

Challenges For Undergraduate Education In Agricultural Sciences

Richard H. Merritt

Introduction

I'm pleased to have the opportunity this afternoon to address your general session. As many of you know, some of your colleagues and I have been involved in a nation-wide effort since the summer of 1982 which attempts to understand what agricultural faculties believe to be unmet needs in undergraduate education, to determine what can be done to meet these needs, and begin to address them. My remarks are based on two projects: (1) The National Assessment of Agricultural and Natural Resources Curricula Project, supported by the Office of Higher Education Programs of the United States Department of Agriculture/Agricultural Research Service and (2) The National Agriculture and Natural Resources Curriculum Development Project, supported by the USDA, industry and the college community, and on my experience on faculties and in the administration of agricultural colleges.

The objectives of the first project, the assessment project, were to identify desirable course and curriculum changes in baccalaureate level agricultural and natural resources programs of study and to suggest ways in which these changes might be effected. The second project, the development project objectives are to develop course materials and conduct faculty training sessions. In what follows I will try to identify and characterize some of the current educational concerns of faculties of agriculture in the United States that we determined in the first project and then describe our efforts to assist faculties to meet the unmet needs.

A Brief History of Educational Changes

It goes almost without saying that, in order to meet the food and fiber needs of the U.S. and the world now and in future decades, we require well-educated and trained people to provide and disseminate new knowledge and technology. Our world and our social and ecological systems are changing. So must our educational institutions. If they do not change, their product — the students — will not be prepared to assume the roles for which they were educated and in

which they are needed. There is evidence, however, that undergraduate agricultural curricula have not changed enough in recent years. Let me briefly review how colleges of agriculture have educated their students since the early 1940's.

The 1940's and 1950's: Undergraduate programs were primarily directed toward the technical, scientific, professional and vocational educational needs of students. A typical curriculum included extensive course work in biology, chemistry, the earth sciences, possibly math and physics, plus technical agricultural course work. Instruction in other disciplines tended to be both minimal and separate from the main thrust of educating agricultural students.

1960's Through the Early 1970's: This period, especially the 60's, was an era of rapid expansion in higher education facilities, faculties, programs, and student numbers. Governments, colleges, and universities responded to the needs of large numbers of young persons who wished to attain higher education. The public was willing to support more higher education, and there was good support from business and industry. Agricultural colleges increased their programs, student body, and faculty size and explored many innovations in teaching and curricula. Activities of three groups contributed to many of the curriculum changes in agriculture:

- (1) the National Academy of Sciences' Commission on Education in Agriculture and Natural Resources (CEANR),
- (2) to a lesser extent, the National Academy of Science Commission on Undergraduate Education in the Biological Sciences (CUEBS), and
- (3) the Kellogg and Knapp study of agricultural colleges supported by the Carnegie Foundation.¹

Among the resultant changes in undergraduate programs were:

- (1) new curricula and courses in agricultural business and marketing.
- (2) the addition of new introductory agricultural courses such as "plant sciences," "animal sciences," and "man and his food," designed to serve majors and non-majors in both agriculture and liberal arts curricula.

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- (3) more course work in literacy, including the addition and re-design of courses in technical and scientific writing, speech, and communications.
- (4) the introduction of course work and programs in Integrated Pest Management.
- (5) in a few institutions, new courses and programs in environmental science and environmental studies.
- (6) again, in a few institutions, re-design of courses and the creation of new courses to bring in systems theory and analysis and ecology. This effort was accompanied by the development of some inter- and multi-disciplinary courses and curricula as some faculties were concerned that progress in agriculture in the United States required graduates who had not only scientific and technical competence, but also competence to deal with related public policy, social and cultural issues. Very few institutions were able to do this.
- (7) a few courses considering humanistic perspectives on agriculture and technology.
- (8) some new courses and curricula in international agricultural development.
- (9) work study, cooperative education, and internship programs to help students apply in their classroom knowledge to the real world.

Excellent progress occurred in the 1960's and early 70's. Many innovative and highly desirable improvements were begun. However, few were given adequate support to develop and diffuse to other institutions. The era now seems one of unfulfilled potential.

The Late 1970's and Early 1980's: Recession, inflation, reduced enrollments, and lowered public support for higher education reduced the real value budgets for U.S. colleges and universities. The period was and is one of retrenchment. One of the several ways in which retrenchment has affected course and curricula innovation is through the reward system. One result of cutbacks has been more stringent promotion criteria which give higher priority, especially in the Land Grant Colleges, to research scholarly activity than to teaching scholarly activities, including course and curriculum innovation. Consequently, faculty efforts have moved away from the latter, and both research and teaching have been increasingly rechanneled into traditional discipline areas rather than problem-oriented and inter- and multi-disciplinary areas. A notable exception to this process was further development of programs and courses in agricultural business, with industry support. This is, however, an exception. While carrying out the "National Assessment" last year, I was told many times by faculty, administrators, and others that the colleges need more innovation and change but that the reward

system and resources required are simply not there to do the job.

The need for some changes has also been recognized at the highest levels of government. On February 10, 1984, the Honorable John R. Block, U.S. Secretary of Agriculture, convened the first Secretary's Challenge Forum — "Investing in Brainpower — Keeping U.S. Agriculture's Competitive Edge." He stated there that "Viability of the agricultural industry relies heavily on our ability to attract outstanding minds; the development of human resources will have as great an impact on the future of an increasingly high technology agriculture as any single factor."

The teaching programs of colleges of agriculture need renewal. As stated in the Secretary's Challenge Forum, "Graduates of the future need to be prepared to deal with technical issues, social issues, political issues, and economic issues. Modern colleges of agriculture must bridge all of the gaps between the farming enterprise, agribusiness, and the most basic research opportunities."

Project 1. The National Assessment of Agriculture and Natural Resources Curricula: The National Assessment project that I directed in 1982-83 developed out of concerns about retrenchment and the need for continued innovation and change on the part of two national groups concerned with higher education in agriculture and natural resources. The first is the National Higher Education Committee, organized by the USDA Joint Council on Food and Agricultural Sciences as a result of Public Law 97-98, Title XIV of the Agriculture and Food Act, in 1981. This committee consists of deans of agriculture and natural resources, home economics, forestry, and veterinary medicine, principally from the National Association of State Universities and Land Grant Colleges (NASULGC) and the American Association of State Colleges and Universities (AASCU). The second is the USDA Office of Higher Education Programs, established in 1977 as a result of Public Law 95-113, which designated the USDA as the lead agency for higher education in food and agricultural sciences. Both groups supported and participated in the 1982-83 curriculum assessment project.

We formed a task force with representatives from the two national associations (NASULGC and AASCU), the National Higher Education Committee, the USDA Office of Higher Education Programs, and an advisory committee from business and industry. The task force held regional and national meetings, developed survey instruments, evaluated the results of the surveys, and recommended long-term and short-term solutions to the problems identified. The survey helped identify and rank twelve course areas of high priority which are not now adequately represented in agricultural curricula. These are the following:

1. Introduction to Food and Agricultural Systems Analysis
2. Problem Solving
3. Ethical and Public Policy Aspects of Domestic and International Agricultural Systems
4. Cultural and Social Aspects of Domestic and International Agricultural Systems
5. Energy Use in Food and Agricultural Systems
6. Integrated Reproduction Management
7. Computers in Agriculture
8. "Man and His Food" — Biological and Consumer Aspects
9. Systems of Integrated Pest Management for Crop Protection
10. Leadership
11. Internships and Cooperative Education
12. Student Projects

The task force recommended that certain of these high priority areas be developed into courses or course modules and that support for development come from external sources: foundations, business, industry, and government. This is the second project. The plan is to develop courses and course materials in six of the twelve high priority areas over the next three to five years. Three are defined as long-term projects because they must essentially start from scratch; three are short-term activities, which can be addressed within 18 to 24 months since some course materials are already available.

Before describing the priority areas for course development, let me explain some of the background for our choices. The three long-term areas selected — Introduction to Food and Agricultural Systems Analysis; Problem Solving; and Ethical and Public Policy Aspects of Domestic and International Agricultural Systems — were among the top four in the ranking of respondents to our survey. One was even higher: Computers in Agriculture. However, this is perhaps the best example of a high priority area that is being widely addressed at present and thus does not require special attention from our national group. The task force and various groups with whom we met also considered course areas beyond our list, such as English, the Life and Physical Sciences, Business, etc. While all agreed that these are extremely important to undergraduate education in agriculture and natural resources, our analysis showed that faculties were adequately including them as key pre-requisites and major courses and that our impact in terms of developing them further would be minimal given the organization of universities. We also did not include the Agricultural Business area, since it has received extension attention in the last four years. The ones selected concern the total education of agriculture students: ways of identifying and looking at problems, solving them, and focusing upon key multi-disciplinary areas within the agricultural system.

Descriptions of the Course Areas

Long-term:

(1) Introduction to Food and Agricultural Systems Analysis — An orientation designed to introduce students to an holistic way to thinking about agriculture. Systems analysis techniques are used to evaluate the technical, scientific, social, political, economic, and humanistic aspects of agriculture. The components analyzed, among others, are national and international agricultural production, marketing, finance, research and development, and policies and their reciprocal interrelationships with human societies and their activities.

(2) Problem Solving — The approaches, fundamentals, and methods used to solve real life problems in agriculture; case study method stressed.

(3) Ethical and Public Policy Aspects of Domestic and International Agricultural Systems — An evaluation of ethical questions of concern to agriculturalists. Analysis of local, state, regional, national and international policy development and their impacts on contemporary issues such as water management and quality, rural poverty, world food hunger, land use, waste management, air pollution, the urban rural interface, etc.

Short-term:

(1) "Man and His Food" — Biological and Consumer Aspects. An historical and contemporary review of culture, food habits and diet, exploration of factors important in selection and consumption of food, relationships between food consumption, food safety, nutrition, and health.

(2) Systems of Integrated Pest Management for Crop Protection (IPM) — An analysis of the various biochemical, chemical, physical, and cultural techniques alone or in combination which are used to control pests of plants in such a way that there is minimal environmental impact.

(3) Leadership — Theories, principles, and application of leadership which may be offered as seminars, courses or through club and student life programs.

The Proposed Process:

The project is based upon the concept that four essential factors are necessary in order to change or modify a college curriculum:

- (a) Faculty interest in and desire to implement changes;
- (b) Availability of text books, syllabi and other teaching materials;
- (c) Training sessions to assist faculty with appropriate credentials in offering new course areas; and
- (d) Feedback activities to improve the courses.

The first factor, faculty interest in changing courses and curricula, is well documented by the

surveys and meetings which were held regionally and nationally 1982-83. The other three required further work. We propose the following steps toward their realization:

Step 1. Develop course materials. We have identified knowledge bases in a few colleges and businesses. Our plan is to sponsor workshops with USDA funds already received. The workshops will bring together faculty teaching in the area, deans, and task force members. The objectives of the workshops will be to organize a team which will develop the course materials, to organize course descriptions, and to identify the major ideas and techniques.

Step 2. Appoint a person to coordinate course development activities.

Step 3. Negotiate with faculty and their universities for released time from their teaching and research responsibilities in order to work on a part time basis (e.g. several months, 10-30 percent of their time) to develop course materials such as:

- (a) A text or teaching modules.
- (b) A teacher's guide, to include (1) introductory activities, (2) suggested teaching methods, (3) problem solving exercises, (4) pertinent vocabulary, (5) discussion questions, (6) performance-based objectives, (7) program goals, (8) key concepts, (9) examination questions, (10) alternative course module outlines.
- (c) Support materials, audio visual aids, computer software, games.

Step 4. Publicize and disseminate teaching materials to the University community.

Step 5. Conduct a six-week faculty training session at the conclusion of the course development phase. Deans and faculties who wish to add this course area to their curriculum will identify and partially support 20 faculty members who will enroll in this course. They will be the professors who will teach the courses at their own universities.

Step 6. One year after the faculty training session, conduct a one-week workshop to make appropriate revisions and develop supplementary course materials.

Step 8. Using the written evaluation, conduct a one-week "continuing education workshop" one year after the revision workshop will be conducted. This will be the final feedback mechanism proposed for the project.

Steps 5 and 7 and/or 8 can be duplicated as necessary to provide the "multiplier" effect.

In summary, then, the process we propose is to establish an external reward system, conduct faculty training sessions for those who will teach the courses on their campuses and, in subsequent years, conduct two one-week workshops and send out an evaluation form to provide three feedback mechanisms to the authors and instructors.

The course development process has begun. From April 30-May 4, 1984, the Food and Agricultural Systems Course Development Workshop was held at the University of California, Davis. This first course development activity of our curriculum renewal project went very well. The following were accomplished:

- (a) Agreement on a common paradigm,
- (b) The development of three possible course syllabi,
- (c) The development of a two-year plan of work during which time a book, a teacher's guide, case studies, an annotated bibliography, and other appropriate teaching materials will be developed,
- (d) A team coordinator, Dr. Kathleen Wilson, University of Hawaii, was appointed,
- (e) A plan of work was developed for each of seven faculty participants for a two-year period of time,
- (f) A budget was developed to make it possible for each of the seven faculty to participate in the project.

The Task Force and Business/Industry representatives who participated during this workshop were impressed with the quality of the seven faculty members who will work on the project. They constitute a multi-disciplinary Food and Agriculture Systems Team and represent the disciplines of agricultural engineering, parasitology, agricultural economics, ecological anthropology, agronomy, and community resource development and come from Texas A&M, University of Hawaii, North Carolina State University, University of California, Davis, Hawksbury Agricultural College in Australia, and Rutgers University.

Funding:

Funds have been received (\$170,000 thus far) and others are being sought on the basis of a joint venture among foundations, business and industry, the USDA, and the University community.

Concluding Remarks

Curriculum development and implementation are complex activities. Appreciating this complexity, our task force is attempting to address certain areas of concern to faculties in agriculture and natural resources, especially those for which resources within universities and colleges are scarce. Our efforts reflect the fact that faculties are much more concerned with the total curricula of their students today than they were a decade ago. They want to know about and have input into the entire program of their students. I recall a talk I gave about ten years ago in which I observed that most faculties were only concerned with their major courses and the co- and pre-requisites. They appeared neither interested nor concerned with "those

**PRIORITY LISTING AND DESCRIPTION OF COURSE AREAS
ASSESSMENT OF AGRICULTURE AND NATURAL RESOURCES
CURRICULUM DEVELOPMENT PROJECT**

Curriculum Component	Description
A. LONG-TERM AREAS	
1. Introduction to Food and Agricultural Systems Analysis	An orientation designed to introduce students to an "holistic" way of thinking about agriculture. Systems analysis techniques are used to evaluate the technical, scientific, social, political, economic, and humanistic aspects of agriculture. The components analyzed among others are national and international agricultural production, marketing finance, research and development, and policies and their reciprocal interrelationship with human societies and their activities.
2. Problem Solving	Approaches, fundamentals and methods used to solve real life problems in agriculture, case study method stressed.
3. Ethical and Public Policy Aspects of Domestic and International Agricultural Systems	Evaluation of ethical questions of concern to agriculturalists. Analyses of local, state, regional, national and international policy development and their impacts on contemporary issues such as water management and quality, rural poverty, world food hunger, land use, waste management, air pollution, the urban-rural interface, etc.
4. Cultural and Social Aspects of Domestic and International Agricultural Systems	The interrelationship between agriculture and social organizations, land tenure systems, demographics, and cultural values of rural communities. Social and cultural implications of agricultural and rural development programs in developing countries and regions will be studied, as well as the concept of integrated rural development (agriculture, health, nutrition, and education).
5. Energy Use in Food and Agricultural Systems	Analysis of the different forms of agricultural production, distribution, and utilization; alternative energy sources and conservation practices. Includes also basic engineering principles and an introduction to robotics.
6. Integrated Reproduction Management	Analysis of all the factors which affect reproduction of food animals including nutrition, genetics, physiology, management, and protection from disease.
B. High Priority Area But Already Being Addressed	Computer applications for decision-making in agriculture; elementary principles, computer languages, and programming.
1. Computers in Agriculture	
C. SHORT-TERM AREAS	
1. "Man and His Food" — Biological and Consumer Aspects	Historical and contemporary review of culture, food habits and diet; exploration of factors important in selection and consumption of food. Relationships between food consumption, food safety, nutrition, and health.
2. Systems of Integrated Pest Management for Crop Production	Analysis of the various biochemical, chemical, physical, and cultural techniques alone or in combination which are used to control pests of plants in such a way that there is minimal environmental impact.
3. Leadership	Theories, principles, and applications of leadership may be offered as seminars, courses, or through club and student life programs.
4. Internships and Cooperative Education	The various kinds offered including details on implementation.
5. Student Projects	The enterprise management program takes the student one step beyond experience in laboratory classes and field trips. The student is provided with an opportunity to manage a single agricultural enterprise project using campus facilities and under the supervision of faculty. The student conducts a semi-commercial agricultural enterprise project and gains experience in planning, organizing, record-keeping, decision-making, and evaluation of an agricultural production enterprise. It is another tool that can provide relevant education especially to students who have had little or no production agriculture experience.

other areas taught by that other college" — i.e. the liberal arts part of their university. The "other college" faculties felt the same way toward the agriculture and natural resource faculties. And the students knew it. Courses were selected in the social sciences and humanities for too many of the wrong reasons, and the result was too often unsatisfactory. The situation appears different now. More and more faculties are concerned about which social science, humanities and ethic courses their students are taking, how they fit into their curricula, and how they interrelate with agriculture, science, and technology. This is a healthy sign that deserves support.

The task of revising courses and curricula and adapting them to present realities and future needs is not easy. Faculties will have to become more critical and aggressive about the goals and objectives of their curricula, how they are implemented, and the results they produce in their graduates. Results of innovations since the 1960's are mixed. Integrated pest management is a good example. In the early 1970's, I co-chaired a national effort to develop courses and curricula in integrated pest management with Charles Browning, now Dean at Oklahoma State University. The last survey I saw, however, showed that only 14 institutions had meaningfully included such course work in their programs of study, out of 142 Land Grant and AASCARR colleges in the United States which offer course work in agriculture and natural resources. That is not much progress. Hopefully, the results of a new survey on the state of the art in integrated pest management, being conducted by Professor Poe at Virginia Polytechnic Institute, will show more progress.

Deans and university officials, in particular, will have to concentrate on creating more appropriate reward systems so that those faculty who are encouraged to embark on course and curricula innovation are not penalized in the promotion process. Research-oriented scholarly activities are the primary reason for the existence of the university and must be key components of the reward system, but they should not be mutually exclusive of other, less recognized though equally important, scholarly endeavors: course and curriculum development.

The development of new knowledge and the dissemination of that knowledge to the farmer or consumer — the research and extension activities of many of our colleges — are two key goals of our colleges and universities. Innovation and the development of new knowledge into technical packages to be used by our constituents is essential if agriculture in the U.S. is to flourish. The term "Technology Transfer" is used to describe this. Is it not also true that we must also reward those who work on the third key goal of the colleges — the dissemination of new and innovative knowledge to our students? I

wonder how much new knowledge — disciplinary — is disseminated further than our graduate students and possibly our majors? And how much of this knowledge leaves the department or college? How much is included in new books and teaching aids? The reward system must recognize the need for new and innovative knowledge transfer to these groups of students as well as to the general agricultural college population and the university community.

The challenge for agricultural colleges is a big one. We must have well-designed and well-implemented programs, relevant to societal needs, in order to graduate knowledgeable, articulate, and analytical doers and leaders for U.S. food, agriculture, and natural resources. It will take concerted and well planned efforts to respond to the challenge.

¹Kellogg, Charles E. and David C. Knapp, *The College of Agriculture - Science in the Public Service*, 237 pp., McGraw-Hill Book Company, New York, 1966.

Changing Requirements for Ag Graduates

Roger Schaefer

We would begin by me lecturing - pointing out:
Change is a natural process and inevitable and etc.
Using many cliches and trying to sound profound.

It is difficult if not impossible to come up with an answer; in fact, it would be presumptuous. Consequently, let's think together. I will need your input. You are experts in your field and I do have experience to offer concerning what industry is looking for in an Ag Grad.

We are both in the business of developing a marketable product. One that will "sell". The best way to measure our success is how well a product sells - volume and profit produced.

Let's talk about measuring success:

- Ag Grad
- Yours
- Mine.

Group discussion on how an advisor and instructor measures their success.

A profile was developed on what the Ag Grad must have for maximum marketability fitting all employment areas.

Requirements: (not necessarily in priority order)

- Above average verbal and written communication skills
- People skills - likeable
- Problem solving skills
- Task oriented - cooperative
- Proven achievement record
- Articulate

Schaefer is Pacific Division Sales Manager for the Ralston-Purina Company. These are notes made of his discussion session at the 30th Annual NACTA Conference held on the Washington State University Campus, June 17-20, 1984.