# The crisis in agricultural education

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***The number of undergraduate student majors in California four-year colleges of agriculture has remained stable but has dropped sharply nationwide. Subject areas in California schools that are not traditionally related to production agriculture have expanded.***

While the trend of declining agricultural college enrollments has been known for some time, it has drawn little if any attention among agricultural leaders. Overshadowed by the economic crisis in agriculture in the past five years, the supply of college-trained professionals in agriculture is now approaching crisis proportions. Joseph Slasulot, the head of placement in agriculture at the University of California at Davis, reports that he can no longer find qualified college graduates for the many vacancies he has for positions in agricultural production, marketing, regulatory work, and programs dealing with toxic chemicals and water quality.

We conducted a study to assess the enrollment trends in four-year colleges of agriculture in California, and to determine how these trends related to the reported economic crisis in agriculture. We also examined curriculum changes and other ways in which programs have adapted to recent changes in the U.S. economy.

In the spring of 1988, the deans of each of the four-year colleges of agriculture were interviewed by telephone. We supplemented the data obtained from them with enrollment statistics from each of their institutions. The seven schools were: California Polytechnic State University, San Luis Obispo; California State Polytechnic University, Pomona; California State University, Fresno; California State University, Chico; University of California at Berkeley; University of California at Davis; and University of California at Riverside. (Humboldt State University was not included since it does not have a school of agriculture, although it has significant programs in forestry, soils, range management, and the like.)

## Enrollment trends

Between 1979 and 1987, total enrollment at the colleges of agriculture was stable (-0.4%) while overall enrollment in these institutions increased 15.6% (fig. 1). Although the percentage increase in total enrollment was identical for the California State University (CSU) and the University of California (UC) systems, enrollment in agricultural colleges declined 8.4% in the CSU system and increased 8.6% in the UC system. The negligible 0.4% decline in California agricultural colleges was considerably less than the 33% nationwide loss in undergraduate enrollment in agriculture between 1979 and 1986 reported by the National Association of State Universities and Land Grant Colleges. However, enrollments in California's four-year agricultural colleges are more similar to the national average than is apparent in the gross figures. The dramatic decline in California enrollment in production-oriented fields was similar to that of the 50 Land Grant institutions nationwide. California, however, has had an offsetting increase in enrollment in basic sciences related to agriculture: genetics, biology, and biochemistry.

## Agricultural production

Enrollments in agronomy and crop sciences, animal science, ornamental horticulture, plant science, and the soil and water sciences in the seven institutions have declined 32%, from 4,449 to 3,028 students, since 1979 (table 1).

All colleges offering courses in production agriculture lost students. The CSU system had nearly four times as many students in agricultural production in 1987 as the UC system did. Consequently, although the drop in the CSU system (32.1%) is almost identical with the loss in the UC system (31.4%), the decline in numbers of students in the CSU system has been more dramatic. The greatest percentage loss in students statewide occurred in soil and water sciences, which declined from 249 to 86 students for a 65.5% loss in eight years. Students in ornamental horticulture and the plant sciences declined by half in the same period. While agronomy and crop sciences declined by a similar percentage (41.4), the animal sciences were significantly less affected, losing only about 11% of their majors. All declines are similar to those reported nationwide.

## Related fields

Enrollment changes in other majors show little consistency (table 1). Agricultural economics majors increased by over 40%; general agriculture lost 68%. Agricultural business and management lost students, while agricultural education and international agriculture remained the same. Agricultural engineering and mechanized agriculture attracted additional majors.

The largest gains and losses of students came from programs within the CSU system. For example, while California Polytechnic State University at San Luis Obispo drew 33.9% more majors to these related fields, California State University at Chico and California State Polytechnic University at Pomona experienced significant losses (46.8% and 41.1%, respectively).

## Supporting fields

This group consists of fields often found in colleges of agriculture that are less directly related to the production of food. Forestry and the wood sciences suffered the most dramatic loss at 71.7%. The University of California at Berkeley and at Davis had similar declines in students in forestry. Enrollment in natural resources and natural resource management also generally declined, although the University of California at Davis actually gained 38% more students in these fields.

Student enrollments in sciences supporting agriculture in the UC system nearly doubled, up 89.4% since 1979. This is understandable in research-oriented agricultural colleges, since areas such as genetics, molecular biology, and biotechnology have attracted the most national attention and student interest in recent years. Increases are also occurring in these subject areas at most CSU colleges but are not reflected in our data, because the majors are not all administered through the colleges of agriculture.

Colleges of agriculture occasionally offer general programs not specifically related to agriculture, such as home economics, human development, environmental design, and community studies. These accounted for 40% of all students in California four-year agricultural colleges in 1987. The College of Natural and Agricultural Sciences at Riverside illustrates this point well: 97.5% of the 1,966 undergraduates there are in programs only indirectly related to agriculture.

## Shifts in areas of study

The deans interviewed reported that students were shifting away from production agriculture areas such as plant and soil sciences. Several deans saw ornamental horticulture as an area that has turned around

TABLE 1. Undergraduate enrollment in California four-year colleges of agriculture by field of study and percent change since 1979

| Field of study | | Chico | Fresno | Pomona | San Luis Obispo | Total CSU | Berkeley | Davis | Riverside | Total UC | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Agricultural production** | | | | | | | | | | | |
| Agronomy and crop sciences | # | 0 | 0 | 44 | 185 | 229 | 0 | 12 | 0 | 12 | 241 |
| | (%) | | | (–61.4) | (–30.7) | (–32.9) | | (–60.0) | | (–60.0) | (–41.4) |
| Animal sciences | # | 46 | 139 | 451 | 733 | 1,369 | 0 | 503 | 0 | 503 | 1,872 |
| | (%) | (–48.9) | (–12.0) | (–21.2) | (+0.8) | (–11.5) | | (–8.7) | | (–8.7) | (–10.8) |
| Ornamental horticulture* | # | 0 | 0 | 150 | 379 | 529 | 0 | 0 | 0 | 0 | 529 |
| | (%) | | | (–55.9) | (–47.1) | (–49.9) | | | | | (–49.9) |
| Plant science | # | 52 | 149 | 0 | 0 | 201 | 0 | 93 | 6 | 99 | 300 |
| | (%) | (–60.6) | (–34.6) | | | (–44.7) | (–100.0) | (–59.9) | (–83.8) | (–58.4) | (–49.8) |
| Soil/water science | # | 4+ | 0 | 15 | 44 | 63 | 7 | 16 | 0 | 23 | 86 |
| | (%) | | | (–60.5) | (–68.3) | (–64.4) | (–70.8) | (–63.6) | (–100.0) | (–68.1) | (–65.5) |
| **Subtotal** | # | 102 | 288 | 660 | 1,343 | 2,391 | 7 | 624 | 6 | 637 | 3,028 |
| | (%) | (–54.1) | (–26.6) | (–38.0) | (–27.5) | (–32.1) | (–76.7) | (–20.3) | (–85.4) | (–31.4) | (–31.9) |
| **Agriculture-related areas** | | | | | | | | | | | |
| Agriculture bus./ management | # | 84 | 256 | 65 | 852 | 1,257 | 0 | 97 | 0 | 97 | 1,354 |
| | (%) | (–26.3) | (–7.6) | (–59.4) | (+4.5) | (–8.0) | | (+1.0) | | (+1.0) | (–7.4) |
| Ag. engineering & mechanized ag. | # | 8 | 23 | 49 | 271 | 351 | 0 | 0 | 0 | 0 | 351 |
| | (%) | (–27.3) | (–1.2) | (+25.6) | (+25.5) | (+20.2) | | | | | (+20.2) |
| Ag. economics | # | 0 | 14 | 0 | 0 | 14 | 0 | 572 | 0 | 572 | 586 |
| | (%) | | (–44.0) | | | (–44.0) | | (+47.4) | | (+47.4) | (+41.9) |
| Ag. education | # | 0 | 55 | 0 | 121 | 176 | 0 | 17 | 0 | 17 | 193 |
| | (%) | | (–14.1) | | (+13.1) | (+2.9) | | (–29.2) | | (–29.2) | (–1.0) |
| International ag. | # | 0 | 2+ | 29 | 0 | 31 | 0 | 29 | 0 | 29 | 60 |
| | (%) | | | (+52.6) | | (+63.2) | | (–27.5) | | (–27.5) | (+1.7) |
| Nutr./food sci. | # | 71 | 87 | 124 | 450 | 732 | 178 | 520 | 0 | 698 | 1,430 |
| | (%) | (+40.8) | (+141.7) | (–39.2) | (+254.3) | (+50.3) | (–5.3) | (–12.0) | | (–10.4) | (–32.7) |
| General ag. | # | 53 | 21 | 53 | 0 | 127 | 0 | 0 | 0 | 0 | 127 |
| | (%) | (–62.1) | (–81.7) | (–56.2) | | (–68.0) | | | | | (–68.0) |
| **Subtotal** | # | 216 | 458 | 320 | 1,694 | 2,688 | 178 | 1,235 | 0 | 1,413 | 4,101 |
| | (%) | (–46.8) | (+15.7) | (–41.1) | (+33.9) | (–2.5) | (–5.3) | (+8.4) | | (+6.5) | (–0.4) |
| **Supporting fields** | | | | | | | | | | | |
| Forestry/wood sci. | # | 0 | 0 | 0 | 0 | 0 | 50 | 6 | 0 | 56 | 56 |
| | (%) | | | | | | (–72.4) | (–64.7) | | (–71.7) | (–71.7) |
| General home econ./textiles | # | 333 | 328 | 156 | 0 | 817 | 0 | 508 | 0 | 508 | 1,325 |
| | (%) | (+160.2) | (–32.6) | (–10.9) | | (+3.4) | | (+12.6) | | (+12.6) | (+6.8) |
| Natural resources & nat. res. mgt | # | 0 | 0 | 37 | 257 | 294 | 302 | 436 | 39 | 777 | 1,071 |
| | (%) | | | (–50.0) | (–32.2) | (–35.1) | (–23.0) | (+38.0) | (–18.8) | (+2.9) | (–11.3) |
| Sci. supporting agriculture | # | 0 | 0 | 0 | 0 | 0 | 141 | 123 | 5 | 269 | 269 |
| | (%) | | | | | | (+187.8) | (+57.7) | (–66.7) | (+89.4) | (+89.4) |
| **Subtotal** | # | 333 | 328 | 193 | 257 | 1,111 | 493 | 1,073 | 44 | 1,610 | 2,721 |
| | (%) | (+160.2) | (–32.6) | (–22.5) | (–32.2) | (–10.6) | (–20.7) | (+24.5) | (–30.2) | (–4.1) | (–2.5) |
| **Total**: Ag., rel. & sup. fields | # | 651 | 1,074 | 1,173 | 3,292 | 6,190 | 678 | 2,932 | 50 | 3,660 | 9,850 |
| | (%) | (–13.9) | (–24.2) | (–36.8) | (–5.8) | (–17.7) | (–19.2) | (+2.6) | (–51.9) | (–3.7) | (–13.0) |
| Other areas taught within the college | # | 0 | 696+ | 0 | 0 | 696+ | 45+ | 1,670 | 1,916 | 3,631 | 4,327 |
| | (%) | | | | | | | (–1.4) | (+56,8) | (+24.6) | (+48.4) |
| **GRAND TOTAL** | # | 651 | 1,770 | 1,173 | 3,292 | 6,886 | 723 | 4,602 | 1,966 | 7,291 | 14,177 |
| | (%) | (–13.9) | (+25.0) | (–36.8) | (–5.8) | (–8.4) | (–13.8) | (+1.1) | (+48.3) | (+8.6) | (–0.4) |

* Ornamental horticulture programs are combined within plant science programs at some universities and do not appear here but are found within the plant sciences.
\+ Percentages are not calculated since this field of study did not exist in 1979.

and is increasingly attracting students. Within the UC system, students are shifting away from production agriculture and forestry into the biological sciences and genetics. Several deans also mentioned nutrition and food sciences as a growth area.

Deans at four of the seven universities reported that interest in agricultural business and management is increasing. The latter may be a recent trend, since enrollment statistics indicate that this area decreased between 1979 and 1987. Another explanation for the inconsistency may be that agricultural economics, which is sometimes included in the same category as business and management, has increased substantially over this period.

## Reasons for the decline

The most logical explanation for the enrollment decline in colleges of agriculture may be the crisis in the nation's agricultural economy. The UC deans interviewed differed distinctly in response from the CSU deans, however, when asked if changes in the agricultural economy had affected their colleges of agriculture. None of the deans in the UC system saw them as directly affecting their particular colleges in a substantial way; all of those in the CSU system saw them as very significant.

The decline in enrollment does not appear to be correlated with job opportunities in agriculture. Every dean interviewed indicated that there were many job opportunities in agriculture, and most said they have even improved in recent years.

Given the growing opportunity for employment in agriculturally related occupations, the declining student interest in agricultural studies is puzzling. It may be due in part to the negative image of agriculture that has been portrayed in the media, according to six of the seven deans.

All deans foresaw changes in their programs resulting from the economy over the next three to five years. There was a general sense that enrollment problems have bottomed-out, but new enrollments will be slow to come. There will be little change in the financing of educational programs, and government contributions to research will

decline further. Job opportunities for students of agriculture will probably increase as other parts of California's economy such as the defense industry suffer setbacks.

## Summary and conclusions

An in-depth examination of student enrollment in California's seven four-year agricultural schools shows that agricultural production areas lost majors in each subfield. An exception was animal science at one state university, where it remained about the same. Enrollment trends between the CSU and UC systems in these areas are strikingly similar.

Fields related to agriculture showed mixed retention of students. Some—agricultural engineering, agricultural economics, and nutrition and food science—expanded, while general agriculture lost students. There was considerable variation in enrollment trends in these areas between the two systems.

Supporting fields of study and other subject areas also showed mixed results. Forestry suffered a dramatic loss of students. Sciences like molecular biology and genetics attracted students.

The negative image of agriculture is generally accepted by agricultural college deans as a major contributor to the loss of interest by students in agriculture.

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# Heat stress and copper supplementation in pigs

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***Controlled feeding trials at UC Davis found no connection between temperature stress and response to copper supplementation, but confirmed overall effects of heat stress on pigs.***

Over 30 years ago, a researcher in Great Britain discovered that adding copper sulfate to the ration of growing-finishing pigs improved their performance. This response has been confirmed by many others, and copper supplementation is common in many countries. However, as is usual in most instances with feed additives, not everyone gets the same results. Some producers have suggested that the higher temperatures found in parts of California where hogs are commonly raised cause the lack of response.

## Feeding study

We have completed five replicates of a study over five farrowing seasons at UC Davis. We used 80 pigs and added 0.1 pound copper sulfate per 100 pounds of ration (255 ppm copper) to a balanced experimental ration based on corn, soybean meal, 50% meat and bone scraps, dicalcium phosphate, limestone, and a vitamin-mineral premix (added 12.3 ppm copper to rations). Two similar temperature-controlled chambers were used for housing; pigs were kept in individual stalls, eight per chamber. One chamber was a control in which temperature was maintained at 73°F, considered ideal for growth and based on prior research; the other was maintained at 91°F. Pigs were fed once a day all the feed they would readily consume, with water available at all times. Respiration was counted for each pig daily in the first four replicates.

The study was designed as a 2 x 2 x 2 x 5 factorial, with two breeds (purebred Durocs and three-way rotational crossbreds), two ambient temperatures (control and high temperature stress), two levels of added copper (0 and 250 ppm), and five replicates. Littermate pairs of pigs were placed on the same copper intake, one in each chamber. Numbers of each sex and each breed were also balanced. Pigs initially averaged 70 pounds (32 kg) and were fed for an average of 66 days. The ration, which was sampled and analyzed regularly, averaged 16% crude protein and either 17 or 279 ppm copper.

## Results and conclusions

The only statistically significant differences due to copper supplementation were in feed efficiency and daily gain (table 1). There was no interaction between air temperature and copper supplementation in effects on gain, feed consumption, or feed per unit of gain. We conclude that temperature stress under the conditions of this study had no effect on the response to copper supplementation.

The effects of temperature on gain and feed consumption confirm results previously reported at Davis: The increase in respiratory count indicates heat stress. The advantages of crossbreeding in commercial hogs are also confirmed with regard to gain, feed consumption, and feed utilization.

**TABLE 1. Relationship of temperature and copper supplementation**

| Item | Avg. daily: Gain | Feed | Feed unit gain | Respiration (breaths/ min.) |
|---|---|---|---|---|
| | *lb* | *lb* | | |
| Supplemented copper level, ppm: | | | | |
| 0 | 1.83 a | 4.65 | 2.63 c | 53.7 |
| 250 | 1.91 b | 4 61 | 2.48 d | 53.9 |
| Temperature: | | | | |
| Control | 2.03 e | 4.98 e | 2.53 | 45.5 e |
| Heat-stressed | 1.71 f | 4.28 f | 2.58 | 62.1 f |
| Breed: | | | | |
| Duroc | 1.77 e | 4.45 e | 2.61 x | 53.8 |
| Crossbred | 1.98 f | 4.81 f | 2.50 y | 53.8 |

Note: Different letters for the same trait in the same column indicate statistically significant difference: a,b = P<0.10; c,d = P<0.005; e,f = P<.001; x,y = P<0.05.

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