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Sheep and wool science education in Australian universities

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Sheep and Wool Science Education at Australian Universities

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Summary

This paper gives an overview of the education environment in Australia and, in particular, sheep and wool science education. Developments occurring in the Sheep Industry Cooperative Research Centre (CRC) are described, including the planned national delivery by distance education of sheep and wool degree units to students at Australian and overseas Universities. A new Bachelor of Livestock Science degree has been developed at the University of New England (UNE) to enable students to specialise in animal breeding, health and nutrition and sheep and wool science. This degree will serve the role formerly played by the Wool and Pastoral Science degree at the University of NSW.

Keywords: tertiary education, animal breeding, animal health, nutrition, sheep and wool, University.

The Education Environment

The sheep and wool education market can be divided into six segments that form two tiers.

TIER 1 (Education participants)

- Primary school students
- Secondary school students
- Participants in tertiary and further education

TIER 2 (Broader community)

- Educators (teachers, librarians, lecturers, curriculum advisers and writers).
- Community (consumers, parents, lobby groups and the media).
- Industry (woolgrowers, industry groups, processing and manufacturing sectors).

There are about 18,000 schools in Australia (Table 1) to service primary and secondary school students.



Table 1 Private and public Australian school numbers
Source: Curriculum Corporation (2002)

Category	ACT	NSW	NT	QLD	SA	Tas	Vic	WA	TOTAL
Kindergarten	174	2700	59	1858	595	124	1784	649	7943
Primary	100	2217	80	1279	572	189	1742	737	6916
Secondary	37	636	18	303	133	56	470	185	1838
K – 12	10	224	98	137	107	45	170	158	949
Special	9	112	5	50	27	14	91	14	322
TAFE's and Uni's	8	184	12	124	56	11	118	70	583
TOTAL	338	6073	272	3751	1490	439	4375	1813	18,551

Higher Education in Australia

Post-secondary education in Australia is divided into:

- *Higher education* with 45 major institutions and 85 other institutions, with about 750,000 students, of which 75% are doing undergraduate courses and 21% postgraduate. Universities have a high degree of autonomy and are self-accrediting.
- *Vocational education and training (VET)* with 3,000 institutions (1000 state Technical and Further Education Colleges), 1.5 million students (75% at TAFE), 60% state-funded, 25% federally-funded.

Establishment of Universities

The earliest major Universities established were Sydney (1850), Melbourne (1853), Adelaide (1874), Tasmania (1890), Queensland (1909) and Western Australia (1912). They were established by Acts of the state parliaments and had little popular demand. Their establishment was seen to meet a need for professional education, (esp. medicine and law), future leadership and as a civilizing influence. The early models were the UK Universities, esp. Edinburgh and London and later models were the US “land grant” colleges established under the 1862 Morrill Act. The early Universities had low enrolments, e.g. 3,300 in 1914 (0.1% of the population), 14,000 in 1939 (0.2%) and received some state funding. Most students paid fees and some endowments were given. The first agricultural college was Roseworthy (1883), followed by Dookie (1886) and Loongerenong (1889) in Victoria. Hawkesbury (1891), Gatton (1897) and Muresk (1926) Colleges followed. University schools of agriculture were established after Federation at Adelaide (1905), Melbourne (1905), Sydney (1910), Western Australia (1914) and Queensland (1927).



Post-World War II

After the war a large surge in enrolments occurred (32,000 by 1948) as the Commonwealth paid for places for ex-servicemen. In 1951 the Commonwealth began to make small direct grants to Universities and provided a system of competitive “Commonwealth Scholarships” covering fees and (means-tested) living expenses. Four more Universities established: ANU (1946), UNSW (1949), New England (1953) and Monash (1958), with agricultural schools established at NSW (1949), New England (1954), Tasmania (1962) and La Trobe (1967).

By 1960 student numbers had reached 53,000. A large parallel growth in other state-funded, post-secondary institutions, such as technical and agricultural colleges, teacher training colleges and institutes of technology occurred. New agricultural colleges were formed at Marcus Oldham (1961), Glenormiston (1971), Wagga Wagga (1949), Murrumbidgee (1963), Orange (1963), Toccal (1965), Longreach (1967), Emerald (1976), Dalby (1978) and the Australian College of Tropical Agriculture (1976).

Funding of Higher Education

In 1988 the binary system was abolished in favour of a “national unified system”. There were funding inducements to Universities and CAEs to convert to the system and for mergers leading to fewer, larger, more efficient institutions (funded places, capital works, etc.).

Commonwealth government funding has fallen from 90% of University revenue in 1981 to 50% of revenue in 2000. Commonwealth government funding as a percentage of total funding of Universities has been decreasing by 2% p.a. over the last 20 years (Fig. 1) so that a decreasing percentage of GDP has been invested in higher education (Fig. 2).

Recent Changes to the University Environment

A summary of recent changes in higher education funding is:

- Universities can charge up to 25% more for government-supported courses (and most are)
- Price caps kept on ‘shortage’ courses of teaching and nursing
- Typical debt: arts degree - \$14,000; law - \$40,000; medicine - \$50,000
- Students must complete course in 7 years or face financial penalties
- Graduates can earn \$36,184 pa before re-paying HECS debt
- Universities receive \$404 million more in base funding over 4 years
- Regional universities receive \$122 million over 5 years
- Total package: \$2.4 billion over 5 years, with majority flowing in later years
- \$52 million fund available for universities willing to implement the government’s IR policies

- More than 9000 new fully funded places over 5 years (out of 625,000 places)
- 17,600 scholarships by 2007 for poorer and regional students
- Scholarships not affected by social security test
- New loan scheme for full-fee-paying students, but with a 'steep' service fee
- Full-fee-paying places (entry at a lower UAI, e.g. -5) capped at 35% of any course
- New loan scheme for studying for a year at overseas universities
- Changes to the governing bodies of universities

Fig. 1 Source of University funding 1939-2000

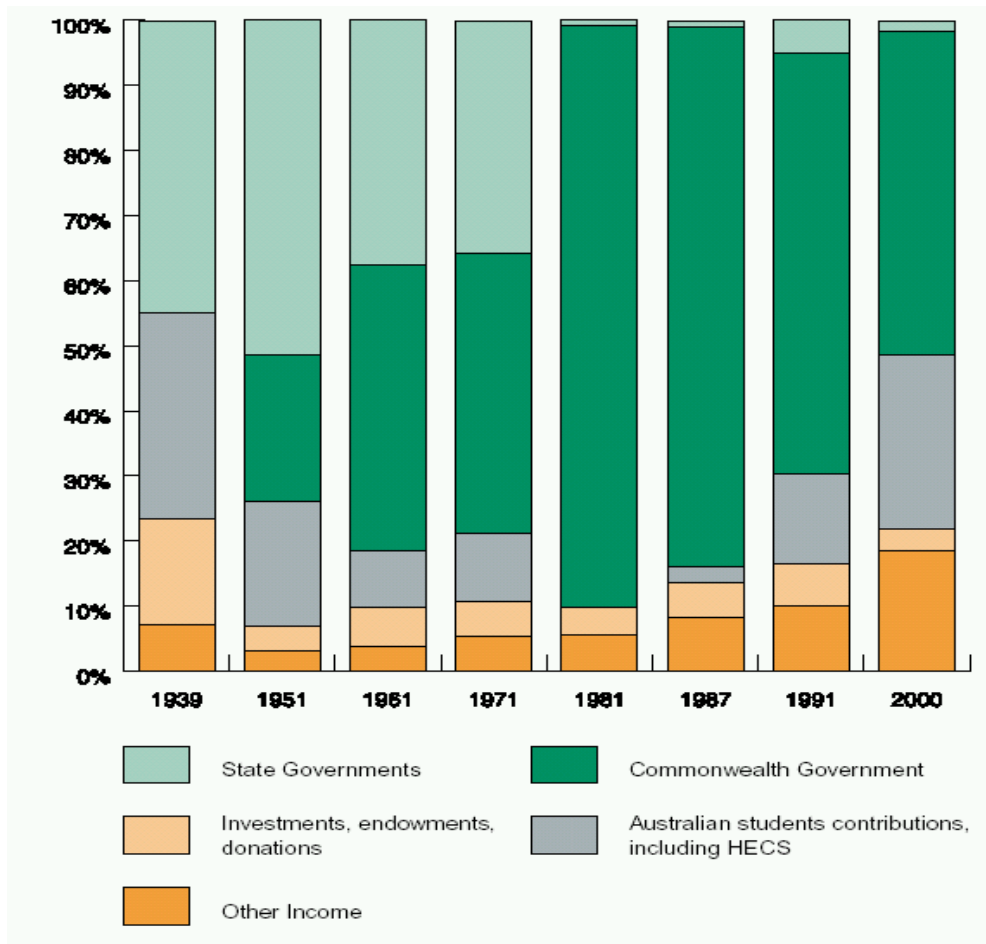
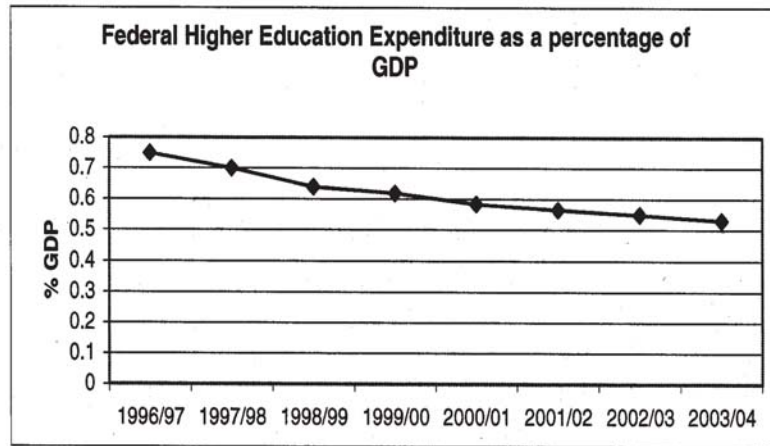


Fig. 2 Public investment in education as a percentage of GDP is falling.
 Source: FASTS (2003)



The view of the Commonwealth Government of the national need for agricultural courses will be critical to the future of sheep and wool education. Given the financial pressures most Universities face from declining relative funding from government there will be pressure to increase HECS fees (Table 2) for all students, including agricultural science and engineering students.

Table 2 Student Contribution (HECS) Levels

2003 arrangements		New arrangements from 2005	
	2003 levels	Projected 2005 levels	New student contribution range ^(a)
Band 3 (law, dentistry, medicine, veterinary science)	\$6,136	\$6,427	Band 3 (law, dentistry, medicine, veterinary science) \$0 – \$8,355
Band 2 (accounting, commerce, administration, economics, maths, statistics, computing, science, surveying, agriculture)	\$5,242	\$5,490	Band 2 (accounting, commerce, administration, economics, maths, statistics, computing, built environment, health, engineering, science, surveying, agriculture) \$0 – \$7,137
Band 1 (humanities, arts, behavioural science, social studies, foreign languages, visual and performing arts, education, nursing)	\$3,680	\$3,854	Band 1 (humanities, arts, behavioural social science, social studies, foreign languages, visual and performing arts) \$0 – \$5,010
			National Priorities (education, nursing) \$0 – \$3,854

(a) Maximum student contributions set at 25% higher than estimated HECS contribution rates for 2005, Universities set student contribution levels. *Wool Technology and Sheep Breeding, Vol. 51 2004*



The Commonwealth Government Higher Education reforms may provide an incentive to increase the relative numbers of agricultural students at Universities in cases where the marginal cost of additional students is lower than the government contribution per agricultural student. The government contribution towards agricultural students is higher than for many other disciplines. In practice, allocation of University places to fields of study is almost totally student demand driven (although in some cases, e.g. medicine, numbers are constrained), where the student demand may not always reflect industry reality, e.g. law graduates. If an industry has an unmet demand for graduates it needs to pro-actively generate student interest in careers in the industry via appropriate funding, e.g. scholarships.

Student trends

Due to Australia's population ageing due to sustained low fertility and increased life expectancy, particularly for females (Figures 3-5), the percentage of students studying agricultural subjects at University who are female, mature age and study by distance education can be expected to increase (Table 3-4). This trend is reflected at UNE where the largest group of UNE students are mature age females studying externally (Table 5-6).

Fig. 3 Median Age of Population (Source: ABS 2002)

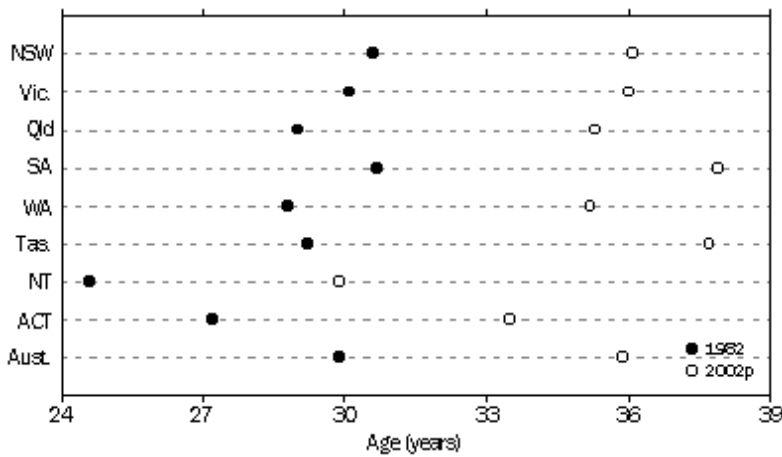




Fig. 4 Population Change, Age group-1982 to 2002 (Source: ABS 2002)

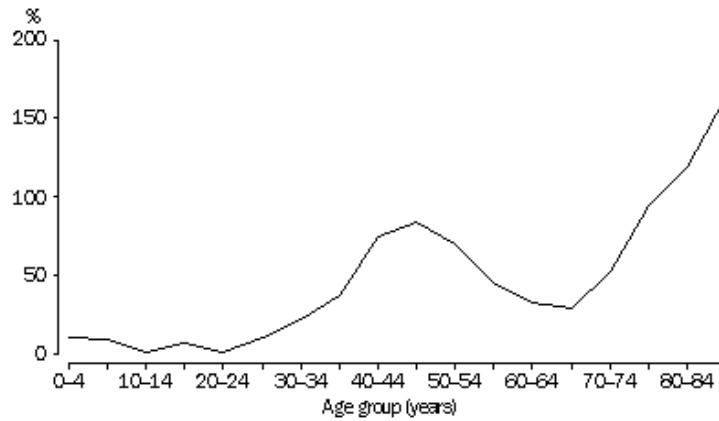


Fig. 5 Population by age and sex, 1982-2002 (Source: ABS 2002)

POPULATION, Age and Sex—1982 and 2002p

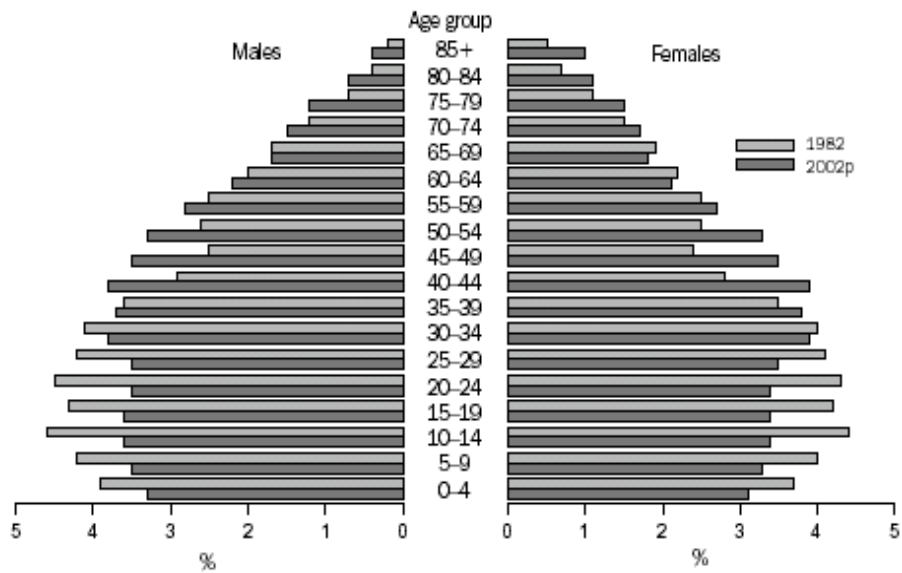


Table 3 Higher Education Students, By Type of Enrolment – 1990 and 2000
Source: DETYA (2002).

	1990			2000		
	Males	Females	Persons	Males	Females	Persons
Percent						
Internal						
- Full-time	61.1	62.3	61.7	58.1	59.1	58.6
- Part-time	28.5	26.4	27.4	28.7	26.8	27.6
External						
	10.4	11.3	10.9	13.1	14.2	13.7
Number '000						
Total	229.4	255.7	485.1	311.3	384.1	695.5

Table 4 Higher Education Students, By Age Group – 1990 to 2000
Source: DETYA (2002).

Age group	1990 '000	1996 '000	1997 '000	1998 '000	1999 '000	2000 '000
<i>19 and under</i>						
Males	71.3	73.2	76.0	76.6	77.8	78.9
Females	90.6	98.6	102.4	104.8	107.7	110.4
Persons	161.8	171.8	178.4	181.4	185.5	189.3
<i>20–24</i>						
Males	71.9	97.3	101.0	103.0	105.2	107.1
Females	69.3	106.6	112.8	117.3	121.9	126.2
Persons	141.2	203.9	213.8	220.4	227.2	233.3
<i>25–29</i>						
Males	30.2	40.0	42.5	44.0	44.8	45.2
Females	27.4	41.3	44.4	46.7	48.1	49.0
Persons	57.6	81.3	86.9	90.7	92.9	94.1
<i>30 and over</i>						
Males	56.1	79.4	80.7	80.8	81.1	80.2
Females	68.3	97.7	99.1	98.6	99.6	98.6
Persons	124.5	177.2	179.8	179.4	180.7	178.8
Total						
Males	229.4	289.9	300.2	304.4	309.0	311.4
Females	255.7	344.2	358.7	367.5	377.3	384.1
Persons	485.1	634.1	658.8	671.9	686.3	695.5

Table 5 Age profile of UNE students in 2002
Source: UNE (2004).

Age	External	Internal
Under 21	406	1,507
21-24	1,671	1,311
25-29	2,504	472
30-39	4,777	532
40-49	3,196	331
50-59	1,378	75
60 and over	399	14
Total	14,331	4,242

Table 6 Female students (%) in 2002
Source: UNE (2004).

Course type	External	Internal
Higher Degree Research	50%	49%
Postgraduate Coursework	56%	57%
Undergraduate	67%	58%
Total	63%	57%

Agricultural science students

Of the 735,000 higher education students in 2000, the fields of study with the largest numbers of award course students (Table 7) were business administration and economics (24%); arts, humanities and social sciences (22%); and science (15%). Agriculture only accounted for 1.5% of students (11,200).

The same trends are evident in the enrolment figures at UNE (Table 8), where students of agriculture account for only 2.2% of students.

Distance Education and on-line learning

The Australian Universities in 2002 with the highest proportion of their students enrolled in distance education were UNE (76.5% of 18,202 students), University of Southern Queensland (76.0% of 24,271), Charles Sturt University (72.6% of 39,776) and Deakin University (42.8% of 33,033) (The Australian, 2004). Distance education at UNE enables the vast majority of enrolled students to come from outside the New England area (Table 9).

Table 7 Higher Education Students, By Level of Course and Field of Study '000
Source: DETYA (2002).

Field	Postgraduate degree	Postgraduate diploma or equivalent	Bachelor degree	Diploma and advanced diploma	Other education	Total courses
Agriculture, animal husbandry	1.3	0.4	7.1	2.3	0.1	11.2
Architecture, building	1.4	1.0	13.0	0.1	—	15.5
Arts, humanities and social sciences	18.9	6.0	141.0	1.8	2.7	170.4
Business, administration, economics	30.0	12.7	136.4	0.4	1.1	180.6
Education	10.9	9.4	51.8	0.8	0.8	73.7
Engineering, surveying	6.0	1.3	42.8	0.6	0.1	50.8
Health	11.6	7.0	60.1	0.9	0.1	79.7
Law, legal studies	2.8	1.4	28.0	4.1	—	36.3
Science	14.4	5.8	93.5	0.8	0.9	115.4
Veterinary science	0.3	—	1.6	—	—	1.9
Total	97.6	45.0	575.3	11.8	5.8	735.5

Table 8 UNE student numbers by discipline enrolled in 2002.
Source: UNE (2004).

Discipline area	Research higher degree	Postgraduate coursework	Undergraduate	Total
<i>Arts Faculty</i>	202	631	5,308	6,179
<i>Economics, Business and Law Faculty</i>	63	1,273	2,907	4,333
Agricultural Economics	8	20	104	132
<i>Education, Health and Professional Studies Faculty</i>	291	1,442	4,122	5,867
<i>The Sciences Faculty</i>	213	262	1,651	2,159
Agriculture & Rural Science	67	59	318	444
Environmental Science	46	100	218	364
UNE Total	769	3,608	13,988	18,573

Table 9 Sources of UNE students enrolled in 2002
Source: UNE (2004).

Home address at enrolment	External	Internal	All students
Armidale campus			
Armidale	417	788	1,205
Remainder of New England	644	544	1,188
NSW North Coast	1,194	637	1,831
Sydney	3,387	192	3,579
Remainder of NSW	3,266	893	4,159
Brisbane	892	51	943
Southern Queensland	1,144	110	1,254
Remainder of Queensland	382	58	440
Victoria	958	49	1,007
A.C.T.	414	25	439
Other States	967	24	991
Overseas (Domestic students)	379	13	392
Overseas (International students)	262	139	401
<i>All Armidale</i>	14,306	3,523	17,829
Other campuses	25	719	744
<i>All students</i>	14,331	4,242	18,573

Student access to resources is improved immensely with new technology, and interaction with peers is much easier than in the past. External students don't feel as isolated and they can build up a rapport with other students that would be much harder without technology. Students need to be self motivated and disciplined to make the best use of an online environment.

Many on-line science-based courses are working well with stand-alone lectures supplemented with email links, direct contact with lecturers through chat rooms and interacting groups across the web. Courses which have a high practical content need to have residential schools to supplement their online component. The residential schools also facilitate networking amongst students. Aspects of on-line learning are described in Table 10.

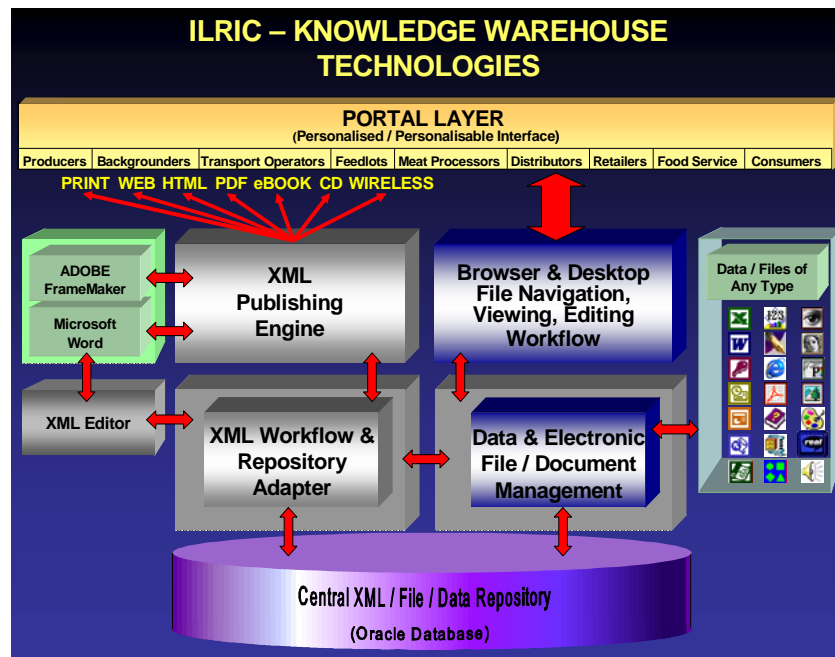
Education resources

Education resources for university students, the VET and industry sectors need to be easily updated and assembled into a range of customised publications that are more rapidly disseminated and easily accessed and utilised by target audiences. Copyright also needs to be managed. This requires the use of a learning resource management system (LRMS), knowledge management system (KMS) or content management system (CMS). An example of a possible CMS is given in Figure 6.

**Table 10 Aspects of an online learning environment**

Aspect of an online learning environment	Examples	Types of student activity
Administration – online support for learning	Unit outline Calendar Notices Class management Assessment submission	Access to administrative resources and details through the Internet.
Communication	Email Discussion/bulletin boards Chat rooms E-conferencing Frequently Asked Questions (FAQs)	Projects with other students (on campus, off campus or remote/international). Interaction with unit coordinator/ tutor. Interaction with discipline experts from other institutions etc. Special event contact with tutor and other students. Online socialisation Information exchange.
Delivery of content	eLectures Handouts PowerPoint slides	Access to learning resources through the Internet.
Assessment	Formative e.g., quizzes Summative e.g., modified essays, assignments	Access to feedback and self-checking resources through the Internet.
Resources	Support material e.g., movies, images Links to other relevant sites Library resources e.g., journals, databases	Access to learning resources through the Internet. Students contributing resources and material to the website
Interactive learning activities	Multimedia Simulations Computer Assisted Learning (CAL) – programs that profile the learner, assesses the students knowledge and then tailors the program to the student's needs Decision Support Software (DSS)	Interaction with learning materials. Projects.

Fig. 6 XML-based sheep knowledge warehouse. Source: Wright (2004).



Only 4% of wool producers currently use educational resources via the internet. Around 18% of Australia's wool producers used the internet in 2002 to obtain information for managing their wool enterprises, which is less than half the percentage with computers (ABARE 2003). Among those producers using the internet, most (85%) sought market information, market intelligence (67%) or weather information (69%), with only 24% seeking education resources.

The Australian Sheep Industry

Sheep are produced across a wide range of environments with most run in NSW (Figure 7). An analysis of the outlook for the sheep industry suggests that the number of students studying sheep and wool should either be maintained or increase as the outlook for the sheep industry is positive despite some recent downward trends, such as a reduction in the sheep population (CRC 2004, Figures 7-9 and Tables 11-12). There is currently a trend towards more sheep meat production and dual purpose sheep but the wool industry is cyclical, so it would be premature to suggest the wool industry is a sunset industry. Australia still exports more greasy wool than any other country in the world (Table 11).



Fig. 7 Sheep are Produced in Many Environments Source: Sheep CRC (2004).

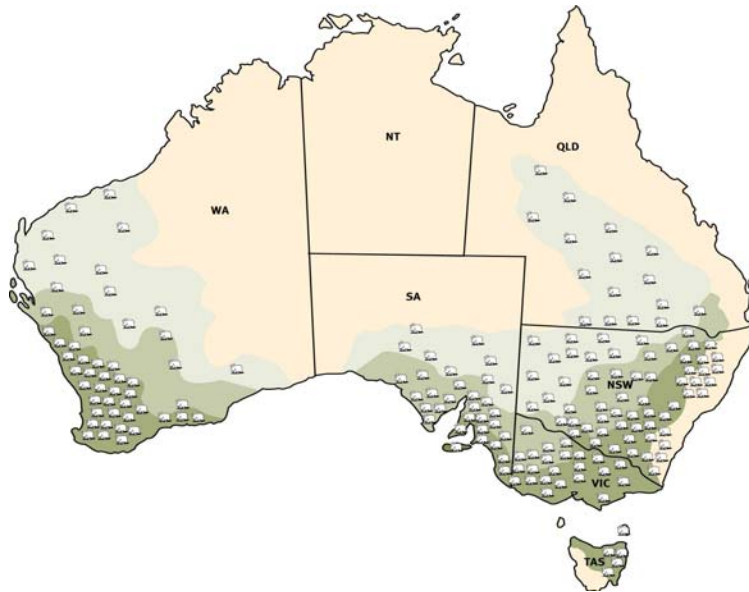


Table 11 World sheep numbers, production and export of wool and meat Source - FAO (2004).

	Australia	NZ	China	Africa	EU	World
Flock size (millions)	113	43	137	240	137	1,034
Lamb + mutton production ('000 t)	631	520	1,600	1,088	974	7,585
Lamb + mutton export ('000 t)	306	346	3	12	162	873
Wool production ('000 t)	607	231	305	211	173	2,211
Wool export (greasy and scoured) ('000 t)	549	173	14	26	96	987
Meat production per sheep (kg)	6	12	12	5	12	7
Greasy wool production per sheep (kg)	5.4	5.4	2.2	0.9	1.6	2.1

Fig. 8 Number of Australian Farms and sheep Source: ABARE 2003

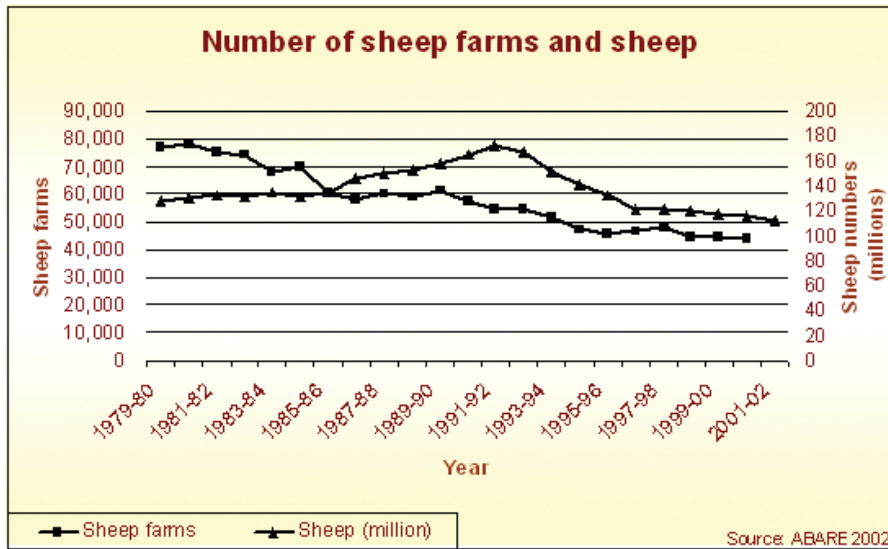


Figure 9 Shee Industry's Export Contribution Source: ABARE 2003



**Table 12 Increase in Merino ewes mated to meat rams****Source: MLA (2004).**

Year	Merino Ewes to meat ramst (million)	Merino Ewes o Merino rams (million)	Total Merino Ewes Mated (million)	Merino ewes to Meat Rams (%)
1990	9	51	60	15%
2002	20	25	45	44%

Servicing Australian University Sheep and Wool Education Future Needs

Student numbers participating in the Wool CRC Education program and a recent survey of Australian University agricultural academics (Table 13) suggest that there is sufficient demand for specialist courses in wool and sheep meat science at Australian Universities (see Appendix A for a full list of agricultural undergraduate degrees) provided there is national and not single site delivery from a University.

Table 13 University degrees that could potentially incorporate Sheep CRC sheep and wool degree units (D Cottle and P Comyn, unpubl. data)

Institution	Program
Victoria	
La Trobe University	B. Animal Science B. Ag Science Masters by coursework
Melbourne University Faculty of Veterinary Science	B. Animal Science B. Veterinary Science
Melbourne University Institute of Land & Food Resources	B. Ag Science B. Animal Science Management M. Agribusiness by coursework
Tasmania	
University of Tasmania	B. Applied Science (Ag) B. Ag Science Masters by coursework
NSW	
University of New England	B. Ag. Sci. B. Rural Sci. B. Livestock Sci. - new 2005

Table 13 continued

University of Sydney Faculty of Veterinary Science	B. Animal Science B. Ag Science B. Veterinary Biosciences B. Veterinary Science M. Agriculture
University of Sydney Faculty of Rural Business Management	B. Farm Management B. Business (Ag. Commerce) B. Management B. Land Management M. Sustainable Agriculture
CSU	B. Agribusiness B. Agriculture B. Applied Science (Agriculture) B. Vet. Sci. - new 2005
South Australia University of Adelaide	B. Agriculture B. Sci. (Animal Science) – new 2004 B. Sci. (Ag.) M. Agriculture – new 2005 Adv. Dip. Ag
Western Australia Murdoch University	B. Veterinary Science B Biomed. Science
Curtin University	B. Agribusiness Assoc. Degree in Agriculture
UWA	B. Animal Science B. Natural Resources B. Agric. M. Natural Resource Management Preliminary Degrees
Queensland UQ (Gatton)	Certificate and Diploma B App. Sci. B. Ag. Sci. (St Lucia) M. Anim. Sc. (coursework) PG certificates and diplomas
UQ (St. Lucia)	B. Vet. Science B. Vet. Biol. M. Vet. Studies (coursework)



It is unlikely that a specialist wool education degree program could be financially justified at more than one Australian University. There is little financial incentive for Universities without current specialist sheep and wool staff or infrastructure to appoint new sheep and wool staff without substantial external funding. For a University to build up specialist staff and infrastructure some assured continuity of funding for teaching and/or research is needed. It is logical that any resources be used as widely as possible across training sectors, e.g. TAFE, and for relevant research and development activities.

University strategic plans normally include the objective of achieving more research students, research funding and more efficient teaching. These strategies could be better met if there was a rationalisation of teaching across organisations and collaboration in research. For example, UNE has a Memorandum of Understanding to collaborate with Deakin University in wool related education and training; staff co-operation on joint projects and research; exchange of staff and research students; academic collaboration; and commercial collaboration which will have community benefits.

Thus the model proposed for Australian University agricultural education is that all Universities with agriculture degrees offer core science and agriculture subjects in-house and provide specialist subjects externally either in-house or from other Universities, with trading of externally offered subjects to balance student load across Universities. That is, Universities should specialise in particular subject areas so that they can achieve a critical mass of students in subject areas and build up the staff and infrastructure to support high quality teaching of these subjects nationally. It is proposed that a number of universities, including UNE, specialise in the delivery of the Sheep CRC sheep and wool units that are developed (Table 14).

Universities are under increasing pressure to increase class sizes while maintaining or increasing the educational experience of students. Students unhappy with the quality of courses can vote with their feet. Students can enrol elsewhere and withdraw from courses. Distance education and flexible cross-articulation gives students greater freedom to consider making course and unit changes during their degrees.

No Australian University has taken on the role of teaching and advancing the field of wool metrology since the School of Wool and Pastoral Sciences at the University of NSW was closed. As sheep breeding and wool marketing rely on objective measurements of wool, this is a major gap in Australia's University teaching and research profile.

UNE has internationally recognised staff in many rural science and natural resource areas, including sheep genetics, nutrition, health and welfare. It also has a strong background in distance education to facilitate the offering of units nationally and internationally.

UNE will be offering a specialist sheep and wool program within its new Livestock Science degree (Appendix B), with all the units developed by the Sheep CRC education program made available via distance education to students studying agriculture at other

participating Universities. UNE will not be the only University delivering the CRC units (Table 14) as it is proposed that Universities should offer units in which they have specialist expertise and facilities.

Table 14 The planned development and delivery of Sheep CRC University sheep and wool degree units

Unit	Proposed Delivery Centre
<i>2003</i>	
Clip Preparation & Wool Marketing	UNE
<i>2004</i>	
Sheep Production (wool and meat)	UNE
Early Stage Wool Processing	UNE Partnerships+Canesis
Late Stage Wool Processing & Product Development	UNE Partnerships+Deakin
Meat Technology	UNE
<i>2005</i>	
Genetic Evaluation and Breeding	UNE
Ecosystem Management and Sustainable Farming	UNE or UQ
Wool Metrology	UNE
<i>2006</i>	
Wool Biology	Adelaide or Sydney or UNE
Sheep Meat Production and Marketing	Melbourne or Murdoch or UNE
Veterinary Health, Nutrition and Biochemistry	Murdoch or UNE or Adelaide
<i>2007</i>	
Sheep Production systems (Case studies/Research project)	La Trobe or Melbourne or UNE

The relatively small number of specialist sheep and wool graduates from the Livestock Science degree (Table 15) is expected to be consistent with the size of the job market for specialists in wool or sheepmeat.

Table 15 Planned number of Sheep and Wool Science undergraduates

Year	UNE Units (no.*units)	Livestock degree (no.)	Non-UNE Units (no.*units)
2005	15	8	40
2006	20	10	60
2007	25	12	75
2008	25	12	115
2009	25	12	120
2010	25	12	120



The possible use of sheep and wool-related lecture material at all levels, i.e. school, VET and University level is predicted to be over 100,000 education hours (people*lectures) per year (Table 16).

Table 16 Possible use of sheep and wool-related lecture material.

	Students/producers	Lectures
University Ag. Sci. and Vet. Sci. core units	855	5
University undergrad. – 2 specialist units	150	70
University undergrad.- specialist program – 4+ units	15	140
University Certificate course	20	70
TAFE wool classers - Cont. Ed.	1,000	10
TAFE wool classers new enrolments	500	20
TAFE agriculture core lectures	500	5
High school agriculture teaching material	6,000	10
Industry re-training and Cont. Ed.	300	15
Total people using sheep and wool material	9,340	
<i>Total education hours (people x lectures)</i>	<i>105,275</i>	

There is also a large potential international market for post-farm wool units delivered via the internet.

Summary

With the advent of the Sheep Industry CRC Education and Training program and the expanding role of UNE in sheep and wool education it is an exciting time for young people to engage in tertiary agricultural education around Australia and consider a career in the sheep industry. There should be continuing employment opportunities in a range of disciplines and organisations.

References

- ABARE (2003) The Australian Sheep Industry, ABARE report to the Sheep Industry CRC - D. Barrett, D. Ashton and W. Shafron
- ABS (2002) Population Statistics from website - <http://www.abs.gov.au/>
- CRC (2004) Sheep Industry CRC Strategic Plan
- Curriculum Corporation (2002) - selected statistics (P. Cooke, pers. comm.),
- DETYA (2002) Students 2000: Selected Higher Education Statistics
- FAO (2004) website - <http://faostat.fao.org/faostat/collections?subset=agriculture>
- FASTS (2003) "Science meets Parliament" Day 2003 pamphlet
- MLA (2004) Lambplan Notes.
- The Australian (2004) Higher Education supplement on on-line learning.
- UNE (2004) website - <http://planning.une.edu.au/statistics/>
- Wright D. (2004) Internal ILRIC document.

Appendix A Australian University Undergraduate Agricultural Courses

In the higher education sector, Universities (and a small number of other institutions) are empowered by government to issue their own qualifications. The listed Universities have wool education as part of their degree, postgraduate diploma, graduate diploma/certificate, diploma or certificate qualification programs. *Subjects in italics have some wool content.*

Charles Sturt University

- Bachelor of Agribusiness (3 years)
- Bachelor of Agriculture (3 years)
- Bachelor of Applied Science (Agriculture) with Honours
- Bachelor of Veterinary Science in 2005.

Undergraduate papers

AGB301 Agribusiness Marketing
ASC170 Principles of Animal Production
 ASC171 Animal Physiology
 ASC272 Animal Nutrition
 ASC350 Animal Health & Welfare
 ASC370 Extensive Animal Production
 ASC374 Intensive Animal Production
 ASC375 Animal Products Technology
 BIO225 Genetics

Curtin University of Technology

- Bachelor of Agribusiness (Agribusiness Marketing)
- Bachelor of Agribusiness (Agribusiness Marketing) with Honours
- Bachelor of Agriculture (Farm Management)
- Bachelor of Agriculture (Farm Management) with Honours
- Bachelor of Science (Food and Technology)
- Agribusiness Farm Management and Marketing Undergraduate Units
- Graduate Certificate in Agribusiness
- Graduate Diploma in Agribusiness

Undergraduate papers

Advanced Animal Science 202
 Animal Breeding 204
 Animal Science 102
 Farm Business Systems Analysis 201
 Food and Fibre Production 101
 Sheep Production 302
Wool Commerce 401
Wool Biology 204
Wool Measurement 302

**Deakin University**

- Bachelor of Textiles S391
- Undergraduate papers
 - SEF202 Fibre Science and Metrology
 - SEF221 Colour Science and Colouration Technology
 - SEF301 Fabric Technology and Structure
 - SEF302 Finishing Technology and Quality

La Trobe University

- Bachelor of Agricultural Science (4 years)
- Bachelor of Science (Animal Science) (3 years)
- Bachelor of Agricultural Science/Bachelor of Business (5 years)
- Postgraduate Diploma in Agricultural Science (1 year)
- Undergraduate papers
 - AGR11SYS Agricultural Systems
 - AGR22PDA Physiology of Domestic Animals
 - AGR31ANP Animal Protection
 - AGR32ANN Animal Nutrition
 - AGR11ANS Animal Systems

Murdoch University

- Bachelor of Science (BSc) in Veterinary Biology
- Bachelor of Veterinary Medicine and Surgery (BVMS)

Royal Melbourne Institute of Technology

- Bachelor of Arts (Textile Design)
- Bachelor of Arts (Textile Design) with Honours
- Certificate I and II in Textile Production
- Certificate III in Textile Production
- Certificate IV in Textile Production
- Diploma of Textiles, Clothing and Footwear (Textile Manufacturing Technology)
- Bachelor of Applied Science (Textile Technology)

Undergraduate papers

- MANU1079 Yarn Technology
- MANU1081 *Fabric Technology*
- MANU1448 *Early Stage Wool Processing*
- MANU1450 *Worsted Spinning*
- MANU1451 *Woollen Spinning*
- MANU1453 *Knitwear Production*
- MANU2031 *Weaving Production*
- MANU1455 *Carpet Production*
- MANU1456A *Non Woven Production (Part A)*
- MANU1456B *Non Woven Production (Part B)*
- MANU2030 *Dyeing Practices*
- MANU1096 *Yarn Engineering*
- MANU1462 *Dyeing and Finishing Technology*



GRAP2113A Textile Design 1 (Part A)
GRAP2113B Textile Design 1 (Part B)
GRAP1158A Textile Technology 1 (Part A)
GRAP1158B Textile Technology 1 (Part B)

The University of Adelaide

- Bachelor of Agriculture (3 years)
- Bachelor of Agriculture with honours (4 years)
- Bachelor of Animal Science with honours (4 years)
- Bachelor of Biotechnology (3 years)
- Bachelor of Rural Enterprise Management (1 year)
- Diploma in Agricultural Production (2 years)

Undergraduate Papers

ANIML SC 3005
WT Wool Marketing,
 ANIML SC 3013
RW Wool Production

The University of Melbourne

- Bachelor of Agriculture (4 years)
- Bachelor of Agriculture/Bachelor of Commerce (5 years)
- Bachelor of Animal Science and Management (4 years)
- Advanced Diploma in Agriculture (2 years)
- Postgraduate Diploma in Agricultural Science
- Graduate Certificate in Agribusiness

Undergraduate papers

208-108 Animals in Society
 208-263 Animal Science and Nutrition
 208-271 Animal Management
 208-101 Farm Animal Biology
 208-207 Animal Management and Production I
 208-212 Agribusiness Marketing
 208-306 Agricultural Marketing
 208-302 Molecular Biology, Breeding and Biotechnology
 208-303 Animal Management and Production II
 208-304 Advanced Topics in Animal Science
 208-412 Advanced Topics in Genetics and Breeding



The University of New England

- Certificate in Wool (0.5 years)
- Certificate in Animal Breeding and Genetics (0.5 years)
- Bachelor of Rural Science (4 years)
- Bachelor of Rural Science with Honours
- Bachelor of Livestock Science with Honours in 2005
- Bachelor of Agriculture (3 years)
- Bachelor of Technology (Agriculture) (3 years)
- Graduate Certificate in Rural Science (0.5 years)
- Graduate Diploma in Rural Science (1 year)

Undergraduate papers

ANSC 200 An Introduction to Animal Production Systems
ANSC 300 Animal Production and Product Science
ANPR 211 Animal Production Systems and Products
WOOL 412 Wool Production
WOOL 422 Wool Marketing
 ANPR 417 Disease in Animal Production
 (see Appendix B)

The University of Queensland

- Bachelor of Agricultural Science (4 years)
- Bachelor of Applied Science (Animal Studies) (3 years)
- Bachelor of Applied Science (Animal Studies) with Honours (4 years)
- Bachelor of Agribusiness
- Bachelor of Agribusiness with Honours
- Diploma of Applied Science (Animal Production)
- Certificate in Agriculture (2 years)
- Certificate in Animal Husbandry (2 years)

Undergraduate papers

ANIM2002 Animal Husbandry
 ANIM3012 Animal Production I
 ANIM3013 Animal Production II

The University of Sydney

- Bachelor of Science in Agriculture
- Bachelor of Animal Science
- Bachelor of Business (Agricultural Commerce)
- Bachelor of Farm Management
- Advanced Diploma of Business (Agricultural Commerce)
- Advanced Diploma of Farm Management
- Graduate Diploma in Agricultural Science
- Graduate Diploma in Sustainable Agriculture
- Graduate Certificate in Sustainable Agriculture

Undergraduate papers

RMN2106 Livestock Management
RMAS1104 Livestock Production Systems
RMAS2105 Livestock Breeding and Selection
ANSC2002 Animal Science 2
ANSC2003 Animal Science 2 for Agric. Economics
ANSC3004 Animal Structure and Function 3B
ANSC3005 Animal Biotechnology 3
ANSC4002 Animal Production 4B

University of Tasmania

- Bachelor of Agricultural Science (4 years)
- Bachelor of Agricultural Science Honours (1 year)
- Bachelor of Applied Science (Agriculture) (3 years)

Undergraduate papers

KLA220/320 Animal Production Systems
KLA326/426 Animal Science

The University of Western Australia

- Bachelor of Science in Wool Science
This degree is not available to new students. Students who wish to study wool science do the Bachelor of Science in Animal Science degree which incorporates elective units in wool science
- Bachelor of Science in Agriculture (4 years) Honours may be awarded
- Bachelor of Animal Science (4 years) Honours may be awarded
- Graduate Diploma in Science in Agriculture

Undergraduate papers

Animal Science 210
Wool Production 305
Wool Marketing and Technology 408
Animal Science and Technology 451

University of Western Sydney

- Bachelor of Systems Agriculture. Majors: Agribusiness; Agriculture for Educators; Agronomy; Agricultural Practice (3 years)
- Graduate Diploma in Systems Agriculture
- Graduate Certificate of Applied Science (Agriculture and Rural Development)
- Graduate Diploma in Agriculture

Undergraduate Papers

AG308A Animal Production 2 Production Systems
AAGC21 Development in Animal Science



Appendix B UNE Bachelor of Livestock Science (with Honours)

The new Livestock Science degree provides scientific training for a wide range of careers associated with the livestock industries. Essentially agricultural in nature it differs from other University courses in its primary orientation towards Australia's commercial livestock industries. Like its companion Bachelor of Rural Science degree, it will adopt a systems approach to learning, placing emphasis on a deep scientific understanding of all components of animal production systems including soil-plant-animal interactions as well as the key disciplinary areas of nutrition, genetics, health and disease, and animal product science. The degree will also have a strong practical emphasis with graduates expected to be able to "hit the ground running" in the practical application of science in the livestock industries.

The course has three specialist streams in: 1) animal breeding and genetics with subject options in quantitative genetics, molecular genetics and/or bioinformatics, 2) animal health and nutrition, with options in sheep, cattle, dairy, pigs or poultry and 3) sheep and wool, with options in production or marketing.

The course provides understanding of the complex interactions between soils, climate, plants, animals, humans and the economy. Studies of the basic sciences and applied biological sciences provide knowledge essential for efficient control of the processes and for improvement of quality and quantity of production. The development of practical abilities lead to an appreciation of pastures, livestock, wool types and management practices best suited to properties and their resources. The course provides unique training for those who engage in livestock breeding and production, woolgrowing, research or extension in the animal industries.

DURATION

Four years (honours)

ASSUMED KNOWLEDGE

Mathematics, chemistry

PART-TIME STUDY

Part-time study is available

HONOURS

Level of honours is awarded based on performance in a compulsory final year honours research project and performance throughout the course



EXCELLENT DEMAND FOR GRADUATES

A survey commissioned by AWI and the Sheep CRC of industry employers of animal breeding, health and nutrition and sheep and wool scientists shows graduates should be highly employable domestically and internationally across a broad range of disciplines. Many undertake postgraduate training or immediately enter the industry on graduation.

Career opportunities include industry or research positions in animal health and quarantine, sustainable agriculture, animal breeding, animal nutrition, molecular genetics, bioinformatics, medical research, conservation of species, ecology, reproductive technology, biotechnology, extensive animal production enterprises, poultry, aquaculture, sheep and cattle studs, rural consultancy, stock broking firms, wool testing firms, wool marketing, secondary and tertiary education. The degree may also provide an entry into postgraduate veterinary science degrees.

WHY ARMIDALE?

There are many advantages to living in an attractive, rural University city, including the cheaper cost of living. Brisbane and Sydney are both only about 5-6 hours away by car for occasional visits to the big smoke. There are many national parks close by for outdoor pursuits and surfing, fishing etc. on the coast are only 2-3 hours away by car.

UNE prides itself on its personal touch. Class sizes are small and students have ready access to staff, computing facilities, the library etc. The Rural Science Undergraduate Society organises various social events including a rodeo, wine and cheese nights and an annual dinner. Students studying Rural Science, Livestock Science and Agricultural Science at UNE make life-long friendships. The university is well endowed with excellent college accommodation together with a vibrant international student community.

FACILITIES AND RESOURCES

Armidale is considered one of the top locations in the world for studying agriculture and live-stock. Most of the teaching is provided by internationally recognised staff from the Schools of Rural Science and Agriculture and Environmental Sciences and Natural Resource Management within the Faculty of The Sciences. The environment is research-intensive with most academic staff also deeply involved in research programs, often funded by the livestock industries. Students will benefit from experiencing first hand the rewards of deep scholarship leading to scientific discovery by each undertaking a research project in their final year. UNE has excellent animal house facilities and laboratories and there is ready access to adjacent rural properties for teaching and research. The picturesque New England area is a premium fine wool stud and wool growing district. It is also close to many cattle properties and the Beef CRC feedlot. The nearby Tamworth area is second only in importance to the Sydney basin as a poultry-producing region in NSW. While pig production is a relatively minor industry in the New England, it is widespread in the nearby grain producing areas.



Other groups located at Armidale include the Animal Genetics and Breeding Unit (AGBU), LAMBPLAN, Merino Genetic Services, headquarters of the Sheep Industry, Beef Quality and Poultry Cooperative Research Centres (CRCs), CSIRO Livestock Industries 'Chiswick' research centre, ILRIC, Select Breeding Services, Agricultural Business Research Institute (ABRI) and headquarters of 21 cattle breed societies and the Australian Red Deer society.

UNDERGRADUATE SCHOLARSHIPS

Industry-funded (Sheep CRC) scholarships are currently worth \$9000 per year for four years, and are awarded on the basis of a minimum UAI of 90 and an interview. There are also many other UNE scholarships available (see:<http://study.une.edu.au>)

PROFESSIONAL EXPERIENCE

24 weeks of professional experience and excursions are required in agricultural/animal-related industries, business and resource industries. Sheep CRC scholarship holders are required to work with the sponsoring companies during their vacations.

Student exchange programs with Purdue and Washington State Universities in the USA are currently available. New exchange agreements are being developed with the Royal Veterinary & Agricultural University, Denmark, University of Wales, UK, Wageningen University & Research Centre, Netherlands and the University of Kassel, Germany. Instruction in these programs will be in English.

COURSE STRUCTURE

In each year students do 8 units. The proportion of specialist units is greater in later years. Students can be given advanced standing of up to 16 units for units studied in other courses to facilitate movement of students to and from other degrees and Universities. The honours project which is worth 2 units.

Students choose one of three streams – Animal Genetics, Animal Health and Nutrition or Sheep and Wool.

FIRST YEAR UNITS OF STUDY

Animal Genetics Stream

Algebra & Differential Calculus; Biology 1&2; Chemistry in Context; Integral Calculus, Differential Equations & Introductory Statistics; Introduction To Computer Science 1&2; Sustainable Resource Use & Environmental Management.

Animal Health And Nutrition And Sheep And Wool Streams

Biology 1&2; Mathematical Methods; Organic Chemistry 1&2; Statistical Modeling; Introduction to Computer Science 1 & 2 or Agriculture Natural Resources and the Environment and Sustainable Resource Use & Environmental Management.

SECOND YEAR UNITS OF STUDY

Animal Genetics Stream

Core: Applied Animal & Plant Breeding; Ecology & Adaptation of Agricultural Plants; Introductory Genetics; Introduction To Biochemistry 1 & Molecular Biology.

Electives: 4 units from Agricultural Ecology & Crop Physiology; Agricultural & Resources In Macroeconomy; Animal Metabolism; Animal Production Systems & Products; Data structures & algorithms; Digestion & Nutrition; Farm & Resource Management; Inference; Introduction to Biochemistry 2; Introduction to Marketing; Introduction to Physiology 1; Introduction to Soil Science; Object orientated programming; Operating systems; Principles of Hydrology; Principles of Management; Probability & Simulation; Scientific computing; Software engineering.

Animal Health and Nutrition and Sheep and Wool Streams

Core: Animal Metabolism, Digestion & Nutrition; Animal Production Systems & Products; Introduction to Biochemistry 1 & Molecular Biology; Introduction to Genetics; Introduction to Soil Science; Statistical Modeling for the Sciences II.

Electives: 2 units from Agricultural Ecology & Crop Physiology; Agricultural & Resources in the Macro-economy; Applied Animal & Plant Breeding; Computer Science 2; Data structures & algorithms; Ecology & Adaptation of Agricultural Plants, Introduction to Biochemistry 1&2; Farm & Resource Management, Introduction to Marketing; Introduction to Physiology 1; Object orientated programming; Operating systems; Principles of Hydrology; Principles of Management; Software engineering.

THIRD YEAR CORE UNITS OF STUDY

Animal Genetics Stream

Animal Function, Health & Welfare; Genetic Evaluation & Breeding Program Design; Molecular Biology.

Animal Health and Nutrition Stream

Animal Function, Health & Welfare; Constraints to Animal Production; Crop & Pasture Management; Endocrinology; Gastro-Intestinal Tract.

Sheep and Wool Stream

Animal Function; Health & Welfare; Crop & Pasture Management; Wool Biology; Wool Metrology.

FOURTH YEAR CORE UNITS OF STUDY

Animal Genetics Stream

Farm Systems; Special Genetics Reading Unit; Honours Project.

Animal Health and Nutrition Stream

Farm Systems; Honours project plus 2 units from Constraints to Animal Production, Disease in Animal Production, Applied Animal Production.

Sheep and Wool Stream

Farm Systems; Honours project plus 2 units from Sheep Production, Wool Marketing, Early Stage Processing, Late Stage Processing, Meat Science.



THIRD AND FOURTH YEAR ELECTIVE UNITS OF STUDY

Select from units to provide a total of 8 units in each year.

Advanced Agronomy; Agricultural Engineering; Agricultural Extension; Agroforestry; Animal Production; Animal Diseases; Applied Animal Production; Aquaculture; Benefit-Cost Analysis; Blood; Bioinformatics; Clinical Biochemistry; Clinical Microbiology; Concurrent Programming; Constraints to Computer networks; Crop & Pasture Management; Crop Protection; Databases; Distribution Theory & Inference; Early Stage Processing; Ecosystem Management & Sustainable Farming; Environmental Soil Science; Environmental Systems Analysis; Evolutionary & Conservation Proteins; Feedlot Management; Forest Science; Fungi, Plants & Environment; Genetic Evaluation & Breeding Program Design; Genetics; Horticultural Science; Introduction to Weed Management; Land Evaluation & Degradation; Late Stage Processing; Limnology; Linear Models; Mammalian Genetics; Neuroscience; Meat Science; Meat Technology; Molecular Biotechnology; Molecular Genetics & Developmental Biology; Plant Protection; Poultry Science 1 & 2 ; Remote Sensing for Resource Management; Resource Policy & Administration; Sheep Meat Production & Marketing; Sheep Production; Sheep Production Systems; Soil Management; Soil Science; Special Topics; Statistical Models 2; Surgery; Sustainable Land Management; Veterinary Health, Nutrition & Biochemistry; Wool Biology; Wool Marketing; Wool Metrology.

Note: Additional subjects offered from other Universities will become available.

Course offering is subject to approval by the UNE Academic Board.

INFORMATION

For application form and further information, contact:

The Admissions Unit
 The University of New England, Armidale NSW 2351
 Telephone: 1800 818 865 or 02 6773 3566
 Fax: 02 6773 3196
 Email: admissions@pobox.une.edu.au