

Student Numbers in Agronomy and Crop Science in the United States: History, Current Status, and Possible Actions¹



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Abstract

Enrollment declines in colleges of agriculture and particularly in agronomy majors threaten the viability of these programs. One consequence is a reduction in the availability of educated professionals for the agricultural industry. This paper surveys the numbers of students receiving Bachelor's degrees in agronomy and crop science nationally and at selected universities since 1984, and makes recommendations to reverse the decline. Total number of degree recipients and their percent of total college graduates has decreased from 764 in 1984-85 (0.45% of total Bachelor's degree graduates) to 523 in 2002-03 (0.26% of total). National trends do not reflect wide variances among individual universities with a few institutions maintaining or increasing numbers of degree recipients. An open-ended survey of a group of universities verifies these quantitative trends and emphasizes that local conditions such as state demographics or the existence of distinctive majors affects enrollment. The Department of Agronomy and Horticulture at the University of Nebraska-Lincoln proposes several measures to enhance its enrollments: (1) Strengthen contacts with community college instructors; (2) develop Advanced Placement (AP) courses directed at upper level secondary students; and (3) add a staff member who will specialize in youth activities, including recruiting and development of outreach educational materials.

Introduction

Concerns about enrollments in undergraduate agronomy programs are not new. The period during and following the "farm crisis" of the 1980s resulted in much soul-searching on enrollment trends in higher education in agriculture and specifically in agronomy (Beyrouy and Bacon, 1986; Dalmasso, 1990). Concerns about the consequences of these declines were and still are important, including the need to maintain a supply of professionals for the agronomy industry and justifying resources for ongoing academic programs (McKenna and Brann, 1992; Reisch, 1984). Nevertheless, many of the

factors involved in determining enrollments have been beyond the control of university faculty and administrators. These factors include demographic trends (declines in college-age or rural populations) and/or economic trends which make the perception of a career in agriculture less attractive.

Perceived powerlessness in the face of large-scale trends has resulted in little consensus on ways to reduce or reverse these enrollment declines. If a single, manageable cause for the declines had been identified, agronomy educators could have taken concrete measures to reverse those declines. In contrast, many, sometimes conflicting, recommendations have been made: recruit the urban student and his or her parents (Taylor, 1990); re-emphasize recruiting the rural student (McKenna and Brann, 1992; Russell, 1993); revise the curriculum to be more attractive (Bradley et al., 2003; Dalmasso, 1990); emphasize print media (Dyer et al., 1999); and most broadly of all, change the image of "agriculture as a field of study...dogged by conservative, dusty, and dull images." (Handelsman, 1992).

The intent of this paper is first, to assemble available data to provide a quantitative picture of current enrollment trends in undergraduate agronomy programs nationally as well as for specific institutions in the time period since the last "ag crisis" in the mid- to late-1980's. Second, we will describe the results of a telephone survey of persons from a wide range of institutions regarding the general "health" of their agronomy and related programs and what measures they may have taken to address enrollment declines. Third, we will describe measures which have been proposed or adopted by the University of Nebraska-Lincoln (UNL) Department of Agronomy and Horticulture to reverse its enrollment decline.

Trends: 1984-2003

A necessary starting point for any analysis of student enrollment is to find a source of data which is authoritative, that is, has been gathered with reasonably consistent methodology over the period of time of interest. Such data are available through the U.S.

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Department of Education (USDE) National Center for Educational Statistics (<http://nces.ed.gov/ipeds/pas/>). While the site is a source of a wealth of data, we chose to focus on Bachelor's degree recipients (hereafter simply called "graduates") identified from agronomy and crop science programs. There were several reasons for this choice. First, the choice of graduates was intended to provide a more stable data set for analysis than total enrollments. Graduation is assumed to be the end-point of enrollment in any academic major. Second, the dataset is relatively complete from 1984 to 2003, providing a window on at least one full "boom-bust" cycle in enrollments.

"Agronomy and crop science" was the classification category in the dataset that best fit agronomy as the term is traditionally used. We recognize that this choice does not include the numbers of soil science or other plant science-related majors which may be housed in departments of agronomy nationally. Finally, we chose to use for our analysis a core group of 54 public universities, most but not all land grant institutions (Table 1). The core group excludes several private colleges and universities as well as some public institutions that produce agronomy and crop science graduates but which are not part of the land grant system. Consequently, trends in the data over time are more meaningful than total numbers of graduates, which actually would be higher than reported here.

Nationally, numbers of agronomy and crop science graduates have changed substantially in the 20 years since 1984 (Figure 1). The first reporting

year (1984-85) is also the highest, with 764 total graduates. This in itself represents a decline from 1978, as reported by Beyrouthy and Bacon (1986), who indicated a decline in enrollment of 51% for the 1978 to 1984 period. The decrease in number of graduates of the late 1980s and early 1990s will come as no surprise to anyone familiar with the "farm crisis" years. Graduate numbers bottomed in 1991-92 at 388, recovering to 631 in 1999-2000. Numbers again have declined more recently. Numbers of female graduates have remained more stable than those of male graduates, but still comprise a very small number of the total (e.g., 127 in 1984-85 and 98 in 2002-03).

The number of Bachelor's graduates with agronomy and crop science majors expressed as a fraction of total college graduates presents a similar picture (Figure 2). Note that the denominator of the fraction shown on the y axis is total number of Bachelor's graduates nationally during the survey years, whereas the numerator is the total number of agronomy and crop science graduates from the 54 survey institutions only, excluding other institutions with agronomy and crop science graduates. Thus, the fraction reported is slightly lower than in fact. The most disturbing aspect of these data is not only that agronomy and crop science majors make up such a small fraction of total graduates, but that the fraction is decreasing. Numbers of graduates are highest at the first sample time (1984-85), recovering in the late 1990s, then decline again. Even at its peak in 1984-85, however, these graduates made up only a minuscule fraction of the total (0.45%). These downward trends continue even in the face of on-going demand for agricultural and food scientists generally, projected to grow at a 3-9% rate through 2012 (Bureau of Labor Statistics, 2004). Current salaries for plant scientists, in the mid-range of Bachelor's degree recipients in agriculture at \$29,934, would also seem to support more robust enrollments (National Association of Colleges and Employers, 2004).

In times of economic stress for universities nationally, resources which are already limited will likely flow preferentially to expanding programs, that is ones with large numbers of

Table 1. Universities comprising core sample group for tracking enrollment in agronomy and crop science majors using U.S. Department of Education (USDE) data.

Auburn University Main Campus	University of Connecticut
California Polytechnic State University-San Luis Obispo	University of Delaware
Clemson University	University of Florida
Colorado State University	University of Georgia
Cornell University-NY State Statutory Colleges	University of Hawaii at Manoa
Iowa State University	University of Idaho
Kansas State University	University of Illinois at Urbana-Champaign
Louisiana State Univ & Ag & Mech & Hebert Laws Ctr	University of Kentucky
Michigan State University	University of Maine
Mississippi State University	University of Maryland-College Park
Montana State University-Bozeman	University of Massachusetts-Amherst
New Mexico State University-Main Campus	University of Minnesota-Twin Cities
North Dakota State University-Main Campus	University of Missouri-Columbia
North Carolina State University at Raleigh	University of Nebraska-Lincoln
Ohio State University-Main Campus	University of Nevada-Reno
Oklahoma State University-Main Campus	University of New Hampshire-Main Campus
Oregon State University	University of Puerto Rico-Mayaguez
Pennsylvania State University-Main Campus	University of Rhode Island
Purdue University-Main Campus	University of Vermont and State Agricultural College
Rutgers University-New Brunswick	University of Wisconsin-Madison
South Dakota State University	University of Wisconsin-Platteville
Texas A & M University	University of Wisconsin-River Falls
Texas Tech University	University of Wyoming
The University of Tennessee	Utah State University
University of Arizona	Virginia Polytechnic Institute and State University
University of Arkansas Main Campus	Washington State University
University of California-Davis	West Virginia University

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graduates. Based on the statistics given above, agronomy would not be one of those expanding programs.

Figure 1. Bachelor's degrees awarded in agronomy and crop science by year, 1984-85 through 2002-03, from a selected group of 54 U.S. universities

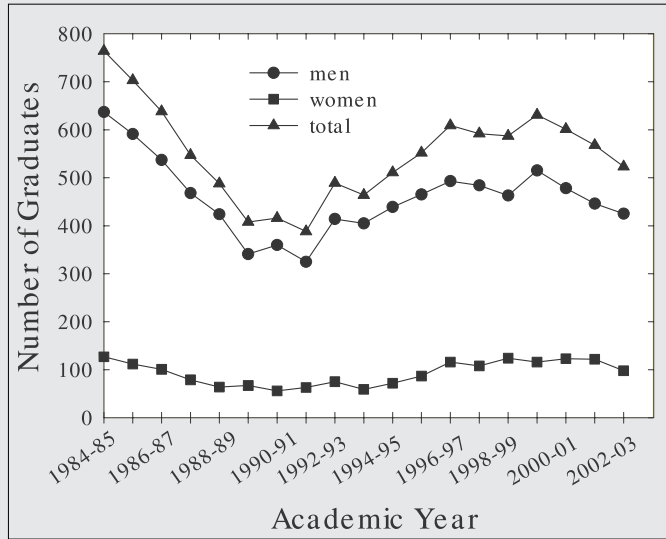
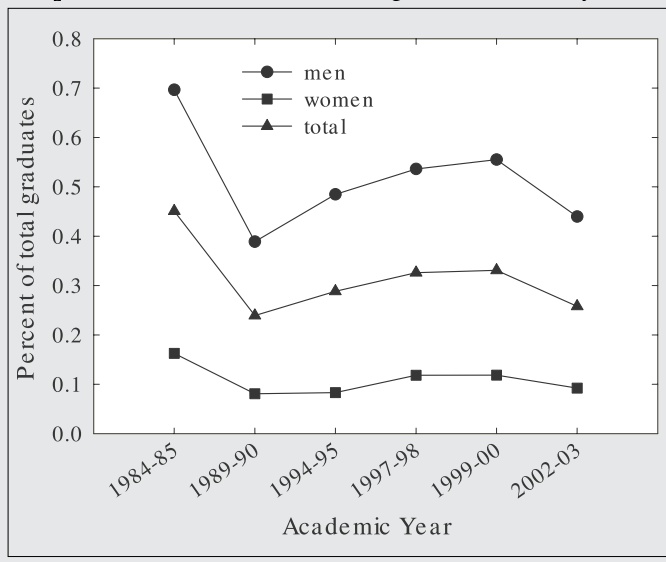


Figure 2. Bachelor's degrees awarded in agronomy and crop science since 1984 from a selected group of 54 U.S. universities as a percent of total U.S. bachelor's graduates in that year.



Trends In Selected States

The total and percentage figures presented above do not describe the situation for any single state. For that reason we next chose to compare agronomy and crop science enrollments at the University of Nebraska-Lincoln (UNL) to a selected subset of four institutions also offering that major. Two of the institutions are regional neighboring land grants, one is a land grant outside the region, and the last is a non-land grant outside the region which has produced large numbers of graduates in the field. These data are presented in Figure 3. Note that at the first

observation (1984-85), all five programs had between 30 and 40 graduates. Trends over time have substantially broadened the spread of the data, so that by 2002-03, graduate numbers ranged from 15 to 60. Our motivation in pursuing this question at UNL is also apparent, with a decline in our graduate numbers to 23, a trend which continues to the present (data not shown). High school graduation projections for Nebraska cannot be expected to reverse the situation in the medium term, as Nebraska high school graduate numbers are predicted to decline to approximately 18000 by 2012 and increase only modestly after that to 2018 (Blanco, 2004). One clear conclusion that can be drawn, however, is that there are “winners” and “losers” in recruitment, retention, and graduation of majors in agronomy and crop science. This conclusion, then, led us to the next part of our research.

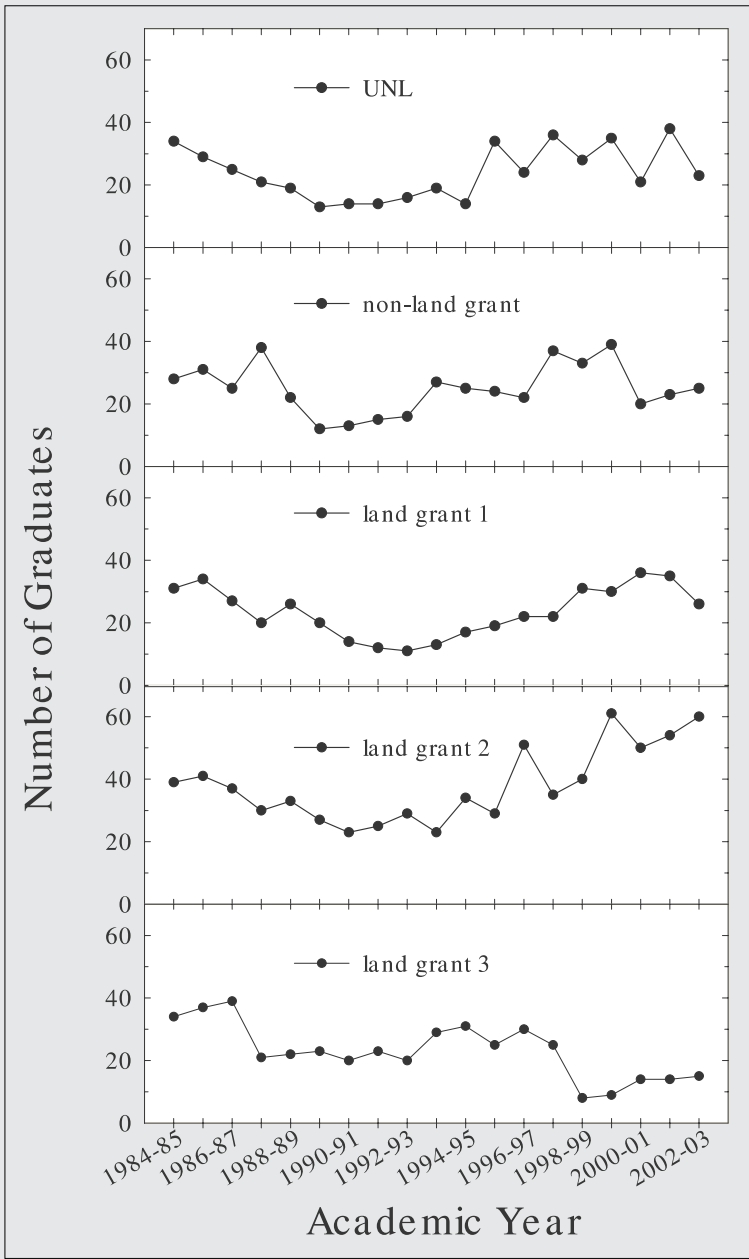
Survey of Agronomy and Crop Science Programs

In the fall of 2003, the authors and several of their colleagues conducted a telephone survey of representatives from a range of institutions offering a major in agronomy or crop science. Because of logistical limitations, the survey group was not the same as that used for the USDE data set described above, but was similarly intended to represent a cross-section of institutions. The questions used in the telephone survey are given in Table 2. The responses, also given in Table 2, are summaries of many contacts, chosen to represent the range of responses received.

The names of majors cited by the survey contacts are broader than “agronomy and crop science,” used in the search of the USDE database described previously. This broadening is in part intentional as it helps to identify techniques that academic departments have used to expand their appeal beyond those two traditional designations. At the same time we acknowledge that the survey respondents were evaluating the status of a diffuse group of majors, which could influence interpretations of the responses that follow.

Estimates of enrollment trends from the survey respondents are not intended to be quantitative to the degree that the USDE data are. In addition, the estimates represent a broad group of majors, as noted above. Nevertheless, the general downward trend in enrollment noted by the interviewees is consistent with the downward trend in graduates cited previously. Interestingly, the one land grant program with a strongly increasing number of graduates (Figure 3) was not identified as such by the respondent in the telephone interview. This indicates that estimates of quantitative trends obtained from individuals must be treated with caution and verified independently when possible.

Figure 3. Bachelor of Science degrees awarded in agronomy and crop science by year, 1984-85 through 2002-03, by the University of Nebraska-Lincoln (UNL) and four comparison institutions.



Demographic trends appear to be highly location-dependent, with states having large urban centers claiming comparably larger urban enrollments. A second trend is the gravitation of urban students toward certain majors, mainly those which could be accurately described as “non-traditional,” such as turfgrass management or agricultural biotechnology. These majors may not have been identified in the USDE dataset as “agronomy and crop production,” however, unless identified as such by the reporting institution, and so would not have contributed to the compiled graduate data. Nevertheless, despite frequently stated efforts to the contrary, the survey

respondents described their enrollments as continuing to be largely rural and male.

In the face of generally declining enrollments among “traditional” agronomy and crop science programs, we then asked what measures the departments were taking to recruit students from “non-traditional” (i.e., non-farm or ranch) backgrounds. In this regard, there was little commonality among responses. There were some broad groupings of initiatives, however. One thrust involved what were often described as more up-to-date, attractive recruiting materials, including web pages; PowerPoint® presentations to be used either by department personnel or sent to high schools; and short, postcard communications sent to prospective high school students. A second thrust was more academic in approach, such as a high school level research apprentice program; establishing and promoting new, novel courses such as in agroecology; and establishing marketable academic areas of concentration, such as plant biotechnology or environmental soil science, within existing majors. A third thrust involved more people-oriented efforts such as using alumni of the major to be representatives at high school career fairs and even having an annual pizza lunch with university general studies advisors, to make them aware of the potential for majors in agronomy, crop science, and related fields for current university students who are not yet decided on a major.

Many states have a well-developed system of two-year colleges which offer academic transfer programs to four-year campuses, including the land grant. The two-year colleges likely will attract some students who might otherwise matriculate directly at the four-year campus, for reasons of cost, convenience, or entrance requirements. While the two-year college alternative should not directly affect the number of graduates from four-year agronomy and crop science programs, it would affect enrollment at any given time. Some students may possibly decide to end their formal postsecondary education after receiving an Associate's degree. For this reason we asked our survey group whether state two-year colleges or other non-agricultural institutions were an effective source of transfer students to their programs. The effectiveness of such a transfer seemed to be very dependent on local or state conditions. The presence at the two-year college of an

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Table 2. Questions and summarized responses from telephone survey of academic institutions offering agronomy majors.

Question	Summary of Responses
Name(s) of major(s)	Agronomy; Crop Science; Plant Science; Crop and Soil Science; Agroecology; Plant and Environmental Soil Science; Soil Science; Earth and Soil Science; Applied Plant Science; Crop, Soil, and Pest Management
What are current enrollment trends in your major(s) (numerical change, time period)?	Mostly down, some nearly 50% over the last 5 years. Exceptions are in programs seen as non-traditional (e.g., turf)
What are demographics and demographic trends in your major(s) (numerical change, time period; rural, urban, male, female, traditional freshman, transfer, ethnic minority, etc.)?	Strongly location-dependent: Programs with access to population centers have >50% urban originating students; others have demographic differences by major (e.g., turf, agricultural biotechnology are heavily urban; soils and crops are mainly rural); most show little change, still mainly male, rural.
How do you attract non-traditional (i.e., non-farm or ranch) students to your major(s)? Do you have any special programs to do so?	Revised web page; professionally-developed PowerPoint, video and print materials; agroecology course (with no pre-reqs); high ACT contacts; Research Apprentice Program (minority-directed); hired recruiter; high school research program; post cards (not letters) to high school students; alumni at high school career fairs; "market careers, not majors"; annual pizza lunch with general studies counselors (for already-enrolled students); establish Plant Biotechnology and Environmental Soil Science concentrations (but little recruiting success from these to date).
Are two-year colleges or other non-agricultural schools an effective supply of transfer students?	Mixed: If community college instructor is alumnus of program; if university has selective enrollment (so many students are forced to start at community college or branch campus); if state mandates transferability (articulation); if connections are of long-standing.
Are you aware of any agronomy or related programs at other institutions that are growing?	Some mentioned, not always accurately when compared with USDE data.
Do you have any recommendations for us?	Strong role of alumni in recruitment; be cautious with name change – can kill a program; hook up with industry; "Adopt a School"; emphasize employment; scholarships as recruiting tool; marketing is as important as (or more than) program itself; FFA contacts (contests, prizes); personal contacts; importance of names (college, department, major); target likely groups; written materials more than the web; "food, land, people, and the environment" in the title; maintain current students, attract different ones.

alumnus of the land grant's agronomy or crop science program was seen to be highly effective in establishing a "pipeline" of transfer students. State politics also are a very important factor, specifically if the four-year institution is selective and forces a group of otherwise qualified students to begin their education on a two-year campus, or if the state higher education governing body mandates seamless transferability between two- and four-year campuses. Finally, history plays a role, if there are long-standing positive relationships between the two- and four-year institutions on the personal or administrative level.

Finally, an open-ended query for recommendations to increase enrollment elicited several suggestions: involve alumni and industry as partners in the recruiting process; carefully consider name changes of programs, to avoid alienating a traditional target recruiting group; emphasize employment and scholarships rather than department names; establish contacts with secondary schools both to promote awareness and nurture interest in the major.

Recommendations

Obviously, recommendations to solve such a seemingly intractable problem as already low and decreasing numbers of graduates from agronomy and crop science programs will not be easy. Such recommen-

dations will also not be universal, because as we have seen, the effectiveness of many of the measures that could be taken will depend on local or state factors. Thus, the following actions which have been adopted by the UNL Department of Agronomy and Horticulture to stabilize and, we hope, increase enrollment may not be appropriate for all programs.

1. Establish person-to-person contacts between faculty of the Department and persons at community colleges in similar areas of expertise. The objectives here are twofold: First, to keep community college teachers "in the loop" with regard to changes in curriculum at UNL which may have an impact on community college students in transfer programs; and second, to strengthen the personal relationships which will encourage community college teachers to recommend students transfer to UNL's agronomy program upon completion of their associate degrees.

2. Establish one or more Advanced Placement (AP) equivalents of current introductory level agronomy courses or of new courses which would allow current high school students to earn college credit. The principal objective of this proposal is to establish stronger ties with current high school teachers and students, encouraging them to see enrollment in agronomy at UNL as a logical extension of their education. We realize that in the short-term, this may mean some loss of enrollment in traditional on-campus sections of introductory courses, but we feel that this loss will be more than offset by the gains for the program overall. We also see the development of such courses as an opportunity to provide significant service to high schools, particularly those in rural areas which may not have the resources to develop such advanced coursework on their own.

3. Redirect department resources to hire a faculty-level recruiting/youth activities specialist. While faculty and staff of the Department of Agronomy and Horticulture already devote considerable time to recruiting activities, such commitment is often ad hoc and uncoordinated. We feel that a faculty-level person, devoted to recruiting and youth activities will be able to work with existing faculty in their professional areas to develop and present effective

recruiting activities. In addition, we anticipate that the specialist will have a major role in developing the AP courses which will indirectly contribute to the recruiting effort.

Other activities, including creating a set of integrated, professionally-developed recruitment materials (print, electronic, web), and on-going review of requirements and options for the agronomy major to broaden the appeal to both urban and traditional students, are also under discussion.

These measures are too new to the UNL Agronomy and Horticulture Department for us to report results. We are convinced that there is no "magic bullet" for solving the enrollment crisis for the agronomy major nationally. Each program or department must examine the conditions which are unique to its circumstances, then devise a set of actions to address those circumstances. It is clear, however, that simply relying on economic or demographic cycles to improve the situation is a recipe for further decline. Only aggressive action will result in the maintenance of the vigor of undergraduate agronomy programs and the continuation of our ability to provide professionals for rewarding careers.

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