# Employment Opportunities for College Graduates in the Food and Agricultural Sciences

Agriculture
Natural Resources
Veterinary Medicine

## 1995-2000


*United States of America*

*During 1995-2000, average annual employment opportunities for college graduates with expertise in the food and agricultural sciences are projected to be 47,918. In contrast, some 45,675 graduates with expertise in agriculture, natural resources, and veterinary medicine are expected to be available to compete each year for the available positions.*

*Projected Average Annual Employment Opportunities for College Graduates in the Food and Agricultural Sciences, United States, 1995-2000*

*Marketing, Merchandising, and Sales Representatives*

*14,353*

*Scientists, Engineers, and Related Specialists*

*13,922*

*Managers and Financial Specialists*

*5,613*

*Communication and Education Specialists*

*5,295*

*Social Services Professionals*

*4,862*

*Agricultural Production Specialists*

*3,873*

# *Agriculture, Natural Resources, and Veterinary Medicine*

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The employment market for U.S. agriculture, natural resources, and veterinary medicine college graduates will continue to be strong in the late 1990s. However, new college graduates with food and agricultural science and business expertise will face an increasingly competitive employment market during the next five years as compared to graduates of the early 1990s.

During 1995-2000, average annual employment opportunities for college graduates with expertise in the food and agricultural sciences are projected to be 47,918. In contrast, some 45,675 graduates with expertise in agriculture, natural resources, and veterinary medicine are expected to be available to compete each year for the available positions.

The 4.7 percent aggregate shortage of graduates is expected to be concentrated in several employment specialties. Nearly three-fourths of the total projected shortage is in the marketing, merchandising, and sales employment cluster. Also, excellent employment opportunities are forecast for graduates having scientific and technical expertise in developing new consumer products from raw agricultural and forest materials. And, there will be strong demand for individuals with expertise in managing water, land, and other natural resources that are used in the U.S. food system.

One major supply factor which underscores the more competitive employment market in the late 1990s is the significant enrollment growth experienced during the past five years by most U.S. colleges producing graduates in the food and agricultural sciences. Another is increased competition from the expanding number of graduates in many allied fields who are capable of competing with food and agricultural science graduates for the same positions in the employment market.

Colleges of agriculture, natural resources, and veterinary medicine will produce about 55 percent of the total qualified graduates with expertise in the food and agricultural sciences. Allied fields such as engineering, business, biology, health sciences, economics, and computer technology will contribute about 45 percent of the qualified graduates.

During the late 1990s, the U.S. employment market for college graduates in the food and agricultural sciences will be strongly influenced by five major factors. Perhaps none of the factors is more critical than the continued consolidation of businesses, including farms and ranches, that make up the U.S. food, agricultural, and natural resource system.

- Merging of food system businesses, including agricultural production units, is expected to continue to occur and to result in greater integration of the supply, production, manufacturing, marketing, and environmental management functions. This suggests that relatively fewer total workers will be required in the food, agricultural, and natural resource system.

In contrast, the growing complexity of problems that must be solved by entrepreneurs or business executives, scientists, natural resource managers, educators, and other workers will require more highly educated and experienced graduates in the food and agricultural sciences. It is anticipated that an increasing number of organizations will utilize temporary or short-term contracted employment programs to control costs and to be more selective in hiring individuals for career positions. Also, a more highly integrated food and agribusiness structure suggests that relatively fewer middle management representatives will be needed by most firms in the coming years.

- Environmental and natural resource management issues and

challenges will continue to be highly important factors which permeate decision-making at all stages of the U.S. food and fiber production and distribution systems.

Graduates having the aptitudes, skills, and experiences to solve, not merely recognize, important environmental problems in the food system will be at a distinct advantage in the professional employment market in the coming years. Graduates having strong life and physical science preparation will likely be in the best position to address the more critical environmental management challenges.

- Economic growth in the food and agricultural sector of the U. S. economy will be largely dependent upon enhancing the value of raw agricultural and forest materials and becoming even more competitive in the international marketplace. The domestic demand for food and fiber and associated services will continue to expand at a relatively slow rate.

These observations suggest strong opportunities for graduates with expertise in food and forest product manufacturing and marketing. Also, graduates having foreign language skills and international experiences from study abroad programs will become increasingly valuable to employers, especially those having multi-national business operations.

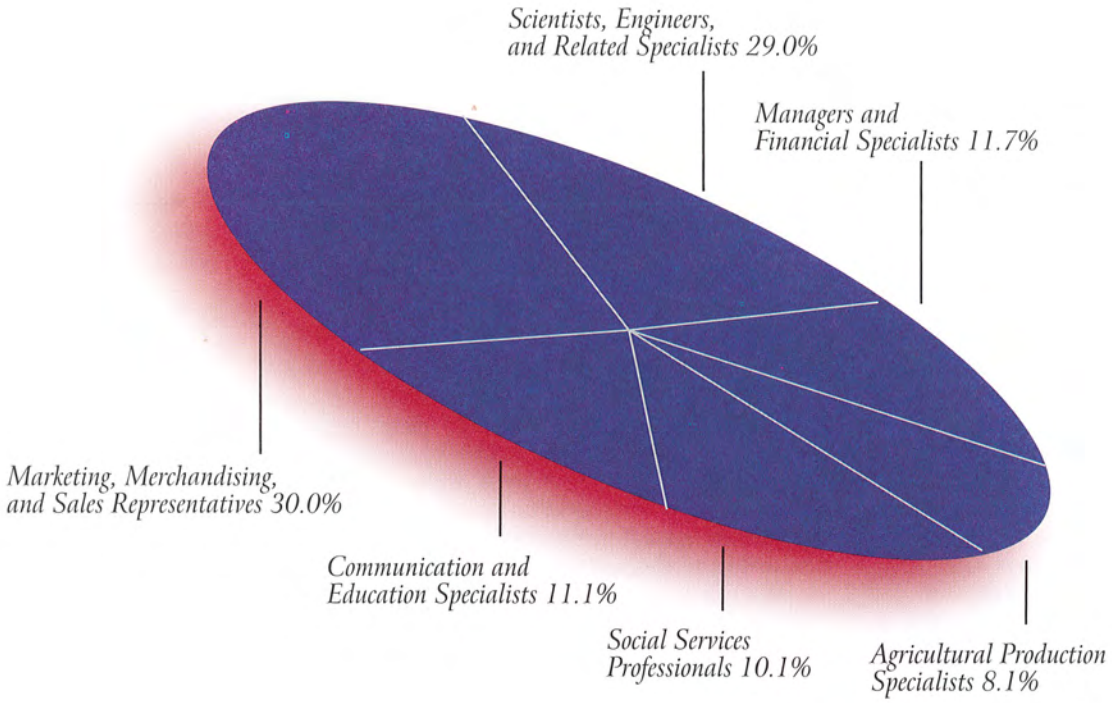
- The aggregate market for new college graduates of agriculture, natural resources, and veterinary medicine programs is expected to be dominated increasingly by the private sector during the next five years. Small businesses are expected to become a more significant factor in the employment market. Current public interest in reducing the size of governmental operations portends relatively fewer hires in the traditional agricultural, forestry, and environmental public agencies which are focused on the management of renewable natural resources.

New opportunities for agricultural and life scientists with advanced degrees will be strongly influenced by the level of governmental investments in food, agricultural, and natural resources research and development programs. While proprietary research operations are expected to expand, especially in developing new products from raw agricultural and forest materials, new opportunities for faculty research and education positions are expected to decline in most agricultural and natural resources colleges during the next five years.

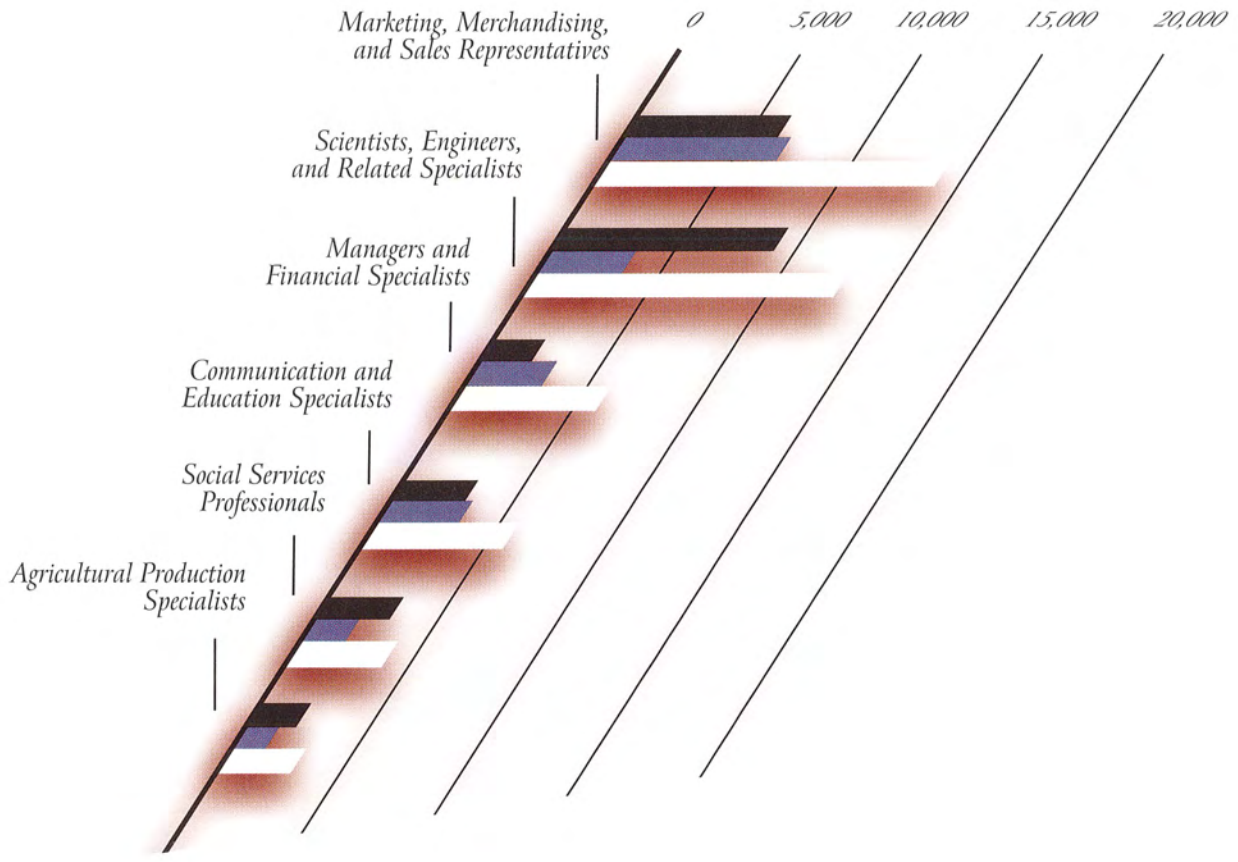
- During 1995-2000, the differences between the food, agricultural, and natural resource management sector and other major segments of the U.S. economy will continue to dissolve. Consequently, the marketplace for food and agricultural science graduates--with expertise in agriculture, natural resources, and veterinary medicine--will become increasingly competitive. Graduates with internship or cooperative education work experiences in their areas of specialization will be in the strongest position for available jobs.

Degree recipients from business, engineering, computer science, chemistry, biology, health sciences and other higher education programs will become even more competitive in filling both traditional and emerging occupations in the food, agricultural, and natural resource system. Likewise, the more broadly educated food and agricultural sciences graduates will experience expanding opportunities to compete for positions in business and scientific occupations outside of the raditional food and agricultural sector.

## Distribution of Employment Opportunities for Graduates



## Annual Available Graduates and Employment Opportunities




| TOTALS | |
|---|---|
| Food and Agricultural Sciences Graduates | 25,287 |
| Allied Graduates | 20,388 |
| Opportunities | 47,918 |

# *Marketing, Merchandising, and Sales Representatives*

*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*

Marketing, merchandising, and sales representatives are expected to account for some 30 percent of the employment opportunities for college graduates with expertise in the food and agricultural sciences.

Annually, some 12,702 qualified graduates are expected to be available. Yearly employment opportunities are projected to be 14,353.

More than one-half of the qualified graduates will come from allied fields including business, marketing, advertising, and retailing.

Although the changing business structure in the food, agricultural, and natural resource system will require new approaches to sales and marketing, employment opportunities in these occupations are projected to be quite strong in the next five years. The expected 11.5 percent annual shortage of qualified marketing, merchandising, and sales and technical service representatives is the most sizable human resources deficit among the six major employment clusters in the food, agricultural, and natural resource system.

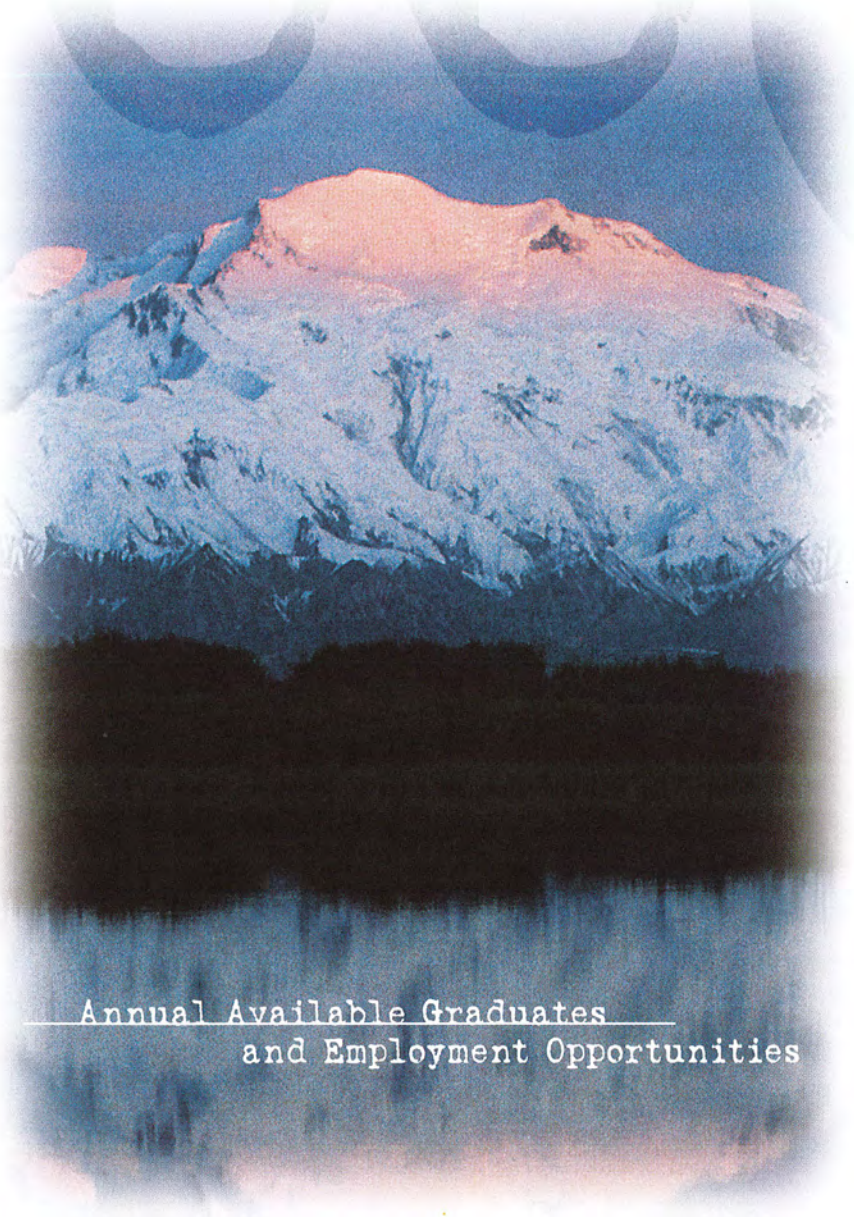
Relatively more of the marketing, merchandising, and sales employment opportunities will be found in food and forest products distribution, and in consumer services associated with landscape horticulture and lawn care. Significantly fewer marketing and sales positions will be available during the next five years in traditional farm and ranch input supply areas such as feed, seed, animal health products, agrichemicals, and machinery.

Graduates with strong oral and written communication skills, good scientific and technical preparation, sales and marketing training, and sales experiences will be most competitive in obtaining priority positions in marketing and merchandising. With a diminishing middle management structure in an increasing number of agribusiness and forestry firms, sales and technical service representatives must be educated with a broader array of problem solving techniques to serve clients most effectively.

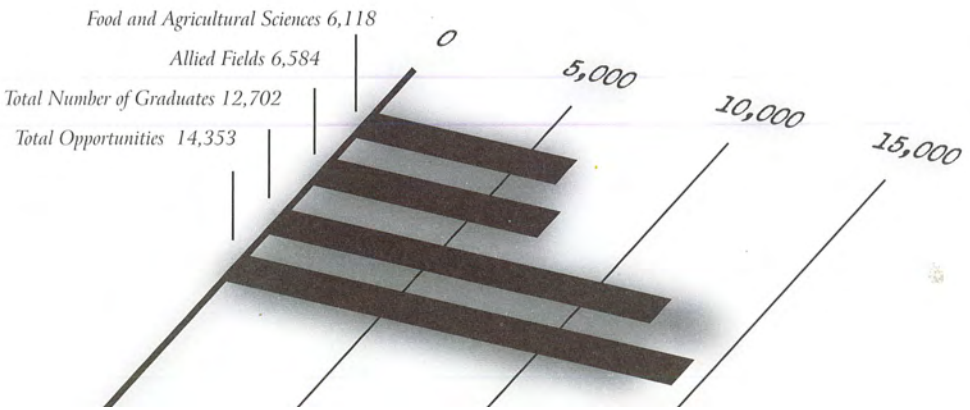
Increasingly, technical service representatives will be advanced-degree holders who have extensive experiences in working on specific problems that are encountered by customers. A growing number of technical service representatives who solve agricultural and forest production problems will be licensed by professional accrediting organizations and governmental agencies that will require regular updating of credentials.

During 1995-2000, it is expected that about 15 percent of the new marketing, merchandising, and sales representatives will have advanced degrees. Most having a master's degree will come from allied fields such as business administration. Most having a doctoral degree will come from specializations offered by colleges of agriculture, natural resources, or veterinary medicine.

Marketing and sales consultants are expected to experience expanded opportunities during the late 1990s as more firms utilize specialized contracted services to handle selected market strategies.



## Annual Available Graduates and Employment Opportunities



## *Scientists, Engineers, and Related Specialists*

*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*

Some 29 percent of the food and agricultural science employment opportunities will be for scientists, engineers, and related specialists. The average annual number of available graduates is expected to be 13,299 compared to 13,922 projected yearly employment opportunities.

More than 70 percent of the available graduates will be produced by higher education programs in the food and agricultural sciences--agriculture, natural resources, and veterinary medicine.

It is anticipated that there will be an average 4.5 percent annual shortage of qualified graduates to become scientists, engineers, and related specialists during the next five years. Yet, some scientific and technical specialties are expected to have more qualified graduates than can be accommodated in the employment market.

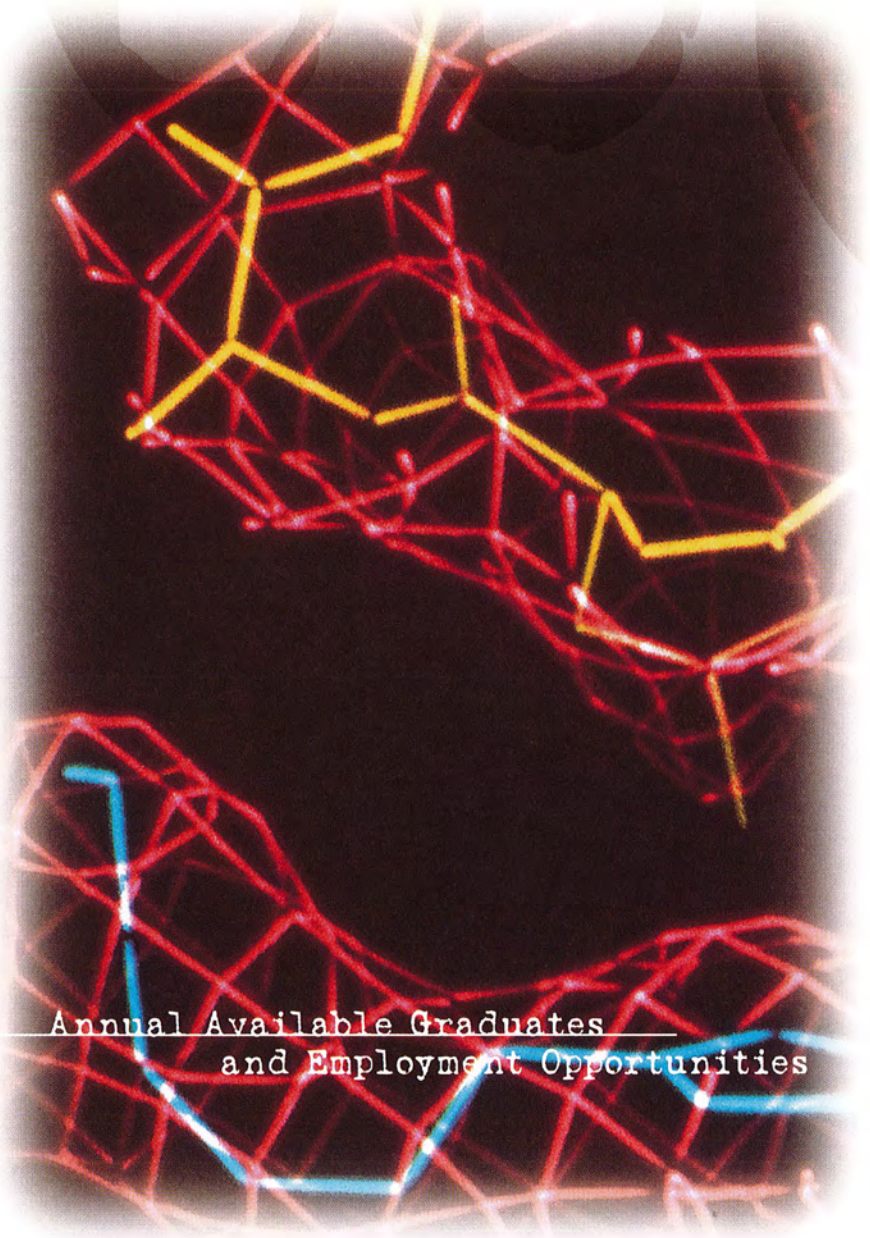
The strongest professional opportunities are projected for food scientists, food process engineers, forest products engineers, and other scientists and technical experts who are involved with the research and development of new consumer products from raw agricultural and forest materials. Also, employment opportunities in food quality control and food safety operations are expected to remain strong in the late 1990s.

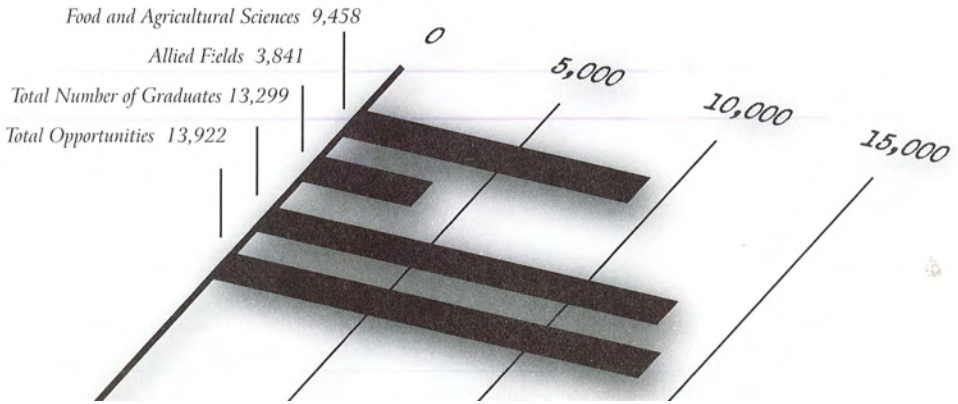
Good opportunities for scientists, engineers, and related specialists are projected for industries dealing with water quality and other environmental management priorities. Biological engineers and technicians, hydrologists, environmental engineers, and soil scientists with expertise on waste management or knowledge of the interaction of agricultural pesticides and the environment are expected to have good opportunities. Likewise, ornamental horticulture scientists, turf scientists, and integrated pest management specialists should experience a strong employment market.

The very rapid growth in the production of molecular biologists during the past several years is expected to fulfill the needs for these scientists in the food and agricultural sector during the next five years. In the past decade, food and agricultural research entities have focused upon adding molecular biologists and related specialists to their operations. While agricultural and forest biotechnology operations will continue to be highly important, shortages of qualified molecular biologists are not expected in the late 1990s.

It is expected that doctors of veterinary medicine who specialize will have professional employment advantages over the general practitioner in the coming years.

In the aggregate, it appears that there will be more than sufficient numbers of wildlife scientists, animal scientists, and production agricultural economists to fulfill emerging needs. Also, the rapidly expanding cadre of baccalaureate degree recipients in natural resources and environmental sciences will exceed the demand for environmental technicians in the late 1990s.


Annual Available Graduates
and Employment Opportunities


Food and Agricultural Sciences 9,458
Allied Fields 3,841
Total Number of Graduates 13,299
Total Opportunities 13,922
0
5,000
10,000
15,000

## *Managers and Financial Specialists*

*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*

Managers and financial specialists will account for nearly 12 percent of the total available employment opportunities for college graduates with expertise in the food and agricultural sciences.

During 1995-2000, average annual employment opportunities are projected at 5,613 compared to 5,469 available graduates. This would result in an average 2.6 percent annual shortage of graduates having qualifications for employment in agriculture, natural resources, or veterinary medicine

As was noted earlier in this report, the ongoing consolidation of firms in food, agricultural, and forest industries indicates that there will be relatively fewer middle management opportunities. Compared to the early 1990s, it is projected that there will be nearly 20 percent fewer annual openings for managers and financial specialists during the late 1990s.

It is expected that private sector marketing managers, financial managers, human resource managers, and information system managers will enjoy the strongest employment opportunities in food, agricultural, and natural resource organizations during the next five years. The growing complexity of managing these businesses will require new managers who have completed higher levels of education, and have obtained significant work experiences before assuming managerial roles. Allied fields--especially business, economics, and accounting programs--are expected to generate some 59 percent of the qualified graduates for positions as managers and financial specialists.

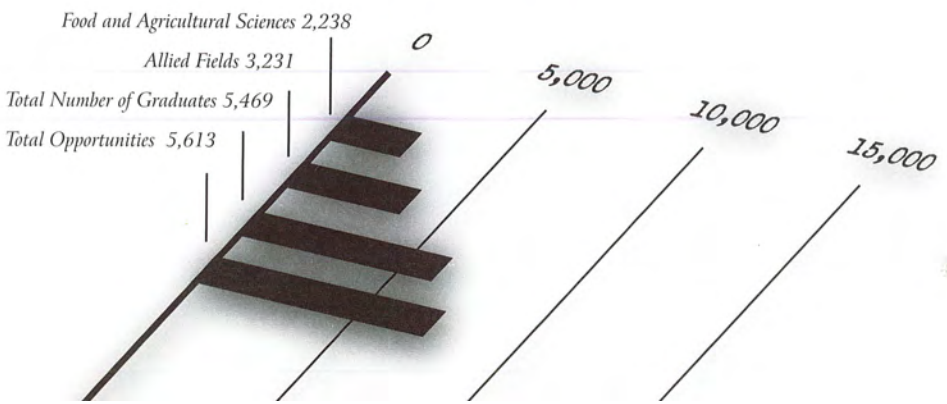
Management consultant opportunities are expected to increase during the late 1990s. An increasing number of firms are attempting to control costs by contracting with outside providers for specialized management and personnel services previously provided from within the organization.

Managerial opportunities in food marketing and distribution, landscape horticulture operations, and outdoor recreation organizations are expected to be strong during the coming years. In contrast, managerial opportunities in traditional agricultural supply businesses--feed, seed, agrichemical, and machinery firms--are expected to continue to decline.

Relatively fewer managerial opportunities are anticipated in public agencies which serve food, agriculture, forestry, and veterinary medicine interests. Projected consolidations of agencies and forecasts of reductions in some governmental management functions suggest that fewer graduates with expertise in the food and agricultural sciences will be entering public sector managerial positions.

Ongoing restructuring and merging of banks and other financial institutions which serve food, agriculture, forestry, and veterinary medicine businesses suggest that fewer, but better trained, financial specialists will be required.


Annual Available Graduates
and Employment Opportunities


Food and Agricultural Sciences 2,238
Allied Fields 3,231
Total Number of Graduates 5,469
Total Opportunities 5,613
0
5,000
10,000
15,000

## *Communication and Education Specialists*

*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*

About 11 percent of all employment opportunities for college graduates with expertise in the food and agricultural sciences will be in communication and education.

The number of annual openings for communication and education specialists is projected to be 5,295. This closely matches the 5,510 graduates per year yielding a surplus of 4.1percent. About 47 percent of the total graduates are expected to be produced by colleges of agriculture, natural resources, or veterinary medicine.

Computer information systems analysts and managers will account for about 40 percent of the annual employment opportunities in this employment cluster. It is expected that there will be very strong demand for qualified personnel in these specialties during the remainder of the 1990s. Also, above average employment opportunities are expected to be available for public relations specialists and educational consultants to selected agricultural and forestry firms. With the expected strong opportunities in marketing, merchandising, and sales in the next five years, it is likely that these areas will continue to attract a large proportion of the new agricultural education graduates.

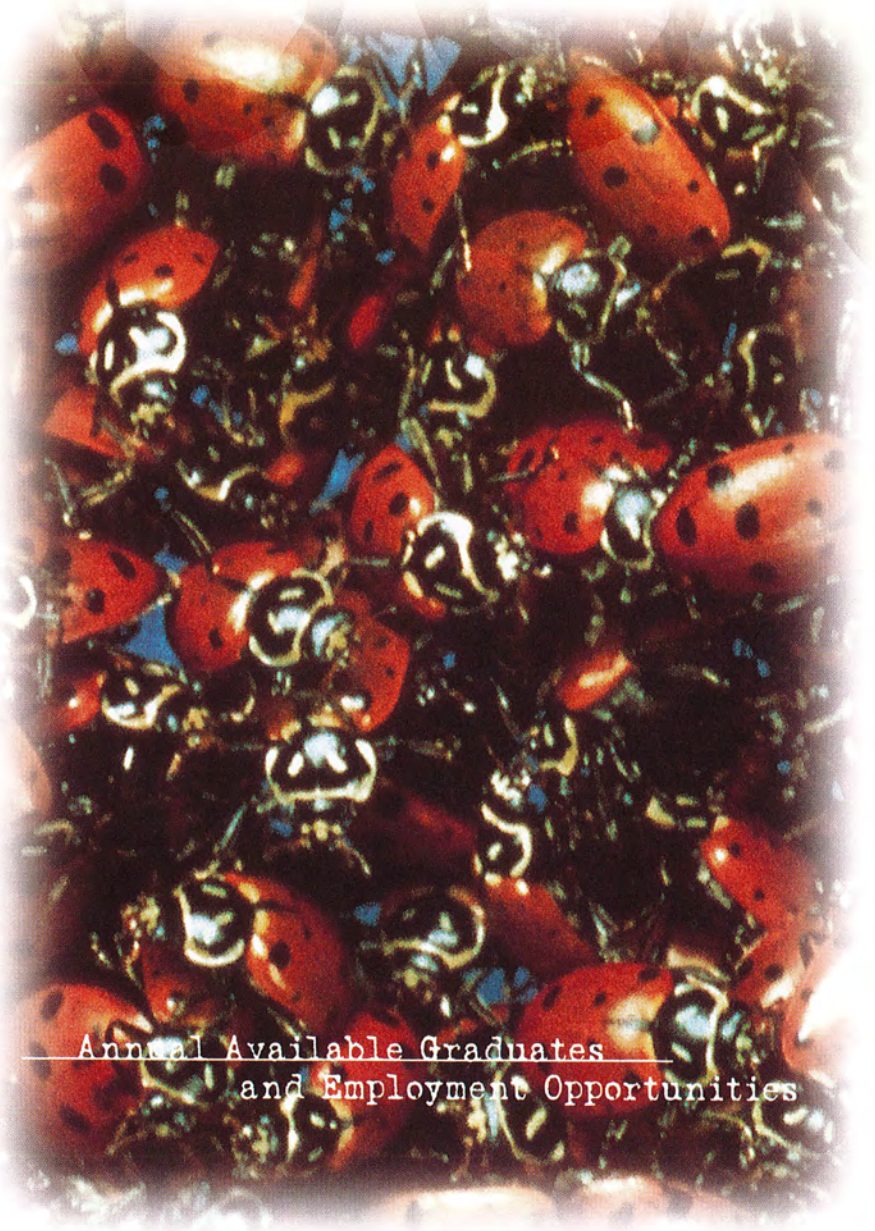
More than 600 annual employment openings are projected for writers, editors, and broadcasters with principal assignments of food, agricultural, and natural resources topics. It is expected that there will be more than enough qualified journalists and communicators to fill these positions. Allied college and university programs in journalism, communication, and public relations are producing more than enough qualified graduates to meet market demands in agriculture, natural resources, and veterinary medicine. Communication graduates who focus on marketing, advertising, and consumer relations should encounter relatively more opportunities as compared to traditional journalism positions.

Demand for food, agricultural, and natural resource educators at the college and university level is expected to be less during the late 1990s. Likewise, the demand for extension educators is projected to decline during the next five years. Most new employment openings for extension educators will likely be replacements for personnel who retire or otherwise leave the profession.

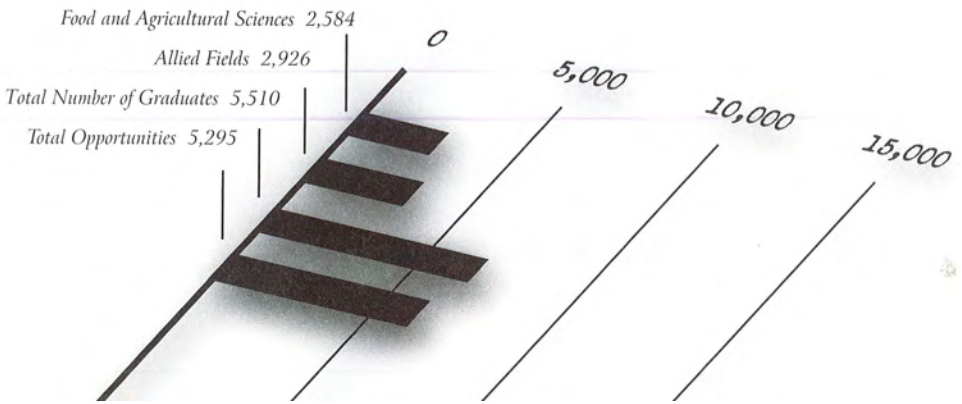
Needs for agricultural science and business teachers in post-secondary technical institutes and community colleges are expected to be more than fulfilled by available qualified candidates.

For many years, only about one-half of the agricultural education degree recipients in the United States has elected to teach in high school agricultural science and business programs. Instead, agricultural education graduates have taken other positions in agribusiness organizations.

The number of middle school and high school agricultural science and business programs is expected to remain steady. However, relatively low current enrollments in agricultural teacher preparation programs in many parts of the United States suggest a strong employment market for agricultural education graduates during the remainder of the decade. This is especially true for graduates having sufficient preparation in the sciences or other areas to be certified to teach in multiple disciplines.



## Annual Available Graduates and Employment Opportunities



## *Social Services Professionals*

*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*

Social service occupations will contribute some 10 percent of the food and agricultural science employment openings during the next five years.

Average annual employment opportunities are projected to be 4,862 compared to 4,564 available graduates. Colleges of agriculture, natural resources, and veterinary medicine are expected to generate nearly 60 percent of the graduates. Allied fields, especially dietetics, will contribute the other graduates for social service jobs.

Two-thirds of the projected annual employment opportunities in this occupational cluster are for dietitians and nutritionists. A strong employment market is projected in these specialties throughout the remainder of the decade in both the public and private sectors. Qualified graduates will continue to be produced by colleges of agriculture in their nutrition and food science programs and by allied colleges which administer degree programs in human nutrition and dietetics. In the aggregate, projected annual shortages of qualified graduates are expected to be near 6 percent.

Other social service professionals included in this employment cluster are food, plant, or animal inspectors and compliance officers, personnel training and labor relations specialists, social workers dealing with food and agricultural governmental programs, recreation workers, and land-use planners. Qualified individuals for these positions are produced by a diverse array of college and university academic programs.

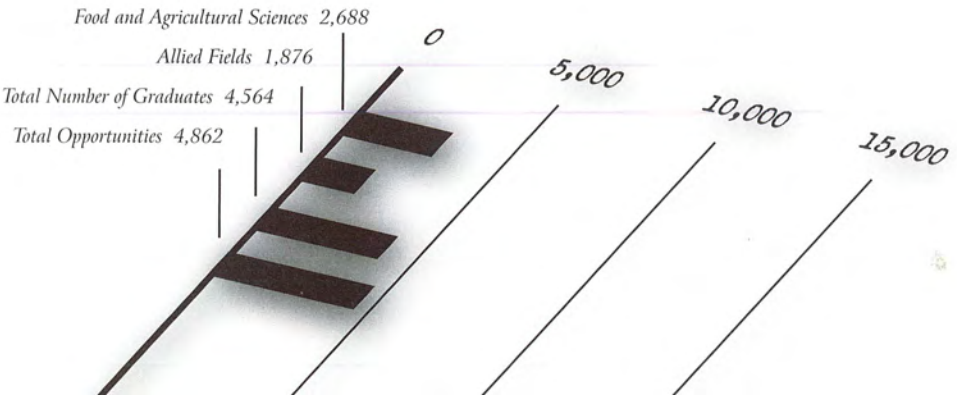
Food safety concerns underscore the continuing needs for food inspectors. Expanding international business activities in the food and agricultural sector are contributing to increased needs for plant and animal inspectors and compliance officers. Likewise, expanded tourism in the United States is expected to generate additional needs for agricultural inspectors during the remainder of the decade.

Demand for social service workers in the food and agricultural sector is expected to increase in relation to U.S. population growth. Relatively more social service activities will be targeted to a rapidly expanding population of elderly citizens.

Although regional planning activities are projected to generate slightly fewer than 100 new jobs for food and agricultural science graduates each year, fiscal and natural resources constraints make economic development and land-use planning increasingly important activities. Some modest growth in the demand for land-use planners is expected during the remainder of the 1990s.

A growing appetite for outdoor recreation activities suggests that the demand for recreation specialists will continue to expand in the coming years. Also, it is expected that a greater proportion of outdoor recreation activities and services will be developed in the private rather than the public sector because of escalating competition among many social services for public funds.

## Annual Available Graduates and Employment Opportunities



# *Agricultural Production Specialists*

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

During 1995-2000, some 8 percent of the total employment opportunities for college graduates in the food and agricultural sciences will be in agricultural and forest production.

Average annual employment opportunities are projected to be 3,873. In contrast, some 4,131 qualified graduates are expected to be available each year. Agriculture, natural resources, and veterinary medicine programs are expected to produce 53 percent of the graduates who will compete for agricultural production positions.

Farm and ranch managers are expected to account for more than 60 percent of the projected employment opportunities for agricultural production specialists during 1995-2000. The changing economic structure in farming and ranching indicates an expanding number of openings for production managers and a declining number of opportunities for farm or ranch owner-operators. The total number of U.S. farms and ranches is expected to continue to decline. In the aggregate, a 6.7 surplus of qualified graduates is projected for agricultural production positions during the next five years.

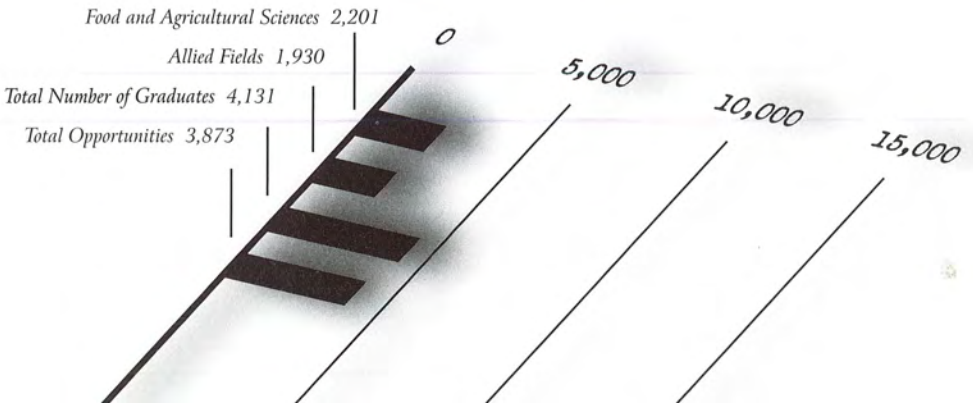
Consumer dietary changes indicate a growing number of production management opportunities in aquaculture and in fruit and vegetable production. The very strong employment market for poultry and swine production managers is expected to continue. Also, increased production management opportunities are projected in the ornamental horticulture and turfgrass industries. Timber production opportunities are expected to continue to be highly specialized in a strongly integrated industry.

The growing complexity of managing large-scale crop and livestock production units is shifting the demand to graduates having more specialized skills and experiences with a particular species or a distinct phase of the production process. While the owner-operator of a farm or ranch may need to have a diverse array of production management skills to be most effective, the trend is to larger scale production units operated by a management team of individuals having highly specialized responsibilities.

Baccalaureate degree recipients are expected to account for more than 90 percent of the college graduates who will be accepting positions in agricultural and forest production positions during the late 1990s, but modest growth in opportunities for advanced degree recipients is anticipated. While graduates will come from a wide array of academic disciplines to agricultural and forest production jobs, nearly all who accept positions will be expected to have work experiences related to the plant or animal enterprise that they will manage.

Individuals planning to be farmers, ranchers, or other producers will need an increasing depth of understanding of the global production system and the interrelationships in the world market economy. Moreover, graduates will need an understanding of the relationship between the environment and the food supply, along with skills to establish values that will allow them to work within a changing societal view of food production.


Annual Available Graduates
and Employment Opportunities


Food and Agricultural Sciences 2,201
Allied Fields 1,930
Total Number of Graduates 4,131
Total Opportunities 3,873
0
5,000
10,000
15,000

# *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 national 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, a panel of experts was used to integrate these information bases into a consistent analytical model. The panel was comprised of college and university administrators with broad experiences in the recruitment of students and the placement of graduates. A summary of methods used to determine relationships between employment opportunities and qualified graduates follows.

**Available Graduates**

In 1977, Congress designated the U.S. Department of Agriculture (USDA) as the lead federal agency for higher education in the food and agricultural sciences. Graduates in the fields of science and business were identified by the Congress as those with baccalaureate or higher degrees in agriculture, natural resources, veterinary medicine, or closely allied fields. This study examines those graduates who qualify for and generally enter scientific and professional occupations. Closely allied fields are included since many of their graduates are equally qualified for and choose to pursue careers related to various aspects of agricultural-biological systems, agribusiness, or agricultural/food production technology. Examples of closely allied fields include biochemistry, cell/molecular biology, genetics, pharmacology, human nutrition, international marketing, environmental sciences, mechanical or civil engineering, and information science and systems.

The major source of data for determining baseline numbers of graduates was the Degrees Conferred Survey. Degrees conferred are among the annual Integrated Post-secondary Education System Surveys (IPEDS) conducted by the National Center for Education Statistics (NCES) of the U.S. Department of Education. Since IPEDS data are reported by all colleges and universities subsequent to the close of the academic year, they require extensive time for collection, validation, and processing. Hence, data for a given academic year are released two years later at the earliest. This study, begun in 1994, used the latest available data, that were submitted for the 1991-92 academic year.

The NCES annual degrees conferred database includes numbers of 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 panel of experts selected all relevant degree specializations for which graduates are deemed qualified for occupations requiring expertise related to agriculture, natural resources, or veterinary medicine. For each degree specialization selected, the panel used historical placement data to estimate the percent of qualified graduates by degree level likely to enter the different food and agricultural scientific and professional occupations. Next, the panel identified education clusters for purposes of categorizing graduates with degree specializations into eight broad areas of expertise. The eight education 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

Estimates of the number of graduates expected for the 1999-2000 academic year stem from trends in fall enrollment data available from the USDA Food and Agricultural Education Information System (FAEIS). This information system includes annual enrollment and degrees conferred

data collected through national surveys of all U.S. colleges of agriculture, colleges of forestry, and colleges of veterinary medicine. For each selected degree specialization at each academic level, the average annual number of graduates expected each year was computed as the mean value between the number of 1992 actual and 2000 projected degrees conferred.

For purposes of this study, two additional factors were considered in arriving at a final determination of the number of available annual graduates. One, the U.S. Department of Education and the U.S. Agency for International Development have long documented that a high proportion of graduate students in agriculture and natural resources are foreign citizens who return to their native countries subsequent to graduation. For some degree specializations this ranges as high as 40 percent of the doctoral graduates. Two, several agricultural and natural resources specializations are characterized by high proportions of baccalaureate and master's graduates pursuing further advanced study. Therefore, data on these two factors, assessed through the National Center for Education Statistics and the Agency for International Development, were applied to the numbers of annual graduates available to arrive at a realistic estimate of annual graduates expected to be available for employment by all types of United States employers.

### 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, Industry/Occupation Matrix. Based on annual surveys 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. This study utilized the most recent BLS data available--1992 actual and 2000 projected. Separation rates for each occupation were used to determine employment openings due to retirement, death, or disability. These rates were acquired from the National Occupation Information Coordinating Committee.

When this series of reports on employment opportunities was first introduced, the panel of experts identified industries and occupations deemed to require graduates with agriculture, natural resources, or veterinary medicine expertise. For each industry chosen, the panel reviewed data on each selected occupation and further estimated and computed the percent of employees having the requisite expertise. Finally, for each occupation, the number of employees was summed across all industries to yield wage and salary occupational employment in food and agricultural scientific and professional positions. Since then, the validity of these estimates by the panel has been confirmed many times. The same percentage estimates were applied to the 1992 BLS occupational employment data, published in the November, 1993, *Monthly Labor Review,* in order to assess opportunities for new college graduates in the food and agricultural sciences.

Corresponding data were established for the year 2000. They were derived from the BLS "moderate" employment projections. The projected average annual changes in employment due to industry growth/diminution from 1992 through 2000 were summed with average annual separations resulting from death, disability, and retirement to yield average annual employment opportunities. Therefore, employment opportunities presented in this report reflect both predicted industry growth/diminution and predicted employee replacements due to permanent labor force separations. It is important to note that this further increases the accuracy and validity of the data on employment opportunities.

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 as follows:

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

The BLS database does not provide definitive employment statistics for secondary and post-secondary agricultural science and business teachers and Cooperative ExtensionServices personnel. Therefore, data for agricultural teachers were obtained from *A National Study of Supply and Demand for Teachers of Agricultural Education in 1992* by Dr. William G. Camp and *A National Study of Supply and Demand for Post-Secondary Teachers of Agriculture in 1992* by Dr. Regina Smick Attisano. Data regarding Cooperative Extension Services personnel were obtained from the USDA personnel file on all U.S. extension professionals.

### Comparison of Employment Opportunities and Available Graduates

For each degree level, the panel established a matrix for relating graduates in each of the eight education clusters to the need for college graduates as new hires in the six different employment clusters. To facilitate this complex process, 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 expected to be available for employment each year within an employment cluster. Hence, for each employment cluster, a comparison can be made readily between available graduates and employment opportunities.

# *Acknowledgments*

We wish to acknowledge the excellent contributions made by several individuals and professional organizations in conducting this study and reporting the results.

This is the fourth in a series of ongoing studies initiated in 1980 to identify major trends with regard to professional employment opportunities for new available college graduates. The basic methodology underlying the ongoing national studies has remained essentially the same throughout the years. Therefore, we would again like to acknowledge the valuable contributions made by several professional organizations in designing the initial research methodology and in conducting the ongoing studies. Among these are: the American Association of State Colleges of Agriculture and Renewable Resources; the Academic Programs Section of the Board on Agriculture of the 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 drawn from many sources, a panel of university experts with notable experiences in the recruitment of students and placement of new college graduates was utilized. The following panel provided extensive advice and guidance on the 1995 study: Allan D. Goecker (chair), Purdue University; Daniel D. Godfrey, North Carolina Agricultural and Technical State University; Kim Harris, Southern Illinois University; Gary Schneider, University of Tennessee; W. David Shoup, University of Arizona; and H. Dean Sutphin, Cornell University. Also, we wish to acknowledge the valuable insights and suggestions extended by Roger Bruene of Iowa State University, Raymond A. Miller of The Ohio State University, and Peter A. Muscato of the U.S. Department of Agriculture, who reviewed drafts of this publication.

Special thanks are extended to Kerry K. Litzenberg, Jennifer Scamardo, and Sheri Stebenne-Whatley of Texas A&M University who coordinate and operate the USDA Food and Agricultural Education Information System which provided enrollment statistics and valuable assistance in the preparation of degrees conferred data. Appreciation is expressed to William G. Camp and Regina Smick Attisano, both of Virginia Polytechnic Institute and State University, for contributing supply and demand data for high school and post-secondary agricultural science and business teachers.

Individuals from other federal agencies who provided advice include: David Frank, Bureau of Labor Statistics; Vance Grant, National Center for Education Statistics; and Richard Dempsey, formerly of the National Occupation Information Coordinating Committee.

Editing and visual design of this report were provided by Amy Page Christiansen and Troy Brown, Agricultural Communications, Purdue University. Photo credits: page 7, Tom Luba; page 9, David Umberger; page 11, 17, Kathryn Elsesser-Luba; page 15, Mike Kerper; page 13, Agricultural Research Service.

Prepared and published by the School of Agriculture, Purdue University, West Lafayette, Indiana. Supported by Science and Education Resources Development, Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, Washington, D.C., and 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. Purdue University and CSREES-USDA are equal opportunity/equal access institutions.

November, 1995.