



# **Revitalising Agricultural Extension**

**A report for the Rural Industries  
Research and Development  
Corporation**

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# Foreword

Research funders, providers, educators and agricultural producers were surveyed for their views regarding the future directions and needs of agricultural and related education. Information was gathered concerning the missions, challenges and likely major changes facing universities and state government agencies associated with agriculture over the next ten years. An overriding focus on issues of environmental management and sustainability was evident in answers with a parallel need for closer interaction between providers of education and research and users of knowledge, that is producers.

The need to attract high performing and motivated students to fields servicing agriculture was highlighted in the stakeholder survey as well as the literature review, and formed part of a second survey. This survey focused on the knowledge of students in regards to the various careers available in agriculture. Year 10 Victorian students from both metropolitan and non-metropolitan regions were surveyed as it was considered that they were at the stage of making first subject choices towards future career paths.

A review of changes occurring in the land grant colleges of the United States and similar institutions in Scotland indicated concerns in similar areas. The report concluded that in common with the United States, existing provision of educational services is failing to meet current expectations of producers in terms of their need for information, creation of learning environments and involvement in decision making of educational providers. It was also noted however, that the development of an education/research provider partnership with industry was seen as a critical outcome of current debates by some persons from each of the employment categories surveyed. From the student survey it was determined that more work needs to be conducted to increase the profile of the variety of careers available in agricultural and related areas.

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**Peter Core**

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# Executive Summary

## Chapter 1: Introduction

In chapter one an outline of the structure and content of the report is given, including the background information to the report.

Agricultural and related education for the purposes of this paper is defined as: post-secondary educational activities at universities, schools of agriculture in colleges of advanced education, agricultural colleges, and schools of agriculture in various state technical and further education systems (TAFE). Areas of education include agricultural production, processing and marketing, soil, water, forest conservation and management. Agriculture and related industries consist of the supplies sector, production and marketing, product processing sector, and the services sector. Services include research, development, outreach/extension, and education and training.

The need for change in agricultural and related education is discussed, along with the social and economic constraints facing the sector and limiting attendance by existing producers. Arguments for and against improving formal educational levels of agricultural producers are noted, as is the proposed need for increased partnerships with industry. Reasoning behind the analysis of the land grant college system in the United States and the Scottish system is given.

The objectives of the project were, to widen the emerging debate concerning agricultural and related education by introducing the more mature debate surrounding Land Grant Universities in the USA and thus provide the outcomes

- a heightened awareness of future requirements from agriculture and related education
- an orientation of education to markets and products for food fibre and recreation
- directions for the introduction of new modes of education, delivery and educational systems

In light of findings from the literature review, a further study was included in the report. This took the form of the survey of Year 10 Victorian students' knowledge and perceptions of agriculture and factors involved in their career decision making.

The objectives for this particular section were to determine

- students' knowledge sources about agriculture and careers in agriculture
- factors which students consider important when choosing a career and whether they consider that agriculture would meet these factors/needs

- students' knowledge of agriculture and the careers available by studying a degree of agricultural science
- attitudes of students toward agriculture and the study of agriculture and whether those with a greater knowledge of agriculture would be more inclined to pursue a career in that area
- what students consider to be the major environmental concerns of today and whether they perceive agriculture as having a positive or negative influence on the environment

The Introduction concludes with a summary of the structure and content of the remainder of the report.

## **Chapter 2: Methodology**

The methodology involved in production of the literature review, two surveys and workshop, are discussed in Chapter two. The literature review forms a context of the report. It covers events and developments leading to the formation of agricultural and related education institutions in Australia today as well as current issues in the agricultural and related education sector. Information from the United States and Scotland was collected widely and is also included in the review.

The first survey was based on a modified Delphi technique, and followed the methodology of Meyer (1992). The first questionnaire included persons involved in the funding, use and policy setting relating to education including its linkages to research and extension. Eighteen leading persons were selected from NFF Round Table Conference leaders and surveyed as Informed Respondents to answer questions drawn from the literature about perceived issues in agricultural and related education (Round 1). Their replies were consolidated and resubmitted to the same persons for ranking in order to determine the main issues and possible solutions for each of the six critical areas (Round 2). Once these were ranked, surveys were circulated to 156 persons from production, research funding, research provider and education backgrounds (Round 3). These persons were also taken from the full participant list of a NFF meeting and were regarded as Involved Respondents.

The second survey was a mail out questionnaire sent to Year 10 students throughout Victoria. Data were collected from 550 respondents which constituted a representative sample which could be applied to all Year 10 students in Victoria. The population was first divided on the basis of metropolitan and non-metropolitan areas. Schools were further divided into Government, Independent and Catholic. Of the schools selected each one was sent a letter addressed to the Science Coordinator asking if they would participate by administering the survey. Those schools agreeing to participate were then sent their requested number of questionnaires. The survey was to be handed out during a class and completed in approximately 10-15 minutes, they were not to be completed at home as one of the objectives of the survey was to test the knowledge of the students of different areas of agriculture. Thus it was important that there be no consultation with any other sources (for example, parents or books) before responding to the questions asked. Analysis of the responses was by calculation of frequencies, percentages, medians and chi-square tests.

Differences between metropolitan and non-metropolitan student responses were considered significant at  $p < 0.05$ .

An electronic workshop was conducted, involving Deans, Heads of Departments and other leaders from Agricultural Faculties and Departments around Australia. It also included interested persons from State and Federal Government agencies, policy makers, industry and the profession. An initial letter was sent to all Deans of Agriculture and Natural Resources (DANR) in Australia in order to decide the preferred venue of the workshop, the result of which was to have an electronic workshop, conducted from Melbourne. An invitation to the workshop was then sent to those on the DANR email server as well as those people from universities and industry with a known interest and who were conducting or had previously conducted work concerning agricultural and related education. Those invited were also given the option of nominating a further three participants interested in taking part in the workshop.

Two reports submitted at the workshop were structured around the two surveys conducted as part of this project. Submissions of other relevant reports were also invited of which one submission, relating to the education of farmers, was received. The workshop was conducted over a period of 15 working days and responses are included in Chapter 5 of the report.

### **Chapter 3: Background and Literature Review**

The main aim of the literature review, which forms chapter three, was to analyse issues facing the agricultural and related education sector. It was also to analyse contrasting systems to Australia's with particular emphasis on the United States. The United States formed a focus because a process of reviewing agricultural institutions was underway which provided insights into the reform process. Scotland had also recently undertaken a review of its system of agricultural education thus also providing information which could serve as a comparison to the current Australian system.

As a result of the literature review several questions were posed for the surveys. For the first survey concerning stakeholders views, six questions were asked. These related to, the missions of universities and State Government agencies involved in providing research, education and/ or extension. Also the major challenges faced by, agricultural units in universities; and State Government Agencies concerned with agriculture and the environment. Stakeholders were also asked; what that thought were the major changes facing undergraduate and postgraduate programs relating to agriculture; the major challenges which should be addressed in agricultural and related research and extension programs.

These questions were influenced by current studies in the United States which were reviewed. It was seen that many of the questions those in the United States were asking of the land grant colleges and their agricultural and related education system related to Australian agricultural and related education. The intent of the questions was to draw out issues and concerns of stakeholders, and to therefore either confirm or refute those as raised in the literature review.

Those issues as identified as being of concern and relevant to Australia from the literature included: environment and sustainability concerns; focusing on customer needs; increased linkages with industry; formation of partnerships with government, industry and the general public; increasing demand for lifelong learning; attracting the brightest students; general as opposed to specialist learning; creating greater community awareness of agriculture and decreasing the gap between rural and urban values. The integration of research, education and extension, which the United States is re-examining, contrasts with part of the Australian debate as to the scope for closer links between these in Australia.

When compiling the literature review and stakeholders views regarding agricultural and related education, it was noted that public perception of agriculture was a recurring theme. This was also a concern in both the United States and Scottish studies in terms of the numbers of students seeking to study agriculture. However, less emphasis had been placed on this area in Australian studies. The views of Year 11 and 12, as well as tertiary students had been examined in an unstructured manner while those students at the Year 10 and lower levels had received little emphasis.

## **Chapter 4: Results**

Chapter four describes the results from both the stakeholder and student surveys. Responses to each Round of the first survey concerning stakeholders views were analysed. The final round (3) was analysed in detail, showing the top three ranked responses from each question.

The three major components for Mission Statements for universities and State Government Agencies involved in providing research, education and/or extension were ranked as: to ensure that the management of natural resources is productive as well as ecologically sustainable; providers of services to Australian agriculture need to be able to adjust to the needs of their clients; to attract adequate investment to ensure that agricultural production in Australia continues to be globally competitive.

The major challenge facing agricultural units in universities was considered to be; to deliver quality courses and foster development of leadership and management skills. While, the major challenge facing State Government agencies concerned with agriculture and the environment was seen as; ensuring that agricultural practices and processes are environmentally friendly to allow for a sustainable future

The major change facing undergraduate and postgraduate programs relating to agriculture was said to be; assisting industry to meet the challenges posed by sustainable land and water use. The major challenge which should be addressed in agricultural and related research programs was listed as; sustainability, environmental issues and long term resource stabilisation. In terms of the major challenge which should be addressed in agriculture and related extension programs, the most highly ranked response was; developing a learning ethos throughout the industry

In the survey of year 10 students in Victoria, it was found that more non-metropolitan than metropolitan students had considered a career in agriculture. It was also found that for both metropolitan and non-metropolitan students; parents/relatives, the media and school had the greatest influence on students' knowledge of careers in agriculture. Those factors which

students rated as the most important when choosing a career were good income, interesting work, job prospects, opportunities for advancement and work location. It was noted that metropolitan students rated good income as the most important factor in choosing a career, yet it was rated as one of the lowest factors that would apply to a career in agriculture.

When asked which careers students thought would be available to a graduate of Agricultural Science, most students responded highest to 'land and environment manager', 'environmental scientist', and 'farmer'. Those with the lowest response were, 'business advisor', 'consultant', 'engineer' and 'economist'. For each of the careers listed only a small percentage of students indicated an interest in pursuing them.

Environmental issues generally, and those issues specified in the questionnaire, were considered very important by both metropolitan and non-metropolitan students. The effect of agricultural practices on these areas of the environment were neither significantly more negative nor positive.

## **Chapter 5: Discussion**

It was noted from the survey concerning stakeholders views on agricultural and related education, that in most cases they shared the same or very similar views to those of their United States counterparts. Views were: the need for change to existing educational services; integration of services and service providers to bring about a more unified and efficient approach to agricultural and related education; along with issues involving sustainability, environment and natural resource management.

The highest rating factors which influenced students' knowledge of careers in agriculture were considered as areas that could be targeted to improve the profile of agricultural careers. Areas viewed as being in need of improvement were those that students' found as important when choosing a career but did not think applied to a career in agriculture. It was considered that increasing the general profile of the various careers available in agriculture would in turn alter students' perceptions of those factors applying to a career in agriculture.

The advantages and disadvantages of the electronic workshop are discussed in Chapter five, along with a summary of responses received. Recommendations from the workshop included

- orientation of programs towards a more generalist approach
- greater linkages between all levels of education
- greater linkages with industry
- increasing agricultural career profiles

## **Chapter 6: Conclusion and Recommendations**

This final chapter summarises the findings of the literature review, the two surveys, and the proposals made at the electronic workshop. All of these components were considered in light of the original objectives of the report and lead to the following recommendations.

### **Recommendations**

Industry, government and educational institutions need to

- acknowledge the inseparability of agricultural education and extension as components of one activity

Industry and educational institutions need to implement strategies to

- increase cooperation in research planning and application between educational institutions and industry
- attract high achieving students to agricultural courses
- emphasise programs on environmental/sustainability issues with a movement towards natural resource management
- emphasise qualities such as leadership, initiative and teamwork within education programs
- increase programs for lifelong learning
- introduce programs to increase the profile of agricultural careers in schools
- work towards promoting the positive image of agriculture, targeting students and those that most influence students, that is, family, school and the media

Educational institutions need to implement strategies to

- provide a greater focus on customers' (including the general public, students and industry) needs in educational institutions
- use new technologies, for example the Internet, to assist formal and non-formal education, while retaining beneficial human/social contact
- study whether those students who select agriculture and related subjects at secondary school, would be more inclined to pursue an agricultural career

# Introduction

## Background

Agricultural and related education is seen by many both within and outside educational establishments as being in need of change (Falvey and Bardsley, 1995). In economic terms, agricultural and related education underpins the agricultural knowledge system which is essential to continuous improvement of agricultural and related production. An emphasis on applied research may have diverted attention from the need to strengthen agricultural and related education. Education includes the educational outreach functions, commonly termed extension. New technologies and increases in efficiency of production assume an improving knowledge base among adopters of technologies and the continued production of researchers and other professional agriculturists concerned with the continuous improvement of agricultural systems (Falvey and Maguire, 1997). The validity of the assumption and the effect of changing circumstances for agriculture in most OECD countries requires debate.

For this paper, agricultural and related education is taken to involve post-secondary educational activities at universities, schools of agriculture in colleges of advanced education, agricultural colleges, and schools of agriculture in various state technical and further education systems (TAFE). Areas of education include agricultural production, processing and marketing, soil, water, forest conservation and management. Agriculture and related industries consist of the supplies sector, production and marketing, product processing sector, and the services sector. Services include research, development, outreach/extension, and education and training.

In social terms, agricultural education as it is currently offered suffers from social and economic constraints which limit attendance by existing producers. At the same time, it appears that improved educational levels of agricultural producers leads to faster rates of adoption of new ideas. Bamber et al. (1997) argue that there is little conclusive evidence of a strong relationship between levels of formal farmer education and agricultural productivity, and therefore good farm management. However others such as Kilpatrick (1996), found that rural businesses benefited from formal and non-formal education and training by being more likely to adopt successful changes with the result of increased profitability. The ability to access new information independently of government support services appears to be accelerating. Modes of delivery of agricultural and related education needs to form part of the wider debate concerning its future orientation.

Falvey and Bardsley (1995) advocate teamwork between providers and the professions. The present emphasis on *industry-driven* TAFE programs provides a useful lesson to higher education yet needs to be widened to *partnership-driven* if programs are to be relevant, useful and able to prepare graduates for the future. Such periods of revitalising are seen as necessary in Australia as they are also in the United States Land Grant College system (Enarson, 1989).

Agricultural and related education also seems to be perceived by the wider public as being a training ground for individuals who are likely to have negative impacts on the

environment. This perception is a problem in itself. The context in which agricultural and related education can be seen to be viable in the future may be one of natural resource management whereby the technical, social and other skills necessary to understand interactions within the environment form the basis of agricultural and related education. While many argue that this is the nature of agricultural courses at present and has been in the past, a wider environmental context appears to be necessary and indeed demanded by persons outside the fields of agriculture. As the major manager of land based environmental matters in Australia, agriculture and related industries require a context of natural resource management for their own public credibility and for responsible practice of future agriculture [see for example, Falvey (1996)].

Anderson (1994) has identified further societal changes of relevance and outlined a reform in an agricultural course including reduced contact time and more choice of electives which will have far-reaching ramifications beyond New Zealand. The small and competitive nature of Australian universities involved in agriculture noted in a NSW study (Derera et al. 1994) is a further constraint to responding to industry needs and to developing a service oriented system. A further change of recent years is an increasing overlap of areas of interest and service between State Departments responsible for agriculture and natural resources and other agencies with universities.

A brief review of processes of major higher agricultural education providers in Australia concluded that there were common trends for changes without apparent integration of providers with their clients to confirm such changes or to offer a sense of ownership to clients (Falvey and Bardsley, 1995).

In the current environment of uncertainty and change, it is necessary to focus on those elements which can gain support from influential groups to determine the mission, challenges and programs for education and training and its linkages to research in the future. To meet this need, a survey of well-informed stakeholders was undertaken in cooperation with the National Farmers Federation (NFF) and with support from the Rural Industries Research and Development Corporation.

It was further noted during the process of this report that despite numerous studies of students' knowledge and perceptions of agriculture in the United States, there appeared to be a lack of relevant studies in Australia. Studies undertaken in Australia have been concentrated at Year 11 level and above. However, the opinions of students at Year 10 level were viewed as important because it is at this level that students are beginning their first subject choices and therefore thoughts towards future career directions.

From the point of view of agricultural and related education the numbers of students choosing agriculture as their first preference have decreased (VTAC, 1996). Concerns have been expressed in the reduction of numbers of quality students as institutions reduce their minimum entry scores in order to attract greater student numbers (McColl et al. 1991; Monteith & Field, 1995). Negative attitudes concerning agriculture's affect on the environment are seen to influence the number of students opting to take up study in agriculture and related areas (Monteith & Field, 1995; Wilkins, 1995). Accounting for all these concerns a second study was undertaken to assess the knowledge and perceptions of metropolitan and non-metropolitan Year 10 students in the state of Victoria, toward agriculture and factors related to their career decision-making.

## **Objectives**

The objectives of the project were, to widen the emerging debate concerning agricultural and related education by introducing the more mature debate surrounding Land Grant Universities in the United States and thus provide the outcomes

- a heightened awareness of future requirements from agriculture and related education
- an orientation of education to markets and products for food fibre and recreation
- directions for the introduction of new modes of education, delivery and educational systems

In order to achieve these objectives, a survey of stakeholders of agricultural education was conducted. This was to gain views from well informed persons regarding currently perceived issues in agricultural and related education. The questionnaire was designed so as to determine perceived missions, challenges and changes occurring in agricultural education institutions related to delivery of education as well as to programs of agricultural education in the future. Future requirements and orientations of agricultural education needed to meet the challenges and changes facing agricultural education were also sought.

The second survey concerning Year 10 students' knowledge and perceptions of agriculture was designed to determine student views as an input to suggesting areas of agricultural education programs which could be altered or to which increased marketing and advertising could be applied to meet the needs of, and attract more, high quality students to agriculture and related courses.

A workshop of Deans, Heads of Departments and other leaders from agricultural faculties and departments, interested persons from State and Federal Government agencies, policy makers, industry and the profession was also conducted. This was to draw opinions from stakeholders once more (particularly those in the education sector), to draw conclusions from the findings of the two surveys and other research presented at the workshop and therefore have their input as to requirements from agricultural education and future directions in agricultural education.

## **Structure and Content of the Report**

Chapter 2 describes the methodology used in the report, for the literature review, the two surveys and the workshop. Chapter 3 reviews the literature about agricultural and related education in Australia. Investigations conducted in the United States and Scotland are also reviewed. The results of the two surveys are presented in Chapter 4 and discussed in Chapter 5. Chapter 5 also includes discussion of the workshop and the feedback received from participants. The final chapter, Chapter 6 discusses the conclusions and makes recommendations from the surveys and the workshop, and compares these to the findings from the literature review within the context of the original objectives.



# Methodology

## Literature Review

A literature review was first conducted to form a background to the study (Chapter 3). The review covered the events and developments leading to the formation of agricultural and related educational institutions in Australia today as well as current issues in the agricultural and related education sector. Information from the United States and Scotland was also included in the review. The reason for particular focus on the United States was that it was well into the process of reviewing its own agricultural institutions thus providing an insight into the reform process. The Scottish system of agricultural education had recently been reviewed (Williams, 1989) thus giving information which could serve as a comparison to the current Australian system.

## Survey 1:

### Stakeholders views concerning agricultural and related education

The first study was based on surveys of informed persons to gather information of direct relevance to currently perceived problems. The initial questionnaire included persons involved in the funding, use and policy setting relating to education including its linkages to research and extension. Eighteen leading persons were selected from NFF Round Table Conference leaders and surveyed as Informed Respondents to answer questions drawn from the literature about perceived issues in agricultural and related education (Round 1). Their replies were consolidated and resubmitted to the same persons for ranking in order to determine the main issues and possible solutions for each of the six critical areas (Round 2). Once these were ranked, surveys were circulated to 156 persons from production, research funding, research provider and education backgrounds (Round 3). These persons were also taken from the full participant list of the NFF meeting.

The survey technique, was a modified Delphi process as described in Delbecq. et al. (1975). The methodology followed that of Meyer (1992) in which opinion leaders were selected to provide the initial information for a wider survey. In an attempt to reduce bias, the Table Coordinators selected by the NFF for their Round Table Conference on Research and Education were engaged as participants for Round 1. The NFF had selected Table Coordinators as informed leaders within the wider agricultural research and producer profiles of the private and public sectors. In that selection, some agricultural educators were represented, these were dropped from Round 1 in the methodology as a further measure to reduce bias in a questionnaire related to agricultural education.

The six survey questions asked were

- What should be three major components for mission statements for universities and State Government agencies involved in providing research, education and/ or extension for the next ten years?

- What will be the major challenges faced by agricultural units in universities in the next ten years?
- What will be the major challenges faced by State Government Agencies concerned with agriculture and the environment in the next ten years?
- What will be the major changes facing undergraduate and postgraduate programs relating to agriculture in the next ten years?
- What are the major challenges which should be addressed in agricultural and related research programs in the next ten years?
- What are the major challenges which should be addressed in agricultural and related extension programs in the next ten years?

Responses from Round 1 were collated and similar statements summarised to generate single statements, using the original wording suggested by the Informed Respondents wherever possible. Prioritising of the key issues in Round 2 allowed three major points to be elicited for each of the six survey questions. In Round 3, the three major points were ranked by the wider group. A copy of the questionnaire from Round 3 is included in Appendix 1.

Chi-square tests were employed to analyse the data generated from Round 3 to determine whether the differences found between various responses were significant. For each test only the top responses (that is, number one ranking) were used. In each case a level of significance of 0.05 was used.

## **Survey 2:**

### **Student knowledge and perceptions of agriculture and factors involved in their career decision making**

Data for the project was collected by means of a mail-out questionnaire, following procedures proposed by Dillman (1978). This was seen to be the most effective way to reach a significantly large sample size. A copy of the survey can be found in Appendix 2.

For questions two, three and four, lists of influences of students in their knowledge of agriculture, factors considered important in choosing a career and whether agriculture meets those factors, were drawn from various relevant studies (Mallory & Sommer, 1986; Reis & Kahler, 1995; UWA, 1995). Careers selected for question five, were selected from the 1996 Australian Institute of Agricultural Science and Elders careers guide to agri-industry along with suggestions from persons engaged in the teaching and/or study of agriculture and related areas. The word 'agricultural' was not included when listing careers such as an agricultural consultant, agricultural economist, or agricultural engineer. By this approach the survey sought to eliminate bias by responses due simply to the presence of the word 'agricultural'. Current environmental issues were chosen using information from Connolly and Keohane (1996) with further suggestions from peers and colleagues.

A five point, Likert scale was used for questions three, four and seven. Respondents were asked to circle their preferred response with 1 being 'not important' or 'does not apply' and 5 being 'extremely important' or 'definitely applies'. In the case of question seven, 1 equalled 'negative effect' and 5 equalled 'positive effect'. For the purposes of analysis responses 1 and 2 were combined into one category, 3 in a separate category (being 'neutral' or 'undecided') and 4 and 5 were also combined into another category.

A trial survey was administered to 20 students from a metropolitan secondary school in Melbourne. The results from the trial, including student responses after completion of the questionnaire were used to amend the survey.

A sample size of between 400 and 700 was chosen using the simple random sampling method (Levy & Lemeshow, 1991). The population was first divided on the basis of metropolitan and non-metropolitan areas. Schools were further divided into Government, Independent and Catholic according to State Government definitions (Directorate of School Education, 1995). Once separated into categories each school was numbered alphabetically and using random numbers generated from the Minitab computer program the schools were selected. Of the schools selected each one was sent a letter addressed to the Science Coordinator asking if they would participate by administering the survey to one class of Year 10 students with a minimum 25-30 students required from each school, this being the size of approximately one class. Twice as many schools as required for an effective sample size were contacted.

Those schools agreeing to participate in the survey were then sent their requested number of questionnaires. The survey was to be handed out during a class and completed in approximately 10-15 minutes. Forms were not to be completed at home as one of the objectives of the survey was to test the knowledge of the students of different areas of agriculture. Thus it was important that there be no consultation with any other sources (for example, parents or books) before responding. Analysis of the responses was carried out using the computer programs Excel and Minitab. Frequencies, percentages, medians and chi-square tests were calculated by the programs. Differences between metropolitan and non-metropolitan student responses were considered significant at  $p < 0.05$ .

## **Workshop**

An electronic workshop was conducted from Melbourne. This was decided upon after consultation with several Deans of Agriculture via the Deans of Agriculture and Natural Resources Email server. The workshop involved Deans, Heads of Departments and other leaders from Agricultural Faculties and Departments around Australia. It also included interested persons from State and Federal Government agencies, policy makers, industry and the profession. It was structured around the draft reports from the surveys. Submission of other relevant reports was also invited. The papers were presented in Word 5.1 and 6.0 format and those unable to receive or read documents were sent a copy by fax.

Several questions were designed as a guide for responses to the papers. These included

- What are your visions for agricultural and related education?
- Are there any approaches you believe should be applied to problems facing the sector?
- Are there any further questions you wish to raise?
- Do you have any particular recommendations to offer?

The workshop was conducted over a period of 21 days with progress of the report being monitored daily. Final responses are summarised and discussed in Chapter 5.

# Background and Literature Review

## Background

### Introduction

In order to discuss agricultural and related education in Australia and the rest of the world today, it is necessary to review its origins and development. This includes, the systems of education present in colleges of agriculture and faculties of agriculture at universities, how these systems have changed over the years and what has brought about change, through to current issues facing agricultural institutions. Issues such as, the needs of the community and environmental concerns and attracting quality students to agricultural and related courses, are relevant as are recent changes in the funding of tertiary education.

The relationships between research, education and extension is another issue facing agricultural and related education institutions including those in less developed countries. One question that will be asked, as part of this report, is whether this model of integration will help to improve the dissemination of information and improvement of agricultural and related courses. Land Grant Colleges and Universities of the United States and the Scottish system were reviewed in this context, to serve as a comparison of different agricultural and related education systems. Whether these integrated systems are appropriate and are able to be applied to other countries such as Australia is then discussed. Upon reviewing the literature it was revealed that further information was needed to inform the future of agricultural education. These investigations form the content of the studies undertaken as part of this project.

### Global Origins of Agricultural and Related Education

With the beginnings of modern science in the sixteenth and seventeenth centuries came the use of knowledge to apply specifically to peoples' daily occupations (True, 1929). Rabelais (1483-1553) and his plan for education had great influence in this area and in the eventual formation of the academies in England. His students studied nature as well as books, assimilating the more practical side of study with their everyday employment. According to Turnbull (1947) the first mention of the need to establish a college specifically for the teaching of agriculture was in 1651 with a book published in London entitled 'An essay for Advancement of Husbandry-Learning: or Propositions for the Erecting a College of Husbandry: and, in order thereunto, for the taking in of Pupils or Apprentices. And also Friends or Fellowes of the Same Colledge or Society'. It contained details of the subjects to be taught as well as the means to acquire financial support for the institution.

The opening of the *Accademia dei Georgici* in Florence, is dated at 1753 by the Institute of Agricultural History at the University of Reading (Falvey, 1996). In 1790, a Chair of Agriculture at Edinburgh University was founded, following the Chair of Agriculture in Padua in 1764 (Beveridge, 1991). Three agricultural schools were established in Hungary from 1779 to 1797 and in 1791 an agricultural school was opened in Tirnava, Bohemia. The final part of the eighteenth century saw Frederick the Great introduce agricultural schools as part of a plan to improve the conditions of agriculture in Prussia. Albrecht Thaer

founded an agricultural school in Moeglin, near Berlin in 1806, and at the same time in Hofwyl, Switzerland, two manual labour schools were being established by Fellenberg. Students at these manual labour schools undertook classes relating to agriculture as well as being expected to do farm work. In 1818 an Agricultural High School was founded in Germany, which is known today as the University of Hohenheim (Falvey, 1996). Agricultural colleges continued to emerge throughout Europe and, according to True (1929), in 1820 Matthieu de Dombasle established the 'first school of agriculture worthy of that name' in Roville, France, which was maintained almost entirely by private means. Pupils from the Dombasle school founded a school at Grigon in 1829 and Grand-Jouan in 1830, which later became state schools (True, 1929).

### **Origins of Agricultural and Related Education in Australia**

The current structure of Australian institutions providing education in agriculture and related areas, arises from distinctive origins and successive funding policy changes over the past 130 years. An understanding of the origins of agricultural and related education provides a context for further analysis.

Agriculture has been and remains, an important industry in Australia and has influenced the early culture of the country. In addition to rural communities, economies of many larger rural towns and cities are dependant on farming industries (Lees et al. 1982). However, while growing in absolute terms, the past 40 years have seen a decline in the influence of agriculture and its contribution to the national income and employment. At the same time, concern over the environment and in particular the affect of agriculture on it has increased. It is therefore of great importance to the community to continue providing a high standard of graduates for agricultural and related sectors to enable this important environment and economic sector.

The foundation of Roseworthy Agricultural College in South Australia in 1883 signalled the beginning of formal agricultural education in Australia (McColl et al. 1991). Elsewhere in the new world, the United States of America, created the land grant colleges (Wadham, 1967). The colleges brought the idea of a unified practical and theoretical agricultural education system in that country into being.

British agricultural education had expanded with its industries at a pace similar to Europe from the 1840s. However, by the 1870s Britain found itself with a surge of competition in the provision of fruit, grain, animal, and dairy products. Improved methods of transport allowed for easier trade between countries and with the extension of railways in the United States came a great expansion of settlement on fertile lands. This also occurred in Australia to a much lesser extent as the railways extended through Victoria to potential wheat-growing districts of South Australia (Wadham, 1956). Throughout this period European grain supplies were at their highest levels ever. For cereal growers in Britain the increase in supplies of grain in other countries depressed prices, putting pressure on the cereal growers of Britain (Wadham, 1956). Furthermore, the introduction of refrigeration on ships, threatened the British market for perishable products and brought greater stress on farmers. British agriculture was unable to compete with this and so from the 1870s experienced economic crisis as farmers tried to compete with new farmers using fertile soil which in most cases did not require fertiliser and had few weed problems.

The problems facing Britain created interest in the application of science to agriculture in attempts to decrease the severity of the rural depression occurring around this time. Support for agricultural colleges and the use of education to improve agriculture owes its origins to these forces (Wadham, 1951). However, there were few people with confidence in the potential of science to improve farming methods. Those who did see this potential were unable to generate agricultural courses, either because they did not have the means or the influence, or did not have the capacity to add to research programmes that had been conducted for several years.

It was in following the lead from Britain and the United States that Australia turned its focus towards the application of science to agriculture (Wadham, 1951). In the various states throughout Australia, heads of government departments saw the need to establish training in support of scientific agriculture. However, the universities established in Australia at that time were not sufficiently developed and did not have adequate funding to apply to such new areas of study. Another obstacle in the process of adopting a system of agricultural education in Australia was that parliaments were not prepared to move of their own accord and external pressure favoured the establishment of separate farming schools (Wadham, 1951). Thus the external stimulus needed to start university agricultural schools (Reeve et al. 1988) was preceded by the formation of colleges, funding of which, particularly in the case of Victoria, borrowed heavily from the United States experiences (Falvey and Bardsley, 1997).

### **Agricultural Colleges in Australia**

Most of the Australian agricultural colleges were established before agricultural high schools and university agricultural faculties in their states. The colleges were designed to 'train men (*sic*) for ordinary mixed farms' (Wadham, 1951) as the amount of scientific knowledge that could be directly applied to farming was considered to be relatively small. The Departments of Agriculture in the respective states managed the agricultural colleges. The influence of Britain could also be seen in the development in these schools and in their complicated systems of management (Campbell, 1980 ).

South Australia was the first state to establish an agricultural college; Roseworthy Agricultural College was established as an agricultural teaching and research centre in 1883 and opened in 1885. From its earliest days, research at Roseworthy Agricultural College had a great impact on Australian agriculture, for example, in the development of fertilisers, of value particularly in wheat growing areas of the time (Farquhar, 1966). The objective of the college was to train young people for farming, who would then become leaders in their field, paving the way towards agricultural progress in their chosen district (Farquhar, 1966). It became formally associated with the University of Adelaide in 1905, although there was little benefit from the relationship until the foundation of the Waite Institute in 1924 (Wadham, 1951). The establishment of Roseworthy Agricultural College was followed closely by the formation of colleges in Victoria, then New South Wales.

Establishment of agricultural colleges in Victoria closely followed the state acts of the 1860s and 1870s (Farquhar, 1966). The Council of Agricultural Education was established under the Agricultural Colleges Act which was passed by the Victorian Parliament in 1884. The Act provided areas of Crown land as an endowment, thus allowing money to be raised from rents to establish and maintain the agricultural colleges (Woodgate, 1951). This

system of endowment of land was similar to the establishment of the land grant colleges in the United States during the 1860s. Since that time developments in the United States and Australia have differed, with land grant colleges in the United States becoming universities, while in Australia this transformation did not occur until the 1980s.

By 1886 sufficient funding had been raised to establish an agricultural college in Victoria. Dookie near Shepparton, was chosen as the site as an experimental farm had already been started there several years earlier (Woodgate, 1951). The emphasis of the college was on practical work (Tulloh, 1984). Longerenong Agricultural College, at Dooen, was founded in 1889 as a result of Dookie College being oversupplied and therefore unable to provide adequate practical work for the number of students it was attracting. Like Dookie Agricultural College, Longerenong was established and maintained by the Council for Agricultural Education until 1944 (Farquhar, 1966). The Council of Agricultural Education had problems financing the colleges as the revenue raised from the endowment lands, and selling of stock and farm produce, was insufficient for the general upkeep, including maintenance and improvements to the colleges (Woodgate, 1951). Responsibility of the colleges was transferred to the Department of Agriculture, with the Council of Agricultural Education being abolished under the Agricultural Colleges Act of 1944. Finance of the colleges under the new Act was separated from the law and variable revenue from endowment lands, and by the end of the 1940s funds from the endowment lands were lost to agricultural education. Funds were provided annually by the Department of Agriculture's budget.

The Victorian Department of Agriculture formed a Division of Agricultural Education for the management of Dookie and Longerenong Agricultural Colleges, and Burnley College of Horticulture. Burnley originated from the Horticultural Society of Victoria's development of what became known as Burnley Gardens. Burnley College was established in 1891. With funding from the Commonwealth Government the new division also provided rural training for returned servicemen and women at the end of World War II (Woodgate, 1951).

Gilbert Chandler College was established as the School of Dairy Technology and Dairy Research Laboratories in 1939. A two year course was modelled on a Massey University program (Falvey and Bardsley, 1997). In 1981 the responsibility of the then College of Dairy Technology was passed to the Chief, Division of Agricultural Education. The College was then designated as an Agricultural College under the Agricultural Colleges Act of 1958.

While the main focus of the Department of Agriculture's Division of Agricultural Education was on education and training there was also a certain amount of time given to research in the colleges (Woodgate, 1951). In this area there were links with the other divisions of the Department of Agriculture.

In 1962 Marcus Oldham College was established in Geelong. The college was privately funded and was available to sons of 'Protestant Parents' (Farquhar, 1966). It specialised in farm management teaching and was the first Victorian college to do so. Glenormiston was the second such college in 1970 (Sims, 1987). The aim of Marcus Oldham College was to train young people with a farming background to manage farm properties. The College varied from the other agricultural colleges in that training was mainly in management of

pastoral properties, and less emphasis was placed on the practical side of farm work, instead being placed on lectures and demonstrations (Farquhar, 1966).

Glenormiston College, like the other 'newer' colleges established from 1965 onwards was designed to fill the gap left by the other colleges upgrading to tertiary status. Their aim was to train young people to go directly into primary production (i.e. farm management) rather than for the servicing sector of agriculture (Black, 1973). In 1976 McMillan Rural Training Centre was formed, in part due to calls from farmers for improved access to technical information and farm business management practices; as well as the need to meet the demand faced by the Department of Agriculture, for advice and group activities; and the success of Marcus-Oldham and Glenormiston Colleges (Falvey and Bardsley, 1997).

The Victorian College of Agriculture and Horticulture was formed in 1983, to amalgamate the Departmental colleges of Dookie, Burnley, Longerenong, Glenormiston, McMillan and Gilbert Chandler. The newly formed college came under the responsibility of the Minister of Education (Sims, 1987).

New South Wales found a strong supporter of science in agriculture as early as 1871 (Yeates, 1987). The Governor of the Colony of New South Wales, wrote to the Chancellor of the University of Sydney with an offer of 300 pounds to be used for a 'gold medal to be given annually to University undergraduates or graduates, for excellence in Geology and Practical Chemistry, with special references to Agriculture' (Yeates, 1987). However it was not until 1891 that Hawkesbury Agricultural College and in 1892 the Wagga Wagga Experimental Farm were established.

Yanco Agricultural Research Station was founded in 1907 with a Farm Certificate course commencing in 1963. Yanco Agricultural college was similar in its structure and objectives to Marcus Oldham Agricultural college in Victoria. Not only did they devote more time to lectures and demonstrations instead of the practical farm work, but they also specifically aimed to train only potential farmers and farm managers (Farquhar, 1966). In 1965 the CB Alexander Presbyterian Agricultural College at Tocal was established with assistance from a bequest by Charles Boyd Alexander (Black, 1973). In 1969 the college was taken over by the state government and administered by the Department of Agriculture due to an inability of the college to meet running costs. A further college founded in New South Wales at Orange in 1973 is now affiliated with the University of Sydney.

In 1896 the Queensland Department of Agriculture was established as an independent administrative board of government. The following year it established the Gatton Agricultural College, which was the first agricultural institution in the state, and at one time it incorporated the only agricultural high school in Queensland (Farquhar, 1966). A special committee of enquiry, held in 1921, recommended linking agricultural education with the state's education system, and in 1923 administration of the college was transferred to the Department of Education. In 1925, after recommendations from a report of the departmental advisory committee (representing agricultural and technical education), Gatton Agricultural College became the Queensland Agricultural High School and College. The high school section consisted of a two year agricultural course. It was suggested that the agricultural high school acted as a 'feeder' of students into the college section. By 1962 the Queensland Agricultural High School and College once more became Queensland Agricultural College, with the final intake of students to the high school section in 1961.

Colleges of Agriculture in Queensland were also established in Longreach and Emerald in 1967 and 1971 respectively (Black, 1973).

Western Australia's agricultural college (Muresk Agricultural College) was founded in 1926 as part of the Department of Agriculture. A review of the role of Muresk Agricultural College in 1950 recommended that training of persons to become farm workers should, after primary school, be followed by two or three years at technical or post-primary school (Farquhar, 1966). In other industries this would be equivalent to a period of apprenticeship of a tradesperson. Further practical experience on a commercial farm was considered essential by the committee (Farquhar, 1966). Here, as at every agricultural location it was debated whether the experience should be obtained prior to, or after college. Experience gained before college would provide a basis for college studies and would also help students decide if this was really the appropriate course for them. Disadvantages included the risk that students may decide not to return to their formal education.

No agricultural college was established in Tasmania, however there had been strong (early) government support of agricultural science (Wade, 1988). Support from the Tasmanian Government came in the form of scholarships for students to obtain formal education in agriculture in New South Wales, Victoria and South Australia (Farquhar, 1966). The Government also established well organised extension services and a range of technical services during the 1930s, with the first field stations at Tewkesbury, Cressy and Summerleas. At the end of the Second World War, establishment of specialised research and advisory groups expanded the Tasmanian Department of Agriculture which had been established in 1875. Previously underdeveloped facilities were upgraded and new research laboratories and stations with modern equipment were started. Staff involved in extension activities also changed from non-formally trained staff to tertiary trained staff (Wade, 1988).

Agriculture was only taught in one or two high schools in Tasmania until 1935 when the Area School System was brought into place. Agriculture was amongst those secondary classes added to the schools and a small farm was then made a feature of most Area Schools. Some high schools also taught agricultural practise (Wade, 1988 ). Technical colleges, such as Burnie Technical College, have also provided some courses relevant to agriculture. An Associate Diploma in Agricultural Business Management was introduced in 1978 by the Tasmanian College of Advanced Education (now the Tasmanian Institute of Technology).

The end to the Second World War in 1945 led to a renewed interest in study at tertiary level. Colleges and universities, not only in agriculture, experienced a rapid increase in enrolments (IOUM, 1985). For the agricultural colleges this meant increased demand for diploma courses. Most of the Departments of Agriculture in each state, provided training in agriculture for those returning from the War.

Variations to agricultural and related education in colleges and universities throughout Australia, including greater divisions between university faculties of agriculture and the colleges can, in part, be attributed to changes in government funding in the 1960s. The Commonwealth Government at this time displayed increased support for the Colleges of Advanced Education (CAEs) (Campbell, 1980). Agricultural colleges were attracted to the CAE model by the possibility of greater federal finance and gradually moved out of the

vocational sector, except those in the states of Victoria and Western Australia. These states retained separate colleges and resisted changes in the approach and curriculum. Changes were said to be due, in part, to an 'effort to achieve the necessary standards for accreditation and partly to achieve higher standards necessary to service a wider employment market' (Campbell, 1980). Some colleges claimed that plans were already in motion to raise standards and entry levels of courses, and Black (1973) believes that the truth most probably lies between these two opinions. In any case, curriculum changed and thus the philosophy of farmer training institutions was dismissed as the colleges entered into open competition with the university faculties of agriculture (Campbell, 1980).

Agricultural education today can be seen to have developed from a system based on agricultural colleges to one involving universities, independent colleges of advanced education, state and private agricultural colleges and technical and further education colleges (Lees et al. 1982) all providing various degrees.

### **Universities and Agricultural Education in Australia**

The universities of Australia were founded at a 'time of growing prosperity and increasing social and institutional sophistication' (Reeve et al. 1988). The first two universities; the University of Sydney and the University of Melbourne founded in 1850 and 1853 respectively (Blainey, 1989), were modelled on the 'newer' British universities of the time rather than on institutions such as those in Cambridge, Oxford and Scotland (Bessant, 1978). The courses at the new universities in Australia concentrated mainly on classics, law, medicine and engineering, though eventually science did become a prominent part of the curriculum. In 1874 a university was established in Adelaide. Tasmania's University was founded in 1893. The University of Queensland was established somewhat later in 1910 followed by the University in Western Australia in 1913 (Blainey, 1989). Both of these universities had Faculties of Arts, Engineering and Science (Reeve et al. 1988). By the First World War each of the six states had one university. The academic staff of the universities were mainly recruited from Britain and most Australian staff undertook their postgraduate training in Britain, with some going to the United States. The only influence of traditions and practices in the universities thus came mainly from Britain (IOUM, 1985).

Agricultural science faculties and departments were established in universities around Australia from 1901. The first teaching of agriculture was established in 1901 at the University of Adelaide in South Australia on the basis of a linkage with the Roseworthy Agricultural College course. In 1924 this was subsumed into the Waite Agricultural Research Institute (Farquhar, 1966), following a generous donation made by Peter Waite to support scientific services to farmers and pastoralists of South Australia. The institute was to be an integral part of the University of Adelaide, with the aims of conducting research in agriculture and providing for undergraduate and postgraduate degrees in agriculture (ARC, 1990). The Waite Institute served to secure the advisory service which was already being provided by the Department of Botany at the university to the State Department of Agriculture.

Waite's wish was for a research institute to be established within the university on one part of his land (which included property purchased by Waite at Urrbrae in 1874) and development of an agricultural high school on the other part. The foundation of the research institute was based on his observation that 'we are approaching a point in the

history of the State and the Commonwealth when our manufacturers will more than keep pace with the local demand. Our population will, however, continue to increase, ... and the natural outlet for the energies of our rising generation appears to me to be in producing wealth from the land....In the future competition threatens to be so keen that we must equip our people in the best possible manner' (Edgeloe, 1984).

Initially equal emphasis was given to teaching and research at the Waite Institute and with the Agricultural Act in 1927, the Government of South Australia provided funds to the Waite Institute for development of research and education. However there was little demand for agricultural graduates in the first 20 years of the Waite Institute's existence and so the focus since its inception, moved more towards research in agriculture and related sciences (ARC, 1990). The Waite Institute has been a great influence on agricultural and biological research in Australia and among other things, catalysed the formation of several Divisions of what is known today as the Commonwealth Scientific Industrial Research Organisation (Edgeloe, 1984).

A Faculty of Agriculture was created in 1905 at the University of Melbourne. The University went a step further than the University of Adelaide at the time by creating a separate faculty of agriculture (Wadham, 1951). However, it was not until 1911 when the Government provided for the salary of the first professor, that special staff for the faculty were recruited (Wadham, 1951). The objective of the course was to train students in science as it applied to agriculture, rather than specific practical training to become farmers (Blainey, 1956).

The second Victorian university to enter agricultural education was La Trobe University which was established in 1967 and admitted students in the following year (Sims, 1987). The existence of two city based schools of agriculture created tensions and debate over thirty years.

The University of Sydney had several supporters for the establishment of a School of Agriculture in the later stages of the 19th century but in New South Wales, as in other states, the existence of agricultural colleges for training in the principles of agriculture, discouraged funding of university courses in agriculture. On completion of college courses, most were then recruited into government Departments of Agriculture, with some going into industry or returning to the land. Establishment of a university school of agriculture was said to be necessary to train agricultural scientists of Australia whose status and expertise could be recognised (Yeates, 1987). In 1910 the University of Sydney established a Faculty of Agriculture with initial funding for both the Schools of Agriculture and Veterinary Science from private donations made contingent on Government provision of buildings and equipment (Wadham, 1951).

The University of Western Australia received a private endowment for a Chair in Agriculture in 1913 and by 1914 Professor J W Paterson started teaching under the Faculty of Science, although it was not until 1937 that a separate Faculty of Agriculture was created (Wadham, 1951).

The Faculty of Agriculture in the University of Queensland began in 1927 with a Professor who was principal of the Agricultural College and High School at Gatton assuming both roles (Wadham, 1951).

A Faculty of Agricultural Science was established in 1962 at the University of Tasmania, and teaching began in 1963. The new faculty provided the only formal tertiary training in agriculture in Tasmania, and was one of the first faculties in Australia to recognise horticultural science as a separate discipline. It acquired a farm for teaching and research during the 1980s and has also developed a research school (Wade, 1988). Restructuring of the course occurred in 1982 with a greater emphasis on economics, management and marketing.

At the end of World War II great change and expansion of the universities occurred, as the numbers of student enrolments rose dramatically. This was reflected in the establishment of several universities around Australia (Blainey, 1989).

From 1974 the Commonwealth government assumed responsibility for funding of universities. In an unusual political arrangement, state governments still held control over the regulation of the composition of the university councils, while the commonwealth held financial control without being directly represented (Blainey, 1989).

Structural adjustment of higher education was initiated in 1988 and was changed from the original binary system of mainstream universities and Colleges of Advanced Education, to a Unified National System with fewer and larger institutions (McColl et al. 1991). This process is continuing today as agricultural colleges and technical colleges merge with universities. A White Paper on higher education (1988) called for the further development and strengthening of linkages between the universities and the TAFE (Technical and Further Education) sector. The importance of the TAFE sector to agricultural and related education, through vocational education in trade, commercial, technical and service occupations at post-secondary level, continues to be its practical orientation and suitability to the diverse levels of education in agricultural industries (McColl et al. 1991).

### **United States and Northern Scotland - Relevance to Australia**

With the system in Australia developing from such diverse institutions and courses, integration of institutions to decrease duplication of courses is widely propounded (Anderson, 1994; Clark, 1995; Wilkins, 1995; Falvey and Bardsley, 1995a).

The United States and Northern Scotland are reviewed here because of their potential relevance to Australian debates concerning agricultural education. The integration of research, education and extension activities represented in these systems, contrasts with the separate origins and systems common to Australia and most other countries (Falvey and Forno, 1997). These two approaches of agricultural education, research and extension can be divided into two main areas: some systems link agricultural education, research and extension institutions, such as in the United States and Scotland, while others such as Australia, the rest of the United Kingdom and Europe separate these functions as institutions.

The mystique of the land grant college system of the United States, is in part due to the unique relationship of the colleges with the federal government and a 'special responsibility to the public' (NRC, 1996a). Federal legislation - the first Morrill Act (1862), the Hatch Act (1887) and the Smith-Lever Act (1914) - gave the colleges their

three-part mission of teaching, research and extension. The cooperative extension services combines the policies of federal, state and county governments.

The Scottish system developed from three regional agricultural colleges at Aberdeen, Edinburgh and Auchencruive. These colleges formed the current Scottish Agricultural Colleges (SAC) which undertake education and training, research and development, and advisory and consultancy (outreach) services. SAC receives grants from the Scottish Office Agriculture and Fisheries Department, but is now also a limited company, having close links with industry.

### **United States- History of Land Grant Colleges (LGC)**

In order to understand the system of the land grant colleges in the United States today it is important to explore their history and influence on agricultural progress through extension, experiment stations and educational institutions.

Development of science and education throughout Europe was the primary influence on the United States system, in particular, the formation of two manual labour schools in Switzerland. The success of models based on these Swiss schools required similar educational and financial conditions. By 1830, there were several manual labour schools throughout the United States (True, 1929). The system in the United States was not a direct copy of that in place in Europe, it also evolved as a response to economic, political and scientific conditions of the time (Huffman and Evenson, 1993).

The land grant system was founded through several pieces of key legislation. The Northwest Ordinance, passed in 1787, authorised the sale of public land to support education and effectively established the principle behind the land grant colleges (NASULGC, 1996). However, it was not until 1862, with the legislation known as the Morrill Act, that the land grant colleges, as they are known today, officially began. The United States Department of Agriculture (USDA) was also established in 1862 taking over the agricultural science functions of the Patent Office and becoming an important force in the promotion of agricultural education and research (True, 1929). Of further importance to the beginning of agricultural education and research was the political support for the early agricultural colleges, provided, at state level, by the Agricultural Societies. These colleges served as models for the (Morrill) Land Grant College Act of 1862 (Huffman and Evenson, 1993).

The Morrill Act of 1862 granted states public land provided that it be sold or used for profit and proceeds used to establish at least one college- hence the name, land grant colleges- to teach courses in agriculture and the mechanical arts. Section 4 of the Act states that:

‘.. all moneys derived from the sale of the lands... by the States... shall be invested in stock of the United States, or some other safe stocks,... the interest of which shall be inviolably appropriated, by each State... to the endowment, support, and maintenance of at least one college where the leading object shall be,... to teach such branches of learning as are related to agriculture and the mechanic arts...’ (Morrill Act, 1862).

In some states, public universities already existed. The commitment of the land grant colleges to higher education in service to the public was a great contrast to the orientation

of most of the nation's academic institutions of the time which emphasised the study of philosophy, theology, law, medicine, and the classics (Meyer, 1993). Most states opened new colleges specifically for agriculture and the mechanical arts rather than adding to the existing institutions (Kerr, 1987). A network of poorly financed colleges known as the 1862s came about from the Morrill Act. In the 1890 Second Morrill Act additional funds were granted to support these land grant colleges. That Act contained a new provision of equality of access regardless of race and hence separate colleges for white and black students could be maintained in states practising racial segregation, as long as equal funding was provided for each (True, 1929). This led to the creation of 17 African American colleges.

The research function of land grant colleges was added with the formation of agricultural experiment stations through the 1887 Hatch Act. This recognised the need for original research and experiments to verify results locally while supporting agricultural teaching (NRC, 1995). Subjects were required to be of direct relevance to the agricultural industry. An experiment station was to be established in each state, most of which would be under the direction of the land grant colleges (Huffman and Evenson, 1993). Under Section 2 of the Hatch Act research stations were directed to :

‘...conduct original and other researches, investigations, and experiments... contributing to the establishment and maintenance of a permanent and effective agricultural industry of the United States, including researches basic to the problems of agriculture in its broadest aspects, and... for... the development and improvement of the rural home and rural life and the maximum contribution by agriculture to the welfare of the consumer’ (Hatch, 1887).

The 1906 Adams Act provided additional federal funding to each state for original research and experimentation. Additional specifications allowing use of part of the funds from the Morrill Acts of 1862 and 1890 for providing courses to prepare instructors for teaching agricultural and mechanic arts subjects, came in the form of the Nelson Amendment in 1907.

Extension services were added to the two other main functions of the land grant colleges in 1914 with the Smith-Lever Act. The aim of the federally supported Cooperative Extension Services was to reach the general public with useful and practical information on agriculture and home economics, and their related subjects, and thus to help solve problems which people were ‘facing in their work, in their homes and their communities’ (Hightower, 1973). The land grant colleges and USDA were to cooperate in extension work which was to consist of instruction as well as practical agricultural and home economics advice to those not attending the land grant colleges.

Additional research funding was provided through the Purnell Act (1925) in order to establish and maintain a permanent and efficient agricultural industry while developing and improving life. The Bankhead-Jones Act of 1935 provided further expansion for research stations and established formula funding for research and federal-state matching grants. Thus State Agricultural Experiment Stations and the USDA could receive additional funding for research into conservation, development, and recreational use of land and water as well as basic agricultural problems, quality improvement of production and distribution methods, and new and extended uses and markets for agricultural commodities. The Research and Marketing Act of 1946 not only extended funding of research institutions but

also linked agricultural research and development to national welfare in order to maintain a balanced farming and industrial economy.

Cooperative extension services received additional funding in 1928, 1935 and again in 1945 with the Capper-Ketcham, Bankhead-Jones and Bankhead-Flannagan Acts respectively (NRC, 1995). This provided for the expansion of the Cooperative Extension Service over the years. Since 1945 there have been continued amendments to existing legislation as well as new legislation which increased funding and further development of the existing integrated education, research and extension system of the land grant colleges. Huffman and Evenson (1993) noted that while funding for agricultural experiment stations in the 1880s was from the Federal Government, by the 1980s this accounted for less than 30 per cent of funding, with State Governments then being the primary source of funding.

Not all the planning and evolutionary developments of the land grant colleges were balanced. For example, Hightower (1973) noted that resource allocations to the black colleges, (otherwise known as the 1890 colleges) had not maintained parity with those given to the 1862 colleges. Of the resource allocations by the USDA for research, it was reported that about 99.5 per cent went to the sixteen white land grant colleges.

In 1994 land grant status was conferred upon 29 Native American Colleges in the form of the Elementary and Secondary Education Reauthorisation Act. Endowments were authorised to fund the colleges, as well as funds for the colleges' education and extension programs in agricultural and natural resources (NRC, 1996a). Today there are 105 institutions comprising the land grant colleges of agriculture system.

## **Current Developments**

### **Agricultural Education in the United States Today**

Development of the land grant college system to its current form has been influenced by the various changes and occurrences to general agriculture and United States society. Creation of such a system in Australia, therefore would not necessarily be appropriate for Australian conditions. It is argued however, that some parts of the system, particularly educational outreach, can be appropriately adapted to the Australian agricultural and related education system (Falvey and Bardsley, 1995b).

In America, future directions of the land grant institutions include, the need to focus on customer needs, and to reinforce and create new linkages both internally (in administration and faculties) and externally (with industry). These issues seem to be similar to those being realised in Australia (AIAS, 1995).

According to Huffman and Evenson (1993), United States agricultural universities should be scaled down or consolidated. They project increased competition for graduates in public and private research sectors; and suggest that the private sector will assume responsibilities for some areas of research which have been traditionally encompassed by public institutions. The system in the United States today is said to be in good but not excellent condition, and its success has been due to responding to political, economic and scientific conditions (Huffman and Evenson, 1993).

Several analyses of the current state and future requirements of United States agricultural education have been, or are being conducted. Major analyses include

- National Academy of Sciences Board on Agriculture: The Future of the Colleges of Agriculture at the Land Grant Universities (NRC, 1995; NRC, 1996a)
- Food Systems Professions Education Initiative (FSPE) (WK Kellogg Foundation, 1994)
- The Public View of Land Grant Universities: Results >From a National Survey (Dillman et al. 1995)
- Conversations on Change within Agricultural Science and Technology (CAST, 1996)
- Agriculture's Role in K-12 Education (NRC, 1996b)
- Future Vision and Mission for the Programs in Food, Agriculture and Natural Resources (NASULGC, 1996)
- National Round Table: Food and Agricultural Research in Changing Times (RMF, 1995)
- Reinventing Agricultural Education for the year 2020 (NCAE, 1997)

These reports and studies include conclusions relevant to Australia as they confront many similar concerns. The issues being debated include: environment and sustainability concerns; focusing on customer needs; increased linkages with industry; formation of partnerships with government, industry and the general public; increasing demand for lifelong learning; attracting the brightest students; general as opposed to specialist learning; creating greater community awareness of agriculture and decreasing the gap between rural and urban values. Finally the issue of integration of research, education and extension is one which United States educators are examining in terms of recommitment and improvement to the existing functions. In Australia the debate in this field concerns the linking of outreach and education functions across separate institutions.

### **National Academy of Sciences Board on Agriculture: The Future of the Colleges of Agriculture at the Land Grant Universities**

The Committee on the Future of the Colleges of Agriculture in the Land Grant University System, (convened by the National Research Council's Board on Agriculture) completed a three year study of the land grant system at the end of 1996. The study was designed to assess the delivery of services of land grant colleges to the changing requirements of the public and industry, and reevaluate the mission of the colleges of agriculture (NRC, 1995). The first stage of the study included collation and assessment of data and information relating to the colleges, including their history and evolution to present day, and activities on national, state and local levels in response to their respective needs. The second stage

consisted of several fora, including public interest groups, industry and those from within the system (NRC, 1995).

The report on Stage One (NRC, 1995) included a history and overview of the land grant system and the agricultural environment, a review of the characteristics of the United States economy, and the role of farming throughout the past 130 years. It considered: the demographics of students and graduates from the colleges; the role of agricultural colleges; the extension service; research funding and beneficiaries of research; the role of the federal government in the system and alternatives to federal funding; links between colleges and the USDA; and the continuation of the unique alignment of research, education and extension. A close examination of the individual colleges and their similarities and differences was also conducted (NRC, 1995).

The first report provided a starting point for public discussion and understanding of the system. The second stage examined, among other issues, the interrelatedness of college activities and public needs, concluding with a series of recommendations. The resulting report (NRC, 1996a) focused on programs of the colleges and recommendations for federal policy. The need to strengthen the existing system of research, education and extension was also discussed in the context of the development and expansion of research programs and academic curricula to reflect expanded views of today's food and agricultural system.

The increasing need for access to higher education, particularly for those in rural areas, was an important issue, which also came to light in a survey by the Social and Economic Sciences Research Centre at Washington State University (Dillman et al. 1995). Other specific issues which were highlighted by the Committee were: the challenge of colleges in attracting and retaining students, which is also related to improving the image of agriculture; the need to increase the relevance of the system to food and agricultural systems; the need for continual advancement in research; and continuing the public interest in the public extension service and possibility of public extension to take more advantage of market opportunities and private financing (NRC, 1996a).

Twenty recommendations were made by the committee. These included: that consultation of stakeholders in resource allocation for research, education and extension must occur; that half of federal formula funding should be directed specifically at the support of projects which integrate research, education and extension, and that there should be frequent evaluation of federally funded research and extension programs. In conclusion, the committee argued that the land grant colleges must re-examine existing, and form new, partnerships with each other, the federal government, customers and units within the universities (NRC, 1996a).

While commending this study as one of the best on a national level for some time, Meyer (1997) noted that the interest of the study concerning the environment seemed to relate only to agriculture and not the problems of the environment as such.

### **Food Systems Professions Education Initiative**

The Food Systems Professions Education Initiative (FSPE), started and partially funded by the WK Kellogg Foundation is made up of two phases. Phase I, the vision building phase, was conducted between 1994-1995, with Phase II, the implementation phase, to be conducted between 1995-2000. The aim of the FSPE is to encourage universities to review

their goals and visions for planning, and collaboration among institutions of higher education, industry and the community (WK Kellogg Foundation, 1994). The FSPE wants to build on changes to university-based education programs already being implemented, to better equip institutions to respond to future needs of the global food system. This recognises the need to prepare food systems professionals for food systems issues into the next century. The strengths of current efforts in food production and utilisation were highlighted as a model for further institutional involvement.

According to the W K Kellogg Foundation (1994) the major issues are the fragility of the food production system and long term sustainability which requires consideration of land use, technology, population and poverty. Public concern over these issues is being recognised by higher-education systems in general, through increased linkage with clients, in the form of the general public and industry (WK Kellogg Foundation, 1994).

Specific issues concerning long-term education that the FSPE has or will explore during the project include: alteration to curriculum in response to consumer needs, inclusion of new technology; lifelong learning; collaboration and integration among academic and scientific disciplines and between institutions; and partnerships with business, industry, and communities.

Twelve groups of higher education institutions conducted individual projects within the guidelines of the visioning phase. Objectives of the projects included

- To link with the community, through shared and continued learning and planning and respond to their needs.
- Increase awareness of how and to whom their programs are delivered and making the programs relevant
- Prepare students for the workplace and instil them with a need to provide service, while educating professionals involved in the food system
- Encourage more bright upcoming students into the food systems professions
- Develop linkages between departments and colleges to address world problems through a single vision, and to determine associated structural changes
- Build capacity to monitor the needs of stakeholders and involve them in educational processes
- Prepare recommendations for expanding connections between food systems research and potential users.

Each of the 12 Projects in the FSPE initiative submitted proposals for implementation of their visions which then formed the basis of Phase II, the Implementation Phase. Phase II will formulate actions towards achieving goals; sharing resources among participating institutions; building the capacity to bring about change; and linking with industry and community.

## **The Public View of Land Grant Universities: Results From a National Survey**

This survey, conducted to gain insight into the views and experiences of Americans' regarding lifelong learning and to observe current public expectations of higher education and views of the land grant universities, was conducted in 1995 (Dillman et al. 1995). It found that, in general, the American public support higher education and the current system and, in particular, the land grant colleges, and those seeking further education. Future services thought to be necessary included, 'undergraduate and graduate teaching; teaching older, returning students; providing off campus technical help; and conducting research'. The majority of those surveyed saw lifelong learning as important for future success in the workplace, and had themselves received some sort of additional job-related training or education over the past three years (Dillman et al. 1995).

Traditional teaching methods, including on-campus education were considered to be unable to meet future demands. For older adults wishing to continue education, short courses and conferences were more accessible and relevant to their needs. Accessibility was seen as an important issue for those who live at a distance from college or university campuses or work during the day. They concluded that more consideration should be given to providing classes off-campus and during evenings and weekends and to distance education, particularly with electronic technology. It was also found that while most of those surveyed wanted to take part in some form of lifelong learning, those wanting to learn entirely new skills, found it difficult to do so. Reasons behind such difficulties included: not having recent training already behind them, those with lower incomes, and persons given little encouragement from employers (Dillman et al. 1995).

From the survey it was concluded that America's colleges and universities have not met the increasing demand from students interested in lifelong learning. They simply continue to target the undergraduate student seeking a college education directly from secondary school. This can be seen in the current structure of courses, held during the day, from Monday to Friday. They argue that universities and colleges need to change their structure to meet this new demand. This should include off-campus and adult learning. Distance learning could benefit students, taxpayers and colleges, as learners will not need to travel as often to the specific campuses. This would reduce demands on campuses to expand. With new technology off-campus students could access information via the Internet and communicate with staff on campus.

## **Conversations on Change Within Agricultural Science and Technology**

The Council for Agricultural Science and Technology (CAST) is directing a project with the aim of initiating conversations about change within Agricultural Science and Technology societies. The program is being supported by the WK Kellogg Foundation and is entitled: Scientific Societies: Conversations on Change. The objectives of the program are to analyse membership challenges in professional societies and the changing employment contract for professionals, including scientists and technologists (Bloome, 1997).

Phase I of the program, a workshop with leaders of scientific societies was completed and the results published in 1996. The purpose of the workshop was to examine the range of studies which had analysed changes in the workplace. It also aimed to generate interactive learning among societies, thus developing networks among societies and their members.

Participants were in favour of increased networking, learning from other societies, sharing of knowledge, and planning for the best possible future. The need for cooperation and collaboration between societies and their members was noted. Traditional approaches to strategic planning, mission writing, and vision statements were seen as outdated. It was agreed by the participants that scientific societies must rethink their missions, markets and strategies, in order to 'facilitate new strategies for service and growth' (CAST, 1996).

Phase II includes another workshop in order to plan for Phase III which is envisaged to take a further two years to complete. The emphasis of Phase III will be on identification and development of those proposals from Phase I of the program.

The changes to professional societies will in turn cause change in CAST itself. The changes will link to most agricultural faculties as those in the land grant universities are members of at least one CAST society. The program is envisaged to contribute to changes in the land grant system itself (Bloome, 1997).

### **Agriculture's Role in K-12 Education**

A forum on the United States National Science Education Standards was held late in 1995. The purpose of the forum was to analyse agriculture's role in K-12 (Kindergarten through to 12th Grade) Education. The main aims of the forum were to examine ways of enhancing science education within the context of agriculture, food, and natural resources and to determine methods of application of the National Science Education Standards report of the National Research Council (NRC), which was released at the forum.

The National Science Education Standards report published in 1996 with contributions from teachers, scientists, science educators, and other United States experts was designed in response to a call for better science education and to help achieve the vision of scientifically literate students, throughout the United States (NRC, 1996b). It contains standards for science content; science teaching; professional development of teachers of science; as well as the science education program and system standards. According to the NRC (1996b) the standards reflect the principles that learning science is an inquiry-based process. A strong grounding in science strengthens many everyday skills, including problem-solving, thinking critically, having the ability to use technology effectively, working in a team environment and valuing life-long learning. These are many of the attributes that employers have noted as important in various studies, including those in agriculture (Anderson, 1994).

### **Future Vision and Mission for the Programs in Food, Agriculture and Natural Resources on Land-Grant Universities**

The Future Vision and Mission for the Programs in Food, Agriculture and Natural Resources on Land-Grant Universities was a project conducted by, the Board on Agriculture of the National Association of State Universities and Land Grant Colleges (NASULGC), in 1996. Listening and synthesis conferences involved various stakeholders to revise the missions and visions of land grant universities in the areas of food, agriculture, and natural resources. Results of the project were directed internally to

administrators and faculty, and externally to traditional and non-traditional customers and policy decision makers (NASULGC, 1996). The report includes actions to be taken in programs in agriculture and natural resources at land grant universities, and builds upon the integrated system of research, education and extension, and further development of international programs.

There was seen to be much change occurring throughout the agricultural industries and education sector. Of increasing importance to both sectors was the challenge for agricultural businesses to compete internationally and to respond to environmental concerns which place new demands on the food and fibre industry. For the survival of institutions, they must change according to the needs of their clients and must actively assess environmental impact and safety regulations, thereby creating food and fibre production systems that are economically, environmentally and socially acceptable, and internationally competitive.

Issues raised included the need to recognise the impact of consumer preferences on decisions about food from production to consumption. New technologies for communication and biotechnology allow land grant universities to alter their modes of responding to client needs and highlight the need to look at customers concerns. In particular, the current departmental/disciplinary organisation was seen to deter and fail to reward effective team participation (NASULGC, 1996).

The importance of focusing on customer needs is also linked to funding, particularly with continuing decreases in Government funding. Since 1990, agriculture and natural resources at land grant universities are estimated to have lost approximately 20-25 per cent of their total effective research and extension capacity as a result of public funding reductions (NASULGC, 1996).

For each land grant university, customers called for: recommitment to the land grant principles of linking research, education and extension and reduced duplication of programs of research and extension between states; recognition of the need for public and private collaboration and greater networking between states; increased links between land grant universities and the USDA in agriculture and natural resources; greater customer involvement in planning; and the maintenance of land grant universities as credible sources of objective information on controversial subjects. Furthermore, international development was seen as an important issue by customers who called for: an increased focus on international development activities and bringing an international dimension to curricula; and development of research partnerships with both developed and developing countries.

The resulting plan for action for agriculture and natural resources included providing an agricultural system that is highly competitive in the global economy. The need to identify nutritional needs of the changing United States population was identified with the need to understand the factors influencing food choices. A greater balance between agriculture and the environment was seen to be necessary along with balanced decision-making in assessing human and environmental risks and benefits. The action plan requires the development of plans at national, regional, state, and local levels (NASULGC, 1996).

This type of change to the land grant colleges of agriculture acts from the national level down to the institutional level (Meyer, 1997). However, Meyer (1997) believes that in the

United States the reverse should be initiated. That effective change to individual land grant colleges should begin from the bottom level upwards, due to the varying needs, issues and concerns and constituents in each state. Changes made at a local level determine state changes in this model, with state changes brought together and used to determine the necessary policies and programs at a national level.

### **National Round Table: Food and Agricultural Research in Changing Times**

In 1995 four listening sessions, focusing on the theme 'Learning from the Grassroots: Inputs for Federal Food and Agricultural Research and Extension Programs' were designed by the Charles Valentine Riley Memorial Foundation. The aim of the sessions was to gain input from customers about expected future requirements of research and extension programs. Participants included private-sector, grassroots consumers of federal agricultural research and extension education systems (RMF, 1995).

Continuing on from the base provided by the 'Grassroots' listening sessions a National Round Table on 'Food and Agricultural Research in Changing Times' was conducted (RMF, 1995). It included persons from industry, land grant colleges, the Federal Government, and public interest groups. The purpose was to review and analyse: information from the listening sessions; current Federal research programs; regional inputs into those from national organisations; and communication and collaboration between the United States Department of Agriculture (USDA), other Federal research agencies, Congress and the Administration.

Current research, education and economics programs of the USDA are conducted both nationally and internationally, through four agencies. They are the Agricultural Research Service (ARS); Economic Research Service (ERS); National Agricultural Statistics Service (NASS) and the Cooperative State Research, Education and Extension Service (CSREES). ARS is the United States' research organisation for the development of food and agricultural technology. ERS provides information in the social sciences and economics. NASS collects agricultural production statistics. The CSREES was formed by the merging of the Cooperative State Research Service (CSRS) and the Extension Service (CES) to help develop greater linkages between the USDA and the land grant universities.

Educating the community and creating an awareness of agriculture and its contributions to society, was highlighted as an important issue. There were also concerns expressed about poor links between USDA and non-USDA research agencies. Participants further concluded that Congress and Administration should continue to support current agricultural, research and extension programs which focus on 'productivity and global markets, environmental protection, food safety, on-farm research, and rural development' (RMF, 1995). They also concluded that there is a need to increase communication between urban and rural interests to decrease the widening gap between urban and rural values. There was also a call for integration of food, agriculture and forestry industries.

Similarities were found between issues brought forward at the Round Table and those emerging from the NASULGC report on the Future Vision and Mission for the Programs in Food, Agriculture and Natural Resources of Land-Grant Universities. These included, a need for increased emphasis on environmental issues, increased focus on the consumer,

and the need to produce, process and distribute safe, attractive, and nutritious foods in a sustainable manner (RMF, 1995).

### **Reinventing Agricultural Education for the Year 2020**

The most recent project on agricultural and related education in the United States will be conducted throughout 1997-1998. It is entitled 'Reinventing Agricultural Education for the Year 2020: A Call to Action' (NCAE, 1997) and is sponsored by the WK Kellogg Foundation. Participants will include agricultural educators, industry representatives and other stakeholders. Amongst the objectives of the initiative is to discuss, the future challenges and opportunities of the United States and global food systems and the relevance of this to education from kindergarten through to adult agricultural education. This step will lead to a visioning process throughout the United States, with various states forming groups and developing visions concerning the future of agricultural education. Results of the consortia will be combined to form a national vision statement, bring about implementation of the visions, and a benchmark report (NCAE, 1997).

### **Summary**

Highlighted in each of the projects taking place throughout the United States was the importance of the integrated structure of the land grant system. The general consensus seemed to be that while institutions need to be aware of changing needs of the community, environmental issues and the global economy and food situation, the basic structure of research, education and extension being linked, is the most appropriate institutional model to service these continuing changes. This is consistent with the conclusions of Falvey and Forno (1997). Meyer (1997), in noting the tendency to impose national solutions to perceived problems, questioned whether national programs can answer current problems of the land grant colleges of agriculture at all.

One of the main concerns evident from many of the United States studies was the need to focus to a greater extent on the needs of customers. According to Enarson (1989), changes in the way that the United States public view environmental issues and universities occurred throughout the late 1980s. This change was due to an increased emphasis on the environment with issues such as oil spills, pesticide usage, water pollution, destruction of rainforests, in particular the Amazon, and the 'greenhouse effect'. There was also a greater concern about science and technology which was viewed as being oblivious to the consequences of its actions. This occurred in a period when many colleges of agriculture in the United States that limited their commitment mainly to commercial agriculture, will have to get most of their input, including research and knowledge and technology transfer, from the private sector (Enarson, 1989).

Many recommendations were developed through the various United States investigations. To date, there seems to be little evidence of implementation plans for recommendations. This was also noted upon review of many of the same studies by Meyer (1997) from a different perspective. However, the major issues were similar to those being discussed in Australia. On the basis of the findings from these studies, a survey of stakeholders of agricultural and related education in Australia was conducted for this report. The purpose of the survey was to determine whether the issues that are being identified in the many studies throughout the United States are the same or similar to those facing Australian institutions. Some examples are; development of curricula which reflect increasing

concerns in the areas of environment and sustainability, the increasing need to focus on the needs of customers, increasing formation of links with government, industry and the community; equipping institutions to deal with the increasing demand for lifelong learning; improving the image of agriculture, and decreasing the gap between rural-urban values.

### **The 'Scottish System'**

The 'Scottish system' as it is known today, began in 1790 with the foundation of the first chair in agriculture, at Edinburgh University. It wasn't until nearly a century later however, that formal courses in agriculture were initiated. The first Edinburgh university student to graduate with a degree in agriculture was in 1888. Before this, departments of colleges and universities provided short courses and lectures to farmers and land owners (OEEC, 1960). The three Scottish colleges of agriculture were established over a period from 1899-1904. Each college was managed by a Board of Governors representative of local authorities, universities, technical colleges and local agricultural and related interests (Williams, 1989). The main objectives of the colleges was to maintain a centralised teaching institution for agriculture and provide associated counties with extension teaching (Beveridge, 1990).

The colleges were classified as 'Central Institutions' under the Education Act of 1908. Funding was originally from the Scottish Education Department (which had been transferred from the Board of Agriculture for Great Britain) but was then passed to the newly formed Board of Agriculture for Scotland. The Board allocated funds to the Colleges for special research and in 1912 established the Rowett Research Institute. This was the first of the research institutes which are now collectively known as the Scottish Agricultural Research Institutes (SARIs). Research in the Scottish System grew considerably and to a greater extent than the rest of the United Kingdom which is one reason for claims of superiority of the Scottish system (Beveridge, 1990).

Formation of the Constable Committee in 1924 to assess agricultural education and research in Scotland, in particular finance and general organisation of institutions, regarded highly the linkages that had formed between universities and colleges. The Constable Committee recommend the expansion of the colleges. The report was supported by the Alness Committee of 1945 which analysed the organisation, staffing, curricula and external services of Agricultural Colleges in Scotland, and the relationships of the Colleges to the Universities and to the Research Institutes. It recommended continuing the links between advisory services and colleges, with costs to be covered entirely by public funding. From the time of the Alness Report, the network of field advisory offices has been administered from the colleges which also provided a back up of specialist services (Beveridge, 1990). This improved the range and quality of advice available while also building up a research base in the colleges and providing resources for students.

With increasing government pressure to reduce spending on advisory services came greater involvement from the private sector. Individual consultancy was replaced with group services and following that, charges for specific services such as soil analysis were introduced. Further public funding cuts in 1985 led to greater cuts to advisory services as well as research and development. The aim of the Government was to improve the efficiency, management and cost effectiveness of the services as well as to encourage those who received private commercial benefit from services to pay for them (Williams 1989).

Formation of Scottish Agricultural Colleges (SAC) began in 1987 in response to further Government reductions in public funding and by 1990 the single institution of SAC was formed. This new body was formed to unite more formally the management of activities of the three Colleges and to reduce costs. It was also to coordinate Advisory Services and the Veterinary Investigation Service (VIS) on a commercial basis (Williams 1989). SAC allocation of grants to Colleges were to be the same as those previously allocated by the Department of Agriculture and Fisheries for Scotland (DAFS). Staffing in the colleges and advisory services was moved to the control of SAC while financial assets of the colleges were retained under their own names.

In both the Scottish and United States systems of agricultural and related education, services have historically been linked to research and extension. These systems have possibly provided greater resistance in times of public funding reductions than systems which fund separate institutions for each function (Falvey and Bardsley, 1995b).

## **Current Issues in Australian Agricultural and Related Education**

### **Changes**

Australian agricultural and related education has changed considerably over the past 130 years and continues to do so. Changes have to a degree followed developments in the agricultural industries. The early challenges of settlement and land development were followed by the need to maintain or increase production. Today, the focus has turned from one of production to sustainable agriculture, a challenge also being addressed by educational institutions. Other challenges facing agricultural and related education include: meeting the needs of industry and other clients (including students and the general public); integration of educational institutions as new technologies break down geographical boundaries; meeting the demand for those wishing to continue education; and adjusting to decreases in Government funding.

From the 1890s to the 1970s, increasing production from available resources was the basis for agricultural and related courses (Dunn, 1990). An initial focus on land productivity was gradually shifted to a focus on labour and capital productivity. Management practices and social sciences in agricultural courses were expanded in the 1970s with graduates realising the importance of communication skills to back up technical knowledge (Dunn, 1990). Social and demographic changes in the make up of Australian society have also affected the attitudes of the community towards agriculture.

### **Stakeholders' Views**

The need for courses to be both relevant to industry needs and accessible is widely recognised. Some go as far as Lees et al. (1982) who suggest that employers need to be directly involved in the development of course curricula. They suggest that previous changes to agricultural and related curricula have been due to stimuli from within the educational system rather than as a response to industry needs. As the number of students selecting studies in agriculture as their first preference decline, such impetus of industry has become more important.

## **Attributes of Students Required by Employers**

Primary industries require highly-educated professionals to apply scientific and managerial knowledge to help society meet challenges such as sustaining natural resources, applying new technologies, business management and most importantly, continuing to feed and clothe the world's increasing population (Anderson, 1994). According to McColl et al. (1991), attributes sought by private sector employers include the ability to: work in a team situation; think critically and conceptually; communicate effectively; and plan and manage time. Other attributes sought by employers include problem-solving, flexibility, entrepreneurship, interpersonal skills, loyalty, integrity and lateral thinking (Anderson, 1994).

## **Generalist versus Specialist Training**

It is believed by some that acquisition of the attributes required by employers should be a focus of agricultural and related education programmes, not simply a by-product of education. Others believe this can be achieved by concentrating courses on a more generalist approach. According to Derera et al. (1994), specialisation is viewed as a necessary component to be internationally competitive, but at the undergraduate level there is a need for generalist teaching to ensure a strong knowledge base. McColl et al. (1991) determined that while there was some specialisation in agricultural science, courses overall provided opportunities to develop general knowledge in other areas. Nevertheless, he reported shortages of graduates with specific training in soil science, production horticulture, agricultural economics and food science and technology.

Some employers, both public and private, require generalists more than specialists to provide flexibility and a broad skills base that can be adapted to a range of situations (McColl et al. 1991). McColl et al. (1991) also noted that organisations such as the CSIRO are leaning more towards the specific disciplines of science rather than general agriculture thus shifting such employment to those with training not necessarily in agriculture. However, also noted was the need for agricultural scientists to maintain a focus on research supported by rural industries. The issue of generalist rather than specialist orientated courses in agriculture is an issue beyond Australia. Lucas (1986) has emphasised the growing demand for graduates with generalist rather than specialist training in agriculture and who are articulate and numerate. Included in this extension of knowledge areas is: the use of new (information) technology; environmental issues; health issues (including diet and welfare); and economics and management.

## **Community Needs**

In order for agricultural and related education to be effective the sector needs to respond to the needs of the community and their perceptions of agriculture. Many people in society today see universities as being inaccessible and unconcerned with everyday problems. Current community concerns include the environment, product quality, chemical residues and food safety (McColl et al. 1991), as well as animal welfare, biotechnology and rural infrastructure decline (Wilkins, 1995).

Current and future graduates need to be well informed on environmental issues to interact with an increasingly environmentally aware public (Dunn, 1990). This issue is

international. For example, farming in Europe is seen as a major polluter and waster of natural resources (Dunn, 1990). The use of pesticides, nitrogen and subsidised overproduction of agricultural commodities have created a poor image of agriculturalists. Various countries throughout Europe balanced this with programs of rural development, organic farming and countryside management. They reason that development of these industries is essential for the continued existence of rural communities and in reducing problems such as pollution and overcrowding in cities (Dunn, 1990).

### **Student Enrolment and Views**

In 1996, 1.9 per cent of all university students in Australia were studying agriculture and animal husbandry. From 1983 to 1996 the number of agriculture students increased by 97 per cent, compared with an 82 per cent overall increase in total student numbers (DEETYA, 1996). However, while student numbers enrolling in agriculture may have increased, numbers choosing agriculture as their first preference have decreased (VTAC, 1996). Concerns have been expressed in the reduction of numbers of quality students as institutions reduce their minimum entry scores in order to attract greater student numbers (McColl et al. 1991). Negative attitudes concerning agriculture's affect on the environment are seen to influence the number of students opting to take up study in agriculture and related areas (Monteith and Field, 1995; Wilkins, 1995).

### **Image**

In Australia, the negative image of agriculture held by the community is reflected in many media releases (Monteith and Field, 1995), such as newspaper articles with the headlines 'Farming our Parched Land' or 'Country Living Happy not Healthy'. Destruction of the environment, floods, drought, and bankruptcy, are typical of images portrayed in the media (Wilkins, 1995). Some sections of the community regard agriculture and related areas as being the cause of environmental problems rather than part of a solution (McColl et al. 1991). In order for the top students to be attracted to agriculture, positive images need to be portrayed in the media and the agricultural sector (Wilkins, 1995). Such positive images may include success in business, new technological advances, social and environmental responsibility, and innovation. The need for a continuation of the forestry emphasis on conservation and environment, including wildlife concerns, forest recreation and land management is one necessary measure (McColl et al. 1991).

Lack of understanding in the community as to the significant role that agriculture plays in the economy has also influenced the negative view of agriculture. The perception of Australian Governments that agriculture is a declining industry also affected public opinion (Monteith and Field, 1995). The decline of the industry of agriculture may be true, relative to other expanding sectors, but in real terms agriculture has in fact grown, particularly if the fast growing food and beverage industry is included (Monteith and Field, 1995). The community needs to be better informed about agriculture and its related economic and environmental benefits.

The literature seems to point towards the negative image of agriculture as held by the general public, which in turn would be passed on to children and thus potential students of agriculture. However, is this the image that teenagers have of agriculture or does agriculture have no image at all, which could also translate to no impact? According to one study in the United States, the image of agriculture throughout the 1980s was of farmers

and foresters destroying natural resources, however today agriculture for teenagers has no image at all (John et al. 1996). Are agriculture and related subjects simply seen as uninteresting? If this is the case in Australia then improving the image of agriculture would encompass, increasing the profile of agriculture and careers available in agriculture and related areas, and providing and publicising the presence of subjects which are intellectually interesting and relevant to today's society. The purpose therefore of the second survey was to determine the image of agriculture as perceived by Year 10 students in Victoria in order to determine what course of action should be taken to increase the number of bright students participating in agriculture and related subjects.

In a conference conducted by the then Australian Institute of Agricultural Science (1995) the need to attract bright young students to agri-industry was seen to be related to image, product development, marketing and customer retention. It was noted that community opinion is important in shaping the views of children and potential students of agriculture, and that attitudes of students towards agriculture and agricultural practices are of importance to attracting good quality graduates to the agricultural industry. Recommendations from the conference included the establishment of a group for the promotion of a positive image of agri-industry, and another group to establish a network for continuing communication between industry and educators to increase the popularity of agri-industry and related courses (Field, 1995).

A survey of Year 12 students found that students from various parts of Western Australia saw famine, as one of the greatest issues that they will have to face before 2050. They view this threat of famine as being due to rising demand for food from an expanding world population under conditions of land degradation, and chemical pollution of soil and water (UWA, 1995).

Student choice of career was studied by a survey of year 11 and 12 Canberra students by Cecchetti et al. (1992). It was found that students' decisions were related to a stable and secure future, using special talents and creativity. Students' did not see any of these being provided by courses in agriculture.

Most recently, it has been argued that increases in private contributions to tertiary education costs have contributed to decreased numbers of students applying for science subjects (McKay, 1997). Others argue that this will not affect course applications as students do not consider cost when choosing a future course of study (Williams, 1997).

Access for rural students is an important aspect in demand for agriculture courses. However, as most courses meet their quota levels, the issue is actually one of equity of access (McColl et al. 1991). The issue of declining university entrance scores then assumes importance as courses reach quota levels by lowering entrance scores (Monteith and Field, 1995). Ways to facilitate access include, improved financial assistance and increased provision of distance education based on new technologies.

Dunn (1990) emphasised that educators must provide a continuing learning service by providing information to rural communities so that they may enter into debates, such as that concerning the environment. While this transmission of information already occurs to an extent, by way of extension activities, it is felt that the interaction can be strengthened.

## **Rural-Urban Issues**

Social and demographic changes in Australian society may be part of the cause of the changes in attitudes of the general population towards agriculture. The emergence of goldmining in the latter half of the 19th Century increased development of towns and communities of inland Australia (Lees et al. 1982). This subsequent drift to a predominantly urban population may affect the ways agriculture and related industries are viewed in government.

Over the past century there has been a significant increase in numbers of people moving from rural to urban areas. In 1921, the total proportion of the Australian population living in metropolitan areas was 43 per cent, in other urban areas it was 19 per cent, and in rural areas, 37 per cent. In 1976 the figures were 65, 21 and 14 respectively (OECD, 1987). With the greater proportion of the population living in metropolitan areas, there is less general empathy with farmers and rising levels of ignorance about rural life and agriculture. Negative attitudes of urban persons toward rural areas have been compounded by publicity not only from newspaper reports, but also from farmers themselves who seek some special assistance. The image that agriculture is destroying the environment is not countered by such actions (Lees et al. 1982).

A book of biographies of women from both rural and urban Australia (Lofthouse, 1995) reflects the feelings of people living in rural areas who believe urban dwellers have little understanding of those living in the country. According to Lofthouse (1995) the country became seen as old-fashioned and irrelevant, with ideas and inventions emanating from the city. Development of modern agricultural techniques and industrial processes have had the effect of decreasing the value seen in older methods. Lofthouse (1995) further argues that the general realities of life in the country are similar to the city: paying bills, getting a job and so on. In order to decrease the gap between the urban and rural areas there is a need to change the attitudes of those in urban areas towards agriculture with greater education about the realities of agriculture. This includes focussing on the future and rectifying previous inaction on environmental problems (Monteith and Field, 1995).

A further contention of the second survey was that the negative image of agriculture is one which has been widened by rural-urban differences. To test this the survey was conducted in both metropolitan and non-metropolitan regions in order to compare student views and the different influences that may affect these views by being raised in different regions.

## **Education Levels of Agriculturists**

Industry and educators have both expressed concern at the low proportion of the agricultural workforce which is tertiary qualified (Ferguson and Simpson, 1995; Kilpatrick, 1996). One study found that the costs involved with living away from home, lower parental income and inconsistencies of Austudy asset testing were the main reasons stopping young farmers from further studies (Weekly Times, 1995). A survey of young farmers determined that decreased numbers of young farmers undertaking tertiary study were due in most cases to their preferring to enter the workforce. Others thought that tertiary study was not necessary to be a good farmer (Hamilton, 1995).

A further survey of consultancy clients, suggested that a high level of agribusiness professionals and farmers have some form of formal higher education (Hamilton, 1995).

Forty-three per cent of those surveyed had tertiary qualifications, which varies substantially from statistics obtained from an ABARE survey that showed 16.1 per cent of farm operators have tertiary qualifications (Hamilton, 1995). However, as this was a survey of the consultancy firms own clients who are progressive farmers, an association between formal higher education and success in farming may be suggested.

Surveys of Tasmanian farmers found a significant correlation between attendance at structured courses and farm cash operating surplus (Kilpatrick, 1996). Farmers have been shown to believe that further education leads to improved farm business management (Hamilton, 1995). A more educated and trained workforce may be better equipped to address issues such as environmental problems and may in the long run present a more positive picture of agriculture to the rest of the community (Dunn, 1990). However, there is little importance placed on formal tertiary education in agriculture by many farmers (Bell and Pandey, 1987; Clarke, 1987).

### **Lifelong learning**

Current trends show a greater demand for those wishing to continue education, sometimes called lifelong learning (Falvey and Bardsley, 1995a). Derera et al. (1994) note the need for those within industry to continue learning in order to be informed of new developments and to be market orientated. They also called for greater funding to education and research. They claim a potentially extensive market for education providers in catering for the needs to the community as well as industry by providing relevant and accessible courses.

### **Linkages**

Analysing changes in agricultural and related education highlights the need to improve linkages between: educational institutions and industry; educational institutions themselves; and educational institutions and prospective students (Lees et al. 1982).

The increase in numbers of agriculture courses on offer and numbers of institutions offering courses which occurred in the past decade has produced a possible oversupply (Falvey and Bardsley, 1995b). In part as a response to the recommendations of the Review of Agricultural and Related Education (McColl et al. 1991), regionally based institutions are becoming integrated with larger metropolitan institutions in some cases, and leading to a more integrated education system. However, both graduates and employers involved in agriculture still believe there to be a lack of coordination between institutions providing agricultural education (Lees et al. 1982). These accompany gaps and overlapping between courses at different levels and in different institutions, and a lack of opportunities for existing graduates to up-grade their qualifications without having to repeat areas of knowledge and skill in which they are already proficient (Lees et al. 1982). Derera et al. (1994) also note imbalance in the courses, suggesting that the emphasis needs to be on the production of graduates able to cope with future challenges to the rural sector.

### **Linking Universities and Colleges of Agriculture**

Great diversity in agricultural and related courses on offer resulted from the establishment of new institutions over the past 30 years but has also brought about an apparent overlap in functions of institutions and courses (Lees et al. 1982). This diversity was brought about by influences within the education system rather than from agricultural industry itself. It is apparent that the educational system needs to work more closely with industry to, amongst

other things, reduce duplication of courses. Linkages with industry have been present in some areas of education however until recently they have mainly been of an informal nature (Dunn, 1990). More recently stakeholders from industry and education sectors are calling for increased linkages between industry and educational units with benefits being foreseen for both parties involved (Falvey and Bardsley, 1995a; Vines, 1995; Wilkins, 1995; Webster, 1995). The need for more integration across educational institutions to decrease overlap of courses and to attract good quality students, will require universities to be less competitive with each other.

The integration of research, education and extension through linkages with institutions and industry is similar, to an extent, to that of the Land Grant College system in the United States and the Scottish Agricultural Colleges. It has been suggested that appropriate parts of the land grant college system can be adapted to Australia but that consideration must be given to the fact that the land grant colleges originated from an agricultural base and therefore the faculties or colleges of agriculture and related sciences usually include departments, which in Australia's case are more likely to be found in Faculties of Science, Medicine and Engineering. To achieve integration of all components, strong linkages with departments in other faculties are required. There is also a need to strengthen research activities, especially in the larger rural and discipline specific campuses (Falvey and Bardsley, 1995a).

In terms of course content, there have been calls from within agricultural and related education institutions to: address the balance required between food production and preservation of the environment; focus on consumer wants and needs; and understand developing markets, particularly in Asia (Greenland, 1992).

The increased emphasis on integration of agricultural and related education systems is due also to changes in Government policies as reflected by McColl et al. (1991) who recommended consolidation and rationalisation of agricultural and related education institutions.

### **Vocational Education Programs**

A 1988 White Paper on higher education called for the further development and strengthening of linkages between the universities and the vocational sector, known as TAFE (Technical and Further Education). TAFE is important to agricultural and related education, through provision of vocational education in trade, commercial, technical and service occupations at post-secondary level, and its practical orientation and suitability to the diverse levels of education in agricultural industries (McColl et al. 1991).

Further recommendation for the linking of TAFE and higher education sectors was made in a Prime Ministerial Statement in 1995. In the statement the aim of these linkages was to form a complementary system whereby a single faculty could offer a range of courses on a range of levels and create more ease of movement from one level to the next. This appears to be occurring through articulation agreements or mergers between TAFE colleges and universities. The Victorian College of Agriculture and Horticulture (VCAH) which provided TAFE level courses in rural studies in Victoria merged with the University of Melbourne in 1997 (Falvey and Bardsley, 1997). The Northern Territory University offers both higher education and TAFE level courses in agriculture, while Muresk College of Agriculture is now part of Curtin University of Technology in Western Australia.

Integration of TAFE with higher education courses in agriculture is possible in Victoria to a greater extent than other states at the present time as a function of institutional histories. Except for Victoria, agricultural colleges became degree granting institutions and moved away from the TAFE sector. Comprehensive TAFE institutes assumed vocational course offerings in agriculture and now find less compatibility with traditional suppliers of agricultural education.

It is important to note that the major concern with the increased number of mergers is in the provision of courses in an efficient manner. Thus duplication of courses needs to be solved, and sharing of resources for teaching across institutions is needed. Other concerns expressed include upholding the high standing/reputation of universities with the incorporation of the TAFE sector.

### **Government Involvement**

Agriculture and related educational institutions have faced decreased Government funding due to changes in Government policies and decreased public investment in agricultural research (McColl et al. 1991). The situation in the United States and European Union however, is that governments plan increases in agricultural science to compensate their farmers for the phased reduction in subsidies.

### **Stakeholders' and Young Students' Views**

Educators and industry representatives seem to be in agreement that there is a need to attract brighter students to agriculture and related courses. However, the lack of top students attracted to agriculture and approaches that should be taken to increase these numbers requires further information. The literature also indicates that the perceptions of agriculture held by the general public are negative. Indications of this are reflected in the media and by lower university entrance scores (Monteith and Field, 1995). Furthermore it has been suggested that the decline in rural populations has lead to an increased proportion of students from urban areas entering college and university courses related to agriculture. The opinions of these persons toward agriculture being generated from newspaper headlines and television which show negative events, has an affect on the numbers of students choosing a career in agriculture (Mallory and Sommer, 1986).

Various studies in the United States (Lam, 1982; Kotlik, 1987; Martin, 1985) have shown that students are influenced mainly by their parents and teachers in their choice of career. Other studies conducted, mainly in the United States, concerning student perceptions of agriculture suggest approaches to attract more students to agriculture and consider approaches to students at secondary levels and below. Similar Australian studies however, have concentrated mainly on students from Year 11 level upwards. It is suggested that while these views are important there is a need to understand student biases at a younger age concerning the potential careers available in agriculture. Eliciting this information forms the basis of the second survey conducted as part of this project (Chapter Four). The survey was conducted to determine the knowledge and perceptions of Year 10 students in Victoria towards agriculture, careers in agriculture and the factors involved in their career decision making.

# Results

## Survey 1:

### Stakeholders views concerning agricultural and related education

A high level of interest in the survey was found. Interest was also indicated in the number of questions raised by respondents through other forms of communication to ensure that the intent of questions was correct.

The number of respondents by employment category for each of the rounds is presented in Table 1

**Table 1: Number of Respondents by Employment Category for Each Round of Questionnaire**

| <b>Employment Category</b>               | <b>Round 1</b> | <b>Round 2</b> | <b>Round 3</b> |
|------------------------------------------|----------------|----------------|----------------|
| Educator                                 |                |                | 16             |
| Producer                                 | 9              | 9              | 41             |
| Researcher                               | 4              | 4              | 20             |
| Research Funder                          | 5              | 5              | 16             |
| Total                                    | 18             | 18             | 93             |
| <b>Total as Percentage of those sent</b> | <b>82%</b>     | <b>100%</b>    | <b>60%</b>     |

## Round One

Eighty-two per cent of Informed Respondents replied to Round One of the questionnaire (Table 1). Replies received were diverse and in the case of Question 1 for example, were able to be grouped into 53 statements. These were classified into seven general categories of: competitiveness and responsiveness to change; sustainability; relevant skills; research development and extension; excellence; customer-focus, and delivery. The content of each of these categories was distilled into short explanatory statements for Round Two of the survey. This process was followed for each question.

In the case of Question 2, the 50 reply statements were categorised into the five groupings of; attracting students; structures; information; funding, and customer needs. For Question 3, 49 replies were categorised into the four groups of: sustainability, research and extension; structures and management systems, and resources and funds. For Question 4, 48 responses were categorised into five groupings: sustainability; excellence; structures; programs, and funding and resources. Question 5 grouped 51 responses into the five areas of: sustainability; research and development; production, producers and products; funding, and customers. Question 6 grouped 47 responses into the five areas of: funding; technology transfer; extension; education, and innovation.

## Round Two

Round Two allowed the same Informed Respondents to rank the succinct statements relating to each grouping in order of priority. This process elicited minimal comment as the Informed Respondents were effectively ranking comments which incorporated their own views from Round One. Once again, response rates and timeliness were of a high level; all Informed Respondents replied with only 5.5% requiring follow up.

In all questions, ranking allowed the selection of three areas above others for inclusion into Round Three.

## Round Three

Round Three which was circulated to 156 persons had a 60% response rate. The range of persons surveyed was diverse, and numbers were sufficient for statistical analysis.

Survey forms (Appendix 1) also included the second three ranking areas (that is, rankings four to six) for each question and provision for other comments. Respondents did not generally deviate from the selection within the top three most critical comments posed by the initial Informed Respondents.

## Responses to Questions

In addressing the question *What should be the three major components for Mission Statements for universities and State Government Agencies involved in providing research, education and/or extension for the next ten years?* - the three responses ranked above others by the Informed Respondents were

- to ensure that the management of natural resources is productive as well as ecologically sustainable
- providers of services to Australian agriculture need to be able to adjust to the needs of their clients
- to attract adequate investment to ensure that agricultural production in Australia continues to be globally competitive

The proportions of the wider sample ranking these three as most important is presented in Appendix 3, Table 1. A Chi-squared analysis (refer Table 2) indicated that these responses differed significantly ( $P < 0.05$ ). A second Chi-squared analysis of persons from the four general employment categories of producers, educators, researchers and research funders indicated no significant ( $P > 0.05$ ) differences between the responses (Appendix 3, Table 2).

In terms of assessing the major challenges faced by agricultural units in universities over the next ten years, respondents ranked the answers as

- to deliver quality courses and foster development of leadership and management skills
- to attract quality students and increase levels of enrolment in agricultural disciplines
- to adopt a closer, more integrated structure with other agricultural agencies to ensure networking and collaboration

There was a significant difference between responses ( $P < 0.05$ ), this favoured the delivery of quality courses and leadership and management. In terms of employment categories however, there was a tendency ( $P > 0.05$ ) among researchers to rank the challenge to attract quality students and increase levels of enrolment ahead of the other two responses, and in the case of educators, no respondents selected the option of adopting a closer, more integrated structure with other agricultural agencies.

In terms of the major challenges faced by State Government agencies concerned with agriculture and the environment in the next ten years, these were seen to be

- to ensure agricultural practices and processes are environmentally friendly to allow for a sustainable future
- to be able to change their focus from a supply to one of demand within a quality ethic; for example through flexibility and adaptation to customer needs
- to have a greater involvement with industry in research and extension for more cooperative research ventures

While there was no significant difference ( $P > 0.05$ ) between the responses, there was a tendency favouring, ensuring that agricultural practices and processes are environmentally friendly. Differences between employment groups were not significant ( $P > 0.05$ ) although there was a tendency for educators to feel most strongly about environmental and sustainability matters while producers tended to focus on ability to change to a demand focus with improved quality.

In terms of *the major changes facing undergraduate and postgraduate programs relating to agriculture in the next ten years*, these were ranked as

- assisting industry to meet the challenges posed by sustainable land and water use
- increase flexibility to address industry needs and keep up with the rapidly expanding changing information technology
- attracting bright young people by improving the image of agriculture and professionals in the industry will become essential.

There were no significant differences ( $P > 0.05$ ) between responses. Educators allocated *attracting bright young people by improving the image of agriculture and professionals in industry* the highest priority, varying from the general tendency of all other groups to rank this statement last.

In terms of the major challenges which should be addressed in agricultural and related research programs in the next ten years, these were ranked as:

- sustainability, environmental issues and long term resource stabilisation
- to improve productivity, profitability and efficiency
- to provide producers with technology to enable them to be competitive

While there were no differences ( $P > 0.05$ ) between the responses, there was a tendency to allocate the lowest priority to the provision of technology to improve competitiveness. Within employer groups there was little consistency with educators and researchers tending to rank sustainability issues above others while producers and research funders focused on the improvement of productivity and efficiency.

In terms of *the major challenges which should be addressed in agriculture and related extension programs in the next ten years*, these were ranked:

- developing a learning ethos throughout the industry
- integration with research and consultation with industry
- developing an understanding of the innovation process in agribusiness

There were significant differences ( $P < 0.05$ ) between responses, and the highest priority was given to developing a learning ethos throughout industry. The same trends were evident in each employment category.

**Table 2: Chi - Square Test Between Responses to Each Question.**  
Level of Significance = .05

| Question | A  | B  | C  |
|----------|----|----|----|
| 1        | 16 | 47 | 23 |
| 2        | 32 | 41 | 19 |
| 3        | 38 | 26 | 28 |
| 4        | 33 | 30 | 25 |
| 5        | 38 | 21 | 34 |
| 6        | 14 | 44 | 32 |

## Survey 2:

### Student Knowledge and Perceptions of Agriculture and Factors Involved in Their Career Decision Making.

#### *Response Rates and Sample Profile*

A 50 percent response rate was obtained from the first letter sent out (Table 3). For some sectors however, responses were over the required 50% and some under. Those over the required amount were still used to ensure that the final sample size was sufficient. Follow up telephone calls were made in the sectors under the required amount. The final response rate from those schools originally agreeing to participate in the survey was approximately 96% with 88.28% of the total surveys sent being completed.

**Table 3: Number of Respondents to Initial Letter by Sector and Region**

| Region                            | Government | Sector   |             | Total |
|-----------------------------------|------------|----------|-------------|-------|
|                                   |            | Catholic | Independent |       |
| Metropolitan                      | 11         | 4        | 1           | 16    |
| Non-Metropolitan                  | 7          | 2        | 1           | 10    |
| <b>Total</b>                      | 18         | 6        | 2           | 26    |
| <b>Total as (%) of those sent</b> | 50         | 50       | 50          | 50    |

Approximately 59% of respondents were from metropolitan regions with approximately 41% from non-metropolitan regions thus satisfying the required population parameters (Levy & Lemeshow, 1991). Of the 550 Year 10 students responding to the survey, 56.43% were male and 43.57% were female (Table 4). Chi-square analysis (Table 4) showed that these did not differ significantly ( $p > 0.05$ ) according to region.

**Table 4: Number and Percentage of Respondents by Gender and Region**

| Gender       | Metro | Metro(%) | Non-Metro | Non-Metro(%) | Total | Total (%) | p-value |
|--------------|-------|----------|-----------|--------------|-------|-----------|---------|
| Female       | 139   | 42.9     | 101       | 44.69        | 240   | 43.64     | 0.677   |
| Male         | 185   | 57.1     | 125       | 55.31        | 310   | 56.36     |         |
| <b>Total</b> | 324   | 100      | 226       | 100          | 550   | 100       |         |

## Survey results

### *Consideration of a Career in Agriculture*

In question one of the survey it was asked whether students had ever considered a career in agriculture. A greater percentage (33.19%) of Year 10 students from non-metropolitan schools had considered a career in agriculture (Table 5) compared with their metropolitan counterparts (16.05%). This difference between the two groups was found to be significant ( $p < 0.05$ ).

**Table 5: Number and Percentage of Respondents Considering a Career in Agriculture by Region**

| Response | Metro | Metro(%) | Non-Metro | Non-Metro(%) | Total | Total(%) | p-value |
|----------|-------|----------|-----------|--------------|-------|----------|---------|
| Yes      | 52    | 16.05    | 75        | 33.19        | 127   | 23.09    | 0.000   |
| No       | 272   | 83.95    | 151       | 66.81        | 423   | 76.91    |         |
| Total    | 324   | 100      | 226       | 100          | 550   | 100      |         |

### ***Factors Governing Knowledge of Careers in Agriculture.***

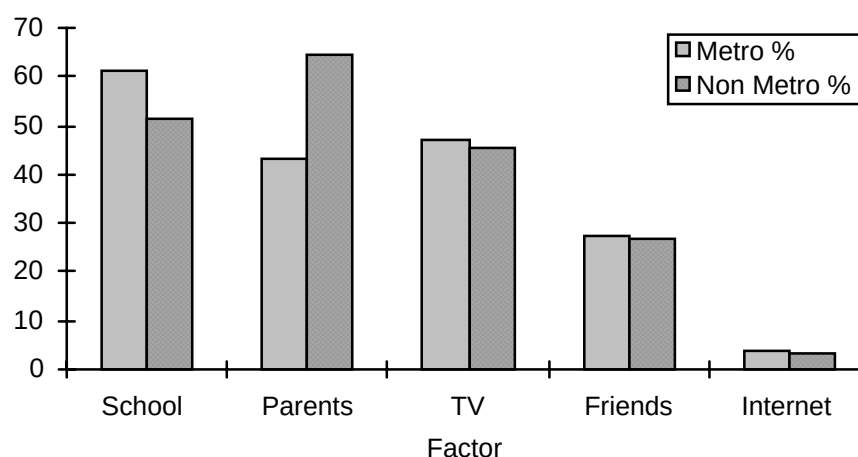
The second question in the survey asked: Does your knowledge of careers in agriculture come from... parents/relatives, television/radio/newspapers, school/teachers, Internet, or friends? Figure 1 shows that, of the 498 students surveyed, 57.27% stated that their knowledge of agriculture came from school, followed by parents (52%), media (46.36%), friends (27.09%). The Internet (3.64%) was found to be the least contributing factor. On completion of a chi-square test (Appendix 3, Table 3) it was found, that significantly ( $p < 0.05$ ) more students in non-metropolitan regions gained their knowledge from parents (64.6%) rather than schools (51.33%). Students in metropolitan regions apart from at school (61.42%), gained their knowledge more from the media (47.22%) than their parents (43.21%), this difference was again found to be significant. Percentages of respondents from metropolitan and non-metropolitan regions did not vary significantly ( $p > 0.05$ ).

### ***Factors Involved in Choosing a Career***

In question three students were asked how important certain factors were in their choice of career. The factors included: conservation/environmental concerns; family approval; good income; helping those in less developed countries; interesting work; job prospects; opportunities for advancement; prospective growth of industry; social responsibility (helping others); work location (for example, city versus country). Table 4, Appendix 3, presents, the results of chi-square tests, to determine if there were significant differences between metropolitan and non metropolitan students in their ranking of the importance of certain factors when choosing a career.

Students from metropolitan areas differed from non-metropolitan students with significantly more ( $p < 0.05$ ) ranking good income as important, above interesting work. Non-metropolitan students placed job prospects equally with opportunities for advancement and above work location. Overall results (Appendix 3, Table 5) indicated that the factors regarded as being most important in choosing a career were: interesting work, good income, opportunities for advancement, work location, job prospects, social responsibility and the prospective growth of the industry, respectively. More students were 'uncertain' about the importance of family approval and conservation and environmental concerns while helping those in less developed countries was seen to be unimportant when choosing a career.

**Figure 1: Factors governing Year 10 students knowledge of careers in agriculture by region**



### ***Factors Applying to a Career in Agriculture***

The same factors in question three were also used in question four. In this instance the question asked was: To what extent do you think each of these factors applies to a career in agriculture? Factors seen as applying to a career in agriculture are presented in Table 6 of Appendix 3. They were: conservation/environmental concerns, interesting work, work location, prospective growth of industry, opportunities for advancement, job prospects, good income, social responsibility, and helping those in less developed countries, respectively.

A greater number of students in both metropolitan and non-metropolitan regions thought that family approval did not apply or were uncertain about whether it applied to a career in agriculture. From the chi-square tests in Table 7, (Appendix 3) it was noted that more students from non-metropolitan regions tended ( $p < 0.1$ ) to rank family approval as applying to a career in agriculture, compared with metropolitan students. It was also observed that significantly ( $p < 0.05$ ) less metropolitan students ranked job prospects as applying to a career in agriculture compared with non metropolitan students. When placing the factors in order of their considered relevance or application to a career in agriculture, metropolitan students differed from non-metropolitan students in rating social responsibility as applying to a career in agriculture, above job prospects and a good income, respectively (Appendix 3, Table 7).

### ***Knowledge and/or Pursuit of Careers Available in Agriculture***

Question five involved two questions. In order to respond to both parts of the question, a list of some careers available to a graduate of Agricultural Science was given (refer Appendix 2 and/or 3 for entire list).

### ***Part A: Knowledge of Agricultural Careers***

The first part of question five was to establish the extent of the knowledge that Year 10 students have of the types of careers available to a graduate in Agricultural Science. For eight out of the 17 careers listed, between 75-90% of respondents in each case thought that these careers would be available to someone with a degree in Agricultural Science (Appendix 3, Figure 1). Those careers with a mid-range response (40-60%) were, 'teacher', 'microbiologist' and 'scientist'. While the careers which most respondents thought unavailable to someone with a degree in Agricultural Science were; 'business advisor', 'consultant', 'engineer' and 'economist'. 'Land and environment manager' received the highest percentage of responses followed by, 'environmental scientist' and 'farmer' (differing by 0.36%), 'environmental science teacher' and 'soil scientist' (equal), 'national park ranger', 'botanist' and 'horticulturalist'. Chi-square analysis (Appendix 3, Table 8) showed that these differences were significant ( $p < 0.05$ ).

Significantly ( $p < 0.05$ ) more students from non-metropolitan regions than metropolitan regions responded 'yes' to a 'teacher' being a potential career from completion of a degree in Agricultural Science. More students from non-metropolitan areas thought it possible to become a property manager by completing an Agricultural Science degree, this was again found to be significant ( $p < 0.05$ ).

### ***Part B: Pursuit of Agricultural Careers***

The second part of question five asked: Would you wish to pursue any of these careers? Table 9 in Appendix 3 shows that the number of students responding 'yes' to wishing to pursue the various careers listed were very low (between 4-33%). It also indicates that differences between metropolitan and non-metropolitan students' responses were not significant ( $p > 0.05$ ). However there was a tendency for more non-metropolitan students to be interested in pursuing a farming career (12.4%). Approximately nine percent more wanted to become a National Park Ranger though this difference was not considered significant ( $p > 0.05$ ).

### ***Environmental Issues***

Question six asked, Do you think that environmental issues are of major concern today? Approximately 80% of respondents answered in the positive (Table 6). Less than 5% said that they were not, with approximately 15% being unsure as to whether environmental issues are of major concern. Responses between regions did not vary significantly ( $p > 0.05$ ) from the overall responses.

### ***Part A: Level of Importance of Environmental Issues***

Continuing on from question six, question seven part A investigated the importance to students of several specific environmental issues. The issues included: air pollution, clearing of tropical rainforests, decrease in the number of species present in the environment, reduction of the ozone layer, global food shortage, global warming/climate change, increase in soil salinity, pollution of rivers and streams, and soil erosion. All of the environmental issues were considered to be important (Appendix 3, Table 10). Those with the highest percentages were pollution of rivers and streams (84.91%), air pollution (81.82%) and reduction of the ozone layer (81.64%). Increasing soil salinity (52.91%) was considered to be less important in comparison to the other issues. In all cases except for the

increase in soil salinity, pollution of rivers and streams and soil erosion, significantly ( $p < 0.05$ ) less non-metropolitan students saw environmental issues as being important (Appendix 3, Table 11).

**Table 6: Level of Concern of Respondents on Environmental Issues, by Region**

| Response      | Metro | Metro (%) | Non-Metro | Non-Metro (%) | Total responses | Total (%) | p-value |
|---------------|-------|-----------|-----------|---------------|-----------------|-----------|---------|
| <b>Yes</b>    | 260   | 80.25     | 165       | 73.01         | 425             | 77.27     | 0.119   |
| <b>No</b>     | 14    | 4.321     | 11        | 4.867         | 25              | 4.545     |         |
| <b>Unsure</b> | 50    | 15.43     | 50        | 22.12         | 100             | 18.18     |         |
| <b>Total</b>  | 324   | 100       | 226       | 100           | 550             | 100       |         |

### ***Part B: Perceived Effect of Agriculture on the Environment***

The second part of question seven then went on to ask how students would rate the effect of agriculture on the same listed areas. Responses were fairly evenly distributed. From Table 12 in Appendix 3 it was observed that generally higher percentages were found for those ranking 1 and 2. The issues of air pollution, reduction of the ozone layer, global food shortage, global warming/climate change increase in soil salinity, pollution of rivers and streams and soil erosion, showed no significant ( $p > 0.05$ ) differences between metropolitan and non-metropolitan groups (Appendix 3, Table 13). A significantly ( $p < 0.05$ ) greater number of non-metropolitan than metropolitan students responded that agriculture had a negative effect on, clearing of tropical rainforests and the decrease in the number of species present in the environment.

# Discussion

## Survey 1

### Stakeholders Views Concerning Agricultural and Related Education

#### Opinions of Informed Respondents

##### ***Suggested Mission Statements For Universities And State Government Agencies***

The majority of respondents saw the roles of these institutions as being related and requiring further integration. However, some respondents saw the roles of universities and state government agencies as being quite different from each other to date and in the future. Most Informed Respondents were concerned with sustainability and natural resource management, servicing clients and investment. Overall, emphasis was on integrating productivity and ecologically sustainable management, in order to provide an intact resource base for the next generation. This finding is consistent with various studies conducted in the United States (RMF, 1995; NRC, 1996a; NRC, 1996b) which found that stewardship of resources was a unifying theme among institutions and the public. This suggests that there may be benefit in following the debate of the United States in agricultural and related education. In Australia advocates of a greater focus towards environmental sustainability and natural resource management in agricultural and related education include Bawden (1992); Pearson and Ison (1992), and Gleeson et al. (1995).

The second ranked choice was the need to meet client demands. Clients were seen to include students, government and industry which represents the same grouping proposed by Falvey and Bardsley (1995). It was suggested by certain Informed Respondents that both state government agencies and universities need to be more accessible and oriented to customer organisations and industry. Furthermore, state government agencies were seen as not working in partnership with industry due to their need to follow political agendas.

Increased client orientation was also one of the main concerns of stakeholders in the United States (W. K. Kellogg Foundation, 1994; RMF, 1995; NASULGC, 1996). One United States study (National Research Council, 1996a), reached a conclusion remarkably similar to that expressed by Australian stakeholders. From that study recommendations were made for increased partnerships between universities, the government, customers and units within universities. This broadens the view expressed in earlier Australian literature which noted the need to design courses to meet the needs of the community (Dunn, 1990; McColl et al. 1991). The formation of the SAC and therefore more integrated structure of research, education and extension in Scotland, was also seen to create a more customer oriented system (SAC, 1996).

Attracting adequate investment to ensure that agricultural production in Australia continues to be globally competitive was ranked third. The Informed Respondents placed particular emphasis on the need for adequate investment in research, education and extension to ensure that Australian agricultural industries remain internationally competitive and

improve at a comparable rate to competitors. This was also said to include being profitable and responsive to market changes and the changing needs for Australian agriculture.

### ***Challenges Faced by Agricultural Units in Universities***

Delivering quality courses and fostering the development of leadership and management skills was considered overall the most significant challenge facing agricultural units in universities over the next decade. While drawing the greatest response in Round 1, attracting quality students and increasing enrolments ranked second in the final round of the survey. This may have been due to the introduction of educators at Round 3 (Table 1). For educators the focus of their work may make them more inclined to favour the improvement of courses. Researchers tended to differ from the other employment groups by placing the attraction of high achieving students first, above the delivery of quality courses and leadership and management. This may represent the potential bias of an employer's own personal and organisation situation as discussed by Schroder (1991).

The need to develop the generalist skills of leadership and management has been expressed by Anderson (1994) and McColl et al. (1991). This contrasts with studies in the United States which placed greater emphasis on environmental awareness and natural resource management being introduced into curricula to improve the quality of courses (RMF, 1995; NRC, 1996a; NRC, 1996b). An earlier study in the United States did however, call for generalists rather than specialists in agricultural and related education (Lucas, 1986). Further support for graduates with generalist skills, in a global context, was given by Falvey and Maguire (1997). They point to the change in agriculture in a way that today's graduates must now compete with scientists, MBA graduates, sociologists and marketing specialists. Thus in the broad field of agriculture, competent, motivated agricultural graduates with broad based skills must be produced. These results may represent the evolution of thought over the past decade, and suggest the need to consider postgraduate education in future analyses of the relative needs for generalists and specialists.

Adopting a closer, more integrated structure with other agricultural agencies ranked significantly lower than the two more frequent responses to statements and was not ranked first by any educators. Some respondents emphasised integration between universities, industry and the community. It was also suggested that universities improve links to Federal and State Government research agencies for better collaboration in addressing industry needs, particularly in view of reduced Government contributions. Such conclusions are consistent with those of Scotland which gave rise to the formation of the SAC with its integration of industry, government and the community (SAC, 1996). Support for such an integrated system was provided by several review committees in Scotland. These included the Constable Committee, Alness Committee and the most recent Williams Committee (Williams, 1989). The continuing benefits of such a system in Scotland are demonstrated, particularly by increased income from research grants and contracts, and advisory and consultancy activities (SAC, 1995).

Studies in the United States noted a need to strengthen the present structure of research, education and extension, in disciplines and between institutions, along with greater linkages with business, industry, government and communities (W. K. Kellogg Foundation, 1994; RMF, 1995; NASULGC, 1996 NRC, 1996a). There have also been

several supporters of an integrated system in Australia (Lees et al. 1982; McColl et al. 1991; Falvey and Bardsley, 1995a; Vines, 1995; Webster, 1995; Wilkins, 1995). With research, education and extension functions often developing in isolation from each other Bawden (1992) described the Australian system as uncoordinated, inefficient and one which creates professional tensions. The results of this survey suggest that leaders in the field may share these views while those involved in service delivery, especially educators, disagree, or are perhaps less informed or concerned with the broader philosophy of integrated service delivery.

### ***Challenges Faced by State Government Agencies***

The highest ranked challenge faced by state government agencies was that of ensuring environmentally friendly agricultural production for sustainable agricultural production in the future. It seemed to be assumed by respondents that producers need to raise the priority of environmental and sustainability issues, and to balance these with development. Certain respondents noted difficulty in convincing industry to invest in long-term environmental benefits when incentives favoured short term decisions. It was suggested that one of the challenges to State Government Agencies is to reverse the trend to isolate research within institutions and bring about greater involvement by industry in the research process with increased emphasis on economic and environmental issues. Conflicts between production and conservation industries were noted, as was the need for State Government Agencies to balance these needs.

The finding that more importance needs to be placed on responsiveness to environmental and sustainability concerns by both industry and educational sectors aligns with the study of NASULGC (1996) in the United States. Sustainability and environmental concerns are also the focus of another United States study currently in progress (W. K. Kellogg Foundation, 1994). While Australian educators tended to place importance on environmental and sustainability matters, producers thought the focus should be on agencies changing to a demand focus by, for example, adapting to customer needs. The conflicting objectives and levels of understanding evident in this finding suggest the need for further investigation concerning means of orienting producers, and disincentives to long term environment decisions in production management.

The third-ranked challenge, to have greater involvement through cooperative research ventures with industry in areas of research and extension, suggests the benefit of merging research and extension into one function. This finding is consistent with those of the United States which confirm the strength of that system's commitment to maintaining research, education and extension in a single organisation (Danbom, 1992; NASULGC, 1996).

### ***Changes Facing Undergraduate and Postgraduate Programs***

The major change seen to be facing undergraduate and postgraduate agricultural programs over the next decade was confirmed through this question to be that of sustainability. In this case, it was expressed in the form of assisting industry to meet the challenges posed by sustainable land and water use.

The major concern seen by educators was that of attracting bright young people to undergraduate and postgraduate programs, through courses attractive to high achievers who

would subsequently make a valuable contribution to the sector. Comments from Informed Respondents included the need to change the perception of agriculture as a declining industry, to focus on primary and secondary educational levels which were said to exert influence on interests and attitudes to a greater extent than can tertiary education. Overall, attracting excellent and appropriate students was ranked third.

Attracting more students to agriculture and improving the image of agriculture has been a major emphasis of studies in the United States and Australia (McColl et al. 1991; Monteith and Field, 1995; Wilkins, 1995; NRC, 1996a). The disparity between rankings of educators and others suggests that the problem has not been experienced by users of the services of graduates. It is possible that the strong emphasis on student achievement, as measured by Tertiary Entrance Ranks may not be an appropriate measure in terms of capability of graduates in the eyes of producers and others. The relationship between agricultural and related education in Tertiary Entrance Ranks, undergraduate academic performance and subsequent graduate and employment performance requires further investigation.

Addressing industry needs and using information technology was seen overall as the second major change to agriculture programs. From a United States study it was found that traditional methods of teaching would be unable to meet future demands (Dillman et al. 1995). This is supported by the analysis of Falvey (1996) who argues that electronic learning aids will increase both quality of and access to agricultural education. The need for greater interaction with industry was again noted in responses from the stakeholder survey although few respondents linked information technology and services and communication with industry.

### ***Major Challenges Which Should be Addressed in Agricultural and Related Research Programs***

In responses to the major challenges to research programs, sustainability again ranked first overall, along with general environmental issues and long term resource stabilisation. Responses in Round 1 included the need to bring productivity and sustainability together in a systems approach; to improve understanding of environmental processes for soil, water, contaminants, and the impacts of agriculture on urban areas; and the need to address the practical economics of sustainable agriculture for the long term with particular attention to the proper balance between economic viability and sustainability.

While educators and researchers tended to rank sustainability issues first, producers and research funders saw the major challenges to be addressed as the improvement of productivity, profitability and efficiency of research programs. A similar indication of levels of understanding of these issues was found in some United States studies (RMF, 1995; NASULGC, 1996). Some survey respondents also noted the need for uniform measures of quality, predictability of quality and market relevance of agricultural output. Research programs were seen to require a shift towards improved communication between producer, processor and consumer and to be directed towards the promotion of differentiated, quality specified, consumer products. The need for investment in research to be maintained or increased was again mentioned, as in responses to previous questions. An increasing trend of contracting out research and extension services was seen to stimulate greater private sector investment in fields previously the responsibility of the public sector (Marsh and Pannell, 1997). Review of the SAC indicated benefits from the 'user-pays' system in Scotland (SAC, 1995).

### ***Major Challenges Which Should be Addressed in Agricultural and Related Extension Programs***

The challenge ranked as being of greatest importance to extension was to develop a learning ethos throughout industry. This was followed by integration with research and in consultation with industry. The view that greater integration with research and linkages with industry is necessary is supported by Prinsley et al. (1994) who reported a lack of private sector input into public sector policy and research. They note that most communication and dissemination of information between input and output sectors and between the public sector and agribusiness is at an informal level based on personal relationships. Marsh and Pannell (1997) note that state departments of agriculture, in creating more formal links with industry, aim to ensure that the needs of their clients are met.

The lowest ranked challenge to agricultural extension was the development of an understanding of the innovation process in agribusiness. Innovation it was suggested, is being blocked or constrained by extension activities as well as statutory and cooperative marketing arrangements. Responses to this question were similar to those for question five, including acknowledgment of customer needs and sustainable practices, the creation of tighter links with industry and ensuring environmentally sound practices. This finding appears to challenge the assumption of many extension programs that producers do not understand the relationships between research and development programs and their potential benefits.

## **Survey 2**

### **Student Knowledge and Perceptions of Agriculture and Factors Involved in Career Decision Making.**

The 25% of surveys which were not completed is an acceptable low figure, and may have been due to students originally counted by teachers not being present on the day the survey was conducted. Some teachers who indicated an interest in participating but not return any surveys. Furthermore, students were informed that they were under no obligation to complete the survey. The sample population size of  $n=550$  Year 10 students, was sufficient to apply to the entire population of Victorian Year 10 students, according to the minimum sample for a population of this size suggested by Krejcie and Morgan (1970).

### ***Consideration of a Career in Agriculture***

While the numbers of students considering a career in agriculture were very low (17.14%), significantly ( $p < 0.05$ ) more non-metropolitan students said that they had considered a career in agriculture. It would therefore seem that non-metropolitan students were more open to the possibility of undertaking a career in agriculture. This was consistent with the findings of Mallory and Sommer (1986) in their study of United States high school students. Low overall numbers could be attributed to students not having a full understanding of careers available in agriculture as observed in question 5(a), with the majority of students choosing 'land and environment manager', 'environmental scientist' and 'farmer' as careers they thought available to a graduate in agricultural science. This is

similar to the views of Meyer (1992) in stating that the general public in the United States considered agriculture as farming only. Those careers styled as 'environmental' had a high response rate, which may possibly have been due to some students responding 'yes' to those careers simply because of the adjectival descriptor 'environmental'. This would also indicate a lack of knowledge by students that may have chosen those careers associated with the descriptor 'environmental', guessing that these careers could be attained from studying agricultural science. Thus 'environmental' was possibly biased in the way that it was expected 'agriculture' would have been. The relatively small number of students considering a career in agriculture may also be due to the negative image of agriculture as expressed by Field and Monteith (1995), and Wilkins (1995).

### ***Knowledge of Careers in Agriculture***

The sources from which Year 10 students learnt about careers available to them from tertiary study were: schools/teachers, parents/guardians, the media, friends and the Internet respectively (Table 4). These results are largely consistent with those of the United States (Lam, 1982; Martin, 1985; Kotlik, 1987) which showed that when deciding on a particular career path, students are influenced mainly by their parents and teachers. The negative image of agriculture may also be associated with the sources of information about careers in agriculture. This suggests that parents, school and the media could be viewed as potential target areas for agricultural educators as well as industry in improving the image of agriculture. The need to alter the negative image of agriculture as portrayed in the media is reflected in the high numbers of Year 10 Victorian students being influenced by this source.

Improvement of teacher knowledge of career opportunities in agriculture and a more positive image of agriculture could improve student knowledge of such careers. Brinsmead (1997) in response to the workshop conducted in association with this study, considers that careers teachers need to be kept well informed of the types of careers available in agriculture and the new developments occurring in agriculture and related areas. He also notes the need for alternative methods to raise the profile of agricultural careers.

### ***Factors in Choosing a Career and Their Application to Careers in Agriculture***

Income was seen as one of the most important factors in choosing a career. It was also one of the lowest ranked factors relating to a career in agriculture. On the other hand conservation and environmental issues were the highest ranked in applying to a career in agriculture, while they were not seen to be as important to students when choosing a career. It may be concluded that students in Year 10 are not looking for the type of career that places an emphasis on these issues. These results concur with those found by Mallory and Sommer (1986); Cecchetti et al. (1992) and the University of Western Australia (1995) in which Australian and United States students decisions regarding a choice of career were related to having a stable and secure future and good income with many students believing that these could not be provided by a career in agriculture.

From the entire student population surveyed, interesting work was rated the most important factor in choosing a career. The University of Western Australia study (1995) also found that interesting work was considered one of the most important factors in considering a

particular career path. In the survey of Year 10 Victorian students, interesting work also rated highly as applying to a career in agriculture. However, these results contrast with those of Cecchetti et al. (1992) who observed a neutral or undecided response from both United States and Australian students as to whether they thought a career in agriculture would be interesting.

It was also found from the survey that the importance of interesting work in choosing a career was 10% greater than the degree to which it was seen to apply to a career in agriculture, thereby suggesting a need to portray agriculture as interesting, particularly to metropolitan students. These results, as also proposed by Mallory and Sommer (1986), could be due to students' holding a negative view of agriculture. This would also agree with those in Australia (Monteith and Field, 1995; Wilkins, 1995) who relate the negative image of agriculture to the decline in students choosing agriculture and related areas of study as their first preference.

### ***Careers Available in Agriculture and Those Wished to be Pursued***

Students seemed to be unaware of the variety of careers available to them by completion of a degree in agricultural science. This is seen from the low percentage of students responding to 'scientist' as a potential career and the greater percentage choosing 'environmental scientist' and 'soil scientist' (Appendix 3, Figure 1). The greater number of non-metropolitan students choosing 'property manager' as a potential career could be due to a greater knowledge of the activities of a property manager. Similarly, Mallory and Sommer (1986) suggested that in the United States students' farm experience promoted a greater awareness and consideration of an agricultural career. The survey results are substantiated from approximately 88% of all respondents selecting 'farmer' as an outcome from an agricultural science degree while only 61.64% chose 'property manager'.

It was revealed that a greater number of students wanted to pursue at least one of the careers listed in the survey, than had responded 'yes' to wanting a career in agriculture. This was found mainly with metropolitan students, for example, 16.05% stated that they had considered a career in agriculture, while 16.98% wished to pursue a career as a 'scientist'; 19.14% a 'business advisor'; 23.77% 'national park ranger'; and 26.23% 'engineer'. A reason for this difference could be that some students did not realise that they could pursue such careers from agriculture. The low level of student knowledge of careers available from undertaking a degree of agricultural science was consistent with that found by Mallory and Sommer (1986) in a United States study. They determined that many high school students were surprised to learn that careers in agriculture were not restricted to farming.

Alternatively, students may have had knowledge of the ability to pursue the various listed careers in question 5(b) through agricultural studies but may not have wanted to pursue them in that particular direction, for example, wanting to become a chemical or electrical engineer rather than an agricultural engineer. If this is the case, it may be attributable to a negative perception of agriculture on the part of students.

### ***Environmental Issues of Concern, Their Level of Importance and the Effect of Agriculture.***

It was found that metropolitan students did not have a significantly ( $p>0.05$ ) more negative view of the effects of agricultural practises on the environment than non-metropolitan students. The issues of clearing of tropical rainforests and the decrease in the number of species present in the environment showed significantly ( $p<0.05$ ) more non-metropolitan students viewing agriculture as having a negative impact. It was observed that on the whole, knowledge about agriculture and the image of agriculture was poor in both metropolitan and non-metropolitan schools. It may be suggested that metropolitan students are not interested in agriculture and do not see its relevance. John et al. (1996) similarly concluded that, among the majority of United States teenagers, agriculture has neither a positive or negative image.

## **Workshop**

Twenty-two people participated in the electronic workshop, at which three major papers and various viewpoints were presented. Two of the papers included results from the surveys conducted as part of this report. The third paper was an executive summary of a report by Bamberry, Dunn and Lamont (1997) entitled, 'A Pilot Study of the Relationship Between Farmer Education and Good Farm Management'. All references from the workshop have been placed in italics.

### ***Experience from the Electronic Workshop***

An electronic workshop was employed as an efficient means of reaching the number and type of participants required. It enrolled persons who, due to various circumstances, such as overseas travel, would have otherwise been unable to participate in such a workshop. These persons were subsequently able to become involved as they travelled or had time available.

Difficulties were found however, with those people who did not have compatible computer programs. Some participants were unable to read larger data tables. To overcome this constraint, such documents were faxed whenever requested. This required additional support staff and communication resources than initially estimated, thereby negating an expected cost advantage for this type of workshop compared with a conventional workshop. Nevertheless, certain participants received information later than others, making it difficult for them to reply. It was observed that some who indicated a willingness to participate in the workshop and who stated that they would consider travelling to Melbourne were subsequently unable to participate due to everyday time constraints.

Certain participants suggested that a wider range of papers could have been included in the workshop if there had been more notice. It was concluded that some persons who had not previously participated in such workshops misunderstood the benefit of regular short interactions.

### ***Summary of Comments From the Workshop***

Several participants in the workshop indicated that industry and employers require general learning across a variety of fields with specific content based knowledge and skills in agriculture being only a part of education required by students. This is similar to that suggested by Derera et al. (1994) and *Dunn (1997)* also advocated the deinstitutionalisation of learning.

According to *Quinn (1997)* and others the trend emerging in higher education and industry is towards the breakdown of disciplines, with new courses and jobs crossing once fixed boundaries. Examples given were; the abundance of vocationally oriented courses, the increase in electives able to be undertaken by undergraduates, the development of graduate diplomas and certificate courses with a professional orientation. In light of this, *Quinn (1997)* suggested that a vision for all educators should be, the development of student skills that are transferable to multiple contexts. This concept of the development of broad based, core skills was also supported by findings of *McColl et al. (1991)* and *Derera et al. (1994)*.

Certain participants mentioned that agricultural education needs to extend a greater focus on personal development rather than moving away from it with the introduction of new information technologies. Both *Dunn (1997)* and *Quinn (1997)* suggested that technology and resource based learning and content driven systems at the expense of personal contact and communication would not enhance agricultural and related education.

Like their United States counterparts (*W. K. Kellogg Foundation, 1994; RMF, 1995; NRC, 1996a*), various participants called for increased links between educational sectors. *Brinsmead's (1997)* vision was for: 'a comprehensive set of programs in agriculture and related disciplines at the secondary, TAFE and tertiary sectors with full articulation between all levels, with each program linked to designated industry outcomes.'

In response to the survey concerning the knowledge and perceptions of Year 10 students in Victoria (Chapter 3) it was noted by *Brinsmead (1997)* that the trend in Victorian education today is towards teaching of agriculture subjects in country schools, and horticulture in Metropolitan schools, with no government schools offering agriculture. In contrast to Victoria, Queensland offers agriculture courses in many private and public high schools at both junior and senior levels, and in New South Wales four agricultural high schools exist (*Synapse Consulting, 1997*). Increasing numbers of students taking up 'Agricultural and Horticultural Studies' in Victoria (introduced into the Victorian Certificate of Education [VCE] in 1992) show that the demand for such a subject seems to be present. Possible reasons for the emphasis on horticulture in metropolitan schools could be that horticulture is more relevant to the life experiences of urban students. For increased awareness and improvement of the image of agriculture at the secondary level, a more active role for educators at tertiary level was suggested, including: school visits by staff and industry representatives, and active involvement of staff on curriculum bodies, examination panels and teacher associations.

The differences in the provision of agricultural courses across the states could also be attributed to differing opinions as to the role that agriculture should take at a secondary level. According to *McColl et al. (1991)* some educational providers believe that agriculture should not be taught at secondary level if it cannot be taught effectively, which is considered to be the case at present. With this in mind *McColl et al. (1991)* recommended that students be given a greater knowledge, empathy and understanding of agriculture through teaching across a range of subjects.

*Brinsmead (1997)* also pointed to evidence of ineffective teaching of agriculture by non-specialist teachers. He noted that schools have found great difficulty finding suitably trained teachers and often revert to appointing a person with little experience of agriculture.

He estimates that less than half the agriculture teachers in Victoria possess sound tertiary qualifications related to the field. No Diploma of Education courses in Victoria contain an agriculture method and students have to undertake methods in science subjects. While agreeing that secondary teaching of agriculture was ineffective, *Brinsmead (1997)* differed in the method seen as most appropriate to remedy such a problem. Suggested methods included: the development and conduct of professional development programs for teachers to upgrade their skill and provide training for non-agricultural teachers; development of a program of training that can be integrated into a Diploma of Education course; and provision of a method for students who wish to specialise in teaching agriculture.

It was also suggested that to increase career profiles, both graduates and undergraduates should be linked with school groups to discuss the reasons behind their chosen career direction. Conduction of 2-3 day courses taking groups of school students into institutions where they could experience agricultural courses first hand were suggested. In a similar way groups of school students could be introduced to industry (*Brinsmead, 1997*). Similar ideas have also been suggested by *Cecchetti et al. (1992)*.

There were a few participants, such as *Dunn (1997)* who did not believe that agricultural and related education problems could be solved by formal education. However, others such as *Crawford (1997)* pointed out that while formal education must continue, educators need to be more aware of the needs of their learners. This reflects the sentiments of those in the United States as reflected in the findings of *Dillman et al. (1995)* and the W. K. Kellogg Foundation, (1994). Several participants mentioned a need to be aware of where, how and what clients want to learn. Courses need to be relevant, useful and purposeful (*Crawford, 1997*). According to *Dunn (1997)* the users of agricultural and related education programs will always demand programs at different levels and with varying curricula. *Quinn (1997)* suggested that agricultural and related educators in the higher education sector should note the developments in the vocational education and training sector. It could be inferred from these varying opinions that while the present system of formal education may be inadequate to solve agricultural and related education problems, the inclusion of vocational education and training and other courses for continued learning, may provide a more integrated and therefore appropriate system to service the sector.

Some participants did not support the delivery of education via new technologies such as the Internet. However, it was recognised that these methods are necessary for the continued competitiveness and dissemination of information to learners. Other participants noted benefits of the Internet including, improving the profile and image of agriculture (*Brinsmead, 1997*).

## Summary

Responses to the stakeholder survey were found to be consistent with those from recent investigations conducted in the United States. Developments in the Scottish system were also regarded as an important model by demonstrating the success of a system that is being considered, with appropriate alterations to the conditions, in Australia. The survey of key stakeholders suggests that future agriculture and related education programs should be directed in the areas of environmental and sustainability management. It was also suggested that an integrated system like that in the United States and Scotland would be most

appropriate to service the agricultural and related sector in the time of change. Evidence pointed to the need to further develop customer, industry and government linkages.

The survey of Year 10 Victorian students suggested that there is a lack of knowledge concerning the variety of careers available in agriculture and related areas. In light of the factors students considered important in choosing a career and their influences or sources of knowledge in regards to the types of careers available, it was suggested that these factors could take up the focus of the promotion of careers available in agriculture and related areas. Subsequently, these factors were also seen to be a potential target for improving the image of agriculture. Whether that image was strongly positive or negative was not able to be fully determined. It was however, suggested that students at this level may have no real image of agriculture as they are unaware of its affect on their lives due to a lack of knowledge and perceived relevance to their everyday lives.

# Conclusions and Recommendations

The objectives for the project to widen the Australian debate concerning agricultural and related education were

- to provide a heightened awareness of future requirements from agriculture and related education
- to determine the future orientation of education to markets and products for food fibre and recreation
- to determine directions for the introduction of new modes of education, delivery and educational systems.

## Environmental Sustainability and Natural Resource Management

Agriculture was once a central focus in developing the new world and consequently agricultural education assumed major importance. Today the emphasis of agriculture has changed with apparent food security in these and other developed countries, improved standards of living and with that an increased understanding of the natural environment, particularly in terms of the empathy in this area by those living in the city.

Increased urbanisation has increased the gap between city and country leading to different understandings. Urban dwellers have increasing concern for environmental protection and may see some agricultural practices as working against this. Rural dwellers believe they are looking after the environment within the confines of maximising their income. The values of today's society are increasingly dominated by those of major urban centres and appear to be developing in terms of responsible natural resource management. This is particularly the case for land and water resources, ensuring quality of food, animal welfare, understanding agriculture as farming linked to processing and marketing business. Most agricultural programs continue to focus on production as distinct from processing and marketing, that is, technical as distinct from a business perspective of the environment in which agriculture is practised.

Orienting the focus of agricultural and related educational programs to sustainability and natural resource management was determined from the literature review of United States experience and Australian stakeholder surveys. Environmental issues were also considered important by a significant majority of all Year 10 students surveyed in both metropolitan and non-metropolitan regions. Students considered all environmental issues listed, from decrease in the number of species present in the environment to soil erosion, to be of importance, although they did not relate this need with agricultural and related education. The need to maintain balance between sustainability of agricultural production and economic viability emphasised another conclusion of the need for stakeholder involvement in agricultural education. Furthermore a strong focus on natural resource management for State Government agencies and universities in a unified approach is required. Along with improving the learning culture of industry at production, processing and marketing levels.

It was therefore recommended that

- agricultural education be conceived in a context of natural resource management

## **Integration**

Foreign experience, the two surveys and the workshop undertaken for this project indicate a need for greater integration between separated institutions and stakeholders concerned with agriculture. Benefits seen by stakeholders from such integration included better service to clients, attracting additional resources and highlighting sustainability and natural resource management issues.

Furthermore, the improvement of present linkages of universities with Federal and State Government research agencies was emphasised as a mechanism which could also accommodate industry. This was also viewed as a method to gain stakeholder commitment to useful services in an environment of declining government investment. The Scottish system provided an example of the ability to adapt to decreases in funding through its integrated system of research, education and extension, which minimises duplication in various areas. Similarly the integrated system of the land grant colleges of agriculture, was considered to be the best system to cope with any changes facing agricultural and related education in the United States.

Improved inter-institutional linkages and involvement of stakeholders appear to confer benefits in attracting more students to agriculture by increasing the profile of courses and the sector. A more active role for tertiary educators to increase the profile of agricultural and related courses appears necessary.

These conclusions lead to the recommendations

- integration between industry, government, educational institutions and the community
- cooperation in research planning and application between educational institutions and industry
- acknowledging the inseparability of agricultural education and extension as components of one activity
- involvement of industry in university decision making
- orientation of university staff to service clients in the form of industry, students and government.

## **Generalists versus Specialists**

The debate concerning the benefits of specialists rather than generalists continues, however from the literature review, stakeholder survey and workshop, a greater demand for general broad based skills was observed. Thus improving the adaptability of graduates to various situations. It emerged that the changes in agricultural and related sectors have brought about different requirements from graduates. Today's market is such that graduates are competing with people in fields from science to sociology, in which case, broad based skills transferable to multiple contexts would be most appropriate. Requirements for generalist versus specialist skills would be determined by closer client contact and recognising the need for courses which include an agricultural science base with an increased orientation towards management, in some cases, or science in others.

## **Vocational Education**

The role of vocational education and training was seen as developing skills as an adjunct to higher education through articulation (carrying forward credits to higher education) from TAFE or through continued learning. Links between stakeholders and markets highlight needs including skills and knowledge which can be provided by TAFE and higher education. TAFE and higher education need to be linked in order to provide improved articulation and continuing education. Historical separation in Australia contrasts with that in the United States where vocational education and training courses have been offered in universities at appropriate stages of historical development in agricultural industries and rural areas. Therefore integration of research, education and extension may be seen to introduce various types of education and training into institutions.

## **Students**

Attracting high achievers to agricultural and related courses appears constrained by students' knowledge of careers in agriculture. Students with a greater knowledge of agriculture and agricultural practices, that is, non-metropolitan students, are more likely to consider a career in agriculture, although both metropolitan and non-metropolitan students related the study of agriculture mainly to farming. The effectiveness or accuracy of TER as an indication of future achievement in agricultural fields is now being widely queried. It is recommended that

- further investigation be undertaken into the appropriateness of using TER as a measure of student ability and subsequent undergraduate and graduate academic performance, and subsequent employment performance

## **Image**

Agriculture, when mentioned to city dwellers is translated as farming and given their decreasing knowledge of rural areas is probably oriented to past practices in farming. Attracting greater numbers of high achievers to agriculture was related to improvement of the image of agriculture in the media and through other sources. There was seen to be a need to portray agriculture as a developing industry which plays a role in all aspects everyday life and offers exciting and rewarding careers.

The negative image of agriculture influences the number of students considering a career in agriculture. As schools, parents/relatives and the media were the most highly rated sources of knowledge of careers in agriculture, they form potential target areas for programs to increase the profile of agriculture. Increasing agricultural awareness in education at primary and secondary level may influence the perceptions of students towards agriculture in the long term.

It is concluded that

- the image of agriculture among students and the community be addressed through a unified program and student opinion makers

### **Lifelong Learning/ New Educational Technologies**

The demand for new technology in the delivery of education while advocated for continued learning, needs to be coupled with personal contact for effective learning in many cases. New educational technology was seen to increase both quality and access to agricultural and related education. Linkages between higher education and vocational education and training was seen as a way of creating a more integrated system appropriate to service a diverse sector. It was recommended that

- new educational technologies such as the Internet be used, to broaden access to education while retaining human interaction, through residential schools and formal classes
- incentives for increased farmer/producer participation in education while maintaining participation in training be introduced

From these studies, it may be concluded that providers of agricultural education need to engage in the major adjustment of their product. The curricula at present is not expected to be able to meet future needs from current approaches. The context of natural resource management in which agricultural production aspects are one part and linked to processing and marketing aspects would provide a basis for discussion with clients in the form of industry and other stakeholders to design specific undergraduate courses and research programs in areas related to both agricultural management and agricultural science. Strong linkages between public sector supporting institutions including universities and State Government agencies is necessary at a planning level to link research, education and extension for all aspects of food and fibre production, processing and marketing.

The attraction of higher achieving students in the future, as discerned from interviews of Year 10 students prior to their making active choices for tertiary study, suggests that addressing course content as described above may be of minimal benefit without improving the knowledge of future students about natural resource management, food and fibre production, processing and marketing. Ensuring a higher level of knowledge of potential students is strongly linked to the advice received from teachers, parents and the

media including the Internet. Current levels of advice appear to be linked to the low level of understanding of agriculture within urban centres, the source of most future students.

The project fulfilled its objectives of widening the debate by accessing global information, adding to the Australian knowledge base and integrating this knowledge for participation of concerned Australian specialists in the workshop. Continuing changes in agricultural education in Australia as part of natural resource management must be seen in a global context in order to remain current and to facilitate use and gain the benefits of interactive electronic technology in place of and as an adjunct to traditional teaching.

# **Appendix 1**

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# **QUESTIONNAIRE**

## **Round Three**

Please rank the points within each question from most important (no. 1) to least important (no. 3)

## QUESTION 1

**What should be three major components for mission statements for Universities and State Government agencies involved in providing research, education and/or extension activities for the next ten years?**

- To attract adequate investment to ensure that agricultural production in Australian continues to be globally competitive
- To ensure that the management of natural resources is productive as well as ecologically sustainable
- Providers of services to Australian agriculture need to be able to adjust to the needs of their clients

Should any of the points below be ranked in the top three?  
If so which point and what rank?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Yes/No

- Ensure persons engaged in the agricultural sector are able to adapt to changing technologies and the multi-disciplinary aspects of agriculture
- Excellence in research, development, extension and education services to agriculture
- Cost effective delivery of services
- Universities and state government agencies in research, education and extension need to be closer linked

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## QUESTION 2

**What will be the major challenges faced by agricultural units in universities in the next ten years?**

- To attract quality students and increase levels of enrolment in agricultural disciplines
- To deliver quality courses and foster development of leadership and management skills
- To adopt a closer, more integrated structure with other agricultural agencies to ensure networking and collaboration

Should any of the points below be ranked in the top three?  
If so which point and what rank?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Yes/No

- To keep pace with changing technology and information
- To focus on customer needs and to meet future market demands in terms of research
- To ensure that agricultural research by universities leads to beneficial outcomes for industry and is recognised as such

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### QUESTION 3

**What will be the major challenges faced by State Government Agencies concerned with agriculture and the environment in the next ten years?**

- To ensure agricultural practices and processes are environmentally friendly to allow for a sustainable future
- To have a greater involvement with industry in research and extension and more cooperative research ventures
- To be able to change their culture from a supply focus to one of a demand focus within a quality ethic. For example, the ability to be flexible and adapt to customer needs

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Should any of the points below be ranked in the top three?

Yes/No

If so which point and what rank?

- To merge research and extension into a single, seamless function
- Development of a flexible management structure that can cope with change
- To develop strategic alliances to provide agriculture related services in the face of pressure on resources

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### QUESTION 4

**What will be the major changes facing undergraduate and postgraduate programs relating to agriculture in the next ten years?**

- Assisting industry to meet the challenges posed by sustainable land and water use
- Increased flexibility to address industry needs and keep up with the rapidly expanding and changing information technology
- Attracting bright people by improving the image of agriculture and professionals in the industry will become essential

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Should any of the points below be ranked in the top three?

Yes/No

If so which point and what rank?

- Adapting programs to changing community and industry needs
- Specialising in particular skills such as management and marketing
- Declining funds and resources

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### QUESTION 5

**What are the major challenges which should be addressed in agricultural and related research programs in the next ten years?**

- Sustainability, environmental issues and long term resource stabilisation \_\_\_\_\_
- To provide producers with technology to enable them to be competitive \_\_\_\_\_
- To improve productivity, profitability and efficiency \_\_\_\_\_

Should any of the points below be ranked in the top three? Yes/No

If so which point and what rank?

- Participation with industry in Research and Development \_\_\_\_\_
- That all research of applied nature has clear, definable benefit \_\_\_\_\_
- To ensure that the research is directed to that which will prove the best outcomes for the customer \_\_\_\_\_

### QUESTION 6

**What are the major challenges which should be addressed in agricultural and related extension programs in the next ten years?**

- Developing a proper understanding of the innovation process in agribusiness \_\_\_\_\_
- Developing a learning ethos throughout the industry \_\_\_\_\_
- Be integrated with research at both ends and in consultation with industry \_\_\_\_\_

Should any of the points below be ranked in the top three? Yes/No

If so which point and what rank?

- Reorientation away from government technical push toward user pays for technical advice \_\_\_\_\_
- To integrate extension into the research and development section so that there is little distinction of extension \_\_\_\_\_
- Linking research results and “open learning” technology to self-help groups through such mechanisms as landcare groups \_\_\_\_\_

**Background Information: (Confidential)**

**Name** \_\_\_\_\_

**Address:** \_\_\_\_\_

\_\_\_\_\_

**Current Position:**\_\_\_\_\_

**Discipline (Please tick):**

Producer \_\_\_\_\_

Researcher: \_\_\_\_\_

Research Funder \_\_\_\_\_

Agricultural Educator \_\_\_\_\_

Educator \_\_\_\_\_

Other (Please Specify) \_\_\_\_\_

*Please return completed questionnaire to :*

***Dean 's Office  
Faculty of Agriculture, Forestry and Horticulture  
University of Melbourne  
Parkville 3025 Melbourne  
AUSTRALIA***

## Appendix 2

FACULTY OF AGRICULTURE, FORESTRY AND HORTICULTURE  
UNIVERSITY OF MELBOURNE

PARKVILLE 3052 MELBOURNE VICTORIA

Telephone: 03 9344 7171      Facsimile: 03 9348 2156

Contact Name: Bernadette Matthews

### STUDENT SURVEY

*Dear Year 10 student,*

*This survey is part of a larger project being completed at the University of Melbourne. We are interested in your views on environmental issues as well as your opinion of various careers in agriculture. There are no right or wrong answers nor are you under any obligation to complete this survey, however your response on these issues is considered to be very important. All responses will remain strictly confidential.*

*Thank you for your time and cooperation.*

**Gender** *(please tick one box only) :*

Female ☐ Male ☐

**1. Have you ever considered a career in agriculture?** *(please tick one box only) :*

Yes ☐ No ☐

**2. Does your knowledge of careers in agriculture come from .....?**  
*(please tick as many boxes as apply to you)*

Parents/Relatives ..... ☐  
Television/Radio/Newspapers ..... ☐  
School/Teachers ..... ☐  
Internet ..... ☐  
Friends ..... ☐

Other (please specify).....

**3. How important are each of these factors in your choice of career?**

*(please rate on a scale of one to five by circling one number for each factor)*

|                                                   | Not<br>Important |   |   | Extremely<br>Important |   |
|---------------------------------------------------|------------------|---|---|------------------------|---|
|                                                   | 1                | 2 | 3 | 4                      | 5 |
| Conservation/environmental concerns.....          |                  |   |   |                        |   |
| Family approval.....                              |                  |   |   |                        |   |
| Good Income.....                                  |                  |   |   |                        |   |
| Helping those in less developed countries.....    |                  |   |   |                        |   |
| Interesting work.....                             |                  |   |   |                        |   |
| Job prospects.....                                |                  |   |   |                        |   |
| Opportunities for advancement.....                |                  |   |   |                        |   |
| Prospective growth of industry.....               |                  |   |   |                        |   |
| Social responsibility (helping others).....       |                  |   |   |                        |   |
| Work location (eg. city vs country, climate)..... |                  |   |   |                        |   |
| Other (please specify).....                       |                  |   |   |                        |   |

**4. To what extent do you think each of these factors applies to a career in agriculture?**

*(please rate on a scale of one to five by circling one number for each factor)*

|                                                   | Does not<br>Apply |   |   | Definitely<br>Applies |   |
|---------------------------------------------------|-------------------|---|---|-----------------------|---|
|                                                   | 1                 | 2 | 3 | 4                     | 5 |
| Conservation/environmental concerns.....          |                   |   |   |                       |   |
| Family approval.....                              |                   |   |   |                       |   |
| Good Income.....                                  |                   |   |   |                       |   |
| Helping those in less developed countries.....    |                   |   |   |                       |   |
| Interesting work.....                             |                   |   |   |                       |   |
| Job prospects.....                                |                   |   |   |                       |   |
| Opportunities for advancement.....                |                   |   |   |                       |   |
| Prospective growth of industry.....               |                   |   |   |                       |   |
| Social responsibility (helping others).....       |                   |   |   |                       |   |
| Work location (eg. city vs country, climate)..... |                   |   |   |                       |   |
| Other (please specify).....                       |                   |   |   |                       |   |

**5. Below is a list of various careers:**

*(please tick as many boxes as appropriate for both sections)*

**(a) Which careers do you think are available to someone with a degree in Agricultural Science?**

**(b) Would you wish to pursue any of these careers? (Tick if yes)**

|                                    | (a)                      | (b)                      |
|------------------------------------|--------------------------|--------------------------|
| Botanist.....                      | <input type="checkbox"/> | <input type="checkbox"/> |
| Business Advisor.....              | <input type="checkbox"/> | <input type="checkbox"/> |
| Consultant.....                    | <input type="checkbox"/> | <input type="checkbox"/> |
| Economist.....                     | <input type="checkbox"/> | <input type="checkbox"/> |
| Engineer.....                      | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental Engineer.....        | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental Scientist.....       | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental Science Teacher..... | <input type="checkbox"/> | <input type="checkbox"/> |
| Farmer.....                        | <input type="checkbox"/> | <input type="checkbox"/> |
| Horticulturalist.....              | <input type="checkbox"/> | <input type="checkbox"/> |
| Land & Environment Manager.....    | <input type="checkbox"/> | <input type="checkbox"/> |
| Microbiologist.....                | <input type="checkbox"/> | <input type="checkbox"/> |
| National Park Ranger.....          | <input type="checkbox"/> | <input type="checkbox"/> |
| Property manager (eg. dairy).....  | <input type="checkbox"/> | <input type="checkbox"/> |
| Scientist.....                     | <input type="checkbox"/> | <input type="checkbox"/> |
| Soil Scientist.....                | <input type="checkbox"/> | <input type="checkbox"/> |
| Teacher.....                       | <input type="checkbox"/> | <input type="checkbox"/> |
| Other (please specify).....        | <input type="checkbox"/> | <input type="checkbox"/> |
| .....                              | <input type="checkbox"/> | <input type="checkbox"/> |

**6. Do you think that environmental issues are of major concern today?**

*(Please tick one)*

Yes ☐ No ☐ Unsure ☐

**7. (a) How important do you consider each of these environmental issues?**

*(Please rate on a scale of one to five by circling one number for each factor)*

|                                                                      | Not<br>Important |   |   |   | Extremely<br>Important |
|----------------------------------------------------------------------|------------------|---|---|---|------------------------|
| Air pollution .....                                                  | 1                | 2 | 3 | 4 | 5                      |
| Clearing of tropical rainforests .....                               | 1                | 2 | 3 | 4 | 5                      |
| Decrease in the number of species present<br>in the environment..... | 1                | 2 | 3 | 4 | 5                      |
| Reduction of ozone layer .....                                       | 1                | 2 | 3 | 4 | 5                      |
| Global food shortage .....                                           | 1                | 2 | 3 | 4 | 5                      |
| Global warming/ Climate change.....                                  | 1                | 2 | 3 | 4 | 5                      |
| Increase in soil salinity .....                                      | 1                | 2 | 3 | 4 | 5                      |
| Pollution of rivers and streams .....                                | 1                | 2 | 3 | 4 | 5                      |
| Soil erosion .....                                                   | 1                | 2 | 3 | 4 | 5                      |
| Other (please specify).....                                          | 1                | 2 | 3 | 4 | 5                      |

**7.(b)** *Some people say that agriculture has a positive impact on the environment while others say that it damages the environment.*

**How would you rate the effect that agriculture has in these areas?**

*(please on a scale of one to five by circling one number for each factor)*

|                                                                      | Negative<br>Effect |   |   |   | Positive<br>Effect |
|----------------------------------------------------------------------|--------------------|---|---|---|--------------------|
| Air pollution .....                                                  | 1                  | 2 | 3 | 4 | 5                  |
| Clearing of tropical rainforests .....                               | 1                  | 2 | 3 | 4 | 5                  |
| Decrease in the number of species present<br>in the environment..... | 1                  | 2 | 3 | 4 | 5                  |
| Reduction of ozone layer .....                                       | 1                  | 2 | 3 | 4 | 5                  |
| Global food shortage .....                                           | 1                  | 2 | 3 | 4 | 5                  |
| Global warming/ Climate change.....                                  | 1                  | 2 | 3 | 4 | 5                  |
| Increase in soil salinity .....                                      | 1                  | 2 | 3 | 4 | 5                  |
| Pollution of rivers and streams .....                                | 1                  | 2 | 3 | 4 | 5                  |
| Soil erosion .....                                                   | 1                  | 2 | 3 | 4 | 5                  |
| Other (please specify).....                                          | 1                  | 2 | 3 | 4 | 5                  |

*Thank you for your time*

# Appendix 3

## Survey 1:

**Table 1: Number and percentage of respondents ranking each statement first.**

| Question         | No. ranking 1 (x) | Percentage (x/y) |
|------------------|-------------------|------------------|
| <b>1a</b>        | 16                | 13.91            |
| <b>b</b>         | 47                | 40.87            |
| <b>c</b>         | 23                | 20               |
| <b>d</b>         | 13                | 11.3             |
| <b>e</b>         | 11                | 9.57             |
| <b>f</b>         | 1                 | 0.87             |
| <b>g</b>         | 4                 | 3.48             |
| <b>Total (y)</b> | <b>115</b>        | <b>100</b>       |
| <b>2a</b>        | 32                | 26.67            |
| <b>b</b>         | 41                | 34.17            |
| <b>c</b>         | 19                | 15.83            |
| <b>d</b>         | 3                 | 2.5              |
| <b>e</b>         | 15                | 12.5             |
| <b>f</b>         | 10                | 8.33             |
| <b>Total</b>     | <b>120</b>        | <b>100</b>       |
| <b>3a</b>        | 38                | 35.19            |
| <b>b</b>         | 26                | 24.07            |
| <b>c</b>         | 28                | 25.93            |
| <b>d</b>         | 10                | 9.26             |
| <b>e</b>         | 1                 | 0.92             |
| <b>f</b>         | 5                 | 4.63             |
| <b>Total</b>     | <b>108</b>        | <b>100</b>       |
| <b>4a</b>        | 33                | 30               |
| <b>b</b>         | 30                | 27.27            |
| <b>c</b>         | 25                | 22.73            |
| <b>d</b>         | 12                | 10.91            |
| <b>e</b>         | 3                 | 2.73             |
| <b>f</b>         | 7                 | 6.36             |
| <b>Total</b>     | <b>110</b>        | <b>100</b>       |
| <b>5a</b>        | 38                | 34.86            |
| <b>b</b>         | 21                | 19.27            |
| <b>c</b>         | 34                | 31.19            |
| <b>d</b>         | 9                 | 8.26             |
| <b>e</b>         | 2                 | 1.83             |
| <b>f</b>         | 5                 | 4.59             |
| <b>Total</b>     | <b>109</b>        | <b>100</b>       |
| <b>6a</b>        | 14                | 12.73            |
| <b>b</b>         | 44                | 40               |
| <b>c</b>         | 32                | 29.09            |
| <b>d</b>         | 2                 | 1.82             |
| <b>e</b>         | 6                 | 5.45             |
| <b>f</b>         | 12                | 10.91            |
| <b>Total</b>     | <b>110</b>        | <b>100</b>       |

**Table 2: Chi - Square Test between various employment groups in response to questions 1 - 6 of the questionnaire**  
**Level of significance = .05**

| Employment      | A  | B  | C  | p value |
|-----------------|----|----|----|---------|
| Question 1      |    |    |    |         |
| Educator        | 2  | 8  | 5  | 0.613   |
| Producer        | 10 | 17 | 11 |         |
| Researcher      | 2  | 12 | 4  |         |
| Research Funder | 2  | 10 | 3  |         |
| Question 2      |    |    |    |         |
| Educator        | 6  | 10 | 0  | 0.066   |
| Producer        | 11 | 17 | 12 |         |
| Researcher      | 11 | 5  | 4  |         |
| Research Funder | 4  | 9  | 3  |         |
| Question 3      |    |    |    |         |
| Educator        | 10 | 2  | 4  | 0.092   |
| Producer        | 11 | 17 | 13 |         |
| Researcher      | 9  | 3  | 8  |         |
| Research Funder | 8  | 4  | 3  |         |
| Question 4      |    |    |    |         |
| Educator        | 6  | 3  | 7  | 0.622   |
| Producer        | 16 | 15 | 8  |         |
| Researcher      | 5  | 7  | 6  |         |
| Research Funder | 6  | 5  | 4  |         |
| Question 5      |    |    |    |         |
| Educator        | 9  | 3  | 3  | 0.061   |
| Producer        | 12 | 10 | 20 |         |
| Researcher      | 13 | 3  | 4  |         |
| Research Funder | 4  | 5  | 7  |         |
| Question 6      |    |    |    |         |
| Educator        | 2  | 8  | 5  | 0.487   |
| Producer        | 3  | 20 | 16 |         |
| Researcher      | 6  | 8  | 7  |         |
| Research Funder | 3  | 8  | 4  |         |

## Survey 2:

**Table 3: Factors influencing students knowledge of careers in agriculture by region.**

| Option                      | Metro      | Metro (%) | Non-Metro  | Non-Metro (%) | Total      | Total (%) | p-value |
|-----------------------------|------------|-----------|------------|---------------|------------|-----------|---------|
| Parents/Relatives           | 140        | 43.21     | 146        | 64.6          | 286        | 52        | 0.007   |
| Television/Radio/Newspapers | 153        | 47.22     | 102        | 45.13         | 255        | 46.36     |         |
| School/Teachers             | 199        | 61.42     | 116        | 51.33         | 315        | 57.27     |         |
| Internet                    | 13         | 4.012     | 7          | 3.097         | 20         | 3.636     |         |
| Friends                     | 89         | 27.47     | 60         | 26.55         | 149        | 27.09     |         |
| <b>Total respondents</b>    | <b>324</b> |           | <b>226</b> |               | <b>550</b> |           |         |

**Table 4: Chi-Square analysis of factors considered important in choosing a career by Year 10 students of differing regions.**

| <b>Factor</b>                                        |                  | <b>Not important</b> | <b>Uncertain</b> | <b>Important</b> | <b>p-value</b> |
|------------------------------------------------------|------------------|----------------------|------------------|------------------|----------------|
| <b>Conservation/<br/>environmental concerns</b>      | <b>Metro</b>     | 113                  | 106              | 105              | 0.430          |
|                                                      | <b>Non-Metro</b> | 69                   | 85               | 72               |                |
| <b>Family Approval</b>                               | <b>Metro</b>     | 102                  | 113              | 109              | 0.910          |
|                                                      | <b>Non-Metro</b> | 75                   | 76               | 75               |                |
| <b>Good Income</b>                                   | <b>Metro</b>     | 16                   | 46               | 262              | 0.000          |
|                                                      | <b>Non-Metro</b> | 10                   | 83               | 163              |                |
| <b>Helping those in less<br/>developed countries</b> | <b>Metro</b>     | 125                  | 109              | 90               | 0.318          |
|                                                      | <b>Non-Metro</b> | 96                   | 80               | 50               |                |
| <b>Interesting work</b>                              | <b>Metro</b>     | 19                   | 44               | 261              | 0.433          |
|                                                      | <b>Non-Metro</b> | 8                    | 29               | 189              |                |
| <b>Job Prospects</b>                                 | <b>Metro</b>     | 23                   | 100              | 201              | 0.333          |
|                                                      | <b>Non-Metro</b> | 23                   | 61               | 142              |                |
| <b>Opportunities for<br/>Advancement</b>             | <b>Metro</b>     | 19                   | 76               | 229              | 0.151          |
|                                                      | <b>Non-Metro</b> | 18                   | 66               | 142              |                |
| <b>Prospective Growth of<br/>Industry</b>            | <b>Metro</b>     | 48                   | 112              | 164              | 0.914          |
|                                                      | <b>Non-Metro</b> | 32                   | 82               | 112              |                |
| <b>Social Responsibility</b>                         | <b>Metro</b>     | 64                   | 88               | 172              | 0.416          |
|                                                      | <b>Non-Metro</b> | 50                   | 69               | 107              |                |
| <b>Work Location</b>                                 | <b>Metro</b>     | 43                   | 62               | 219              | 0.307          |
|                                                      | <b>Non-Metro</b> | 31                   | 55               | 140              |                |

**Table 5: Level of importance of various factors for Year 10 students when choosing a career.**

| Factor                                       | Not Important |           |           |               |       |           |
|----------------------------------------------|---------------|-----------|-----------|---------------|-------|-----------|
|                                              | Metro         | Metro (%) | Non Metro | Non-Metro (%) | Total | Total (%) |
| Conservation/<br>environmental concerns      | 113           | 34.88     | 69        | 30.53         | 182   | 33.09     |
| Family approval                              | 102           | 31.48     | 75        | 33.19         | 177   | 32.18     |
| Good income                                  | 16            | 4.938     | 10        | 4.425         | 26    | 4.727     |
| Helping those in less<br>developed countries | 125           | 38.58     | 96        | 42.48         | 221   | 40.18     |
| Interesting work                             | 19            | 5.864     | 8         | 3.54          | 27    | 4.909     |
| Job prospects                                | 23            | 7.099     | 23        | 10.18         | 46    | 8.364     |
| Opportunities for<br>advancement             | 19            | 0.059     | 18        | 7.965         | 37    | 6.727     |
| Prospective growth of<br>industry            | 48            | 14.81     | 32        | 14.16         | 80    | 14.55     |
| Social responsibility                        | 64            | 19.75     | 50        | 22.12         | 114   | 20.73     |
| Work location                                | 43            | 13.27     | 31        | 13.72         | 74    | 13.45     |
|                                              | Uncertain     |           |           |               |       |           |
|                                              | Metro         | Metro (%) | Non Metro | Non-Metro (%) | Total | Total (%) |
| Conservation/<br>environmental concerns      | 106           | 32.72     | 85        | 37.61         | 191   | 34.73     |
| Family approval                              | 113           | 34.88     | 76        | 33.63         | 189   | 34.36     |
| Good income                                  | 46            | 14.2      | 83        | 36.73         | 129   | 23.45     |
| Helping those in less<br>developed countries | 109           | 33.64     | 80        | 35.4          | 189   | 34.36     |
| Interesting work                             | 44            | 13.58     | 29        | 12.83         | 73    | 13.27     |
| Job prospects                                | 100           | 30.86     | 61        | 26.99         | 161   | 29.27     |
| Opportunities for<br>advancement             | 76            | 23.46     | 66        | 29.2          | 142   | 25.82     |
| Prospective growth of<br>industry            | 112           | 34.57     | 82        | 36.28         | 194   | 35.27     |
| Social responsibility                        | 88            | 27.16     | 69        | 30.53         | 157   | 28.55     |
| Work location                                | 62            | 19.14     | 55        | 24.34         | 117   | 21.27     |
|                                              | Important     |           |           |               |       |           |
|                                              | Metro         | Metro (%) | Non-Metro | Non-Metro (%) | Total | Total (%) |
| Conservation/<br>environmental concerns      | 105           | 32.41     | 72        | 31.86         | 177   | 32.18     |
| Family approval                              | 109           | 33.64     | 75        | 33.19         | 184   | 33.45     |
| Good income                                  | 262           | 80.86     | 163       | 72.12         | 425   | 77.27     |
| Helping those in less<br>developed countries | 90            | 27.78     | 50        | 22.12         | 140   | 25.45     |
| Interesting work                             | 261           | 80.56     | 189       | 83.63         | 450   | 81.82     |
| Job prospects                                | 201           | 62.04     | 142       | 62.83         | 343   | 62.36     |
| Opportunities for<br>advancement             | 229           | 70.68     | 142       | 62.83         | 371   | 67.45     |
| Prospective growth of<br>industry            | 164           | 50.62     | 112       | 49.56         | 276   | 50.18     |
| Social responsibility                        | 172           | 53.09     | 107       | 47.35         | 279   | 50.73     |
| Work location                                | 219           | 67.59     | 140       | 61.95         | 359   | 65.27     |

**Table 6: The extent that certain factors are considered to apply to a career in agriculture, by Year 10 students of differing regions.**

| Factor                                       | Does Not  |           | Apply     |               | Total | Total (%) |
|----------------------------------------------|-----------|-----------|-----------|---------------|-------|-----------|
|                                              | Metro     | Metro (%) | Non-Metro | Non-Metro (%) |       |           |
| Conservation/<br>environmental concerns      | 34        | 10.49     | 18        | 7.965         | 52    | 9.455     |
| Family approval                              | 157       | 48.46     | 91        | 40.27         | 248   | 45.09     |
| Good income                                  | 69        | 21.3      | 35        | 15.49         | 104   | 18.91     |
| Helping those in less<br>developed countries | 105       | 32.41     | 71        | 31.42         | 176   | 32        |
| Interesting work                             | 35        | 10.8      | 16        | 7.08          | 51    | 9.273     |
| Job prospects                                | 59        | 18.21     | 23        | 10.18         | 82    | 14.91     |
| Opportunities for<br>advancement             | 46        | 0.142     | 30        | 13.27         | 76    | 13.82     |
| Prospective growth of<br>industry            | 47        | 14.51     | 23        | 10.18         | 70    | 12.73     |
| Social responsibility                        | 70        | 21.6      | 50        | 22.12         | 120   | 21.82     |
| Work location                                | 49        | 15.12     | 27        | 11.95         | 76    | 13.82     |
|                                              | Uncertain |           |           |               | Total | Total (%) |
|                                              | Metro     | Metro (%) | Non-Metro | Non-Metro (%) |       |           |
| Conservation/<br>environmental concerns      | 56        | 17.28     | 53        | 23.45         | 109   | 19.82     |
| Family approval                              | 91        | 28.09     | 64        | 28.32         | 155   | 28.18     |
| Good income                                  | 107       | 33.02     | 78        | 34.51         | 185   | 33.64     |
| Helping those in less<br>developed countries | 87        | 26.85     | 62        | 27.43         | 149   | 27.09     |
| Interesting work                             | 77        | 23.77     | 55        | 24.34         | 132   | 24        |
| Job prospects                                | 116       | 35.8      | 80        | 35.4          | 196   | 35.64     |
| Opportunities for<br>advancement             | 95        | 29.32     | 68        | 30.09         | 163   | 29.64     |
| Prospective growth of<br>industry            | 96        | 29.63     | 71        | 31.42         | 167   | 30.36     |
| Social responsibility                        | 100       | 30.86     | 88        | 38.94         | 188   | 34.18     |
| Work location                                | 63        | 19.44     | 54        | 23.89         | 117   | 21.27     |
|                                              | Applies   |           |           |               | Total | Total (%) |
|                                              | Metro     | Metro (%) | Non-Metro | Non-Metro (%) |       |           |
| Conservation/<br>environmental concerns      | 234       | 72.22     | 155       | 68.58         | 389   | 70.73     |
| Family approval                              | 76        | 23.46     | 71        | 31.42         | 147   | 26.73     |
| Good income                                  | 148       | 45.68     | 113       | 50            | 261   | 47.45     |
| Helping those in less<br>developed countries | 132       | 40.74     | 93        | 41.15         | 225   | 40.91     |
| Interesting work                             | 212       | 65.43     | 155       | 68.58         | 367   | 66.73     |
| Job prospects                                | 149       | 45.99     | 123       | 54.42         | 272   | 49.45     |
| Opportunities for<br>advancement             | 183       | 56.48     | 128       | 56.64         | 311   | 56.55     |
| Prospective growth of<br>industry            | 181       | 55.86     | 132       | 58.41         | 313   | 56.91     |
| Social responsibility                        | 154       | 47.53     | 88        | 38.94         | 242   | 44        |
| Work location                                | 212       | 65.43     | 145       | 64.16         | 357   | 64.91     |

**Table 7: Chi-Square analysis of the extent that certain factors are considered to apply to a career in agriculture, by Year 10 students of differing regions.**

| Factor                                       |           | Not important | Uncertain | Important | p-value |
|----------------------------------------------|-----------|---------------|-----------|-----------|---------|
| Conservation/<br>environmental concerns      | Metro     | 34            | 56        | 234       | 0.157   |
|                                              | Non-Metro | 18            | 53        | 155       |         |
| Family Approval                              | Metro     | 157           | 91        | 76        | 0.077   |
|                                              | Non-Metro | 91            | 64        | 71        |         |
| Good Income                                  | Metro     | 69            | 107       | 148       | 0.225   |
|                                              | Non-Metro | 35            | 78        | 113       |         |
| Helping those in less<br>developed countries | Metro     | 105           | 87        | 132       | 0.969   |
|                                              | Non-Metro | 71            | 62        | 93        |         |
| Interesting work                             | Metro     | 35            | 77        | 212       | 0.332   |
|                                              | Non-Metro | 16            | 55        | 155       |         |
| Job Prospects                                | Metro     | 59            | 116       | 149       | 0.022   |
|                                              | Non-Metro | 23            | 80        | 123       |         |
| Opportunities for<br>Advancement             | Metro     | 46            | 116       | 183       | 0.965   |
|                                              | Non-Metro | 30            | 80        | 128       |         |
| Prospective Growth of<br>Industry            | Metro     | 47            | 96        | 181       | 0.325   |
|                                              | Non-Metro | 23            | 71        | 132       |         |
| Social Responsibility                        | Metro     | 70            | 100       | 154       | 0.092   |
|                                              | Non-Metro | 50            | 88        | 88        |         |
| Work Location                                | Metro     | 49            | 63        | 212       | 0.326   |
|                                              | Non-Metro | 27            | 54        | 145       |         |

**Table 8: Careers respondents considered available to someone with a degree in Agricultural Science by region (includes percentages and chi-square results).**

|                               | Metro | Metro(%) | Non-Metro | Non-Metro (%) | Total | Total(%) | p-value      |
|-------------------------------|-------|----------|-----------|---------------|-------|----------|--------------|
| Botanist                      | 262   | 80.86    | 168       | 74.34         | 430   | 78.18    | <b>0.001</b> |
| Business Advisor              | 49    | 15.12    | 45        | 19.91         | 94    | 17.09    |              |
| Consultant                    | 57    | 17.59    | 43        | 19.03         | 100   | 18.18    |              |
| Economist                     | 124   | 38.27    | 83        | 36.73         | 207   | 37.64    |              |
| Engineer                      | 69    | 21.3     | 57        | 25.22         | 126   | 22.91    |              |
| Environmental Engineer        | 247   | 76.23    | 163       | 72.12         | 410   | 74.55    |              |
| Environmental Scientist       | 283   | 87.35    | 202       | 89.38         | 485   | 88.18    |              |
| Environmental Science Teacher | 277   | 85.49    | 190       | 84.07         | 467   | 84.91    |              |
| Farmer                        | 283   | 87.35    | 200       | 88.5          | 483   | 87.82    |              |
| Horticulturalist              | 241   | 74.38    | 188       | 83.19         | 429   | 78       |              |
| Land & Environment Manager    | 292   | 90.12    | 202       | 89.38         | 494   | 89.82    |              |
| Microbiologist                | 147   | 45.37    | 112       | 49.56         | 259   | 47.09    |              |
| National Park Ranger          | 269   | 83.02    | 185       | 81.86         | 454   | 82.55    |              |
| Property Manager              | 181   | 55.86    | 158       | 69.91         | 339   | 61.64    |              |
| Scientist                     | 176   | 54.32    | 135       | 59.73         | 311   | 56.55    |              |
| Soil Scientist                | 279   | 86.11    | 188       | 83.19         | 467   | 84.91    |              |
| Teacher                       | 141   | 43.52    | 91        | 40.27         | 232   | 42.18    |              |

**Table 9: Careers respondents wished to pursue, by region (includes percentages and chi-square results).**

|                                       | Metro | Metro(%) | Non-Metro | Non-Metro (%) | Total | Total(%) | p-value      |
|---------------------------------------|-------|----------|-----------|---------------|-------|----------|--------------|
| <b>Botanist</b>                       | 25    | 7.716    | 23        | 10.18         | 48    | 8.727    | <b>0.074</b> |
| <b>Business Advisor</b>               | 62    | 19.14    | 42        | 18.58         | 104   | 18.91    |              |
| <b>Consultant</b>                     | 46    | 14.2     | 32        | 14.16         | 78    | 14.18    |              |
| <b>Economist</b>                      | 31    | 9.568    | 34        | 15.04         | 65    | 11.82    |              |
| <b>Engineer</b>                       | 85    | 26.23    | 58        | 25.66         | 143   | 26       |              |
| <b>Environmental Engineer</b>         | 36    | 11.11    | 31        | 13.72         | 67    | 12.18    |              |
| <b>Environmental Scientist</b>        | 47    | 14.51    | 28        | 12.39         | 75    | 13.64    |              |
| <b>Environmental Science Teacher</b>  | 26    | 8.025    | 14        | 6.195         | 40    | 7.273    |              |
| <b>Farmer</b>                         | 53    | 16.36    | 65        | 28.76         | 118   | 21.45    |              |
| <b>Horticulturalist</b>               | 34    | 10.49    | 35        | 15.49         | 69    | 12.55    |              |
| <b>Land &amp; Environment Manager</b> | 35    | 10.8     | 36        | 15.93         | 71    | 12.91    |              |
| <b>Microbiologist</b>                 | 44    | 13.58    | 23        | 10.18         | 67    | 12.18    |              |
| <b>National Park Ranger</b>           | 77    | 23.77    | 73        | 32.3          | 150   | 27.27    |              |
| <b>Property Manager</b>               | 33    | 10.19    | 40        | 17.7          | 73    | 13.27    |              |
| <b>Scientist</b>                      | 55    | 16.98    | 33        | 14.6          | 88    | 16       |              |
| <b>Soil Scientist</b>                 | 15    | 4.63     | 20        | 8.85          | 35    | 6.364    |              |
| <b>Teacher</b>                        | 53    | 16.36    | 43        | 19.03         | 96    | 17.45    |              |

**Table 10: Rating of respondents on the level of importance of various environmental issues, by region.**

| Environmental issues                                         | Not Important |            |            |                | Total | Total % |
|--------------------------------------------------------------|---------------|------------|------------|----------------|-------|---------|
|                                                              | Metro.        | Metro. (%) | Non-Metro. | Non-Metro. (%) |       |         |
| Air pollution                                                | 10            | 3.086      | 18         | 7.965          | 28    | 5.091   |
| Clearing of tropical rainforests                             | 21            | 6.481      | 29         | 12.83          | 50    | 9.091   |
| Decrease in the number of species present in the environment | 20            | 6.173      | 25         | 11.06          | 45    | 8.182   |
| Reduction of ozone layer                                     | 11            | 3.395      | 17         | 7.522          | 28    | 5.091   |
| Global food shortage                                         | 29            | 8.951      | 20         | 8.85           | 49    | 8.909   |
| Global warming/ Climate change                               | 28            | 8.642      | 25         | 11.06          | 53    | 9.636   |
| Increase in soil salinity                                    | 55            | 16.98      | 33         | 14.6           | 88    | 16      |
| Pollution of rivers and streams                              | 11            | 3.395      | 7          | 3.097          | 18    | 3.273   |
| Soil erosion                                                 | 43            | 13.27      | 28         | 12.39          | 71    | 12.91   |
| Environmental issues                                         | Uncertain     |            |            |                | Total | Total % |
|                                                              | Metro.        | Metro. (%) | Non-Metro. | Non-Metro. (%) |       |         |
| Air pollution                                                | 36            | 11.11      | 36         | 15.93          | 72    | 13.09   |
| Clearing of tropical rainforests                             | 42            | 12.96      | 36         | 15.93          | 78    | 14.18   |
| Decrease in the number of species present in the environment | 48            | 14.81      | 55         | 24.34          | 103   | 18.73   |
| Reduction of ozone layer                                     | 34            | 10.49      | 39         | 17.26          | 73    | 13.27   |
| Global food shortage                                         | 56            | 17.28      | 67         | 29.65          | 123   | 22.36   |
| Global warming/ Climate change                               | 61            | 18.83      | 70         | 30.97          | 131   | 23.82   |
| Increase in soil salinity                                    | 101           | 31.17      | 70         | 30.97          | 171   | 31.09   |
| Pollution of rivers and streams                              | 34            | 10.49      | 31         | 13.72          | 65    | 11.82   |
| Soil erosion                                                 | 80            | 24.69      | 67         | 29.65          | 147   | 26.73   |
| Environmental issues                                         | Important     |            |            |                | Total | Total % |
|                                                              | Metro.        | Metro. (%) | Non-Metro. | Non-Metro. (%) |       |         |
| Air pollution                                                | 278           | 85.8       | 172        | 76.11          | 450   | 81.82   |
| Clearing of tropical rainforests                             | 261           | 80.56      | 161        | 71.24          | 422   | 76.73   |
| Decrease in the number of species present in the environment | 256           | 79.01      | 146        | 64.6           | 402   | 73.09   |
| Reduction of ozone layer                                     | 279           | 86.11      | 170        | 75.22          | 449   | 81.64   |
| Global food shortage                                         | 239           | 73.77      | 139        | 61.5           | 378   | 68.73   |
| Global warming/ Climate change                               | 235           | 72.53      | 131        | 57.96          | 366   | 66.55   |
| Increase in soil salinity                                    | 168           | 51.85      | 123        | 54.42          | 291   | 52.91   |
| Pollution of rivers and streams                              | 279           | 86.11      | 188        | 83.19          | 467   | 84.91   |
| Soil erosion                                                 | 201           | 62.04      | 131        | 57.96          | 332   | 60.36   |

**Table 11: Chi-Square analysis of the considered level of importance of certain environmental issues, by Year 10 students of differing regions.**

| <b>Factor</b>                                                       |                  | <b>Not important</b> | <b>Uncertain</b> | <b>Important</b> | <b>p-value</b> |
|---------------------------------------------------------------------|------------------|----------------------|------------------|------------------|----------------|
| <b>Air pollution</b>                                                | <b>Metro</b>     | 10                   | 36               | 278              | <b>0.007</b>   |
|                                                                     | <b>Non-Metro</b> | 18                   | 36               | 172              |                |
| <b>Clearing of tropical rainforests</b>                             | <b>Metro</b>     | 21                   | 42               | 261              | <b>0.017</b>   |
|                                                                     | <b>Non-Metro</b> | 29                   | 36               | 161              |                |
| <b>Decrease in the number of species present in the environment</b> | <b>Metro</b>     | 20                   | 48               | 256              | <b>0.001</b>   |
|                                                                     | <b>Non-Metro</b> | 25                   | 55               | 146              |                |
| <b>Reduction of ozone layer</b>                                     | <b>Metro</b>     | 11                   | 34               | 279              | <b>0.004</b>   |
|                                                                     | <b>Non-Metro</b> | 17                   | 39               | 170              |                |
| <b>Global food shortage</b>                                         | <b>Metro</b>     | 29                   | 56               | 239              | <b>0.003</b>   |
|                                                                     | <b>Non-Metro</b> | 20                   | 67               | 139              |                |
| <b>Global warming/ Climate change</b>                               | <b>Metro</b>     | 28                   | 61               | 235              | <b>0.001</b>   |
|                                                                     | <b>Non-Metro</b> | 25                   | 70               | 131              |                |
| <b>Increase in soil salinity</b>                                    | <b>Metro</b>     | 55                   | 101              | 168              | <b>0.727</b>   |
|                                                                     | <b>Non-Metro</b> | 33                   | 70               | 123              |                |
| <b>Pollution of rivers and streams</b>                              | <b>Metro</b>     | 11                   | 34               | 279              | <b>0.512</b>   |
|                                                                     | <b>Non-Metro</b> | 7                    | 31               | 188              |                |
| <b>Soil erosion</b>                                                 | <b>Metro</b>     | 43                   | 101              | 201              | <b>0.995</b>   |
|                                                                     | <b>Non-Metro</b> | 28                   | 67               | 131              |                |

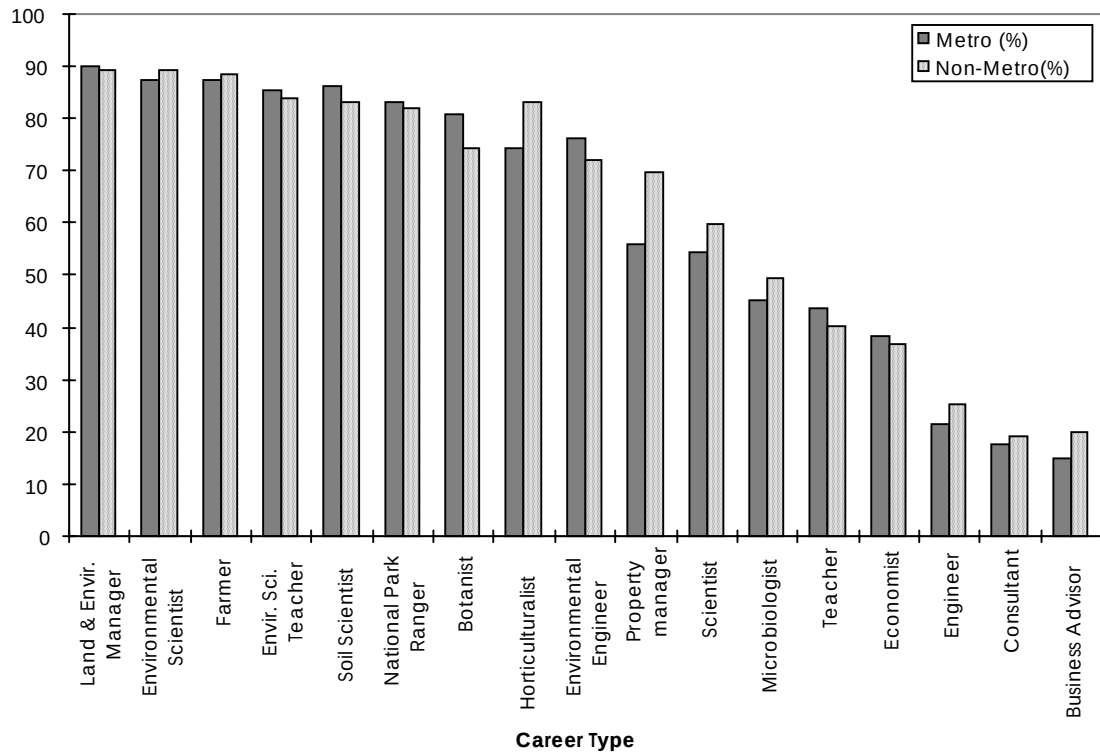
**Table 12: Rating of respondents on the effect of agriculture on various areas of the environment, by region.**

| Environmental issues                                         | Negative Effect |            |            |                |       |         |
|--------------------------------------------------------------|-----------------|------------|------------|----------------|-------|---------|
|                                                              | Metro.          | Metro. (%) | Non-Metro. | Non-Metro. (%) | Total | Total % |
| Air pollution                                                | 97              | 29.94      | 66         | 29.2           | 163   | 29.64   |
| Clearing of tropical rainforests                             | 100             | 30.86      | 94         | 41.59          | 194   | 35.27   |
| Decrease in the number of species present in the environment | 92              | 28.4       | 80         | 35.4           | 172   | 31.27   |
| Reduction of ozone layer                                     | 92              | 28.4       | 62         | 27.43          | 154   | 28      |
| Global food shortage                                         | 85              | 26.23      | 51         | 22.57          | 136   | 24.73   |
| Global warming/ Climate change                               | 98              | 30.25      | 59         | 26.11          | 157   | 28.55   |
| Increase in soil salinity                                    | 83              | 25.62      | 66         | 29.2           | 149   | 27.09   |
| Pollution of rivers and streams                              | 89              | 27.47      | 63         | 27.88          | 152   | 27.64   |
| Soil erosion                                                 | 99              | 30.56      | 79         | 34.96          | 178   | 32.36   |
|                                                              | No Effect       |            |            |                |       |         |
|                                                              | Metro.          | Metro. (%) | Non-Metro. | Non-Metro. (%) | Total | Total % |
| Air pollution                                                | 108             | 33.33      | 83         | 36.73          | 191   | 34.73   |
| Clearing of tropical rainforests                             | 81              | 25         | 68         | 30.09          | 149   | 27.09   |
| Decrease in the number of species present in the environment | 98              | 30.25      | 82         | 36.28          | 180   | 32.73   |
| Reduction of ozone layer                                     | 109             | 33.64      | 87         | 38.5           | 196   | 35.64   |
| Global food shortage                                         | 91              | 28.09      | 82         | 36.28          | 173   | 31.45   |
| Global warming/ Climate change                               | 116             | 35.8       | 102        | 45.13          | 218   | 39.64   |
| Increase in soil salinity                                    | 101             | 31.17      | 76         | 33.63          | 177   | 32.18   |
| Pollution of rivers and streams                              | 93              | 28.7       | 67         | 29.65          | 160   | 29.09   |
| Soil erosion                                                 | 86              | 26.54      | 67         | 29.65          | 153   | 27.82   |
|                                                              | Positive Effect |            |            |                |       |         |
|                                                              | Metro.          | Metro. (%) | Non-Metro. | Non-Metro. (%) | Total | Total % |
| Air pollution                                                | 119             | 36.73      | 77         | 34.07          | 196   | 35.64   |
| Clearing of tropical rainforests                             | 143             | 44.14      | 64         | 28.32          | 207   | 37.64   |
| Decrease in the number of species present in the environment | 134             | 41.36      | 64         | 28.32          | 198   | 36      |
| Reduction of ozone layer                                     | 123             | 37.96      | 77         | 34.07          | 200   | 36.36   |
| Global food shortage                                         | 148             | 45.68      | 93         | 41.15          | 241   | 43.82   |
| Global warming/ Climate change                               | 110             | 33.95      | 65         | 28.76          | 175   | 31.82   |
| Increase in soil salinity                                    | 140             | 43.21      | 84         | 37.17          | 224   | 40.73   |
| Pollution of rivers and streams                              | 142             | 43.83      | 96         | 42.48          | 238   | 43.27   |
| Soil erosion                                                 | 139             | 42.9       | 80         | 35.4           | 219   | 39.82   |

**Table 13: Chi-Square analysis of the perceived effect of agriculture on the environment, by Year 10 students of differing regions.**

| Factor                                                       |           | Not important | Uncertain | Important | p-value      |
|--------------------------------------------------------------|-----------|---------------|-----------|-----------|--------------|
| Air pollution                                                | Metro     | 97            | 108       | 119       |              |
|                                                              | Non-Metro | 66            | 83        | 77        |              |
| Clearing of tropical rainforests                             | Metro     | 100           | 81        | 143       | <b>0.001</b> |
|                                                              | Non-Metro | 94            | 68        | 64        |              |
| Decrease in the number of species present in the environment | Metro     | 92            | 98        | 134       | <b>0.007</b> |
|                                                              | Non-Metro | 80            | 82        | 64        |              |
| Reduction of ozone layer                                     | Metro     | 92            | 109       | 123       | <b>0.478</b> |
|                                                              | Non-Metro | 62            | 87        | 77        |              |
| Global food shortage                                         | Metro     | 85            | 92        | 148       | <b>0.138</b> |
|                                                              | Non-Metro | 51            | 82        | 93        |              |
| Global warming/ Climate change                               | Metro     | 98            | 116       | 110       | <b>0.089</b> |
|                                                              | Non-Metro | 59            | 102       | 65        |              |
| Increase in soil salinity                                    | Metro     | 83            | 101       | 140       | <b>0.355</b> |
|                                                              | Non-Metro | 66            | 76        | 84        |              |
| Pollution of rivers and streams                              | Metro     | 89            | 93        | 142       | <b>0.949</b> |
|                                                              | Non-Metro | 63            | 67        | 96        |              |
| Soil erosion                                                 | Metro     | 99            | 86        | 139       | <b>0.209</b> |
|                                                              | Non-Metro | 79            | 67        | 80        |              |

**Figure 1: Careers Year 10 students thought available to someone with a degree in Agricultural Science, by region**



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