1. Teaching agronomy for the future of the profession

Craig J. Pearson

School of Crop Sciences, University of Sydney, N.S.W. 2006

Abstract

An agronomist identifies and helps solve problems in crop management, where crops are defined broadly as plant communities which are managed for profit, pleasure or other purposes eg. reclamation.

This article discusses the goals and tactics of producing professional agronomists, the need for identification with our client industry; structural problems which cause a lack of professionalism; the challenge to rationalize and innovate in teaching and for education to serve external students.

Goals

As a nation we should be debating our goals: where do we want to be in 20 years, and therefore, what are the goals we want for today's teaching programs which will produce the elite, the national decision-makers, in 2007? Currently, the world political climate is such that the goals of many nations are being identified with words like "efficiency" and "comparative advantage" and this leads naturall^{y} to tactics of free trade and free-market allocation of resources. However, Australians will only begin debating our goals seriously when we ask: What are the social consequences of a goal directed exclusively to achieving comparative

advantage at all levels: individual, industry, sector and nation? What if, as a nation, our agriculture has no comparative advantage or (more likely) our trading partners have different goals and therefore continue to use different strategies eg. protectionism? Duncan and Fogarty, in a perceptive analysis of the agriculture-led development of Australia in contrast to the stagnation of Argentina, indicate the serious consequences of identifying the wrong goals or even appropriate goals but wrong strategies (10). Sadly Australian goals are often not identified, eg. in recent books on public decision-making (2) and Aboriginal education (26).

The goal of universities and colleges should be to produce graduates with one attribute: professionalism. Professionalism encompasses the skills, dedication and truthfulness needed by the diversity of graduates who

identify with agronomy in serving agriculture. These graduates are concerned with optimising the output from systems, usually from farm management, crops and animal-grassland interactions (Fig. 1: Source 24).

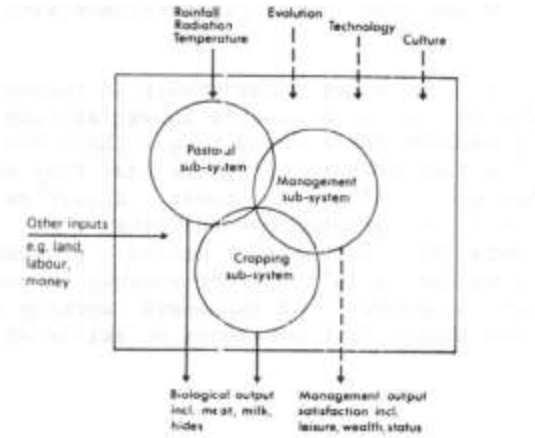

Fig. 1. A model of a farming system as a human activity.

Graduate agronomists may be employed in management (the organization of resources including labor), research (finding more efficient ways to put resources together), communication (selecting and supplying relevant information to the manager and researcher) and sales (supplying the resources).

Professionalism, to me, requires graduates to have:

- Empathy or identification with their client industry, namely agriculture including horticulture, and environmental management.
- An independence of, or more desirably an interdependence on, others. Graduates must be self-starters and stayers, not dependent on others (teachers) for ideas and information.
- A problem-solving approach: a keenness and a methodology to identify situations which may be improved and to seek solutions to these problems.
- A rigorous "knowledge base" in the scientific technological, social and economic disciplines which underpin agronomy.
- Humility: appreciation of what they don't know and where to get help, which is probably more important than graduates appreciating what they do know.
- Communication skills, which are essential for correct problem identification and communication of innovative ideas..

These six requirements may be seen as goals for teaching agronomy: they are attributes which people have according to their natural abilities but which may be developed, ignored or discouraged in education. Our better graduates - those leaders in 2007 - will develop further because after graduation they will in their post-graduation experience integrate these attributes and develop better judgement than their fellow graduates.

Commitment and Involvement

Are these goals yours? Their order is contentious. Many people prefer to stress the importance of the knowledge base (eg.18) whereas I stress that identification with a client is the first quality of a professional. Identification with agriculture was also the concern of Norman (22) in his address to the first Australian Agronomy Conference. He said that agronomists should be fundamentally concerned with changing or manipulating the crop/environment complex, and that "whereas understanding without manipulation is a legitimate scientific activity for agronomists to manipulate without understanding is in most circumstances unproductive". Regrettably within agricultural faculties we have highly talented individuals who have precious little empathy with agriculture.

I challenge you: the future of our profession depends on your commitment to these goals. Commitment contrasts with involvement just as the contribution to a plate of ham and eggs by the pig contrasts with that of the hen!

If Australian agriculture is to regain world leadership in innovation our faculties must produce graduates who wish to work in agriculture i.e. in the client industry. The graduates don't need to get their boots dirty every day but to be effective they need to recognize that they work in a laboratory or whatever because (owing to their abilities) their contribution to agriculture will be greater by so doing. My view of agricultural scientists is very akin to that of medical graduates. In this context I remind you that Australia's current success in innovation in medicine is due to medical graduates and engineers working in high-technology research, not to any change in the numbers or skills of general practitioners.

Tactics

Agricultural faculties fragmented into specializations in post-war growth. This was a tactic to justify growth, but it was also felt that this would strengthen our profession. As Lindsay (18) points out, it has not done so. There have been recent changes towards amalgamation of specializations and the adopting of a systems view, with the formation of the School of Agriculture at the University of Western Australia in 1985 and the School of Crop Sciences at the University of Sydney in 1987. Recent changes should not be seen as a choice of a systems perspective over reductionism: both synthesis and dissection are essential for systems analysis although some people in my opinion, place undue emphasis on one or the other as if they were alternative routes to our goal.

It may be argued that some specializations of agriculture may be removed from field problems because they serve (or act through) an agronomist. I suggest that this is not so. Resources for agricultural teaching and research are scarce so that all our graduates should have a close affinity with our industry and specializations which do not have such affinity can be taught within faculties of science more efficiently and perhaps more rigorously because of the traditional narrowness of a science syllabus.

We might well consider how to strengthen the bond between teacher, student and client which is usually farmer. Surveys are one possibility which we are now using at Sydney. Exploratory surveys and rapid rural appraisal techniques are gaining emphasis in less developed countries (e.g. 30,31).

Problems

A significant minority of agricultural graduates lack elements of professionalism. This is not surprising; many urbanites, reared on TV, are immature at 21. However, they may not acquire professionalism during their "internship", their two or so years of employment shortly after graduation, and worse still, these unprofessionals often remain in agriculture because they lack the wit to go anywhere else. I do not see any compelling evidence that this unprofessional minority is increasing with time although I do suggest that structural problems in our industry, teaching, and employment, encourage mediocrity. These problems are:

1. Industry: A national apathy towards scientific research, the "agricultural crisis", and how we are not responding to these.

2. Teaching: poor or uneven quality of student intake; proliferation of courses and places for students; increasing complexity and change in our subject material.

3. Employment: historically dominated by the Public Service.

It is well recognised that Australian industry, particularly secondary industry, is apathetic towards research by the private sector. Government incentives such as a 150% tax incentive and a new offsets policy are encouraging research, but current private R and D is only about one billion dollars (2). This is small

relative to government funding (Fig. 2) and it is small internationally: One billion dollars is less than one-third of the R and D expenditure of General Motors or IBM.

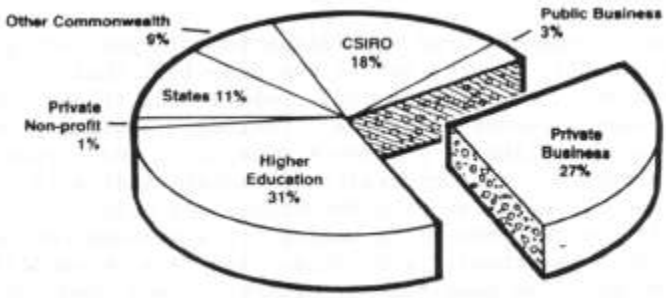

Fig 2. Australian Research and Development, 1984/85.

Add to this national apathy the "agricultural crisis". This crisis of 1986- has arisen through declining terms of trade, erosion of markets by dumping and tariffs by other countries, and inadequate rural adjustment. The public is well aware of this crisis; the popular press publishes estimates such as "40,000 farm families will quit in the next few years" (6) and that "farm values have shown up to a 50% decline within 1986 alone" (17).

The point of such citations is the public awareness, not the accuracy of the numbers. Public awareness of an "agricultural crisis" causes agriculture to be ranked poorly by high school graduates who rank security and stability as the highest of all factors in determining choice of profession (Table 1).

Table 1: Results of a survey of 613 Californian students as to their perception of job characteristics as related to career choices and to agriculture (source: 19). Values are mean ranks from 1 (highest) to 8 (lowest).

	How important are these factors in choice of career?	How well does agriculture meet these factors?
Stability & security	1	8
Lots of money	2	7
Opportunity to work with people	3	3
Use of special talents	4	4
Permits creativity	5	6
Respected position in community	6	5
Make contribution to society	7	1
Can be own boss	8	2

As professional agronomists we are not publicly contributing to solve the crisis: do we get press coverage as individuals or through our professional societies? Also, we are not encouraging good students to

enter agriculture: agriculture can give career stability and money and the opportunity to work with people to the same extent as does say veterinary science. Indeed, employment of agriculturists shortly after graduation, although shifting markedly to the private sector, has seen no greater erosion of salaries relative to non-professionals than has occurred in other professions (Fig. 3: Source 13)

A perception that agronomy is not a top career has led to agriculture now having a university entry requirement lower than any other profession.

While we still attract some top quality students, this low quality "tail" (as assessed by high school examinations) makes teaching difficult because of the range of background experience, and this contributes to failure and inefficient teaching.

Low quality of entry in tertiary courses should not lead to the suggestion of greater selectively. The contrary is true: less than a quarter of Australian farmers have any formal education beyond year 10, while in

Europe the figure is 907. and in the US and New Zealand 50% (6). Nationally only 87. of entry into the workforce has tertiary qualifications whereas in Japan it is 357. (16). Our goal should remain to increase the education of our workforce. Increased education might be approached using a tactic of more highly efficient teaching with emphasis on vocational skills ie. through college diplomas and external courses.

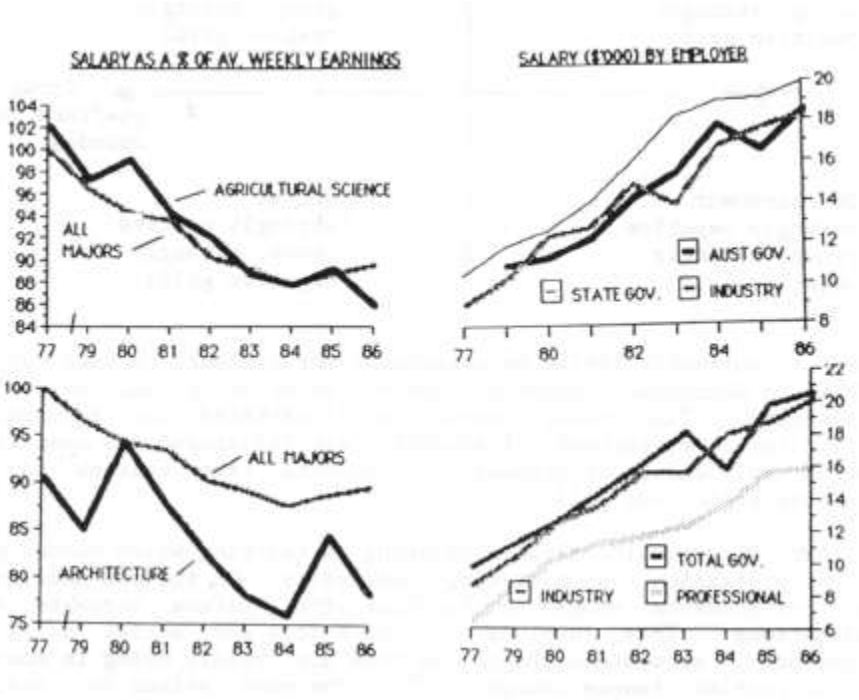

Fig 3. Recent trends in relative and absolute salary of agricultural graduates and, for comparison, architecture graduates.

Also, we should begin to appreciate that our society is more heterogeneous than, say, twenty years ago. My graduating class was almost exclusively middle-class WASP and male-dominated. Today our students, like their future clients, are heterogeneous: there is a mosaic rather than a single, shared belief about how society works (9). From within this mosaic, pictured in Fig. 4, we have a high proportion of students who could be described as having attributes of a "negative group" (egalitarian, non elitist) and "positive grid" (accepting hierarchy and role definitions). These people are not naturally innovators or entrepreneurs. Moreover, they contrast with the cultural view of farmers and agribusiness.

Shouldn't we actively encourage greater representation by other socio- economic groups in our courses? Shouldn't we recognise the diversity among students and clients in our teaching?

Yet what has happened? There has been proliferation of courses in agriculture and applied science, proliferation of institutes offering these courses, upward push from skills-directed courses towards scientifically based degree courses, and emphasis on full-time attendance. There are nationally about 66 full-time courses of degree or graduate diploma status ie. 2 years or more full-time study, excluding these which deal exclusively with animals or veterinary science (6).

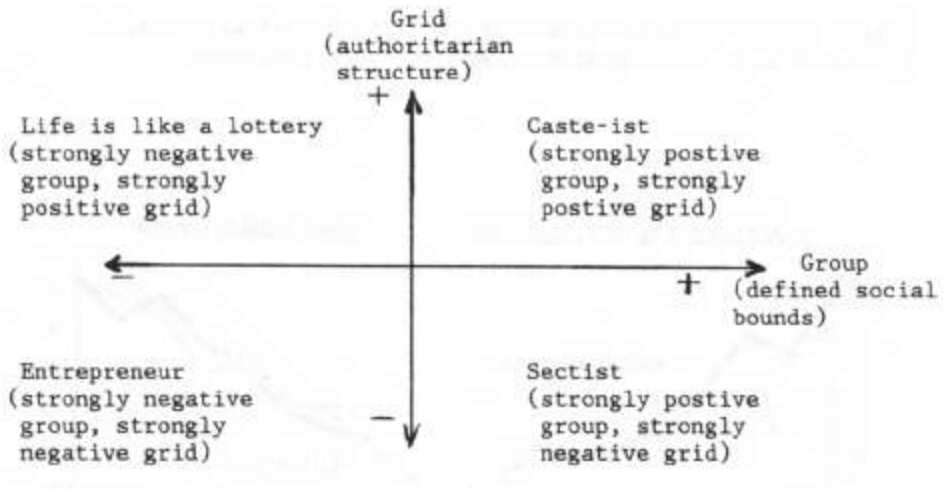

Fig 4. Social context and cultural categories of individuals

There is currently little encouragement for students to take courses which relate to employment opportunities or value of production in particular disciplines. This point cannot be illustrated for agronomy but in horticulture, 60 percent of students are registered in amenity courses, whereas only about 15 percent of students take courses in fruit or vegetable production (12).

A final "structural" problem relating to teaching which causes mediocrity in our profession is increasing complexity. On the one hand, we suggest that our students should be familiar with systems concepts and their implications. This involves both technical and social issues (Fig 1). Furthermore, as systems change, as they are rapidly doing in Australia, so do the problem issues change (25). The need arises for teaching and research at the interface between agronomy and social economics (23): for people who will change our way of farming (3). Agronomists have produced good studies of socio-agronomic systems (eg. 14). However, it is difficult to formulate problems, experiment and to propose best' technical solutions for large systems (eg. 8, 21). At the other extreme, six orders of biological organization below the ecosystem, and with response times 106 faster than those operating within the system, our students are also being taught about molecular genetics. Additionally, how much should our students know of the "tools" of our trade? We teach them how to calibrate a seed drill; in the mid-1980's the technology has expanded to include anything from robotics applied to tissue culture (3) to sheep shearing, to computers and expert systems (21). The perceived need for passing information - facts' - to students is immense, giving rise to "Too much teaching and not enough learning takes place in higher education" (11).

The Future

I commend to you these comments, relating to the United States (4):

"In the future, high-wage-level societies will be those whose economies are based on the use of a wide scale of very highly skilled workers, backed up by the most advanced technologies" and:

"While it is easy to move capital and technology, it is exceedingly difficult to create and sustain the conditions under which very large numbers of people become and remain well educated"

In Australia, I think the future of our profession depends on: (a) agreeing on our educational goals (b) committing ourselves to preparing positively for the future (c) overcoming structural problems, rather than

either pretending they don't exist or reacting perversely and (d) embracing private enterprise.

Throughout Australia there are attempts to evaluate agricultural teaching and research, in industry sectors (eg. 29), each of the RIRF Councils, agriculture as a whole (eg.15) and in our universities and colleges. Sydney University is in the middle of changing the curricula for its

BScAgr. & BAgEc degree in response to our changing agricultural environment. It will strengthen its commitment to its client industry but this will be without compromise: agriculture will still be the most broadly-based science degree at that University.

I hope that for the future, retention of such courses is complemented by rationalization among teaching institutions and innovation in courses for external students. There is evidence that there is little or no relationship between age and ability to learn (20) so let us pay more attention to older students already in the workforce serving agriculture.

Finally, we must ask, who pays? Traditionally, agricultural education has been funded by governments. Yet, government support for higher education is low compared with other OECD countries. This "seriously limits the return which the nation receives from higher education research" (1). We should get greater relevance in teaching and more cost-effective extension and research services if we operate more closely with agricultural industries and run courses and services which recover their costs. As

Thompson recently stated(27): ".. Facilitation and interpretation of information are precesses using definable and quantifiable resources and thus can attract a service fee."

In this paper I have introduced issues and problems which I think we should all consider: education should not be left only to the teachers. As Norman said, "Your future depends on agronomy" (22). In considering the future please consider also a recent statement attributed to Jones, the Minister for Science (6 April, 1987): "We must overcome our fear of change ... we cling to a disappointing present for fear that the future will be worse".

Acknowlegement

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