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SCIENCE, ORGANIZATION AND THE INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

Iowa State University

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Science, organization and
the international agricultural research centers

by

Hemchandra Laxman Gajbhiye

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
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Major: Rural Sociology

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SECTION IV: PUBLICATION PRODUCTIVITY AND AGRICULTURAL SCIENTISTS: TOWARD AN ANALYSIS OF PERSONAL AND ORGANIZATIONAL CONTEXT

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APPENDIX
GENERAL INTRODUCTION

Explanation of Dissertation Format

This four-phase research plan is set within the recently adopted alternate dissertation format. This format provides for the production of a series of papers, suitable for submission to professional journals of appropriate tenor, as a means of satisfying the requirements for the Doctoral degree. With regard to the four papers in the present work, this format is ideally suited to the research plan. All four papers deal with a single topic, but do so by addressing various facets of the same phenomena. Each paper is able to stand on its own merit, yet taken together they provide a thorough investigation of the research subject.

A definite strong point of this dissertation format is that it allows the investigator to pursue a wide range of variables and divergent methods of analysis, thereby allowing for a wider analysis of the topic. Further, in keeping with the pedagogical intent of education, it permits one to explore various research techniques and aids in keeping the dissertation within the parameters of a true learning experience.

In broad terms, this dissertation deals with examining the science as practiced by agricultural scientists in international agricultural research centers (IARCs) through the organizational perspective. In more precise terms, the research focuses on determining how and what sociological factors influence the process of scientific knowledge creation and its diffusion in organized work setting in agricultural sciences.
In the succeeding section, the problem is defined in terms of the importance of international agricultural research centers in relation to the global food situation, now and decades later. Further, it is explained how sociological study of IARCs can help in understanding intellectual content of this system and thereby recognizing its legitimate role. The latter part of this section is devoted in synthesizing the literature on all predictive variables and the conceptual model is built around the theoretical framework.

This general introduction is followed by the first of the four papers, which deals with the issue of research problem selection process in IARCs. Several criteria of research problem selection as perceived by scientists are examined. The hypothesis is tested that the organizational priority is the most important criteria for problem selection in organized international agricultural research. It is argued that comparative influence of intrinsic scientific or paradigm related criteria is minimal. Neither the scientists are motivated for recognition or by desire to extend certified knowledge, but the work organizations constrain work patterns so that research focuses on a particular problem and other problems are perceived as less important.

The intent of this part of the dissertation is to understand the science in IARCs. The discussion is mostly centered on understanding how work organization influences the scientific development.

The second paper deals with the issue of work alienation among the agricultural scientists working with IARCs. The demographic, personal, and organization variables are studied to explain the variations in organizational alienation. The purpose of this section
of the dissertation is to bring the "free floating scientist" to "an employee" constrained by work organization. The discussion is centered on attempt to prove that scientists working in organizations do react to the work environment just like other workers do.

The third paper of the dissertation is centered around understanding the organization of modern science. It is argued that in spite of a high degree of uncertainty in scientific work, hierarchy of authority, power distribution, and formalization are no less observable in scientific institutions than in other types of work organization. In this part of the dissertation an attempt is made to explain how the broad organizational structure affects the organizational climate and supervisory as well as peer leadership in research work settings. The discussion is centered on how structure influences the process variables in organizations, that are specifically designed for research enterprise.

The final paper is devoted to studying the publication productivity among the agricultural scientists. Since all literature on publication productivity indicate that only a small group of scientists produce the bulk of publications and the vast majority publish little or nothing, an attempt is made to study how demographic, personal, and organizational variables contribute to publication productivity. The main concern of this part of the dissertation is with the diffusion of certified knowledge in the scientific community and how personal attributes of scientists as well as work organizations contribute to that process.

In the last part of the dissertation all four papers are
summarized and the dissertation is concluded with some suggestions for future lines of research.

Statement of Problem

Global food situation

Despite the chronic food shortages in sub-Saharan Africa, the world agriculture situation is more optimistic today than it was projected in the 1970s. Over the decade, global food production reflected one of the largest increases in human history which resulted in partial rebuilding of grain stocks. In fact during 1984-85, combined world production of all grains rose 10% above the previous season and 6.5% above the previous record two years earlier. Early indications point to a further increase in world grain production in 1985-86 with an increase in grain carryover stock, especially in the U.S., European Community and India (World Food Institute, 1985:1).

However, the experts predict that during the next few decades the world food situation will be unusually dynamic. An ever-increasing number of African, Asian and Latin American countries will pass through a development phase in which rising per capita incomes will fuel a sharp increase in the domestic demand for food. The still fledgling agricultural sectors of many developing countries will be hard-pressed to meet such food demand increases. This will put added pressure on the export capabilities of the more mature economies. At present, the world is locked in the throes of a major recession, which has significantly reduced both the rate of food demand growth and the level of real food prices. But once this recession has run its
course, the interaction of long pent-up income and growth factors will very likely produce a strong increase in food demand throughout the developing world (Mellor, 1983:393). Rising incomes in the developing world will necessarily raise the effective demand for food, because of the high marginal propensity of low income people to spend increments of income on food. This may well provoke a gradual rise in the real price of food, as the total Third World demand for food shifts far more rapidly than supply (Mellor, 1983:393). The World Bank projected that adequate food for the world's population over the next two decades requires increases in production at a rate of three to four percent per year in most developing countries and average increases in yield on already cropped land of no less than about two percent yearly, if malnutrition is to be reduced, increased food costs are to be avoided and economic growth not threatened (World Bank, 1981:5).

**Agricultural research**

Throughout most of human history, increases in agricultural output have been achieved almost entirely from increases in cultivated areas. Since any more increases in cultivated areas at the present time may disturb the ecological balance, much of the projected increase in food production will have to come from increases in yield on land that is now under cultivation. During the 20th century, agriculture has been undergoing a transition from a resource-based sector to a science based industry. Growth in agricultural output is increasingly based on development of scientific and technological capacity to invent new biological, mechanical and chemical technologies. It is increasingly dependent on the growth of the
capacity of the industrial sector and a technology based subsector of agriculture to embody advances in agricultural science and technology in new and more productive inputs like seeds, fertilizers, herbicides, insecticides, machines, equipments and so on. The impact of technology is then enhanced by increased investment in the formal and informal education of rural people that enlarges their capacity to discriminate among the new technologies that have become available to them, based on effectiveness. The education also helps cultivators to employ efficiently the new technology and the new practices under the wide variations in the physical, economic, and cultural environments in which they practice agriculture. Evidently, it is the agricultural research that has stimulated the tremendous growth in food production during the last 50 years.

The larger amounts of money and trained manpower committed to agricultural research in recent years reflect, in part, the high actual or expected rates of return on such investment. The exceedingly high returns to countries from investment in such research, "the payoff from research," is well-documented. For example, Ruttan (1982:237) argues that under a wide range of circumstances the economic returns to investment in agricultural research have been very high in comparison to almost any other investment available to society. While compiling some of the studies on the investment-return ratio for agricultural research, World Bank (1981:19) noted that realized rates of return on investment in agricultural research are much higher, generally two to three times greater than likely returns from most alternative investment
opportunities in the countries concerned. The available evidence strongly supports the inference that organized agricultural research has been a most profitable investment (Wortman and Cummings, 1981:291). However, Ruttan points out that although the return to investment testify to the efficient allocation of the research resources that society has made available to the agricultural science community, they also indicate a continuing underinvestment in agricultural research (1982:37).

Although a rich country like the U.S. is accused of underinvestment in agricultural research as compared to some European countries, the problem is very severe for the developing countries. A recent review by the International Food Policy Research Institute covering some 65 countries suggests that serious problems of understaffing and underfinancing in agricultural research exist in low income countries that have important agriculture sectors (Oram, 1978). Among the low-income countries, the equivalent of only 0.26 percent of the agricultural gross domestic product was spent on agricultural research in 1975, compared to one to two percent in developed countries. Among the 65 poor countries surveyed, the number of professional staff engaged in agricultural research (about 23,000) is hardly more than the number that exists in Japan alone. Besides underinvestment and understaffing, Oram observed that research is often not well aligned to national needs and priorities. Research efforts are frequently weakened by being divided between various ministries and departments. Many scientists are poorly informed about the state of knowledge, conditions of service often frustrate sound
research, low salaries and limited career prospects fail to attract keen young scientists. Research efforts also fail to integrate biological and socioeconomic information (1982:383). Wortman and Cummings (1981:129) observed that there is a lack of commitment to implement new agricultural research policies on the part of research organizations in developing countries.

One of the ways to overcome the weaknesses in research efforts (production of technology) is direct transfer of technology from developed countries with more advanced scientific establishments to the poor countries who do not have enough resources to invest more in agricultural research. However, widespread failure has occurred in attempts to import more sophisticated agricultural technology because agricultural research that is needed in any particular country is determined in part by the unique soils, climate, socioeconomic and political conditions. Whereas bicycles or radios are highly transferable across environments with little or no modification, much of agricultural technology is not. Secondly, the research services in poor countries are not staffed or supported to develop new technology from design transfer.

The problem of building national research capabilities is made more complex by giving priority to agricultural extension over research in allocating meager national resources. Since the strategy of increasing food production in any country depends heavily on adequate extension services, extension tended to be given priority in a tight money and manpower situation. This bias for extension on the cost of research is illustrated by Boyce and Evenson (1975) who
concluded that many developing countries are able to produce extension skills indigenously, whereas local institutions frequently do not have the capacity to produce more demanding scientific skills.

The international research system

Clearly the developing countries need help in conducting agricultural research and they might best receive it from international no-strings attached research centers situated in the third world itself (George, 1981:282). This was the basis of the establishment of an international agriculture research system. The Rockefeller Foundation with its successes in Mexico teamed up with the Ford Foundation to establish the International Rice Research Institute (IRRI) in the Philippines in 1960 with the cooperation of the host government. IRRI was the first unit in what has now become an international system of agricultural research. Funding of the IRRI was the institutional embodiment of the conviction that high quality agricultural research and its technological extensions would increase rice production, ease the food supply situation, speed commercial prosperity in the rural areas, and diffuse agrarian radicalism (Anderson et al., 1982:7).

Significant international support for these and other international institutions began in 1972 through the newly established Consultative Group on International Agricultural Research (CGIAR), a multilateral forum of donors. The CGIAR system expanded rapidly during the 1970s from $12 million being channeled to four centers in 1971 to over $120 million in 1980 (Ruttan, 1982:123), to support a network of 13 International Agricultural Research Centers (IARCs) with
some eight hundred scientists working in a wide range of disciplines (Oram, 1982:392). In addition to its co-sponsors, the CGIAR system is supported by 30 donors including 20 national governments from both developed and developing countries plus a number of private foundations. This research system, although still quite new, now covers most of the major crops and animals, and extends to most areas of the developing countries.

The IARCs work on difficult problems of regional or international importance. They make germplasm freely available to cooperating countries, provide scientists to work cooperatively in national programs, hold meetings to review programs and exchange information, and train national scientists. The international institutes constitute one of the more successful modern day examples of international cooperation. There is no doubt that the IARCs are planning a vital role in checking world hunger. As pointed out by Ruttan (1982:132), "The world will continue to need a system of international institutes that will play a strategic role in the areas of crop and livestock improvement."

Sociology of IARCs

Although the International Agricultural Research Centers are highly esteemed, surprisingly very little is known about their operations. There have been several studies to estimate the overall economic returns from research in relation to the total investment to sustain the International Agricultural Research Centers (see Arndt et al., 1977). There also have been several attempts to describe the historical development of the international agricultural research
network and its role in international politics (see Ruttan, 1982; Anderson et al., 1982). Besides, World Bank (1981) has published a sector policy paper on agricultural research outlining the future of international centers. However, no systematic attention has been paid to understand the social system operating in these centers, which makes them so effective. Very little is known about their scientific research community. The nature of the connection between social factors within that community and its cognitive development and the relationship between the research community and external environment. What is more important is the intellectual content of the international agriculture research, its relation to what is deemed politically relevant and urgent.

It is these aspects of agricultural research in the international arena that this study seeks to explore. In this study, an attempt will be made to analyze the relationship between the environment which includes scientific, social, ideological and organizational context and the selection of research problems, work alienation and publication productivity, the three social conditions which affect the process of discovery, evaluation and diffusion of ideas.

This study not only addresses the concerns of academicians who are trying to understand the processes of knowledge creation in agricultural sciences, but also may challenge some of the cherished underlying assumptions of international agricultural research.

This study will also raise questions about the potential contradictions between external demands on science and the role of the scientific community in monitoring the quality of research.
It can contribute to strengthening the social responsibility which scientists feel for the consequences of their research.

Finally, this study can generate some policy implications for the research administrators, Consultative Group on International Agriculture Research, and donor countries, agencies, and foundations which support the international network of agricultural research.

Theoretical Framework

Although in recent years the sociology of science has become a thriving research field, it has not yet reached that level of maturity where problems are clearly defined and where investigation is guided by a generally accepted interpretive framework (Mulkey, 1972:5).

However, if we wait for the perfect theory of science before doing more research, we would be waiting for Godot, since we wouldn't know how to recognize it anyway (Whitley, 1972:86). This study is an attempt to help construct a framework for the sociological analysis of scientists, their organizations and their products in agricultural research.

One of the ways to study scientific knowledge production is through open system perspective. In some respects an open system is not a theory, but rather a framework, a meta theory, a model in the broadest sense of that overused term.

The functioning of any open system as prescribed by Katz and Kahn (1978:752) consists of recurrent cycles of input, throughput and output. Of these three basic systemic processes, input and output are transactions involving the system and some sectors of its immediate environment. Throughput is a process contained within the system.
Scientific knowledge production as an open system imports some form of energy from the external environment. The personality of scientists, their scientific outlooks, theoretical orientations, and problem selections are all influenced by the world external to the knowledge production system. In other words, the functioning personality heavily depends upon the continuous inflow of stimulation from the external environment. Similarly, knowledge production systems must draw renewed supplies of energy from other institutions or people or the material environment.

These acquired inputs are then transformed into outputs. The system converts the social, economic, and political material and influences into thought patterns of scientists. The basic energy transformations in the system involve the processing of inputs and molding of system participants. In molding the system participants knowledge production system is guided by norms of science. This is done through adopting appropriate structures articulated by leadership. The throughput embodies the primary goal that the external environment has set for the organization.

The realized goal, i.e., production of certified knowledge is then exported to the environment in the form of scientific publications. This contribution to suprasystem is made through various outlets made available to the scientific community.

The open system approach dictates a strategy of research where the first step should always be to go to the next higher level of system organization. The researchers should start from studying the
dependence of the system in question upon the supersystem of which it is a part, because the supersystem sets the limit of variance of behavior of the dependent system (Katz and Kahn, 1978:63). The knowledge production system is a part of a wider society, thus the overall social influence will be reflected in the content of science. This influence is well documented, for example, in the process of problem choice.

In his study of science in seventeenth century England, Merton (1970, chaps. 7-10) took as one of his principal problems the identification of cognitive and extrascience influences upon problem choice in science. More recently sociologists have begun to adopt the self-amplifying stance that problem choice must be a central issue in studies of scientific development (Zuckerman, 1974, 1978; Edge and Mulkey, 1976; Weinstein, 1976; Edge, 1977; Gieryn, 1977, 1978; Busch and Lacy, 1983). The current investigations of research problem selection have taken various approaches.

Some researchers have examined problem choice in the sciences by exploring how problems become defined as interesting or even as basic. Zuckerman (1978), in summarizing some of these studies, concluded that scientists define some problems as pertinent and others as uninteresting or even illegitimate, primarily on the basis of theoretical commitments and other assumption structures. Theory and its associated concepts can preempt research attention by defining certain observations as irrelevant, specifying certain investigations as unfeasible, defining certain areas as not problematic and directing attention from certain issues.
Another approach has been to focus primarily on the emergence of science specialties and to treat problem choice as a collateral issue. The background, social characteristics, and research experiences of scientists are examined to discover patterns among scientists entering certain fields or specialties (Edge and Mulkey, 1976). Related work focuses on identifying sequences of change and continuity in the problem choices of scientists, and recognizing the social and cognitive conditions that contribute to continuity for certain research problems and those conditions that lead to problem change (Gieryn, 1978).

A third equally important research perspective focuses on how scientists choose from the range of identified problems. This orientation has explored the determinants or criteria for problem selection (Edge and Mulkey, 1976; Lacy et al., 1980; Zuckerman, 1978). Several criteria have been suggested as the major determinants for problem choice. Zuckerman (1978) concluded that two main criteria were (1) the assessed scientific importance of a problem, and (2) the feasibility of arriving at solutions. The importance of avoiding, error-prone fields and focusing on solvable research problems was stressed by Medawar (1967:7).

The interplay of scientific or paradigmatic criteria and social factors in problem choice is complicated, as judgements about appropriate research are also influenced by social processes internal to science. Merton noted that research problem choice may be influenced by reactions to the inferred critical attitudes or actual criticism of other scientists and by an adjustment of behavior in
accordance with these attitudes (1970:219). In addition, the social system of science provides institutionalized motivation and reward not only for solving major scientific problems, but for solving them first. This reward system motivates large numbers of scientists to migrate to interesting and substantively important emerging areas, often referred to as hot topics (Busch and Lacy, 1983:43). Sullivan, et al. (1977) noted that physicists try to maximize the chances of both achieving priority and solving significant problems. This emphasis on priority may increase the motivation of scientists to choose research that has a high probability of publication in professional journals.

Other researchers have raised the issue of important extrascientific influences on problem choice. Merton (1970) in his analysis of science in seventeenth century England concluded that research problem choice followed directly from intrinsic scientific and technical developments and indirectly from scientific concern with extrinsic military, economic and technological problems. Weinstein (1976) argued more forcefully that the intrinsic scientific or paradigm-related criteria constitute only one of four important groups of criteria for problem choice. The other three determinants are administrative directive, political commitment, and personal avocation. Some argue that the key criteria for problem choice may simply be the research agendas established by those institutions providing the funding. Evenson and Kislev (1975) proposed that the most important external influences upon agricultural scientists' research choices are various commodity groups that financially and
politically support selected aspects of agricultural research.

Among researchers studying science, a major debate has emerged regarding which of these criteria operate in the sciences. This brief summary suggests that the scientists' choices of research are influenced in a wide variety of ways by a diverse array of factors. Some of these criteria are clearly disciplinary in character while others are external to science. It is often difficult to make a clear distinction between internal and external influences (Busch and Lacy, 1983:44). Furthermore, two or more criteria are frequently operating in the choice of research problems, and it is difficult to judge which is the most important or even which ones are present. Decisions made by scientists regarding problem choice emerge from a complex process of negotiation within themselves and with other scientists, administrators, and clients (Busch, 1980).

Of the four norms of science suggested by Merton (1973:273), "communism" is one of the most important norms which denotes the fact that there is a common ownership of goods in the scientific community. Scientists are enjoined not to consider their inventions or discoveries as personal property and do all in their power to inform their colleagues of the work that they are doing. Merton further argues that the social system that values originality and rules that one's work should be freely available to others naturally encourages scientists to publish articles. Without free and open communication of findings it would be impossible for scientists to subject all knowledge-claims to the same critical appraisal or to apply their universalistic criteria of scientific adequacy consistently (Mulkey,
1979:24): The institutional conception of science as part of the public domain is linked with the imperative for communication of findings. Secrecy is the antithesis of this norm; full and open communication is inaction (Merton, 1973:274). The pressure for diffusion of results is reinforced by the institutional goal of advancing the boundaries of knowledge and by the incentive of recognition, which is of course contingent upon publications. The social structure of scholarship (disciplines, specialties, and networks) is organized around communication, and publication is the principal means of that communication (Mullins, 1973).

The central rewards of publication act as both a "stimulus" and a "control" in academia (Wilson, 1979). Recognition and esteem validate past performances by bringing attention to accomplishments judged to be of high quality. The rewards also provide motivation for future performance by encouraging successful scholars to continue to be productive (Cole and Cole, 1973; Zuckerman, 1970). These mechanisms in turn reinforce standards of performance by focusing attention upon work that helps set the pace of scholarly achievement. If in fact, honor follows excellence, then the most visible rewards can evoke performance in others by conveying research standards of a high order. In this way, recognition and reputation both reflect and generate productivity (Gaston, 1978). Fame may be the reward that few will attain, but its elusive promise serves as an incentive for many others (Blau, 1973).

Despite the centrality of publication to science, average levels of performance are low. In a sample of academics from both natural
and social sciences, Cole (1979) found that two years after the
degree, 53% had failed to publish a single paper and 34% had
published just one. In most years, 70% of these academics published
nothing. With a national sample of faculty across fields, Ladd and
Lipset (1975) also documented astonishingly low levels of publication:
over half of the full-time academics had never written or edited any
sort of book; more than one-third had never published an article; and
more than one-quarter had never published a scholarly work of any kind
over the course of their careers. While average levels of publication
are low, the variation between academics is very high. Whether one
considers publications over the past two years, past five years, or
professional lifetime, publication productivity varies enormously.
Fox (1985:259) summarizing many of these studies, concluded that the
publication productivity is strongly skewed, with a small group
producing the bulk of publications and the vast majority publishing
little or nothing.

Thus, the data on publications show conclusively that (1) the
average level of performance is low and (2) it is highly variable.
But beyond these two facts, agreement splinters and explanations of
the determinants of these patterns is a central problem in the study
of science (Fox, 1985:258).

Explanations of productivity in publications fall broadly into
categories. The first emphasizes the role of personal or
individual characteristics. One version of this perspective has been
termed the "sacred spark" theory because it attributes productivity
to "inner compulsion" which persists even in the absence of external
rewards (Cole and Cole, 1973). A second variant of this perspective focuses not so much on motivation and attitude but on stamina or the capacity to work hard, tolerate frustration, and persist in the pursuit of long-range goals (Merton, 1973; Zuckerman, 1970). A third variety of the psychological perspective is represented by clinical investigations of the emotional styles (Roe, 1964) and the biographical backgrounds such as childhood experiences, sources of satisfaction and dissatisfaction, attitudes, values and interests (Taylor and Ellison, 1967) and the cognitive structure of productive scientists (Wilkes, 1980).

The fundamental problem of the psychological perspective is that personality traits and attributes do not exist in a vacuum. They are strongly affected by the social and organizational context in which they exist (Andrews, 1976).

Among investigations of individual characteristics and productivity are studies of demographic characteristics. Among the demographic characteristics, age has received the widest attention. While summarizing several studies on age and publication productivity, Fox (1985) concluded that the association between age and productivity is neither linear nor monotonic. The first productivity peak reached about the tenth year of career age followed by a second peak near retirement age. However, most of these studies have been criticized because they fail to control for factors such as early experience, institutional location, primary work activity, and availability of resources.

The most recent studies of individual characteristics have
focused on gender. These studies converge on one point: as a group, academic women publish less than men. Although data vary somewhat, they indicate that, within a given period, women publish about half as many articles as men (Fox, 1985:263).

The second major category of productivity studies focuses on the structural context often overlooked in investigations of individual characteristics. These studies emphasize the importance of early academic environment (i.e., graduate school background) and characteristics of subsequent environment, particularly the calibre of graduate school training (Chubin et al., 1981), the prestige of scientists' institutional affiliation (Long and McGinnis, 1981), and the level of freedom (Vollmer, 1970). Although these studies suggest the general importance of organizational climate, they tell us little about particular processes of environment as they affect publications in academic settings.

While the psychological theories assume a simple additive relationship between publications and individual characteristics, the environmental perspective begins to suggest feedback processes -- whereby initial appointment affects productivity and, in turn, subsequent employment and productivity patterns. These reciprocal processes of environment, resources, and rewards are the very focus of the cumulative advantage perspective.

From this perspective, scholars who experience early success are able to command increased time, facilities and support for continued research. Once these rewards are obtained, they have an independent effect upon the acquisition of further resources and rewards. Thus,
the accumulation of advantage involves getting ahead initially and moving further and further out front (Zuckerman, 1977:61).

A major gap in all these investigations, however, lies in their failure to explain the joint effects of psychological, demographic and environmental factors on the publication productivity in the academic setting. Secondly, although claiming their independence from epistemological domination and the validity of sociological analyses of intellectual changes, these studies effectively reproduced the privileged position of the science by accepting Kuhn’s unitary model of knowledge development and its self-sufficient nature. It is difficult to see how a genuine sociology of scientific knowledge can be produced without considering how intellectual production and assessment can change in different ways in different circumstances. Science as a form of work occurring in employing organizations has been almost entirely ignored in sociological studies of science except for some discussions of the "industrialization" of research (Ravetz, 1971:44-57), incorporation of science (Rose and Rose, 1979), and scientists in organizations (Pelz and Andrews, 1976). The possibility of differences in knowledge structures being connected to the structure of work in the science is rarely countenanced (Whitley, 1977:21). A major consequence of this conception of the sociology of science has been the lack of attention paid to how the research situation is structured and how it affects the process of knowledge production.

In emphasizing the organization perspective in studying science, Whitley argues that scientific knowledge and its production both in
terms of quality and quantity vary and these variations are linked to differences in the way scientific work is organized. Intellectual structures are social products and differences in their organization reflect and affect systems of knowledge production (1977:21). Bitz et al. (1975) also emphasized studying the science through work organizations by arguing that the day to day exigencies of research direct the researchers' actions and views far more than any research program and paradigm. By providing this alternative approach to study the social and cognitive structure in relation to work organization, Whitley (1977:23) argues that the conditions under which scientists act and produce knowledge become relevant to the real sociology of science instead of being relegated to the sociology of organizations or even non-sociologists. The organizations of work in the sciences produce existing social and cognitive relations but like other production systems not strictly homomorphically.

If we agree that scientific research is a type of craftwork which involves problem solving and diffusing the solutions, then it seems reasonable to analyze the social organization which structures and controls this activity as a system of work organization which can be understood in a similar way to other forms of work organization (Whitley, 1984:10). The organization and control of work in the sciences reflect general aspects of work structure and control in that issues of task formulation, differentiation, allocation, coordination and evaluation are involved. Additionally, of course, hierarchy of job authority and power distribution are important features of work organizations in most industrialized societies and are no less
observable in the science (Whitley, 1984:14).

However, a high degree of uncertainty in scientific work clearly differentiates it from other production systems. Differentiating research organizations from other bureaucratic systems, Whitley (1984:14-15) argued that control over work processes in science is on the whole exerted by practitioners at the research site and is not governed by elaborate systems of rules and regulations established by an administrative hierarchy. Secondly, authority is shared between scientists and administrators. Thirdly, the nature of the product is difficult to specify clearly in advance and is subject to negotiation when it has emerged. In the science organization public communication in the form of publications highlights the innovatory nature of research. In effect, the constant changes in work procedures and purposes are managed by a very high degree of decentralization of control over work processes to the individual scientist, which makes the organization very flexible and responsive to variations in the environment, coupled with a formal reporting system which enables task outcomes to be compared and coordinated (Whitley, 1984:19). Etzioni (1975:52) argued that the highest degree of professionalism, high intrinsic satisfaction from work, positive involvement and control through normative power constitutes the predominant characteristics of research organizations.

As the science transformed in organized work settings, researchers started looking for some of the behavior patterns of scientists as observed in other types of work settings. Recently, organizational alienation among scientist has received some attention.
Hajda (1982) argued that there should be a low degree of alienation among scientists because scientists are well aware that they enjoy considerable prestige and trust from the clients and organizational managers. Most of the research indicates that the more professionalized the occupation, the less alienated are those in it (Montagna, 1977:231). Aiken and Hage (1966) pointed out that potential for alienation is less in organizations which have professional staff. Because, by virtue of their advanced training, the professionals enjoy norms of autonomy and expectations of involvement in shaping the goals of the organization. However, Gross and Etzioni (1985:92) argued that when people bring into the organization high expectations of autonomy and discretion as highly educated and specialized scientists usually do, the degree of work alienation may be especially high.

Putting the organization of science in a different perspective, Rose and Rose (1979:32) argued that the changed mode of production of scientific knowledge has resulted in a shift in the internal organization and social relations of science. Gradually, scientific community became scientific factory, and scientific workers became indifferent to the norms of science and instead are preoccupied by conditions of work, pay, security and prospectus. The present hierarchically organized scientific institution, which is characterized by increasingly intense division of labor, makes rank and file of scientific workers expert in only fragmented partial skills bound to a purpose only fully understood by the project director and those who set the goals. Scientific workers are not free
to take the decisions as assumed, only a small group of inner elites takes all major decisions on science. As the general intelligence of science grows, the individual scientific worker is deskillled both in terms of his intelligence and his manual skills. They further argued that for the rank and file of scientific workers, alienation is the norm, but with the double burden imposed by an ideology which insists that within the pocket of every scientists' coat lies the gold medal of the Nobel laureate.

Based on this theoretical orientation, the following model of the study is suggested. The assumed relationships are shown by arrows. Criteria for problem selection, publication productivity and organizational alienation are predictive variables. The rest of the variables are explanatory variables. The unit of analysis is individual.
Figure 1. Model of the study
SECTION I: PROBLEM CHOICE IN AGRICULTURAL SCIENCES: SOME CORRELATES IN INTERNATIONAL WORK SETTINGS

Introduction

Scientists rarely make a career decision more consequential than the selection of a research problem. Identifying a legitimate problem and selecting it for research provides greater satisfaction, derive prestige and enhances access to resources for further research (Gieryn, 1978). Selection of a research problem not only has consequences for the career of scientists, but also the development of a discipline and science (Busch and Lacy, 1983:41).

Problem choice then, is an important topic through which scientists display the significance and feasibility of a problem area that needs to be addressed, thus explaining the rationality of social action in science. Despite the importance of problem choice for understanding science and its practitioners, very little systematic work has been conducted to explore this process. The handful of systematic analyses have largely focused on emergence of scientific specialties (Edge and Mulkey, 1976), and how problems are retained or changed in science (Gieryn, 1978). However, the sociology of science has failed to pay systematic attention to study the patterns in problem choice (Busch and Lacy, 1983:41).

A consistent neglect has occurred in spite of the deep roots of the topic of problem selection in sociology of science. Some fifty years ago, in his study of science in seventeenth century England, Merton ([1936] 1970) took as one of his principal problems, the
identification of cognitive and extrascientific influences upon problem choice in science. However, only recently have sociologists begun to adopt the self-emplifying stance that problem choice must be a central issue in studies of scientific development (e.g., Zuckerman, 1974, 1978; Edge and Mulkey, 1976; Weinstein, 1976; Edge, 1977; Gieryn, 1978; Busch and Lacy, 1983).

The current investigation of the patterns of problem choice have taken various approaches. Some researchers have examined problem choice in the sciences by exploring how problems become defined as interesting or even as fundamental. Another approach has been to focus primarily on the emergence of science specialties and to treat problem choice as a collateral issue. With this approach, the background, social characteristics, and research experiences of scientists are examined to discover patterns among scientists entering certain fields or specialties (Edge and Mulkey, 1976).

The third equally important research perspective focuses on how scientists choose topics from the range of identified problems. This orientation has explored the wide range of determinants of criteria for problem selection (Busch and Lacy, 1983). However, a major debate has emerged regarding which criteria actually operate in the science. Some of these criteria are clearly scientific in character such as the extent of competition and expectation of rewards, while others are external to science such as political directives or economic and military needs. However, it is often difficult to make a clear distinction between internal and external influences on problem choice. Furthermore, two or more criteria frequently operate in the
choice of research problems, and it is difficult to judge which ones are present (Busch and Lacy, 1983:44).

The Brooks report has made a valid distinction between two kinds of choices: tactical choices, which deal with scientific problems and projects within a given field and are basically dependent upon internal scientific criteria; and strategic choices, which concern areas of great priority and must be guided by objectives, external to the scientific community (quoted in Salomon, 1977:65).

A close look at the literature on criteria of problem choice, however, reveals that there are three broad types of criteria that influence the problem selection process. The first of these criteria are internal to science, such as scientific curiosity, and theoretical preemption. It is argued that scientists select problems primarily to understand the phenomena which fascinates them. The attraction for a particular natural phenomena is developed as a result of unresolved issues brought up by previous research or accidental findings. Busch and Lacy (1983:46) found that scientific curiosity is one of the most important criteria of problem selection.

Gieryn (1978) observed that theory and its associated concepts can preempt research attention by defining certain observations as irrelevant, unfeasible or incorrect and therefore not worth following up, because they are inconsistent with prevailing theoretical view. Zuckerman (1978) extended the same line of reasoning by arguing that scientists define some problems as pertinent and others as uninteresting or even illegitimate primarily on the basis of theoretical commitments and other assumption structures. The basic
argument of this perspective is that science is for the sake of science and scientists are basically motivated to pursue scientific knowledge without considering their career or their reputation, and they are guided by theoretical commitments which are reflected in their choice of research problems. Judgements about appropriate research topics are determined by intellectual processes which are internal to science. Science, they argue, consists of a series of disinterested attempts to solve interesting problems set by the physical world, social recognition is merely a by-product of formulating a correct solution. The emphasis on the cognitive aspect and scientific paradigm is compatible with Kuhnian (1970) tradition.

The second type of criteria finds its roots in social exchange process. Researchers argue that not pure intellectual interest but perceived reward in the form of professional recognition is the driving force behind selection of a research problem. Mulkey suggested that scientists use up fairly quickly the problems which offer most social rewards. Then, because they desire recognition, they begin to consider more risky investigation (quoted in Whitley, 1972:72). This emphasis on social rewards and social exchange is compatible with the Mertonian tradition. Whatever a particular scientist's motives are for engaging in research, it appears that they can only be satisfied to the extend to which he/she establishes a good professional reputation. And the recognition necessary for such a reputation depends on his/her meeting the social and intellectual requirements of the research community and especially on his/her producing information regarded as valuable and publishing it in
professional outlets (Mulkey, 1977:104). The social system of science provides institutionalized motive and reward for achieving priority in solving significant problems at the moving frontier of the field (Merton, 1973, chap. 14). The reward system motivates a large number of scientists to migrate to substantively important emerging areas often referred to as "hot topics" (Busch and Lacy, 1983:43). Sullivan et al. (1977) found that physicists try to maximize the chances of both achieving priority and solving significant problems. This emphasis on priority may increase the motivation of scientists to choose a research problem that has a high probability of publication in professional journals.

Besides probability of publication, the very choice of a research problem as interesting involves a judgement of recognition likely to accrue to a successful solution (Mulkey, 1972:8). The basic argument of this perspective is that scientists are not motivated by pure intellectual interest in selecting a research problem. Rather, the criteria that most influence the selection of a research problem are perceived rewards that scientists will receive in the form of recognition and monetary gain.

The third group of criteria emerge from the important extra-scientific influences on problem choice, particularly the work organization, where scientific activities are carried out in an organized form. Bitz and his associates observed that the day to day exigencies of research direct the actions and views of scientists far more than any "research program" or community paradigm (quoted in Whitley, 1977:24). Weinstein (1976) argued that the intrinsic
scientific or paradigm-related criteria constitute only one of four important groups of criteria for problem choice. The other three determinants are: administrative directive, political commitment, and personal avocation.

Busch and Lacy (1983:41) argued that the broad organizational structure of science provides the context in which key decisions and choices are negotiated. Therefore, organizations exert great influence on problem selection. Some argued that the key criteria for problem choice may simply be the research agendas published by those institutions providing the funding. For example, C. Wright Mills stated that since many studies in the social sciences are quite expensive; they have to be shaped by some concern for the problems of the interest that have paid for them (1959:64). Similarly Fujimoto and Kopper (1975) and Evenson and Kislev (1975) proposed that the most important external influence upon agricultural scientists’ research choices are various commodity groups that financially and politically support selected aspects of agricultural research.

It is clear from the above discussion that there are fundamental disagreements on what type of criteria most influence the problem choice. However, all researchers seem to agree that various scientists use various criteria while selecting problems for their research. Then the real issue for sociological concern is that if scientists vary on the criteria used for problem choice, what may be the factors that affect this variation? Unfortunately, this issue has not received enough attention. Only recently, in their very extensive study of problem choice Busch and Lacy (1983) found that younger
scientists are more likely to base their choices on publication productivity and "hot topics." Their study further reveals that scientists with urban backgrounds are more likely to identify criteria that represent a commitment to scientific ideals than the scientists coming from rural backgrounds. Scientists who more frequently communicate with other scientists are more likely to employ scientifically oriented criteria than those who communicate more with clients and administrators. They further found that research goals also influence the criteria scientists employ in choosing research problems. Besides research goals, the image of who benefits from their research may also affect the relative weight given to various criteria for problem choice. They also found that scientists devoted to basic research are more likely to consider criteria that represent a commitment to specific ideals.

However, certain reservations must be made about these studies. First, although no study explicitly claimed that any one type of criteria influence the whole process of problem selection, none of them reported the comparative influence of all three factors. Thus, there is no evidence that specifies which type of problem-selection criteria are more important for which type of scientists. Secondly, most of these studies have focused only on U.S. or West European scientists. Thirdly, as pointed out by Mulkey (1977:103), there is a tendency among investigators to concentrate on the discipline of physics. Thus, we do not know whether the same patterns of problem selection are found in other sciences. Nor can we be entirely sure that other national scientific communities have scientific and extra-
scientific influences similar to their counterparts in the U.S. and Western Europe.

In this study, an attempt is made to supplement the existing knowledge by examining the comparative influence of various criteria of problem choice and to study key correlates of criteria of problem choice in agricultural sciences with special reference to international work settings. Based on the earlier discussion and findings of Busch and Lacy (1983), it is hypothesized that criteria of problem choice are influenced by the age of scientists, their background (rural/urban), national origin, research communication, research orientation, research goals and perceived research beneficiaries.

Method

Participants

The basic data for this study have been collected from senior and middle-level scientists working in two major international agricultural research centers (IARCs). Although both centers work under the same international parent body, they are independent of each other. Scientists from all major agricultural disciplines participated in this study. Data were gathered by personal interviews and self-administered questionnaires. Of the 145 potential respondents, 108 scientists participated in this study. The data were gathered during the summer of 1984.
Measures

Problem choice For this study, problem choice is defined as the decision by an individual agricultural scientist to carry out a program of research on a related set of problems or simply in a problem areas (Gieryn, 1978). A problem refers to the accepted knowledge and recognized questions associated with a substantive object of study area within an instrumental means of inquiry. A problem set is the set of problem areas in which an individual scientist does research at a designated time. A problem area is made up of a number of related, though discrete, problems, and a number of related areas are said to make up a specialty.

Examining the criteria used by agricultural scientists is a very complex process. Busch and Lacy (1983:45) have developed a relatively comprehensive list of 21 criteria of research problem choice thought to be relevant for agricultural sciences in the U.S. Because the factor analysis failed to identify any meaningful dimensions, we have selected six criteria which fall into three distinct categories. The first category of criteria reflects the internal scientific orientation. It includes two items: 1) potential contribution to scientific theory, and 2) scientific curiosity. The second set of criteria deal with reward expectations. It includes two items: 1) publication probability in professional journals, and 2) colleagues' approval. The third set of criteria has to do with the commitment to work in an organization, and it has two items: 1) priorities of the research organization and 2) demands raised by clientele. Scientists were asked, "During the last five years, how important were the
following considerations in your choice of research problem?" For each item, they selected a number from 1 to 7, e.g., 1 (not important) to 7 (very important).

**Age** Age is the scientist's age measured in years. Respondents who were below 30 are scored (1), 31 to 40 are scored (2), 41 to 50 are scored (3), and 51 and above are scored (4).

**Background** By background, we mean the size of community where the scientists were living at age 16. It is implied that scientists coming from small communities are having rural backgrounds, and scientists coming from large communities and cities are having urban backgrounds.

**National origin** National origin is a dichotomous variable. Scientists from the country where the centers are situated (natives) are scored 1 and scientists who are foreigners (non-natives) are scored 2.

**Research orientation** By research orientation we mean the type of research, i.e., basic or applied, that scientists complete. The mandate for the IARCs require that every scientist should invest most of his/her time in the applied research (Chandler, 1982:102). Still, scientists often divide their research time between applied and basic research. We utilized the definition of basic research developed by Busch and Lacy (1983:66) as "which stresses that it is directed toward an increase of knowledge in science with ... the primary aim of the investigator ... a fuller knowledge or understanding of the subject under study, rather than a practical application thereof." In terms of this definition, the scientists were asked how they would
characterize their research during the last five years by indicating the percent of time they have spent in basic research. It is implied that scientists spending less time in basic research spend more time in applied research.

Research communication  For this study, research communication is defined as the frequency of interaction with system participants regarding the research. Scientists were asked to report their frequency of communication regarding research with: 1) scientists in department, 2) agricultural scientists outside department, 3) non-agricultural scientists, 4) administrators, 5) clients, 6) funding agencies, and 7) extension staff. Responses were scored on a 1 to 5 range: Rarely (1), Monthly (2), Bi-weekly (3), Weekly (4), and Daily (5). The scores were added to form a measure of research communication. A higher score indicates a higher degree of research communication.

Research goals  Scientists both as individuals and as members of an organization may see their research contributing to one or more broader goals. Of the eleven goals of agricultural research proposed by Bush and Lacy (1983:189), we selected five research goals which were most relevant for the international work setting. The goals included: 1) increased agricultural productivity, 2) assist developing nations, 3) improve nutrition and protect consumer health, 4) develop new products, and 5) develop new knowledge. Respondents were asked to rate each goal in terms of its importance ranging from 1 (of no importance) to 7 (of highest importance).
Research beneficiaries  The international agricultural research centers were born out of a need to produce more food in poor countries. However, questions have been raised recently about who actually benefits most from research conducted in these centers. Evidence indicate that only large farmers, and agri-businesses receive all the benefits on the cost of small farmers (George, 1977). Moreover, the debate is still unresolved on whether the producer or consumer should be the major beneficiary of agricultural research. To assess scientists' perceptions of the beneficiaries of their research, we asked the following question: "Apart form your discipline, do you believe that your research and publishing over the past five years has already or will directly or indirectly benefit any of the following?" Scientist were provided with a list of six potential beneficiaries: 1) small farmers, 2) large farmers, 3) agri-businesses, 4) various national governments, 5) general public, and 6) other scientific disciplines. Responses were scored on a five-point scale ranging form 1 (not at all) to 5 (a great deal).

Statistical procedure

Relations between demographic, personal, organizational, intrinsic variables, and criteria of problem choice are complex and multidimensional. No causal relations - in even the loosest sense - between these groups of variables can yet be stated. Nor are we aware of any empirical research which sheds light on the causal relationship. Therefore, we report herein the correlations between selected criteria of problem choice and the set of explanatory variables, so as to display a pattern in the relationships.
Results and Discussion

The means and standard deviations of three types of criteria are presented in Table 1. The data reveal that organizational criteria are the most important criteria of problem choice for agricultural scientists in the international work setting. The mean of organizational criteria (10.66) is significantly greater than the mean of the other two criteria. However, there is no significant difference between the mean of reward criteria and scientific criteria. The findings are consistent with Cole (1979:392), who concluded that the members of research organizations do not look to the priorities of their discipline for the outline of their research program but rather to the organizational goals as articulated by the organizational leaders.

Table 1. Descriptive statistics for various criteria of problem choice.

<table>
<thead>
<tr>
<th>Type of criteria</th>
<th>Mean</th>
<th>St. dev.</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1  2  3</td>
</tr>
<tr>
<td>1. Organizational</td>
<td>10.66*</td>
<td>2.45</td>
<td></td>
</tr>
<tr>
<td>criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Reward criteria</td>
<td>8.38</td>
<td>2.59</td>
<td>-.09</td>
</tr>
<tr>
<td>3. Scientific criteria</td>
<td>8.20</td>
<td>2.66</td>
<td>-.13  .25*</td>
</tr>
</tbody>
</table>

*aColumn pair differences \( p < .01 \).

* \( p < .01 \).
Traditionally, science has been looked upon as a cognitive enterprise rather than a social activity. This focused attention on the "free floating" scientist who is relatively unattached to any work organization and free to choose his research problem. However, the transformation of science to a knowledge-producing industry resulted eventually in nearly all scientific work being done by "employees" and reputational control over labor markets. Because of the establishment of research institutions, both in the public and private sector, which are relatively well-bounded and distinct social organizations, the research topics are controlled and directed. The leaders of these organizations may be instrumental in controlling the research problem areas through allocating rewards according to the merits of intellectual contributions in the desired areas.

As the results indicate, the influence of the scientific work organization is quite strong. By organizing scientific activities, work organizations exert control over science. This control is reflected in recruitment and promotion decisions. Only those scientists specializing in the priority problem areas are appointed and promoted. Control is also exercised through the provision of technical apparatus and technicians, making available only those technical instruments which are used for solving the priority problems.

The influence of organizational priorities on problem choice in agricultural sciences may be more explicit. This is because most of the disciplines in the agricultural sciences are "unrestricted," meaning that they do not have high institutionalized boundaries, and
their internal structure is less differentiated unlike physics and chemistry (Whitley, 1977:34).

The central ideas of agricultural disciplines do not clearly define work areas and identities. Many research tasks legitimately require the crossing of disciplinary boundaries. Plant protection is an excellent example of a topic which crosses the boundaries of agronomy, entomology and plant pathology. Thus, a dominant cognitive structure that orders and constrains work is less evident in the agricultural sciences. This relative lack of a central, defining set of ideas which control research priorities and strategies reduce the influence of any scientific discipline over the influence of the work organization. Therefore, patterns of problem selection are more likely to be influenced by organizational consideration and societal problems than by a central and dominant cognitive structure.

The organizational consideration also seems to be more important than reward considerations such as publications in professional journals or colleagues' approval. The rationale for this can be traced to another characteristic of agricultural sciences. The nature of problems and fields in agricultural sciences are relatively open ended. Thus, the identification of "hot topics" and potential publications are comparatively uncertain. This makes the research directed by a dominant set of assumptions difficult. Instead, the importance of problem areas depends largely on the inclination and experience of organizational leaders, who exercise influence and control. They control both the production of knowledge and their outlet. Thus, scientists end up getting more rewards if they do what
is desired by the organizational leaders.

When we look at the correlations between the three types of criteria (Table 1), it is evident that only reward criteria and scientific criteria are positively correlated. These two criteria are negatively, but not significantly, correlated with organizational criteria. The results indicate that high intrinsic scientific motivation is associated with a higher degree of reward orientation while selecting a research problem.

Table 2. Correlations between age, background, research orientation, research communication and criteria of problem choice.

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
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<tr>
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<tr>
<td>2. Background</td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Research</td>
<td></td>
<td>.05</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>orientation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Research</td>
<td></td>
<td>.34</td>
<td>-.02</td>
<td>.19</td>
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<tr>
<td>communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Scientific</td>
<td></td>
<td>-.08</td>
<td>-.01</td>
<td>.25</td>
</tr>
<tr>
<td>criteria</td>
<td></td>
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<td></td>
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<tr>
<td>6. Reward</td>
<td></td>
<td>-.01</td>
<td>.13</td>
<td>.08</td>
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<tr>
<td>criteria</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Organizational</td>
<td></td>
<td>-.09</td>
<td>-.11</td>
<td>-.24</td>
</tr>
<tr>
<td>criteria</td>
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*p < .05.  
**p < .01.  
***p < .001.

The correlations between the social demographic variables and work characteristics, and criteria of problem choice are presented in
Table 2. The correlations reveal that age of the scientist does not significantly correlate with any of the criteria. The consistent negative relationship indicate that younger scientists may be giving more importance to the three criteria than older scientists, which may reflect their struggle to advance their career. Busch and Lacy (1983:53) made the same observation when they found that younger scientists are more likely to base their choices on problems which will yield more publication and other scientific rewards.

The correlations between the rural/urban background of scientists and criteria of problem selection are also not significant. The positive correlation between background and reward criteria \( (r = .13) \) indicates that scientists with an urban background are more likely to consider rewards in the form of publications and approval by colleagues while choosing a research problem. The negative relationship between background and organizational criteria \( (r = .11) \) reveals that agricultural scientists raised in rural areas are more likely to select problems which reflect organizational priorities.

The rural socialization definitely reflects a farming background. Then it is possible that those with a farming background integrate their research with their earlier farm experiences, which in turn, coincide with the organizational priorities. Secondly, scientists with a rural background may be more aware of the needs of the farm sector and therefore more likely to consider the importance of their research to the clients. Then the questions is, will these considerations of clientele decline in their importance if fewer agricultural scientists are drawn from a rural background?
When we look at work characteristics of the scientists, it can be observed from Table 2 that their research orientations have a positive and significant relationship with scientific criteria ($r = .25$), and a negative correlation with organizational criteria ($r = -.24$). The pattern of relationship indicate that scientists who spend more time in basic research are more likely to consider criteria that represent commitment to scientific ideals including scientific curiosity and potential contribution to scientific theory. On the other hand, scientists who spend less time in basic research and more time in applied research are more likely to choose the problems that reflect commitment to the organization. The results are consistent with those of Busch and Lacy (1983:70).

The scientists' orientation to basic or applied research can affect the way in which they establish research agendas and choose problems. In our study, it is apparent that more time scientists spend in basic research, more they look to problems that are fundamental in nature. As the time spent in applied research increases, scientists view client needs, the relevance of their work for society and the accountability to sponsors as more important. Because of this the applied research institutions, through the complex process of differential selection, ensure that those highly committed to basic research are not likely to enter the organization.

The data presented in Table 2 also indicate that research communication is negatively related to scientific criteria and reward criteria; however, the relationships are not significant. The relationship between research communication and organizational
Table 4. Correlations between perceived research goals and criteria of problem choice

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</thead>
<tbody>
<tr>
<td>1. Other scientific disciplines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Small farmers</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Large farmers</td>
<td>.08</td>
<td>.28**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Agri-business</td>
<td>-.10</td>
<td>.23**</td>
<td>.52***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. National governments</td>
<td>.12</td>
<td>.12</td>
<td>.26***</td>
<td>.38***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. General public</td>
<td>.02</td>
<td>.29***</td>
<td>.25**</td>
<td>.28**</td>
<td>.35***</td>
<td></td>
</tr>
<tr>
<td>7. Scientific criteria</td>
<td>.06</td>
<td>.02</td>
<td>.02</td>
<td>-.13</td>
<td>.09</td>
<td>.06</td>
</tr>
<tr>
<td>8. Reward criteria</td>
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<td>.04</td>
<td>.01</td>
<td>.04</td>
<td>.06</td>
<td>.07</td>
</tr>
<tr>
<td>9. Organizational criteria</td>
<td>.13</td>
<td>.01</td>
<td>.12</td>
<td>.24**</td>
<td>.31***</td>
<td>.20*</td>
</tr>
</tbody>
</table>

* < .05.
** < .01.
*** < .001.
Table 3. Correlations between perceived research goals and criteria of problem choice

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
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<th>3</th>
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<th>6</th>
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</thead>
<tbody>
<tr>
<td>1. Increase agricultural</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>productivity</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>2. Assist developing nations</td>
<td>.24**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Improve nutrition</td>
<td>.01</td>
<td>.23**</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>4. Develop new products</td>
<td>.15*</td>
<td>.19*</td>
<td>.26**</td>
<td></td>
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<tr>
<td>5. Expand export markets</td>
<td>.01</td>
<td>.17*</td>
<td>.33</td>
<td>.32***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Develop new knowledge</td>
<td>.08</td>
<td>.20*</td>
<td>.17*</td>
<td>.07</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>7. Scientific criteria</td>
<td>-.18*</td>
<td>.18*</td>
<td>.17*</td>
<td>.07</td>
<td>-.02</td>
<td>.05</td>
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<tr>
<td>8. Reward criteria</td>
<td>-.28*</td>
<td>.14*</td>
<td>.18*</td>
<td>.18*</td>
<td>.10</td>
<td>.13</td>
</tr>
<tr>
<td>9. Organizational criteria</td>
<td>.26*</td>
<td>.08</td>
<td>.17*</td>
<td>.18*</td>
<td>.39***</td>
<td>.21***</td>
</tr>
</tbody>
</table>

*p < .05.  
**p < .01.  
***p < .001.
criteria is positive and significant ($r = .17$). The scientists who communicate more with the other members of the organization are more likely to consider criteria that represent a commitment to the organization rather than to scientific ideas or perceived rewards. While the formal communication system is highly visible and central to the science, the informal communication is more difficult to observe. However, informal communication in its various forms involves a significant fraction of the scientists' working life. It may be that the more the scientists informally communicate with other scientists, organizational leaders, funding agencies, extension personal and clients, the more they become concerned with client needs as well as the organizational priorities. Moreover, as pointed out earlier, the agricultural sciences are characterized by a lack of dominant cognitive structure. This relative lack of dominant ideas mitigate the influence of any paradigm over the organizational concerns which are shaped by the informal communication with other participants in the organization.

While the objective to be accomplished by any specific agricultural research project is generally quite narrow, scientists both as individuals and as members of the organization are likely to see their research as contributing to one or more broader goals. The data reported in Table 3 reveal that the research goals also influence the type of problems selected for research. The correlations indicate that an "increase in agricultural productivity" as a research goal is negatively related with scientific criteria ($r = -.18$), as well as with reward criteria ($r = -.28$). On the other hand, it is positively
correlated with organizational criteria ($r = .25$). Obviously, increasing agricultural productivity is the first priority of the research organization, and scientists who perceive this as the most important goal of their research are more likely to select problems that reflect the organizational concern. The negative relationship with scientific and reward criteria reveals that scientists motivated by the goal of increasing agricultural productivity are not as concerned with scientific theory or the professional rewards they may expect.

Surprisingly, the sign of correlations changes when scientists were asked about "assisting the developing nations" as their research goal. The positive correlation with scientific and reward criteria, and nonsignificant correlation with organizational criteria reveals that scientists do not necessarily agree that IARCs are assisting developing nations specifically. Rather the knowledge and technology that are developed can be used by any country on the globe, not just the developing nations. Although the technology produced by IARCs can be used for increasing food production, the tremendously varied germplasm collected and stored by these centers are being used by many developed nations in their breeding programs, too. The results clearly point to the scientists' preferences for assisting any country that participate in the network of international agricultural research and not exclusively the developing nations.

The point becomes more evident when the goal of "improving nutrition and protecting consumer health" is correlated with criteria of problem choice. The positive and significant correlations with all
three types of criteria indicate that scientists' goal of improving the nutritional status of the global community and producing non-toxic, non-polluting agricultural technology correlates equally with whatever criteria they consider in problem choice.

As expected, "developing new products" and "expanding export markets" as research goals are significantly and positively correlated with organizational criteria. Developing new products and expanding export markets are the important goals of IARCs, and scientists who perceive these as their own research goals are also likely to select problems that reflect these organizational directives. The positive correlation between developing new products and reward criteria reflects the fact that they are more likely to be motivated by professional as well as monetary rewards which generally accompany such new products or methods.

Surprisingly, there is a non-significant relationship between "developing new knowledge" as a research goal and scientific criteria of problem choice. On the other hand it is significantly and positively correlated to organizational criteria ($r = .21$). It may be that scientists at IARCs perceive developing new knowledge as the priority of the organization which ultimately will be transformed into increased agricultural productivity rather than ending up in some theoretical journal.

In short, the pursuit of every goal brings with it motivation for conducting research in a particular area or topic; for it would answer the question "Research for what?" However, the question "Research for whom?" still remains unanswered. Because of the pursuit of any given
goal, certain groups and individuals are more likely than others to derive benefits. Whereas other groups and individuals are likely to incur costs (Busch and Lacy, 1983:204). The perceived beneficiaries of research then emerge as the important explanatory variable for studying the patterns of problem selection.

The correlations between perceived beneficiaries and criteria of problem choice (Table 4) reveal that none of the perceived beneficiaries are significantly correlated with scientific criteria, not even the other scientific disciplines. This means that those scientists who give more importance to scientific criteria while selecting a research problem do not necessarily perceive any of the listed groups as benefiting from their research, not even other scientific disciplines. It may be that scientists are mainly concerned with their own discipline, and when they think of scientific criteria in choosing the problem they may perceive their own disciplines as the sole beneficiaries of their research. On the other hand, organizational criteria have a stronger association with agri-business, various national governments and the general public as perceived beneficiaries.

The results indicate that scientists who perceive the agri-business, different national governments and the general public in various countries as the beneficiaries of their research are more likely to select problems based on organizational priorities. Since agri-business and national governments are the traditional clientele of international agricultural research, they not only legitimize the international centers, but also provide funds for maintenance of an
international network of agricultural research.

It is also interesting to note the positive correlation between "general public" as research beneficiaries and organizational criteria (r = .20). The general public as a consumer is consistently and positively correlated with organizational criteria. This reflects the concern of agricultural scientists for the general public as consumers of products which are produced by the technology developed in IARCs. The question then arises "Who needs to be benefited most?" Is it the farmer who wants more gains for his labor, or the consumer who wants better food at a reasonable price? The question is very complex and there are no easy solutions. It is also not very clear to what extent agricultural scientists can address this issue, which is basically a political one.

Conclusion

The results presented here point out that the criteria used by agricultural scientists in selecting a research problem is still a largely unexplained phenomenon. However, even in the absence of any recognized causal model, some patterns do emerge. It can be observed that purely scientific criteria of problem choice are most associated with the basic research orientation of scientists. Scientific criteria are also positively correlated with research goals of scientists, such as increased agricultural productivity, assisting developing nations, and protecting consumer health and improving nutrition.

The reward criteria are most associated with research goals such as increasing agricultural productivity, developing new products, and
expanding export markets. The organizational criteria seem to associate with research orientation, research communication, certain research goals such as increasing agricultural productivity, improving nutrition, developing new knowledge, new products and expanding export markets. It is also associated with perceived beneficiaries of research such as agri-business, various national governments, and the general public all over the world. The patterns of relationship reveal that problem selection is a very complex process, which may be influenced by a variety of criteria, some of which are clearly scientific in character while others are external to science. Furthermore, two or more criteria frequently operate in the choice of research problems. The most striking general impression one gets from results is that scientists' actual behavior corresponds only imperfectly with epistemological prescriptions of how they should behave. This may be particularly true for agricultural sciences which lack a dominant cognitive structure. The results reveal that patterns of problem choice are most likely to be influenced by organizational consideration and societal problems than by reward consideration in a social exchange process or by a desire to extend certified knowledge.
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SECTION II:

WORK ALIENATION AND AGRICULTURAL SCIENTISTS:
A STUDY OF INTERNATIONAL WORK SETTINGS

Introduction

From a broader Marxian theory no concept has captured social psychological thinking as much as alienation, which is the negative aspect of the internalization of conventional goals in that it suggests an active rejection of them (Katz and Kahn, 1978:380). Social scientists have become enamored and perhaps inebriated with the idea of alienation in modern society (Aiken and Hage, 1966). Historically as seen in the writings of Marx, alienation is construed as a state in which the job is external to the individual, not a part of his or her nature, a state resulting from the lack of autonomy at work (Organ and Greene, 1981). Dubin (1956) appeared to carry forward this notion of a job-alienated person as one who does not regard the job as a part of the intrinsic nature of one's self, but who works only for extrinsic reason. Alienation in the work place has received considerable attention among the organization researchers in the '60s and '70s and the study of work alienation has moved from value laden and impressionistic accounts to the systematic study of the nature, causes and correlates of alienation (Blauner, 1964; Seeman, 1972; Aiken and Hage, 1966; Pearl, 1962; Fullan, 1970; Tudor, 1972; Nightingale and Toulouse, 1978; Dewar and Werbel, 1979).

However, questions have been raised with regard to differentiating alienation from other work states. To Shepard (1972),
organizational alienation is merely an extension of job satisfaction. Payne and Pugh (1976:1141) argued that morale, job satisfaction, and work alienation have had almost three separate literatures, although operational measures of each have had much in common. Blauner (1964) seems to distinguish between work alienation and job satisfaction by equating the latter with a more immediate reaction to the work situation and the former as an orienting motivational response concerned with the degree of one's "involvement" in the job. Etzioni (1975:9) refers to positive involvement as commitment and to negative involvement as alienation. Montagna (1977:231) also agrees that work commitment and work alienation are opposite sides of the same coin of involvement.

Despite conceptual and operational difficulties some progress has been made in identifying key correlates and determinants of organizational alienation. However, empirical studies of organizational alienation have typically left a good deal of variance to be explained (Nightingale and Toulouse, 1978). Several studies have considered demographic characteristics of employees and found positive relationships with organizational alienation. Dean (1961) observed that high alienation is experienced by employees with higher age, low education, low salary, and lower occupational prestige. Nightingale and Toulouse (1978) found the same pattern of relationship. They also found that older French-Canadians tend to be more alienated from work than older English-Canadian employees. Besides age, education, income, and occupational prestige other important personal characteristics that are related to organizational
alienation are race, marital status, length of time in organization, and urban-rural background (Mottaz, 1981).

Among the organizational variables, organizational structure as a potential source of organizational alienation has received very wide attention. Aiken and Hage (1966) found a positive relationship between centralization, formalization and alienation from organization. Subsequent research has supported their findings (Kirsch and Lengermann, 1971; Cotgrove, 1972; Bonjean and Grimes, 1970; Nightingale and Toulouse, 1978). However, other studies provided conflicting evidence. Organ and Greene (1981) concluded that formalization lowers alienation among professionals in organization. Perrow (1979) cited evidence that managers appreciate well-structured roles, apparently because of clear expectations and predictability of behavior they provide. Kohn (1971) found that employees who worked in more bureaucratic firms tended to be open minded, intellectually flexible, and spent their leisure time in intellectually demanding activities. Zeitz (1984) concluded that more formalization in fact enhances job satisfaction among employees.

Besides organizational structure, few attempts have been made to establish the relationship between organizational climate, leadership and alienation. In their extensive review of studies on organizational climate, Payne and Pugh (1976:1161) reported several studies that have established moderate relations between organizational climate and satisfaction with work, superiors and colleagues. Schnieder and Hall (1972) also reported moderate to high correlations between organizational climate and satisfaction with
work, supervision and people.

Some research has been directed towards leadership and alienation. Hall (1982:183) reported that leadership behavior at higher levels affects both behavior and attitudes at lower levels in the organization. In their excellent review of the research in the leadership area, Filley and House (1969:462) observed that supportive leadership as opposed to autocratic leadership is quite consistently related to several indicators of subordinate satisfaction. Jermier and Berks (1979) found that satisfaction and commitment to the organization were related to more supportive leadership.

Surprisingly very few studies have examined the simultaneous impact of organizational structure, organizational climate, leadership and personal characteristics on work alienation. Consequently, very little is known of the joint effects of various organizational characteristics as well as personality traits, and their relative importance for explaining work alienation.

Our concern in this paper is to examine the concept of work alienation in highly professional organizations: the international agricultural research centers (IARCs). The research organizations are basically different from any other type of work organizations. This difference is sometimes put in terms of scientists' disliking for administrators (Kaplan, 1959). Highest degree of professionalism, high intrinsic satisfaction from work, positive involvement and control through normative power constitute the predominant characteristics of research organizations (Etzioni, 1975:52).

Past research suggests that there should be a low degree of
alienation among scientists because scientists are well aware that they enjoy considerable prestige and trust from the clients and organizational managers (Hajda, 1982). Nearly all research indicates that more professionalized the occupation, the less alienated are those in it (Montagna, 1977:231). Aiken and Hage (1966) argued that potential for alienation is less in organizations which have professional staff. Because, by virtue of their advanced training, the professionals enjoy norms of autonomy and expectations of involvement in shaping the goals of the organization. However, Gross and Etzioni (1985:92) point out that when people bring into the organization high expectations of autonomy and discretion, as highly educated and specialized scientists usually do, the degree of work alienation may be especially high.

Putting the organization of science in a different perspective Rose and Rose (1979:32) argued that the changed mode of production of scientific knowledge has resulted in a shift in the internal organization and social relations of science. Gradually, scientific community becomes scientific factory and scientific workers became indifference to the norms of science and instead are preoccupied by conditions of work, pay, security, and prospectus. The present hierarchically organized scientific institution, which is characterized by increasingly intense division of labor, makes rank and file of scientific workers expert in only fragmented partial skills bound to a purpose only fully understood by the project director and those who set the goals. Scientific workers are not free to take the decisions as assumed, only a small group of inner elites
takes all major decisions on science. As the general intelligence of science grows, the individual scientific worker is deskilled both in terms of his intelligence and his manual skills. Rose and Rose (1979:32) further argued that for the rank and file of scientific workers, alienation is the norm, but with the double burden imposed by an ideology which insist that within the pocket of every scientists coat lies the gold medal of the Nobel laureate.

In this paper, an attempt is made to examine the relationship between the national origin of scientists and age of scientist, centralization, formalization, perceived organizational climate, supervisory and peer leadership and work alienation in two different work settings of organized agricultural research in the international arena. The specific hypotheses examined are:

Hypothesis 1a: The native scientists are likely to be more alienated from work than foreign scientists.

Hypothesis 1b: The older scientists are likely to be more alienated from work than younger scientists.

Hypothesis 2: The scientists who perceive more centralization in organization are likely to be more alienated from work.

Hypothesis 3: The scientists who perceive more formalization in organization are likely to be more alienated from work.

Hypothesis 4: The scientists who perceive the organizational climate as more effective are likely to be less alienated from work.

Hypothesis 5: The scientists who perceive the organizational leadership behavior as supportive, helpful and goal-oriented are likely to be less alienated from work.
Method

Participants

The basic data for this study have been collected from senior and middle level scientists working in two major international agricultural research centers. Although both centers work under the same international parent body, they are independent of each other. Scientists from all major agricultural disciplines have participated in this study. The data were obtained by personal interviews as well as by self-administered questionnaires. Of the 145 potential respondents, 108 scientists participated in this study. The data were gathered during the summer of 1984.

Concepts and measurement

Work alienation

Following Aiken and Hage (1966), work alienation is defined here as a feeling of disappointment with career and professional development.

Measures for work alienation were adopted from Aiken and Hage (1966) with slight modification to suit the setting of international agricultural research centers. Alienation from work was computed on the basis of responses to six questions. The response pattern of the original Aiken and Hage scale was reversed. They have measured the response from 1 (not at all) to 5 (most satisfied). We have measured the alienation on 1 (most satisfied) to 5 (not at all) in order to avoid confusion. The internal reliability coefficient was .89 for the combined measures of work alienation.
Demographic characteristics  Two demographic variables were selected for this analysis. Nationality is a dichotomous variable where scientists belonging to the country where the center is situated (native) are scored 1 and scientists who are foreigners (non-natives) are scored 2.

Age is the respondent's age, measured in years. Scientists who are 40 and below are scored 1, and above 40 are scored 2.

Centralization  Centralization in this study is defined as "the locus of decision making authority within an organization" (Van de Ven et al., 1980:399). A centralized organization generally implies that most decisions are made hierarchically. Aiken and Hage (1966) pointed out two important aspects of centralization. First, organizations vary in the extent to which members are assigned tasks and then provided with the freedom to implement them without interruption from superiors. They called this the degree of hierarchy of job authority. The modified version of the Aiken and Hage scale proposed by Mulford et al. (1984) was used to measure hierarchy of job authority. This scale has five items and responses were measured on a five point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Higher score means high degree of hierarchy of job authority. The reliability coefficient for this scale was .91.

A second and equally important aspect of the distribution of power is the degree to which staff members participate in setting the goals and policies of the entire organization. Aiken and Hage (1966) called it the degree of participation in decision making. A scale proposed by Mulford et al. (1984) which was the modification of the
Aiken and Hage (1966) Scale was used to measure participation in decision making. This scale has four items and responses were recorded from 1 (never) to 5 (always). Higher score indicates high degree of perceived participation in decision making. The reliability coefficient was .80.

**Formalization**

By formalization we mean the proportion of work activities regulated by rules and procedures and the degree of specificity of rules and procedures. It is implied, the application of rules to work activities, and not just their existence in organizational manuals (Hall, 1982:95). A high degree of formalization implies not only a preponderance of rules defining jobs and specifying what is to be done, but also the enforcement of those rules. In the literature, three subconstructs of formalization can be found. First, job codification which reflects the degree to which job incumbents must consult rules in fulfilling professional responsibilities. A scale proposed by Mulford et al. (1984), which was a modified version of Aiken and Hage (1966) scale, was adopted to measure the degree of job codification. It has three items and responses were scored from 1 (disagree) to 5 (strongly agree). Higher score implies higher degree of job codification. The reliability coefficient was .77.

The second subconstruct: rule observation reflects the degree to which employees are observed for rule violations. A three item scale proposed by Mulford et al. (1984) was used to measure rule observation. The responses were scored on a five point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher score means
higher degree of rule observation. The reliability coefficient was .68.

The third subconstruct, job specificity, reflects the degree to which operating procedures on jobs are specified. A six item scale developed by Mulford et al. (1984), which is the modified version of Aiken and Hage (1966) scale, was used to measure job specificity. Each item was recorded on a 1 (strongly disagree) to 5 (strongly agree) range. Higher score implies higher degree of job specificity. The internal reliability coefficient was .66.

Organizational climate It is argued here that organizational climate exist in the perceptions by individuals of their organizational environment. In forming climate perceptions the individual acts as an information processor, using inputs from (a) the objective events in and characteristics of the organization and (b) characteristics (e.g., values, needs) of the perceiver. Global perceptions of the organization emerge as a result of numerous activities, interactions, reactions and other daily experiences the person has with the organization (Schneider and Hall, 1972). For this study we subscribe to Tagiuri and Litwin (1968:27) who defined organizational climate as a relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior and (c) can be described in terms of the values of a particular set of characteristics (or attributes) of the organization.

In the literature several factors of climate are identified. Taylor and Bowers (1974:71) proposed a 13 item organizational climate
measure, comprised of five distinct dimensions. These include technological readiness, human resource primacy, communication flow, decision making practices and motivational conditions. However, the factor analysis resulted in only two factors with eigen values 6.41 and 1.1, respectively. Factor one explained 49.3 percent of the total item variance, whereas factor two explained 8.8 percent of the variance. Based on high loading in factor one, we selected six items to create a composite of organizational climate. These include: 1) extent to which work activities are sensibly organized; 2) extent to which organization tries to improve working conditions; 3) extent to which decisions are made at those levels, where most adequate and accurate information is available; 4) extent to which those affected by decisions are asked for their ideas; 5) extent to which information is widely shared; and 6) how effectively the interunit conflicts are handled. This factor combines Taylor and Bowers' emphasis on human resource primacy and motivational conditions. The responses were scored from 1 (very little extent) to 5 (great extent). The reliability coefficient was .90 for the global measure of climate.

**Organizational leadership** The leader is any individual whose behavior stimulates patterning of the behavior in some group (Gouldner, 1950:17). The leader therefore is an influence on what the members of the group do and think (Hall, 1982:159). Katz and Kahn (1978:528) followed this line of reasoning when they note "The essence of organizational leadership is the influential increment over an above mechanical compliance with the routine directions of the organization." Thus, leadership is closely related to power, but
involves more than simply the power allocated to a position in the organization claimed by a member or members of an organization. However, we subscribe to Fleishman (1973:3), who defined leadership as interpersonal influence, directed through the communication process, toward the attainment of some goal or goals.

Defined in this manner, leadership amounts to a large aggregation of separate behavior, which may be classified in a great variety of ways. We adopted Taylor and Bowers (1974) measures of organizational leadership who postulate a four-factor theory of leadership applicable to the activities of group members, as well as to the activities of a formal designated leader. They delineate two parallel structures of leadership: (1) supervisory leadership in the four dimensions of support, goal emphasis, work facilitation, and interaction facilitation, and (2) peer leadership in the same four dimensions. However, the factor analysis of Taylor and Bowers' scale resulted in only two factors for supervisory leadership behavior, with eigen values 7.5 and 1.2, respectively. Based on higher loading on factor one, we selected six items to create a composite of supervisory leadership behavior. These include: 1) extent to which superiors are friendly and easy to approach; 2) attentive; 3) willing to listen to problems; 4) encourage people to give their best effort; 5) set an example by working hard; and 6) encourage subordinates to take action without waiting for their approval. This factor combines Taylor and Bowers' dimensions of support, goal emphasis and work facilitation. The responses were scored from 1 (very little extent) to 5 (great extent). The internal reliability coefficient was .92 for the
composite of supervisory leadership behavior.

Factor analysis of 11 items of peer leadership also resulted in only two factors, with eigen values of 6.5 and 1.0, respectively. Based on higher loading on factor one, we selected six items to create a composite of peer leadership behavior. These include: 1) extent to which people in work group maintain high standards of performance; 2) help in finding ways to do a better job; 3) offer new ideas; 4) encourage to work as a team; 5) emphasize a team goal; and 6) exchange opinions and ideas. This factor combines Taylor and Bowers' emphasis on goals, work facilitation, and interaction facilitation. The responses were scored from 1 (very little extent) to 5 (great extent). The reliability coefficient was .90 for the global measure of peer leadership behavior.

Unit of analysis

The level at which a theoretical argument is pitched makes a considerable difference both conceptually and methodologically (Zeitz, 1984). For studying alienation, organization was treated as the unit of analysis by Aiken and Hage (1966). However, subsequent literature argued that since various facets of organization and work situation are not equally valued by workers, the individual should be the unit of analysis if work alienation is to be accurately assessed (Kirsch and Lengermann, 1971; Plasek, 1974). Zeitz (1984) extended the same line of reasoning by arguing that given the organizations are somewhat loosely coupled, there should be considerable variation within organization in the way roles are organized, and thus different paths through which forces at the organizational level affects attitude.
For this study it is argued that alienation is largely a function of individual level forces, therefore the unit of analysis is the individual and not the organization.

**Statistical procedure**

Means, standard deviations, correlations and analysis of covariance are reported to indicate direction and strength of relationship between variables. Analysis of covariance is used to help identify the level of analysis at which forces operate, thus eliminating one source of interpretation error. The nationality of scientists and age were dummy coded while entering the whole model for regression. There is no explicit provision for interactions.

**Results and Discussion**

**Hypothesis 1a**

Mean and standard deviations presented in Table 1 reveal that native scientists seem to be more alienated from organization than foreign scientists. The significant difference in means supports the hypothesis. One of the possible explanations for the higher degree of alienation among native scientist may be found in perceived inequity of rewards. Some discrimination does occur in the salaries and other benefits paid to scientists employed from the country where the center is situated and scientists drawn from international resources, in spite of comparable scientific and professional merit. This perceived inequity by native scientists may lead to more alienation from organization. Mottaz (1981) also observed that pay inequity leads to work alienation. To estimate the strength of relationship between
nationality and alienation, correlation analysis was performed (Table 2). It was found that a strong and significant relationship exists between nationality and alienation from work \((r = .50)\). The regression coefficients presented in Table 4 further confirm that nationality is a very important predictor of organizational alienation \((\text{Beta} = .24)\). It is also possible that scientists who have been socialized in different cultural, political, economic and educational situations inherit distinctive traditions, values and historical experiences of society. This distinctive socialization may affect the conception and purpose of science and the scientific community's position within society. When the multicultural groups of scientists are brought together under one organization for unified objective, there bound to be different work values and attitudes which may lead to different degrees of alienation from work. Toren and Griffel (1983) also noted that the different orientations of American and Soviet scientists migrated to Israel clearly reflect the respective dominant value system of their original societies.

**Hypothesis 1b**

Data presented in Table 1 do not support the hypothesis that scientists above 40 years of age are more alienated than scientists below 40. The significant difference in means indicate that younger scientists are more alienated from work than older scientists. The correlation analysis also indicate a negative relationship between the age of scientists and alienation from organization and the relationship is moderate \((.22)\). Multivariate analysis also yielded the negative beta \((- .07)\). One of the reasons for a higher degree of
alienation among younger scientists may be that younger scientists who adopted a research paradigm during their doctoral training which emphasize a basic research, do not fit in an applied situations like international agricultural research center or perhaps well-established scientific hierarchy in the departments and institutions may force the newly employed young scientists to change their research paradigm. It is argued that change in scientific outlook or in scientific paradigm involves bitter disputes and generates strong opposition from scientific orthodoxy (Mulkey, 1977:121). This may lead to work alienation. These results are consistent with several studies which suggest that young employees place greater emphasis on intrinsic job factors than their older counterparts. Thus, young workers react more strongly to alienating job conditions, but tend to adjust to these conditions as they become older (Mottaz, 1981).

Table 1. Description of subpopulations for organizational alienation

<table>
<thead>
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<th>Subpopulation</th>
<th>Mean</th>
<th>Std. Dev.</th>
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<td>Native Scientists</td>
<td>20.8a</td>
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<tr>
<td>Foreign Scientist</td>
<td>14.6</td>
<td>4.9</td>
<td>64</td>
</tr>
<tr>
<td>40 and below 40 years of age</td>
<td>19.8a</td>
<td>6.1</td>
<td>41</td>
</tr>
<tr>
<td>Above 40 years of age</td>
<td>15.4</td>
<td>5.3</td>
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Column pair differences p < .01.
Table 2. Zero-order correlation coefficients

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<tr>
<td>2. Age</td>
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<td>3. Participation in decision making</td>
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<td>4. Hierarchy of job authority</td>
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<td>-.22*</td>
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<td>7. Job specificity</td>
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<td>-.15</td>
<td>-.04</td>
<td>.33***</td>
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<td>8. Organizational climate</td>
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<td>.29***</td>
<td>.70***</td>
<td>-.43***</td>
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<td>9. Supervisory leadership</td>
<td>-.43***</td>
<td>.16*</td>
<td>.43***</td>
<td>-.43***</td>
</tr>
<tr>
<td>10. Peer leadership</td>
<td>-.25**</td>
<td>.30***</td>
<td>.61***</td>
<td>-.36***</td>
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<tr>
<td>11. Organizational alienation</td>
<td>.50***</td>
<td>-.22**</td>
<td>-.54***</td>
<td>.53***</td>
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* P < .05.
** P < .01.
*** P < .001.
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<td>-.15</td>
<td>.22**</td>
<td>.07</td>
<td>-.66***</td>
<td>-.58***</td>
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Hypothesis 2

Table 2 reveals that of the two indices of centralization, participation in decision making has a negative correlation with alienation and the relationship is significant. The strength of correlation (.54) seems to be quite strong. In fact among all the structural variables, participation in decision making has the strongest bivariate relationship with alienation. The multivariate analysis also yield the negative relationship (Beta = .07). The consistent results indicate that agricultural scientists who perceive the lack of participation by rank and file scientists in decision on new programs, new policies or professional recruitment and promotions, seem to be more alienated from work. This can be rationalized by perceived powerlessness by the scientists. Centralization of task decisions indicate that superiors make a large proportion of decisions. This prevents rank and file scientists from exercising control over such salient issues as the choice of theory, methods, tools, techniques and even the problem set to be addressed. As scientists are deprived of this control, the level of alienation increases. The negative relationship is consistent with several previous studies (Aiken and Hage, 1966; Dewar and Werbel, 1979; Bonjean and Grimes, 1970).

The second subconstruct of centralization, hierarchy of job authority, is positively related to alienation and the relationship is significant and quite strong (.53). The scientists who perceive more hierarchy of job authority appear to be more alienated from organization. The results of analysis of covariance presented in
Table 3 not only confirms the relationship but also indicate that hierarchy of job authority has a most appreciable effect on work alienation compared to all structural variables, when effects of other variables are partialed out (Beta = .25). One of the ways to explain these results is that strict hierarchy of job authority reduces the autonomy of scientists, which is vital to the process of innovation. Scientists undertake a domain of activities that incorporates a high degree of uncertainty. The autonomy in the work situation reduces the uncertainty to a great extent and keeps the system moving. When scientists feel that their autonomy is threatened by more hierarchy of job authority, the situation may lead to increased alienation from work. Zietz (1984) also observed that well-educated employees require more autonomy and are more dissatisfied when they do not get it. These results are consistent with the studies of Dewar and Werbel (1979), Ivancevich and Donnelly (1975) and Scott (1981:151).

Hypothesis 3

Among the three indices of formalization, the degree of job codification is negatively associated with organizational alienation in bivariate analysis ($r = .15$). Table 2 also reveals that the other two indices are positively related to organizational alienation. The magnitude of association between rule observation and alienation is moderate ($r = .22$), and the correlation between job specificity and alienation is non-significant ($r = .07$). However, one of the most significant departures of the multivariate analysis from the bivariate analysis is the consistent negative beta, when all three indices of formalization are entered in the regression model to partial out the
influence of other explanatory variables.

The results conclusively suggest that even in research organizations which are characterized by the highest degree of professionalism, formalization tend to reduce work alienation among professional employees. This evidence joins other studies which indicate that bureaucratic structure is not always harmful to effective climate. Two reasons might account for this. First, formalization probably enhances role clarity, thus reducing subjective uncertainty and providing a greater sense of direction and meaning. Secondly, it may provide an understanding of managemental expectations as well as peer expectation. In the modern agricultural research where several scientists work on the same project, a higher degree of formalization can avoid the interpersonal conflict which may arise because of unclear expectations and unpredictable behavior of co-researchers. Zeitz (1984) also cited evidence that formalization in fact enhances satisfaction of employees. Other research by Kohn (1971) and Perrow (1979) came to the same conclusion.

Hypothesis 4

Data presented in Table 2 indicate that there is a strong but negative bivariate association between perceived organizational climate and work alienation ($r = .66$). In fact among all the variables in the study, climate has the strongest correlation with organizational alienation. The regression coefficient presented in Table 3 confirms the relationship and organizational climate seems to have a most appreciable effect on work alienation (Beta = .32). The negative effect implies that those scientists who perceive the
Table 3. Standardized partial regression coefficients of demographic and organizational variables on organizational alienation

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<tr>
<th>Variables</th>
<th>Beta</th>
<th>T</th>
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<tr>
<td>Nationality</td>
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<td>2.82</td>
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<td>Age</td>
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<td>Job codification</td>
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<td>-.23</td>
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<tr>
<td>Rule observation</td>
<td>-.09</td>
<td>-1.1</td>
</tr>
<tr>
<td>Job specificity</td>
<td>-.05</td>
<td>-.55</td>
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<tr>
<td>Organizational climate</td>
<td>-.33**</td>
<td>-2.67</td>
</tr>
<tr>
<td>Supervisory leadership</td>
<td>-.17*</td>
<td>-1.92</td>
</tr>
<tr>
<td>Peer leadership</td>
<td>-.03</td>
<td>-.31</td>
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</table>

Multiple R     .76***
R Square        .58

*p < .05.
**p < .01.
***p < .001.
organizational climate as more effective are likely to be less alienated from organization. Thus we find the support for our hypothesis. These results are consistent with the findings of Payne and Pugh (1976:1162), and Zeitz (1984). Friedlander (1963) also found that satisfaction from work is associated with a climate high in trust and low in hindrance.

Obviously research scientists need a work climate where scientific equipment and facilities are kept adequate, efficient and up-to-date. The scientists who do not get adequate facilities to perform research activities may develop the alienation from work. Scientists also may feel alienated if the primacy is not given to human resources in organizing work activities. Communication flow within the organization plays a very important role in forming climate perceptions in research institutions. The scientists who feel that they are not getting an adequate amount of information about what is going on in their own department and other departments may be more alienated. Effective climate also depends on the ways in which barriers caused by interpersonal or interunit conflicts and disagreements are resolved. The situation where disagreements are always avoided, denied or suppressed may lead to a high degree of alienation from work.

Hypothesis 5

Among the two indices of organizational leadership, supervisory leadership is strongly and negatively related to work alienation (Table 2). The bivariate association is significant and quite strong ($r = .58$). The negative correlation indicates that scientists who
perceive the supervisory leadership as effective and supportive are likely to be less alienated from organization. The results are consistent with several past studies (House and Mitchell, 1974; House and Dressler, 1974; Jermier and Berks, 1979).

A look at Table 3 confirms the relationship and analysis of covariance reveal that supervisory leadership contributes significantly to the explanation of alienation (Beta = -.17). Work situations in research organizations typically involve a comparatively small number of persons who receive directions from one person. However, the idea that all a research director or project leader needs to do is to hire good people and let them "do their own thing" has only minimal relevance at a time when the solutions to many significant agricultural problems require concerted research efforts. The research directors and project leaders have to be involved in defining and redefining organizational mission and role. This is obviously vital in a rapidly changing science policy and priorities particularly in agricultural sciences and must be viewed as a dynamic process. The leaders build this policy into the structure of organization and decide upon the means to achieve the ends desired. Besides, research directors have to protect the legitimacy on client level and resolve internal conflicts on employee level. The perceived lack of these abilities in research leadership behavior may lead to work alienation among scientists.

As shown in Table 2, peer leadership is strongly and negatively related to organizational alienation in bivariate analysis. The relationship is significant and quite strong ($r = .50$). Confirming
the inverse relationship, multivariate analysis also yields negative beta, thus supporting the hypothesis. The results are consistent with the findings of Nightingale and Toulouse (1978). The negative relationship implies that scientists who perceive peer leadership behavior as supportive, goal oriented and helpful are likely to be less alienated from work. Research organizations are characterized by higher degrees of peer influence on day to day work as well as research designs. Moreover, the recent emphasis on team efforts to formulate interdisciplinary problems in agricultural sciences given coworker relations is a very important dimension in studying agricultural science organizations. Interaction in team not only sets conditions affecting role creation, but also affect professional identity. Peers play key roles in research designs, choice of problems, method, key concepts and theoretical orientation. Then it is expected that colleagues in the departments and organization should be friendly and provide help, so that all of the team members can plan, organize and schedule work ahead of time. It is also expected that peers should provide new ideas, encourage people to work as a team and exchange opinions and ideas. The perceived lack of these qualities in peer leadership behavior may lead to work alienation among scientists.

Findings of analysis of variance presented in Table 3 suggest that the predictive power of this model is not only highly significant but also quite powerful in strength. The analysis indicate that 58 percent of the variance in organizational alienation among agricultural scientists is explained by this model. Among all the
variables in the model perceived, organizational climate emerge as the very strong predictor for alienation, followed by hierarchy of job authority and nationality.

Conclusion

The purpose of this study was to examine the nature and sources of work alienation in agricultural research centers. The outcome confirms a notion suggested earlier that work alienation is a very complex phenomenon. Demographic factors which are consistently neglected in previous alienation studies seem to interact with the work situation to produce different levels of work alienation. In this study, the national origin of scientist seems to make a significant difference in alienation. The native scientists appear to be more alienated than foreign scientists. Age of scientists also seems to affect the alienation. Younger agricultural scientists appear to be more alienated than older scientists indicating that younger scientists react more strongly to alienating job conditions.

The findings on the relationship between organizational structure and alienation consistently appear to be significant. Lack of participation by rank and file scientists in decision making on new projects, new policies and new priorities may enhance the alienating condition. The study also indicate that more hierarchy of job authority is positively related to work alienation. These results confirm the notion that effectiveness of science organizations depend on the environment which can provide the higher degree of autonomy to its members. The overall results on the relationship between formalization and alienation can best be described as surprising.
Agricultural scientists seem to like formalization. It is possible that formalization enhances role clarity, thus reducing subjective uncertainty and providing a greater sense of direction and meaning.

Further, organizational climate emerges as a very strong predictor of alienation. To avoid the alienating conditions, organizations need to provide latest and adequate scientific facilities to scientists along with the adequate amount of information about what is going on in other departments or other organizations having similar objectives. Agricultural scientists also seem to react strongly if the interpersonal and interunit conflicts are not resolved successfully.

The results on supervisory leadership and alienation are quite consistent. It seems organizational leadership plays an important role for alienating work conditions in agricultural research centers. Agricultural scientists expect the research directors and project leaders to be supportive, goal oriented, helpful and easy to approach. This means not only acquiring the necessary human and financial resources but also performing the more difficult task of creating an institutional environment in which these resources can become productive. The negative relationship between peer leadership and work alienation also indicate that agricultural scientists expect their colleagues to be easy to approach, friendly, supportive and help in generating new ideas and new problems so that interactions in the team can be creative and productive.

The overall productive power of this model is significant and quite strong. Fifty-eight percent of variance in work alienation can
be explained by this model. The pattern of relationship suggests that not only organizational structure is an important source of alienation, but some demographic variables and also the process variables like climate and leadership should be paid attention while studying work alienation. In fact in agricultural research work settings, organizational climate emerges as a single most important predictor for organizational alienation. Finally the results presented here may be interpreted with caution, because international agricultural research centers live in the climate of more uncertainty than national agricultural research organizations.

However, considering the contribution of scientists to the society, work alienation among scientist is no more a subject which can be consistently neglected. Scientists are human beings and they do react strongly to organizational environment like other professional or non-professional employees react.
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SECTION III:
ORGANIZATIONAL STRUCTURE, CLIMATE, AND LEADERSHIP BEHAVIOR:
A CLOSER LOOK AT THE RESEARCH ORGANIZATION

Introduction

The topic of organizational structure dominated the field of organizational analyses during the '60s and '70s. Interest in this topic has apparently declined, with attention now focused on the environments of organizations and other broad issues. This shift in focus has been beneficial in that organizational analysts are now examining a broader range of phenomena than once was the case.

The unfortunate aspect of this shift in focus is that it has deflected analyses away from the limited theoretical development that was emerging in regard to structure (Hall, 1982:49). The shift in focus has also led to a situation in which much of what is known about organizations and what is important to organizations is receiving little attention in the literature. Some contemporary writers such as Perrow (1979) and Hall (1982) continue to emphasize the importance of structure but others such as Aldrich (1979) scarcely pay attention to the issue at all.

The present analysis is intended to study the organizational structure of research organizations. The research organizations are conceived here as relatively well-bounded and distinct social organizations which control and direct the conduct of research on particular issues.

Traditionally, scientific institutions have been relatively free
from bureaucratic control and other forms of outside influence. The research organizations derive their uniqueness from their commitment to producing novelty and innovations. This means that outcomes of research tasks are inherently different and uncertain and the level of uncertainty in the production system is greater than in most other work organizations. This in turn, leads to the need for a particular structure for organizing and controlling research.

Differentiating research organizations from other bureaucratic systems, Whitley (1984:14-15) argued that control over work processes in science is on the whole exerted by practitioners at the research site and is not governed by elaborate system of rules and regulations established by an administrative hierarchy. Secondly, authority is shared between scientists and administrators. Thirdly, the nature of the product is difficult to specify clearly in advance and is subject to negotiation when it has emerged.

Public communication in the form of publications highlights the innovatory nature of research. The constant changes in work procedures and purposes are managed by a very high degree of decentralization of control over work processes. This makes the organization very flexible and responsive to variations in the environment, coupled with a formal reporting system which enables task outcome to be compared and coordinated.

Etzioni (1975:52) has argued that the highest degree of professionalism, high intrinsic satisfaction from work, positive involvement and control through normative power constitute the predominant characteristics of research organizations.
In spite of their unique characteristics, in recent years there has been a trend toward the bureaucratization and stratification of research organizations (Cheng and McKinley, 1983). To the extent that this trend continues and intensifies, as documented by many science observers (e.g., Hagstrom, 1964; Merton, 1977; Whitley, 1984) it is important to investigate the effects that bureaucratic control may have on the effectiveness of science organizations.

This study addresses two key questions arising from the debate on the bureaucratization of research organizations:

1. How significant is the role of bureaucratic structure in research organizations?
2. Do different structures produce different climates and leadership behavior?

**Structure and climate**

The open systems concept proposed by Katz and Kahn (1966) had enormous impact on organizational theory. The distinguishing features of an open system, such as interaction with the environment, has transformed organizational researchers' traditionally specific and static concerns with commitment, alienation and job performance into more general and dynamic interests in the organization. Discovering how the organization is a socially meaningful environment for individual and organizational members has led to the concept of organizational climate.

While summarizing some of the studies on the relationship between structure and climate, Payne and Pugh (1976:1145) concluded that an organization perceived as more bureaucratic are thought to have a climate perceived as cold, threatening, or low in cohesiveness.
Organizations perceived as having decentralized decision making are thought to have climates perceived as warm, supportive, encouraging and risk taking. However, utilizing data from members of the advance management program at Harvard University, Tagiuri (1968) found that structural factors had little or no relationship with the climate factors. On the other hand, George and Bishop (1971) observed that school structures which were perceived as formalized, centralized, complex and having little professional latitude produced climates which were perceived as low in consideration and intimacy and high in production emphasis. The bulk of the evidence suggests the following hypotheses:

Hypothesis 1. When centralization of power is relatively high, the perceived climate tends to be less positive in research organizations.

Hypothesis 2. When formalization is relatively high, the perceived climate tends to be less positive in research organizations.

Structure and leadership behavior

Work situations in research organizations typically reflect comparatively less influence from leadership behavior. However, the idea that all a research director or project leader needs to do is to hire good people and let them "do their own thing" has only minimal relevance at a time when science policies and priorities are changing very rapidly. Research leaders are required to translate policy into research projects and decide upon the means to achieve them. In addition, leaders have to protect legitimacy on the client level and resolve internal conflicts.

Sociological theories of organizations have all but ignored the
question of leadership. This tendency has several sources. As Meyer (1975) has pointed out, the theory of bureaucracy overlooks leadership on the grounds that organizations which are rational, and hence bureaucratic, are so efficient compared to other forms of administration that changes in leadership cannot affect their stability. Contemporary organizational theory deemphasizes leadership because environmental uncertainties require considerable boundary-spanning activity, only part of which can be handled by a single leader. So great is the gap between sociological theorizing and research on leadership that it is tempting to dismiss leadership as a sociological variable altogether. An alternative is to reformulate theories so that sociologically interesting propositions emerge and can be tested.

The traditional leadership theories, which mostly have psychological roots, looked at personality characteristics for the explanation of effective leader. However, this proved to be an oversimplified conception of leadership. As Vroom (1976:1530) pointed out, instead of looking at the personality of the effective leader, we should be searching for behavioral correlates of effective leadership. Effective and ineffective leaders may not be distinguishable by a battery of psychological tests, but may be distinguished by their characteristic behavior patterns in their work roles. Research should focus on variables describing the larger network of relationships in which leadership roles are embedded (Meyer, 1975).

This change in focus in turn opens up a whole new set of variables needed to explain leadership behavior. One such variable is
organizational structure. As Hall (1982:173) has pointed out, organizational structure affects how much impact leadership can have. In organizations with relatively loose structures, either in terms of formalization or centralization, leadership behavior will have a large impact. Meyer (1975) also noted that autonomy of leadership is associated with unstable structure. Hellriegel et al. (1986:312) also stressed that hierarchy of authority and formalization may affect the leadership behavior. Based on these observations, the following hypotheses are derived:

Hypothesis 3. When centralization of power is relatively high, leadership behavior tends to be less supportive, less facilitative and less achievement oriented in research organizations.

Hypothesis 4. When formalization in organization is relatively high, leadership behavior tends to be less supportive, less facilitative and less achievement oriented.

Method

Participants

The basic data for this study have been collected from senior and middle level scientists working in two major international agricultural research centers (IARCs). Although both centers work under the same international parent body, they are independent of each other. Scientists from all major agricultural disciplines have participated in this study. The data were obtained by personal interviews as well as by self-administered questionnaires. Of the 145 potential subjects, 108 scientists participated in this study. The data were gathered during the summer of 1984.
Concepts and measurement

Centralization  Centralization in this study is defined as "the extent to which power is distributed among social positions" (Hage and Aiken, 1967). A centralized organization generally implies that most decisions are made hierarchically. Aiken and Hage (1966) pointed out two important aspects of centralization. First, organizations vary in the extent to which members are assigned tasks and then provided with the freedom to implement them without interruption from superiors. They called this the degree of hierarchy of job authority. The modified version of the Aiken and Hage scale proposed by Mulford et al. (1984) was used to measure hierarchy of job authority. This scale has five items and responses were measured on a five point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). A higher score means a high degree of hierarchy of job authority. The internal reliability coefficient was .92 for this scale.

A second and equally important aspect of the distribution of power is the degree to which staff members participate in setting the goals and policies of the entire organization. Aiken and Hage (1966) called it the degree of participation in decision making. A scale proposed by Mulford et al. (1984) which was the modification of the Aiken and Hage (1966) scale was used to measure participation in decision making. This scale has four items and responses were recorded from 1 (never) to 5 (always). Higher scores indicate a high degree of perceived participation in decision making. The reliability coefficient was .80.
Formalization  By formalization, we mean the proportion of work activities regulated by rules and procedures. It is implied, the application of rules to work activities, and not just their existence in organizational manuals (Hall, 1982:95). A high degree of formalization implies not only a preponderance of rules defining jobs and specifying what is to be done, but also the enforcement of those rules. In the literature, three subconstructs of formalization can be found. First, job codification which reflects the degree to which job incumbents must consult rules in fulfilling professional responsibilities. A scale proposed by Mulford et al. (1984), which was a modified version of the Aiken and Hage (1966) scale, was adopted to measure the degree of job codification. It has three items and responses were scored from 1 (disagree) to 5 (strongly agree). A higher score implies a higher degree of job codification. The reliability coefficient was .77 for the composite of job codification.

The second subconstruct, rule observation, reflects the degree to which employees are observed for rule violations. A three item scale proposed by Mulford et al. (1984) was used to measure rule observation. The responses were scored on a five point scale ranging from 1 (strongly disagree) to 5 (strongly agree). A higher score means a higher degree of rule observation. The reliability coefficient was .68.

The third subconstruct, job specificity, reflects the degree to which operating procedures on jobs are specified. A six item scale developed by Mulford et al. (1984), which is a modified version of the Aiken and Hage (1966) scale, was used to measure job specificity.
Each item was recorded on a 1 (strongly disagree) to 5 (strongly agree) range. A higher score implies a higher degree of job specificity. The internal reliability coefficient was .66.

**Organizational climate**

It is argued that organizational climate exists in the perceptions by individuals of their organizational environment. In forming climate perceptions the individual acts as an information processor, using inputs from (a) the objective events in and characteristics of the organization and (b) characteristics (e.g., values, needs) of the perceiver. Global perceptions of the organization emerge as a result of numerous activities, interactions, reactions and other daily experiences the person has with the organization (Schneider and Hall, 1972). For this study we subscribe to Tagiuri and Litwin (1968:27) who defined organizational climate as a relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior and (c) can be described in terms of the values of a particular set of characteristics (or attributes) of the organization.

In the literature several factors of climate are identified. Taylor and Bowers (1974:71) proposed a 13 item organizational climate measure, comprised of five distinct dimensions. These include technological readiness, human resource primacy, communication flow, decision making practices and motivational conditions. However, the factor analysis resulted in only two factors with eigenvalues, 6.41 and 1.1, respectively. Factor one explained 49.3 percent of the total item variance, whereas factor two explained 8.5 percent of the
variance. Based on higher loading in factor one, we selected six items to create a composite of organizational climate. These include:
1) extent to which work activities are sensibly organized, 2) extent to which the organization tries to improve working conditions, 3) extent to which decisions are made at those levels, where most adequate and accurate information is available, 4) extent to which those affected by decisions are asked for their ideas, 5) extent to which information is widely shared, and 6) how effectively the interunit conflicts are handled. This factor combines Taylor and Bowers' emphasis on human resource primacy and motivational conditions. The responses were scored from 1 (very less extent) to 5 (great extent). The reliability coefficient was .90 for the global measure of organizational climate.

Organizational leadership The leadership is an influence which stimulates patterning of the behavior in some group. Katz and Kahn (1978:528) followed this line of reasoning when they note "The essence of organizational leadership is the influential increment over and above mechanical compliance with the routine directions of the organization." Thus, leadership is closely related to power, but involves more than simply the power allocated to a position in the organization claimed by a member or members of an organization. However, we subscribe to Fleishman (1973:3), who defined leadership as interpersonal influence, directed through the communication process, toward the attainment of some goal or goals.

Defined in this manner, leadership amounts to a large aggregation of separate behavior, which may be classified in a great variety of
ways. We adopted Taylor and Bowers' (1974) measures of organizational leadership who postulate a four-factor theory of leadership applicable to the activities of group members, as well as to the activities of a formal designated leader. They delineate two parallel structures of leadership: 1) supervisory leadership in the four dimensions of support, goal emphasis, work facilitation, and interaction facilitation, and 2) peer leadership in the same four dimensions. However, the factor analysis of Taylor and Bowers' scale resulted in only two factors for supervisory leadership behavior. With eigenvalues 7.5 and 1.2, respectively. Based on higher loading on factor one, we selected six items to create a composite of supervisory leadership behavior. These include: 1) extent to which supervisors are friendly and easy to approach, 2) attentive, 3) willing to listen to problems, 4) encourage people to give their best effort, 5) set an example by working hard, and 6) encourage subordinates to take action without waiting for their approval. This factor combines Taylor and Bowers' dimensions of support, goal emphasis, and work facilitation. The responses were scored from 1 (very less extent) to 5 (great extent). The internal reliability coefficient was .92 for the composite of supervisory leadership behavior.

Factor analysis of 11 items of peer leadership also resulted in only two factors, with eigenvalues of 6.5 and 1.0, respectively. Based on higher loading on factor one, we selected six items to create a composite of peer leadership behavior. These include: 1) extent to which people in work group maintain high standards of performance, 2) help in finding ways to do a better job, 3) offer new ideas, 4)
encourage to work as a team, 5) emphasize a team goal, and 6) exchange opinions and ideas. This factor combines Taylor and Bowers’ emphasis on goals, work facilitation, and interaction facilitation. The responses were scored from 1 (very less extent) to 5 (great extent). The reliability coefficient was .90 for the global measure of peer leadership behavior.

Unit of analysis

The level at which a theoretical argument is pitched makes considerable difference both conceptually and methodologically (Zeitz, 1984). Several studies on organizational structure have treated organization as the unit of analysis (Aiken and Hage, 1966; Duncan, 1972; Glisson, 1978; Pennings, 1973). However, in subsequent literature the issue is raised whether the organization or the individual should be the unit of analysis (Lincoln and Zeitz, 1980).

Some have argued that since various facets of organization and work situation are not equally valued by all system participants, each member differs on perceptions about structure. Therefore, for some research, it is appropriate for the individual to be the unit of analysis. Similar is the case with organizational climate and leadership behavior. A person’s attributes, needs, abilities, satisfaction, and goals affect his or her perception and thus directly influence perceptions of climate and leadership. Because of the focus on individual productivity in this study, individual perceptions of structure, climate, and leadership are used in the analysis.
Results

The correlations among various facets of organizational structure are presented in Table 1. The patterns in relationships indicate that both the indices of centralization, i.e., participation in decision making and hierarchy of job authority, are strongly and negatively correlated ($r = -.41$). The results are consistent with Hage and Aiken (1967). The negative correlations between the two indices of centralization reveal that employees who perceive a higher degree of participation in decision making are likely to see a lower degree of hierarchy.

Table 1. Zero order correlation coefficients for centralization and formalization

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participation in decision making</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Hierarchy of job authority</td>
<td>-.41***</td>
<td>.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Job codification</td>
<td></td>
<td>.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Rule observation</td>
<td>-.22*</td>
<td>.40***</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td>5. Job specificity</td>
<td>-.04</td>
<td>.33***</td>
<td>.39***</td>
<td>.40***</td>
</tr>
</tbody>
</table>

*p < .05.
***p < .001.

Table 1 further reveals that all three indices of formalization are positively correlated. The results indicate that scientists who perceive a higher degree of job codification are also likely to perceive a higher degree of rule observation and a higher degree of
job specificity. The association between job specificity and the other two indices are stronger.

With the exception of job codification, all formalization variables seem to be associated with centralization and the strength of association is moderate to strong. The overall pattern indicates that scientists perceiving a higher degree of centralization of power are also likely to perceive a higher degree of formalization in the organization.

To determine the magnitude of the relationship between structure, climate and leadership behavior, partial correlations were computed. While computing the correlations between centralization and response variables the effects of formalization were partialed out. When the correlations between formalization and response variables were computed, the effects of centralization were controlled.

The bivariate relationships dictated the strategy for multivariate analysis. The multivariate analyses were organized around three sets of linear regression models. The first model was derived for organizational climate and the remaining two models were tested to explain structure effects on two types of leadership. The structure of each regression model conforms to the classical fixed effects, least-squares configuration. Each model assumes that the effects are linear and additive and makes no explicit provision for interactions.

Hypothesis 1

The data presented in Table 2 reveal that there is a positive correlation between participation in decision making and
organizational climate \((r = .69)\) and a negative relationship between hierarchy of job authority and climate \((r = -.40)\) after controlling for formalization. The pattern of relationship indicate that a lower degree of centralization is associated with more favorable climate. Hypothesis 1 is further supported when centralization is entered in multivariate analysis. The regression coefficients presented in Table 3 confirm the negative effect of centralization on organizational climate. Table 3 further reveals that both subconstructs of centralization, i.e., participation in decision making \((\text{Beta} = .58)\) and hierarchy of job authority \((\text{Beta} = -.18)\) contribute significantly to the explanation of organizational climate.

Table 2. Partial correlation coefficients for centralization, climate and leadership behavior after controlling for formalization

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participation in decision making</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Hierarchy of job authority</td>
<td>-.37***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Organizational climate</td>
<td>.69***</td>
<td>-.41***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Supervisory leadership</td>
<td>.38***</td>
<td>-.34***</td>
<td>.55***</td>
<td>-</td>
</tr>
<tr>
<td>5. Peer leadership</td>
<td>.62***</td>
<td>-.40***</td>
<td>.71***</td>
<td>.51***</td>
</tr>
</tbody>
</table>

***p < .001.
Table 3. Standardized partial regression coefficients of structure variables on organizational climate

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in decision making</td>
<td>.58***</td>
<td>8.31</td>
</tr>
<tr>
<td>Hierarchy of job authority</td>
<td>-.18***</td>
<td>-2.37</td>
</tr>
<tr>
<td>Job codification</td>
<td>.18**</td>
<td>2.59</td>
</tr>
<tr>
<td>Rule observation</td>
<td>-.17*</td>
<td>-2.30</td>
</tr>
<tr>
<td>Job specificity</td>
<td>.14</td>
<td>1.79</td>
</tr>
<tr>
<td></td>
<td>Multiple R</td>
<td>.77***</td>
</tr>
<tr>
<td></td>
<td>R Square</td>
<td>.59</td>
</tr>
</tbody>
</table>

* p < .05.
** p < .01.
*** p < .001.

Hypothesis 2

The correlation analysis (Table 4) indicates that when the effects of centralization are controlled, job codification and job specificity are positively associated with favorable climate. However, rule observation has a negative correlation. Multivariate analysis (Table 3) also yields the same pattern of relationship. A higher degree of job codification (Beta = .18) and job specificity (Beta = .14) seems to contribute for favorable organizational climate. In spite of negative Beta for rule observation, it can be concluded that a higher degree of formalization tends to create more favorable organizational climate in research institutions. Zeitz (1984) has also presented evidence that formalization can have positive effects
on members' perceptions of organizational climate.

Table 3 further reveals that centralization and formalization have a very appreciable effect on organizational climate. The regression model indicates that 59 percent of the variation in organizational climate is accounted for by centralization and formalization.

**Hypothesis 3**

The bivariate relationship between centralization and leadership behavior presented in Table 2 supports the hypothesis, in that a higher degree of centralization is associated with less supportive, less facilitative and less achievement oriented leadership behaviors. The relationship is consistent for both types of leadership behavior.

The strength of the association between both indices of centralization and supervisory leadership as well as peer leadership is quite strong. The multivariate analysis (Table 3) further reveals that participation in decision making contributes significantly to the explanation of supervisory leadership (Beta = .28) as well as peer leadership (Beta = .57). Hierarchy of job authority also seems to have an appreciable effect on supervisory leadership (Beta = -.25) as well as peer leadership (Beta = -.21).

**Hypothesis 4**

When the effect of centralization is controlled, the three indices of formalization do not have consistent association with leadership behavior. Moreover, the strength of association between formalization and both types of leadership behavior seem to be either non-
Supervisory leadership is positively associated with job codification ($r = .10$), negatively with rule observation ($r = -.17$), and again positively with job specificity ($r = .01$). Only the relationship between rule observation and supervisory leadership is significant. Peer leadership is positively related with rule observation ($r = .14$) and job specificity ($r = .14$), but negatively related with job codification ($r = -.08$). However, none of these correlations seems to be significant. These results can best be described as mixed.

Table 4. Partial correlation coefficients for formalization climate and leadership behavior after controlling for centralization

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Job codification</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Rule observation</td>
<td>.17*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Job specificity</td>
<td>.40***</td>
<td>.31***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Org. climate</td>
<td>.29***</td>
<td>-.12</td>
<td>.22**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Supervisory leadership</td>
<td>.10</td>
<td>-.17*</td>
<td>.01</td>
<td>.42***</td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$.  
** $p < .01$.  
*** $p < .001$.

No consistent relationship emerged. Even the multivariate analysis (Table 5) does not yield any consistent relationships. Rule
observation seems to affect supervisory leadership negatively (Beta = -.19), while the other two indices of formalization affect it positively. In the case of peer leadership, job codification appears to have a negative effect (Beta = -.13) and the other two indices have a positive effect.

Table 5. Standardized partial regression coefficients of structure variables on leadership behavior

<table>
<thead>
<tr>
<th>Variables</th>
<th>Supervisory leadership</th>
<th>Peer leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beta</td>
<td>T</td>
</tr>
<tr>
<td>Participation in decision making</td>
<td>.28**</td>
<td>3.05</td>
</tr>
<tr>
<td>Hierarchy of job authority</td>
<td>-.25**</td>
<td>-2.46</td>
</tr>
<tr>
<td>Job codification</td>
<td>.11</td>
<td>1.18</td>
</tr>
<tr>
<td>Rule observation</td>
<td>-.19*</td>
<td>-1.99</td>
</tr>
<tr>
<td>Job specificity</td>
<td>.02</td>
<td>.18</td>
</tr>
<tr>
<td>Multiple R</td>
<td>.54***</td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>.29</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05.
**p < .01.
***p < .001.

Centralization and formalization, however, have an appreciable effect on both supervisory and peer leadership behavior. In fact, 29 percent of the variation in supervisory leadership behavior is explained by these two structure variables. The same is the case with
peer leadership. The model explains 43 percent of the variation in peer leadership behavior.

Discussion and Conclusion

This study has evaluated the role of organizational structure in research institutions. This involved taking a closer look at specific characteristics of research organizations. Two facets of centralization of power are analyzed. The first is an indicator of participation in decisions about the regular activities that facilitate the organization's output. The second is an indicator of centralization of organizational decisions regarding research policy and allocation of resources to various activities. The consequences of these decisions are both immediate and pervasive.

Those scientists who participate in major organizational decisions do not rely on work decisions by others at higher levels in the hierarchy. Scientists have advanced training and normally adopt codes of professional behavior that foster norms of autonomy and expectations of involvement in shaping the goals of the organization. Thus, in typical research organizations, power is greatly distributed among the members. The power which is shared is exercised in influencing matters of importance not only to the organization but also to the discipline and science.

Research work is characterized by a high degree of task uncertainty, unpredictability and low visibility of task outcomes. The innovative nature of work makes it non-routine. The issue of routinization and uncertainty and their relationship to centralization is closely linked to the level of professionalization of the personnel
in the organization (Hall, 1982:119). Lincoln and Zeitz (1980) have reported that a high level of professionalization in an organization results in all employees experiencing an increase in influence.

However, Hall (1982) has pointed out, the fact that there is participation by organization members may not mean that power is delegated. If final decisions still rest in the hands of superiors, little power is actually delegated and participation is advisory at best.

The decentralization of power is associated with less reliance on formalized rules and procedures. The presence of a highly trained staff reduces the need for extensive rules and policies. One of the hallmarks of scientific staff is the ability and willingness to make decisions based upon professional training and experience. It is not surprising to find lower levels of formalization in research organizations. Most studies have concluded that professionalization and formalization are incompatible (Hall, 1982:110). The more professionalized the work force, the more likely that formalization will lead to conflict and alienation.

Formalization and professionalization are actually designed to do the same thing -- organize and regularize the behavior of members. Formalization is the process in which an organization sets the rules and procedures and the means of ensuring that they are followed. Professionalization, on the other hand, is a non-organizationally based means of doing the same thing. From the organization's point of view, either technique would be appropriate as long as the work gets done.
The extent to which centralization and formalization affect organizational climate is surprising. There is no doubt that the research scientists need a work climate where scientific equipment and facilities are kept adequate, efficient and up-to-date. They also need a climate where primacy is given to human resources in organizing work activities. An effective climate is also one in which barriers caused by interpersonal or inter-unit conflicts and disagreements are resolved.

It appears that a higher degree of centralization contributes negatively to an effective climate. Centralization of power reduces the decision making authority of scientists. This creates a dissatisfying and alienating climate for members by imposing a great deal of structure on work roles, leaving them with little autonomy, flexibility or intrinsic meaning.

On the other hand, formalization does not seem to be harmful for a favorable climate. Two reasons might account for this. First, formalization probably enhances role clarity, thus reducing subjective uncertainty and providing a greater sense of direction and meaning. Secondly, it may provide an understanding of managemental expectation as well as peer expectation. In modern organized science where several scientists work on various aspects of the same project, a higher degree of formalization can avoid the interpersonal conflict which may arise because of unclear expectations and unpredictable behavior of co-researchers.

The results suggest the possibility that it is not leadership behavior which affects the structure of an organization, as some argue
(Meyer, 1975). On the contrary, it is possible that organizational structure constrains leadership behavior. In this research, the impact of centralization on leadership behavior is interesting.

A decentralized structure encourages more supportive, helpful and goal-oriented leadership behavior on the part of both superiors and peers. One possible explanation for this may be found in power relations. In research organizations, where rank and file scientists enjoy considerable autonomy, decentralization leaves project leaders and research directors with only limited formal power over scientists. This situation could lead to a reduced organizational effectiveness because various system members have conflicting goals.

To overcome this dilemma, superiors may exercise informal power by providing supportive and helpful leadership. Since they cannot overtly control the activities of rank and file scientists, they have only personal power to rely on. Etzioni (1975:52) also pointed out that informal control through social power is highly effective in professional organizations.

Peer leadership also seems to be more supportive and helpful in decentralized structures of research organizations. As pointed out earlier, research organizations do not have inbuilt power structures to check the power of expertise enjoyed by each scientist. In such situations individual power is controlled by collective power. For instance, what happens when a single scientist acts to force a change in a system? In such situations, collective behavior acts as a control mechanism. Collectively, the situation can be redefined or existing understanding is reaffirmed around the deviant member. The
experience of being excluded by one's peers places social pressure on the deviant, leading either to his withdrawal or to an effort to collaborate and thereby remain in the system. Blankenship (1977:411) also argued that collective negotiation may be seen as one form of control mechanism that may operate when hierarchical mechanisms are not present.
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Whitley, Richard

Zeitz, Gerald
SECTION IV:

PUBLICATION PRODUCTIVITY AND AGRICULTURAL SCIENTISTS:
TOWARD AN ANALYSIS OF PERSONAL AND ORGANIZATIONAL CONTEXT

Introduction

The complexity of modern society and the sweeping changes that have occurred in rural societies over the past twenty years have placed new responsibilities on various agricultural research systems in both economically developed and developing countries. The variety of concerns with which agricultural research systems are involved have increased enormously, to take account of modern social wants and needs in both rural and urban sectors. On the other hand, competition for resources has intensified greatly because of diminishing political support to agricultural research in many developed countries and diversion of resources to agricultural extension activities in developing countries.

As a consequence, the importance of improving the productivity and effectiveness of agricultural research has been recognized. However, as Arndt and Ruttan (1977:8) pointed out, the effectiveness of agricultural research is conditioned by many circumstances. These include the state of scientific knowledge, the capacity of industry to supply inputs and materials, the level of technical and scientific skill embodied in people, the distortions in the market, and tugs and pulls of social and political circumstances. Because of these limitations, it is difficult to measure the effectiveness of an agricultural research system. One possible way to begin a conception
of an effective research organization is in terms of the output of individual scientists working in that organization, because much of the data about performance of research organizations come from their members as individual scientists (Andrews, 1979:19).

The effectiveness of agricultural scientists can be equated with the volume of scholarly publications they write. Scientific publications not only are the measure of their performance but they allow scientists to verify the reliability of information, to acquire a sense of relative importance of a contribution and to obtain critical responses to their work (Skiff, 1980).

It is through publications that scientists receive professional recognition and esteem, as well as promotion, advancement and funding for future research. In fact, scientific work becomes "a work" only when it takes a published form, which can be received, assessed and acknowledged by scientific community (Fox, 1983). Various authors (Hagstrom, 1965; Blau, 1973) agree that research output in the form of books and articles is one major standard by which the performance of individual scientists and research units are judged. Furthermore, there is evidence that academic researchers and research administrators are consistent in using publication output as criteria for evaluating research performance (Birnbaum, 1981; Gross and Gramback, 1968; Jauch and Glueck, 1975). Thus, it appears that research productivity, indicated by the number of various forms of scholarly publications, can be used as a reasonable measure of scientific performance (Cheng and McKinley, 1983).

However, Melzter and Salter (1962:354) have pointed out some of
the objections that might be raised against this measure: a co-author is given the same amount of credit as a full author, and a short paper is counted the same as a long one: No distinction is made between poor and excellent products. No differences can be distinguished between highly original work and the repetition of old ideas, and the benefits of having written the product may be attributed to those who only exploited the ideas or research work of others.

Despite the plausibility of these arguments, fairly consistent evidence in the literature suggests a high or moderate correlation between sheer volume of the scientists' publications and the quality of his/her work as measured by the ratings of competence by peers, or citations counts (Knorr et al., 1979:60). The conclusion seems to be that where citation accounts are not readily available, publication counts are roughly adequate indicators of the significance of a scientist's work (Cole and Cole, 1971).

Despite the centrality of publications to the process of scientific performance, average levels of performance are very low. For example, in a sample of academics from both natural and social sciences, Cole (1979) found that two years after the doctorate 53 percent of all scholars have failed to publish a single paper and 34 percent have published just one. In most years, 70 percent of those academics publish nothing. With a national sample of faculty across fields, Ladd and Lipset (1975) also documented astonishingly low levels of publications. Over half of the full-time academics had never written or edited any sort of book; more than one-third had never published an article; and more than one-quarter had never
published a scholarly work of any kind over the course of their careers. The data on agricultural scientists from the U.S. presented by Busch and Lacy (1983:80) confirm the notion that agricultural scientists are not an exception to this pattern.

While average levels of production tend to be low, the variation between scientists is very high. After examining the results of several studies, Fox (1983) concluded that whether one looks at publications over a year, a five year span, or the entire professional lifetime, productivity varies enormously between scientists. A great bulk of papers are produced by a small minority of scholars and a great majority of scientists produce nothing or very few papers. In the only major study of agricultural scientists, Busch and Lacy (1983:121) found that 10 percent of the scientists in all agricultural disciplines produced about 36 percent of all journal articles and 50 percent of the scientific population produced 83 percent of all articles.

The question arises, how these variations can be explained? In the search for explanation of productivity levels among scientists, researchers first looked at individual level variables such as psychological traits, work habits and demographic characteristics. The psychological perspective has attributed productivity to an "inner compulsion" and to motivation, which persist even in the absence of external rewards (Cole and Cole, 1973). Some authors focus not so much on motivation and attitudes but on stamina or the capacity to work hard, tolerate frustration and persist in the pursuit of long-range goals (Merton, 1973; Zuckerman, 1970). A few studies focused on
the cognitive structure of productive scientists (Wilkes, 1980).

A second group of studies have focused on demographic characteristics of scientists. Summarizing some of these studies, Fox (1983) concluded that age, experience, sex, graduate school background, prestige of institutional affiliation, and level of freedom can affect scientific productivity.

A third group of studies emphasized that work characteristics affects the publication productivity. For example, Busch and Lacy found that time spent in research and communication regarding research affects the publication productivity of agricultural scientists. They also found that those scientists who select the problems based on a criteria of "being a hot topic" or "publications in professional journals" tend to produce more publications (1983:Chapter 3-4).

A major gap in all these investigations, however, lies in their failure to explain the joint effects of psychological, demographic and environmental factors on the publication productivity of scientists. Secondly, although claiming their independence from epistemological domaination and validity of sociological analysis of intellectual changes, these studies effectively reproduced the privileged position of the science by accepting Kuhn's (1970) unitary model of knowledge development and its self-sufficient nature. If we agree that scientific research is a type of work which is done by employees and controlled through reputation over labor markets, then it seems reasonable to analyze the social organization that controls this activity as a system of work organization which can be understood in a
similar way to other forms of work organizations (Whitley, 1984:10). In other words, the impact of work organization should be taken into account while explaining publication productivity.

Thirdly, as pointed out by Mulkey (1977:103), there is a tendency among investigators to concentrate on the discipline of physics, which is a highly structured science. Thus, we do not know whether the same pattern of publication productivity is found in agricultural sciences.

This study seeks to explore and assess the importance of personal, work and organizational factors that may influence the scientific performance of agricultural scientists working with international agricultural research centers (IARCs). An attempt is made particularly to assess the effect of age of scientists, time spent in research, and research orientation on publication productivity. The organizational variables thought to be important for publication productivity are centralization, formalization, leadership behavior, work alienation, and research communication.

Method

Participants

The basic data for this study were collected from senior and middle level scientists, working with two major international agricultural research centers (IARCs). Although both centers work under the same international parent body, they are independent of each other. One center is working on a single crop, whereas the other center has a mandate for research on several crops.

Scientists from all major agricultural disciplines participated in this study. The data were gathered by personal interviews, as well
as by self-administered questionnaires. Of the 169 potential subjects who worked in the two centers, 108 scientists participated in this study. The response rate was 74.5 percent. The data were gathered during the summer of 1984.

**Measures**

**Publication productivity** For this study, publication productivity is defined as the volume of formal scholarly documents of individual scientists in published form, which has been produced to diffuse the scientific knowledge. A composite measure of publication productivity was constructed from information provided by the respondents regarding the numbers of various types of publications either authored or co-authored during the previous five years. The types of scholarly publications include: 1) books, 2) journal articles, 3) book chapters, 4) abstracts, 5) internal reports, 6) bulletins, and 7) other publications.

Because the various types of publications are of unequal scientific importance, it was necessary to determine a relative weight for each type of output in making a composite measure of publication productivity. In the absence of any reliable weighing system, detailed discussions were carried out with some of the subjects and many other agricultural scientists from various national agricultural research systems. Based on the discussions, it was decided that the following weights would be given for various kinds of publications: books authored (10); books co-authored (5); journal articles authored (2); journal articles co-authored (1); book chapters authored (2); book chapters co-authored (1); abstracts authored (.5); abstracts co-
authored (.25); bulletins authored (1); bulletins co-authored (.5); reports authored (1); reports co-authored (.5); other publications authored (.5); and other publications co-authored (.25). The sum of all transformed items were treated as the composite of publication productivity. To test the internal consistency of various items, Cronbach's alpha was computed with revisions described above. The standardized item alpha was .71, indicating that the composite is reasonably reliable.

Since the original output scores showed skewed distributions, they were all transformed to lognormal scores using the Pelz and Andrews (1978:273-274) procedure.

**Age** Age is the respondent's age measured in years. Scientists below 40 were scored (1); 41 to 50 were scored (2); and above 50 were scored (3).

**Research time** Agricultural scientists vary in the time they spent on various activities such as research, teaching, administration, extension, and other activities. To find out how much time they spend doing research, we asked them to report the percentage of their total time spent on research in the last twelve months. Scientists who spent 50 to less than 50 percent time were scored (1); 51 to 75 percent time in research were scored (2); and more than 75 percent of time in research were scored (3).

**Research orientation** By research orientation, we mean the type of research, i.e., basic or applied, undertaken by the scientists. Although the mandate for IARCs require that every scientist should invest more of his/her time in applied research, they
often divide their research time between applied and basic research. We used the definition of basic research provided by Busch and Lacy (1983:66) as "which stresses that it is directed toward increase of knowledge in science ... with the primary aim of the investigator ... a fuller knowledge or understanding of the subject under study, rather than a practical application thereof."

To find out their basic research orientation, we asked the scientists, using this definition, how they would characterize their research during the last five years, indicating the percentage of research time spent in basic research. It is implied that scientists spending less time in basic research are devoting more time to applied research.

**Centralization** Centralization in this study is defined as the extent to which power is distributed among social positions (Hage and Aiken, 1967). A centralized organization generally implies that most decisions are made hierarchically. Aiken and Hage (1966) have pointed out two important aspects of centralization. First, organizations vary in the extent to which members are assigned tasks and then provided the freedom to implement them without interruption from superiors. They called this the degree of hierarchy of job authority. The modified version of the Aiken and Hage scale proposed by Mulford et al. (1984) was used to measure hierarchy of job authority. This scale has five items and responses were measured on a five point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate higher degrees of hierarchy of job authority. The reliability coefficient for this scale .92.
A second and equally important aspect of the distribution of power is the degree to which staff members participate in setting the goals and policies of the entire organization. Aiken and Hage (1966) called this the degree of participation in decision making. A scale proposed by Mulford et al. (1984), which is a revised version of the Aiken and Hage (1966) scale, was used to measure participation in decision making. This scale has four items and responses were scored from 1 (never) to 5 (always). A higher score indicates a higher degree of perceived participation in decision making. The internal reliability coefficient was .80 for this scale.

**Formalization**  
By formalization we mean the proportion of work activities regulated by rules and procedures and the degree of specificity of rules and procedures. A high degree of formalization implies not only a preponderance of rules defining jobs and specifying what is to be done, but also the enforcement of those rules (Hall, 1982:95). In the literature, two subconstructs of formalization can be found. First, job codification, which reflects the degree to which job incumbents must consult rules in fulfilling professional responsibilities. A scale proposed by Mulford et al. (1984), which was a modified version of the Aiken and Hage (1966) scale, was adopted to measure the degree of job codification. The reliability coefficient was .77 for this scale.

The second subconstruct, job specificity, reflects the degree to which operating procedures on jobs are specified. A six item scale developed by Mulford et al. (1984), which is the modified version of the Aiken and Hage (1966) scale, was used to measure job specificity.
Each item was recorded on a 1 (strongly disagree) to 5 (strongly agree) range. A higher score implies a higher degree of job specificity. The internal reliability coefficient of .66 was obtained for this scale.

**Organizational leadership** For this study, organizational leadership is defined as the interpersonal influence directed through the communication process toward the attainment of some goal or goals (Fleishman, 1973:3). Defined in this manner, leadership amounts to a large aggregation of separate behaviors which may be classified in a great variety of ways.

Taylor and Bowers (1974) have postulated a four factor theory of leadership. They delineate two parallel structures of leadership: 1) supervisory leadership in the four dimensions of support, goal emphasis, work facilitation and interaction facilitation; and 2) peer leadership in the same four dimensions.

However, the factor analysis of the Taylor and Bowers scales resulted in only two factors for supervisory leadership behavior, with eigen values 7.5 and 1.2, respectively. Based on higher loading on factor one, we selected six items to create a composite of supervisory leadership behavior. These include: 1) extent to which superiors are friendly and easy to approach; 2) attentive; 3) willing to listen to problems, 4) encourage people to give their best effort; 5) set an example by working hard, and 6) encourage subordinates to take action without waiting for their approval. This factor combines Taylor and Bowers' dimensions of support, goal emphasis and work facilitation. The responses were scored from 1 (very less extent) to 5 (great
extent). The internal reliability coefficient was .92 for the composite of supervisory leadership behavior.

Factor analysis of eleven items of peer leadership also resulted in only two factors, with eigenvalues of 6.5 and 1.0, respectively. Based on higher loading on factor one, we selected six items to create a composite of peer leadership behavior. These include: 1) extent to which people in work group maintain high standards of performance; 2) help in finding ways to do a better job; 3) offer new ideas; 4) encourage to work as a team; 5) emphasize a team goal; and 6) exchange opinions and ideas. This factor combines Taylor and Bowers' emphasis on goals, work facilitation and interaction facilitation. The responses were scored from 1 (very less extent) to 5 (great extent). The reliability coefficient was .90 for the global measure of peer leadership behavior.

**Work alienation** Following Aiken and Hage (1966), work alienation is defined as feelings of disappointment with career and professional development. The composite of six items was adopted from Aiken and Hage (1966) to measure the work alienation of agricultural scientists. The responses were recorded on a five-point scale ranging from 1 (most satisfied) to 5 (not at all). The internal reliability was .89 for this scale.

**Research communication** For this study, communication is defined as the frequency of interaction with others regarding research. Scientists were asked to report the frequency of communication regarding research with the following: 1) scientists in department; 2) agricultural scientists outside the department; 3) non-
agricultural scientists; 4) administrators; 5) clients; 6) funding agencies; and 7) extension staff. Responses were scored on a 1 to 5 range, indicating rarely (1); monthly (2); bi-weekly (3); weekly (4); and daily (5). The sum of the scores for all system members were treated as the communication. The reliability coefficient was .60.

Results

Before proceeding to an analysis of the predictors of the publication productivity of agricultural scientists, it is useful to explore in general terms the patterns and distribution of publication productivity of agricultural scientists working with IARCs. This analytical component, which is primarily descriptive, is intended to characterize agricultural scientists on the basis of their scholarly publications.

Table 1. Five year scientific publication rates per scientist by type of publication

<table>
<thead>
<tr>
<th>Type of Publication</th>
<th>Authored Mean</th>
<th>Authored Std. Dev.</th>
<th>Co-authored Mean</th>
<th>Co-authored Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal articles</td>
<td>6.05</td>
<td>8.24</td>
<td>7.34</td>
<td>7.84</td>
</tr>
<tr>
<td>Books</td>
<td>0.78</td>
<td>0.79</td>
<td>0.64</td>
<td>0.75</td>
</tr>
<tr>
<td>Book chapters</td>
<td>2.00</td>
<td>2.15</td>
<td>2.38</td>
<td>3.61</td>
</tr>
<tr>
<td>Abstracts</td>
<td>3.83</td>
<td>4.12</td>
<td>4.00</td>
<td>5.62</td>
</tr>
<tr>
<td>Bulletins</td>
<td>3.57</td>
<td>5.01</td>
<td>2.63</td>
<td>4.01</td>
</tr>
<tr>
<td>Reports</td>
<td>10.49</td>
<td>23.46</td>
<td>8.56</td>
<td>10.68</td>
</tr>
<tr>
<td>Other publications</td>
<td>5.85</td>
<td>6.47</td>
<td>3.20</td>
<td>3.12</td>
</tr>
</tbody>
</table>
The means and standard deviations presented in Table 1 confirm the consistent findings that average scientific productivity is quite low. In fact, over the period of five years, scientists at IARCs have published an average of 6.05 journal articles as first or only author, and 7.34 as co-author. That comes to about 1.2 authored and 1.5 co-authored articles annually.

The scientists have also written an average of 2 authored, and 2.38 co-authored book chapters over the period of five years. The low productivity is also reflected in the books published. Our sample of agricultural scientists published an average of .78 books as author and .64 as co-authored during the same period of time. Thus, the data show conclusively that the average level of publication productivity of agricultural scientists conform to the global pattern of low productivity. However, data also indicate that the publication productivity of agricultural scientists is comparatively higher than many other disciplines such as physiologists (Meltzer, 1956), chemists (Reskin, 1977), humanists and social scientists (Wanner et al., 1981), and sociologists (Yoels, 1973). Interestingly, the publication productivity of agricultural scientists working with IARCs is higher than American agricultural scientists (Gajbhiye and Hadwiger, 1985).

The higher productivity of agricultural scientists can be partly accounted for by different styles of reporting research. In agricultural sciences, articles are comparatively shorter, therefore, journals can accommodate more articles. Consequently, there is more probability of getting articles accepted for publication than in other natural and social sciences. Secondly, IARCs are very prestigious
research institutions in agricultural sciences, and the affiliation with such prestigious institutions significantly improves one's chances of getting research published (Mulkey, 1977:102). Third, because of the high priority of increasing food production, many economically developing countries significantly increased the number of the research journals for rapid diffusion of knowledge, thus providing more outlets for publications than other mainstream sciences.

Although the average production of scholarly publications look comparatively high, the distribution is highly skewed, which is consistent with the global pattern. For example, only 9 percent of the scientists studied are responsible for about 75 percent of all journal articles as first author or only author and 23 percent of the scientists have failed to produce a single journal article as first or only author over the five year period. The same pattern is repeated when co-authored journal articles are considered. Again, 25 percent of the scientists have not contributed any journal articles as co-author and only 9 percent of the scientists are responsible for 66 percent of the articles as co-author. Only 15 percent of the scientists produced all the books (authored), and only 10 percent of the scientists have contributed all the books produced as co-author.

These distributions are more skewed than the one Price suggested some 23 years ago. Price (1963) concluded that scientific productivity conform to an "inverse square law" whereby the square root of the population of publishing scientists produced half the work. Other studies by Cole (1979), Reskin (1977) and Allison and
Stewart (1974) also reported highly skewed distributions. There is a long standing belief that the age of scientists affects their publication productivity, and that the relationship is curvilinear. However, in our study the relationship between age and publication productivity was found to be linear and scientists seem to publish more as they advance in age (Figure 1).

![Mean of publications](image)

Figure 1. Relationship between age and publication productivity

To test the hypothesis that publication productivity increases with age, we computed zero-order correlations between age and publication productivity. These coefficients, along with those compiled for other personal and work variables, are presented in Table 2. Confirming the pattern of relationship, the correlations reveal that there is a positive and significant relationship between age and publication productivity ($r = .20$). This result is consistent with
Hammel (1980). Older scientists have more experience and more resources at their disposal, which can be transformed into publications. As the scientists grow older, their understanding of the organization and its environment increases and they tend to occupy administrative posts. Thus, their time spent in actual research is reduced, but it enables them to supervise and guide the work of many younger scientists. Consequently, older scientists are associated with all the work they supervise, thus having more publications than each younger scientist.

The hypothesis gains further support when the relationship between age and research time is revealed. The correlation is negative \((r = -.48)\) and quite strong. The negative relationship indicates that older scientists tend to spend less time in research. While considering the relationship between research time and publication productivity, there was a possibility of a curvilinear relationship as pointed out by Busch and Lacy (1983:120). However, Figure 2 reveals that the relationship is linear and the productivity seems to increase as the time spent in research decreased up to 50 percent. Obviously if no time is spent on research, no scholarly publications can be written. But then, such employees cannot be called researchers.

As expected, the correlation between research time and publication productivity was negative and significant \((r = -.28)\), confirming the inverse relationship. In an unpublished paper (reported in Pelz and Andrews, 1978:56), Meltzer also found that full-time researchers published less than those spending three-quarters of
their time on research. Furthermore, Busch and Lacy (1983:120) observed that after 65 percent of a scientist’s time is spent in research, additional increments of time do not result in an increase in productivity and may even result in a decrease.

Mean of publications

![Graph showing the relationship between time spent in research and publication productivity.](image)

Figure 2. Relationship between time spent in research and publication productivity

As Knorr et al. (1979:69) pointed out, it is not the time spent in research which is important, but the nature of the involvement in research that accounts for the productive differences. Devoting relatively small amounts of time to many projects at the early stages (research conceptualization) and late stages (report and paper writing) clearly offers better opportunities for authorship or co-authorship than devoting large amounts of time to actually doing all the tedious work in research tasks.
Table 2. Zero-order correlations between personal and work characteristics and publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Research time</td>
<td>-.48***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3. Research orientation</td>
<td>.11</td>
<td>-.02</td>
<td></td>
</tr>
<tr>
<td>4. publication productivity</td>
<td>.20**</td>
<td>-.28**</td>
<td>.22**</td>
</tr>
</tbody>
</table>

**P < .01.  
***P < .001.

Further, we looked at the association between time spent in basic research (research orientation) and publication productivity. The correlation is positive and moderate in strength (r = .22). It appears that as the scientists spend more time in basic research they tend to produce more publications. It has been argued that in research organizations which are oriented toward applied research, scientists doing basic research are downgraded (Pelz and Andrews, 1978:64). Consequently, they receive comparatively less social rewards from organizations than their counterparts doing applied research. Then, scientists spending more time in basic research try to change the imbalance in rewards by producing and sharing more scientific information which gives them recognition. The more recognition a scientist receives, the more productive he/she is subsequently likely to become (Cole and Cole, 1971). Thus, basic researchers in applied research organizations such as IARCs are pushed to publish as much and as quickly as possible in order to survive in
the organization. On the other hand, as pointed out by Shepard (1956), an applied orientation tends to separate researchers from their professional reference group. This reduces their access to certified scientific knowledge and thus lowers their publication productivity.

In the succeeding portion of the analysis, we developed a series of general regression models to explain variations in publication productivity. Each model assumes that the effects are linear and additive and makes no explicit provision for interactions because there is insufficient theoretical justifications for recognizing particular interactions. Table 3 presents summary data for age, research time and research orientation. The overall model is significant and the 12 percent of the variation in individual publication productivity is explained by this model.

Table 3. Standardized regression coefficients of personal and work characteristics on publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.07</td>
<td>0.65</td>
</tr>
<tr>
<td>Research time</td>
<td>-.24*</td>
<td>-2.30</td>
</tr>
<tr>
<td>Research orientation</td>
<td>.20*</td>
<td>2.16</td>
</tr>
<tr>
<td>Multiple R</td>
<td>.35**</td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>.12</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05.  
**p < .01.
Research time (Beta = -.24) and research orientation (Beta = .20) appear to exert more appreciable effects on the publication productivity of agricultural scientists. One of the most significant contributions of multivariate analysis to the bivariate analysis is the consistent negative beta for research time, which confirms the inverse relationship between time spent in research and publication productivity. Age has a positive effect on the number of publications written. This is consistent with the bivariate relationship.

Further, to determine the magnitude of the bivariate association between organizational structure and publication productivity, we compiled partial correlations after controlling for leadership behavior, work alienation, and research communication. The pattern of relations summarized in Table 4 suggest that among the two indices of centralization, participation in decision making has a positive relationship with publication productivity (r = .22), and hierarchy of job authority has a negative relationship (r = -.16). The results indicate that those who participate more in decision making tend to be more productive.

The decision making process in the organization is the basis of any power structure (Zey-Ferrell, 1979:142). In research organizations, scientists derive their power by virtue of their training and expertise. It does not mean that all scientists are delegated equal power. The degree of power not only depends on the level of expertise, but also the contribution of members to achieve organizational goals. Those who are granted more power are in a better position to control the scarce resources. They can have a
greater number of technical and research assistants, more workers to perform field operations, thus, acquiring more data at a faster rate. This may be reflected in a higher number of publications.

Table 4. Partial correlations between organizational structure and publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participation in decision making</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Hierarchy of job authority</td>
<td>-.19*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Job codification</td>
<td>.11</td>
<td>.08</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Job specificity</td>
<td>-.04</td>
<td>.34***</td>
<td>.42***</td>
<td>-</td>
</tr>
<tr>
<td>5. Publication productivity</td>
<td>.22**</td>
<td>-.16*</td>
<td>-.27**</td>
<td>-.14</td>
</tr>
</tbody>
</table>

*p < .05.
**p < .01.
***p < .001.

The association between hierarchy of job authority and publication productivity is in the expected direction. Obviously, strict hierarchy of job authority reduces the autonomy of scientists, which is vital to the process of innovation. Pelz and Andrews (1978:27) also found that scientific contribution rose with increasing autonomy. Scientists undertake a domain of activities that incorporate a high degree of uncertainty. The autonomy in the work situation reduces the uncertainty to a great extent and keeps the system moving. When scientists feel that their autonomy is threatened by more hierarchy, their productivity may be affected.
Table 4 further reveals that both indices of formalization, job codification and job specificity, have negative correlations with publication productivity. The correlation between job specificity and publication productivity is not significant ($r = -0.14$), but the strength of the association between job codification and publication productivity is moderate ($r = -0.27$). The results seem to indicate that an increased degree of formalization is associated with lowered publication productivity.

High formalization imposes a great deal of structure on work roles leaving scientists with little autonomy, flexibility, and intrinsic meaning. The control of job activities by administrative rules and procedures reduces autonomy and render one's contribution to larger ends less meaningful. Formalization contravenes professional norms of control by expertise and collegial influence. It engenders normlessness and isolation by undermining professional standards. Formal structuring also brings with it some reduction in discretion and participation.

In other words, a higher degree of formalization makes it difficult for scientists to operate within the norms of science. These conditions lead ultimately to a self-estrangement in which the scientists view the job as preventing the expression of their full potential, resulting in less publications.

Table 5 represents summary information for the second regression model that was fitted to the structural variables. The overall model is significant and 17 percent of the variation in individual publication productivity is explained by this model. This is higher
that the first model of personal variables. The results are relatively consistent with the bivariate coefficients. Participation in decision making (Beta = .25) and job codification (Beta = -.28) emerge as the significant predictors for publication productivity.

Table 5. Standardized partial regression coefficients of structure variables on publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in decision making</td>
<td>.25**</td>
<td>2.60</td>
</tr>
<tr>
<td>Hierarchy of job authority</td>
<td>-.11</td>
<td>-1.09</td>
</tr>
<tr>
<td>Job codification</td>
<td>-.28**</td>
<td>-2.82</td>
</tr>
<tr>
<td>Job specificity</td>
<td>.01</td>
<td>.11</td>
</tr>
<tr>
<td>Multiple R</td>
<td>.41***</td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>.17</td>
<td></td>
</tr>
</tbody>
</table>

**p < .01.  
***p < .001.

To test the bivariate relations between leadership behavior, work alienation, research communication and publication productivity we computed partial correlations after controlling the effects of centralization and formalization (Table 6). The bivariate association between supervisory leadership behavior and publication productivity is positive (r = .02), but not significant. Knorr et al. (1979:105) has reported a moderate association between supervisory leadership behavior and scientific productivity.

An effective supervisory behavior may inspire junior members of a
team to high achievement, protect them from debilitating outside pressure and structure the group in such a way so that subordinates stimulate one another. Besides, leadership behavior may be very instrumental in finding new resources particularly research funding, which can make a great difference in productivity of participants.

Table 6. Partial correlations between leadership behavior, work alienation, research communication and publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supervisory leadership</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Peer leadership</td>
<td>.31***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Work alienation</td>
<td>-.37***</td>
<td>-.22**</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. Research communication</td>
<td>.15*</td>
<td>.08</td>
<td>-.01</td>
<td></td>
</tr>
<tr>
<td>5. Publication productivity</td>
<td>.02</td>
<td>-.08</td>
<td>-.01</td>
<td>.03</td>
</tr>
</tbody>
</table>

*p < .05.
**p < .01.
***p < .001.

Surprisingly, the relationship between peer leadership behavior and publication productivity is negative but not significant (r = -.08). Further, we examined the relationship between work alienation and publication productivity. As expected, the correlation was negative, but not significant (r = -.01). The negative coefficient suggests that a higher degree of organizational alienation is associated with lower publication productivity. Work alienation,
which reflects the feeling of powerlessness, meaninglessness, normlessness, isolation and self-estrangement, leads to less than optimal research efforts.

Table 6 also reveals that there is a positive but nonsignificant correlation between research communication and publication productivity \( r = .03 \).

Pelz and Andrews (1978:36) reported positive correlations between communication and scientific productivity. It seems plausible that communication with others, including colleagues, administrators, and clients, may provide new ideas, and efficient ways of doing things. Sometimes a colleague or project leader may know something other scientists need to know. Then there is the possibility of a colleague or other member of an organization catching an error which the scientist is too engrossed to see. Sometimes knowing that even one other person thinks a problem is worth working on may be all it takes to keep a person going in a new area (Pelz and Andrews, 1978:52).

To examine the multivariate relationship, we regressed leadership behavior, work alienation and research communication on publication productivity. The results presented in Table 7 reveal that the multivariate relationships are relatively consistent with the bivariate relationships except peer leadership behavior. In the multivariate analysis, peer leadership contributes positively to publication productivity. However, the overall model is not significant and these four variables do not seem to have an appreciable effect on publication productivity.
Table 7. Standardized partial regression coefficients of leadership behavior, work alienation and research communication on publication productivity

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisory leadership</td>
<td>.03</td>
<td>.26</td>
</tr>
<tr>
<td>Peer leadership</td>
<td>.06</td>
<td>.54</td>
</tr>
<tr>
<td>Work alienation</td>
<td>-.10</td>
<td>-.79</td>
</tr>
<tr>
<td>Research communication</td>
<td>.08</td>
<td>.76</td>
</tr>
<tr>
<td>Multiple R</td>
<td>.20</td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>.04</td>
<td></td>
</tr>
</tbody>
</table>

Discussion and Conclusion

The results are generally supportive of the previous research findings of low productivity and skewed distribution. However, the agricultural scientists at IARCs seem to author comparatively more publications than their counterparts in the United States and also in other disciplines. Very interesting patterns of relationships emerge between explanatory variables and publication productivity of agricultural scientists. The results consistently indicate that older scientists are more productive than younger scientists. Those agricultural scientists who besides research spend some time in other activities such as teaching, administration, extension and consultation tend to write more publications. Also, those who are basic research oriented publish more.

So far the unexplored domain of organizational structure gains importance when the relationship of centralization and formalization
with publication productivity is unfolded. The productivity of agricultural scientists seems to be greatly affected by centralization and formalization. More hierarchy of job authority and more formalization tends to reduce the number of publications written. On the other hand, more participation in decision making increases the productivity. Surprisingly, both supervisory leadership behavior and peer leadership behavior do not seem to affect publication productivity of individual scientists. Work alienation and research communication also do not contribute significantly for the explanation of individual scientist's contribution to certified knowledge.

Thus, it is very clear that publication productivity of agricultural scientists is affected by a variety of factors. What is interesting to note is that organizational factors, particularly organizational structure, emerges as a more important predictor of publication productivity than personal attributes or work characteristics. These results seem to support the notion forwarded by researchers in organizations that the structures are designed to minimize or at least regulate the influence of individual variations on the organization.

However, the results presented here may be generalized with caution, because international centers live in more uncertain environments than any other national agricultural research system. Secondly, due to their international nature, IARCs have access to a very large pool of the most creative scientists. Thus, through an extremely efficient, albeit uncoordinated, process of selective recruitment and patronage, IARCs are able to maintain a higher degree
of scientific performance.

The identification of such relationship open up numerous possibilities for ways in which performance of agricultural experiment stations and research institutes might be enhanced through improved management techniques, particularly at a time when the growth of agricultural science is leveling off and political support is declining for public investment. The consequences of this may be devastating not just for a food production system and its structure, but also to most of the rural population. Then the conditions under which the agricultural research organizations can work more efficiently and effectively despite the reduced funding become more relevant to rural sociology instead of being relegated to the sociology of organization or even non-sociologists who cannot fully understand the complexity of agricultural research in the public sector. As Busch and Lacy (1983:22) pointed out, rural sociologists tended more and more to avoid agricultural issues altogether. The voluminous literature on rural communities often ignored the agricultural base upon which those communities were founded.
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The network of international agricultural research centers (IARCs), under the umbrella of the Consultative Group on International Research (CGIAR), did play and will continue to play a strategic role in crop and livestock improvement all over the world. Although these centers are highly esteemed, very little is known about their operations. There have been several studies conducted to estimate the overall economic returns on investment in IARCs, but no systematic attention has been paid to understanding the IARCs as social systems.

In this study, an attempt has been made to analyze relationships between scientific, social, ideological, and organizational factors and the process of knowledge creation, evaluation and diffusion of ideas in IARCs.

This study was done with 108 senior and middle level scientists working in two major international agricultural research centers. The data were obtained by personal interviews as well as by self-administered questionnaires during the summer of 1984.

The first paper of the dissertation deals with the research problem selection process in IARCs. Several criteria of research problem choice are examined. The use of a purely scientific criterion is associated with the research orientation of scientists, and research goals such as increasing agricultural productivity, assisting developing nations and protecting consumer health. The reward-oriented criterion is associated with research goals such as increasing agricultural productivity, developing new products, and expanding export markets. The organizational criterion is associated
with research orientation, research communication, certain research goals and perceived beneficiaries.

Problem selection is a very complex process which may be influenced by a variety of criteria, some of which are clearly scientific in character while others are external to science. Furthermore, two or more criteria frequently operate at the same time in the choice of research problems.

The most striking general impression one gets from the results is that scientists' actual behavior corresponds only imperfectly with epistemological prescriptions of how they should behave, particularly in sciences such as agricultural which lack a dominant cognitive structure. Patterns of problem choice are more likely to be influenced by organizational consideration and societal problems than by reward considerations or by desire to extend certified knowledge.

In the second paper, the issue of work alienation among agricultural scientists is addressed. Demographic, personal and organizational variables were studied to explain variations in work alienation. The results reveal that the national origin of scientists has an appreciable effect on work alienation. The native scientists are more alienated than foreign scientists. Also younger scientists are more alienated.

The results also confirm the notion that the effectiveness of science organizations may depend on the work environment which can provide the higher degree of autonomy coupled with opportunities to participate in decision making to its members. On the other hand, a higher degree of formalization seems to reduce alienation.
Not only is organizational structure an important source of alienation, but other organizational variables such as perceived organizational climate and leadership behavior also have appreciable effects on work alienation. Organizational climate emerges as the single most important predictor of work alienation among scientists.

Traditionally, research institutions have been relatively free from bureaucratic control and other forms of outside influence. In recent years, however, there has been a growing trend toward bureaucratization and stratification. The third section of this dissertation is devoted to understanding the effects of bureaucratization on organizational climate and leadership behavior.

The results indicate that centralization of power creates dissatisfying and alienating organizational climate. On the other hand, formalization which includes rule enforcement and role constraints, does not seem to be harmful for effective climate in research organizations.

Further, it is interesting to note that a decentralized structure encourages more supportive, helpful, and goal oriented leadership behavior on the part of both superiors and peers. Perhaps informal control through social power is most effective in research organizations.

The last section of the dissertation focuses upon the publication productivity of agricultural scientists. Scientists at IARCs publish comparatively more scientific literature than scientists in other mainstream sciences. The results consistently indicate that older scientists are more productive than younger scientists. Those
agricultural scientists who besides research spend some time in other activities such as teaching, administration, extension and consultation tend to write more publications. Also, those who are basic research oriented publish more.

The productivity of agricultural scientists is greatly affected by centralization and formalization. A higher degree of participation in decision making coupled with a lower formalization tends to increase publication productivity. On the other hand, leadership behavior, research communication and work alienation have only minor effects on publication productivity.

These results suggest ways in which the efficiency and effectiveness of agricultural experiment stations and research institutes might be enhanced through improved management techniques. This is more important at a time when the growth of agricultural sciences is leveling off in most affluent countries, as well as in many poor countries that do not have the resources and/or political will to invest more in agricultural research.

However, the results presented here should be interpreted with caution because the data were gathered in only one time frame. Further research is needed to verify the relationships between variables. Scientific knowledge production is a very dynamic process. Therefore, longitudinal studies should be carried out before generalization. Secondly, this study was conducted with scientists in only two international centers. There are 13 international centers operating under other Consultative Group on International Agricultural Research. Other data should be collected from some of the remaining
11 institutes. Other research should also be considered in university settings, too.
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Busch, Lawrence

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Merton, Robert K.

Montagna, Paul D.

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Mulkey, Michael J.
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>Pelz, Donald C. and Frank M. Andrews</td>
<td>Scientists in Organizations</td>
<td>Ann Arbor, MI: Univ. of Michigan.</td>
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My stay in the U.S. for the Ph.D. program has been facilitated by a couple of institutions and several individuals whom I cannot enumerate here. Nevertheless, to my sponsor, Ministry of Home Affairs, Government of India, Indian Consulate in Chicago, and Indian Council of Agricultural Research, I owe a deep sense of gratitude.

Thanks are also extended to Dr. Charlotte Roderuck, Director, World Food Institute, for granting me an opportunity to visit IRRI and ICRISAT for data collection.

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The Iowa State University Committee on the Use of Human Subjects in Research reviewed this project and concluded that the rights and welfare of the human subjects were adequately protected, that risks were outweighed by the potential benefits and expected value of the knowledge sought, that confidentiality of data was assured and that informed consent was obtained by appropriate procedures.

My special thanks to Dr. M.S. Swaminathan, Director, General IRRI, and Dr. J.S. Kaniwar, Deputy Director, General ICRISAT, for
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I would also like to thank Dr. David G. Bowers, Institute for Social Research, University of Michigan, Ann Arbor, for permission to use their organizational climate and leadership scales for this research.

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Last, but not least, I must offer my heartiest gratitude to Smita, my wife, who put up with my irrational behavior during a very stressful period of my life. My daughters, Shweta and Sonal, contributed their bit by wondering loudly, what sort of doctor I will be without having a stethoscope hanging on my chest.
SCIENTISTS' QUESTIONNAIRE

PART I

Background

In order to analyze research problem choices, we need to first examine the degree to which personal, educational, and career background contribute to one’s research strategy. Therefore, we would appreciate your answers to the following questions. Please circle the appropriate number in each question.

1) Name of institute
   1 ____ I.R.R.I.
   2 ____ I.C.R.I.S.A.T.

2) What is your sex?
   1 ____ Male
   2 ____ Female

3) Are you a citizen of this country?
   1 ____ Yes
   2 ____ No

4) What is your age?
   1 ____ Less than 30
   2 ____ 31-40
   3 ____ 41-50
   4 ____ 51 and above

5) What is the size of the community where you were living at age 16?
   1 ____ Open country
   2 ____ Town of 2,499 or less
   3 ____ Town of 2,500 - 9,999
   4 ____ Town of 10,000 - 24,999
   5 ____ Town of 25,000 - 50,000
   6 ____ City of more than 50,000
6) What is your educational background?

<table>
<thead>
<tr>
<th>Degree</th>
<th>Year Completed</th>
<th>Institution</th>
<th>Field or Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctorate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postdoctorate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7) During the last 12 months what have been the actual (not formal) conditions of your appointment?

___% research    ___% administration
___% teaching    ___% extension
___% other (specify)__________________________

PART II
Problem Choice and Communication
Section A

In this section we are interested in many aspects of your work, your choice of research topics and your opinions about your discipline. Some of the questions are complex and others call for opinions and ideas on topics to which you may not have given much thought. Please try to answer all of the questions. When the precoded answers do not reflect your situation or attitudes, please check the open ended response and elaborate.

Basic research: stresses that it is directed toward increases of knowledge in science with "... the primary aim of the investigator ... a fuller knowledge or understanding of the subject under study, rather than a practical application thereof."

Applied research: is directed toward practical application of knowledge. It covers "... research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either produces or processes."
Development: may be summarized as "... the systematic use of scientific knowledge directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes.

Using these definitions, how would you characterize your research during the last 5 years (1978-1983)? (Indicate percentage of research time.) What do you think it should be?

<table>
<thead>
<tr>
<th>Actual %</th>
<th>Ideal %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic research</td>
<td></td>
</tr>
<tr>
<td>Applied research</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td></td>
</tr>
</tbody>
</table>

Section B

1) During the last 5 years, how important were the following considerations in your choice of research problems? Please rate each criterion by circling one number from "Not Important" (1) to "Very Important" (7).

<table>
<thead>
<tr>
<th>CRITERIA FOR PROBLEM CHOICE</th>
<th>Not Important</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Potential contribution to scientific theory</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2. Likelihood of clear empirical results</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3. Potential creation of new methods, useful materials and devices</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4. Potential marketability of the final product</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5. Funding</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6. Length of time required to complete the research</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>7. Publication probability in professional journal</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>8. Publication probability in farm and/or industrial journal</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>1</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>Publication probability in experiment station or research service bulletins and reports</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Availability of research facilities</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Currently a &quot;hot&quot; topic</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Evaluation of research by scientists in your field</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Colleagues' approval</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Credibility of other investigators doing similar research</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Enjoy doing this kind of research</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Importance to society</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Scientific curiosity</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Demands raised by clientele</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Feedback from extension personnel</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Client needs as assessed by you</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Priorities of the research organization</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Other (specify)</td>
<td></td>
</tr>
</tbody>
</table>

2) How frequently do you communicate with the following people regarding your research? (Please circle one number for each group.)

<table>
<thead>
<tr>
<th></th>
<th>Rarely</th>
<th>Monthly</th>
<th>Bi-weekly</th>
<th>Weekly</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists in your department</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural scientists outside your department</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (non-agricultural) scientists</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section C

Over the last 5 years, how many of each of the following types of publications have you authored or co-authored?

<table>
<thead>
<tr>
<th>Authored</th>
<th>Co-authored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal articles</td>
<td></td>
</tr>
<tr>
<td>Books</td>
<td></td>
</tr>
<tr>
<td>Book chapters</td>
<td></td>
</tr>
<tr>
<td>Abstracts</td>
<td></td>
</tr>
<tr>
<td>Bulletins</td>
<td></td>
</tr>
<tr>
<td>Reports</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Section D

Below is a list of eleven goals for agricultural research often used by funding agencies. These goals vary in importance and in the degree to which a given research project reflects any or all of them. We would appreciate it if you would tell us how important you believe each goal to be and the degree to which your research contributes to each goal using a scale of 1 (OF NO IMPORTANCE) to 7 (OF HIGHEST IMPORTANCE).
<table>
<thead>
<tr>
<th>Importance to you as a goal</th>
<th>Degree your research contributes to this goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Increase agricultural productivity</td>
<td>Increase agricultural productivity</td>
</tr>
<tr>
<td>Protect forests, crops, and livestock from insects, diseases and other hazards</td>
<td>Protect forests, crops, and livestock from insects, diseases and other hazards</td>
</tr>
<tr>
<td>Decrease production costs of farm/forest products</td>
<td>Decrease production costs of farm/forest products</td>
</tr>
<tr>
<td>Expand demand by developing new products or enhancing product quality</td>
<td>Expand demand by developing new products or enhancing product quality</td>
</tr>
<tr>
<td>Improve marketing efficiency</td>
<td>Improve marketing efficiency</td>
</tr>
<tr>
<td>Expand export markets</td>
<td>Expand export markets</td>
</tr>
<tr>
<td>Assist developing nations</td>
<td>Assist developing nations</td>
</tr>
<tr>
<td>Protect consumer health and improve nutrition</td>
<td>Protect consumer health and improve nutrition</td>
</tr>
<tr>
<td>Improve level of living of rural communities</td>
<td>Improve level of living of rural communities</td>
</tr>
<tr>
<td>Promote community improvement</td>
<td>Promote community improvement</td>
</tr>
<tr>
<td>Develop new knowledge or improved methodology</td>
<td>Develop new knowledge or improved methodology</td>
</tr>
</tbody>
</table>
Section E

Apart from your discipline, do you believe that your research and publishing over the past 5 years has already or will directly or indirectly benefit any of the following? In your opinion, who should your research benefit?

<table>
<thead>
<tr>
<th>Will or Does Benefit</th>
<th>Should Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at All 1 2 3 4 5</td>
<td>Not at All 1 2 3 4 5</td>
</tr>
<tr>
<td>A great Deal 1 2 3 4 5</td>
<td>A great Deal 1 2 3 4 5</td>
</tr>
</tbody>
</table>

- Other scientific disciplines (specify)
- Small farmers
- Large farmers
- Agri-business
- Rural residents
- General public
- Local or state government agencies
- Federal agencies
- Foreign groups, institutions or governments
- Other

1 2 3 4 5
Although scientists achieve recognition from peers in their respective disciplines, the demands of modern science require that they work within an organizational framework. The broad organizational environment provides the context in which key decisions and choices are negotiated. We would appreciate it if you would tell us how you perceive your organization on the following issues. Please circle the appropriate number.

### Section A

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How frequently do staff usually participate in the decisions to adopt new programs?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. How frequently do staff usually participate in decisions on the adoption of new policies?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. How frequently do staff usually participate in the decisions to hire new staff?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. How frequently do staff usually participate in the decisions on the promotions of any of the professional staff?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. There can be little action taken here by a staff person until a supervisor approves a decision.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. A staff person who wants to make his/her own decision would be quickly discouraged here.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Even small matters dealt with by staff have to be referred to someone higher up for a final answer.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Staff persons have to ask their boss before they do almost anything.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
9. Any decision a staff person makes has to have his/her supervisor's approval.

10. Salary determinations are based upon detailed job descriptions.

11. Most positions have written job descriptions.

12. Job descriptions are periodically reviewed and revised as needed.

13. Staff here are constantly being checked for rule violations.

14. Staff here feel they are being watched to see that they conform to work standards.

15. Staff who follow the rules very closely receive the most favorable performance evaluation.

16. Whatever situation arises, staff have standard procedures in dealing with it.

17. Everyone has a specific job to do.

18. It is important to orient new staff so they fully understand work procedures here.

19. This organization keeps written records of everyone's job performance.

20. Staff are to follow strict operating procedures at all times.

21. Work procedures for all positions are written and periodically revised as needed.
Section B

<table>
<thead>
<tr>
<th></th>
<th>To what extent is this organization generally quick to use improved work methods?</th>
<th>To a Very Less Extent</th>
<th>To a Great Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>To what extent does this organization have a real interest in the welfare and happiness of those who work here?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>How much does this organization try to improve working conditions?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>To what extent does this organization have clear-cut, reasonable goals and objectives?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>To what extent are work activities sensibly organized in this organization?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>How adequate for your needs is the amount of information you get about what is going on in other departments?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>How receptive are those above you to your ideas and suggestions?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>To what extent are you told what you need to know to do your job in the best possible way?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>To what extent are there things about working here (people, policies, or conditions) that encourage you to work hard?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>To what extent do different departments or units plan together and coordinate their efforts?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>To what extent are the equipment and resources you have to do your work with adequate, efficient, and well-maintained?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>
12. In this institute, to what extent are decisions made at those levels where the most adequate and accurate information is available? 1 2 3 4 5

13. When decisions are being made, to what extent are the persons affected asked for their ideas? 1 2 3 4 5

14. People at all levels of the institute usually have know-how that could be of use to decision-makers. To what extent is information widely shared in this institute so that those who make decisions have access to all available know-how? 1 2 3 4 5

15. How are differences and disagreements between units or departments handled in this organization? (Please circle just one number which is most appropriate.)

1. Disagreements are almost always avoided, denied, or suppressed.
2. Disagreements are often avoided, denied, or suppressed.
3. Sometimes disagreements are accepted and worked through; sometimes they are avoided or suppressed.
4. Disagreements are usually accepted as necessary and desirable and worked through.
5. Disagreements are almost always accepted as necessary and desirable and worked through.

16. Why do people work hard in this organization? (Please circle just one number which is most appropriate.)

1. Just to keep their jobs and avoid being chewed out.
2. To keep their jobs and to make money.
3. To keep their jobs, make money, and to seek promotions.
4. To keep their jobs, make money, seek promotion, and for the satisfaction of a job well done.
5. To keep their jobs, make money, seek promotion, do a satisfying job and because other people in their work group expect it.
1) To what extent is (does) your supervisor ... | To a Very Less Extent | To a Great Extent
---|---|---
1. Friendly and easy to approach? | 1 | 2 | 3 | 4 | 5
2. Attentive to what you say? | 1 | 2 | 3 | 4 | 5
3. Willing to listen to your problems? | 1 | 2 | 3 | 4 | 5
4. Encourage people to give their best effort? | 1 | 2 | 3 | 4 | 5
5. Maintain high standard of performance? | 1 | 2 | 3 | 4 | 5
6. Set an example by working hard himself? | 1 | 2 | 3 | 4 | 5
7. Encourage subordinates to take action without waiting for detailed review and approval from him? | 1 | 2 | 3 | 4 | 5
8. Show you how to improve your performance? | 1 | 2 | 3 | 4 | 5
9. Provide the help you need so that you can schedule work ahead of time? | 1 | 2 | 3 | 4 | 5
10. Offer new ideas for solving job-related problems? | 1 | 2 | 3 | 4 | 5
11. Encourage the persons who work for him to work as a team? | 1 | 2 | 3 | 4 | 5
12. Encourage people who work for him to exchange opinions and ideas? | 1 | 2 | 3 | 4 | 5
13. How often does your supervisor hold group meetings where he and the people who work for him can really discuss things together? | 1 | 2 | 3 | 4 | 5
2) To what extent are (do) people in your work group ...

<table>
<thead>
<tr>
<th>Question</th>
<th>To a Very Less Extent</th>
<th>To a Great Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Friendly and easy to approach?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2. Pay attention to what you’re saying?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3. Willing to listen to your problems?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4. Encourage people to give their best?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5. Maintain high standards of performance?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6. Help you find ways to do a better job?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7. Provide the help you need so that you can plan, organize, and schedule work ahead of time?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8. Offer new ideas for solving job related problems?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9. Encourage its people to work as a team?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10. Emphasize a team goal?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>11. Exchange opinions and ideas?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Section D

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>Most satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How satisfied are you that you have been given enough authority by your Director General to do your job well?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2. How satisfied are you with your present job when you compare it to similar positions in your country?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3. How satisfied are you with the progress you are making towards the goals which you set for yourself in your present position?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>
4. On the whole, how satisfied are you that (your superior and peers) accept you as a professional expert to the degree to which you are entitled by reason of position, training and experience? 1 2 3 4 5

5. On the whole, how satisfied are you with your present job when you consider the expectations you had when you took this job? 1 2 3 4 5

6. How satisfied are you with your present job in light of career expectations? 1 2 3 4 5

7. How satisfied are you with your supervisor? 1 2 3 4 5

8. How satisfied are you with your fellow workers? 1 2 3 4 5

Executive Summary of Results

Do you wish to have a copy of the executive summary of the results mailed to you?

1 ____ Yes
2 ____ No

THANK YOU VERY MUCH FOR YOUR COOPERATION