

AGRICULTURAL UNIVERSITIES FOR THE TWENTY-FIRST CENTURY

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Introduction

One of the great institutional innovations of the nineteenth century was the creation of agricultural universities.¹ Behind this seemingly simple idea were the notions that (1) farming could benefit from the systematic application of the findings of scientific and technical studies, and thereby, (2) the level of living of the entire rural population could be improved bringing prosperity to all. In many nations as well, agricultural universities were also seen as (3) a way of bringing the farm and rural population more fully into the political life of the nation. These universities would develop activities which would include research in a variety of different disciplines, instruction of students enrolled in undergraduate and graduate programs, and the extension of research findings and non-formal education for people working in rural areas.

Initially, these universities were established in Europe, North America, and Australasia. Then, during the 1960s and 1970s, most Third World nations followed suit. Often this was accomplished as a result of projects sponsored by the Agency for International Development (AID) and its predecessor agencies.

Over the following years, these universities have grown and evolved in many different ways particularly in response to the local conditions which surround them. Many lessons have been learned yet all too often this learning has not been shared, for one reason or another. This paper is written in the context of the advantages of sharing experiences and lessons learned.

Accordingly we have three interrelated objectives: First, we summarize the findings of a ten nation study of agricultural universities sponsored by AID focusing more on the issues raised than on the successes noted in the individual country reports. Then, we examine the changes affecting the organization, structure, mission, and functioning of agricultural universities, not only in less developed nations but worldwide. Finally, we propose some strategies that agricultural universities can use as they attempt to meet the challenges posed by these changes.

I. Some Study Findings and Issues.

The study undertaken by AID involved 23 universities in 10 nations. Those nations were Brazil, Dominican Republic, Ethiopia, India, Indonesia, Malawi, Mexico, Morocco, Nigeria, and Thailand. In each case one or more teams were sent for various periods to evaluate the agricultural universities. The findings were that while there is wide variation in the organization, mission, and functioning of these institutions, there were nevertheless far more similarities than differences among them. Hence, it was possible to develop several generalizations about them.

For example, in virtually every case examined the agricultural university in question had been institutionalized and was now an accepted part of the national scene. Every institution could point to some successes, many of great magnitude, in the field of higher agricultural education. Graduates of the various agricultural universities were to be found across a wide range of different vocations within the public sector. Thus they were involved in scientific research, technological development, education and communication within most ministries of agriculture, in agricultural extension services, and in many other agriculture-related commissions and services.

In some nations they were also found in considerable numbers in the private sector. Finally, of course, many have stayed on in academia and have become professors themselves. These graduates have undoubtedly changed all these organizations by infusing new competencies, energies and understandings into them.

In addition, the study teams noted considerable successes in the application of technological research and development especially in the area of crop plant improvement and the widespread adoption of new varieties. The very impressive gains in overall food production that were noted, especially in those nations with large areas devoted to wheat and rice cultivation could often be associated with the activities of the agricultural universities in the region or nation. These improvements in crop plant productivity have not been confined to the use of higher yielding varieties alone. The development of better fertilizer regimes (and in a few cases, improved fertilizers), new cropping patterns, the integrated control of pests, parasites and pathogens, and the resolution of micronutrient shortages have all been noted as well.

Most could point to successes in the adoption of improved animal agriculture as well. Improvements ranged from the breeding of more efficient animals, to improved animal nutrition, and to the widespread use of artificial insemination. These animal production increases were found in a whole host of livestock species including poultry, pigs, cattle (both draft and production) buffalo, sheep, goats and even fish, silkworms and honeybees.

Improvements in credit facilities, marketing infrastructures and the development of other vital services could also be directly attributed to the functions of the universities in some instances. And a similar story could also be told for changes in the standards of nutrition, hygiene and literacy in very many rural communities. Two areas of endeavour which also seemed to be receiving increasing attention at agricultural universities in most of the nations examined were, agricultural engineering for cultivation, storage

facilities and energy generation, and a variety of initiatives associated with business management and commerce.

As this brief discussion makes clear, the achievements of the agricultural universities have been substantial, especially given the short period of their existence. In addition to these constructive achievements, however, the study also revealed a wide variety of issues of concern which were threatening to the continuing development of many, if not most of these institutions. Indeed, these issues are so widespread around the world that we believe that they merit discussion here in some detail.

1. Mission. Organizations, like individuals, engage in purposeful activities. These purposes are regarded as the "mission" of the organization and, in the corporate world, they are often formalized as written statements. There was an identifiable sense of mission in all of the universities examined although there were very wide differences in the extent to which it was formalized. At the most effective of these institutions, missions were clearly defined, known to all associated with the university, and the subject of continuous redefinition in light of changing realities. However, at many institutions missions were poorly defined, rarely discussed, and a subject of which few were even aware. Hence, there was a concern that faculty, staff, students, and others associated with the university were floundering.

2. Role in National Development. The mission of universities very often includes the notion of the role of the organization in the overall development of the region in which it is located or even of the nation as a whole. That is to say, the university was and is expected by the government to play a relatively important role in ameliorating real problems and improving real situations faced by the people in their everyday lives. In no cases of which we are aware were agricultural universities formed without this apparently essential feature. Nevertheless, the study teams noted wide variations in the degree to which both members of the university community and those outside the university were aware of this important role. This variation was found both within and across nations. In some cases not only did the university community work hard to achieve this goal but the importance of this role was well understood by government officials and farmers. In other cases, however, those within and outside the university community were not aware of this as a goal and were even surprised when it was mentioned.

3. Leadership. No matter what system of governance a university may have, leadership remains an essential component of its functioning. In particular in the early stages of institutional development, the review teams found that one or more dynamic leaders were a key variable that often made a difference between success or failure. Universities may encourage leadership by rewarding its development among faculty and students, or they may discourage it by refusing to reward it or even thwarting those who wish to lead. The review teams found evidence of both at the various agricultural universities visited. In some cases leadership was rewarded by verbal and written praise, promotion, and advancement of intellectual projects. However, in other cases, leadership was frustrated by rapid rotation through various leadership roles, diffuse lines of authority, or overly rigid systems of rules and procedures.

4. Environmental concerns. When the agricultural universities studied were founded, environmental issues were of far less concern than they are today. This was in part due to a lack of awareness, but it was also due to lower levels of environmental degradation of all sorts. In any case, concern over environmental pollution stemming from agricultural activities (e.g., soil erosion, pesticide pollution, fertilizer runoff) emerged at most of the institutions studied. However, only a few of the institutions had developed programs that integrated environmental concerns into their ongoing teaching, research, and extension programs.

5. Employment of graduates. All of the institutions studied were founded at a time when national agricultural (and related) services were very short of qualified personnel. Hence, the emphasis in the educational programs of the universities was on preparing graduates for public service careers. In most nations, agricultural civil service positions are no longer available in large numbers. The same can be said of positions within the universities themselves as their academic establishments have levelled off. This has markedly affected the employment prospects of graduates with higher degrees, which in turn has depressed enrollments in graduate degrees. In response to these changes, some universities have adapted their curricula to focus more on the knowledge and skills needed for employment in the private, commercial sector. Many, on the other hand, have not made adjustments to such environmental change. Indeed, many have actually reduced undergraduate enrollments as a reaction to the shrinking demands of the civil service.

6. Breadth of Perspective. One major reason for the formation of many agricultural universities during the 1950s and 1960s was an almost universal concern about serious shortages of food on both national and global scales. This led to a strong emphasis on the need to increase dramatically the levels of agricultural production. The focus on increasing yields also applied to the production of "estate" and cash crops as a result of the quest for higher farm and national export income. And these factors were not confined to developing economies. The focus of agricultural universities throughout the world at that time was on production increases. This strong orientation toward production, to the virtual exclusion of other goals, has remained a central feature of many of the institutions included in the present study. However, as we note below, the needs of those in the agricultural and rural sectors for sustainable development, have changed very significantly over the years, and, indeed, they continue to change at an ever-increasing rate today.

7. Organizational linkages. The most effective agricultural universities studied have developed strong linkages with various other organizations. These active inter-relationships involve extension and extension-related services, farmer organizations, input suppliers, output processors, and the ministries of agriculture, livestock, education, planning and finance. It is as a result of such inter-institutional cooperation that the successful universities have been so influential. On the other hand, many of the agricultural universities have remained, or have become detached from their institutional environment, such that they are remote from the very people they were designed to help.

II. Toward the Twenty-First Century

Today, after more than one hundred years of experience worldwide, these universities are increasingly finding themselves in social, political, cultural, technical, and natural environments that are rapidly changing. Moreover, the changes that are occurring are likely to require profound adaptations that would not have even been contemplated as little as twenty years ago.

1. A changing world agriculture. All nations of the world are now faced by a rapidly changing global agriculture. Agricultural commodities of all kinds now exist in a volatile world market in which new technical changes can make previously distinct commodities interchangeable. For example, beet and cane sugar as well as high fructose corn syrup (HFCS) can substitute for each other for many industrial uses. Similarly, palm, coconut, soy, sunflower, olive, cottonseed, and other cooking oils are now essentially interchangeable for most industrial processes. These new cross-elasticities make for more volatile markets with wide price fluctuations. Moreover, lower shipping costs resulting from improved air and sea transportation now make it possible for producers thousands of kilometers away to compete with local producers. This is even true now for certain fresh fruits and vegetables.

Dietary demands have also begun to change. Whereas in earlier decades the emphasis was on increasing demand for cereals, today consumers are seeking more variety in their diet and more meat, fruits, and vegetables. This is a result of the growing incomes, and, thus, increasing effective demands of substantial segments of the population in many nations. This is especially so in nations where opportunities for urban employment continue to grow. As these changes occur, there are emerging demands for scientists to address issues of post-harvest storage, processing and preservation, in addition to increasing production. Also, as more and more nations reach the point where food production keeps pace with increasing effective demand, the problems of productivity and sustainability loom large. In periods of scarcity it is easy to convince farmers to produce more; in periods when supply begins to equal demand or even surpass it, serious problems relating to productivity emerge. This is as true in Western Europe, the United States, and Australia as it is in less developed nations. Under these circumstances questions concerning the economic aspects of food production assume a much higher profile.

At the same time, the great successes in increasing world food production made in the 1970s are unlikely to be repeated in the future as the backlog of unused research that made those successes possible no longer exists. In many nations, particularly those of Africa, per capita food production still lags behind population growth. And, as this year has demonstrated so well, simultaneous drought situations in several major grain-producing nations can rapidly reduce the world grain supply to dangerously low levels and threaten to raise prices to levels that are far above the ability of the poor to pay. Future research programs will have to develop whole new strategies that involve multidisciplinary teams rather than merely disciplinary specialists to deal with these complex issues.

2. A growing environmental awareness. The higher levels of production have brought with them the recognition of environmental deterioration including soil erosion, aquifer depletion, deforestation, chemical pollution, and destruction of the habitats of wildlife. These issues could remain largely ignored as long as they were of relatively minor proportions. Today, however, in some areas of the world deforestation threatens to create major climatic changes and/or to destroy irrigation systems. Similarly, the widespread use (and misuse) of agricultural chemicals in an effort to increase production has led to both acute and chronic illness among farmers, farmworkers, and even urban consumers. It has also reduced fish populations thereby eliminating a valuable natural resource. Considerable research efforts will be needed to develop safer chemicals, biological substitutes, and new cultural practices that require less intervention.

Irrigation has been a blessing to many as it has increased food production and opened previously uncultivated lands to agricultural production. However, at the same time, in many places it has led to overuse of water resources threatening aquifer depletion. Intensive cultivation coupled with low income, has also led to greater problems resulting from soil erosion as farmers have sought to maximize production while putting off needed erosion control measures. Finally, the natural dynamics of many plant and animal populations have been so violently disturbed through intensive farming practices, that very serious negative impacts have occurred in the ecology of vast areas of the world. These issues are so complex that universities face the prospect of having to develop new ways of inquiry which will address problems which currently remain unaddressed.

3. New linkages. The linkages between agriculture, industry, and the service sector are being rethought as the problem of finding work for all has taken on global proportions. Today, nearly every nation of the world faces considerable unemployment. Previous solutions tended to focus entirely on the industrial sector. However, it is now apparent that industrial development alone will not be adequate to provide employment for all. At the same time, technical changes in agriculture have often been labor-displacing, even in areas where labor was in short supply. Only recently has it become apparent that more consideration will have to be given to the linkages between farm and off-farm activities if agriculture is to remain a dynamic sector of the economy. This means that more attention in both research and teaching will need to be devoted to village-level processing of agricultural products, to part-time non-farm activities for farmers, and to the development of new products and markets.

4. New developments in science and technology. Recent developments in several fields of science are likely to have a profound effect on world agriculture, both at the production and processing stages. In the field of molecular biology recent developments have made possible the transfer of genetic material from one organism to another. This has opened huge new areas of research in plant and animal improvement. For example, new animal vaccines and diagnostic kits have been developed. Similarly, research is proceeding to develop plants with more pest resistance. Genetic engineering techniques will also allow particular production-related genes to be manipulated resulting in new "super" breeds and varieties and the transfer of specific processes from one species to another. At the same time molecular biology has opened

possibilities for more efficient systems of fermentation and even the production of specific natural products in "bioreactors." Certain agriculturally-derived pharmaceutical products are already being produced in this manner.

Nor are the new developments limited to molecular biology. Recent developments in computerization have begun to affect agriculture in three ways. First, computers represent an incredible resource for the processing and storage of vast amounts of information thus providing a whole new range of opportunities for the transmission, or extension of knowledge. Such developments will revolutionize education and extension. Second, computers also present researchers with the capacity to simulate very complex interactions as mathematical functions. This will have many uses from aiding on-farm decisions to guiding experimental research through the construction and running of simulation models. Finally, computers are now being incorporated into mechanized systems such as controlled-environment housing for plants and livestock, into irrigation systems and even into cultivation machinery. The use of robots in a number of agricultural applications is an extension of this aspect of computers.

Nor should these areas of new developments be seen as independent. More and more they are being seen as complementary. Computer-controlled bioreactors that produce natural products from plant cells have already been developed. Similarly, robots that are computer controlled are now in use in industrial activities though their agricultural uses remain on the horizon. Whilst at first glance most of this high technology seems very remote from the realities of village life, rare indeed are those places in the world not yet serviced by transistor radios or even television sets. In fact, many of these new developments will be much cheaper and/or more effective, than the present human services they would replace; extension services are a clear case in point.

5. Some emerging theories and philosophies. Most of the scientific and technological developments mentioned above have been associated with a new understanding of "the way the world seems to work": new theories and principles from the sciences which underpin agricultural development. Universities have been very good at generating these new concepts and translating them into useful technologies for use in the field. Thus, innovative agricultural management practices have been developed based on new theories from biology, physics, mathematics and chemistry, and from economics, sociology, psychology and anthropology. What these same universities have been less successful at, is generating theories and developing practices which they can use in their own self-management! This is particularly true in the case of those agricultural universities which have not developed strong connections with other multi-faculty universities where organizational and management theories are investigated, or where theories and philosophies of curriculum and research might be commonly debated in open forums.

In essence then, these new developments in theories, practices and philosophies are placing fresh demands on agricultural universities across the world. They are requiring these institutions to draw upon bodies of knowledge previously outside their normal domains of expertise. This also means that they will more than probably want to add to their faculty establishments

academics from fields far removed from what traditionally have been seen as the core disciplines of agriculture. There will also be the need for new sciences actually to be created, especially for those concerned with the analysis of complexity.

Perhaps the greatest change in the way universities currently operate however, will be in the areas of policies and operations for the allocation of scarce resources, and in the way the potential impacts of the various activities are assessed and used in the processes of organizational management.

III. Strategies for the Future.

In short, the new worldwide challenge for the universities which we have been discussing, is to move from a focus on food production to that of sustainable and productive rural development. This will include a shift in the way universities are both organized and managed. Several steps in these directions have already been taken by individuals within universities in virtually every nation. They have recognized that agriculture needs to move away from a commodity focus to an emphasis on the development of new agricultural systems. These new and complex systems will include not merely the production of agricultural commodities but their integration with other key activities of the farm household, including concern for markets for their sale, facilities for their processing, the delivery of farm inputs, the availability of credit, the formulation of national resource and agricultural policies, and measures of effective demand.

Restructuring agricultural universities throughout the world to meet these new challenges requires not merely the addition of new departments (although that may be necessary as well), but consideration of new ways of knowing as well as new kinds of knowledge. For example, there is now a whole range of new theories of knowledge and its diffusion. There have been major changes in cognitive theory, the theory of research, and philosophy of science. These new theories suggest that, rather than a single way, there are multiple ways by which knowledge can be created, each of which is relevant and appropriate under different circumstances. Moreover, thinking is shifting from a focus on the parts to a focus on the whole, where knowledge about how the parts fit together is regarded as just as important as knowledge about the parts themselves. Furthermore, borrowing a metaphor from biology, development is being reconceptualized as the co-evolution of people with their environments. Put differently, people and their institutions do not simply exist, but are constantly responding to changes in their social and natural environments. These changes, in turn, change the environment again in a continuing process of co-adaptation and co-development.

The import of this change of perspective is that many agricultural universities are no longer being seen (by themselves or by others) as places where knowledge is created by scientists, handed to students or extension workers, and in turn passed on to farmers. Instead, as universities struggle to remain relevant to future needs, they are developing new approaches, new curricula, new paradigms, new theories and new practices, based on the active participation of all as learners. That is to say, agricultural universities are now being thought about such that they are seen as places for the

simultaneous learning of all actors--students, faculty, farmers, public officials, and others--about the real issues faced by the agricultural and rural sector. Doing so involves the participation of all parties involved in both teaching and learning.

A. Strategic Planning

Recent evidence makes clear that large hierarchical organizations of the type frequently found in both government and the private sector are slow to respond to such changes. Moreover, hierarchical organizations tend to be reactive rather than proactive with respect to their environment. The problems and responsibilities facing all agricultural universities including those in more as well as less developed nations are such that they can only succeed if they become proactive--seeking to restructure their own environment so as to insure the success of their mission. This requires rethinking the way in which agricultural universities function so as to make impacts rather than outputs the criteria of success. If, for example, one wishes to have the impact of raised incomes among smallholders, then interdisciplinary teams need to be put together that can work toward that end not only with respect to designing new technologies but also with respect to restructuring the rural social, economic, and physical environment in furtherance of that end. This may mean that socioeconomic studies of barriers to increased income need to be undertaken. It will certainly mean the participation of a wide range, and large number of people both from within the university and from the rural community targeted. It will involve scientists from the natural, social and ecological sciences working together with each other and with their "co-learning clients". These groups will also contain state legislators and officials from institutions beyond the university itself. And it may mean that the university will need to negotiate directly with other government agencies to achieve its objectives.

Only by marshalling the capacities of all members of the organization and by building in mechanisms for response to change can organizations function effectively in such environments. This means that planning and evaluation cannot be activities engaged in once every year or five years but must become a central feature of the ongoing activities of the organization. Similarly, priority setting must be given greater weight than it has had in the past. It also means that individual and organizational learning must be designed into the institutional fabric. In particular, instead of emphasizing knowledge we need to emphasize ways of knowing. This is particularly true of learning institutions such as universities.

Designing these new types of agricultural institutions will not be easy as no nations now have them in abundance. It is our hope that one outcome of this workshop will be the beginning of a dialogue between agricultural faculty and administrators in many countries as to how more effective higher agricultural educational institutions might be created.

1) Participation. Considerable research indicates that organizational change is most effective and lasting when it is the product of widespread participation of people from all strata within the organization. Moreover, it is unfair to expect top administrators to accomplish these tasks themselves. Everyone needs to be exposed not only to new visions but to strategies for

thinking about new visions, for what we are talking about here is not mere tinkering with curricula or re-ordering research priorities, but fundamental reform of the purposes, functions and organizational structures of universities. The kind of fundamental change needed is one that challenges worldviews, paradigms, and philosophical stances. This is inherently disturbing for it forces people to question those things not usually questioned, and to face issues not usually faced.

2) Continuing education for faculty is essential if agricultural universities are to keep pace with the rapid changes in science and agriculture. Scientist exchange programs, sabbatical leaves, teaching seminars, increased attendance at scientific meetings, and collaborative research projects and programs were proposed by many individuals as a measure for insuring that faculty remain abreast of the latest developments in their respective fields. What forms such exchanges and collaborative research might take deserves careful consideration.

3) Monitoring university impacts. Another aspect of strategic planning is the need to document the impacts that agricultural university programs and projects have. All too often universities have only vague information on the success of adoption of recommended techniques and practices. They need to use such information to document their successes and to correct their mistakes. Also, such information needs to be used to show state and central government officials that agricultural education, research, and extension are investments in the future of the state and nation and not costs to be borne as the price of progress.

B. Building New Constituencies

Throughout the world agricultural universities will only continue to flourish to the extent that they build constituent groups in their respective nations and states. The organization of farmers into clubs or other groups (already underway in some nations) is essential to the political support of the universities. It also offers an excellent vehicle by which they may make their needs and demands known to university scientists.

Conclusions: Building Effective Agricultural Universities

There are at least three ways to think about organizations. The most common is to think of them as being well-bounded with little contact with or influence from their external environment. The second is to think of them as responding to a continuing array of pressures and requests from an external environment that may be friendly or hostile. The third is to think of organizations as active shapers of their own environment.

Throughout the world, the leaders of most organizations still think mainly in terms of the first model. They are largely concerned with the day to day internal dynamics of their organizations such that they rarely have time to consider what is happening outside the organization. For organizations that have stable environments, this model may be quite appropriate.

A considerably smaller number subscribe to the second model. They see themselves as attempting to respond rapidly to whatever new potentials or threats the institutional environment may offer. As such, they are able to guide their respective organizations through hard times and to take advantage of opportunities. However, they are content to wait for opportunities to come along, believing that they have little or no ability to create the opportunities themselves.

Finally, a very small group of organizational leaders have discovered that successful organizations are those that seek to change their environment such that the probability of organizational success is markedly enhanced. Like those who subscribe to the second model, they take advantage of opportunities. However, in addition, they are engaged in constant negotiation and persuasion of others, forming alliances and locating common interests. Through these processes they are constantly reconstructing the world in which the organization functions, and in so doing restructuring the organization as well.

The majority of leaders of agricultural universities around the world seem to fall into the first category. They receive a certain sum annually from their governments which they employ in about the same way as they employed the money the year before. A smaller number are very effective in following the second model. They attempt to respond rapidly to clients and in so doing are able to increase their resources. However, they do this at the expense of having coherent goals. Their goals become whatever their clients' goals happen to be at that time.

Finally, a small number fall into the third category. They have a vision of what their institutions should be, who they should serve, what projects and programs they should undertake, and they actively seek support to further those ends.

The challenge facing most agricultural universities around the world over the next decade -- including without question those in the U.S.-- is to move from model one or two to model three. Unfortunately, no blueprint exists for accomplishing a task of this magnitude for those who have been successful have often been unreflective about their endeavor, chalking it up to the charisma of one or two individuals. Nevertheless, some guidelines can be put forward.

Perhaps the key feature of such change is political support from the national government that will permit the agricultural university to develop into a proactive organization. Without that clearly demonstrated political support and commitment, it is unlikely that the universities themselves will accomplish much.

Also of particular importance is the formation of linkages between the university and the other organizations that are found in its immediate environment. These include other government agencies, international agencies (e.g., the IARCs, foreign aid agencies, private voluntary associations, universities in other nations, etc.), alumni groups, farmer organizations, organizations of transporters, manufacturers of farm inputs, processors of farm outputs, banks, and other rural development-oriented groups. The nature of these connections may vary from the very informal to the very formalized.

For example, relations with extension may be carefully elaborated to insure a smooth two-way flow of information and no duplication of effort. In contrast, relations with alumni groups may consist of annual informal meetings to provide alumni with a forum in which to make suggestions to faculty on improvements in curricula and to speak to students about career opportunities.

A second element in restructuring the university's environment is having a process of strategic planning as described above. Only by having a clearly established planning process that produces plans which are highly flexible can a university hope to be a creative and innovative organization producing innovative and creative ideas and people!

A central feature in reorganizing the university's environment must be the use of the extension service to feed information into the university. By this is not meant feedback on adoption of innovations by farmers, but translation of farmers' needs into researchable topics. In all nations of the world this is an exceedingly difficult goal to achieve. In fact, the most effective extension services (and by implication the most effective research organizations) are those that have developed the mechanisms necessary to insure that the research that farmers want is the research that is being done. The move toward Farming Systems Research (FSR) is one strategy toward achieving this end. In short, farmers must be taken seriously as partners in the development process in order to insure the success of the university in its role.

Worldwide, it is a curious fact that students have rarely been used to help universities accomplish this end. Though many universities have introduced practicums as means for introducing students to agriculture and rural life as it is practiced, students have not been used to gather information on issues of concern to farmers that research might be able to solve. This would serve the twin goals of educating students as to the nature of village life and providing an easy, effective way of insuring that the university faculty was conducting research on topics relevant to the real needs of farmers and rural residents.

One particular advantage that agricultural universities have in reconstructing the environment in which they find themselves is the very technology that they are capable of generating. Technology is an extraordinarily powerful tool for reconstructing the social world. One need only look at the profound social changes that have accompanied technical changes (e.g., the Green Revolution) to begin to understand the power of technical change. Of course critics of the Green Revolution have, with some accuracy, noted that some of the social changes that occurred as a result of the Green Revolution were undesirable. This is because the technical consequences of the technical changes were not considered conjointly with the socioeconomic consequences. With the advantage of the great strides and mistakes of the Green Revolution behind us, we can now see that agricultural universities have an enormous source of potential power to bring about dramatic planned social change if they plan technical changes while incorporating in advance social science knowledge about their probable impacts. The point to be emphasized, however, is that social scientists cannot merely be brought in to assess the impacts of new technologies after they are developed; they must be involved in the planning for those

technologies so that the intended beneficiaries do in fact benefit, and many of the consequences are known in advance.

In conclusion, the agricultural universities have accomplished much in the short period of their existence. Their very success has created a new range of problems that were only vaguely foreseen at their inception. The challenge for the next century is to move from production to productivity, from immediate needs to long term sustainability, from disciplinary to interdisciplinary research, from a commodity focus to a systems focus, from reactive organizations to proactive ones, from hierarchical organizations to participatory ones, from agricultural universities to universities for rural development. Given their record so far, we are confident that they have within them the people who can effect changes of such great magnitude.

Notes:

1/ We use the term "agricultural university" here to refer to institutions of agricultural higher education. In most cases these institutions are the equivalent of universities. However, in many cases they are referred to by different names.