THE EMERGING ROLE FOR AGRICULTURAL EDUCATION IN PRODUCING FUTURE RESEARCHERS

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Abstract

Agricultural education is changing and will continue to do so in response to changes in the definition of the agricultural sector, communication technology and funding imperatives. Bachelor’s graduates will probably focus on career opportunities in natural resource management and vocationally oriented agricultural production, processing, and marketing fields. The small proportion of agricultural graduates with the aptitude and motivation to work effectively in research forms an important part of the post-graduate agricultural education pool and requires specific orientation to the changes occurring in agricultural research systems. Mechanisms used in some developed countries may be of benefit and provide a basis for strengthening overall human resource development and management in agricultural research systems, both in terms of the management of existing researchers, and the continuous training of new researchers. The approaches described in the paper have relevance to both more and less developed countries, particularly in agricultural knowledge systems that separate extension and applied research from education.

Two unrelenting pressures will sustain an ongoing need for an active and productive agricultural research base in the world’s major agricultural countries. These pressures, that of producing an ever increasing quantity of food for a growing population with rising individual consumption demands, and the need to protect the natural resource base and remaining areas of natural environment, provide a context for the consideration of agricultural education and research needs for the future. Issues and trends are relevant to both less developed countries (LDC) and more developed countries (MDC).

The Present Situation and Future Scenarios

Traditional agriculture in MDCs relied on secondary and tertiary educational institutions to produce specifically trained graduates for work in an apparently uncomplicated sector. The educational institutions responded and, over the decades, educated and trained scientists, technicians, and farmers to lead the sector to unprecedented success in feeding a growing world population. But traditional, uncomplicated agriculture has changed as has the classical image of the high-achieving agricultural science graduate becoming the
researcher, the subject matter specialist wearing a specific sub-sector label, the extension worker being a generalist, and the vocational student becoming the farmer. Science, management, and markets have transformed agriculture, and the graduates of today’s agricultural institutions compete for work with scientists skilled in genetics, bioengineering, and biochemistry; with MBA graduates, marketing specialists, and sociologists. The primary responsibility of tertiary agricultural education institutions is not the production of agricultural scientists for research but graduates who can find a niche in a sector where science and management combine to demand hybrid skills that were unknown a generation ago. For example, graduates could serve as advisers on environmental legislation to satisfy urban populations that farmers will care for the national land resource.

Several possible future scenarios for agricultural education can be posited. One of these, discussed in this paper, is the need to integrate research and education institutions, and the training of agricultural researchers in:

2. Maintenance of a source of researchers through post-graduate programs.
3. Improved human resource management in research systems.

Agricultural education has a wide span of objectives and prepares students for a range of opportunities and for that reason alone cannot be designed around the needs of agricultural research, and, in particular, the production of agricultural researchers. However, in a period of great change in agricultural education, we must all be sure that a reliable stream of broadly based, competent and motivated potential agricultural researchers flows from our agricultural education systems. Improved management of the resources of an Agricultural Research System (ARS) is a common interest for both LDCs and MDCs.

**Maintaining Dynamic Agricultural Research Systems**

Qualified and motivated researchers working in well-managed institutions are central to active and efficient ARSs. Effective agricultural knowledge systems in more developed countries link research providers to users of research outcomes. However, most agricultural knowledge systems can be described as institutionally separated (Falvey, 1995) in that applied research and extension are controlled by a ministry or department which is separate from the ministry or department overseeing agricultural education. By contrast, the land grant college model of the USA is an example of an institutionally integrated system, in which research, education, and extension (Meyer, 1995) are integrated in agricultural universities.

In most LDCs, universities operate independently from national research bodies and are seen, at best, as marginally relevant to ARSs and of little direct benefit to the private sector. At the same time, ARSs are often unable to readily find an adequate number of young, qualified researchers trained in research techniques in priority program areas. Universities are engaged primarily in teaching and research and tend to exclude extension activities. A dynamic ARS requires appropriate research and development (extension) planning and agreement on programs and objectives among all research institutions which comprise the ARS. Under these circumstances, universities can interact with ARSs more effectively. One example of an apparent failure to align the policies of research and educational institutions was a large-scale attempt to introduce into India an integrated system similar to that of the USA which was culturally inappropriate to the Indian context (World Bank, 1995). In that case, funding external to the university and foreign views tended to favor research at the expense of teaching and extension (Busch, 1988; Ryan, 1993).
While most students enrolled in agricultural degree programs will pursue careers other than research, the education and/or training of potential researchers remains a critical function of universities. Even though the proportion of students who demonstrate an interest in and an aptitude for research may be small, these students require support from an ARS to focus their research training on relevant fields and gain formative experiences with practical researchers. Research training in agriculture should extend beyond the traditional technical areas in the plant and animal sciences to such areas as consumer, extension and vocational education.

Research activities of graduate students should be aligned with the priorities established by an ARS. This is in contrast with the traditional selection of research topics by professors to complement their own research interests. In an applied area of science such as agriculture, it is appropriate that research conducted by university staff reflects applied and strategic research interests that overlap, even if not fully, with those of the state or national research institutions. The following survey results indicate that MDCs committed to either the institutionally integrated or institutionally separated models for agricultural knowledge systems are developing mechanisms to ensure the production of motivated and competent agricultural researchers.

Information on successful innovations in the education of future researchers in MDCs was elicited through a survey of 13 informed and influential persons engaged in management of research in government research organizations, universities, and research funding organizations in Australia, New Zealand and the USA. The overriding conclusions of the survey were that (a) current mechanisms of funding post-graduate study through scholarships are beneficial, (b) industry support for such research training is critical in all applied fields, (c) joint industry and government funding through levy or check-off schemes are valuable funding mechanisms when managed jointly with industry, (d) there needs to be a constant awareness of the traits which are common to successful researchers and guidance offered to undergraduates who possess such traits, and (e) research training is more effective and more attractive when it is conducted in industrial or research institutional facilities and is linked to continuing employment. The strong emphasis on applied research implied in these approaches was not seen as a concern for any of the three countries, provided basic research was also conducted, sometimes in faculties other than agriculture.

The findings of the survey and international development experience in general suggest that the management of agricultural research systems and the development and management of human resources for and in these systems is critical. Figure 1 introduces a means of understanding the integration of human resource needs for long-term effectiveness in an ARS. It indicates the links between management of research institutions with both general and agricultural universities for the conduct of research and the production of future researchers.

Managing Agricultural Research Systems

Perhaps the major global investor in changes to ARSs is the World Bank, which is now seeking to integrate research and education to a greater extent than it has done in the past (Falvey & Maguire, 1996). Further development of agricultural education to include information technology brings education and extension closer by increasing access and delivery alternatives (Zijp, 1995). Mechanisms employed in selected MDCs that support the linking of research, education, and extension and the focus of each on the needs of national and private developers include the following:
1. **Joint appointments of research staff between universities and state or national research institutions.** These positions may be funded externally, or by the two organizations concerned, and have responsibility to both organizations in a field of agreed mutual importance. Such positions may be appropriate in circumstances in which a key research field requires both ongoing research and the production of a stream of future researchers. One example is that of the joint funding of a new position which combines the senior horticultural research position for the State of Victoria in Australia and a new professorial fellow position at the University of Melbourne. The position aims to link all research programs and to strengthen linkages to education and extension. However, perhaps the best developed examples are those of the joint operations of the research, education and extension systems of the land grant colleges of the USA.

2. **Industry contributions through levies or other funding mechanisms, matched by government, which are reliable and long term for the commissioning of required research.** Such funds provide a mechanism independent of the agencies engaged in research and education and therefore remove a possible bias in the selection of research programs of both researchers and students. They also provide an effective means of maintaining industry commitment to efficient allocation of government funds as well as maintaining research relevancy. This mechanism provides much of the operational funding for agricultural research in Australia through the Rural Research and Development Corporations which are funded through check-offs of commodities matched by government funds.

3. **Scholarship programs for high-performing graduate research students which specify priority research fields.** Such scholarships share the benefits of independence of industry-funded research and also allow significant control over the area of research study for top students. Scholarships may include a guarantee of employment by the research institution in situations where the problem of poorly defined career paths exists. This mechanism is used in New Zealand to a significant extent in selecting outstanding students and orienting their research studies to national priority areas.

4. **Competitive funds for research, scholarships and joint appointments (where applicable) open for all universities with the capacity to serve agriculture.** As agriculture and agricultural research require sophisticated skills, it is no longer feasible to access all resources from single institutions or one type of institution. Agricultural faculties and universities will continue to provide the majority of education for integrating disciplines and applied fields and much of the strategic research. However, faculties in such fields as molecular biology, microbiology, biochemistry and botany also have expertise important to agriculture.

5. **Joint supervision of research students by university and line agency staff.** Research students and university staff will gain from exposure to staff in non-university research institutions and the real world of agricultural research. Research topics selected will also be better focused on applied field problems. New Zealand universities, among those of other countries, accredit staff of research agencies to act as supervisors of research students.

6. **Involvement of universities in ARS policy.** Universities form a critical component in all countries with an active ARS, and, as such, should be considered in all relevant policy matters. This allows estimation of the benefits of incorporating mechanisms to stimulate redirection of university activities, producing future competent and relevant researchers, and expanding the pool of active researchers in the ARS. This mechanism is best evidenced in the US land grant colleges which seek to link research policy with extension and education policy.

7. **Selective use by LDCs of MDC universities.** Past concerns of the cost and retention rates of LDC researchers educated in more developed
countries may be reduced by strategic management of the key skills required from foreign universities. This appears to be occurring as LDC countries assume control of funds to engage foreign institutions as distinct from past aid oriented projects designed, at least in part, by staff of the foreign universities.

8. **Ensure adequacy of core funding for the maintenance of the university human resource.** The OECD (1987) has noted that the future of a university is largely dependent on the quality, dedication, motivation, and productivity of academic staff. Investments in ARS should acknowledge such a critical role and consider supplementary investment for key institutions. While reductions in funding from government to universities in most MDCs may appear to contrast with this point, these reductions could result in greater efficiencies because of an enhanced management focus on strategic strengths. This suggests that major agricultural universities in each country could benefit from a core funding approach supplemented by external resources. LDC universities, on the other hand, are often underfunded to such an extent that no one discipline area can be reliably maintained.

9. **Building on strengths and needs.** The combined impact of increased fiscal accountability and new communication technologies is expected to lead to major changes in staffing profiles and attitudes to and modes of teaching in agricultural universities in MDCs. LDCs are likely to follow the trend. One might expect to see fewer institutions which have a critical mass of specialist and generalist scientists active in fields directly relevant to industry in their locale. The focused approach of New Zealand which orients research students to national priorities is one of building on national strengths and strategies.

Many of these mechanisms are to be found in the US land grant college system which integrates research, teaching, and extension through single institutions. However, that system is unique to the USA, and the conditions that fostered the establishment of those colleges (World Bank, 1992) cannot be readily duplicated in other countries. Separate institutional arrangements commonly found in those countries require such mechanisms to be established.

The above mechanisms aimed at linking education and research in agricultural research systems which are not integrated can be accommodated through initial project planning in the case of LDCs which borrow funds to develop their research systems, and through ongoing human resource development and management programs.

**Management of Human Resources in Research**

Considerable effort may be invested in designing advanced training programs for research staff and, in some countries for academic programs, without realizing the full potential of trained staff. Each ARS requires systematic human resource management to link needed skilled researchers with compatible assignments, to provide incentives for high grade performance, to create opportunities for intellectual growth, and to offer promotion based on fair and transparent merit criteria.

ARSs need a human resource development and management capacity, and any institutional rearrangement of an ARS should include analysis of existing capability and the need for improvement. The essential human resource development and management elements to be considered are:

1. Skill mix identification based on future research priorities.
2. Accurate job descriptions for use in hiring new personnel.
3. Selection of staff based on areas of competence.
4. Ability to conduct training needs assessments.

5. Ability to plan and manage in-service training programs.

6. Capacity to evaluate the impact of in-service training.

7. Willingness of managers to acknowledge superior performance.

8. Provision of opportunities for intellectual growth, such as sabbaticals.


To be effective, human resource development and management must be the responsibility of all management, and manager level workshops should be conducted to clarify concepts, define responsibilities, and develop skills. Managers’ job descriptions need to reflect these responsibilities. Linkages to research students will allow personnel in human resource development and management systems to manage both current and, to an extent, future researchers. Linkages also allow enculturation of prospective researchers to the system and thereby reduce the risk of trained researchers being unsuitable to a particular research organization.

In-service training in an ARS should be continuous and include both formal and non-formal activities. Such training and interaction with the larger research community can be further enhanced through use of media such as video and the Internet. As education and training become increasingly recognized as an individual’s life-long responsibility, the opportunity for tertiary educational institutions to offer customized courses or other training interventions will lead progressive institutions to further integrate with dynamic ARSs.

References


