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BAAT

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Inside BAAT

Who is NSWAAT

President
Patrick McCann
St Josephs College
HUNTERS HILL 2110
02 9816 1044 (W)
02 9879 6804(F)
02 9817 1212 (H)
pamccann@bigpond.com.au

Secretary
Leonie Mutch
St Ignatius College
LANE COVE 2066
02 9882 8222 (P)
02 9882 8588 (F)
lmutch@riverview.nsw.edu.au

Treasurer
Karen Heap
Muirfield High School
NORTH ROCKS 2151
02 9872 2244 (P)
02 9871 4106 (F)
kaz@cia.com.au

Technology/Communication
Rowland Clark
Canberra Grammar
RED HILL 2603
02 62951833 (P)
02 62952923 (F)
rowland.clark@cgs.act.edu.au

Editors

Brigitte Hermann
Plumpton High School
PLUMPTON 2761
02 96257020 (P)
02 98381852 (F)
brigitte@zipworld.com.au

Milton Gower
Macarthur Anglican College.
COBBITTY 2570
02 4647 5333 (P)
02 46475444 (F)

John Killeen
Girraween High School
GIRRAWEEN 2145
02 96367293 (P)
02 98963274 (F)
j_killeen@optusnet.com.au

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Merry Christmas!

Editorial

Well, this is about it for another year. Apologies for this late (or early in the year, for some), arrival of this issue; numerous power failures, an exploding computer and the hectic nature of the time of year, intervened. Special thanks to the people who contributed to this issue, in particular, Rob Forsberg, Nigel Cox, Tanya Henry and Lyndal Maloney. As always, material from the Cotton Store and Paul Robey is appreciated greatly.

Thanks again, to our sponsors, who assist in making this publication possible: UWS-Hawkesbury and NSW Agriculture, who have both been strong supporters of the Association for many years; and McGraw-Hill who are still offering a 10% discount for financial members of the AAT. Further details can be obtained from Miriam Marckx, Fax: 9417 2248, PH: 9415 9845.

Hopefully everyone will have/have had (cross out whichever is not applicable), an enjoyable and relaxing break.

Until the New Year.....Ed.

APOLOGY

In the last issue of BAAT, the telephone contact for Macarthur Tractors was quoted incorrectly.

The correct number is: **02-4647 9077**

We apologise unreservedly for any difficulties this may have caused our readers or Macarthur Tractors

We Need Your Input!!!

Stuff to send:

School or Show Reports
Teaching Resources
AAT Branch Updates
Committee Reports
Inservice/ practical Ag info
Letters
Classifieds (ie Buy/Swap/Sell, etc)
Student Successes
Upcoming Events
Interesting Bits.....etc. etc.

e-mailed material in MS Word (pc) format, works best.
Pictures/photos in .jpg or .gif, if possible.

Contact or send material to the editor of your choice

President's Report, AUGUST 2001

Welcome to the third edition of BAAT for 2001.

Firstly I would like to thank Brigitte and her team for the second edition of BAAT. I am sure that all our members would be happy to extend thanks for all the hard work and effort that goes into getting BAAT out.

There are at the present time a lot of things occurring that affect us as Agriculture teachers. The most important is the review and revision of the Years 7 to 10 syllabus. The first stage is the evaluation surveys, which are on the Boards Web site and have also been sent to each school, it is very important that the BOS receives as much feedback on the views of as many Agriculture teachers as possible. How often have you complained about something to do with a syllabus, now is your chance to express any concerns or revisions you may feel necessary to our current stage 4/5 syllabus.

After the evaluation surveys, a team of writers will be formed to develop a writing brief, which will have a period of consultation from the 13th June to 21st July 2002, it is at the consultative period that again you will have the chance to comment. The comments from the consultation will then be taken into account and a draft syllabus will be developed for consultation from the 27th Jan to 3rd March 2003 and the draft will become the new syllabus with any revisions identified in the consultation, and will be in schools in June 2003. A question remains however in regard to implementation which may be February 2004 or could be as late as February 2006.

This is an extract of a letter I received from a member of our association, I have copied it here to stimulate a bit of thought while you are filling in the evaluation of the current syllabus. If it is seen by a large percentage of our members that we would like to be placed back into Science, we will, as an association, get in contact with the relevant people to express the thoughts of our members.

"I am aware that some people/groups are using the 7-10 review opportunity to request the possibility of reclassifying Agriculture back into the Science KLA from where it was moved a number of years ago. You may wish to use this survey to give your views on such a move. It may be mindful to consider the continuance of an Agriculture context in the Stage 4/5 D&T syllabus as well to ensure some exposure of Agriculture to kids in all schools where this may still occur.

I remember well the furore that associated the move of Agriculture into the TAS KLA that happened some years ago and the associated incorporation of an Agriculture "context" into the 4/5 D&T syllabus. Given that most if not all Agriculture teachers had been traditionally attached to the science faculty, many letters/submissions were tabled along lines of teaching area, curriculum similarities and career pathways for Agriculture teachers.

Discussions and thoughts now are related to the possibility of "grouping" Agriculture back into the Science KLA, assuming KLA's will continue to exist. Given that KLA's have now disappeared from Stage 6 it may be timely to revisit Agriculture and it's grouping in Stage 4/5. I have been advised that if it were the wishes of teachers and associations to suggest this move, it may well be reconsidered and possibly favorably.

My initial inquiries and experience suggest that most Agriculture teachers (but certainly not all) still essentially reside within the "Science" area, be it staff rooms or administratively. Many also still teach or would like to teach in the science area, not Food/Textiles/IA etc.

Additionally, where schools are teaching Stage 4 D&T, many are still basically teaching Stage 4 Agriculture rightly or wrongly, rather than a specific Design Brief focus. I am not saying that this does not happen, but feel it is often in a token or limited way. Nor am I suggesting that an Agriculture context could not remain in the D&T syllabus revision because I feel that in many schools this may be the only way for some schools to "access" potential stage 5 elective students."

If you have similar feelings or you are quite happy where Agriculture sits in TAS please express those views in the evaluation surveys. I would also like as much feedback as I can so I know the general feeling of our members in any discussions that are held on this issue.

As many of our members are probably aware there have been a number of problems in regard to certain aspects of the Primary Industries Course in particular the SMARTtrain chemical course. Peter Jones and I recently had a meeting with Mr. Bob Smith who is the Director VET in Schools and Fran Maloney also from DET to express our concerns and raise a number of issues.

The meeting was very productive and as a result we were assured that the resource CD ROM to supplement the SMARTtrain chemical course, which has been promised for over 12 months, is currently being produced and will in schools very soon. A central register of students who have completed the SMARTtrain course is going to be held at Murrumbidgee College at Yanco as well as the cards being printed there and all students who have completed the course will also

receive a certificate from TAFE. I have been assured the nearly all the teething problems that have been associated with the SMARTtrain course are nearly if not already solved, for this year at least.

If members who are teaching Primary Industries would they like to see their students receive a certificate for the successful completion of the tractor units in the electives they may consider doing the Tractor Operation and Maintenance course which is run by NSW Agriculture, the course takes 3 days and both Yanco and Tocal colleges offer this course to Primary Industries and Agriculture students. Both colleges also offer the SMARTtrain chemical course as well. If you are interested you could contact either Murrumbidgee or Tocal colleges. It needs to be realised however is that it does entail a fee to do either course through these colleges.

I have over the last 12 months sent a number of surveys or questionnaires out to members, I wish to thank all those teachers who have taken the time to fill out them out and return them to me. For us to have any chance of making changes to the way we want our subjects taught we must have evidence to put to the BOS, DET, CEC or AIS. I do realise at times it is an inconvenience to find the time to fill them out but if there are issues that are affecting our association it is important that I get as much feedback as possible. It is possible to make change and get results if we can for example go to the BOS and say that over 250 Agriculture teachers support or disagree with a particular issue.

If you have any issues affecting you in regard to teaching Agriculture or Primary Industries let me know, it may be an issue affecting many other teachers, please contact me at work on (02) 9816 1044, home (02) 9817 1212 or by fax or e-mail pamccann@bigpond.com.au It is my job as President to ensure that we are meeting the needs of **every one** of our members in every part of the state, so please give us some feedback so we can help you.

A reminder that the National Association of Agriculture Educators (NAAE) is having their 2002 conference in Hobart from January 14th to 18th 2002 titled '*Educating for a clean and green Future*'. I am sure that it will be a very enjoyable and informative conference. Included in this edition is an outline of the conference to help you make up your mind if you are thinking of attending.

A reminder that BAAT is only as good as the contributions it receives. Please send submissions of any articles, resources, worksheets, programming ideas, and reports on your school or show results to Brigitte, John or Milton.

Patrick McCann

PROPERTY PLANNING COMPETITION

GUNNEDAH MAY, 2001.

Agriculture students and teachers in the North-West region of the state were recently involved in a very worthwhile project that enabled students in year 12 to study many aspects of sustainability in a novel and useful way. The syllabus places considerable emphasis on the role of agricultural sustainability but it is sometimes difficult, and often boring, trying to place this very important concept into our ordinary day to day teaching.

The Property Planning competition, organised in conjunction with the Department of Land and Water Conservation in Tamworth, provides a unique opportunity for students to develop a real awareness of this critical component of the HSC course.

Schools wishing to enter simply had to register their intention. The DLWC sends out relevant information on the property to be studied, in this case "Hartfell", at Gunnedah. This preliminary information contains overlays on such physical resources as soils and landform and natural vegetation as well as cropping and pasture. The students must research some vital information on rainfall and temperature so they can relate this to aspects of management.

The big day out finally arrives and thousands of students and teachers arrive at the property early so that they can make a start. Groups have been determined and each group is given their initial activity. These include demonstrations, discussions, hands-on activities carried out by professional staff from the departments mentioned above. It was a great day this year with lots of sun and winter warmth. Students then headed home with a very real example of how a property could be improved from a sustainable production viewpoint. Saline areas had been identified, vegetation corridors isolated, flood management proposals discussed, and tree planting areas located-all with the aim of improving the sustainable production of this property.

The students and teachers returned to their various schools and had a small amount of time in which to complete their project before sending it off to Mr. Col Eastern, Catchment Education Officer, and Tamworth. The professional officers from the various departments marked all the assignments and the two winners were Glen Innes High School and New England Girls School in Armidale.

The whole process was a resounding success and Col Eastern and his colleagues should be warmly congratulated.

Rob Forsberg-TAS.

2001 INTERCOLLEGIATE MEAT JUDGING COMPETITION WAGGA,14/10/01.

This competition may not be for high school students studying HSC Agriculture but I thought it would be of considerable interest for those students who were contemplating a career and further study in Agriculture or related fields.

I was lucky enough (or otherwise) to have the opportunity of attending this competition in Wagga Wagga as I was the driver of the bus that transported 20 Rural Science students and their coaches to the competition. The competition is open to students studying Meat Science courses at University, TAFE or Colleges of Agriculture i.e. Yanco or Tocal. The wonderful thing about this competition is that if you do well you have a chance of making the Australian Intercollegiate Meat Judging Team that travels to the US to compete. The Australian team that competed in 2000 actually won the competition- the first time that this has happened! Sponsorship for this competition is widespread with the main one being MLA.

The competition involves teams being "coached" in the finer points of judging a range of carcases, primal cuts and retail cuts. This naturally involves a lot of early starts and trips to abattoirs so that the students can gain the necessary training and experience. Trips are also made to Coles and Woolworths meat departments. The entry into the abattoirs is stringent and it is a necessary requirement of entry that students have a Q-fever injection or othewise wear a facemask.

The competition this year was tough with students coming from Emerald Ag. College, Tocal, Sydney University, University of Western Sydney, Hawkesbury, Regency TAFE and Adelaide University, University of New England, Armidale, Gatton and OAC (Sydney Uni.).

All competitors judge carcases, primals and retail cuts and they are graded on this competition. From this the top 10 competitors are chosen to further place and judge whatever carcases the judges put up. Sixty odd students

competed and 11 were chosen to go into the final. In the final, competitors have to justify why they placed the carcases the way they did and also to answer a specific question from Mr. John Carter, long time mover and shaker in the meat industry, on how they would use the experience gained from travelling and competing in the USA.

The final was a tribute to the knowledge and dedication demonstrated by all students but only five could be picked to tour. These were announced at a formal dinner on Sunday night and four women and one male were chosen to represent their country. A wonderful achievement indeed!

Yes, for those of you with inquiring minds-we, in the North-West region, are already looking into the possibility of getting a similar competition up and running for school students. It was run in a very small way in Tamworth earlier this year but a number of refinements are going to be made.

Rob Forsberg,
Agriculture Teacher, T.A.S.

A HISTORICAL PERSPECTIVE OF AGRICULTURAL EDUCATION

Agricultural education has had a long history in the NSW school system. Sir Henry Parkes, who is considered to be the father of the New South Wales Educational system, as early as 1856 identified the application of science to Agriculture and industry and the need for technical training in order to develop the resources of the young colony (Smith & Spaull, 1925).

Agriculture first appeared as part of the school curriculum in 1860 when it was usually disguised under the heading of 'object lessons' (Spencer, 1993). In 1889 Agriculture and beekeeping were included in the subjects offered in Primary Schools. These were seen as preliminary training in technical subjects (Smith & Spaull, 1925). By 1891 Agriculture was made compulsory in all State Schools. This was under the instruction of the Secretary of Public Instruction (Spencer 1993).

In 1907 increased facilities were established for training boys in Agricultural occupations. Continuation schools were opened at Hurlstone, Newcastle and Goulburn. At these schools students were given instruction in the theory and practice of Agriculture, elementary Science, and work in wood and iron (Smith & Spaull, 1925).

A. C. Carmichael (1915) in his report on Agricultural Schools in 1915 stated that "Successful agriculture demands technical and scientific theory" (p.4). He reported that NSW had a thoroughly coordinated system of education in all its branches except in regard to Agricultural instruction. Scientific Agricultural education had yet to be incorporated into the now organised and complex education system. The Department of Agriculture at this time had some influence in Agricultural education as they ran the Hawkesbury Agricultural College, the Pitt Town Farm for Boys and various experimental farms which provided training in Agriculture. This dual control of Agricultural education was seen as a problem by Carmichael, who called on effective cooperation so that there would be no wastage.

Carmichael proposed five stages of organisation for Agricultural education in NSW.
1. The Primary School.
2. The Primary School with the Agricultural "top."
3. The Agricultural High School.
4. The Agricultural College.
5. The University School of Agriculture.

The primary schools would provide interest in rural occupations through nature study and school gardening activities. After primary school boys (yes, no girls) who intended following an Agricultural career would attend one of two types of schools. The first was an Agricultural High School such as Hurlstone Agricultural High School which provided a two year course, intermediate between Primary School and Hawkesbury Agricultural College. He advised that further schools should be established and that they should have land of some 100 acres. These schools would be located outside of town centres.

The second was a Rural Day School for those who could not be sent to a boarding school. This type of school would be located in a farming area and draw students from nearby small schools. Advanced students would receive specialised Agricultural education in their final two years. Carmichael recommended Rural Schools needed an area of about 5 acres for

horticultural activities. The development of Cookery Schools for girls, where they would learn the "..women's part in making the farm profitable - the making of fruit preserves and jams, and the growing of flowers and vegetables" was also recommended by Carmichael (1915, p.14).

By 1939 three Agricultural High Schools were in operation - Hurlstone, Yanco and Farrer. In addition Agricultural courses were offered in nine ordinary High Schools and two Intermediate High Schools (Cunningham & Pratt, 1940). These schools had a small farm of between 2 and 10 acres available for students practical work. Fifteen District Rural Schools offered three year courses of which the first is pre-vocational.

The 1948-1954 review noted that Agricultural education in NSW was abreast of recent advances in primary industry. Students in primary schools were introduced to Agriculture through the study of natural science, school gardens and project work. These activities were run in association with the Junior Farmers' Clubs. A three year course in Agriculture was available at 24 country high schools, fourteen district rural schools and 25 central schools. Practical work was provided by these schools at attached school farms or local experimental farms. The three Agricultural high schools and most country high schools offered a five year course (McDonnell, Radford & Torrington, 1956).

James Ruse Agricultural High School opened in 1959, bringing the total number of Agricultural high schools to four. All except James Ruse had boarding facilities. At this time most metropolitan schools had been single sex, though there was now a trend towards co educational schools. In contrast nearly all country schools were already co-educational (Australian Council for Educational Research, 1964).

Accurate figures of the numbers of students studying Agriculture for each year are not available. Farquhar's study provided figures for 1963. At this time the Agricultural high schools and some country schools provided five year courses in Agriculture. Other government secondary schools in the country provided three year courses. The NSW education system stated that these Agricultural courses were part of the general education rather than pre-vocational training.

Over 100 government secondary schools offered Agriculture or related subjects in for the more capable student. Devin (1973) stated that most electives were studied at two levels. The new syllabuses were based on five periods per week of Agricultural instruction. The Higher School Certificate would also be examined at three levels.

The 1970s and 80s saw a rapid growth in the number of students studying Agriculture, an increase by over 300% (Francis, 1994). Whereas Agriculture was mainly restricted to rural schools and the Agricultural High Schools up until this period, it was now offered by some 300 out of 1000 schools and over 40,000 students studied it in some form (Francis, 1994). Francis attributes this dramatic increase to three factors which include an availability of money to develop Agriculture, an attempt to maintain a link to the Agricultural history of suburban areas as farming land was developed for housing, and a drive for environmental activities in schools.

Since this boom period a number of factors have and may be continuing to exert pressure on Agricultural education in high schools. Francis sees these as being economic factors, competition in an expanding curriculum, and reluctance of teachers to change.

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John Killeen

Salt and Water in the Soil

It is necessary to recognise that salinity can occur naturally without any interference from humans. However most of the recent salinity problems have developed as a result of human activity since the arrival of the European settlers.

Primary Salinity.

This is salinity that occurs through **natural processes** that end in the discharge of saline groundwater at the surface. In the Murray Darling Basin large areas have been salinised at different times of the geological past. Primary salinity may occur as "salt pans" in depressed locations. "Dry scalds" are saline subsoils in non-irrigated conditions exposed after overgrazing and wind erosion.

Secondary Salinity.

This refers to the salinity that has occurred as a **result of European land management** practices. Irrigation salinity is always secondary salinity and much of the dryland salinity in NSW is secondary also.

The Water Balance

Water comes into the soil as rainfall (and irrigation). Water leaves the soil through plant absorption and transpiration, surface evaporation, surface run-off and groundwater flow. If the amount of water leaving the groundwater system is the same amount as the rainfall adding to the groundwater then the groundwater is in balance.

Many parts of Australia have a very low rainfall and high evaporation. Prior to the agricultural land use, most of the water that fell on the land was either evaporated directly or used by plants and transpired. Native vegetation was well adapted to the low fertility soil and the harsh climate and was usually able to remove all the water from the root-zone.

Over a long period of time all groundwater systems will reach a state of balance with inflows and outflows being equal. However an increase in recharge from changed land use can make a groundwater system out of balance. The change in balance causes the watertable to rise and bring with it any salts that are in the groundwater or stored low in the soil profile. There is usually a lag time from the clearing of land or change in land use, to when the increases in the recharge causes the watertable to rise to near the surface where it can cause waterlogging or salinity problems. It may take over a 100 years for the watertable to rise to the extent where it will cause problems in the root-zone.

The Accumulation of Salt

The concentration of salt in the soil or groundwater can increase as a result of several processes.

- leaching of soluble salt by water percolating down through the strata above the ground water.
- evaporation of water from the surface area concentrating the salt left behind.
- the removal of water from the surface by plant roots.

How Salt occurs in the Root Zone and on the Surface

Water is able to move upwards through the soil profile. This process is associated with adhesive forces between water and particles of soil, and is called **capillary rise**. The process is aided by the heat of the sun, **evaporating moisture** in the upper layers of soil, either via plants (though **transpiration**) or directly from the surface. The dry soil at the top of the profile acts like a sponge and draws water up from the water table below.

Capillary rise is significant to agriculture because it introduces salt to the root zone. The water dissolves the salt, but water evaporates and salt doesn't.

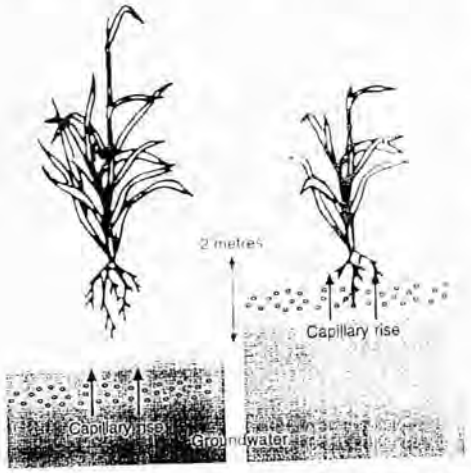


Figure . Capillary rise: soil suction draws groundwater (containing salts) towards the surface. If the watertable is within 2 metres of the surface, salts enter the rootzone and affect plant growth.

There is a 'critical depth' at which the water from the water table starts to reach the upper profile by capillary rise.

If the water table is higher than the critical depth, capillary rise will occur.

Soil types conduct water differently and have different critical depths:

1.2m for clay and sandy soils
2m for medium textured soils

As a result, medium soils are put at risk from rising water tables sooner.

During rainfall and irrigation, surface salt accumulations can be leached downward in the root zone especially when the watertable has been lowered through dry periods.

Signs of Salinity.

Plant Indicators.

There are many plants that have adapted to saline soils and whose presence may indicate a saline soil. These are wimmera ryegrass *(Lolium rigidum),* sea barley grass *(Hordeum marinum),* couch (*Cynodon dactylon),* annual beard grass (*Polypogon monspeliensis)* and spiny rush *Juncus acutus).*

The water plant cumbungi or bullrush (*Typha orientalis* and *Typha domingenus*) often grows well in saline water (Taylor 1996).

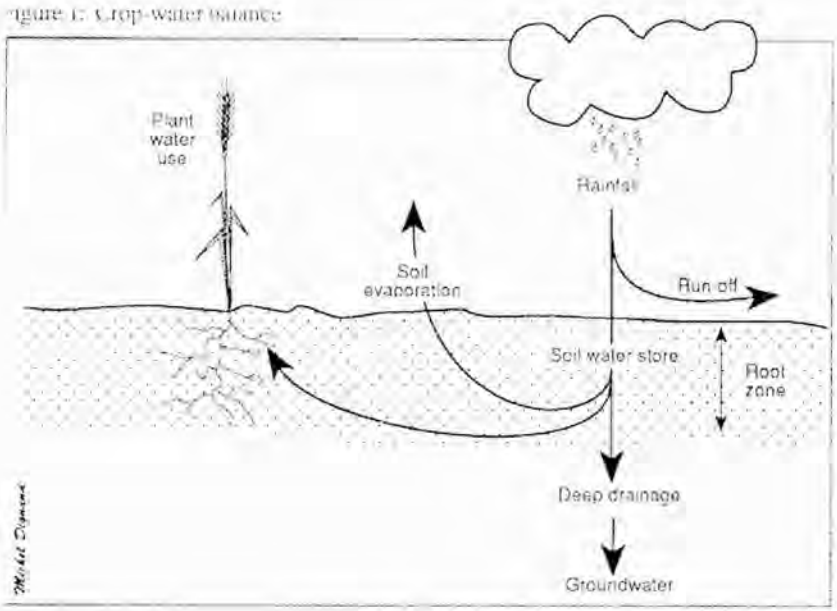
Other Indicators.

A group of dead trees is often an indicator of salinity. More subtle signs such as trees showing thin canopies and die back can also indicate salinity. Where salinity (as opposed to insect attack or disease) is the cause of Eucalyptus dieback the upper branches appear to become completely devoid of foliage and develop a skeletal appearance (Taylor 1996).

The discharge site can be bare of plants but this can be confused with waterlogging, acidity, overgrazing and herbicides. Salt crystals are not always present on the surface but a white powder like dust on the surface may be salt crystals. Black staining and sticky wet clay associated with a bad odour are other indicators of salinity. Saline dam water is often clear.

Dryland saline discharge sites are often associated with a topographical and/or geological variation such as road, rock strata outcrop (eg dyke) or a clay layer in a mid-slope location which forces the groundwater to the surface.

Sites which have some of the above indicators may be saline and soil and/or water samples should be tested for electrical conductivity levels to confirm the presence of salt.



Irrigation Salinity.

Causes and Processes

Irrigation salinity occurs as a result of either a rising saline watertable or the application of saline irrigation water. The practices and factors that lead to this watertable rise and the accumulation of salt in the surface soil are:

- the replacement of deep-rooted perennial plants with annual species such as cereals and annual pasture plants means that more water drains past the shallow root zones and into the ground water.
- over watering by applying more water than is required by the crop or pasture. If this excess of water isn't removed by drains it will seep through the soil to the ground water system.
- irrigating unsuitable soil. Sandy soil has large pore spaces that let water seep through easily. Sand holds less water than loam or clay and more water seeps through to the ground water.
- irrigating on uneven ground and/or poor drainage means that a paddock may not drain freely after irrigation and water lies in the depressions. The only way the water can leave is through evaporation or seeping through to the groundwater system.
- channel seepage is a major contributor to groundwater.
- irrigating on uneven slopes will result in more water being applied than is necessary to meet the needs of the plants. Irrigation takes longer, giving water more time to seep past the root-zone, especially in the top end of the paddock.
- infrequent watering allowing the soil to dry out means that large amounts of water are applied. Much of this water may then flow through cracks in the soil to the watertable. Another effect of dry soil is the death of some roots which in turn reduces the ability of the plant to use the water.

All of these factors lead to excess water moving out of the root zone and into the ground water, resulting in a rising watertable and, if present, salt is deposited within the root zone of plants.

Processes involved with Irrigation Salinity

Three Phases Of Salinity

Phase One: Before land clearing and farming, deep water tables and non saline soil

Phase Two: leaching of salt to the water table continues, water tables begin to rise, salinity becomes a threat to agriculture.

Phase Three: Equilibrium might be achieved if watertables are kept below the critical depth for a particular soil. In this way, the leaching ability of the soil is maintained and at least matches the rate that salt arrives by capillary rise. A balance between salt arriving and salt leaving is achieved. The key is to keep the water table below the critical depth.
The use of saline water for irrigation comes from either an increase in salinity of the river system through contamination of the river water by saline groundwater or surface water further up the catchment or the re-use of saline drainage water from irrigated paddocks.

The basic processes involved with irrigation salinity are:

- the **movement of water** past the root zone and into the ground water system
- the **leaching of salt** in the soil and the addition of the salt to the ground water.
- the **rising of the water table**.
- the **capillary rise of the water** (and dissolved salt if present) toward the surface through the root zone.
- the **concentrating of the salt at the surface** through evaporation of water.

An excess of water reaching the water table and putting the groundwater system out of balance causes the rising water table. The water not used by plants, or removed through evaporation and drainage, seeps through until it reaches a dense layer of soil or rock. This excess water may have many sources, but if the irrigation application exceeds the amount of water required by the plants the excess water moves through the soil to the water table.

Other contributions to the ground water system resulting in a rise in the level of the water table are:

- **rainfall during the irrigation** period as this could be in excess of the crop requirements.
- **channel seepage**. This can make a considerable unwanted contribution to the local ground water, the amount varies considerably depending on the soil types and channel lining.
- **road works and other engineering activity** such as earth works, railways and flood control banks, although not directly adding more water, change the drainage patterns and reduced the effectiveness of natural surface drainage patterns causing water to pond in low lying areas. Water may then move from these waterlogged areas into the groundwater system.
- **Road compaction** creates a barrier to groundwater movement and can cause groundwater to back up and the water table to rise and even discharge near the road. Many roads in NSW are affected by waterlogging and salinity created by the compaction that exists under the road for often for considerable depth.

As the ground water system fills up the water table level rises toward the surface. Sometimes a watertable may occur near the soil surface above the main regional watertable deeper in the soil. This watertable table is called a **perched watertable** and is probably separated from the lower watertable by a dense layer of soil or rock.

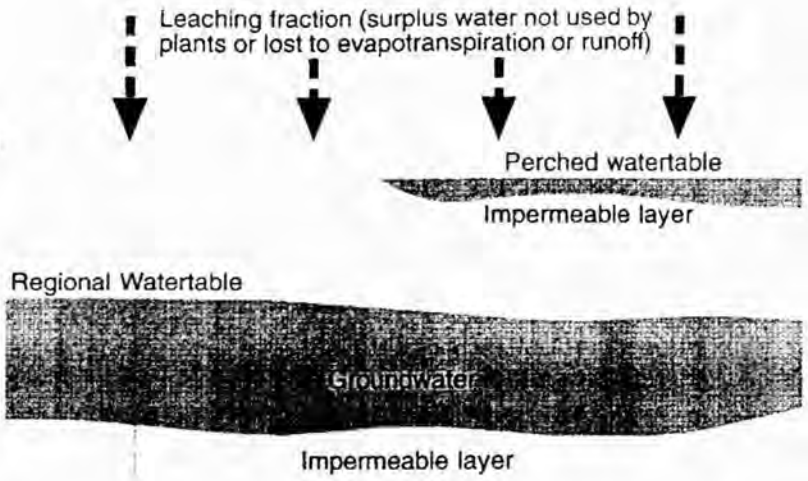


Figure Surplus water from the surface flows down through the profile until it reaches an impermeable layer (such as a clay or calcrete horizon). It then starts to fill up (saturate) the soil profile. If the impermeable layer lies above the main regional impermeable layer then a perched watertable forms, that may cause localised salinity and waterlogging problems. Perched watertables can be controlled with groundwater pumping and improved irrigation management.

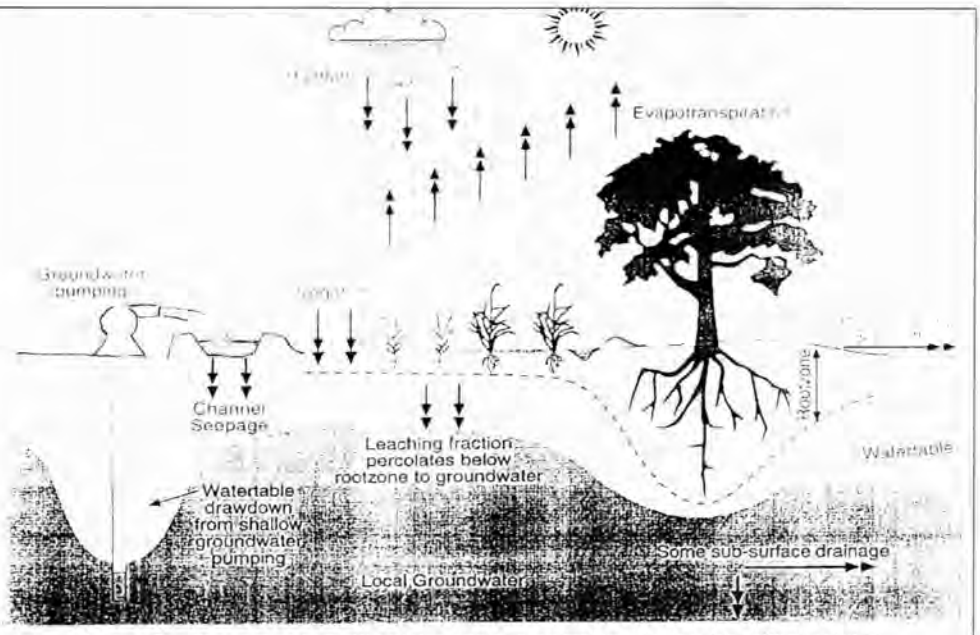


Figure 3 Components of the water cycle in an irrigated area that affect salinity

Procedures to Alleviate the Problem of Irrigation Salinity

The problems of salinity can be alleviated by addressing the main processes involved, ie. Lowering the watertable and reducing the concentration of salt in the soil surface area.
Irrigation management is the key to alleviating the problems of salinity. The following practices will help to avoid and alleviate salinity problems and lead to a more efficient use of water and farm facilities.

LAND MANAGEMENT USING SALINITY CLASSES OF LAND

The first step in land management is to know the water table depth and the salinity of the soil and ground water. Water table depth and ground water salinity can be monitored using test wells or piezometers. Soil salinity levels can be mapped using EM instruments or by taking soil samples. Areas with high water tables and high groundwater salinity levels have a high risk of soil salinity level increasing.

To help in making land management decisions land can be divided into one of four land use classes specially classified for irrigation land. (See Irrigation salinity Note. No.5.). Class A and B lands can be grouped together as areas capable of successful agricultural production; while class C and D lands are lands requiring careful management and protection.

LAND CLASSIFIED BY SALINITY CLASS

Salinity Class	Root zone ECe	Level	Comment
	(dS/m)		
A	0-2	Low	Land is suited to agricultural production
B	2-6	Medium	"
C	6-15	High	Land requires protection
D	>15	Extreme	"

NOTE: The salinity of a given area of land is dynamic, and can change from season to season.

WHOLE FARM PLANNING.
This gives a structured approach to farm development and takes into account land classes, farm layout, cropping and livestock production program and irrigation techniques and facilities. A whole farm irrigation design is essential to integrate water supply and drainage as well as irrigation layout.

IRRIGATION MANAGEMENT.
Poor irrigation layout and practices often result in excess amounts of water being applied to the land. An excess of applied water will usually result in unwanted additions to the ground water system.

- Irrigation timing (called water scheduling) should be matched to the needs of the crops and pastures. This reduces over watering and means there should be no excess to move to the ground water. Soil moisture is monitored by a variety of techniques (eg gypsum blocks, tensiometers, enviroscans or neutron probes) and irrigation is scheduled accordingly.

- Watering and draining paddocks the paddocks should be done as quickly as possible to limit the seepage of water to the groundwater system.

- The type of irrigation technique (flood, sprinkler or drip) must be suitable for the type of crop and it should be designed, installed and operated to take into account potential or existing salinity problems.

- Laser controlled land-forming reduces waterlogging and therefore additions of excess water to the water table.

- Draining, storing, and reusing irrigation water not only reduces water costs but also allows the farmer to use the water more effectively. This can alleviate the potential for salinity by controlling excess water including unwanted rain water and giving the farmer the flexibility of using the water when it is needed. Drainage water should be monitored for salinity (EC measurement) and mixed with fresh water if necessary.

DRAINAGE PRACTICES

A. SURFACE DRAINS.

Surface drainage is important to reduce waterlogging and therefore the chance of adding to the watertable and increasing the potential for salinity problems. The drains should be able to remove the surplus water from every irrigated paddock on the property. They should also enable the paddock to be drained quickly to minimise the amount of water seeping into the groundwater system.

Drains should be properly planned, designed and constructed taking into account engineering factors such as slope, length soil type. Maintenance of the drains should include weed control to ensure the rapid removal of water from a paddock.

B. SUB-SURFACE DRAINAGE

This involves removing water from the soil after it has passed below the soil surface and before it reaches the local watertable. Tile or mole drains and groundwater pumps are the most common method of sub-surface drainage.

Tile drainage

Tile drains are networks of small drains (made out of terracotta or plastic pipes) collecting the sub-surface water from all over a paddock. The water is collected and removed from the system. The cost of large scale tile drainage can be very high and is generally only used with high value crops.

Mole drainage.

Mole drains are formed by making small tunnels though the soil at depths of 50-60cm. This is done by dragging a small pointed cylinder through the soil behind a ripper.

The effectiveness of this technique depends on the stability of the soil type as mole drains can collapse if the soil is not suitable. Research carried out by CSIRO at Griffith has shown that mole drains are a viable management option for controlling waterlogging and salinity in the root zone of irrigated crops on self-mulching grey clays. (See Irrigation Salinity Facts 10: *Using Mole Drainage* for more information).

Groundwater pumping.

In some areas it is possible to pump water from highly permeable aquifers (beds of gravel or sand in the soil). On-farm groundwater pumping usually takes water from shallow aquifers using a spearpoint system.

The effectiveness of groundwater pumping for controlling water tables depends on how much water is pumped, how quickly the aquifer fills up again and the permeability and thickness of the aquifer. A thick aquifer of coarse sand or gravel will usually mean that the water is drawn from a large area whereas an aquifer made up of a thinner band of finer particles will usually yield less water and may be less effective in lowering the watertable over a wide area.

The water pumped may be used for irrigation, depending on its salinity. (see Salt Action Information Sheet *Using Shallow Groundwater for Irrigation*, available from NSW Agriculture)

CROP MANAGEMENT

Crop plant selection.

Perennial plants such as lucerne and phalaris or other crops with deep taproot systems can use water through a greater depth of surface soil and can be used to lower the watertable. In saline areas some salt tolerant pastures such as puccinellia, balansa clover and strawberry clover can be more productive than other less tolerant plants.

Salt loving plants (called halophytes) such as salt bush and blue bush have been established on salt affected areas and used as sheep fodder.

Trees especially salt tolerant species such as river red gum (*Eucalyptus calaldulensis)* are effective in reducing water table levels and should be part of the whole farm plan.

Plants for ground cover

In irrigated areas it is a good practice to keep soil surface covered with vegetation as much as possible and to avoid the practice of bare fallowing. Bare soil will be an access point (recharge) for rainfall to add to the groundwater

system and will also facilitate capillary rise and surface evaporation that will concentrate salt on the soil surface. A plant cover will protect the soil surface from the sun and reduce capillary action salting. Overgrazing should also be avoided as it reduces a plants ability to recover.

Plant Health
Improving crop and pasture growth though pest and disease management and good plant nutrition will encourage the crop to grow to its maximum potential and use more soil water.

Dryland Salinity

Causes and Processes

With dryland salinity the processes leading to the watertable rise are often different from irrigation salinity as there is no increase in the amount of water coming onto the land through rainfall. Dryland salinity is mainly caused by the clearing of the deep rooted trees, shrubs and perennial grasses and their replacement with shallow rooted annual plants such as cereal crops and annual pastures. This causes water tables to rise and when the watertable nears the surface seepages or discharge will occur. All groundwater contains dissolved minerals and evaporation can concentrate these to problem levels in areas of slow groundwater discharge.

Processes involved with Dryland Salinity

Salinity problems occur when more water enters the ground water than is discharged under natural conditions. This causes the groundwater level to rise and bring any stored salt to the surface. For salinity to occur there needs to be both an increase in the total water into the groundwater as well as a source of salt to dissolve into the rising groundwater.

Recharge and Discharge Areas
The rainwater moving into the groundwater usually enters in the shallow soils and unprotected soils (by vegetation cover) often in the upper slopes and ridges. The areas where this process occurs are called the **"recharge areas"**. The area in which there is upward movement of groundwater and where ground water occurs at the soil surface is called the **"discharge area".**

Rainfall
Rainfall is the source of groundwater recharge. The amount of recharge depends on how much and when the rain falls. Recharge may occur in any season. In winter, especially in southern NSW plant water and evaporation are limited and the water moves out of the rootzone into the groundwater system. Excess summer rainfall, common in northern NSW, can also move beyond the rootzone into the groundwater system.

The role of Trees and other Deep Rooted Plants.

Before the land was cleared, native trees, shrubs and other plants absorbed much of the water infiltrating into the root zone. The transpiration of water by these plants removed much of the water. Estimates of the amount of water removed by large eucalypts are around 250L/day. The depth to which roots penetrate the soil vary with the species. Wheat roots have been reported at 2m while some eucalypts and banksias have special roots that go to depths of 40m (Salama 1998).

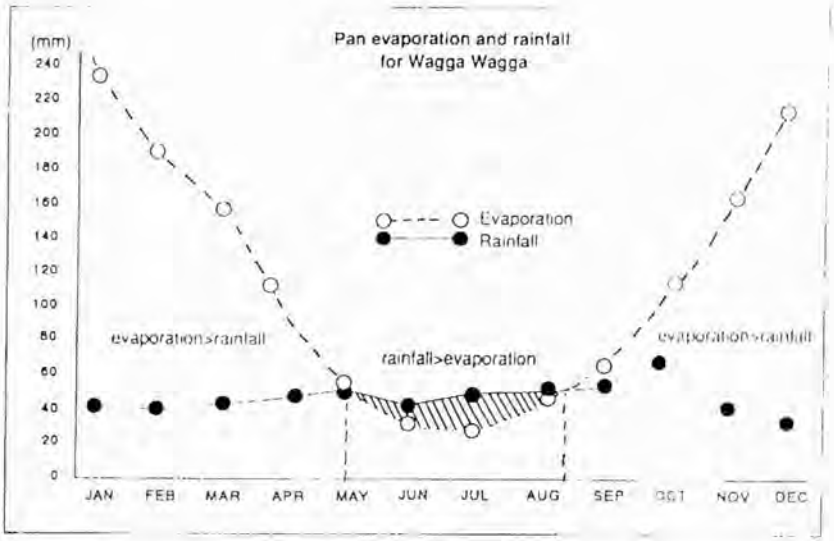
Recharge Areas.

Recharge occurs when the rainwater moves through the soil and away from the rootzone toward the groundwater. Recharge is maximised where:

- soils are shallow.
- soils overlie a fractured rock strata or permeable consolidated sediments.
- soil are well drained.

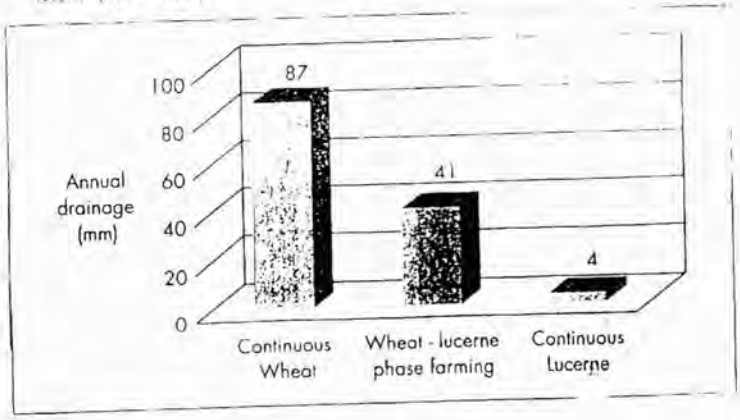
- outcrops of fractured rock occur.
- vegetation is shallow-rooted.
- There is no vegetation
- rainfall exceeds evaporation for a period of the year.

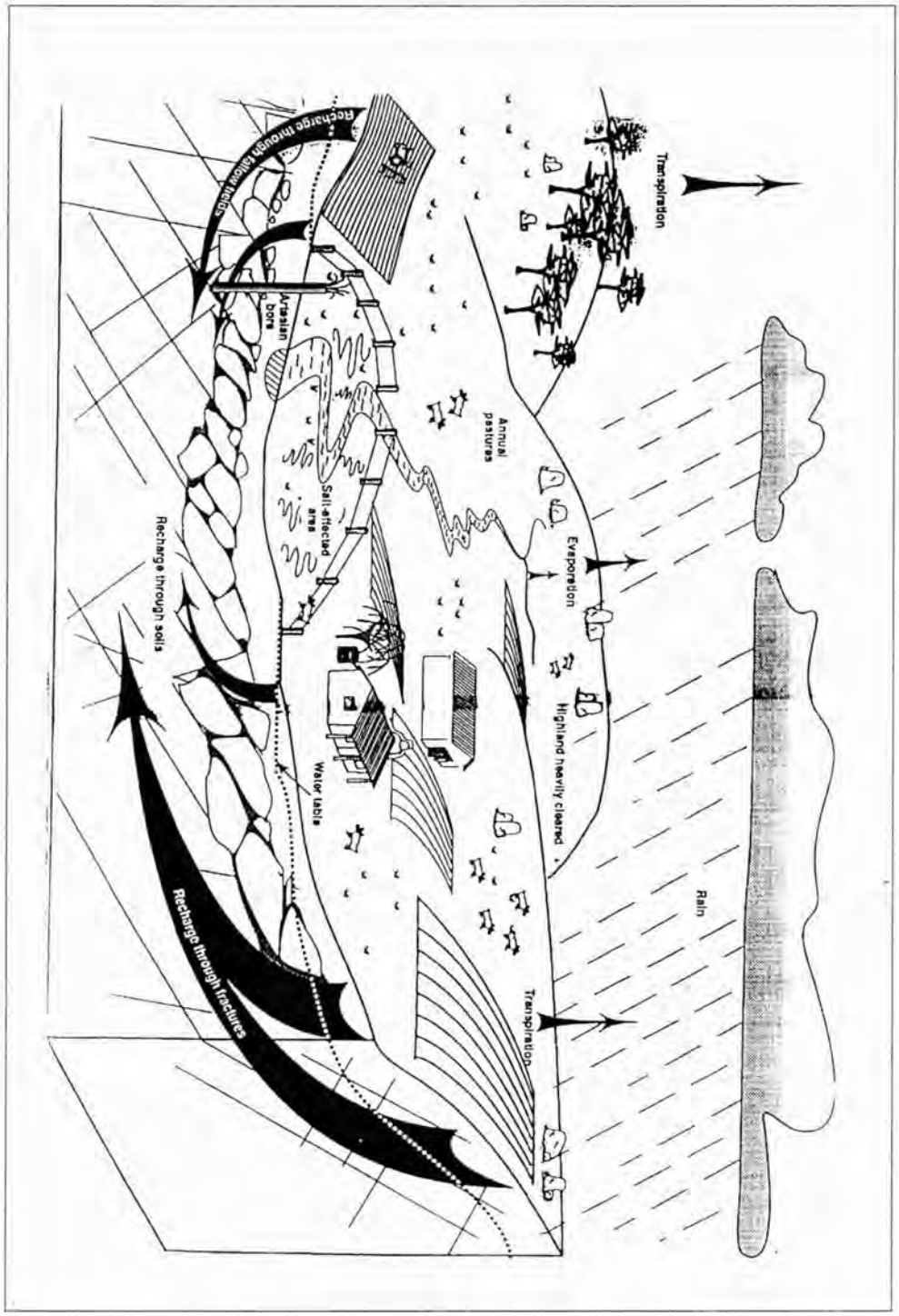
Recharge can occur anywhere in a catchment but areas that are more permeable such as sandy soils and shallow rocky soils on the high areas in a catchment, as well as cultivated crop-land, can contribute large amounts of recharge.



As indicated by the hatched area, recharge is most likely to occur during periods when rainfall exceeds pan evaporation (evaporation from a body of water)

APSIM estimates of deep drainage under different crop/pasture systems. Figures shown are long term averages simulated for the Wagga Wagga climate record (1957-1998)




Recharge through fallow fields
Transpiration
Artesian bore
Annual pastures
Salt-affected area
Evaporation
Recharge through soils
Highland heavily cleared
Water table
Rain
Recharge through fractures
Transpiration

The Movement of Water in the Soil

Water not used by the plants or not involved with surface run-off is either evaporated from the surface or moves through the soil until it reaches the groundwater. Groundwater moves slowly by percolating through pores in the soil and rocks. These layers of sediments and rocks through which the water moves are called **aquifers.**
The rate at which water moves is affected by the type of material in the aquifer, the hydraulic gradient of flow and any restrictions to the flow such as underground compaction from a road on the surface.
Water moves through the ground in different zones. The area where the water enters the ground is the **recharge zone.** Where the water leaves at the soil surface through evaporation or evapotranspiration is the **discharge zone.** The third zone is the area where the groundwater (and dissolved salt if present) moves from the recharge zone to the discharge zone and is called the **ground water flow path.**

The Flow of Groundwater

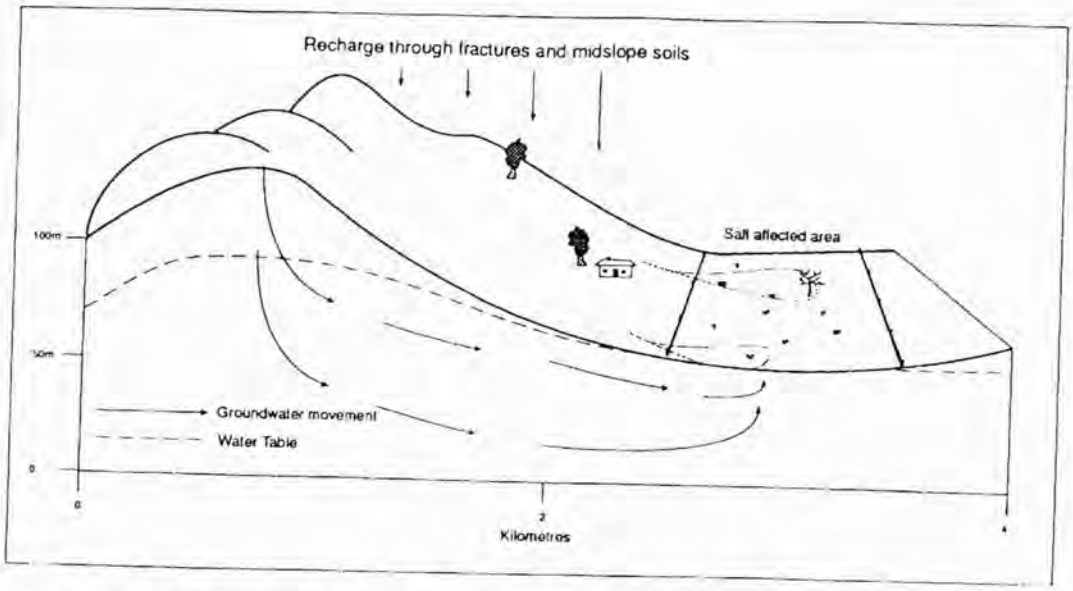
Local Flows
When the recharge and discharge of water are within a few kilometres (or even less) of each other in a catchment the flow system of groundwater is called a local flow. Rainfall recharges the groundwater system through aquifers exposed at the surface in the highland area and through well drained soils in the lower slopes. These systems are quick to respond to a change in the water balance and to date have been responsible for most of the current dryland salinity problems (Martin and Metcalfe 1998).
If a salinity problem occurs in the discharge of a local flow system then salinity management options by the community can be achieved in a much shorter time than those where regional flows are involved.

Regional Flows
These are flows where the recharge and discharge zones are separated by 10s or 100s of kilometres. In these systems the groundwater movements are not necessarily related to the topography of the surface. These systems involve long flow paths and residence times. Changes in the groundwater system take a much longer period to respond in the discharge zone and a water balance would also take a long period.

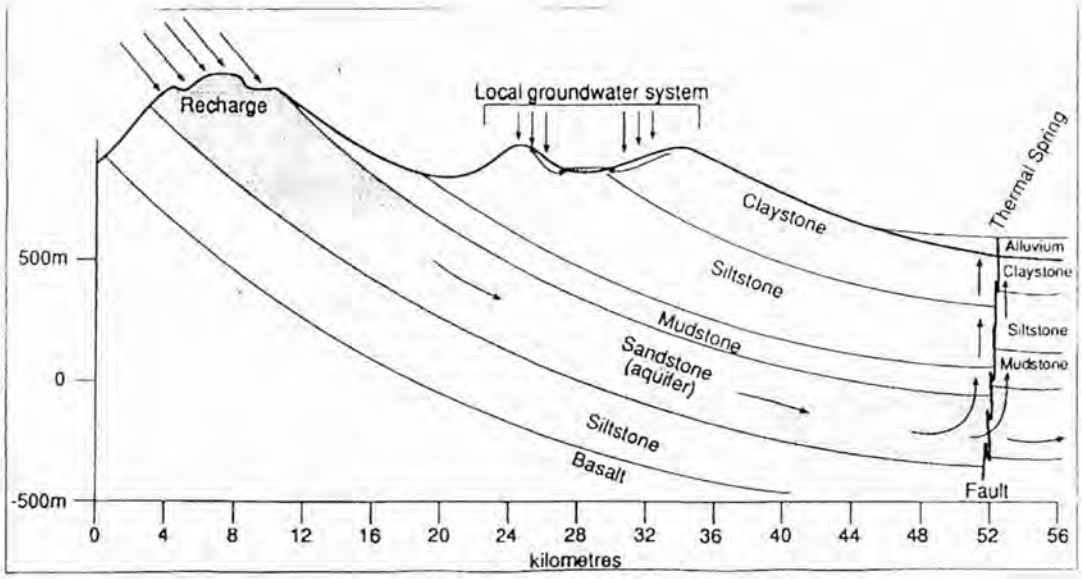
The Effect of the Topography and Geology of the Catchment on Groundwater Flows

The flow of groundwater can be altered by;

- changes in the geology of the aquifer.
- geological obstacles eg dykes (common in WA but not in NSW).
- changes in the slope
- changes in the soil type.
- man-made obstacles such as road compaction.
- topographical restrictions eg narrowing of valleys.



Example of a local groundwater system driving salinisation. Recharge occurs through fractures open at the surface in highland areas, and through mid slope areas. This example shows groundwater discharging at the change in slope.



An example of a regional groundwater system, where a fault has allowed some of the groundwater to rise to the surface and form a thermal spring.

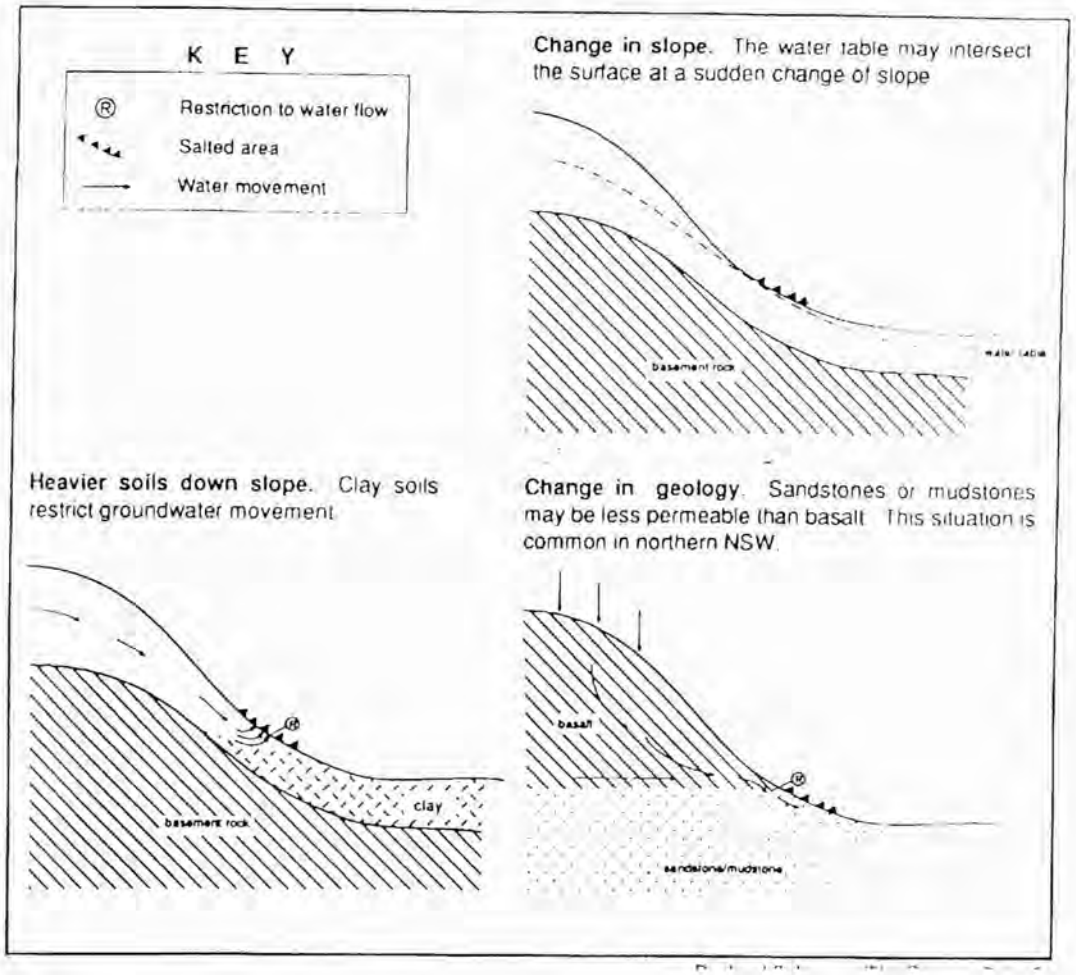
Discharge Areas.

Discharge occurs where the groundwater comes to the surface through capillary rise and evaporation as well as through seepage and springs which may be driven by hydraulic pressure. Discharge areas often occur in the lower slopes, where the ground is flat, or where underground restrictions occur or a combination of these and other topographic and geological features. In a undulating landscape several discharge sites can occur at different heights. The watertable in a discharge is at the surface.

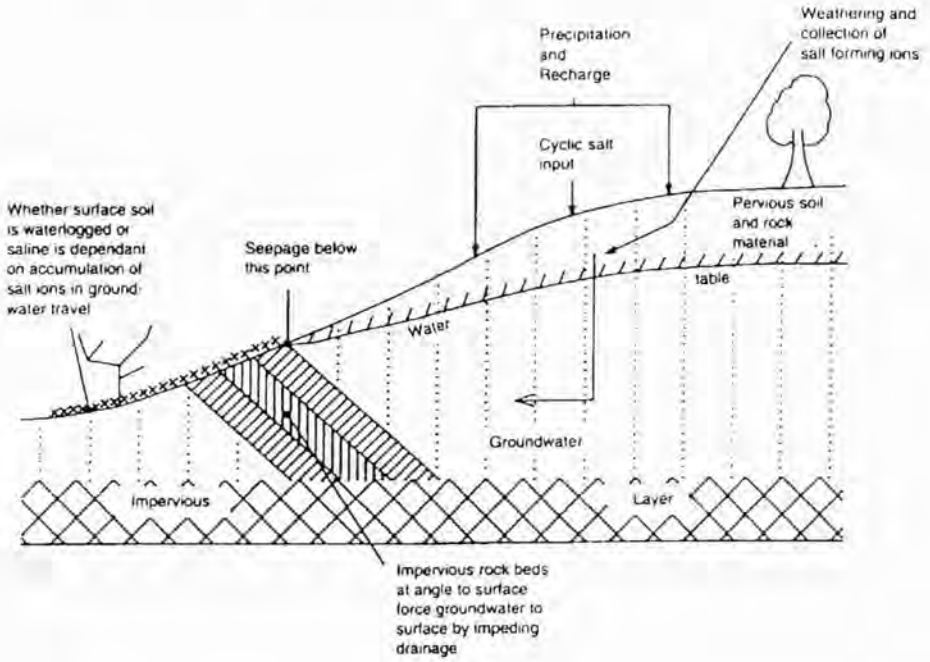
Two types of discharge have been recognised: point discharge and diffuse discharge.

Point Discharge is limited in area and occurs where the discharge is focused into a specific area. Point discharges are often seen as springs or seeps. Another form of point discharge is the discharge of groundwater into lakes or streams.

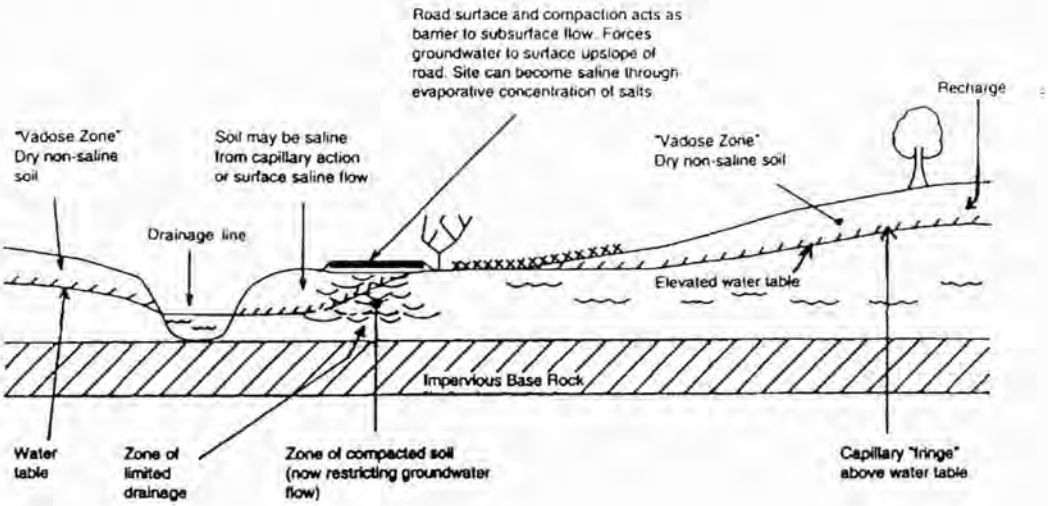
Diffuse Discharge is a discharge site where the groundwater is spread rather than focused in area. The Diffuse discharge is the most common type of discharge associated with salinity in areas of shallow water tables and an arid climate (Salama 1998).



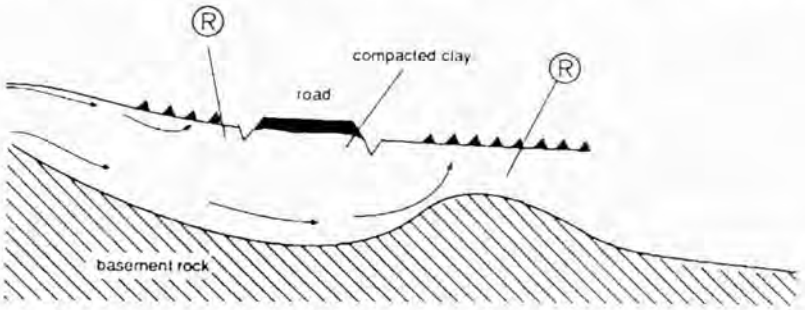
Unconfined Aquifer with Impaired Drainage Leading to Groundwater Discharge



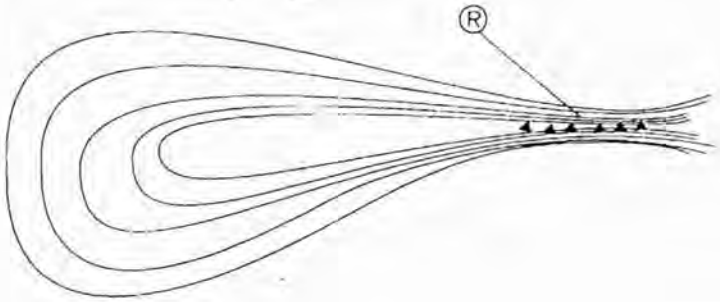
The Effect of Road Compaction of Soil Material on Groundwater in Shallow Soils



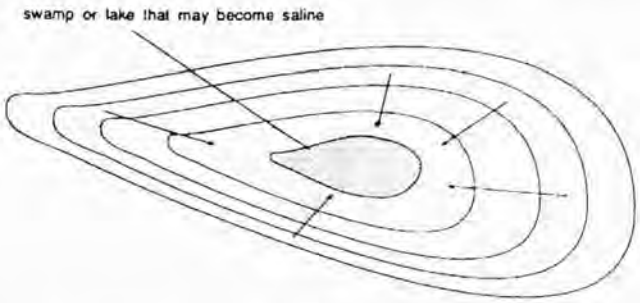
Rise in basement rock and compaction under roads. A road constructed on clay soils may restri shallow water movement. A rise in basement rock causing an underground "dam" will cause a restrictio



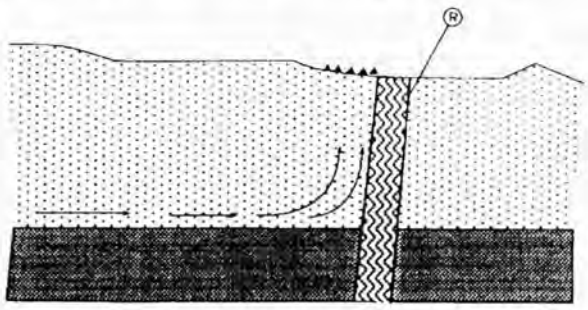
Valley restrictions. A narrowing of the width or a reduction in depth of the catchment throat is a commo groundwater restriction around Wagga Wagga.



Closed basins. Some catchments have an extremely small or no outlet. The Goran Basin in northern NSW has a very limited groundwater outlet.



Dykes. A vertical layer of less permeable material restricts groundwater flow.



Land Management Techniques to Alleviate the Problem of Dryland Salinity

To prevent dryland salinity and to reclaim land degraded through saline discharge a program must involve the integration of groundwater management with the management of the land.
To address the water balance mismatch it is necessary to work on a regional groundwater flow basis. Excess water may travel in the ground water system mobilising salt and cause discharge somewhere else in the region through hydraulic pressure.

Requirement for a Strategy

A strategic approach is required at all levels of salinity management from the individual land manager in small catchments, the catchment community, the large catchment (eg the Murray Darling Basin) to the national level.

In order to develop a strategy it is necessary to know the source of the salt, the movement of the ground water and the salt as well as the discharge sites. This information needs to be collected and analysed on a catchment basis so that there can be a systematic and long term approach involving all the people affected and those involved through being land managers, tax payers and concerned citizens.

Identifying the Problem Areas.

Many of the processes leading to the salinity problem occur underground and are therefore difficult to identify and locate. However various techniques are available and some recently developed technologies have had spectacular results.

The use of Ground Water Monitoring Bores

Test wells and piezometers are small bores used to gain data and monitor ground water. The piezometer is a bore that is drilled directly into the aquifer to measure the pressure level or hydraulic head of the water table. Test wells are PVC pipes put in holes in the ground (to about 3 metres) which are used measure the free water depth to the local watertable. Individual data can be useful for a land manager and collectively they can provide a picture of what is happening to ground water over a region.

Remote Sensing Data

The amount of salt and the extent in the landscape can be estimated and mapped using a number of remote sensing technologies. These include:

Aerial photography.

Provides information on soils, vegetation, topography etc.
Suitable for farming and catchment planning

Landsat.

Provides digital data
Useful for small catchments to regional applications
Provides information on vegetation, landforms land resources and land use.

Electromagnetic Induction

Various types with different characteristics
Can measure salinity in the root-zone to 150m depth.
Can be used to map salinity, ground water and geological variation.

All the data gained from ground measurement and remote sensing can be computer analysed in a combined form to provide valuable information about what is happening on the ground and under the ground. The data gained from remote sensing should be checked on the ground and the digital information should be calibrated against that information.

This processed information has been used to locate concentrations of salt sources, paleochannels and groundwater flows. This type of information will be extremely useful in developing strategies that will contain or reduce salinity and yet maintain or even increase economic productivity of the land. Identifying the sites of recharge, groundwater flows, salt sources and discharge sites will do this.

Monitoring River Water Quality

Trends in the salt loads in rivers and creeks can be monitored over long periods of time through the use of gauging stations. Data from 87 gauging stations in NSW, Qld, Vic and SA is used by the Murray Darling Basin Commission to provide information to identify problem sites, develop strategies and evaluate the effectiveness of actions taken.

Managing the Recharge

All types of landscapes are capable of recharge but the degree to which this occurs depends on topography, soil type, geology and the type of landuse.

Prevention of dryland salinity involves keeping the watertable at levels where the processes of surface discharge and capillary rise to the surface can be eliminated and the leaching of salts by rainwater to the deeper groundwater can take place.

Various techniques of reducing recharge can be used and whilst all of these may not be appropriate to an individual enterprise combinations of these procedures can be adopted in to a farm management plant to help secure sustainable land use and farm production.

The main strategy is to use the water where it falls.

The aim is to prevent the water accumulated in the root zone from leaking into the groundwater system. This is a mainly achieved by keeping the soil surface covered with an actively growing, healthy plant cover.

Plants need to have plenty of leaf area to enable the removal of excess water from the root zone and scientists have found that most of the water removed by plants occurs in the warmer months when the plants are actively growing.

Farmers can reduce or eliminate recharge through leakage from the root-zone through the following farm practices.

- **Growing lucerne** not only as a user of water but as an economic producer in the farm plan eg as an alternative to clover pastures and an alternative to shallow rooted annual crops. Lucerne can be used to control recharge through **phase farming** (Ridley et. al. 1998). In areas where the rainfall is less than 600mm pa., lucerne can remove excess water from the root-zone and make a positive contribution to the lowering of the water table over the first 3 years of a lucerne crop in a rotation phase.

- **Alley farming** involves using a planned, managed combination of shrubs and/or trees in lines with cropping or grazing in-between.

- Planting **trees and woodlots** especially in steep, shallow and rocky recharge areas.

- Growing tree plantation as a commercial crop, ie **agro-forestry**.

- Avoiding summer fallows.

- Using **opportunity cropping** or double cropping. This is the practice of growing winter and summer crops in a well managed rotation.

Why trees are not enough.

The solution to reducing rising water tables, waterlogging and salinity will not be achieved by just planting trees. To reduce the amount of water reaching the groundwater system by the amount necessary to lower the water table in salt affected areas other types of deep rooted perennial plants are required in farming programs. In many cases trees will not be enough to achieve the desired result unless much of the land is completely reafforested. Shallow rooted annual plants such as cereal crops and annual pastures, that are currently a major component of farming systems, will have to be replaced by deep- rooted perennial plants. Plants such as lucerne can play an important role in both the reduction of soil water leakage to the groundwater system and the economic productivity of the farm.

Plants such as lucerne used in rotations in a "phase farming" system reduce the soil water leakage over a large area, dry out the deep sub soil and allow cropping with cereals with no recharge for a few years (Ridley et al 1998).

Improving the general health of crops to create maximum use of water not only reduces leakage to the ground water but also can also increases crop or pasture productivity and hopefully profitability.

The solutions will involve agricultural as well as engineering strategies such as installing groundwater pumps and sub-surface drainage systems. In places where the groundwater is fresh this can be used for irrigation and where the groundwater is saline it may be used to harvest salt in evaporation basins.

Changes to Current Farming Practices to Reduce Salinity

- Use of perennial crops and trees wherever possible.
- Improve the economics of growing perennial crops and trees by developing new products and markets to make the growing of these perennial plants more profitable.
- Implement whole farm planning and integrate farm planning with catchment management planning.
- Develop partnership and co-operation between farmers, community and governments.
- Develop farming systems and products that utilise salt affected land or water.

Germination Experiment - Student Activity

Introduction

This experiment is done with seeds wrapped in rolls or "dollies" of *CHUX* cloths instead of in petri dishes and cotton wool. This helps to maintain moisture levels favourable for germination without drying out or being saturated.

Students should also be encouraged to fully randomise and replicate the experiment to increase scientific validity.

Aim

To observe the effect of increasing saline concentrations in water on the seed germination of some common agricultural plants.

Material

- *CHUX* cloths. These should be new and well rinsed in water before use.
- Common seeds eg cereal crops (wheat, oats, barley), legume crops (lupins, faba beans, chick peas).
- *Clingwrap* or similar plastic film.
- Paddle pop sticks and permanent marker pens.
- Plastic tub for placing the "dollies" into.
- string or rubber bands.
- Saline solutions.

  distilled water
  2.5 g/L salt (approx. 4 dS/m)
  5.1 g/L salt (" 8 dS/m)
  10.2 g/L (" 16dS/m)
  20.5 g/L (" 32dS/m)
  41 g/L (" 64dS/m or sea water)

Method

1. Prepare the saline solutions
2. Count out 100 (or 50) seeds per "dolly"
3. Prepare the "dollies" as follows.
   a) The cloths can be divided lengthwise to make two pieces.
   b) Fold each cloth lengthwise and lay it flat.
   c) Place the seeds in rows of 10 seeds starting about 1/3 in from the end and leaving a similar space at the other end.
   d) Cover the seeds by folding over the 1/3 flaps and rolling the cloth into a roll or "dolly"
   e) Tie off each end or with string or rubber band.
   f) Label each roll with a marked paddle pop stick.
   g) Thoroughly wet each roll by dipping them in the appropriate solution.
   h) Gently squeeze **excess** saline solution from each roll **(DO NOT SQUEEZE DRY).**
   i) Wrap each roll in cling wrap to seal it.
   j) Place dollies or rolls in a tray and put into a warm darkened area.
4. Leave for 7-10 days depending on temperature (ie longer in cold weather).
5. Roll out each dolly and record the number of germinated seed. Germination should be determined by the presence of a healthy plumule (shoot). In some cases a radicle (seed root) may emerge but has been burnt off and no plumule has emerged.
6. Calculate the "germination %" for each treatment.
7. Collate and present data in table and/or a graph and analyse results.
8. Make conclusions about the results.

Sustainable Farming Practices 2 - Student Activity

1. Research the technique known as phase farming using lucerne and prepare a report. The report should address the following points.

- Describe the technique
- describe its effect on soil water and watertable levels
- outline its agronomic limitations
- outline the economic advantages or disadvantages of phase farming compared to cropping of annual plants
- evaluate the economic potential especially in relation to sustainability and salinity management.

Some web sites.

www.atse.org.au/publications/symposia/proc-1998p14.htm

http://life.csu.edu.au/argonomy/ note. 1. The incorrect spelling of "agronomy"
note 2. Use index to look at "phase farming"
note 3 scientific papers- students may need help.

2. Research the technique known as Alley farming and prepare a report. The report should address the following points.

- Describe the technique
- describe its effect on soil water and watertable levels
- outline its limitations in relation to the ability to reduce groundwater accumulation and water table rise.
- outline the economic advantages or disadvantages of alley farming.
- evaluate the economic potential especially in relation to sustainability and salinity management.

Useful Web site

www.agric.wa.gov.au/proserve/natural/trees/uses/alleyslt.htm
www.rirdc.gov.au/pub/shortreps/sr8.html

3. Use a search engine (eg google) to research the farm technique known as "opportunity cropping" in Australia. Report in a similar manner to that outlined in questions 1 and 2 above.

Thank you Paul Robey...

There Can Only Be One

This might be a good idea around which to base a genetics prac.....

Whenever I get a package of plain M&Ms, I make it my duty to continue the strength and robustness of the M&M as a species. To this end, I hold M&M duels.

Taking two M&Ms between my thumb and forefinger, I apply pressure, squeezing them together until one of them cracks and splinters.

That is the "loser," and I eat the inferior one immediately. The winner gets to go another round.

I have found that, in general, the brown and red M&Ms are tougher, and the newer blue ones are genetically inferior. I have hypothesized that the blue M&Ms, as a race, cannot survive long in the intense theatre of competition that is the modern candy and snack-food world.

Occasionally I will get a mutation, an M&M that is misshapen, or pointier, or flatter than the rest. Almost invariably this proves to be a weakness, but on very rare occasions it gives extra strength. In this way, the species continues to adapt to its environment.

When I reach the end of the pack, I am left with one M&M, the strongest of the herd. Since it would make no sense to eat this one as well, I pack it neatly in an envelope and send it to: M&M Mars, A Division of Mars, Inc. Hackettstown, NJ 17840-1503 U.S.A, along with a 3x5 card reading:

"Please use this M&M for breeding purposes."

This week they wrote back to thank me, and sent me a coupon for a free 500g bag of plain M&Ms. I consider this "grant money." I have set aside the weekend for a 'grand tournament. From a field of hundreds, we will discover the True Champion.

There can be only one.

Non-Chemical Agriculture

Many people are of the opinion that the use of chemical fertilisers, pesticides and herbicides are not only dangerous to the environment but can also affect people if they get into the food chain. These fears have prompted renewed interest into the use of non-chemical inputs in the use of food production. The practice of growing plants without any chemical additives is often termed "organic", and is said to produce "organically grown" food products. Often "organic" methods are not as effective as they don't kill all the pests or weeds but people are often willing to accept a few holes or slugs in their lettuce if they know they won't be eating any chemicals.

Examples of organic methods:

Fertilisers:
Animal manures and composts are ideal ways to increase the level of nutrients in a soil. Animal manures can be obtained from nurseries or stalls on the side of the road. Backyard compost heaps provide a good way of recycling household food and garden scraps. An increasing number of people are using worm farms to recycle kitchen scraps into nutrient-rich organic fertilisers.

Weed Prevention:
Weeds can be prevented by using mulches around the roots. These mulches can be organic (from living things eg, manures, pine bark or straw) or inorganic (man made or not living, eg, plastic or pebbles). These cover the ground and stop weeds growing. Mechanical methods of weed control eg: pulling or digging weeds out are also "environmentally friendly'.

Pest Prevention:
Many non-chemical methods can be used to rid a garden of plant-eating pests. The easiest method for large pests (and for someone with lots of spare time) is to pick pests off plants by hand. Coarse sawdust sprinkled around the base of plants will make it uncomfortable for snails to travel over and therefore will stop them eating your plants. Rolled up newspapers placed on damp ground overnight will be filled with snails and slugs in the morning, ready to be thrown out.
Common food products can also be used to trap or deter pests. Beer placed in a saucer can be used to attract snails. Red wine is apparently irresistible to moths. Both garlic and rhubarb leaves can be boiled- when cool, the liquid can be sprayed onto leaves to prevent pests eating them. Onions and garlic planted between other plants will also help keep some pests at bay.
The use of other living things to control pests is called Biological Control. Certain insects eat plant-munching garden pests, for example lady beetles feed on aphids. Many native snail species are carnivorous and simply love eating garden slugs and snails. These should be encouraged as they help keep pest numbers down. People with larger gardens often keep chickens or ducks to help keep their gardens pest free.

Task:
Design and construct a pamphlet or poster that could be used to give householders information on backyard agriculture without the use of chemicals. Your creation must describe:

- 2 non-chemical ways to increase soil nutrients
- 2 non-chemical ways to prevent weeds
- Biological control with at least one example
- 2 other non-chemical ways of controlling pests

Illustrations and colour should be used

YEAR 9/10 JUNIOR AGRICULTURE PROGRAM

ENTERPRISE: VEGETABLE PRODUCTION SYSTEMS

Devised by: N A Cox
Implemented: 2001-05-31

ENTERPRISE: VEGETABLE PRODUCTION SYSTEMS

Duration: 1 year (Depending on vegetable choice) Stages 4 and 5

Unit Aim: To develop an understanding of the factors involved in vegetable production and develop skills in plant management techniques. In meeting the syllabus outcomes, the following areas of focus, processes and perspectives have been integrated into the program.

(from syllabus support document)

Areas of Focus

Interactions: between vegetables and: - micro-organisms, invertebrates - soils, water and climate - people (farm community) - minerals and energy - technology	Management - marketing - product appraisal and specifications - planning for sowing to post harvest - factors affecting production - timing and types of operations - crop and variety selection - record keeping - skills to maintain crop - plant structure and function - pest and disease control

Factors to Consider

- Year 9 Agriculture classes operating (timetable issue) - skill and interest of the class - selection of vegetables relative to recommended district sowing times	- limit area for student (2 sq. metres)

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

ENTERPRISE: VEGETABLE PRODUCTION SYSTEMS

Processes

Designing - designing solutions to problems such as: - water and nutrient use - pest and disease control - weed control - product harvesting, packaging and handling - marketing vegetable products - Using the design process or aspects of it to establish or maintain vegetable production Using Technology - using appropriate technology and current technology associated with vegetable production - using tools and equipment safely - us material to improve production such as fertilisers, lime etc - harvesting vegetables - calculate profitability of vegetable production	Investigating – conducting scientific investigation into vegetable production - conducting controlled experiments involving vegetables - visit commercial producers and processors (Subject to availability and excursion dates) Communicating – communicating in a range of media, including writing, speaking and multi-media - working cooperatively - organising information - recording information for effective enterprise performance monitoring

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

ENTERPRISE:

perspectives

Aboriginal - Compare the gathering of vegetables/fruit based on maturity time to extensive ground preparation, for vegetable production. Environmental - Recognise the importance of using legumes and limited beneficial fertilisers for soil quality and sustainable production. Historical – Recognise the effect of consumer preference on vegetable production. Careers and Further Study – Investigate careers in plant breeding and developing and importing new vegetable varieties	Community – compare the traditional methods of vegetable uses and presentation to the modern day situation considering Australia's ethnic cultural mix. Animal Welfare – N/A Health and Safety – Understand the reasons for Occupational Health and Safety regulations when operating farm machinery

ENTERPRISE: VEGETABLE PRODUCTION SYSTEMES

Assessment Strategies – Topic Test on vegetables - see files
- see current assessment schedules

Literacy Strategies – The following are key words associated with this topic. These can be placed as a list at the start of the topic or used in context. climate, weather, vegetable, anemometer, molybdenum, herbicide, insecticide, cauliflower, harvest, fertiliser

Resources – Dynamic Agriculture Book I and 11 (1st and 2nd Edition). Please note the page references in the program are keyed to the 2nd edition. DA 1 and DA 11.

- videotapes in library
- Yates Garden Guide
- Home Vegetable Garden
- Sutherland J. Introduction to Agriculture
- Francis/Hanlon Agriculture and You 1

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
3.2 1.1	Describe the main aspects of climate and weather and how they may determine the success or failure of vegetable crop production	- Distinguish between the terms weather and climate a) Define the terms: temperature, (max, min, optimum), rainfall, evaporation, wind, humidity b) Describe the functions of thermometers, stevenson's screen, rain gauge, evaporimeter, wet/dry bulb, anemometer - Emphasise the link between weather/climate conditions and the pursuit/success of Agriculture ventures. eg: timing for sowing specific vegetables Hail/Frost damage - Relate the location of the Singleton area to Australia to the pursuit and /or limits to types of Agriculture plant production - Justify location of broad acre vegetable growing along large river systems - Explain how weather forecasting can assist producers	D.A. 1. p. 72 – 80 D.A. 1 p. 73 Yates Garden Guide p. 2 – 3 D.A. 1 p. 72-80		
7,.2 5.1	Identify and use apparatus used to measure climatic components (subject to availability)	Identify thermometers wet/dry bulbs, stevenson's screen, rain gauge, anemometer, weather vane, evaporimeter	D.A. 1 p.72-80		

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
3.2 8.1	List and describe the physical aspects of soil important for the growth of plants	Distinguish between the organic and inorganic components of a soil. * Define the following terms and explain how they relate to soil production potential * soil texture * soil structure * soil air (pore space) * soil temperature (dark and light soils) * soil water	D A 11 p. 33-47 Yates Garden Guide p. 30-31		
4.1 7.2 10.1 9.1 11.2 12.1 13.1	Assess the physical status of a soil	* determine the soil texture status of a soil sample * measure soil temperature at various depths * assess soil structure of a soil sample * measure the amount of soil moisture in a soil sample * outline the role of a neutron probe in determining soil moisture quantity	D A 11 p. 33-47		

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
3.2 8.1	List and describe the chemical aspects of soil important to the growth of plants	* Determine the source and role of nutrients needed by plants viz: Nitrogen) Major Phosphorus) Potassium) Elements Copper) Minor Molybdenum) Elements	D A 11 p. 99-101		
5.1 7.2 1.4 8.1 3.2	Assess the chemical status of a soil List soil problems that may affect vegetable production and nominate practical solutions to these problems	* carry out pH tests of soil * modify the pH status of a soil using lime if required * Relate the following soil problems to appropriate corrective measures * soil acid conditions use lime * soil chemical deficiencies use fertilisers (emphasis on Nitrogen, Phosphorus, Molybdenum deficiencies and the use of single, compound, organic and foliar fertilisers) viz: Superphosphate, Sulfate of Ammonia, Dynamic Lifter, No 17, Aquasol * soil structure problems use Gypsum * Disease/pests low nutrient levels use crop rotation	D A 1 Chapter 10 Chapter 14 Home Vegetable Garden p. 9, 10 & 11		

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
3.2	List the procedures needed for the sustainable growing of vegetable crops NB: this objective was treated in Year 8	* List/Revise steps involved in successful/sustainable vegetable garden establishment viz: soil preparation, seeding, transplanting, equipment available	D A 1 p. 133-140		
11.1 5.1 3.4	Individually grow and satisfactorily maintain in a prepared seed bed at least three vegetable types	* Students are to grow potatoes, a legume vegetable, (beans, and/or peas) and at least one other vegetable employ principles as appropriate ie: hilling, cutting seed potatoes, transplanting, sowing using correct fertilisers * Practice safe and correct pest/disease weed control techniques in maintaining the above. (ie gloves for weeds, washing after chemical use, avoid skin contact, chipping for weeds and aeration	see following outcome D A 1 Chapter 10		

SINGLETON HIGH SCHOOL
YEARS 9/10 JUNIOR AGRICULTURE PROGRAM

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
3.1 3.2	Describe the physiology and management routine for potatoes, a legume vegetable (beans or peas production) Notes: A study of an additional vegetable can also be carried out perhaps as an assignment or class option or to supplement a Year 8 Design and Technology brief	* Study the biology of the plants opposite. This to include structure, flower arrangement, growth habit. (Parameters of study as indicated in the references) * List the main end uses of selected vegetables * A study of management of the plants opposite This to include sowing time, sowing depth, planting method, harvesting time * Briefly study the main insect pests/diseases that can affect the above plants and nominate appropriate controls. These can include: Potato Moth, Bean Fly, Damping off disease, Green vegetable Bug, Cabbage white Butterfly	Ag and You 1 p. 25 Introduction to Agriculture p. 172 Home and Vegetable Garden p. 52, p. 28 Yates Garden Guide p. 136, p. 104 Home Vegetable Garden p. 89, 82, 77, 79		
8.1 3.2	Describe how weeds, pests, and diseases may limit plant production and nominate corrective measures	* List and describe common garden weeds and note their biological success as plants and how they limit vegetative productivity. These to include nut grass, stinging nettle, Khaki weed, winter grass * Explain the term and use of herbicides * Describe the life cycle of a typical plant pest and identify the damaging and vulnerability points of its cycle	D A 1 chapter 10 D A 1 p. 163		

Outcome	Enterprise – specific outcomes At the end of this unit, students should be able to	Suggested teaching/learning strategies	References	Evaluation	Registration
		(Use cabbage/white butterfly as an example) ie: egg, larvae, pupae, adult	D A 1 p. 107,108 Ag and You 1		
3.2	Identify selected weed, pest and disease types of vegetables (see opposite)	* Define the terms insecticide, contact/systemic insecticide, fungicide, integrated controls	p. 25		
		* Describe the effects of plant pests and diseases on plant productivity	D A 11 p. 98 –99		
5.2 5.1 11.1	Apply correct harvesting techniques when harvesting vegetables	* Correctly harvest vegetables grown previously	Home vegetable garden p. 17		
3.1	Describe how a commercial vegetable is marketed	* Emphasise the free market situation regarding the marketing of cabbages, cauliflowers and potatoes	D A 1 p. 139		
		* Examine quality controls as they apply to potatoes, beans	D A 11 p. 122		
		* Recall average yield, hectare and prices for selected vegetables	D A 11 p. 297		
		* Apply simple profit/loss principles to vegetable production	p. 289		

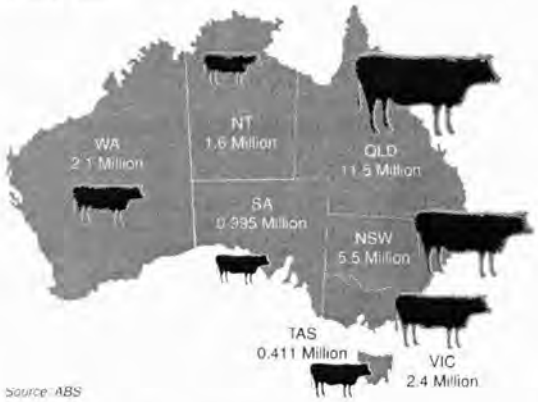
Fast Facts

Australia's Beef Industry

Australia is one of the world's leading producers of cattle and is the world's largest exporter of beef.

Australian beef herd

as at June 2000



Source: ABS

Australian cattle on feed

Total = 609,009 head (December quarter 2000)



Source: ABS/AFFA

Australian beef production

Total = 2 million tonnes cw (2000)



Source: ABS

Did you know...

- 70% of total Australian beef production is sourced from Queensland and NSW (ABS 2000).
- Around 64% of the Australian beef herd are carried on 'specialist beef properties' - that is, properties that were engaged mainly in running beef cattle (ABARE).
- In the December quarter 2000 there were 609,009 head of cattle on feed (ALFA/ MLA Survey).
- Each year Australia produces about 2 million tonnes of beef (ABS 2000).
- The gross value of production of Australian cattle and calf production (including live cattle exports) is approximately $4.8 billion (ABARE 2000).
- Australia has a 'whole of chain' approach to the production of safe and wholesome beef. It relies on each sector implementing a HACCP-based quality assurance system to ensure safe practices and enabling traceback to all levels, right back to the farmer and the animal.

Herd facts and figures:

- 76,662 properties with beef cattle (ABS 2000)
- 24.4 million beef cattle (ABS 2000)
- 12.3 million beef cows and heifers (ABS 2000)

Consumption:

- Australians eat 35.7 kg per person yearly (carcase weight – MLA 2000 estimate).
- Around 82% of Australian households buy fresh beef (Roy Morgan Brand Planner 2000).
- In volume terms beef is the second most popular fresh meat consumed through the food service industry after chicken (BIS Shrapnel June 1999).

MEAT & LIVESTOCK AUSTRALIA

Beef exports

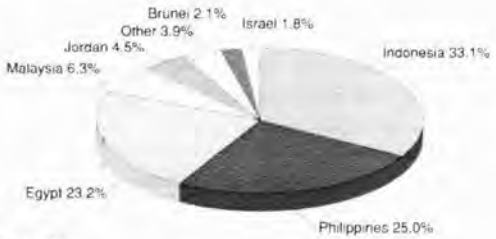
Total = 901,630 tonnes sw (2000)



Source: ABS/AFFA

Live cattle exports

Total = 895,344 head (2000)



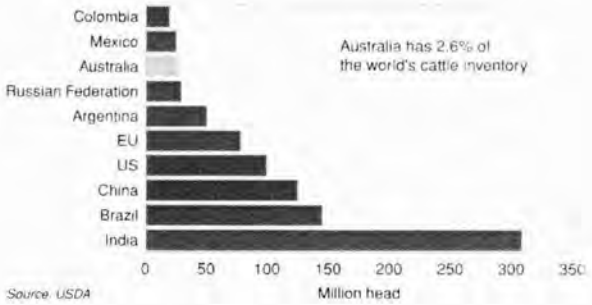
Source: ABS

Export facts and figures:

- In 2000, Australia exported 66% of its total beef production (AFFA/ABS).
- The value of total beef exports in 2000 was approx $3.5 billion (AFFA/ABS).
- In 2000, 43% of Australia's beef and veal exports was manufacturing grade beef (over half of this was sent to the US) and 50% of exports were boneless primal cuts (over half of these were sent to Japan). Bone in primals accounted for around 3% of total beef and veal exports and carcases acounted for 2% (AFFA).
- Australian live cattle exports were valued at $479 million in 2000 (ABS).
- Over 37% of live cattle exported from Australia are shipped from WA, and another 34% from the Northern Territory (ABS 2000).

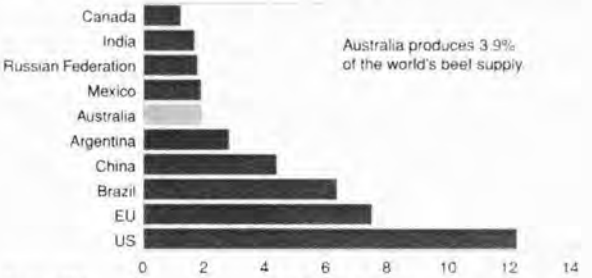
Around the world:

Top ten world cattle inventories



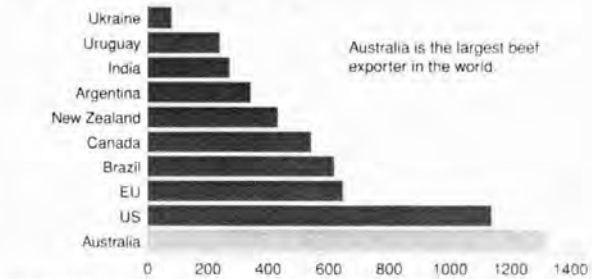
Source: USDA

Top ten world beef producing countries



Source: USDA

Top ten world beef exporters



Source: USDA

Contact
Sylvia Athas, MLA Tel: (02) 9463 9218
email: sathas@mla.com.au

MEAT & LIVESTOCK AUSTRALIA
165 Walker Street, North Sydney NSW 2060
Tel: (02) 9463 9333 Fax: (02) 9463 9393 www.mla.com.au
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Head Office: Level 1, 165 Walker St, North Sydney NSW 2060 AUSTRALIA Tel +61 2 9463 9333 Fax +61 2 9463 9393
Americas: 1401 K Street NW; Suite 602; Washington DC 20005, USA Tel +1 202 521 2551 Fax +1 202 521 2699
Korea: 11th Floor, Kyobo Building 1, Chongro, 1-ka Chrongro-ku, Seoul 110714 REPUBLIC OF KOREA Tel +82 2 720 7091 Fax +82 2 733 8337
Middle East: 5th Floor, Yateem Centre, Almutanabi Road, Manama, BAHRAIN Tel +973 223 003 Fax +973 225 394
Japan: World Trade Centre Bldg, PO Box 29, Trade Centre, 2-4-1 Hamamatscho, Minato-ku, Tokyo 105-6112 JAPAN Tel +81 3 3435 5785 Fax +81 3 3438 1677
Europe: c/o Australian Consulate General; 5th floor, Gruneburweg 58-62; Frankfurt-Main; 60322 GERMANY Tel: +49 69 9055 8500 Fax: +49 69 9055 8519

MEAT & LIVESTOCK AUSTRALIA

Australia is one of the world's leading producers of cattle and sheep. The red meat industry chain begins in the paddock and ends on the plate. It comprises many industry associations and private companies that plan and market livestock and meat products. One of these organisations is Meat & Livestock Australia Ltd.

Meat & Livestock Australia (or MLA as it is known), first and foremost provides services to its owners – Australia's livestock producers – and offers support to the cattle, sheep and goat industries in strategic planning. The company also provides services to other industry sectors, such as meat processors and live animal exporters.

Producers fund MLA through levies collected when livestock is sold. This is supplemented by cooperative contributions from individual processors, wholesalers, food service operators and retailers. Processors and live animal exporters pay levies under contract to MLA. The Commonwealth Government provides funds specifically for research and development.

Funds collected are split almost equally between marketing and research. In many cases a research activity is rendered deficient without marketing, and vice versa. The total funding available is around $84 million each year.

CASE STUDY

THE FIGHT TO RETAIN US LAMB EXPORTS

The export of Fresh Australian Range Lamb, an MLA-branded product, to the US, is 'an efficient, competitive and unsubsidised Australian export industry, whose trade with the US is worth more than $100 million a year'.*

– This trade has grown rapidly due to the product quality and US consumer acceptance.

– However, US sheep farmers continually lobby the US government to impose crippling restrictions, stopping free trade between the two countries.

– MLA's market access role is to work with the Australian Government to lobby against the raising of tariffs, which would harm this trade.

* Sydney Morning Herald, 17/6/99.



MARKETING

A primary concern for MLA in marketing red meat is gaining acceptance by overseas consumers. The company promotes the image that Australian meat is a high quality food, free from disease and additives, providing excellent nutrition at an affordable price.

MLA promotes beef, lamb and goatmeat to the domestic market in a similar way, with the aim of featuring beef and lamb regularly in the consumer's diet. Red meat is the best source of iron and zinc, essential elements for growth and good health.



RESEARCH & DEVELOPMENT

The research arm of MLA supports the marketing effort using processes that seek to continually improve the product. Research and development (R&D) projects are the key to innovation in livestock production and in processing and product development.

ON FARM R&D

Livestock production projects cover meat standards, development of a consumer-oriented grading system, quality assurance in farms and animal identification throughout the red meat chain. MLA encourages producers to listen to what



consumers want, and raise livestock to meet this need. Modern business practice and the use of information technology skills on the farm are now accepted practice among progressive producers.

continued overleaf

continued from front

OFF FARM R&D

Processing and product innovation has the same aim of satisfying the consumer. MLA's research and development program is wide ranging. It covers environment, equipment development, product development, process redesign, health and safety, education and training.

It is also concerned with technology development and commercialisation,



food safety and microbiological research, and co-product innovations such as leather, sheepskin and bone.

MARKET INTELLIGENCE

Apart from these services, MLA has other roles.

- It acts as a knowledge bank for the industry through compilation and interpretation of statistical information and market intelligence.
- It forms links between overseas markets and the local industry.
- It provides expert advice and advocacy on industry issues.
- It plays a major role in educating and updating producers, processors and consumers, including students, about what is happening within the industry, in Australia and overseas.
- It is often the facilitator between the industry, peak industry councils and government.



INTRODUCING THE
MSA beef grading and labelling system

Domestic consumption of beef has declined by nearly 30% in the last 18 years. The US has taken export market share from Australia as its grading system is considered to be the world's best. All this contributed to a fall in returns to producers.

- Extensive research to identify why consumers were moving away from beef showed 81% believed price was no indicator of eating quality. Nearly all believed fat equated to poor quality while 57% could not select tender beef.
- However, overseas and domestic consumers were willing to buy more and pay more for beef, if they were satisfied with the product.
- The introduction by MLA of the Meat Standards Australia grading and labelling program guarantees that eating quality and consumption. It is hoped that higher consumer demand will also increase returns to producers.
- MSA was developed after consumers tested more than 140,000 samples involving 14,000 retail cuts. Of all the people who had purchased MSA beef, 94% were either satisfied or very satisfied with the product and 86% had subsequently repurchased.
- The first phase of MSA was launched in Brisbane on 6 June 1999.

OTHER INDUSTRY BODIES

The peak councils that play a significant role within Australia's red meat industry include:

- *Red Meat Advisory Council*
- *Australian Meat Council*
- *National Meat Association*
- *Australian Livestock Exporters Council*
- *Cattle Council of Australia*
- *Australian Lot Feeders' Association*
- *Sheepmeat Council of Australia*
- *Goat Industry Council of Australia*

Other bodies with an important role are:

- *Australian Meat Processors' Corporation (AMPC)*
- *Livecorp*
- *SAFEMEAT*
- *AUS-MEAT*
- *Australian Council of Livestock Agents*
- *National & State Farmer Organisations*
- *Agriculture, Fisheries & Forestry-Australia*
- *State Agricultural Departments*
- *State Meat Authorities*
- *Office of the Chief Veterinary Officer*



If you would like more information about Meat & Livestock Australia, its work or the industry in general, visit MLA's website at www.mla.com.au or phone toll free **1800 023 100**

MEAT & LIVESTOCK AUSTRALIA

FEEDLOTS in Australia

A beef feedlot is where cattle are mechanically or hand fed to produce meat of consistent quality. Cattle are kept in pens and do not eat pasture like cattle raised on farms. They are fed grain-based diets and hay or silage. The meat from cattle that are fed a grain-based diet can be sold as grainfed beef. Lot feeding is an intensive (high throughput) production system.

Feedlot Fact

Australian feedlots have the capacity to feed up to 800,000 beef cattle. The largest feedlot in Australia is located in Queensland and can hold up to 60,000 cattle.



Feedlots have operated in Australia since the 1960s to 'finish' cattle for market and to ensure a consistent supply of finished cattle. Consistency is not always possible through extensive (grass) grazing of cattle, due to Australia's varying climate (eg droughts).

There are over 780 feedlots Australia-wide that produce grainfed cattle. Most of the feedlots are located in south east Queensland and New South Wales. They are located in mixed farming areas for easy access to cattle, grain and other feed sources.

Markets for grainfed beef

Grainfed meat is highly valued by many of our export markets such as Japan which is our biggest market for grainfed beef. Cattle for the Japanese market remain in the feedlot for between 180 and 360 days. This results in meat that is 'marbled', where the fat is distributed through the muscle.

Over half of the grainfed beef produced in Australia is exported to Japan, with the domestic market and Korea taking most of the remaining product.

All feedlots producing meat for export need to be accredited under the National Feedlot Accreditation Scheme, the industry's quality assurance scheme. This is to ensure Australia maintains a high standard of production and supply to all markets. The scheme ensures proper care of the animals and the environment.

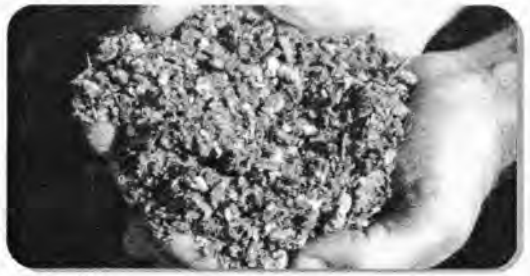
The process of lot feeding

Lot feeding is the most intensive of the beef cattle production systems so management of feed rations, water, animal health and the environment is very important.

Like to find out more about feedlots? Investigate Meat and Livestock Australia's website at
www.mla.com.au

1. Sourcing the cattle

The people operating the feedlot may breed their own cattle to put in the feedlot, or they may buy cattle from other producers. Some feedlots offer a custom feeding service where producers can pay to have their cattle 'finished' in the feedlot before they are sold to meet specific market requirements.



2. Feeding

Feeding the cattle is one of the most important jobs on the feedlot. The food they are fed (called feed rations) is managed so their growth and weight can be controlled. When cattle enter the feedlot, they are introduced to the feed ration gradually because it is different from their previous diet.

Different feed rations can be given to the cattle depending on the weight gain that is required and the meat qualities wanted by the market. In a feedlot it is possible to determine quite accurately how fast each animal is growing and when it will be ready for market. In large feedlots grain and other feed is stored in large silos and the rations are accurately weighed and mixed.

Feedlot cattle may be fed once or twice a day. The rations are put into large troughs, usually just outside the pens. This allows the cattle to reach the feed but not make it dirty. Water is available at all times in the pens.

Feedlot production is affected by the price and availability of grain. If grain prices are high (as in times of drought) or if grain has to be transported long distances, the production cost of grainfed beef is high.

MEAT & LIVESTOCK AUSTRALIA

3. Checking the cattle

Checking that the cattle are healthy and caring for sick cattle is also an important activity in the feedlot. Trained stockmen on horseback or on foot work the cattle gently around the yards everyday and can easily spot any sick animals because they will be slow or look unsettled. If a sick animal is found, they move it away from the other cattle, usually into a separate hospital pen for treatment and care.

Feedlot cattle are usually weighed on entry to the feedlot and sometimes during the feeding period to check their progress. The scales used by feedlots to weigh cattle are big enough for the animal to stand on and are surrounded by a 'cattle crush', a fenced pen that holds the animal still while the weight is recorded.

Holding the cattle in the crush also enables feedlot workers to ear-tag the animals, which helps to identify them. This makes sorting cattle much easier. They may also receive a treament to boost their health and resistance to disease.









4. Managing the waste

With so many cattle housed in feedlots, not surprisingly there is a lot of waste to dispose of such as manure and effluent. It is necessary to treat the waste so there are no strong odours or environmental problems.

The yards are usually built so that run-off (including manure) drains away to a large collection or ponding area. It is then removed, treated and composted, used in other areas of the property, or sold to other farms as a fertiliser or soil conditioner.

Manure is also a valuable by-product as it can be composted and used as a natural fertiliser.

5. Selling the cattle

Cattle ready for the market are weighed and checked before loading onto large trucks, which take them to the abattoir.

Care of the Environment

The beef cattle lot feeding industry in Australia is committed to caring for the environment. Feedlots require a lot less land for the production of beef ... but sometimes there are problems with odour, water and waste.

Feedlots are therefore required to protect the land, groundwater resources, surface water resources and community amenities. In addition they must utilise effluent and manure in a responsible way.

FEEDLOT TALK

MARBLING - refers to flecks of fat distributed through the muscle. It is highly valued in Japan.

FEED RATIONS - is the mix of grains and other food fed to cattle on the feedlot.

FINISHING - means putting cattle on a feed ration to meet a specific market need. Cattle which are 'finished' are processed immediately for meat.

SHORT FED - cattle are grainfed for 70-150 days to supply the domestic or export market.

MEDIUM FED - cattle are grainfed for 150-200 days generally for the Japanese or Korean market.

LONG FED - cattle are grainfed for over 200 days (up to 360 days) for the top Japanese markets (eg fine dining restaurants).

CONSISTENCY - is the ability of feedlots to continually produce meat of the same high quality, regardless of seasons.



Meat and Livestock Australia is committed to providing information on the Australian red meat industry and values your feedback to develop future materials. For further information please contact:

Meat & Livestock Australia Ltd
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Email: learn@mla.com.au Web: www.mla.com.au

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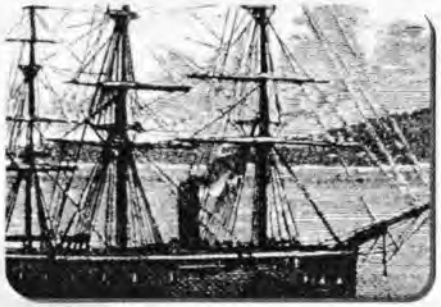
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Spring 2001 BAAT Edition No 19

LIVE CATTLE Exports

The transport of live animals by sea has a long history in Australia. It is how Australia's cattle industry started when cattle and other livestock arrived in Australia on the ships of the First Fleet in January 1788. The cattle were purchased in Cape Town, South Africa, as the ships made their way to Australia. In a colony struggling to feed itself, cattle were to become critical for milk and meat. Each successive ship to Australia carried new stock for the early settlers.

From these humble beginnings, Australia is now the leading exporter of cattle in the world. We export livestock by sea from 18 Australian ports to 44 overseas destinations, mostly in South East Asia and the Middle East. In 2000, Australia exported almost 900,000 head of cattle, valued at $480 million.



Industry location

The live cattle trade in Northern Australia has provided many benefits to local producers and the community. Distances and travel times to South East Asia are minimal and the predominant cattle species, *Bos indicus*, cope well with the tropical conditions. The live export trade supports many local businesses such as feed suppliers, livestock transporters, musterers and shipping agents.

Western Australia and the southern states also benefit from live cattle exports to the North African and Middle Eastern markets that prefer *Bos taurus* breeds.

Darwin is the largest shipping port for the live cattle trade in Australia with most cattle going to South East Asia. Fremantle in Western Australia is the main port for loading cattle to the Middle East and North Africa. Port Hedland, Broome, Karumba, Townsville, Wyndham, Portland and Adelaide also load large numbers of cattle for the live export trade.



Page 1

The voyage

Cattle travel from the farm or feedlot on trucks or trains to the port where the ship is held (docked). Before loading, they are checked by veterinarians to ensure they are healthy to travel and are sorted according to weight and breed type.

The cattle travel on large ships specially designed to carry them. The ships vary in size and can carry shipments of up to 15,000 cattle at a time, although generally between 1,000 and 6,000 are shipped.

On the ship, cattle are grouped into ventilated pens, allowing sufficient airflow to keep them cool and comfortable. They cannot run around the ship because of risk of injury, so are confined in the pens throughout the journey. However, they can move within the pens to water and feed troughs. The pens are usually lined with straw or sawdust, acting as a bed for the cattle, and are cleaned regularly.

Good ship design means cattle can travel on the top decks (above the waterline) or lower decks (below the waterline). When loading the ship, the heaviest cattle are loaded onto the lower decks first to ensure the ship remains stable. Lighter cattle are put on the upper decks. Animals are allocated the most appropriate pen according to their weight, breed and friends (where possible they stay with their own mob). Heavier animals are given larger pens to allow them to move more freely.



Meet the crew

Crews will differ depending on the voyage but generally, the following people are important for the running of the ship.

Master of the vessel/Captain is in charge of all operations and activities on board the vessel.

Chief Officer manages the feed distribution, loading and unloading of stock and other important activities such as stability of the ship.

Accredited Stockman is employed by the exporter to look after the health and welfare of the animals throughout the journey.

The Crew help maintain the ship, feed the animals, clean the decks and change bedding for the animals.

Bosun is generally the head stockman in charge of the crew and ship maintenance.

Veterinarian checks the animals before they are loaded, and for some markets may accompany the animals on their journey.

The Cook prepares all meals for the crew.

The cattle have plenty of water and food on the voyage. They are fed twice a day in most cases (once in the morning and once mid-afternoon) on a combination of special pellets, chaff and hay. Fresh water is available to each animal. Each animal can drink up to 35 litres of water each day (that's almost 150 glasses of water!). Heavier animals drink even more.



MEAT & LIVESTOCK AUSTRALIA



Live cattle imports suit the needs of many countries

The majority of live cattle exports are destined for South East Asian markets where domestic cattle are in short supply. This is because most land is used for production of staple food items such as rice. There is a high demand for Australian cattle in Asian feedlots.

In addition to the shortage of cattle in these countries, they have religious requirements relating to the slaughter of cattle.

Refrigeration is also a problem in Asia and supplying chilled meat is not always possible.

Countries in North Africa, such as Egypt prefer Australian cattle because they are free of exotic diseases.

Our largest markets for live cattle are the Philippines, Indonesia and Egypt. We also export to Malaysia, Jordan, Libya, Brunei, Japan, Israel and Mexico.

Caring for the animals on board

Whether the ship journey is a few days or a few weeks, caring for the animals is the most important job on board the ship.

Stress from the heat or cold is a leading cause of cattle illness on the ship so checking the temperature, humidity, and ventilation is important. On the top decks, shading is used to keep the cattle cool and dry. On the lower deck, fans may be used.

The ship's Master or First Officer checks weather forecasts to prepare for any hot, cold or rough weather. Sometimes ships are steered off course to avoid bad weather.

Experienced stockmen check cattle in the morning, during the hottest part of the day and after feeding. The stockmen look for cattle that may be distressed and in need of extra care. Healthy cattle look well with shiny coats, are eating and drinking and have good respiration (breathing) rates. Sick cattle receive extra care and are sometimes moved to a special pen for treatment (the 'sick pen').



Page 2

Like to find out more about live cattle exports? Investigate Meat and Livestock Australia's website at www.mla.com.au

CLASSROOM ACTIVITY



- Mark on a map where the major ports are (Darwin, Fremantle, and Portland). Guess how long it would take a ship to reach the Philippines and Egypt.
- Trace a journey from the port of Darwin to the Philippines or from Fremantle to Egypt.

LIVE EXPORT TALK

PORT - the place where the cattle are loaded onto, or unloaded from, ships.

PEN - a small enclosure where the animal is held while on the ship.

LOAD PLAN - a plan detailing the location of the pens and space requirements within the pens.

STOCKING DENSITY - how much space each animal needs in the pen.

LEAP - (Live Export Accreditation Program)
A quality assurance system which focuses on the welfare of the animal. All exporters of live cattle must have a LEAP in place, in order to get their licence to export.



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MEAT & LIVESTOCK

Banksia Beef

Situation

A chilled branded beef program was needed to consolidate and expand Aussie beef's position in selected Asian markets. Over 150 producers from the New England / southern Queensland area banded together into an alliance that in turn formed a joint venture with Warwick Bacon to establish this program. This beef, which is all Halal-certified and hormone free, is marketed under the 'Banksia Beef' brand.

Task

MLA's initial task was to facilitate the development of the producer alliances, their merger to provide year round supply and the formation of a joint venture with a processor/exporter. Then MLA's marketing team took over to support the launch of Asian export markets.

Action

MLA facilitated in the development of a joint venture between 'Banksia Beef' producers and Warwick Bacon. Usage for a broad range of cuts including knuckle, rump, outside flat and oyster blade had to be developed. MLA developed a merchandising program with in-store demonstration materials, recipe cards & holders, brochures, flaglines, wobblers, t-shirts, aprons and shelf dividers to support the 'Banksia Beef' brand in supermarkets. MLA's technical consultant trained butchers at the supermarkets to cut and merchandise the beef.

Result

The first shipment of 'Banksia Beef' left Australia for Singapore in October 1999 and was placed on supermarket shelves at NTUC in Singapore and Jusco in Malaysia. Launched in Taiwan at Sung Ching supermarkets in September 2000, the preliminary success of 'Banksia Beef' has been proven with this expansion & currently the sustainability of the trade is very encouraging. Both producer groups and exporter are working well, with the results achieved so far for this program being well above expectations. Currently more that 10 tonnes of 'Banksia Beef' is produced and exported each fortnight with a 50% increase in shipments planned for the near future.

More Info

Georgia Jacklyn
(02) 9463 9150
Email: gjacklyn@mla.com.au

Australian Chilled Beef Standards

Situation

The Korean market will liberalise in January 2001 and it is imperative that the beef industry is able to take advantage of growth opportunities that will result.

Task

To increase demand for a variety of Australian chilled beef cuts in the targeted areas of the Korean market.

Actions

The Australian Chilled Beef Standards program has been developed collectively by leading exporters with the support of industry peak councils via the Korean Taskforce.

The four standards have been given Korean names to ensure the names easily differentiate between grades of beef to make ordering easier for the Korean customer.

Korean Names	Hoju Choi-sang	Hoju Sang	Hoju Joong	Hoju Teuk
Interpretation of Korean names	Australian The highest	Australian High	Australian Medium	Australian Special
Age	Approx 30 months Dentitian up to 6 teeth	Approx 30 months Dentitian up to 6 teeth	Approx 30 months Dentitian up to 6 teeth	Approx 30 months Dentitian up to 6 teeth
Marbling	3 and above	2 and above	1 and above	1 and above
Meat colour	1B-2	1B-2	1B-2	1B-3
Fat colour	0-2	0-2	0-2	0-4
Carcase weight	Min 290kg	Min 290kg	Min 290kg	Min 290kg
Feed type	Min 200 days grain fed	Grain fed	Grain fed	Pasture fed

Results

On 30 October 2000 MLA and leading exporters launched the system in Seoul, Korea and to help promote the standards followed-up the launch with two days of seminars to educate Korean importers and end-users about how to use Australian Chilled Beef Standards.

More info

Allister Lugsdin, (02) 9463 9148
Email: alugsdin@mla.com.au



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THE TIBETAN RAIN DANCE

Background Information:

The Tibetan people participate in a ceremony at the same time every year. This ceremony involves family groups gathering and having water fights with other family groups. This ceremony lasts for days, and the Tibetan's believe that it encourages the rain Gods to commence the rains for their spring crops.

Aim: To test the hypothesis that water fights increase the likelihood of rain.

Method: Segregate the class into 'family' groups. The class must then simulate the water fights of the Tibetan family groups - this must be conducted in a sensible manner.

Results: Record the date of the water fight and for each consecutive day, record the rainfall.

Date of water fight : _____

Date Rainfall (mm)

Conclusion: What can you conclude from this experiment in response to the aim?

_____

_____

_____

_____

_____

Junior Ag Camp 2001 Report

Junior Ag Camp 2001 was held for it's eighth successive year, at the University of Western Sydney - Hawkesbury Campus, from Friday the 3rd until Sunday the 5th of August. The activity packed program ran for three days and two nights finishing on the Sunday afternoon at 3.00pm

Again, as in previous years the Junior Ag Camp, acted as a catalyst for both staff and students to network in a mutually beneficial three-day weekend.

This year 125 students from 42 schools attended, this is the largest cohort ever. The program began early on the Friday morning when students registered, were allocated their room, were issued with their Ag camp Sweatshirt and surprise show bag. Students were then introduced to their UWS student mentor. The students were then organised into their Ag Camp Groups, these were Red Rams and Heifers, Blue Bulls and Bucks, Green Colts and Fillies and Yellow Chicks and Ducks. Each group has about 14 students and 3 male and female mentors. After reluctant hugs and kisses from parents, students attended a brief official welcome from Associate Professor Rob Mulley, the Head of the School of Environment and Agriculture.


The Challenge: "Bob Hawke Walk"

"The Challenge" was the first Ag Camp 2001 activity. This was designed so that students were encouraged in a fun way, to step out of their "comfort zone", make friends and interact with students form other schools. The rest of the Friday consisted of a series of rotational activities like: Environmental Measurement, Equine Reproduction. These were organised and presented by UWS Hawkesbury Campus Staff. Peter Jones from Chifley College , Mt Druitt Campus, gave a guest demonstration about chemical safety.


Equine Reproduction: Semen Evaluation 2

On Friday evening the "Pig and the Cow" entertained the staff, students and mentors with a program of "Ice Breaker" team games. The evening concluded with a camp fire near the woolshed. The second day of the weekend consisted of four activities. Each activity was called "a station". The four colour groups rotated through each station throughout the day. This allowed every

student to experience a diverse range of agricultural activities.

These activities included:

1. **Sheep** - at this activity there is an indoor section where students engage in a shearing demonstration and shed management routines. They also learnt some wool classing fundamentals. There is also an outdoor section where students learnt about moving sheep around the yards, using the race, drenching, catching and holding sheep and drafting them successfully. They are also shown how to set up the electronic scales for weighing the sheep.
2. **Cattle** – there are two main activities. Firstly students work with a mob of cattle and learn to move them around the yards and into a crush. They learn to operate the crush, drench the cattle and draft them. Secondly students learn about show preparation, grooming, leading and parading. This last section was offered by Allan Woods of the Richmond College of TAFE at their nearby facilities
3. **Deer and Horses** – two activities. Firstly students learn about the species of commercial and wild deer. They learn about the behaviour patterns of deer and their habits. They are shown the handling facilities and assist with a simple deer management procedure. Secondly students learn some basic horse husbandry/management skills like grooming, feeding, behaviour and leading.
4. **Farm Machinery, Safety and Tractor Driving** – students engage in tractor driving. Included in this activity is: attaching a implement such as a carry, all to the three point linkage system, attaching a trailer and learning to reverse with it. They learn about machinery maintenance, and safety aspects to be observed, not only whilst operating, but also working around machinery.



Sheep Activity at the Yards

This learning environment, which was developed by the Ag Camp organising committee, generated opportunities for the students, who may not have access to facilities at their school, to gain knowledge and develop practical skills in Agriculture. It exposes the students to new ways of looking at different situations with a focus on agriculture.

This year saw the introduction of "The Agricultural Mini Olympics", which was adopted from a similar activity held at the Penrith Show. This program consisted of 8 events, which are designed to give students an opportunity to apply their general knowledge and skills and also that developed over the weekend. Not all students participated in all events. It was part of the strategy to encourage each colour group to align students, with knowledge and skills consistent with the choice of events and construct the most "suitable team"

The events included:

1. **Fencing Event** - 3 wires, 8 droppers, knots, measurements, and strainers.
2. **Three Point Linkage Event** - attach carry-all, load and secure bales, reverse, unload, detach carry-all, multiple drivers.
3. **Tractor and Trailer Event** - attach trailer, load and secure bales, reverse, unload, detach trailer, multiple drivers.
4. **Woolshed Event** - rank fleeces, name sheep parts, bale contamination relay.
5. **Sheep Event (yard work)** - drenching, drafting, weighing, graphing.
6. **Chemical Safety Event** - safety gear dress up relay, chemical mix and spray, safety questionnaire.
7. **Transplant Event** - mix two potting mixes, transplant seedlings, label and display.
8. **Cattle Event (yard work)** - race, crush/squeeze, weighing, drafting, graphing.

Each activity had set outcomes to be achieved and a scoring system associated with those achievements. Each Colour group was divided and the half groups followed a rotational timetable. Each half group engaged in two activities throughout the morning. Marks were tallied and prizes awarded,


Cattle Activity at the Yards

According to the student evaluations, the top three most popular events for the mini Olympics were the cattle yards event, followed by woolshed/ classing event and the tractor and trailer event.

The members of the two most successful groups ("A" team and "B" team) each received commemorative medallions. The inaugural winning colour group of the Ag Camp Mini Olympics Cup, was the Yellow Chicks and Ducks. They were presented with a perpetual trophy at the closing ceremony on the Sunday. The trophy will be engraved and presented for competition at Ag Camp 2002

Tanya Henry



Ag Camp 2002 will follow a similar program watch out for your invitation package. If you have not attended Ag Camp before and would like to send your students, please contact Ken Langford on 45701322 or email on ; K.Langford @uws.edu.au.

I would like to thank all of the organising staff, the staff who managed activities, the UWS Student Mentors, the UWS Staff, for contributing to such an enjoyable program. I would also like to thank Tanya for writing the Ag camp 2001 BAAT Report.

Ken

AgCamp 2001

Participating High Schools

Albion Park High School
Bass Hill High School
Bathurst High
Berkeley Vale High
Blayney High School
Bossley Park High School
Camden High School
Caroline Chisholm
Colo High School
Cranebrook High
Doonside Technology High School
Dungog High School
Elizabeth Macarthur High School
Erskine Park High School
Girraween High School
Gosford High School
Hawkesbury High
Henry Kendall High School
Hurlstone Agricultural H.S.
Kingswood High
Leumeah High School
Macarthur Girls High
Menai High School
Muirfield High School
Nagle College
Oakhill College
Pendle Hill High School
Plumpton High School
Pymble Ladies College
Quakers Hill High School
Richmond High School
Riverstone High
Rutherford Technology High School
Scone Grammar
St Clair High School
St Johns Park High
St Pauls Grammar School
Terrigal High School
Windsor High School
Yanco Ag. High School.
Macarthur Anglican College
Lithgow High School

Staff Members attending Ag Camp 2001

Family Name	Given Name	School		Family Name	Given Name	School
Akonda	Joseph	St Johns Park		Kleinschafer	Brendan	Bathurst
Armstrong	Kiri	Blayney		Maloney	Lyndal	Girraween
Bowles	Saxon	Oakhill College		Mikan	Christina	Bass Hill
Breene	Catherine	Oakhill College		Mulligan	Don	Caroline Chisholm
Brookes	Kerry	Narrandera		Myers	Hilary	Caroline Chisholm
Cassels	Charles	Richmond		Nath	Vijay	Doonside
Clerke	Geoffrey	Caroline Chisholm		Newbury	Kate	Terrigal
Dagher	Elena	Bossley Park		Nield	Erin	Erksine Park
Damic	Karen	Bathurst		Prott	Fiona	Kingswood
Groschner	Hilmat	Hawkesbury High		Randle	Helen	Rutherford
Grover	Phillip	Cranebrook		Ross-New	Paul	Kingswood
Hassanpour	Matt	St Clair		Ruis	Liz	Windsor
Hawkins	John	Colo High		Tolputt	Stephen	Erskine Park
Herrmann	Brigitte	Plumpton HS		Wall	Michael	Hurlstone
Holmes	Ann-Maree	Menai High		Wells	Graeme	Riverstone
Hurst	Phil	Hawkesbury High		Westerhof	Nicolet	Elizabeth Macarth.
James	Lachlan	Scone Grammar		Willard	Peter	Oakhill College
Kelly	Arthur	Camden		Williams	Ian	Leumeah
Kenaly	Sharon	Hurlstone		Wilson	Simone	Yanco Ag.H.S.
Kitchener	Jo	PLC		Smith	Geoff	Northmead
Turner	Tony	Muirfield		Jones	Peter	Chifley College
Pearce	Jane	Regional Office				

COTTON

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Cotton Processing

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at www.cottonaustralia.com.au
or ring the Cotton Discovery Centre
on 02 92112888.
to book a school excursion

Transport and Sorting

Once the cotton is picked it is compacted into *modules* and is then transported to a cotton gin. Cotton gins are the factories that complete the first stage of processing cotton — separating the lint from the seed.



Loading a module onto a truck

A piece of equipment called an *infield loader* is used to lift the cotton modules onto the trucks. At this stage the seed cotton (cotton just as it is picked) is made up of lint and seed which is separated at the gin.

Minimal waste

When the seed cotton is processed in the gin, three products result — cotton seed, lint and waste.

Seed
About 55% of the seed cotton that comes from the farm contains seed. The seeds are very valuable and are used for a variety of products such as oil, plastics, explosives, stock feed, cosmetics, margarine and insecticides. They might also be used as seeds for the next cotton crop.

Lint
Lint makes up approximately 35% of the seed cotton. Once the lint has been separated it has to be processed further (just as wool needs further processing once it is removed from the sheep's back!) and is compacted into bales for easy transporting. The cotton bales are then either taken to spinning mills for further processing or they are transported directly to Australian ports for export to other countries which will process the cotton.

Waste product
That leaves about 10% of the seed cotton which is classed as waste product. The waste can also be put to good use. Cotton fibre waste has been used in the clean up of oil slicks that take place at sea. Researchers in Japan and the USA have found ways to recover oil by trapping it inside the raw cotton fibre. The raw cotton fibre contains natural waxes which do not absorb water readily and help it to remain afloat.

Residual leaves and sticks from the cotton bush, bracts and other foreign materials which are cleaned from the lint at the gin are destroyed by composting in large pits. This material is called 'cotton trash'.

Ginning

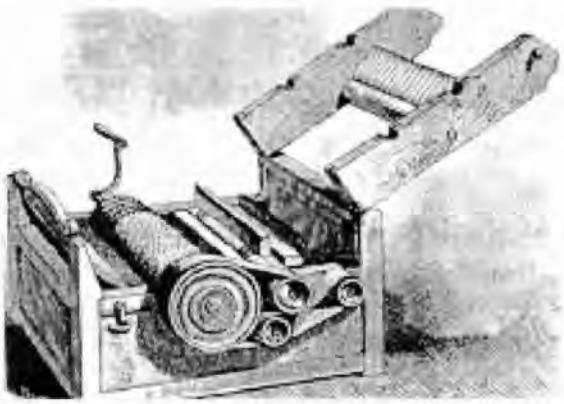
Background

'Ginning' separates the cotton fibres (lint) from the cotton seed, removes any foreign material such as leaves from the lint, and **combs** the finished fibres. The machine that carries out this process is called a 'gin'.

Before the gin was invented, the lint and seed had to be separated by hand. It took one person a whole day to separate only half a kilo of the lint from the cotton seed.

In 1793 an American called Eli Whitney (1765 – 1825) invented the cotton gin. Cotton gins greatly speed up the process of separating the seed from the lint — Whitney's first gin could separate as much cotton in a day as 50 people. Modern gins can separate and bale about 230,000 kilograms of cotton in one day!

Cotton gins usually operate for about three to four months every year. Gins can be quite expensive to operate and therefore to keep costs down, they are often owned by a group of cotton growers called a co-operative. Some cotton farms are large enough to have their own gins, particularly those that are run as independent companies that grow, gin and market their own cotton.



A hand gin



A modern cotton gin

The ginning process

Step 1 — Opening the bolls
A machine called a 'moon buggy' picks up the modules of cotton and loads them onto semi-trailers which transport them from the farm to the gin. The modules are stored at the gin in large specially drained areas called 'gin yards'. The modules remain here until they are ready for ginning when the moon buggy again picks them up and places them onto a chain which feeds them into the gin.

From there, the cotton is fed into the first part of the gin machinery which opens up the cotton and takes out any green bolls, rocks and sticks which may damage machinery.

The gin is operated centrally from a sound proofed control room with computers, control panels and various other technologies to monitor the machinery.

If you were walking around inside the gin you would need to be wearing earmuffs to protect your ears from the noise of the machinery and a face mask to avoid breathing in any of the fine dust particles.

Step 2 — Drying out
Moisture levels are very important to successful ginning. If the cotton gets too moist it forms small lumpy balls called **neps**. On the other hand, if it is too dry, the fibres break or can cause static electricity. Ideally, cotton is ginned at a moisture level of 5%. If the moisture is too low, water is added. If it is too high, the cotton is heated up in order to dry it out.

Step 3 — Pre-cleaning
During the whole process the seed cotton is transported through the machinery by being blown along by warm air currents. The next stop in the process is the pre-cleaning centre. At this stage many different sized and shaped cleaners go into action to try and get rid of all the 'trash' — i.e. the dirt, stalks, leaves etc.

Horizontal cleaners with metal spikes spin around and drag the cotton over screens. *Stick machines* spin the cotton around cylinders and *impact cleaners* beat the cotton between rows of spiked rollers. The *extract-feeder* then feeds cotton into the gin stand (which is where the actual separation occurs) and finally, after all of this cleaning, the cotton moves along a conveyer belt to the top of the gin stand.

Step 4 — Seed separation
Separating the seed from the lint is completed by a *saw gin* located inside the *gin stand*. The saw gin consists of a series of circular saws rotating at high speed. The teeth on the saw blades pull the fibre away from the seeds. High-speed brushes then take the lint off the saw blades and the seeds drop out of sight and into storage. The few remaining lint fibres on the seeds are removed in a later process and are used to make low-grade yarn and paper.



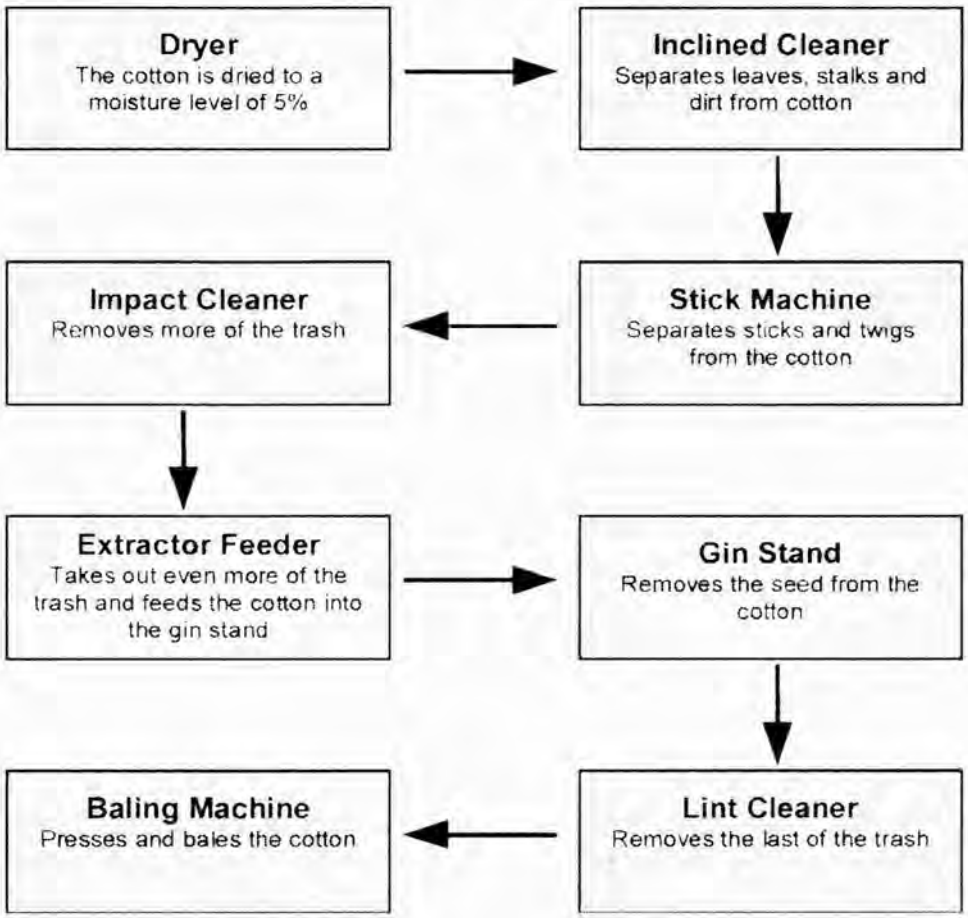
Cotton seeds left after ginning

Step 5 — A final clean and wrap

After separation from the seed there is still some trash remaining in the lint. To remove this trash, the lint goes through another cleaning process which involves blow dry cleaning through the *air jet cleaner*, some more rolling through a *lint cleaner*, and finally, one more pass through the *saw gin*.

At the end of the ginning process the clean lint is pressed into bales (weighing 227 kilos each). Samples are taken from each bale at this stage for the purpose of classing or grading the cotton.

Bales are lastly wrapped in **hessian** to help protect the lint. From here it is taken to a warehouse to be put into shipping containers for travel by train or road to a spinning mill or a port for export overseas.



The ginning process

Classing

Cotton classing

In general terms cotton classing is the way in which cotton fibre is sorted into different quality-based grades (or classes). The higher the class, the better the quality of the cotton fibre, and hence the higher the price that will be paid.

Manual classing

A more traditional method of testing the cotton quality involves using only specially trained 'classers' who manually examine the cotton fibres. This testing involves the classer taking a sample from each bale of cotton and assessing it by colour (bright or dull, white or grey), trash content (the amount of stalk, leaf or dirt), and character (whether the sample has a smooth or lumpy appearance).

Grades

Fibre grading in Australia is based on the system used by the United States Department of Agriculture's *Universal Standards for Grades of American Upland Cotton*. Australia has 20 grades in common use, so it can take many years of training and on-the-job experience before manual classers grade and staple (assess the length of the fibres) by eye alone. Inexperienced classers use *Standard Guide Boxes* as a reference point.

The grading categories are revised and updated, usually on an annual basis. Below are some examples of the terms used.

	White Grades	Spotted Grades	Tinged Grades
best ▲	Good Middling	—	—
	Strict Middling	Strict Middling	—
	Middling	Middling	Middling
	Strict Low Middling	Strict Low Middling	Strict Low Middling
	Low Middling	Low Middling	Low Middling
	Strict Good Ordinary	Strict Good Ordinary	Strict Good Ordinary
	Good Ordinary	Good Ordinary	—
	◄ increasing quality		

In the white grades, the 'Good Middling' represents the highest grade, i.e. bright colour, virtually free from trash and smooth. Australia generally produces cotton at the top end of the middling group. Pima (*Gossypium Barbadense)* is above the middling group. It is a premium, fine, long stapled variety. Pima has longer, stronger fibres than the Upland variety, and grows in the warm dry climate of Menindee Lakes and Bourke NSW. It receives a higher price than the Upland variety but is more susceptible to water damage. Pima makes up around 10% of the total Australian cotton crop.

'Good Ordinary' graded cotton has a very dull colour, a lot of foreign trash and is lumpy. 'Spotted' and 'Tinged' grades describe lower quality cotton, usually affected by rain.

Cotton also has special 'properties' that can be tested. There are three main tests used:

- **Micronaire** measures the cross section of the fibre.
- Maturity which measures the thickness of the fibre walls
- Pressley which measures the strength of the fibre.

At the end of the classing process each 227kg bale of cotton carries the classer's description. This grade will decide whether the cotton is sold for a higher or lower price, known as premium or discount.



Cotton classing by hand



HVI testing

HVI testing

High Volume Instrument (HVI) testing is a technically based method used by both marketers and buyers to accurately check the quality and exact value of cotton fibres. The technique originated in the USA and is being constantly improved and expanded. Australian companies have also contributed to the world's knowledge about HVI testing.

HVI testing is a system designed to test the various properties of cotton at high volumes. HVIs can in fact measure key properties of several hundred samples during a normal eight-hour day (i.e. it takes just 40 seconds to process one sample).

In addition to being able to test high volumes of cotton, it can also be cost-effective for the industry, especially when compared with similar testing or inspection costs for wool, meat and precious metals. An HVI test print-out includes information relating to the following areas:

Grade	relating to any visible impurities and the degree of whiteness.
Length	the price of cotton is roughly proportional to staple length. Australian crops typically produce 28mm (1.15 inch) staple if irrigated, but shorter from a dryland crop.
Micronaire	or the fineness of the cotton which affects how quickly it can be spun.
Trash and dust	the number of trash and dust particles that are in the cotton.
Tenacity and elongation	strength and stretching. If the cotton is stronger it can be used in smaller quantities.

The more accurate testing can become, the greater the chance that the appropriate line (quality of cotton fibre) will be used to manufacture the final product. HVI testing aims to deliver non-subjective, standardised results at greater speeds. Therefore, as the volume of cotton produced in Australia grows, and as technology becomes more sophisticated, HVI testing is being employed more and more.

Cotton Seed Oil

Cotton seed is produced during the ginning process and is a very valuable commodity with many uses. Once the cotton seed is separated from the lint it is covered in very short white fibres which give it a fuzzy appearance. It is delinted and either crushed for oil extraction and used in the manufacture of many other products, or used for planting future crops.

Stage 1: Delinting

Before the seed can be crushed to make the oil, it has to be cleaned of any excess lint that is still attached to it. The process of removing the remaining lint is called **delinting**. Even these final short fibres (**linters**) are used to make many industrial and domestic products.

Examples of products made from the linters are mops, cleaning cloths, yarns for fleecy-backed fabric and wadding. Industrial examples include: flock linings for industrial gloves, paper, non-woven products, and as a strengthening agent in moulded plastic products.

Stage 2: Preparing the seed for crushing

Before the cotton seed is crushed to produce oil it must first undergo some more processing. The first step is to remove the 'hull' which is the hard shell covering the seed. The hulls can be used to make such products as stock feeds and compost.

Flattening and cooking

Inside the hull is the 'kernel' — the really valuable part of the seed. The kernels are flattened using rollers and then cooked at very high temperatures.

Stage 3: Crushing

The kernels are squeezed and crushed and the oil flows out. This oil is then processed and refined further, turning it into a light yellow, tasteless and odourless oil. Cotton seed oil is used in the manufacture of products such as:

- vegetable oil
- salad oil
- margarine
- soap
- plastics
- synthetic
- rubber
- insecticides
- fungicides
- waterproofing products
- man-made textiles.

Excess kernel
In a similar way that any excess hull can be used for stock feeds and compost, leftover parts of the kernel can be used for feeding animals such as pigs, cattle and poultry.

Spinning

The process of turning cotton lint into fabric involves several distinct manufacturing operations and numerous complex machines.

Ginned cotton is brought to the opening room of the mill where the bales are opened up by machine. Cotton of similar grade but from different bales is blended together into batches of uniform quality. Usually between 12 and 40 bales are blended in each batch.

Stage 1: Opening and cleaning

The cotton is opened to remove sand, grit and any other unwanted matter that has snuck into the bale. Openers have a beating action which loosens the fibres and separates the impurities from the fibre. The fibres are also blown with air to remove sand and other gritty materials.

Stage 2: Blending

Fibres from different bales are blended (mixed) to ensure uniformity of the product.

Stage 3: Carding

The cotton fibres are combed to make them run parallel (i.e. to run in the same direction as each other). A web-like fibre is formed using a **carding** machine consisting of rollers which have pointed wires protruding from the surface. The wires pull the cotton fibre into line forming a **sliver** or a type of rope.



Carding cotton



Slivers of carded cotton

Stage 4: Drawing and drafting

The slivers are thinned out by using a process called drawing and drafting. This is completed by a series of rollers which make the fibres a consistent size in preparation for spinning.

Stage 5: Spinning

This is the final stage of the process, often referred to as 'ring spinning'. The cotton fibres pass through the final rollers of the drawing and drafting process. They are then pulled through a small metal hole called the 'pot eye' and then under a small ring, called a 'traveller', to the **bobbin**. The bobbin spins on a spindle and the yarn is wound very evenly around it.

The two most popular methods are ring spinning (usually for finer yarns and all combed yarns) and open-ended spinning or rotor spinning (used for medium to coarse yarns.



Cotton ready for spinning machines



Spinning

Manufacturing

After the cotton lint has been spun into yarn it is then woven or knitted into fabric.

Weaving

Weaving is done on a machine called a loom. Before the weaving can start, the loom needs to be set up with *warp* yarn. Warp yarn runs up and down the loom. ***Weft*** yarn is then woven (or sewn) over and under the warps from side to side. The weaving is done by a torpedo-like implement at very high speeds. Many hundreds of metres of yarn are used per minute during weaving. The resulting fabric is particularly strong.



Weaving fabric



Knitting spun cotton

Knitting

Knitting fabric from cotton yarn is a simpler process than weaving. Knitting involves forming loops with one or more single continuous yarns and joining each loop to its neighbours to form a fabric.

The loops of knitted fabric form a series of chains called *wales* running down the length of the fabric. The loops form lines or rows called *courses*, at right angles to the wales. Wales and courses are the equivalents of warp and weft in woven fabric. Knitted fabric can be either *warp-knitted* or *weft-knitted*.

Warp-knitted fabrics have a series of yarns running down the length of fabric and are intertwined to produce a stable fabric.

Weft-knitted fabrics have yarns running across the fabric, as in hand knitting. These fabrics can be produced on *flat bed* machines (usually used for making garment pieces, e.g. fully fashioned garments) or *circular bed* machines (used

for piece goods, e.g. underwear, and double jersey fabric used for outerwear).

Fabric finishing

Once cotton has been woven or knitted into fabric it has probably not been affected by water — in fact the processes that it has been through since harvest are all 'dry'. Most of the trash has been taken out through cleaning and carding processes, leaving the cotton an off-white colour (if it is upland cotton) or a creamy colour (if it is Pima cotton).

This colour gives a 'natural' look to the fabric that could be used for some knitted outerwear (i.e. garments worn on the outside). When woven the fabric is generally greyish in colour, and is made into things like **canvas**, butter **muslin** (cheesecloth) and some industrial fabrics. The fabric is not usually attractive enough for the fashion industry.

Fabric finishing makes the fibre look and feel better. It is the final step in the manufacturing process. Some fabric, such as bagging, is ready for use straight from the loom. There are many ways to finish off the fabric including bleaching, dyeing, Sanforising or stentering to prevent shrinkage and resin treatment to produce minimum-care fabrics. Some of these finishes are described below.

Scouring

Cotton fibres have a natural wax coating, and up to this point it is still left in the cotton. Unfortunately 'microdust' and other tiny bits of trash, stick to the wax. *Scouring* is a process that involves cleaning the cotton in a hot detergent solution to remove the microdust. In some cases this is enough to produce a fabric that is still quite natural and of a quality high enough to produce fashion garments.

Peroxide

If the fabric still has a slight natural colouring, it might need to be *bleached*. This is done by soaking the fabric in non-polluting hydrogen peroxide, similar to the peroxide that you can bleach your hair with. The resulting fabric has a brilliant off-white colour.

Gassing

Most customers, particularly in the fashion industry, like a smooth finish to the fabric. To create this finish, the fabric is singed by a gas flame which burns off any little fibres that are sticking out, making it smoother. This is sometimes referred to as *gassing* because the fabric passes under an open gas flame.

Stentering
Shrinkage and wrinkling of knitted or woven fabrics can be prevented through a non-chemical process called *stentering*. This means that the fabric is held under tension (held quite tight) while it is dried.

Sanforising
Shrinkage of woven fabrics is prevented using a process called Sanforising. This process effectively pushes the yarns together to stop the shrinkage.

Calendering
Another popular finishing touch for the fabric before it goes to the manufacturers is *calendering*. This is where the fabric is given a final press (ironing) usually between huge *calender* rollers. A range of different effects can be made to the fabric during this process (e.g. engraving patterns onto the calender rollers to add a pattern to the fabric).

Dyeing
Colour is added to the fabric either by yarn or piece dyeing. In yarn dyeing, packages of yarn are placed in the dye vats before the yarn is made into fabric. Otherwise fabric is dyed by passing it through a series of dye baths and over heated rollers to produce a solid colour. Fabric can also be printed to apply colours and patterns.

Permanent press
Other finishes which give the fabric special qualities include chemical additives for permanent press, water repellency and resistance to fire and dirt. Permanent press finishes are designed to keep the fabric 'permanently pressed' — not needing ironing as often. Regular ironing of garments can damage the fibres, so the permanent press process limits this need to constantly iron.

Initially permanent press finishes had quite a few limitations, but new scientific and technological advancements have seen increases in its use. Permanent press garments can now have additional benefits such as some flame proofing and shrink proofing effects.

The invention of polyester with its great 'wrinkle recovery qualities' meant that cotton could be blended with the polyester, and the chemicals normally used for permanent press were no longer necessary. Researchers continued to develop new options and finally found that by adding certain chemicals to the blend of cotton and polyester they had a fabric that was more effectively permanently pressed than ever before.

Glossary

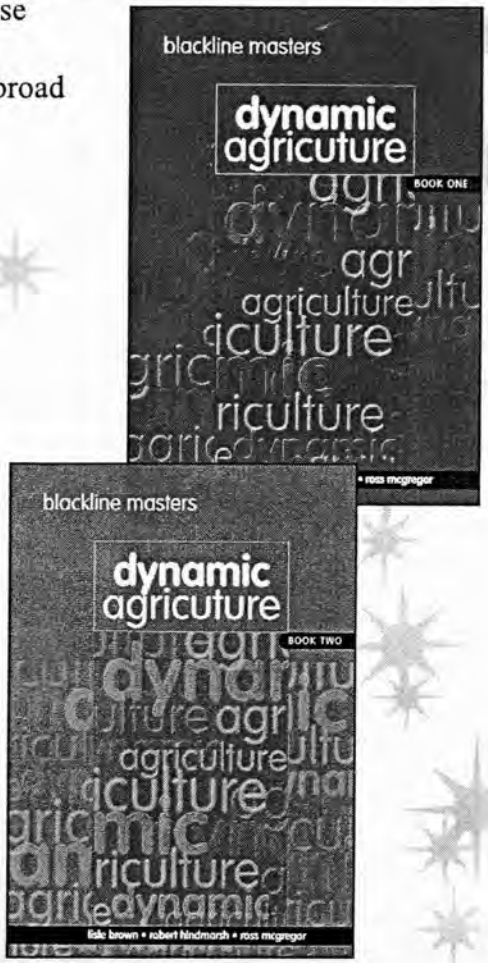
Bobbin	A cone shaped object which holds yarn.
Muslin (or calico)	Common topweight plainweave carded fabric, grey or finished, traded as a commodity in New York. Includes printcloth; often dyed or printed, as well as resist- printed fabric in bold colours (as in calico cat). Used both in sheets and apparel.
Canvas (or duck)	Heavy plain weave fabric with coarse weft and the warp yarns woven in pairs. Common in tents, tarpaulins and awnings, as well as some trousers, including those issued to convicts transported to Australia.
Carding	Cotton lint fibres that have been untangled and left lying in the same direction.
Combs	Carded cotton that has had most of the trash and short fibres combed out. This enables finer yarns to be spun from a given quality of cotton, producing strong, smooth cloth.
Delinting	Removal of fibres that remain on the surface of cottonseed after ginning. 1. Mechanical, in which one or two cutting processes remove linters, making the seed suitable for crushing. 2. Chemical, where acid dissolves all remaining linters, leaving clean seed for treatment and planting.
Hessian	A rough, tough material made from jute.
High Volume Instrument (HVI)	Refined testing apparatus for quick and accurate measurement of fibre reflectance/yellowness (grade/colour), fibre length, micronaire, strength and extensibility. Modern versions optionally (but less accurately) analyse neps, trash, fineness and maturity and predict yarn tenacity.
Knitting	Making patterns from fabric by looping yarns together.
Linters	Shorter, fury fibres separated from the seed after ginning.
Micronaire	Measure of mass per unit length of cotton fibre.
Neps	Small knots of fibres.
Sliver	Twisting fibres together to make yarn.
Weft	Yarns inserted across the width of woven fabric.

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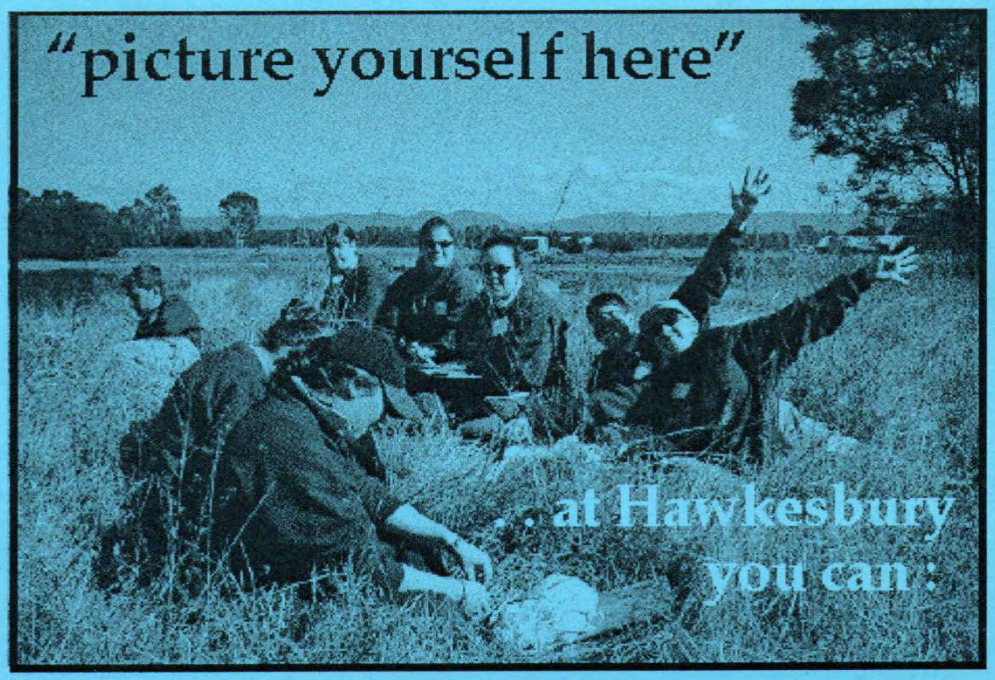
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