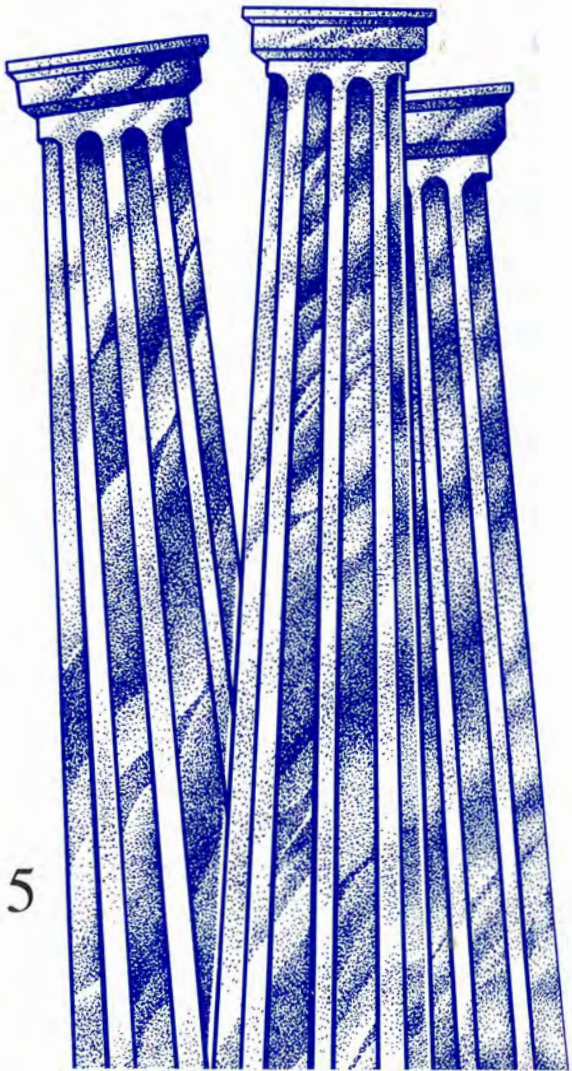
Employment Opportunities for College Graduates in the Food and Agricultural Sciences

Agriculture, Natural Resources, and Veterinary Medicine



1990-1995

Greenhouse Manager • Agricultural Engineer • Account Executive • Journalist • Vitaculturist • Animal Scientist • Advertising Manager • Information Systems Analyst • Nursery Products Grower • Biochemist • Commodity Broker • Illustrator • Turf Producer • Cell Biologist • Consumer Information Manager • Career Counselor • Entomologist • Export Sales Manager • Caseworker • Environmental Scientist • Food Broker • Community Development Specialist • Farm Manager • Food Engineer • Forest Products Merchandiser • Youth Program Director • Food Scientist • Technical Service Representative • Rural Sociologist • Forest Scientist• Sales Representative • Regulatory Agent • Geneticist • Real Estate Broker • Conservation Officer • Landscape Architect• Purchasing Manager • Consumer Counselor • Microbiologist • Marketing Manager • Dietitian • Rancher • Molecular Biologist • Market Analyst • Food Inspector • Natural Resources Scientist • Landscape Contractor • Regional Planner• Nutritionist • Insurance Agent • Peace Corps Representative • Pathologist • Grain Merchandiser • Park Manager• Physiologist • College Teacher • Labor Relations Specialist• Plant Scientist • Computer Software Designer • Naturalist• Quality Assurance Specialist • Computer Systems Analyst • Nutrition Counselor • Rangeland Scientist • Conference Manager • Outdoor Recreation Specialist • Research Technician • Training Manager • Aquaculturalist • Resource Economist • Radio/Television Broadcaster • Farmer • Soil Scientist • Public Relations Representative • Statistician • Personnel Development Specialist • Feedlot Manager • Toxicologist • Veterinarian • Wildlife Manager • Journalist

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K. Jane Coulter,
Allan D. Goecker, and
Marge Stanton

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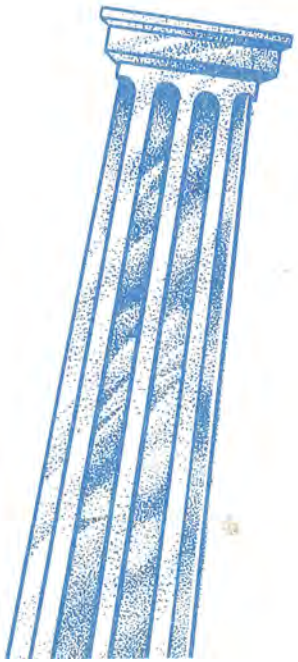
Acknowledgments

We wish to acknowledge the valuable contributions made by several professional organizations in designing the original research methodology and in conducting the project. Among these were: the American Association of State Colleges of Agriculture and Renewable Resources; the Resident Instruction Section of the Division of Agriculture, National Association of State Universities and Land-Grant Colleges; the National Association of Professional Forestry Schools and Colleges; the Association of American Veterinary Medical Colleges; and the American Vocational Association.

In order to integrate diverse information obtained from many sources, a panel of experts with wide experiences in the placement of graduates was established. The following administrators of university academic programs in food, agricultural, and natural resource disciplines provided exemplary service in this capacity: Allan D. Goecker (Chair) Purdue University; James B. Marcum, University of Massachusetts; Gary Schneider, University of Tennessee; James W. Shuford, Alabama Agricultural and Mechanical University; Weldon S. Sleight, Utah State University; and Warren K. Wessels, University of Illinois.

Many individuals in the USDA gave administrative support to the project: Charles E. Hess, Assistant Secretary, Science and Education; John Patrick Jordan, Administrator, Cooperative State Research Service; and William Carlson, Associate Administrator, Office of Grants and Program Systems, Cooperative State Research Service. Richard Thompson, Manager, Food and Agricultural Education Information System, provided selected education and employment statistics. Jobyna Littrell, Personnel Management Specialist, Extension Service, provided employment statistics for the Cooperative Extension Service. Individuals from other Federal agencies who provided advice included David Frank, Bureau of Labor Statistics and Vance Grant, National Center for Education Statistics.

Illustrations and visual design of this report were provided by Pamela K. Lassiter and Sharon E. Katz, Agricultural Communication Service, Purdue University. ◆



Introduction

For more than two centuries, America's food, agricultural, and natural resource system has been nurtured and sustained by highly dedicated people committed to providing excellent products. The efficient and integrated system faces some stiff challenges in the 1990's. Will techniques and business practices be developed and adopted that maintain a sustainable agricultural and forest system in harmony with the environment? Can the system be modified to produce an even more nutritious and safe food supply at lower relative costs? Will emerging scientific advancements be acceptable to a population with an apparent shrinking scientific literacy?

Perhaps the most critical challenge to the food, agricultural, and natural resource system in the 1990's will be attracting and educating the requisite human resources. Not enough talented college graduates in the food and agricultural sciences are being produced to fill highly important roles in business, science, and environmental management.

Among the responsibilities of the U.S. Department of Agriculture through its Higher Education Programs (HEP) office is the assessment of the availability of and employment opportunities for higher education graduates in the food and agricultural sciences.

This document presents updated statistical summaries previously reported in the 1980 U.S. Department of Agriculture (USDA) report, *Graduates of Higher Education in the Food and Agricultural Sciences* (Miscellaneous Publication Number 1385), and in the 1986 report, *Employment Opportunities for College Graduates in the Food and Agricultural Sciences: Agriculture, Natural Resources, and Veterinary Medicine.*

Because of refinements in the methodology, the three reports are not entirely compatible. For example, associate degree graduates were included in the 1980 report, but not in the latter two reports. The employment taxonomy used for reporting Bureau of Labor Statistics data differs in the current report.

However, the three documents can be used to identify major trends with regard to professional opportunities for available graduates. The basic methodology underlying these national analyses of employment opportunities remains essentially the same.

The strategic importance of our food, agricultural and natural resource system will grow during the decade. This will require even stronger leaders, more creative scientists, greater international business understanding, and increased sensitivity for consumers and the environment.

So, it's largely human resources which will chart the course of the U.S. food, agricultural, and natural resources in the 1990's and beyond.◆

Executive Summary

College graduates with expertise in food, agricultural, and natural resource disciplines will experience a strong employment market through the mid-1990's. More than 48,000 annual openings are projected for baccalaureate, master's, and doctoral degree recipients. Slightly more than 43,500 new qualified graduates are expected each year, leaving an annual shortage of nearly 11 percent.This strong professional market will place very intense pressure upon graduate and professional schools to compete for excellent students.

Marketing, merchandising, and technical sales positions will likely be the most difficult to fill, with an expected annual 18 percent shortfall of qualified graduates. Also, it will be difficult to find qualified graduates for priority positions as scientists, engineers, and related specialists. An annual 15 percent shortage is expected.

In contrast, more than the requisite number of qualified graduates will be available to compete for positions in communication, education, and agricultural production specialities.

The food, agricultural, and natural resource professional employment market through the mid-1990's will reflect three principal characteristics.

Stable Number of Professional Opportunities

Through 1995, annual professional openings for college graduates in agriculture, natural resources, and veterinary medicine are expected to remain relatively stable. Further consolidation of agricultural and forest businesses and agencies is expected to reduce the total number of new positions. However, the complexities of conducting science and business in the 1990's will require more highly educated workers.

It is expected that employment reductions caused by business and agency consolidations in the 1990's will be offset by an increasing proportion of college graduates taking available positions. Therefore, the aggregate number of professional opportunities for college graduates in the food, agricultural, and natural resource system should remain relatively constant.

Professional opportunity projections are based upon national macroeconomic conditions comparable to those observed in July, 1990. Significant long-term variations from that economic climate would result in expanded or diminished numbers of opportunities for graduates.

Shrinking Supply of Qualified Graduates

The shrinking supply of graduates is the most critical force which will impact the human resource market through the mid-1990's.

Current enrollments in higher education programs which produce graduates with expertise in food, agricultural, and natural resource disciplines suggest further erosion of the number graduates who will become

available through the mid-1990's.

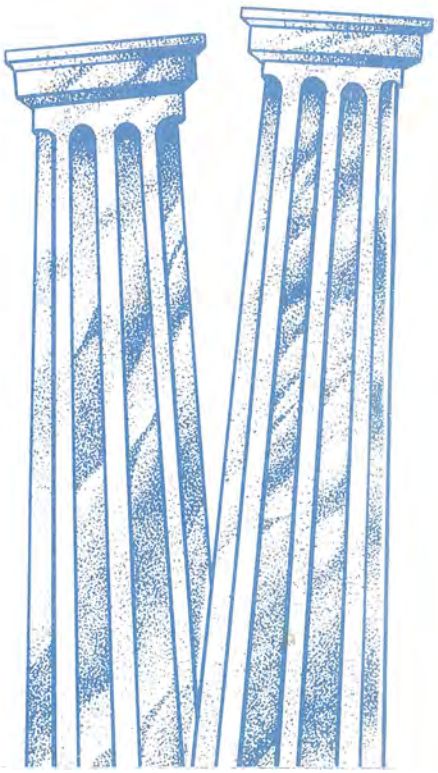
Not only are somewhat fewer individuals preparing for careers in the food, agricultural, and natural resource system, but also there is evidence that students are taking longer to complete college degree programs. Consequently, relatively fewer graduates are being produced each year.

Fewer Graduates from Colleges of Agriculture, Natural Resources, and Veterinary Medicine

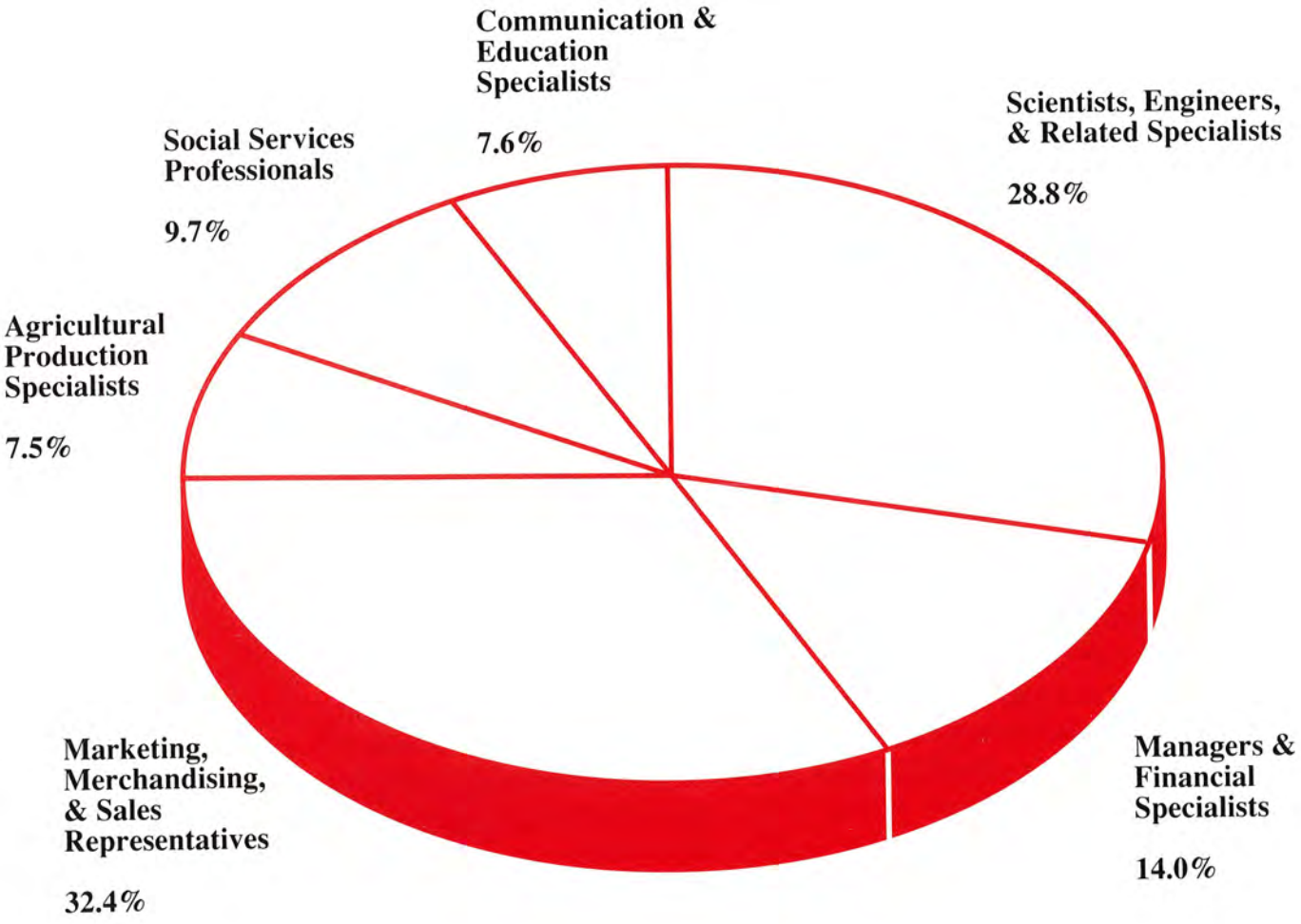
Unless enrollment trends reverse quickly, employers will look increasingly to higher education programs outside colleges of agriculture, natural resources, and veterinary medicine for qualified graduates.

Compared to the average annual number of graduates produced during 1985-1990, colleges of agriculture, natural resources, and veterinary medicine are expected to generate an average of 2,900 fewer graduates each year during 1990-1995. In contrast, higher education programs outside these colleges are expected to contribute some 2,500 additional qualified graduates each year in the early 1990's compared to 1985-1990.

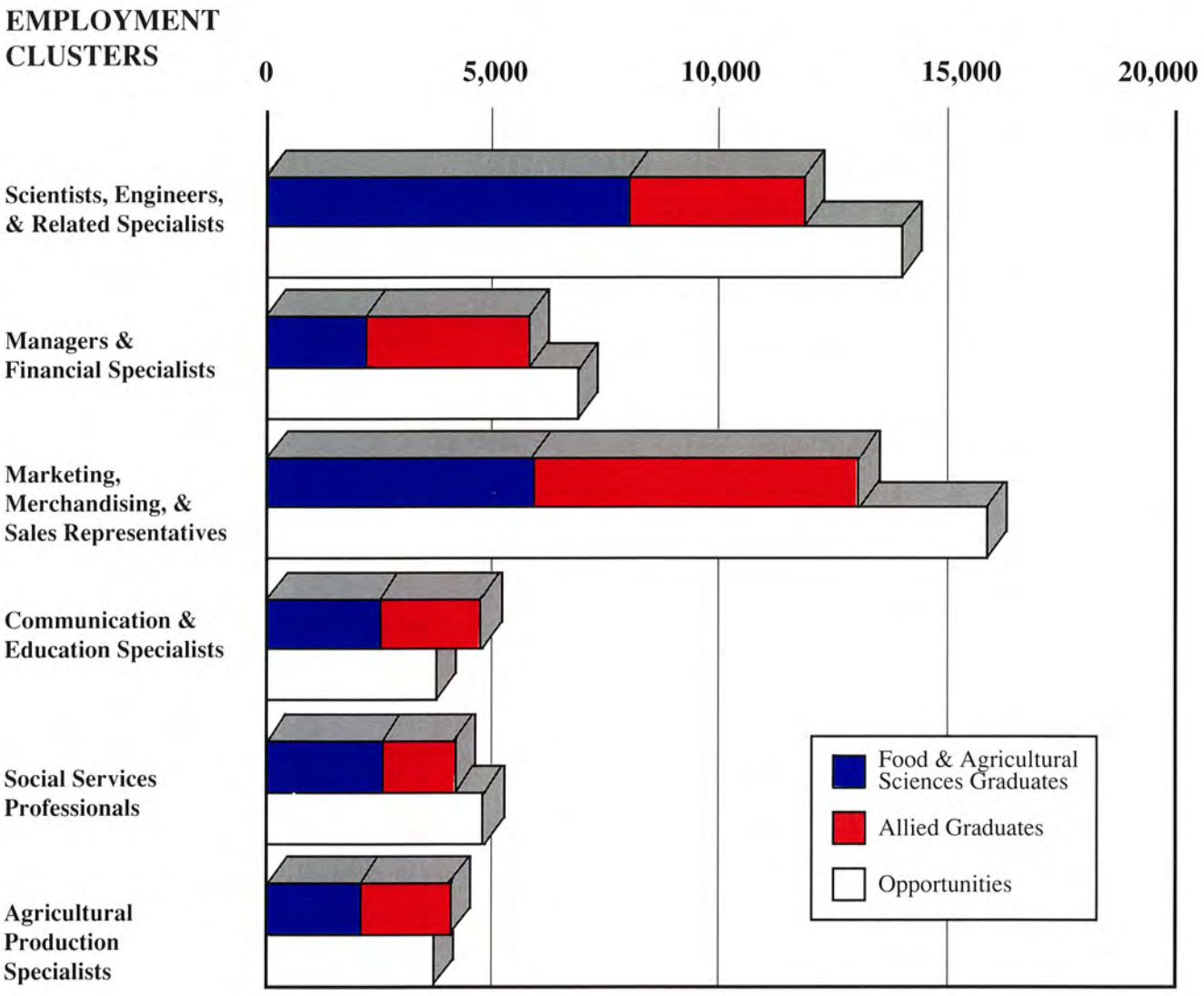
During the next five years, relatively more of the available marketing, merchandising, sales, and financial management positions are expected to be filled by graduates from allied programs of study than by graduates from colleges of agriculture, natural resources, and veterinary medicine. Conversely, graduates from agriculture, natural resources, and veterinary medicine will fill more than two-thirds of the available positions as food and agricultural scientists, engineers, and related specialists. ◆



Distribution Of Employment Opportunities for Graduates



Annual Available Graduates and Employment Opportunities

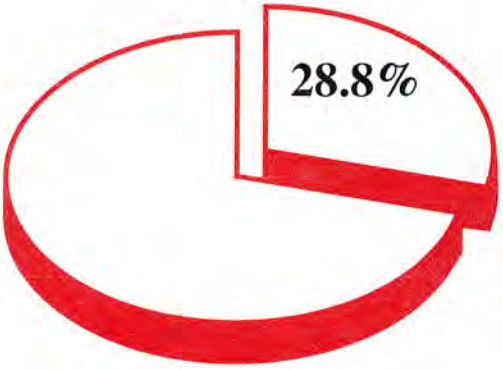


TOTALS

Food and Agricultural Sciences Graduates	**23,091**
Allied Graduates	**20,423**
Opportunities	**48,793**

Scientists, Engineers, and Related Specialists

Scientists, engineers, and related specialists are expected to account for nearly 30 percent of the total projected annual openings for college graduates in agriculture, natural resources, and veterinary medicine. More than 14,000 annual new employment opportunites are expected through 1995. Fewer than 11,900 graduates are anticipated each year, leaving an annual shortage of 15 percent.



Food, agricultural, and natural resource scientists and engineers are critically important problem solvers in dealing with environmental challenges. Likewise, they are focused on assuring a safe, nutritious, and economical food supply.

Excellent opportunites are projected through the mid-1990's for biochemists, environmental scientists, food process engineers, plant geneticists, food scientists, entomologists, and soil scientists. Also, very good opportunities are forecast for bioprocess engineers, forest scientists, pest management specialists, horticultural scientists, and animal reproductive physiologists. Positions will be available in universities, government laboratories, and privately operated research programs.

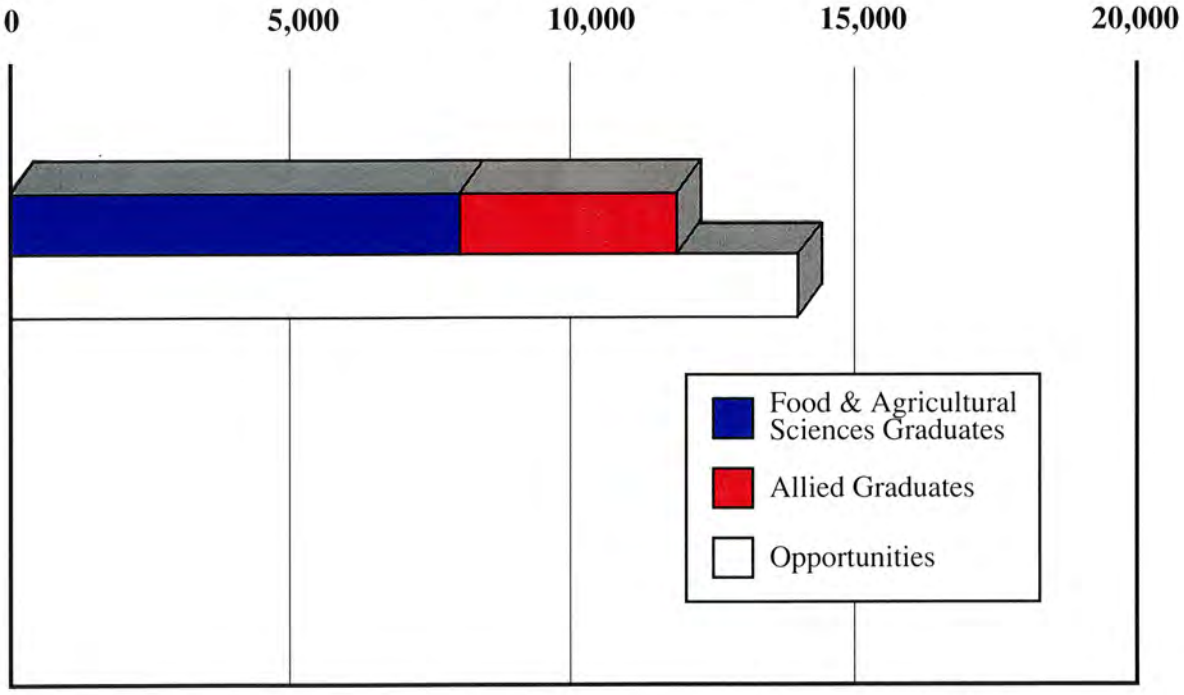
Adequate numbers of graduates are projected in a number of specialities including veterinary medicine, wildlife science, and human nutrition. No significant shortages are projected for statisticians, meteorologists, economists, or landscape architects.

Most available positions in this occupational cluster will require individuals having advanced degrees. While slightly more than 5,500 advanced degree recipients are expected each year, some 1,800 will earn Doctor of Veterinary Medicine degrees and 2,500 will complete master's degree programs in all agricultural and natural resource programs of study. Therefore, only about 1,200 doctoral graduates will be available annually to meet the needs of the U.S. food, agricultural, and natural resource system.

The shortage of scientists and engineers will not be alleviated quickly. Relatively fewer individuals are earning baccalaureate degrees in most food and agricultural science disciplines compared to five years ago. The problem is especially acute in the plant sciences and bioprocess engineering.

Some 15-20 percent fewer baccalaureate degrees in science-oriented programs of study are expected to be awarded by U.S. colleges of agriculture and natural resources in the mid-1990's than in the late 1980's, based upon enrollment and demographic data.◆

Annual Available Graduates and Employment Opportunities



Food & Agricultural Sciences Graduates	**7,999**
Allied Graduates	**3,882**
Opportunities	**14,021**

CAREERS

Agricultural Engineer
Animal Scientist
Biochemist
Cell Biologist
Entomologist
Environmental Scientist
Food Engineer
Food Scientist
Forest Scientist
Geneticist
Landscape Architect
Microbiologist
Molecular Biologist
Natural Resources Scientist
Nutritionist
Pathologist
Physiologist
Plant Scientist
Quality Assurance Specialist
Rangeland Scientist
Research Technician
Resource Economist
Soil Scientist
Statistician
Toxicologist
Veterinarian
Waste Management Specialist
Water Quality Specialist
Weed Scientist

Managers and Financial Specialists

More than 6,800 annual employment opportunities are projected for managers and financial specialists through the mid-1990's. Agribusiness financial managers and planners, government program managers, accountants, food distribution managers, credit managers, property managers, and human resource managers represent more than one-half of the positions in this occupational cluster.

Nearly 5,800 graduates will be available each year, leaving an annual shortage of about 1,000. Fewer than 1,500 master's graduates will be available to fill positions in financial management, environmental program management, business management, and related areas where relatively more individuals with advanced degrees will be required.

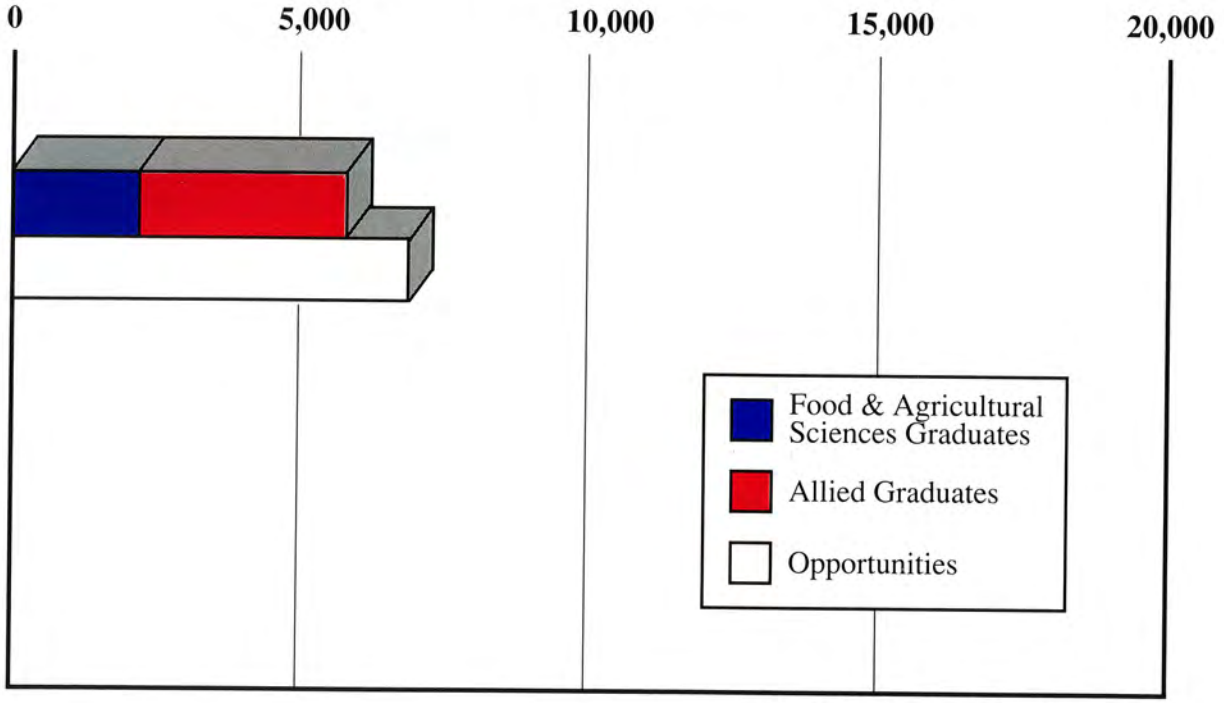
Managers and financial specialists will account for some 14 percent of the aggregate annual openings for college graduates in the food and agricultural disciplines. Managerial categories which are expected to grow most rapidly include environmental program managers, landscape managers, and retail food service managers.

Declining numbers of managerial positions are projected for several agricultural industries, including agrichemicals, seeds, feeds, lending institutions, animal health products, petroleum products, and machinery. Extensive consolidation of agribusiness has occurred during the past decade and is expected to continue into the 1990's. Sizeable numbers of middle management positions are being erased through these structural changes which have eliminated more than 30 percent of the firms during the past ten years.

While relatively fewer total agricultural and natural resource managerial positions are projected in the 1990's, more complex management problems and larger operational units will require more highly educated individuals. Consequently, college graduates, especially master's degree recipients, will fill a larger proportion of new managerial openings. Losses of employment opportunities resulting from business mergers are expected to be offset by the greater emphasis on hiring college graduates to be managers and financial specialists.

About 3,600—more than 60 percent—of the available graduates are expected to come from allied programs of study such as business adminstration, accounting, and finance which are offered by colleges other than agriculture and natural resources. ◆

Annual Available Graduates and Employment Opportunities



Food & Agricultural Sciences Graduates	**2,172**
Allied Graduates	**3,618**
Opportunities	**6,844**

CAREERS

Accountant
Appraiser
Auditor
Banker
Business Manager
Consultant
Contract Manager
Credit Analyst
Customer Service Manager
Economist
Financial Analyst
Food Service Manager
Government Program Manager
Grants Manager
Human Resource Development Manager
Insurance Agency Manager
Insurance Risk Manager
Landscape Manager
Policy Analyst
Research and Development Manager
Retail Manager
Wholesale Manager

Marketing, Merchandising, and Sales Representatives

Nearly 16,000 annual openings are projected for marketing, merchandising, and sales representatives. This is approximately one-third of the 48,793 total annual U.S. employment opportunities for college graduates in the food and agricultural sciences and is the largest occupational group.

Slightly fewer than 13,000 graduates are expected to be available each year, leaving an 18 percent annual shortfall of qualified marketing, merchandising, and sales personnel. Excellent opportunities are projected for sales and marketing representatives of plant protection products, seeds, fertilizers, forest products, and lawn, garden, and nursery products. Also, there will be very good opportunities for grain merchandisers, purchasing agents, and pest control operators.

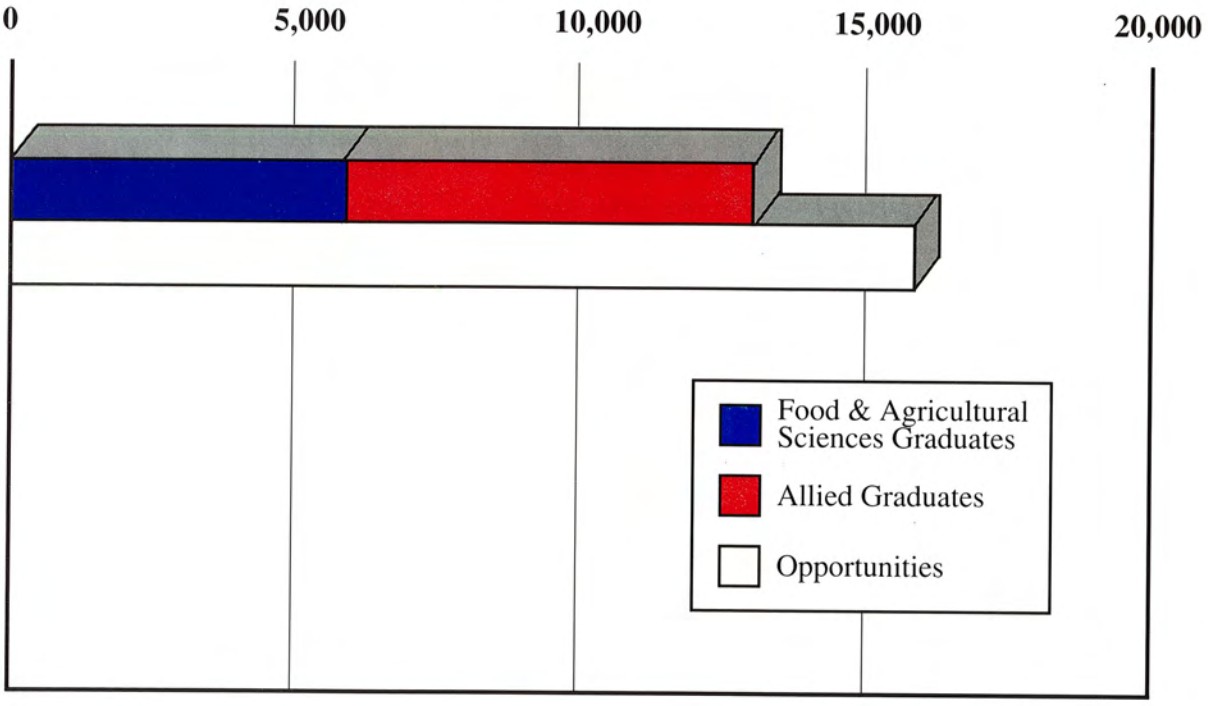
As marketing functions become more complex with expanding regulations and increasing emphasis on foreign trade, there will be growing opportunities for trade and market analysts. Likewise, there will be larger numbers of market consultants who will provide specialized marketing services to product users. Also, a growing number of marketing agents will provide technical services to customers. These agents must understand how to use a broad array of scientific and business management tools.

More than 85 percent of the available graduates with a baccalaureate degree will compete for entry sales, merchandising, and marketing positions. Yet, the increasingly sophisticated marketing functions will require more highly educated individuals. Experienced persons with master's degrees will be hired in a growing number of market management and technical service positions in the coming years.

Only about 45 percent of the graduates who are now competing for marketing, merchandising, and sales positions in food, agricultural, and natural resource industries earned degrees in colleges of agriculture and natural resources. An increasing proportion of the graduates are being produced in other degree programs because agricultural sales and business-oriented degree programs are not producing enough graduates with an interest in and understanding of marketing and merchandising.

Marketing, merchandising, and sales representative positions are accepted by graduates from a wide range of agricultural and natural resource disciplines. If the paucity of qualified graduates is to be ameliorated, all food, agricultural, and natural resource programs of study must increase enrollments.◆

Annual Available Graduates and Employment Opportunities



Food & Agricultural Sciences Graduates	**5,865**
Allied Graduates	**7,064**
Opportunities	**15,806**

CAREERS

Account Executive
Advertising Manager
Commodity Broker
Consumer Information Manager
Export Sales Manager
Food Broker
Forest Products Merchandiser
Grain Merchandiser
Insurance Agent
Landscape Contractor
Market Analyst
Marketing Manager
Purchasing Manager
Real Estate Broker
Sales Representative
Technical Service Representative

Communication and Education Specialists

The food, agricultural, and natural resource system is expected to generate more than 3,700 annual employment opportunities for college graduates in communication and education through the mid-1990's. This 20 percent increase from the late 1980's is largely the result of growth in computerized information management systems and the very strong emphasis on business communication networks. Conversely, the number of new openings for high school agriculture teachers and local extension educators is expected to decrease through the 1990's as programs are consolidated in many local areas. Rates of educational consolidation are expected to vary among regions of the United States.

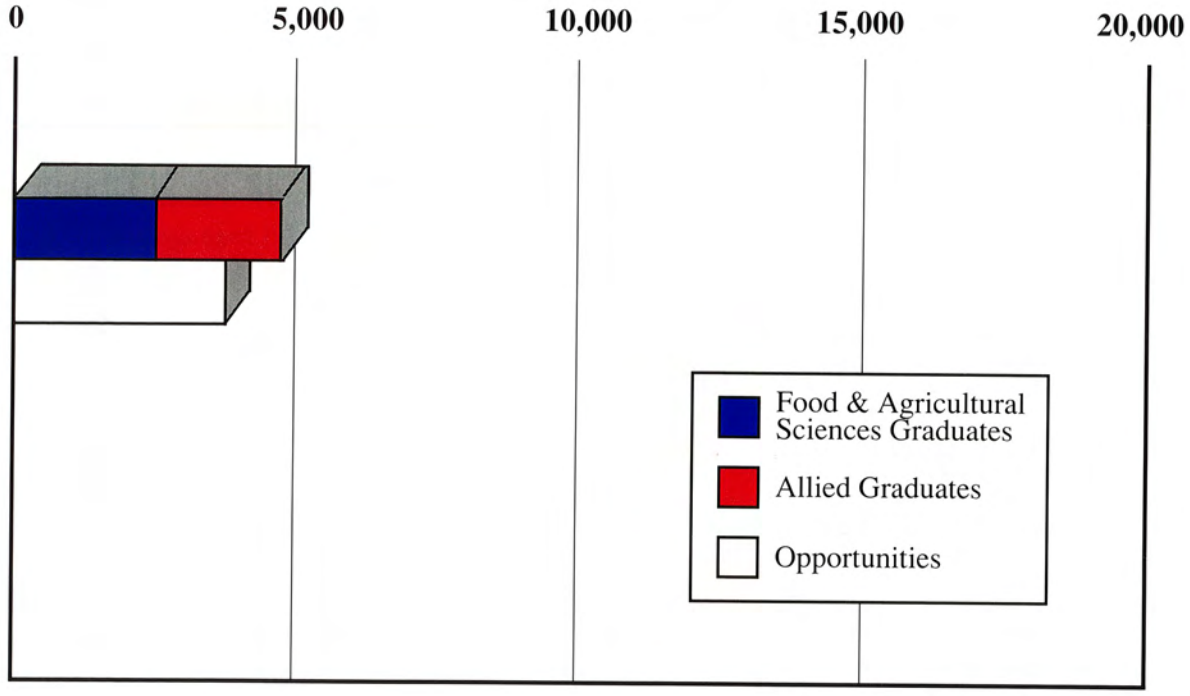
No growth is projected for positions as journalists, writers, and broadcasters. Syndications and other forms of concentrated media operations are expected to dominate mass communication in the decade.

Annually, more than 4,700 qualified communication and education graduates are expected. There will be far more graduates from electronic communication and journalism programs of study than can be accomodated by the market during the next five years. Writers who have specialized skills to become science editors or environmental correspondents will fare much better in the employment market.

An increasing proportion of the agricultural and natural resource education functions will be directed by private business and industrial representatives through internal training programs and through contracted short-term educational programs with colleges and universities. Also, most agribusiness firms will be providing more management information and technical consulting with their products, increasing the employment opportunities for individuals who may have previously looked to public agencies for educational positions.

There will be excellent opportunities for high school educators who are qualified to offer courses in agricultural science and environmental education in the 1990's. These programs will help to foster a highly important understanding of the agricultural and natural resource system by the general public and will be a high, local educational priority. Also, agricultural and natural resource education graduates will increasingly look to the private sector to utilize their educational aptitudes and skills during the 1990's.◆

Annual Available Graduates and Employment Opportunities



Food & Agricultural Sciences Graduates	**2,473**
Allied Graduates	**2,248**
Opportunities	**3,714**

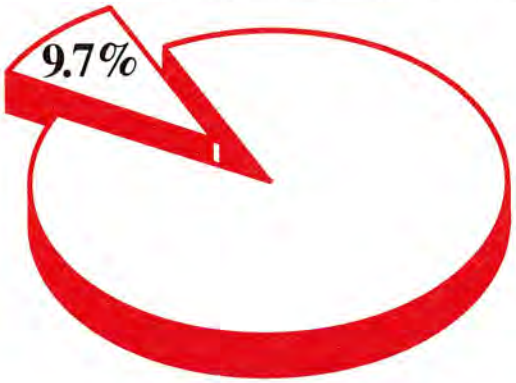
CAREERS

College Teacher
Computer Software Designer
Computer Systems Analyst
Conference Manager
Cooperative Extension Agent
Editor
Educational Specialist
High School Teacher
Illustrator
Information Specialist
Information Systems Analyst
Journalist
Personnel Development Specialist
Public Relations Representative
Radio/Television Broadcaster
Training Manager

Social Services Professionals

Some 4,750 annual employment opportunities are projected for college graduates in agricultural, natural resource, and veterinary medical positions. Public interest in the environment, outdoor recreation activities, and safe and nutritious foods are the principal factors which will generate most of the social service positions in the 1990's. Nutritionists and dietitians will account for more than one-half of the annual openings. Also, there will be excellent opportunities for outdoor recreation specialists, land use planners, Peace Corps representatives, food and environmental inspectors, and compliance officers.

Only about 10 percent of the annual aggregate employment opportunities for all graduates are in social service positions. However, many of these individuals will be in highly visible professional positions in public health care and recreational organizations.



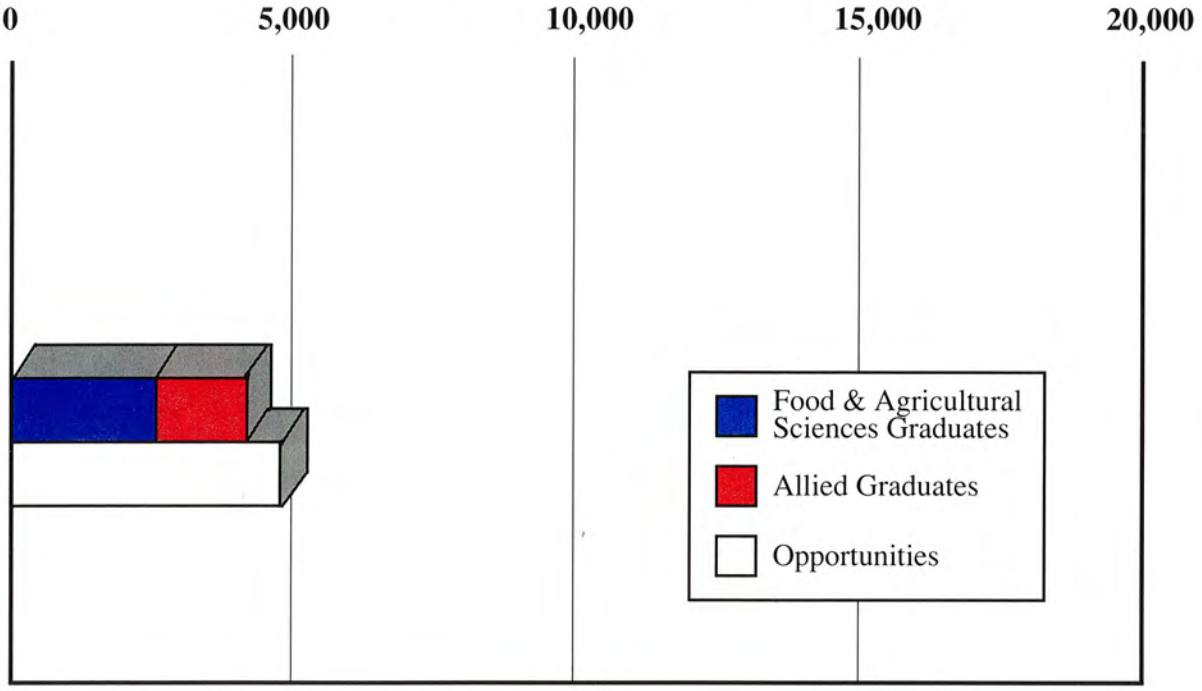
Annually, fewer than 4,200 graduates will be available for the social service positions, leaving a shortage of some 13 percent. Of the qualified graduates, more than 3,400 will enter the social services employment market with baccalaureate degrees. Yet, a growing number of counseling and regional planning positions will be filled by individuals having advanced degrees.

Significant numbers of new positions are expected for graduates who will be involved in environmental planning and management. These individuals will assess environmental quality factors, develop alternative management models, and evaluate the effectiveness of programs in meeting environmental objectives. They will work with a wide array of agricultural and forest managers, business representatives, and consumers to achieve local environmental objectives.

Increasing numbers of land-use planning specialists will be required in the 1990's. Individuals must have a broad educational preparation, including courses in economics, biological and physical sciences, communication, and data base management.

The public concern for a safe and nutritious food supply will require more highly educated individuals to be involved in the inspection processes to utilize more highly sophisticated instruments and inspection procedures. While no significant growth is expected in the number of plant, animal, and food inspectors, relatively more college graduates will conduct inspection operations in the coming decade.◆

Annual Available Graduates and Employment Opportunities



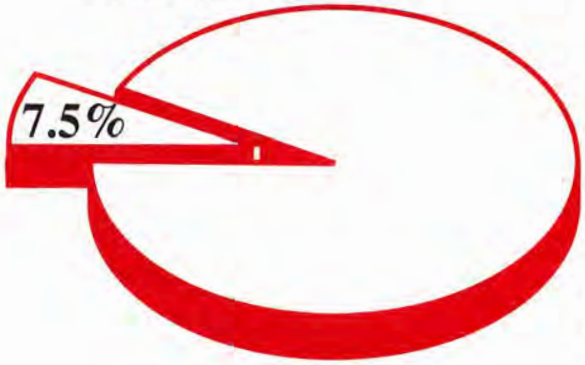
Food & Agricultural Sciences Graduates	**2,527**
Allied Graduates	**1,622**
Opportunities	**4,750**

CAREERS

Career Counselor
Caseworker
Community Development Specialist
Conservation Officer
Consumer Counselor
Dietitian
Food Inspector
Labor Relations Specialist
Naturalist
Nutrition Counselor
Outdoor Recreation Specialist
Park Manager
Peace Corps Representative
Regional Planner
Regulatory Agent
Rural Sociologist
Youth Program Director

Agricultural Production Specialists

Further consolidation of agricultural and forest production units in the 1990's will reduce the total number of employment opportunities for agricultural production specialists. Some 3,650 annual openings—about 7.5 percent of all employment opportunities for agriculture and natural resource college graduates—are expected. Two-thirds of the positions will be farm managers and forest land resources managers. There will be relatively fewer openings for traditional farm and ranch owner/operators as commercial units become larger.



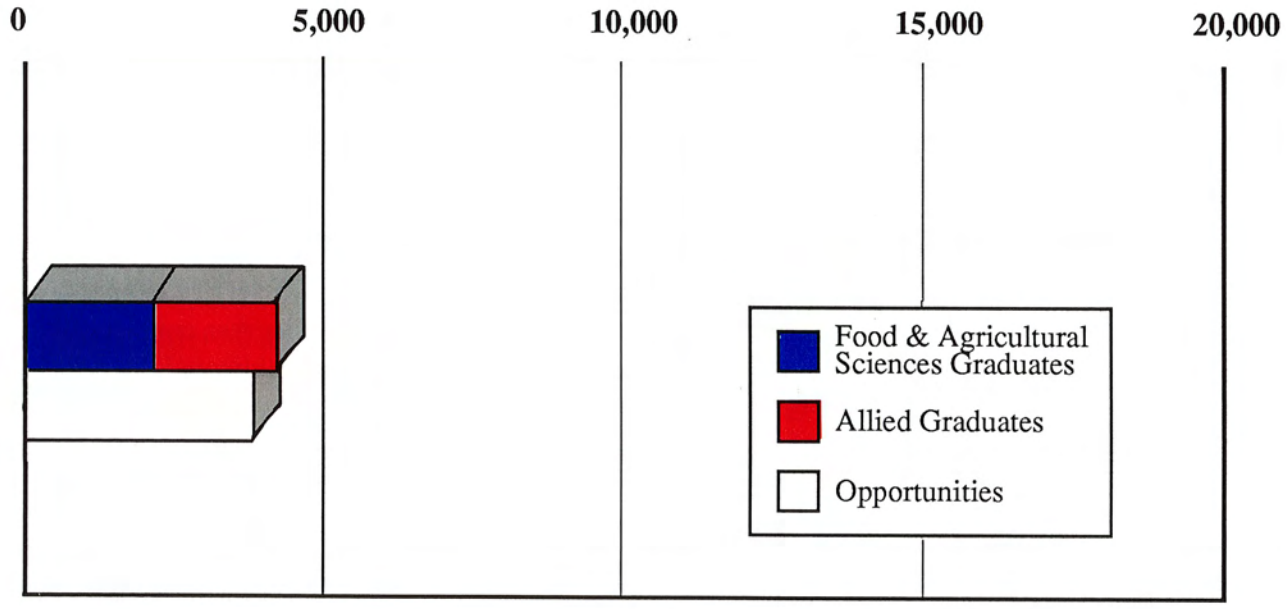
Some 4,000 qualified graduates will be available to compete for the agricultural and forest production positions. More than 90 percent of the available graduates will have baccalaureate degrees. While some production specialities can utilize an advanced degree recipient, most operations do not require education beyond the baccalaureate degree. However, it should be noted that the size and complexity of many commercial production units will make it increasingly necessary to hire college degree recipients as managers in lieu of high school graduates.

Relatively more college-educated farm managers will be hired in commercial plant and animal operations as each becomes more economically integrated. Likewise, there will be excellent production management opportunities in commercial horticulture and turf operations. Animal sciences, crops and soils, commercial horticulture, and agricultural economics curricula will continue to contribute the major share of graduates qualified for agricultural production positions. Forestry and natural resources curricula will generate the graduates for forest production jobs.

In larger operations, highly specialized production managers will become more common. Individuals may oversee specific commodities or species. Others will focus exclusively on marketing functions or financial management, and some may specialize in mechanical systems operations. In some cases, the increased specialization will require managers with advanced degrees in highly specific areas of expertise.

In summary, most citizens largely equate employment opportunities for agricultural and natural resource college graduates with production positions. Yet, only 7.5 percent of the aggregate opportunities are expected to be in this occupational cluster. It underscores the high productivity of agricultural and forest producers who use the integrated inputs of scientists, educators, business representatives, and natural resource managers.◆

Annual Available Graduates and Employment Opportunities



Food & Agricultural Sciences Graduates	**2,055**
Allied Graduates	**1,989**
Opportunities	**3,658**

CAREERS

Aquaculturalist
Farmer
Feedlot Manager
Forest Resources Manager
Fruit and Vegetable Grower
Greenhouse Manager
Nursery Products Grower
Farm Manager
Rancher
Turf Producer
Vitaculturist
Wildlife Manager

Methodology

Scientific and professional opportunities as well as available qualified college graduates in agriculture, natural resources, veterinary medicine, and closely allied fields were determined primarily by using data sources maintained by the U.S. Departments of Labor, Education, and Agriculture. Significant differences exist between the educational and occupational taxonomies used to classify data by the various agencies. Consequently, it was necessary to use a panel of experts throughout the study to integrate information bases into a single consistent analytical model. A summary of the methods used to determine the relationship between employment opportunities and qualified available graduates follows.

Available Graduates

For purposes of this study, graduates in the food and agricultural sciences include those earning baccalaureate and higher degrees in agriculture, natural resources, veterinary medicine, and closely allied fields who qualify for or enter scientific and professional occupations. Closely allied fields were included because many of their graduates are well qualified for and choose to pursue careers related to various aspects of agricultural/biological systems, agribusiness, or agricultural/food technology. Examples of such allied fields are: biochemistry; cell/molecular biology; genetics; business economics; mechanical engineering; and systems analysis.

The major source of data used to determine numbers of graduates was the *1987-88 Degrees Conferred Survey*. This particular survey is one of the Integrated Post-Secondary Education System Surveys conducted annually by the National Center for Education Statistics (NCES), U.S. Department of Education.

The NCES annual degrees conferred data base includes post-secondary degrees conferred by all accredited public and private colleges and universities in the United States and its territories. Graduates are classified by degree level, degree specialization, selected demographic characteristics, and type of institution.

Using the NCES data base, the USDA Higher Education Programs (HEP) panel of experts selected those degree specializations whose graduates are deemed qualified for occupations requiring expertise in agriculture, natural resources, or veterinary medicine. For each degree specialization selected, the panel estimated the percent of qualified graduates by degree level who enter food and agricultural scientific and professional occupations. Eight educational clusters were identified for purposes of categorizing degree specializations based on general areas of graduates' expertise. The eight clusters are:

- Agricultural Economics, Business, and Management
- Agricultural Engineering and Mechanization
- Agricultural Social Sciences and Communications
- Animal Sciences, including

Veterinary Medicine
- Food Sciences, Food Engineering, and Human Nutrition
- Forestry and Natural Resources
- Plant Sciences
- Soil Sciences

In previous USDA studies on employment opportunities for graduates in the food and agricultural sciences, projections on numbers of future graduates were based on NCES data. The NCES data do not facilitate specific projections for different academic specializations. Rather, they employ a standardized rate across all academic specializations. Based upon actual enrollment data for the past decade, the use of a standardized projection rate, allowing for no differences among specializations, was deemed invalid. The food and agricultural sciences are characterized by significantly different enrollment patterns across academic specializations. Therefore, the panel estimated the increase or decrease expected by 1995/1996 to be applied to the current number of graduates in each of the educational clusters. These projections, which were based primarily on historical data from the National Association of State Universities and Land-Grant Colleges and the American Association of State Colleges of Agriculture and Renewable Resources, were used to compute estimated numbers of graduates through 1995/1996 in each educational cluster. Subsequently, average annual graduates were computed as the mean value of the number of 1987/1988 graduates and the 1995/1996 projected graduates.

Two additional factors were considered in arriving at a final determination of available annual graduates. One, the U.S. Department of Education and the U.S. Department of State have long documented that a high proportion of graduate students in agriculture and natural resources are foreign citizens who return to their native countries (e.g., 40 percent of the doctoral graduates in agricultural engineering). Two, several agriculture and natural resource specializations are characterized by high proportions of graduates pursuing advanced study. Therefore, data on these two factors, accessed through the NCES and the Agency for International Development, were applied to annual total graduates to arrive at annual available graduates.

Employment Opportunities

The primary source of data utilized in calculating employment opportunities was the U.S. Department of Labor, Bureau of Labor Statistics (BLS), Division of Occupational Outlook, 1988 Industry/Occupation Matrix (I/O Matrix), which is based on a survey of all U.S. business establishments. These data cross-classify wage and salary employees by industry and occupation and include employment projections for each occupation within each industry. Employment data on self-employed individuals were also obtained from the BLS and are based on *The Current*

Population Survey. Separation rates for each occupation were used to determine openings due to retirement, death, or disability. These rates were acquired from the National Occupation Information Coordinating Committee.

From the total I/O Matrix, the panel of experts selected the occupations and industries deemed to require college graduates with agriculture, natural resources, or veterinary medicine expertise. For each industry chosen, the panel reviewed data on each selected occupation and estimated the number of employees having the requisite expertise. The numbers of employees selected within each industry and occupation were summed across all industries to yield 1988 wage and salaried occupational employment in food and agricultural scientific and professional positions. For each occupation, the composite number of workers employed across the various industries was subsequently converted to a percent of total U.S. workers in the occupation. This process involved rounding of data to avoid fractions. Therefore, the percents are reported as whole numbers in the employment tables and often do not compute precisely to the frequencies reported in the tables.

The Department of Commerce uses *The Current Population Survey* data to produce estimates of the number of self-employed workers within an occupation. The panel used these data to estimate the percent of self-employed professionals in each occupation requiring agriculture, natural resources, or veterinary medicine expertise. The resulting figures were summed with wage and salary data to yield total employment within a given occupation.

Corresponding data for 1995 were derived from the BLS employment projections. The BLS projected average annual change in employment due to industry growth/dimunition from 1988 through 2000. These changes were summed with average annual separations resulting from death, disability, and retirement to yield average annual employment opportunities. Thus, employment opportunities presented in this report include both predicted industry growth/dimunition and predicted employment replacements due to permanent labor force separations.

Six employment clusters were identified for the purpose of classifying the selected occupations relative to the general type of expertise required of workers. These six clusters are:

- Scientists, Engineers, and Related Specialists
- Managers and Financial Specialists
- Marketing, Merchandising, and Sales Representatives
- Communication and Education Specialists
- Social Services Professionals
- Agricultural Production Specialists

The BLS data base does not provide definitive employment statistics for high school vocational agri-

culture teachers, college faculty employed in the food and agricultural sciences, and Cooperative Extension Service personnel. Therefore, these data were obtained from the National Council for Agricultural Education, the USDA-HEP 1988 *Survey of College Faculty in the Food and Agricultural Sciences,* the Association of American Veterinary Medical Colleges, and the USDA Extension Service master personnel file, respectively.

Comparison of Employment Opportunities and Available Graduates

For each degree level, the panel established an education/employment matrix. To compare employment opportunities and available graduates, the following procedures were undertaken. One, for each education cluster the panel estimated the percent of graduates at each degree level qualified for and entering employment in the different employment clusters. Two, computations based on these estimates were summed to yield the total graduates available for employment within an employment cluster. Hence, for each employment cluster, comparisons can be made readily between available graduates and employment opportunities.

This summary report presents updated statistical information originally published in the USDA 1980 report *Graduates of Higher Education in the Food and Agricultural Sciences* (Miscellaneous Publication Number 1385), and the USDA 1986 report *Employment Opportunities for College Graduates in the Food and Agricultural Sciences*. Because of minor refinements in methodology, the previous reports and this one are not entirely compatible. For example, associate degree graduates were included in the 1980 report, but not in the subsequent analyses. Self-employed individuals are included in the 1986 and 1990 reports, but were not considered in the 1980 study. Additionally, this report reflects refinements in both education and labor data bases used for purposes of comparing graduates and opportunities. Nevertheless, the three reports can be used to identify major trends with regard to professional opportunities for available graduates.◆

Technical Addendum

A separate technical addendum published in conjunction with this report provides in-depth information and detailed statistics on:

- specific aspects of the research design and methodology;
- graduates in different specializations comprising the food and agricultural sciences;
- employment opportunities for the specific occupations likely to require food and agricultural scientific and professional expertise.

The supplementary volume is entitled *Technical Addendum to Employment Opportunities for College Graduates in the Food and Agricultural Sciences: Agriculture, Natural Resources, and Veterinary Medicine - 1990-95*. Limited copies are available from the Director, Higher Education Programs, U.S. Department of Agriculture, 14th and Independence Avenue, SW, Washington, D.C. 20250.

The technical addendum is organized to facilitate comparison with this summary report. The following chart denotes where major types of information/data are referred to in this report and presented in the technical addendum.

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Veterinarian • Wildlife Manager • Forest Resources Manager • Water Quality Specialist • High School Teacher • Weed Scientist Fruit and Vegetable Grower • Greenhouse Manager • Agricultural Engineer • Account Executive • Journalist • Vitaculturist Animal Scientist • Advertising Manager • Information Systems Analyst • Nursery Products Grower • Biochemist • Commodity Broker • Illustrator • Turf Producer • Cell Biologist • Consumer Information Manager • Career Counselor • Entomologist • Export Sales Manager • Caseworker • Environmental Scientist • Food Broker • Community Development Specialist • Farm Manager • Food Engineer • Forest Products Merchandiser Youth Program Director • Food Scientist • Technical Service Representative • Rural Sociologist • Forest Scientist • Sales Representative • Regulatory Agent • Geneticist • Real Estate Broker Conservation Officer • Landscape Architect • Purchasing Manager • Consumer Counselor • Microbiologist • Marketing Manager • Dietitian • Rancher • Molecular Biologist • Market Analyst • Food Inspector • Natural Resources Scientist • Landscape Contractor • Regional Planner • Nutritionist • Insurance Agent • Peace Corps Representative • Pathologist • Grain Merchandiser • Park Manager • Physiologist • College Teacher Labor

Prepared and published by Higher Education Programs, Cooperative State Research Service, U.S. Department of Agriculture, Washington, D.C. 20250.

Printed and distributed by Food and Agricultural Careers for Tomorrow,
127 Agricultural Administration Building, Purdue University, West Lafayette, IN 47907.

Issued in furtherance of higher education in the food and agricultural sciences,
the National Agricultural Research, Extension, and Teaching Policy Act of 1977, as amended.

December 1990