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Extracts from the Department of Agriculture's annual report, 1974-75

Department of Agriculture, Western Australia

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The Department of Agriculture's Annual Report for the year ended June 30, 1975, took the form of short reviews of selected activities of the Department during the year. Some of these reviews are reprinted below to give an idea of the range of activities undertaken by the Department. A limited number of copies of the full report are available to interested organisations from the Department of Agriculture, Jarrah Road, South Perth, 6151.

In past years the Department's report has taken the form of a relatively detailed technical summary of the work of each Division. Because of the large volume of information involved this is no longer practical and the information is now made available in technical annual reports of the Divisions.

GRAIN CROPS

GRAIN STORAGE INSECTS

Although grain storage insects are well known because they damage grain held on the farm, their real significance lies in their danger to the export trade. World markets demand insect-free grain and countries such as Canada and the United States of America can readily meet this requirement. Australia's warmer climate makes its wheat susceptible to weevil development in bulk storage and thus we rely heavily on chemical controls to meet the nil-insect content demanded by importing countries.

The Australian industry has used malathion to achieve insect control but over recent years the grain storage insect complex has developed resistance to this chemical. A complication is that resistance to the only other internationally accepted protectant, dichlorvos, generally follows as a cross resistance once malathion resistance develops. The situation suggests a distinct possibility that the industry will have to change its method of insect control to one of fumigation.

To prolong the useful life of malathion the Department has developed a monitoring programme to provide the industry with a resistance testing service. It is hoped that prompt detection of resistant infestations can be controlled before they become widespread.

In 1974/75 the monitoring service processed 834 samples from various sources of the handling and processing industry and multi-resistant strains of the primary grain insect *Rhyzopertha dominica* (F.) were found.

To gain further information on the distribution and occurrence of infestations, a survey of grower's deliveries of wheat held on farms for several months was conducted over the last two seasons. Of 339 samples collected in 1973, 38 per cent yielded live insects. In 1974, 65 per cent of the 195 samples examined were infested, emphasising the role that farms play in contributing to the grain infestation problem.

Work on non-chemical control measures for grain storage has continued and an aeration system for on-farm storage developed. Present investigations deal with airtight techniques in combination with aeration and an underground 120 tonne airtight storage trial in a plastic lined pit at Salmon Gums is now in its second year.

Grain insects are susceptible to low oxygen tensions and use of an underground pit provides a convenient and economic method of achieving these conditions on farms. The Salmon Gums trial has indicated satisfactory control during the experimental period.

A further underground aeration trial has been set up at the Merredin Research Station where 50 tonnes of grain was aerated to lower its temperature then sealed in an air-
tight condition. A shortcoming of the airtight storage technique is that infestation may develop when the pit is opened for removal of grain but further work is planned to establish techniques to overcome this. One possibility being tested this year is the use of aboveground butyl plastic airtight silos supported in steel mesh structures.

Sampling bulk malt for examination as it is loaded into a container. Constant vigilance is maintained to ensure quality and freedom from insect pests in export cargoes.

**HORTICULTURAL ACTIVITIES**

**STUDY OF THE POTATO INDUSTRY**

There have been several enquiries into the potato industry since the W.A. Potato Marketing Board began operations in 1948. These have included studies by Parliamentary Select Committees, a Royal Commission and a private consultant, which have emphasised administrative management and marketing functions rather than production and technical aspects of the industry. Recent changes in growing areas, cost/price structure, technology and market outlook, prompted the Government to invite Professor Jay Garner, a potato specialist from Idaho, U.S.A., to investigate the State’s potato industry and report on its problems.

As well as being required to make an overall assessment of production problems, Professor Garner was asked to comment on the following aspects:

- Factors affecting the yield of ware potatoes in the main potato-growing areas in Western Australia, particularly the Manjimup and Pemberton districts.
- The influence of present cropping programmes on the spread of leaf-roll virus and the maintenance of seed lines, particularly in regard to the shift of production to the Manjimup and Pemberton districts.
- The rationalisation of growing times to assist farmers faced with increasing production costs.
- The impact of modern technology, transport and wage costs on current organisation of the potato industry.
- The potential for increasing usage of Western Australian potatoes through promotion and development of varieties for special uses.

In his report Professor Garner discussed the above factors and emphasised the difficulties involved in keeping production costs at a low level where the scale of operations is limited.

Advocating better potato storage, Professor Garner pointed out that Western Australian potato growers produced 65 per cent of the State’s potatoes during summer when yields were little more than half those from spring plantings. He recommended that consideration be given to the erection of storage facilities to reduce dependence on summer planting.

He also stressed the need for an improved seed potato programme and pointed out that the present high incidence of leaf-roll virus in many crops was adversely affecting crop yields and was a threat to the maintenance of a healthy seed supply.
SEED POTATO PRODUCTION

Since the late 1960s the incidence of potato leaf-roll virus has increased in Western Australia to such an extent that it is necessary to modify the Certified and Approved Seed potato programmes.

The primary cause of the increased incidence has been poor control of aphids, the vectors of the disease, because of their increased tolerance to systemic insecticides and the lower efficiency of chemicals applied through sprinkler irrigation systems.

Other factors include increased plantings of overlapping spring and summer crops and the persistence of volunteer plants. In the Warren district for example, where crops are planted from August to January, and where green potato foliage is available for aphid feeding throughout the year, the rate of spread has been particularly rapid.

Increased use of cool storage facilities in which growers save potatoes for seed from one crop to the next has also contributed to the overall decline in potato health. In the Albany/Denmark area this practice and the planting of infected seed close to certified seed growing properties has threatened seed potato production in the area.

In 1972 a programme involving exclusive allocation of subsidised certified seed to growers in the south coastal area was introduced. The cost was subsidised from the Potato Industry Trust Fund to the extent of $30 per tonne and was successful as the certified seed planted throughout the district provided a barrier to leaf roll contamination of crops being grown for certification. Unfortunately, not all districts supported the increased Trust Fund levy needed to continue the programme.

A basic requirement of a new programme is that all commercial potato crops in Western Australia, whether grown for seed or ware purposes, will be planted with seed which has been inspected and found to comply with health and purity standards established by the Department of Agriculture. The issue of growers’ licences is conditional upon this requirement. The quantity and source of seed used must be declared by each grower when making application to the Potato Marketing Board for a licence, or when a planting statement is submitted.

Growers in suitable areas who are particularly interested in seed production will be encouraged to specialise in growing approved seed. The selected growers will also be expected to produce seed only, although at times it may be necessary for some seed to be sold as ware. Applications from growers interested in specialised seed production are handled by the W.A. Potato Marketing Board but the Department of Agriculture will provide specialist seed growers with assistance and advice in the general care of seed crops.

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Doublegee has long been regarded as a serious weed of crops and pastures, particularly in the northern and central wheatbelt, and an estimated 1.5 million hectares of agricultural land are infested. The combined loss of cereal yield and animal production in Western Australia is estimated to exceed $5 million annually.

Doublegee research

The major doublegee research objectives are to measure pasture growth and doublegee growth in a competitive situation, to measure the effect of crops and pastures on distribution of viable seed, and to study means of chemical, cultural and biological weed control, particularly in pastures.

Important results to date are that highest levels of viable doublegee seed are recovered from paddocks which have grown pasture for a year after a crop and that most seed is found in the top 50 mm of soil. From this depth the seedlings can readily emerge, indicating the need for a reliable method of selective doublegee control in pasture, particularly in the first year of a ley rotation.

Many agriculturally significant weeds belong to the family Polygonaceae and although most are readily controlled in cereal crops they are difficult to control selectively in pasture and non-cereal crops.

Weevil Apion antiquum (arrowed) on the leaf of a doublegee plant. The weevils were released in a CSIRO/Department of Agriculture biological control project.
Screening trials for selective herbicides were conducted at seven pasture sites in the northern and central wheatbelt, and indicated that Methabenzthiazuron (Tribunil) can selectively control doublegee in legume pasture. However the results were unreliable and it will be necessary to define clearly the conditions under which this compound will give reliable control.

Biological control of doublegee has been successful in Hawaii and in co-operation with CSIRO the weevil Apion antiquum was released at two wheatbelt sites in August 1974. Minor damage to doublegee was apparent by the end of the growing season and insects were recovered at both sites 12 weeks after introduction, showing they had completed at least one life cycle. There were no signs of activity this year but further releases are proposed for the 1975 growing season.

LIVESTOCK

Satisfying Middle East Sheep Markets

Market surveys in the Middle East carried out by the Department of Agriculture's Sheep and Wool Branch have stimulated interest in the production and export of sheep meats. Companies with established markets in the area have increased their exports and new companies have entered the market.

It is estimated that by 1980 the Middle East will require 0.5 million tonnes of sheep meat per year. The surveys established that the meat should be young and tender and the flesh should be pale in colour with only a thin covering of fat on the carcass. What fat there is should be white.

The Department has embarked on a large research programme into methods of production for and transport to markets, ways of increasing the availability of sheep to supply the markets, and classification of sheep for producers.

The programme includes the whole of the sheep flock at Avondale Research Station, together with sheep at Wongan Hills, Badgingarra, Newdegate and Mt Barker Research Stations which have been committed to an investigation of breeds of sheep, times of lambing, feeding treatments, time of turn-off, suitability of products to market requirements and profitability of alternative production systems.

Results have indicated that the Merino is a highly suitable sheep for the Middle East market in terms of carcass quality and also because Western Australia can produce this carcass continuously throughout the year. Other findings are that times of turn-off can be manipulated, at equal liveweights there are no differences in the amounts of fat on the carcasses of different breeds, entire males are leaner than ewes, and visual differences in fatness between Merino and crossbred carcasses are caused by differences in the proportions of subcutaneous fat.

Investigations into ways of improving live shipping to the Middle East have resulted in improved feeding techniques, opportunities for reducing death rates, and integration of assembly for shipping and handling of sheep in land-based facilities.

Research and extension have shown that Western Australia can rapidly increase its supply of the type of sheep required by running less wethers and mating more ewes in its flocks. Such a change in the sex structure of flocks would greatly increase the supply of young sheep available for turn-off without necessarily increasing total numbers carried on farms. Wool production could be slightly reduced because of the increased proportions of ewes and younger sheep but the loss would be more than compensated for by increased meat production.

It is estimated that meat production could be increased by as much as 65 per cent with the same total sheep numbers if farmers adopted these strategies, whereas wool production would be reduced by only about 6 per cent.

Investigations of problems associated with farmers' acceptance of these ideas are planned for the near future.

Improving Sheep Fertility

Although some 15 million of the 35 million Western Australian sheep are ewes, only about 74 per cent of these ewes lamb. Early investigations...
into this problem on some 20 commercial sheep properties in 1970, 1971 and 1972 suggested that the main causes of low fertility were that the ewes did not produce enough eggs when mated. For every 100 ewes served by rams an average of only 110 eggs were released; an ovulation rate of 1.10. Obviously much higher ovulation rates are needed.

Two effects flow from higher ovulation rates—the increased proportion of ewes which conceive when mated, and the increased proportion of ewes which produce twin lambs. Because of this evidence recent research has aimed at discovering practical and economic means of increasing the ovulation rate of ewes. Past research into sheep infertility has shown that improving the nutrition level to lift the liveweight of ewes at mating time increases ovulation rate and fertility. The research suggested that high energy rations would be most effective and in 1973 a number of experiments in which ewes were supplemented with cereal grain as wheat, oats or barley were conducted. The results showed conclusively that under Western Australian conditions feeding cereal grain does not necessarily improve ovulation rate or fertility and hence it was decided to use a supplement containing a higher level of protein. Lupins were chosen as they contain about 30 per cent protein and the crop is grown extensively in the State.

Two experiments with lupins in 1974 gave dramatic results indicating that feeding lupin grain increases ovulation rate and fertility. The results also suggested that ewes respond very quickly to lupin feeding as feeding for only 14 days before joining with rams was as effective as feeding for 35 days. Once feeding ceased, ovulation rate and fertility quickly fell back to pre-feeding levels.

The 1974 results were seen as a “breakthrough” as they showed that big responses in lamb production could be obtained by feeding lupin supplements to ewes at joining. However, because of the cost of lupins, further research was needed to develop practical and economic feeding programmes. The 1975 programme was designed to establish whether less than 14 days feeding would be effective, and to determine whether low rates of lupin supplementation fed for short periods would be effective. The programme is still in progress but preliminary results indicate that with feeding at around 500 g/head/day, ovulation rates will respond after only seven days feeding. At lower supplement rates, say 250 g/head/day, about 14 days feeding is necessary.

Research is also examining alternative protein sources including peas, rapeseed meal, soya bean meal and urea. Peas in particular offer promise as they can be grown extensively throughout the agricultural areas.

Current indications are that the cost of each extra lamb produced with lupin supplements would lie between $2 and $4 per head. The lower end of this cost scale seems reasonable for many specialist sheep producers (such as those producing prime lambs or hoggets for export) but is probably too costly for most farmers.

CHEESY GLAND RESEARCH

Caseous lymphadenitis (CLA) or cheesy gland is a bacterial disease of sheep which causes abscesses on lymph nodes and lungs. There is little evidence that it causes ill health in the animal but it is an important disease economically because of trade restrictions imposed on affected carcasses by overseas countries.

It has been estimated that CLA causes the loss of about $5 million per year in Australia because of condemned and rejected carcasses at abattoirs, and the costs of inspection. The disease is world-wide but is especially common in Australian Merinos, which have an incidence of about 60 per cent in adult sheep.

During the past four years a large number of sheep affected with CLA have been examined by the Animal Health Laboratory. The Australian Meat Research Committee helped finance the research during which the disease was reproduced experimentally, using a variety of techniques. A significant early discovery was that bacteria causing CLA enter the animal body directly through unbroken skin, making it unnecessary to have a shearing cut in order to establish infection. It has also been found that sheep dipping fluids can transmit the causative organism and that dipping young clean animals with the same dip used for older infected sheep may be a way for CLA to spread through a flock.

After developing techniques for isolating the organisms from materials such as dirt, wool and faeces, it was possible to demonstrate that the causative bacteria can survive on wool for at least four weeks. Experiments are in progress to determine survival times in dirt and faeces around the shearing shed. Blood tests have been developed during the research for identification of infected live animals.

Over the past year the research emphasis has shifted towards immunity to the disease. Considerable progress has been achieved towards developing an effective vaccine and preliminary experiments have started with this material.

Future work includes further consideration of immunity with emphasis on vaccine production and methods of spread of the disease from sheep to sheep. Evidence suggests that lung lesions and coughing may contribute to contamination of the environment but once transmission is better understood it will be possible to recommend control procedures.

BEEF PRODUCTION RESEARCH

Stubbles for weaner cattle

Two experiments with weaner cattle have been completed at Chapman Research Station. One compared the growth responses of weaners in pens and in the field to low and high energy supplements for barley stubble. The other examined growth responses of weaners grazing wheat stubble or sweet lupin stubble at different grazing intensities. Among penned animals unsupplemented weaners consistently lost weight, weaners on low energy supplements maintained bodyweight and animals receiving a high energy supplement gained an average of 14 kg liveweight. Weaners grazing stubble but getting no supplement gained 24 kg, while those on the low energy supplement and the high energy supplement gained 30 and 29 kg respectively.
The conclusions were that pen experiments can be a poor guide to paddock response and that barley stubble was a useful feed source for carrying store weaners at low stocking rates. Neither type of supplement was likely to be economically worthwhile for carrying store weaners under low stocking rates where the animals could selectively graze the stubble.

In the second experiment all weaners on wheat stubble lost weight and differences between animals at three grazing intensities were small—only 11 kg between those at high versus low grazing intensities. At a high grazing intensity on lupin stubbles weaners initially gained weight but finally showed an average loss of 21 kg per head, the same as weaners on wheat stubble at medium grazing intensity. At a medium stocking intensity on lupin stubble weaners gained 10 kg weight in about 70 days then lost weight for an average total gain of 2 kg. At low grazing intensity they gained weight more or less continuously to show a final average gain of 28 kg per head over the 110 day trial period. No clinical cases of lupinosis were found in spite of periodic rains and high humidities.

The conclusions were that although lupin stubble could be a useful feed source to carry store weaner cattle over summer, low stocking densities would be necessary for reasonable animal growth. Wheat stubble, even at low stocking densities, proved a poor feed for weaner cattle.

COMPOSITIONAL QUALITY OF MILK
A practical problem associated with the minimum standard of 8·5 per cent solids-not-fat (SNF) of milk in summer-autumn months is the high proportion of Friesian cows in the State’s dairy herds.

The Friesian produces a large milk volume but has difficulty in maintaining a high SNF level during times of energy deficiency in her ration. High prices of cereal grains are also making it difficult for farmers to feed sufficient high energy concentrates to counteract the low quality pasture available to the cows in summer and autumn.

The milk quality incentive scheme introduced by the Dairy Industry Authority on October 1, 1974, was an attempt to ensure that bulk milk meets the minimum standards. Under the scheme increased payment incentives are offered for milk testing 8·6 per cent SNF or more during December—April, and there are financial penalties for milk with less than 8·5 per cent SNF.

Most market milk producers would have received up to $200 as an incentive over the five summer months while among those failing to maintain the standard a few would have suffered penalties of $1 000 or more.

The Department of Agriculture’s role has been to advise farmers on the steps needed to produce milk to meet the standard, and at the most economical level. It has also laid down standard test procedures at factories to ensure that testing is carried out fairly and accurately.

Requests for advice relating to low SNF levels have been less frequent than in recent years probably because of the intense educational campaign conducted to make farmers aware of remedial measures. During the critical feed period the campaign was organised through radio, Press, in Departmental publications and at farmer meetings.

A trial at Wokalup Research Station was also used to demonstrate the importance of nutrition in maintaining protein and SNF percentages in milk. The trial used different grazing pressures and gave the following results.

BRUCELLOSIS ERADICATION
Australia’s national programme to eradicate brucellosis began in 1970 with the general plan based on initial survey and vaccination, followed by test and slaughter. Apart from Tasmania, which is regarded as free of the disease, only Western Australia and the Northern Territory...
have entered the test and slaughter phase.

The Australian Government assists the programme by subsidising operating costs but it does not assist with compensation for brucellosis. Because of decreased income associated with the fall in cattle prices, the Compensation Fund is now under stress and in September the Industries Assistance Commission recommended that the Australian Government assist with compensation payment. Despite these difficulties however, 1974/75 marks a point in the programme where as long as effort can be sustained, eradication of brucellosis is in sight.

Most infected herds are detected initially by trace-back when blood samples from breeding animals slaughtered at major meat works are sent back to the laboratory. February 1975 was the first month ever in which no new properties were detected and at no time during the year did the number of trace-backs exceed 10 per month. (The maximum was 32 in August 1972.) The continuing low rate of detection is heartening as it indicates a low-level of disease remaining in the farming areas and allows diversion of testing resources to more intensive work on infected properties.

Herds known to be infected with brucellosis are placed under quarantine until no infection is discovered in two tests six months apart. The number of herds under quarantine had stabilised at about 400 between September 1972 and December 1974 and a fall to 300 in June 1975 must be seen as significant progress in the eradication campaign.

The capacity to test blood samples has been an important factor in the campaign and continuing efforts have been made to improve throughput. During 1974/75, the Laboratory achieved its planned capacity of 500 000 samples at a rate of 10 000 per week but efficiency will be improved still further by the recent delivery of an automatic serum tester which can deal with 500 serum samples each day.

An automatic serum tester will allow a considerable increase beyond the 10 000 blood samples a week now handled by the Department's Brucellosis Laboratory

The Department of Agriculture's water economy activities have centred on publicity plus demonstration work. In the commercial horticultural field, and in civic and home garden areas, officers provide advice on all aspects of irrigation, and design systems and schedules for individuals or groups. Information has been supplied via television programmes, radio broadcasts, publication of several booklets, participation in a major seminar on water economy, and lectures to a number of horticultural societies and similar groups.

This campaign has had considerable impact as at least three Government departments have adopted trickle irrigation on major landscape schemes, and many firms and local government areas have requested assistance. The response from the general public has also been enthusiastic and following one television programme nearly 100 telephone calls and more than 200 letters were received requesting information about trickle irrigation. Publicity work in water economy will continue but research on water...
requirements for Metropolitan usage will concentrate on needs of lawn types and use of mulches, etc. in gardens.

**Trickle irrigation**

Early trials with trickle irrigation equipment gave every indication of promise, with the greatest breakthroughs coming from Victorian work which led to the development of a cheap, easily installed system. Not all problems were solved however and trials in Western Australia have progressively refined the system to a reasonably-priced and reliable irrigation method. Two local developments which have materially assisted the introduction of trickle irrigation are the development of an efficient in-line filter system and development of a computer programme for trickle irrigation design.

About half the State's commercial orchards are now trickle irrigated and more recently tomato growers and melon growers in the Metropolitan Area, and banana growers at Carnarvon have installed trickle systems. The results for all have included considerable savings in time, labour, water and finance. The successful adaptation of micro-tube trickle irrigation to home gardens has proved extremely popular. Further research will be aimed at watering regimes, fertiliser requirements and testing of new equipment.

**Farm water supply surveys**

Water supply surveys over the past 10 years are being used as a basis for formulating an integrated farm water supply policy for the cereal and sheep districts. The surveys have been conducted in many agricultural areas to show where and how farmers get their water supplies, and to indicate the reliability or difficulty associated with the supplies. In some districts, such as the West Midlands and the Eradu sandplain, supplies of good quality groundwater are commonly available but at great depth (150 to 200 metres). Surface water supplies are notoriously unreliable or unavailable in these districts but bores to such depths often have a high capital cost or are plagued by silting problems. Comparatively, throughout much of the northern, north-eastern, central and eastern wheatbelt, farmers have a good chance of developing either surface water supplies (farm dams) or groundwater supplies (bores). The success rate of finding groundwater is generally low (about one hole in 10 is worth developing) but there are less problems in developing these relatively shallow groundwater supplies than in areas such as the West Midlands.

Great Southern farmers on the other hand have relied fairly heavily on soaks, and farm dams with natural catchments, but suffer widespread water shortages in low rainfall years.

In the southern and south-eastern wheatbelt, the south coast, the Esperance and mallee districts, little groundwater of stock quality has been found. Soils mostly have a sandy surface, and as the natural slopes are very low farmers have been forced to rely heavily on farm dams with improved catchments. The surveys have proved the existence of important developed water supplies throughout the agricultural areas, and shown that most areas have great potential for further water supply development. About 40 per cent of stock in the cereal and sheep districts now have access to on-farm drought-proof water supplies, while another 20 per cent are watered on the Comprehensive Water Supply Scheme. Most of the remaining 40 per cent are on farms with good potential for development of on-farm drought-proof water supplies which would allow maximum stock carrying capacity.

The Department of Agriculture's aim now is to encourage this further sound development of on-farm water supplies. In times of on-farm water deficiency in some areas, some stock might still have to be sold, but more than now could remain on farms and less water would need to be carted from expensively developed off-farm sources. In contrast with bores and wells which yield much the same from year to year regardless of droughts, surface supplies like soaks and farm dams often fail in years of low rainfall. Evidence from numerous farm water supply surveys has shown that over a large part of the cereal and sheep districts, failure of farm dams to fill is the greatest single cause of water supply failure in years of below average rainfall. About 30 per cent of farm dams do not fill in 50 per cent of years, mostly because of inefficient natural catchments.

This indicates that a considerable proportion of the Department's research effort should be aimed at increasing catchment run-off efficiency to ensure run-off from light showers.

**STREAM SALINITY STUDIES**

**Bauxite mining leases**

Because of concern over likely effects of bauxite mining in the Darling Range on the quality of water resources and on forests, an inter-departmental committee, the “Hunt Steering Committee”, was formed to oversee a group of seven research projects. One undertaken by the Department of Agriculture is the study of salinity of small streams in the bauxite mining lease areas to determine the relationship between land use and stream salinity. The study involves frequent and intensive stream sampling, and will make considerable use of mathematical analyses in an effort to devise an equation from which stream salinity changes can be predicted from a range of catchment characteristics. It is expected that this project will be completed in two years and could provide a valuable aid to prediction of the effects of land-use changes such as forest to mining or forest to agriculture on stream salinity.

**Wellington Dam catchment area**

Clearing of land for agriculture in the Wellington Dam catchment area has led to the release of salts originally stored in the deep subsoils. The salts have subsequently moved into streams and rivers and over the years, with more and more land being cleared, the salinity of water in Wellington Dam has reached the level where it could have an adverse effect, in some seasons, on irrigated pastures.

A salt and water balance study of a 200 hectare site in the Collie Irrigation Area near Waterloo aims to assess the efficiency of irrigation water usage and to determine whether irrigation with water from
Wellington Dam is causing an accumulation of salts in the area. The first results will be collected in 1975/76.

Woodchip licence area
At an early stage in proposals for the establishment of a woodchip area in the South-West there was concern over possible adverse affects of large scale clearing on the salinity of streams in the area. The Department co-operated with the Forests and Public Works Departments, and the Geological Survey of W.A., to study land use and salinity in the area and made its report in the Department's Technical Bulletin Series No. 27.

The study concluded that the most vulnerable areas from a salinity point of view were the catchments of the Donnelly, Wilgarup and Perup Rivers, and those parts of the Warren River receiving an annual rainfall of less than about 1000 to 1200 mm. An additional stream sampling programme is being established within these catchment areas to more accurately delineate salt prone areas.

MINING AND SOIL CONSERVATION
The Soil Conservation Service has been under increasing pressure from the general public, the Environmental Protection Authority, and mining companies, to become more actively involved in soil conservation related to mining.

The full Report of the Service is presented separately. This pressure has resulted in a soil conservation officer working full time on various aspects of soil conservation and mining, an indication of the important role that officers of the Department of Agriculture can play in non-agricultural situations.

Involvement so far has included contacting and being contacted by mining companies in a range of mining enterprises, giving advice wherever possible, defining limits to available knowledge, assisting to develop research needs and advising on experimental design.

The work obviously fulfills a need and will continue to promote awareness of the association between mining and soil erosion, and the need for erosion prevention and control.

RANGELAND SURVEYS
Western Australia has about 750,000 square kilometres of pastoral land, most of which has been used for grazing since the turn of the century. Unfortunately, in common with similar land elsewhere, its grazing capacity has generally declined because of droughts and improper use. Because the viability of the pastoral industry depends on stable and productive pastoral areas, the Pastoral Appraisement Board, in co-operation with the Department of Agriculture's Rangeland Management Branch, is conducting surveys of range condition to provide precise information on the nature and quality of the pastoral resource. The arrangement is a logical outcome of many years of research into rangeland management carried out by the Department of Agriculture.

The first step in such a survey is to obtain aerial photographs at 1:400,000 or 1:860,000 to allow the land to be divided into recognisable areas called rangeland types or land systems. These are then described in the field, and mapped at 1:250,000 to show the land systems, range condition and erosion in the survey area.

The resulting survey reports are used by the Pastoral Appraisement Board to re-assess permitted stocking levels and, where necessary to set up de-stocking programmes on individual pastoral leases. In some instances the information is used to produce Range Condition Guides to help pastoralists assess range condition on their leases.

The Department is also responsible for monitoring changes occurring since de-stocking began on the Gascoyne catchment. Sites have been set up in areas from which stock have been removed and changes occurring since de-stocking are being monitored by aerial photography.

Rangeland surveys and monitoring the trend in range condition are relatively new aspects of the work of the Rangeland Management Branch. The survey work is expected to continue for at least 10 years, while monitoring will become a permanent activity. The work is contributing to a better understanding of the basal resources of the pastoral industry and should lead to better use of the pastoral resource.

Rangeland condition surveys have now been carried out in the Gascoyne, West Kimberley and Eastern Nullarbor, as well as a survey into land suitable for Townsville Stylo in the North Kimberley.

Rangeland research worker classifying a ribbon grass pasture in the Kimberleys. The information gained can be used, with soil condition evaluation, to rank the site in terms of total range condition.