more in southern human skills and capacity. Further, northern businesses discovered the industrial and commercial possibilities of the South which had been neglected since the outbreak of the Civil War. Southern agriculture in the period since World War II has prospered as the South has overcome the constraints of its poor pre-World War II technology; its inadequate policies, and institutions; has invested in its own people; and had benefitted from the in-migration of the persons in whom considerable capital had been invested. It took a long time for southern agriculture to work out the complex interrelated processes of improving its policies and institutions, its technologies, and its human skills to make southern farming and agribusiness productive, to promote rural development and to make related improvements in general welfare. Throughout the Civil War and since, the humanities made some important contributions. Since the mid-thirties, the moral social sciences have contributed importantly to the development of policies and the design of programs to assist southern agriculture.

Midwestern US agriculture, on the other hand, has never had a legacy of cheap labour through many of its family farms have yielded relatively low returns to family and operator labour (Johnson and Quance, 1972). When the Civil War took farm labourers from Midwestern (then, western farms), there were no slaves to operate them. The result was a wartime and immediate post-war emphasis on horses and machines as substitutes for labour. This emphasis continued after the Civil War as midwestern agriculture stretched its labour supply by expanding into the Great Plains beyond the Mississippi. Throughout this period, heavy national, state, and especially local educational investments were made in the development of human skills and capacities. National and midwestern policies, programs, and institutions were also favourable to the development of technology, institutional and infrastructural improvements and human capital in appropriate workable combinations for midwestern and Great Plains agricultures. Production grew and rural development took place with rapidity. In the Midwest and Great Plains, private agricultural

capital quickly accumulated and was supplemented with public capital investments in infrastructure -- railroads, roads, river transport, and the like. At the same time, agribusiness rapidly extended its marketing network to provide inputs and to market products in the more populus east and in Europe. This region mastered the complex process of getting technology, policies and institutions, human skills and conventional capital together in at least somewhat appropriate combinations for both growth in production and rural development so as to make major contribution to the general welfare of the country. It helped, of course, that the Midwest and the northern Great Plains were on the winning side in the Civil War and did not suffer from the regional discrimination against them as did the South. Be that as it may be, however, the Midwest and the Great Plains did not enter the post-Civil War era with an unfortunate heritage of under-investment in human capital and with institutions that kept labour unduly cheap to the detriment of technological advance.

Japan, Taiwan, and South Korea provide examples of agricultural sectors where substantial investments had been made in human capital and where technologies had been developed to save and more fully exploit their scarce land resources and to utilize their large supply of relatively cheap labour. First Japan, and after World War II, Taiwan, with a US imposed land reforms and with policies and institutions that favoured agriculture, succeeded in finding an appropriate balance among agricultural technology, institutions, and human skills, in view of the natural resources available. South Korea lagged in substantial part because of the devastation of the Korean war. Once peace was established in South Korea and the importance of South Korean's agricultural sector was recognized, Korea followed Taiwan and Japan in developing a balance between technological advance; policies, programs, and institutions including a land reform; and investments in human development. These three economies now provide examples of agricultural sectors all of which are highly productive and which contribute substantially to rural development and the general welfare of their countries. In all three countries equality has been sought with land and social reform without neglecting the importance of increased production (Johnson, 1983, 1986).

One can also go around the world and find one country after another whose agricultural sectors are severely constrained by inappropriate policies and institutions, by lack of investments in human development and by the absence of appropriate technologies. The continued existence of such countries attests to the difficulty and complexity of the task of getting all of the parts in place. Technology alone does not do it. Neither do policies and institutions alone. Also, substantial investments in human development without appropriate policies and technologies do not lead to success. Inflows of external capital without human skills, appropriate technologies and supporting policies, programs, and institutions and lead nowhere. Contributions to the general welfare have often depended on social and land reforms as parts of the needed supporting policies, programs and institutions.

THE NEGLECT OF THE RURAL SOCIAL SCIENCES BY THE AGRICULTURAL AND SCIENCE ESTABLISHMENTS

In view of the geographical and historical perspective provided above, it is truly astounding that the contributions of the rural social sciences to the development of appropriate policies, programs and institutions and to the development of human skills and capacities are so badly neglected by the agricultural establishments of the world. The neglect is prevalent in both national and international research institutions. Though the summary paragraphs which follow merely highlight this neglect, supporting documentation is cited.

President Ford established the World Food and Nutrition Study (National Academy of Sciences, 1977) to establish priorities whereby US agricultural research capacity could make its best contribution to the solution of problems involving hunger and malnutrition. As I have pointed out elsewhere (Johnson, 1985), that study examined a broad range of research opportunities and established priorities among those opportunities. In the final budgetary priorities, the rural social sciences were allocated three/tenths of one per cent of the recommended budgets.

The Presidential World Hunger Commission established by President Carter (1980) had a broader base inasmuch as it included political and agricultural leaders as well as agricultural scientists and researchers. Its final recommendations were somewhat more balanced than those of the World Food and Nutrition Study, but nonetheless placed primary emphasis on technology, to the neglect of (1) improvements in policies, programs and institutions (including social reforms) and (2) investments in human capacities and skills (Johnson, 1977).

There have been two international crop productivity conferences to develop research priorities; one, eleven years ago (Brown, et al., 1975) and another last year (Gibbs and Carlson, 1986). Both placed primary emphasis on research and development to generate new technologies for producing crops. The token rural social scientists involved played the roles of "hand maidens" to the technical agricultural seciences and scientists. The technical agricultural scientists in charge of these conferences were interested in what social scientists could do to prove the importance of technical research and to get that research into use. There was little interest displayed in research on policies, programs, and institutions including social reforms and research on human development to help attain the balance among the three which has proven time and again to be crucial for success.

There has also been a conference to set research priorities with respect to animal agriculture (Pond, et al., 1980). Again the social sciences were neglected.

A conference on agricultural research is being planned for this next Spring at the University of Minnesota. The program and its explanation indicates that the emphasis will be mainly on technological research. Though one group at the Minnesota conference will look at institutions, it will, unfortunately, examine primarily the research institutions of the US Department of Agriculture, the agricultural experiment stations and the international research centres. There is no indication that consideration will be given to research on agricultural policies, programs and institutions. With respect to research on human development, the program appears to

neglect even the development of scientific expertise for staffing the technical research institutes and agencies.

Agro-Ethics

Over the past several years at least ten major conferences have been held on agricultural ethics, part of which have been published (Haynes and Lanier, 1982; Knowles, 1983; Dahlberg, 1986; Edens, et al., 1985). These have considered problems involving environmental pollution, food chain contamination, malnutrition and starvation, energy shortages, erosion and soil conservation, water quality, poverty, gender inequality, family farming, family stress, appropriate technology, off-farm migration, regenerative agriculture, the demise of the family farm, multinations, corporate farming, and the like. In the seventies and even the early eighties, food shortages were a favourite concern which has been predictively replaced with concern over the current "farm crisis" and surpluses. These conferences have dealt with social issues but have not led to delineation of priorities for social sciences research. These conferences have sometimes been more activist than academically objective. An interesting development is the NASULGC and AASCARR project which is developing undergraduate teaching materials to be used in colleges of agriculture courses involving agro-ethical problems.

Society seems to have developed a love affair with the basic hard sciences and technology. When he made the case after World War II for much greater investments in United States research, Vannevar Bush argued for a balance between applied and basic research. The National Academy of Science and the National Science Foundation have pushed the balance toward basic disciplinary research. Even for agriculture, the emphasis since Bush advanced his argument has been placed on basic disciplinary research to the neglect of applied research in the hard sciences, partly as a result of the Pound report (National Academy of Sciences, 1972). This is unfortunate for the social sciences because applied research is necessarily multidisciplinary in such a way as to include the social sciences whereas social science is not nearly so relevant for the disciplinary research of the physical and biological sciences. This diversion of effort to the basic disciplinary research in the biological and physical sciences is part of the neglect of the rural social sciences by the agricultural research establishment. With respect to all of the research establishment, this neglect has been noted in Shapley's and Roy's book entitled "Lost on the Frontier" (1985), an obvious sequel to Vannevar Bush's post-World War II document entitled "Science: The Endless Frontier" (1945).

A part of the neglect of the social sciences is also attributable to the dominance of logical positivism, the philosophy which finds its most appropriate applications in the work of the physical and biological sciences. Logical positivism represses research on values. In turn, such repression constrains prescriptive research on policies, programs and institutions and indeed, for that matter, on technology assessment (Collin, 1985). In the period after World War II, normativistic philosophies lost respectability in scientific circles. So did pragmatism, the philosophy that so often undergirds teaching and research methods in colleges of education, agricultural extension and vocational agriculture.

THE FOUR MAIN FORCES FOR IMPROVING: FOOD, FIBER AND FORESTRY SYSTEMS, RURAL DEVELOPMENT AND THEIR CONTRIBUTIONS TO GENERAL WELFARE

The four main sources of improvements in our food, fiber and forests systems, rural development and related improvements in general welfare have already been identified. They are, of course, technological advance, institutional improvements (broadly interpreted to include policies, programs, and infrastructure, including social reforms) greater human skills and, finally, growing stocks of physical and biological capital at the disposal of a food, fiber and forestry system. After discussing interactions among them, each of these four has a special section below to emphasize its fundamental importance, essentiality and dependence for effectiveness on the other three.

Interactions Among the Main Forces

The four forces - technology, institutions, human development, and capital growth - are all important in attaining increased production from the food, fiber and forestry system, rural development, and related increases in general welfare.

Economists, particularly, but others as well, sometimes conceive of technological advance, institutional improvements, human improvement and biological and physical capital as inputs in a production process (Ruttan, 1984). That production process is viewed as generating various combinations of farm and agribusiness production, rural development and contributions to general welfare. Despite their currency and widespread use, such views appear inappropriate for a number of reasons. For one thing, there is too much complementarity among the four forces for one to believe that their impacts can be approximated with a single production function conforming to the law of diminishing returns. Further, this view of things sometimes presumes ability to aggregate increased production, rural development, and contributions to welfare into a single measure of the output. A further difficulty is that technological advance, institutional improvements, human skills, and various forms of capital originate, combine and are utilized in complex, time-consuming processes with many feedback loops, hardly reconcilable with a conventionally conceived production function. The relationships among the main driving forces and farm and agribusiness production, rural development and contibutions to welfare are themselves extremely complex and are the result of other extremely complex interactions among complex resources involving political, sociological, economic, psychological and related activities. It appears, unfortunately, that many economists, like Charlie Brown, bring their production functions along as "security blankets" to be used whether appropriate or not. Alternatively, such economists can be interpreted as persons who "have production fucntions and will use them" whether appropriate or not.

Once the complexity of the relationships among these variables is recognized, it appears futile to try to differentiate mathematically the separate payoffs for technological, institutional and human improvements. Recognition of this difficulty does not mean, however, that attempts to develop and effectively use new technology, improved institutions, and better human capital are unanalyzable and unpredictable; instead, it only means that the processes of generating and utilizing such improvements are too complex to be analyzed with statis, sophomoric production functions concepts.

If we are to understand the complex processes and interactions

involved in the generation and use of the four main forces, there must be a reciprocal exchange between the rural social and technical agricultural sciences and their underlying basic disciplines. This exchange is particularly needed when we move away from our own disciplinary interests as social scientists to address the multidisciplinary practical issues and problems of agriculture.

THREE BROAD CATEGORIES OF RESEARCH AND RELATED ACTIVITIES IN THE AGRICULTURAL ESTABLISHMENT

The last sentence of the preceding section suggests that it is important to distinguish the basic disciplinary interests of researchers from their problem-solving and subject matter research interests. In this paper (Johnson, forthcoming-a) disciplinary (basic) research is defined as research to improve the theories, measurements and techniques of one of the traditional disciplines of traditional universities. Problem solving research is defined as multidisciplinary research having as its objective the solution of a particular practical problem faced by a specific real world decision-maker in either the public or the private sector. Between disciplinary and problem-solving research is subject matter research, which like problem-solving research is multidisciplinary. Subject matter research is defined as research on a set of multidisciplinary problems to rather well-defined set of decision-makers concerned with a rather well-defined set of problems.

It is important to distinguish among the three kinds of research defined above as there are important differences among them with respect to financing and accountability, supervision and conduct, administration, the meaning of excellence (review and evaluation) and durability and practicality (Johnson, forthcoming-a, Chs. 13-16). Rural social scientists engage in all three kinds of research. They make basic disciplinary social science contributions (some relevant to agriculture) as well as contributions to multidisciplinary problem solving and subject matter research. Efforts to establish priorities for rural social science research which contributes to food, fiber and forest systems, rural development, and related welfare need to be classified as falling in one of these categories so that we can understand differences in their financing, administration, conduct, evaluation and what we can expect them to contribute to agriculture.

Many research efforts are mixtures of the three kinds of research and that the divisions among the three types of research are far from clear cut. This does not detract from the usefulness of the categories. When a research effort is recognized as involving disciplinary as well as multidisciplinary subject matter and problem solving research, such recognition helps one understand the particular needs of its different components, vis-a-vis financing and accountability, supervision and conduct, administration and review and evaluation.

By its very nature, agricultural research establishments are necessarily concerned with all of these three kinds of research and related activities. They are expected, in some instances, to arrive at specific recommendations or prescriptions to solve problems of farmers, agribusiness men and government officials at all levels of government. They are also expected to mobilize expertise from many basic disciplines (biological and physical as well as social) to

develop bodies of multidisciplinary knowledge important to groups of decision-makers facing groups of problems. For instance, most departments in a typical college of agriculture or agricultural experiment station are multidisciplinary not disciplinary. Thus, agronomy departments typically include chemists concerned with soil chemistry, physicists concerned with soil structure, bacteriologists concerned with the bacterial flora of soil, geneticists to contribute to plant breeding work and molecular biologists to restructure plants as well as statisticians and even economists and sociologists concerned with farming systems and the management of crop enterprises. Agronomy departments like most other departments in colleges of agriculture are more like institutes than they are like the disciplinary departments of traditional universities.

SUBJECT MATTER CONTRIBUTIONS OF RURAL SOCIAL SCIENCES

As noted above, subject matter research is multidisciplinary in nature. As the subject matter research in which rural social scientists participate is not entirely stable, it is necessary in setting up, conducting and administering such research to provide administrative and philosophic flixibility. Matching the need for administrative flexibility is a need for flexibility and willingness on the part of rural social scientists to join multidisciplinary subject matter research teams and accept administrative direction.

The more stable subject matter areas in which rural social scientists are involved are often recognized with departmental status. Presently there are rural sociology departments in existence and major sections of rural sociology in sociology departments. In the past there were more separate departments of rural sociology than now. Presently there are more departments of agricultural economics than there are rural sociology departments but as for rural sociology, there are also agricultural economic sections in departments of economics. Rural sociology and agricultural economics, like agronomy are not purely disciplinary. The adjectives "agricultural" and "rural" indicate a multidisciplinarity not to be found in disciplinary departments of sociology and economics.

It is useful to consider some of the multidisciplinary subject matter research efforts which involve the social scientists. The following list of multidisciplinary subjects has not been prioritized but is presented here to indicate something about the range and stability or instability of subject matter research to which social scientists can contribute. The general area of integrated pest management ordinarily involves contributions from social scientists. So does farming systems research, farm management, marketing and agribusiness management, all of which are multidisciplinary subjects. Energy is another subject matter area requiring contributions from the social sciences. Other multidisciplinary subject areas include: enviornmental pollution and waste management, food safety, community development. On the human development side, multidisciplinary subject matter areas of research include child development, stress management, youth development. Other multidisciplinary subject matter areas include park and recreational development, regenerative agriculture, animal rights, conservation, agricultural science policy and nutritional education. Other subject matter areas include agribusiness management, water conservation and management, assistance to local governments, technology assessment, risk management, development of

LDC food systems, forestry, and forestry management. The agricultural policy issues involving international trade, international finance, the current farm crises, survival fo the family and the like are multidisciplinary among the social sciences and, because of their technological dimensions, the physical and biological agricultural sciences.

PROBLEM SOLVING RESEARCH

As there is an important difference between disciplinary questions and practical problems, we should be careful not to confuse the two. Disciplinary questions need to be answered in order to improve a discipline by further developing its theory, providing better empirical knowledge of phenomena of concern to the discipline or by improving its techniques. By contrast, practical problems need to be solved in order to run our every day affairs.

In this section we are concerned with solving practical problems. The next section on disciplinary research will consider the answering of disciplinary questions.

Practical problems to be researched are less stable than subject matter research topics. Practical problems arise and are solved or people learn to live with them. Meanwhile, new problems arise to be addressed. Still further, the mixes of disciplines vary widely from practical problems to practical problem. The result is great difficulty in setting up and administering research units for doing practical research (Johnson, forthcoming-a, Ch.14). Both administrative units and disciplinary specialists are required to be flexible if they are to respond to the private and public decision makers facing the sequence of ever changing practical problems.

Because practical problems are multidisciplinary, disciplinarians such as economists, philosophers, sociologists, molecular biologists, political scientists and physicists, often find themselves inept, clumsy and unduly specialized for recognizing and defining problems. Defining and solving practical problems and setting priorities among them requires close contact with decision makers (public and private) and affected persons from whom academicians in their ivory towers are isolated. These administrative needs also carry over to financing, accounting, conduct and the evaluation and appraisal of problem solving research in manners I discuss elsewhere (Johnson, forthcoming-a) in more detail than is possible here.

The above stresses the complex nature of problem solving research and the unstable ephemeral nature of problems. In turn, these considerations indicate that one should not expect to be able to list stable problems or categories of problems to be addressed by social scientists. Instead, about all one can do is to indicate some of the problems on which we should be currently working while realizing fully, that the list is incomplete, changing and unstable but always present. A short illustrative list follows:

- problems associated with the farm crisis
- community problems associated with the changing demography of rural areas
- societal problems associated with the changing structure and distributions of power in agribusiness
- investment and disinvestment problems of governments and private industry

- pollution, waste management and food contamination problems of governments and food system firms
- problems of racial, gender and wealth inequality.

DISCIPLINARY CONTRIBUTIONS NEEDED FROM THE RURAL SOCIAL SCIENCES

The social sciences, like all disciplines have special responsibilities with respect to disciplinary knowledge. Like the biological and physical sciences, the rural social sciences generate the basic disciplinary advances which, in turn, provide the foundation for application in the form of improved policies, the development of rural human resources and improved agricultural institutions (both public and private), policies and programs. As for the biological and physical sciences, not all disciplinary research of the social sciences is relevant for agriculture.

By and large the needs for disciplinary research are relatively stable and well known. An area of disciplinary research particularly relevant for agriculture includes the need for improved perception and measurements of the outputs of food, fiber and forestry systems; rural development; and sectorial contributions to general welfare.

Also needed are improved knowledge of (1) public choice and decision processes and (2) private decision-making and managerial processes.

Much progress is also needed on ways of obtaining descriptive knowledge of values -- monetary as well as non-monetary, extrinsic as well as intrinsic, ontological as well as deontological, and instrumental as well as intrinsic.

The social sciences also need to contribute improved perceptions and measurement of technological and institutional change, human development, the generation, saving and utilization of biological and physical capital and the conservation, development and utilization of natural resources.

Better measures of general welfare are needed. Our present methods often lack interpersonal validity and tend to be cardinal rather than ordinal. The social scientists need to provide a better understanding of the social and private dimensions of technological advance, institutional improvement, human change and growth in physical and biological capital. Also the social sciences can be expected to provide additional and improved information and knowledge about the creation and modification and utilization of power including attention to the role covenants in public and private decision making.

Elsewhere, I (Johnson, forthcoming-b) have considered the needs for disciplinary advances in economics if we are to improve our contributions to applied (subject matter and problem solving) agricultural research. These noted needs include extending and clarifying our theories vis-a-vis risk preference and aversion, "technical" versus "economic" efficiency, and frontier productions functions. Also needed is work on the empirical validity of aggregation production functions as related to specification and aggregation difficulties. Until the empirical use of such functions is established, the empirical use of duality theory at the macro level will remain questionable.

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PLENARY SESSIONS