ATLAS OF AUSTRALIAN RESOURCES

Third Series

Volume 3

AGRICULTURE

Division of National Mapping, Canberra, 1982

PREFACE

This volume presents Australian agriculture in the late 1970s from a geographic viewpoint. Most emphasis is placed on where the major crops are grown and the main types of livestock grazed, both in relation to each other and to climate, soils and landforms. This is in keeping with the underlying theme of the Atlas, which is concerned, as the title implies, with the spatial distribution of resources and their use.

Most of the maps have been derived to some degree from the 1:5 million scale map of land use in Volume 1, *Soils and Land Use*. Readers wanting a regional treatment of agricultural land use should find that volume of particular interest.

Agriculture in Australia lends itself well to presentation in maps because of its extent and the availability of uniform statistical information about many of its facets.

The volume might properly be dedicated to the farming community: underlying nearly all maps are statistics for shires (or their equivalents) aggregated by the Australian Bureau of Statistics from annual agricultural census forms returned by farmers.

Other sources of data were the many published maps and reports bearing on the nature and location of farming activities. Landsat imagery also proved to be useful. What a contrast there is between statistics derived from agricultural census returns and images taken from a satellite 900 kilometres above the earth, with each image providing a record of the land surface over an area of 34 000 square kilometres! With so much information available, it takes self-discipline to achieve a synopsis appropriate for a national atlas, especially one for a country with an area of 7.7 million square kilometres.

Many of the 21 maps in this volume deal with individual items, such as wheat, or with several related items. But an understanding of Australian agriculture also calls for synthesis. Therefore, in dealing with grazing density, the author has used livestock units to equate beef and dairy cattle with sheep. Other examples of synthesis will be found in the maps of farm types and agricultural productivity, both of which are based on small-area statistics not previously available.

The nine maps at 1:10 million scale have also been published separately in National Mapping's *Australia Small Scale Thematic Map Series*.

In the previous edition of the Atlas comparable material for the late 1960s was presented in five large map-sheets and in five separate commentaries— 'Croplands', 'Crop Production', 'Livestock', 'Sheep and Wool', and 'Grasslands'. Comparison of the present volume with these maps and those of the first edition, produced in the 1950s, not only highlights major changes in Australian agriculture over the last three decades but also indicates advances in geographic knowledge, cartography and printing.

The volume was planned and produced by National Mapping staff. On page 24 the author, Frank Bullen, acknowledges the valuable contributions made by those outside National Mapping—mainly staff members of CSIRO, the Bureau of Agricultural Economics and the Australian Bureau of Statistics.

Colleagues within National Mapping's Geographic Branch assisted the author in the preparation of map data and commentary material. Laurance Hazlewood supervised the geographic work and Murray de Plater, assisted in turn by Phil Woodward, Graham Leahy and Ruth Dodd, was responsible for cartographic production.

Trevor Plumb

Editor

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COVER PHOTOGRAPH: Merinos on sown pasture in high-rainfall sheep country, A.C.T. *Australian Information Service*

GENERAL INTRODUCTION

Settled agriculture, never practised by the Aboriginal inhabitants, was introduced to Australia by Europeans in the late 18th century. After early setbacks, due largely to the unfamiliar environment, agriculture has consistently provided almost all the food consumed domestically and, until the early 1970s, the bulk of export income.

Agricultural production has greatly increased in this century, and particularly since the Second World War, through large increases in improved pasture, cropping, fertiliser usage and irrigation, aided by scientific and technical advances. However, due to even greater increases in other sectors of the national economy, agriculture's contribution to the gross domestic product has declined from nearly 20% in the early 1950s to about 5%. Nevertheless agricultural products still form a large proportion of Australia's exports, amounting to about 40% by value in recent years.

Australia's 180 000 farms cover 500 million hectares, or about two-thirds of the land surface, and produced commodities worth $A11 000 million in 1979–80.

Livestock have always formed the basis of Australian agriculture and still do, despite recent large increases in cropping. By far the largest proportion of agricultural land is used for grazing and, even where cropping is important, more than 80% of the land is grazed except in some of the small areas of intensive cropping.

The geography of Australian agriculture strongly reflects *effective rainfall*, which is the amount of rain available for plant growth after run-off and evaporative loss. Australia has universally hot summers and mild winters; temperatures low enough to stop plant growth only occur in relatively small upland areas of the south-east and Tasmania. Evaporative losses are accordingly high in summer and winter rain is more effective for plant growth and agricultural productivity. Even in the northern half of the continent, which receives much more rain in summer than in winter, the most productive areas are those which receive significant winter rain, as on the Pacific coast and hinterland of Queensland.

Australian agricultural land (Figure 1) can be broadly divided into three zones:

- The pastoral zone of the semi-arid inland and monsoonal north, where livestock graze on native pastures at low stocking rates and crops are virtually absent.
- The wheat belts of the sub-humid south and east, which contain most of the cropland. Even so, more than 80% is grazing land, much of which is sown pasture grown in rotation with crops. Stocking rates are, accordingly, much higher than in the pastoral zone.
- The high-rainfall livestock zones of the humid south and east, coastward from the wheat belts, where grazing predominates but which also contain relatively small areas of intensive cropping. The livestock are grazed mainly on permanent sown pasture, particularly in the south, and the average stocking rate is the highest of all three zones.

Most of the agriculturally unused land in the interior is desert, while nearer the coast it is mostly forested mountain and hill country.

The pastures, the resource upon which the grazing livestock depend, are described in the first topic of this volume. The spatial distribution and productivity of the main types of livestock and of the major crops are mapped and described in the following two topics. The final topic deals with the economic units of agricultural production—the farms—and with the economic productivity of farm land.

Nearly all the maps in this volume are based on data collected by the Australian Bureau of Statistics at the annual agricultural census of 31 March 1976. If available, figures for 1980 have been added in the text and tables. The 1976 figures were the most recent statistics when map compilation began and they refer to a year in which agricultural production was not abnormally affected by the weather. Much of Australia received above-average rainfall in the years immediately preceding 1975–76 but since then prolonged droughts have affected large areas.

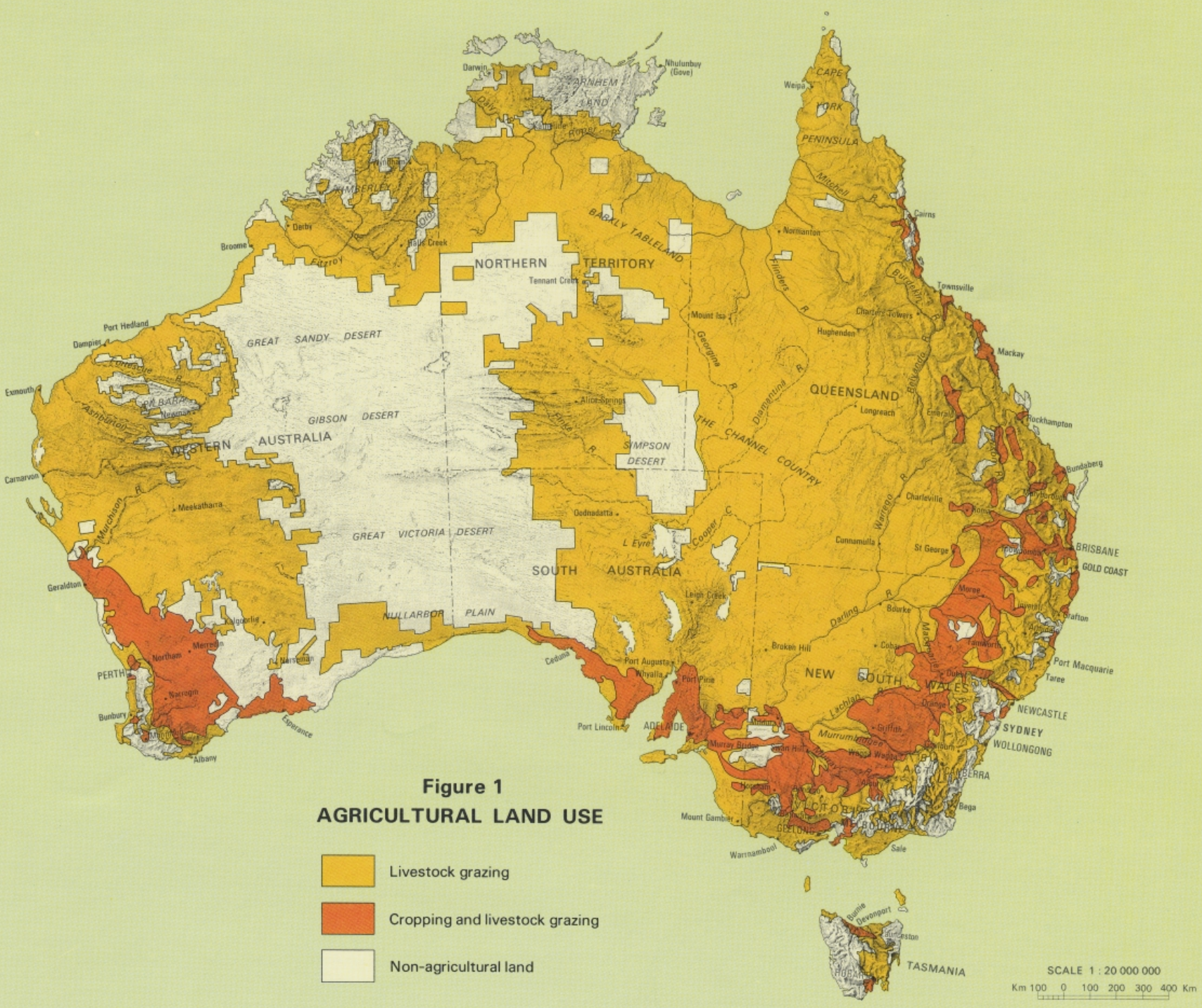


Figure 1
AGRICULTURAL LAND USE

Livestock grazing

Cropping and livestock grazing

Non-agricultural land

PASTURES

INTRODUCTION

Australian sheep and cattle are almost completely dependent upon pasture grazed in the paddocks. Most fodder grain is used as pig and poultry feed while hay and silage are used as dry-season supplementary feed or reserved for times of drought.

Australia's 500 million hectares of grazing land can be divided into two markedly different sets of regions. First, the humid and sub-humid regions of the south and east, which contain a quarter of the grazing land including almost all the improved pasture, provide grazing for three-quarters of the nation's sheep and cattle. Second, the arid and semi-arid regions together with the monsoonal north contain three-quarters of the grazing land, little of which is improved pasture, and support only a quarter of all livestock.

Before the widespread introduction of exotic pasture plants, which has largely occurred in the last thirty years, the pastoral industries had to rely on native pastures. These are generally poor in comparison with those in other parts of the world where European-style animal husbandry is practised. Most native Australian grasses grow in tussocks as opposed to the sward-forming grasses which make the most suitable grazing for domestic livestock.

Before European settlement, the greatest pressure on Australia's native pastures had been grazing by free-ranging marsupial herbivores able to respond rapidly to drought by cessation of breeding and by migration. Many pastures have been unable to withstand continuous heavy grazing by large flocks of sheep or herds of cattle confined in fenced paddocks and have, accordingly, deteriorated.

Another factor leading to deterioration was the all too successful introduction of rabbits in Victoria in 1859. Within 50 years they had spread through most of the southern half of the country, causing serious pasture damage over large areas. This occurred when graziers were still learning how to manage the land and overstocking was common, particularly in the semi-arid regions.

Rabbits and overstocking have diminished the more palatable plants, which have been replaced by less useful or even harmful ones. In more extreme cases perennials needed to maintain year-round grazing were eliminated or the pasture totally destroyed, creating bare 'scalds' which are very difficult to revegetate on some soils.

On the other hand the area of native pasture has been considerably increased by the clearance of trees and shrubs. In the past, especially in the drier areas, this was achieved by ring-barking trees, allowing native pasture to advance slowly into the clearings as the trees eventually died. More recently, mechanical clearance of trees and shrubs has made possible a more rapid increase in pasture area, although cleared areas are now commonly sown with crops or non-native pastures.

This large increase has certainly raised livestock carrying capacities but has created some new problems and exacerbated others. On some soils and on steeper slopes clearance of trees and shrubs has led to serious soil erosion. The breeding and feeding habitats of native grassland fauna have expanded and some—notably kangaroos, locusts, grasshoppers and certain beetles whose larvae feed on the roots of grasses—now increase more frequently to pest levels.

The most dramatic improvement of Australian pastures has resulted from the introduction of high-yielding pasture plants from overseas. This began around the turn of the century but the largest gains in area have been achieved since the Second World War. This development has been largely confined to the more humid regions, particularly in the cereal-growing belts. An essential part of this development has been the extensive use of fertilisers (notably superphosphate), trace elements and nitrogen-fixing clovers, which have largely overcome the problems posed by Australia's inherently poor soils.

Where land has been converted to sown pasture, stocking rates have on average quadrupled and the large increase in sheep and cattle numbers since the turn of the century has been almost completely due to this conversion.

Today sown pastures cover nearly 30 million hectares, mostly concentrated in the humid and sub-humid regions of the south and east, where they cover about a quarter of the grazing land. However, nationally, they occupy only about 6% of the grazed land and accordingly the mean Australian stocking rate, equivalent to about one sheep to 1.25 ha or one beef beast to 10 ha of grazed land, is low by comparison with other major livestock producing countries. For example, the mean stocking rate of the U.S.A. is one beef beast to about 2 ha.

Table 1. Sown Pastures ('000 ha)

State	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Queensland	716	1 593	3 582	3 170
New South Wales & A.C.T.	1 611	4 958	5 788	6 049
Victoria	2 910	6 108	6 234	5 671
Tasmania	285	683	935	895
South Australia	437	2 722	3 589	3 211
Western Australia	1 453	4 611	7 463	7 141
Northern Territory	n.a.	7	116	99
AUSTRALIA	7 410	20 682	27 707	26 236

Notes: Lucerne included in all years.
Figures in this and later tables may not add exactly to totals shown because of rounding.

Sources: Australian Bureau of Statistics—*Primary Industries: Part I—Rural Industries: 1950–51*, Bulletin No. 45; *Rural Industries 1965–66* No. 4; and *Agricultural Land Use, Improvements and Labour: Australia: 1978–79* and *1979–80* (N.T. revised).

NATIVE PASTURES

The map 'Native Pastures' shows the distribution of fourteen broad types and those areas where native pastures have been to a large extent replaced by introduced sown pastures and crops or greatly altered by self-sown naturalised species. Areas which still retain native vegetation that is largely unsuitable for grazing are also shown. Much of this is forest, shrub or heathland in which the ground cover is generally of low fodder value. Many such areas are reserved for forestry or nature conservation, from which grazing is generally excluded.

The pattern of native pasture types reflects, to a large extent, the combined influences of climate and soils. The climatic factors of greatest influence on pasture composition and growth are the amount and seasonality of the rainfall. The wettest season is normally the summer (November–April) in the north and the winter in the south. Thus, except where there is an overlap in rainfall regimes as in central New South Wales, there is usually only one season of vigorous plant growth. However, even during the wet seasons other climatic factors adversely affect growth. In the north, summer rainfall coincides with maximum temperatures so that much moisture is lost by evaporation. In the south, considerable proportions of the higher rainfall areas are at sufficiently high altitudes for the low temperatures in the winter wet season to severely retard plant growth so that autumn and spring are the best growing periods.

Because vigorous growth is generally so restricted seasonally, the pastures need a high proportion of perennial species to maintain year-round grazing. Thus the relative values of Australian pastures for grazing livestock are determined to a large extent by their perennial components, even though these may be less palatable and nutritious than many of the annual plants that are briefly available during the limited wet season. Unfortunately, the heavy grazing pressures that these perennials have had to withstand during prolonged droughts—a recurrent feature of the Australian climate—has led to their decline over large areas and, in some places, to their complete elimination.

Much of Australia has poor soils supporting equally poor pastures. Sandy, saline, shallow or inherently infertile soils cover most of the interior and shallow soils occur over much of the more humid upland areas nearer the coasts, especially in the north. All these support pastures with very low stock carrying capacities. The best native pastures are those largely composed of perennial Mitchell grass, which cover extensive inland plains of deep, self-mulching, cracking clays.

Descriptions of the types of native pasture shown on the map are given in the Appendix at the end of this topic. These also include some brief comments on management problems and indications of the relative usefulness of each type.

Today, the large areas of grazed native pastures probably support less than a third of all livestock and this proportion is declining as the area of sown pastures increases.

SOWN PASTURES

The expansion of sown pastures of introduced species has been comparatively recent (see Figure 2). Although a few farmers were advocating their value at the turn of the century, significant increase did not begin until the 1920s, when State agricultural departments began to encourage their establishment and when the application of phosphatic fertilisers to pasture had been accepted as profitable. The really large expansion has occurred since the Second World War, quadrupling the area to reach a peak of 28.6 million hectares in 1975. Since then economic factors caused a slight decline to about 26 million hectares in 1980 (see Table 1).

Almost all this development has occurred in the humid and sub-humid regions of the south and east: there has been little in the semi-arid and monsoon regions and none in the arid interior, as the map 'Sown Pastures and Fodder Crops' shows. Sown pasture forms an integral component of the now widespread wheat-pasture rotation (ley farming) so that much of the increase has been linked directly to the large increase in the wheat crop since 1950.

In the regions in which sown pastures have become concentrated they, together with crops and volunteer exotic plants, have largely replaced native vegetation on most of the best land and have quadrupled the carrying capacity over large areas.

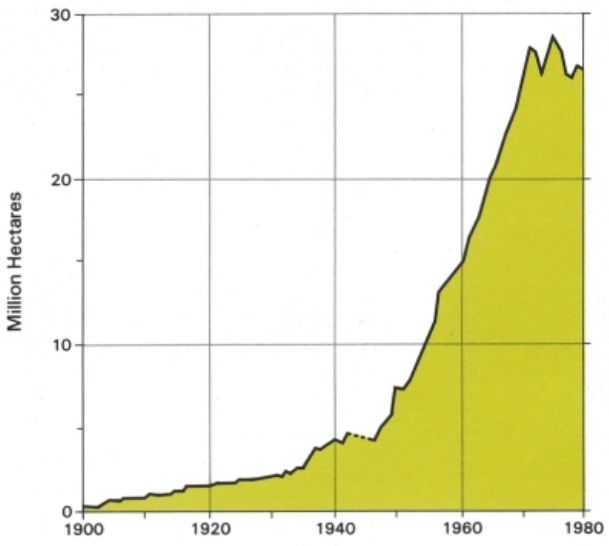


Figure 2. Area of Sown Pastures, Australia 1900–80
Based on statistics in various publications of the Australian Bureau of Statistics, with estimates for Queensland 1936–38 and 1939–42 and for New South Wales 1945–46. Statistics are not available for three or more States for 1942–45. Lucerne, classified by the Bureau as a crop before 1970–71, is included in all years.

PHOTOGRAPH ABOVE: Sown pastures of clover and grass support the wool and fat lamb industries of the Southern Tablelands of New South Wales.

This photograph and Figure 4 and 10 by Australian Information Service; Figures 3, 5–9 and 11 by F. T. Bullen.

Types of Sown Pasture

No one plant or combination of plants is suited to the entire range of climates and soils in which sown pastures have been established. Early introductions were largely temperate European plants which proved suitable mainly for the cooler and wetter climates of Tasmania and southern Victoria. Later, plants of Mediterranean, African and South American origin were introduced. These introductions were largely unsystematic but gradually plant breeders began developing varieties suited to local environments. It was not until the early 1950s that systematic efforts were made to collect species and varieties of potential value from climatically similar regions overseas.

No suitable source map or statistics are presently available from which a reasonably accurate map of major sown pasture types could be drawn. An indication is given by the generalised map of regional suitability included in the map-sheet 'Grasslands' (1970) of the Second Series of this Atlas.

Sown pasture development began in the cooler temperate south-east with the introduction of perennial European clovers, notably white clover (*Trifolium repens*) and perennial ryegrass (*Lolium perenne*), and advanced most rapidly in Tasmania and Victoria. Pastures of clover and ryegrass now cover much of the grazing land in Tasmania, the wetter plains and hill country of southern Victoria, the wetter eastern tablelands of New South Wales, and patches in the southern Queensland hill country as far north as the Burnett Valley. These pastures provide some of the best grazing land in Australia, such as the dairying country of Gippsland and the northern Tasmania coast, where grazing densities are commonly better than one dairy cow per hectare. Elsewhere beef cattle can be fattened for market in 18–24 months and, on slightly drier inland areas, sheep for fat lamb production can be stocked at about 8–12 per hectare.

In the drier coastal areas of Victoria and south-eastern Tasmania the self-regenerating annual subterranean clover (*Trifolium subterraneum*) takes the place of white clover in the perennial ryegrass pastures. On the western slopes of the New South Wales tablelands and extending through central Victoria, on the South Australian hill country and in the wetter south-west corner of Western Australia, pastures of perennial phalaris grass (*Phalaris aquatica*) and subterranean clover predominate. In wetter areas of the wheat belt in the south-eastern States and throughout the Western Australian wheat belt, sown pastures of subterranean clover together with annual (or Wimmera) ryegrass (*Lolium rigidum*) are widespread. In these areas, particularly in Western Australia, subterranean clover is also commonly sown into natural pastures mostly composed of volunteer grasses and forbs (other herbaceous plants) of Mediterranean and South African origin.

Subterranean clover (of Mediterranean origin) is the most important pasture plant grown in Australia. Accidentally introduced and unimportant in its place of origin, the value of subterranean clover under Australian conditions was first realised by a South Australian pastoralist in the 1890s but did not receive widespread recognition until the 1920s. Although an annual, it is a prolific seeder and regenerates easily. It grows well on poor acid soils and responds well to fertilisers, especially superphosphate. Like other legumes it fixes nitrogen in the soil, thus improving fertility, and is accordingly an ideal plant in a pasture-crop rotation. It requires a cold spell in winter for flower initiation and is therefore unsuitable for tropical areas. In all wheat-growing States except Queensland the large increase in sown pasture area since the Second World War (shown in Table 1 and Figure 2) was due to the widespread introduction of subterranean clover. Early maturing varieties suitable for the drier parts of the wheat belt have contributed much to the expansion and consolidation of wool-wheat farming in Western Australia in particular. Stocking rates in areas with much subterranean clover pasture range from about 1–2 sheep per hectare on the drier margins up to 8 sheep in wetter areas.

Lucerne (*Medicago sativa*), a legume of Middle Eastern origin, is locally important in areas of good soils. The largest concentration of lucerne growing is in south-eastern South Australia and it is also important on river flats in central and northern New South Wales, south-eastern Queensland and in parts of the Murray irrigated lands. In contrast with subterranean clover, lucerne was already recognised as an excellent fodder plant long before its introduction in Australia. It is highly productive and a long-lived perennial provided it is not grazed continuously. About a million hectares were grown in pure stands in 1976 declining to less than half a million in 1979, due to damage by an aphid species that has recently appeared in Australia. Mixed lucerne and grass pastures cover a larger area, probably about two million hectares.

In the driest marginal areas of the wheat belts, annual medics of Mediterranean origin, notably barrel medic (*Medicago truncatula*), are used instead of subterranean clover. Stocking rates are lower than for subterranean clover pastures but are generally better than one sheep to two hectares.

The sown pasture species in the northern tropical and sub-tropical areas are quite different from those of the more temperate south, with little overlap except in north-eastern New South Wales and south-eastern Queensland.

Pastures in the wetter areas along the coastal fringe of Queensland and northern New South Wales commonly include perennial grasses of South American or African origin, notably paspalum (*Paspalum dilatatum*), kikuyu (*Pennisetum clandestinum*) and Guinea grass (*Panicum maximum*). A number of tropical legumes are grown with these grasses, notably siratro (*Macroptilium atropurpureum*) and desmodium (*Desmodium* spp.), but none has gained the pre-eminent position that white clover has in pastures of the equivalent southern higher rainfall areas. Protein deficiency in the dry winters, common to all tropical pastures, is a constant problem and the carrying capacity of these pastures is generally inferior to that of their southern equivalents. However, they are much superior to the tropical tall grass native pastures they have replaced and allow marketing of beef cattle 2–3½ years old.

In drier areas further inland, in central Queensland, sown pastures consist of xerophytic perennial grasses mainly of African origin such as Rhodes grass (*Chloris gayana*), green panic (*Panicum maximum* var. *trichoglume*) and buffel grass (*Cenchrus ciliaris*). These are the species commonly sown on cleared brigalow land; sowing has increased considerably in the last twenty years as land development has progressed. They have contributed most to Queensland's late upswing in sown pasture area in the 1960s (Table 1). Although a number of temperate legumes (in south-central Queensland) and tropical legumes are grown or are being tried, it is generally too hot and humid in summer for the former and too cold in winter for the latter. Accordingly none has found the general acceptance that subterranean clover has in equivalent southern areas. Stocking rates can be as high as one cattle beast per hectare but are generally much lower.

Buffel grass is also the most commonly sown species in cleared areas of acacia woodland (mainly gidgee, *Acacia cambagei*) in the Blackall area of semi-arid central Queensland. This is the only semi-arid area where sown pastures are grown on a large scale.

In the northern monsoon region sown pasture development began in the mid-1960s, mainly with sowings of Townsville stylo (*Stylosanthes humilis*), a legume of South American origin. However, an outbreak of anthracnose disease and lower beef prices in the early 1970s reduced sowings (exemplified by data for the Northern Territory in Table 1). Caribbean stylo (*S. hamata*), less prone to disease and comercially released in the mid-1970s, is now more frequently sown. In Queensland *Brachiaria, Panicum* and *Setaria* grasses and *Neonotonia* and *Desmodium* legumes are also sown.

Irrigation of Pastures

Nearly one million hectares of mainly sown pastures were irrigated in 1975–76, as shown on the accompanying map. This was a slight decrease from a peak of just over one million hectares in 1972–73. Complete data have not been collected since 1976. Irrigated pastures are heavily concentrated in the south-east, about two-thirds being in the Riverina of New South Wales and adjacent areas of northern Victoria (see enlargement on map overleaf). Here irrigated pastures fall into two types, annual and perennial. Annual ryegrass and subterranean clover pastures require much less water than the more productive perennial ryegrass and white clover pastures, which are common only where irrigation water is plentiful and cheap.

Lucerne is a characteristic plant of irrigated river flats in central and northern New South Wales and the lower Murray in South Australia, as already mentioned. When grown as a pure stand almost all irrigated lucerne (nearly 100 000 ha in 1975–76) is cut for hay.

Figure 3. *Irrigated lucerne on alluvial flats along the Macquarie River, central New South Wales.*

Because of the heavy concentration of irrigated pasture on the well-levelled land of the Murray-Murrumbidgee irrigation areas, 80% is flood irrigated. Pasture on unlevelled land is spray irrigated.

Stocking rates on irrigated pastures are high, generally better than 8 sheep or one cattle beast per hectare. Dairying predominates in coastal areas and in north-central Victoria. Elsewhere irrigated pastures are used for fat lamb production or for finishing beef cattle for slaughter.

Fertiliser Use on Pastures

In general, Australian native pastures show a poor response to fertilisers so that most of the 9 million hectares of pastures fertilised in 1975–76 were sown pastures—see the map overleaf. (The statistics used for the map exclude the use of lime, gypsum and dolomite, which are soil conditioners rather than fertilisers.) This area was half that fertilised two years previously, due largely to low market returns on livestock products and the temporary removal of a government bounty on superphosphate, which makes up 90% of all fertilisers used on pastures (1.08 million out of 1.19 million tonnes in 1975–76). However, fertiliser use on pastures is again increasing and in 1979–80 2 million tonnes was spread on nearly 15 million hectares.

Figure 4. *Aircraft top-dressing sown pasture with superphosphate in the Southern Tablelands of New South Wales. In 1979–80 aircraft spread 500 000 tonnes of superphosphate, top-dressing and seeding 4.4 million hectares.*

The proportion of sown pastures fertilised also reflects the quality of the soils on which they are grown. This proportion ranges from more than half the sown pasture on the poor soils of Western Australia, through about a third to a quarter in South Australia, Victoria, Tasmania and southern New South Wales, to very low proportions in northern New South Wales and southern Queensland. In these northern areas relatively greater amounts of nitrogenous fertilisers are used to offset the lack of suitable nitrogen-fixing leguminous pasture plants. Fertilisers are rarely applied to sown pastures on the fertile brigalow soils of central Queensland.

FODDER CROPS

About one million hectares of fodder crops were grown in 1975–76 and this area has changed little in recent years. Of this, 750 000 ha were under winter cereals grown for green feed and silage. Oats make up about three-quarters of this area and are grown widely for this purpose throughout the wheat belts. The greatest concentration of winter-cereal grazing occurs in northern New South Wales and southern Queensland, where oats form an important source of winter feed, making up for the lack of suitable cool-season pasture plants.

Cereals cut for hay make up most of the remaining fodder crop area, producing 0.7 million tonnes from 230 000 hectares in 1975–76 to supplement the 3.7 million tonnes of hay made from almost a million hectares of pasture. Hay is mostly used as dry-season feed or drought reserve.

Other fodder crops of regional importance are forage sorghum, vegetables and lupins. Forage sorghums are grown in southern Queensland and northern New South Wales, where they provide summer fodder (85 000 ha in 1975–76) complementary to winter-grown oats.

About 20 000 ha of vegetables for stock feed are grown, mostly in Tasmania and southern Victoria. These are mainly turnips and chou moellier, a thick-stemmed variety of kale. Depending on the time of sowing they provide grazing in winter or late summer and autumn.

Lupins, a comparatively new leguminous fodder crop, covered a peak area of 139 000 ha in 1975–76, of which 120 000 ha were in Western Australia, in the northern and western margins of the wheat belt. Since then the total area has declined to 68 000 ha in 1978–79 even though lupin cultivation has increased markedly in the eastern States. The green plants have a toxically high alkaloid content but the dry foliage, pods and seeds form nutritious grazing for sheep in summer. Newer, low-alkaloid varieties are now available. Lupins have a number of other uses but, because the area statistics are not subdivided according to use, they were mapped here as a fodder crop and again in the 'Crops' topic as a cash crop.

PASTURES IRRIGATED

Area of pastures irrigated during 1975–76

• 2000 hectares

SOURCES: Statistics for local government areas from the Australian Bureau of Statistics supplemented by satellite imagery and water authority data for irrigation areas.

PASTURES FERTILISED

Area of pastures to which artificial fertilisers (not lime, gypsum or dolomite) were applied during 1975–76

• 10 000 hectares

SOURCE: Statistics for local government areas from the Australian Bureau of Statistics.

APPENDIX. NATIVE PASTURES

A broad division has been made on the map 'Native Pastures' between those native pastures that are naturally treeless or have only a sparse tree or tall shrub cover and those with a denser top cover. In the latter, pasture area is limited by tree shading but has been increased over large areas by the clearance of top cover.

In these descriptions grasses which commonly grow to more than one metre in height are termed *tall*; between a half and one metre, *mid*; and less than half a metre, *short*.

PASTURES WITH LITTLE OR NO NATURAL TOP COVER

BLUEGRASS

Grasslands with perennial bluegrasses (*Dichanthium* spp.) dominant or co-dominant occur on the wetter edges (average annual rainfall generally more than 500 mm) of treeless, cracking clay plains in northern Australia and in the Central Highlands of Queensland. Other co-dominant perennials are silky browntop grass (*Eulalia fulva*) in the Queensland Gulf Country and ribbon grasses (*Chrysopogon* spp.) in the Kimberley region of Western Australia. They form medium or occasionally tall tussocks between which there is ample space for the summer wet season growth of a complex mixture of annual, and generally more palatable, grasses (such as Flinders grasses, *Iseilema* spp.) and other herbs (forbs).

During the winter dry season, when the annuals have dried off, grazing is restricted to the small central portions of the perennial grass tussocks that remain green. Controlled burning in the late wet season and at times during the dry improves the accessibility of this small amount of green feed and stimulates limited regrowth; nevertheless, cattle lose condition in the dry season. However, these grasslands are better than those adjacent to them, with the exception of the Mitchell grasslands. Stocking rates vary between one beef beast to 10 ha on the best river frontage land to one beast to about 25 ha elsewhere.

Sown pastures are virtually absent but buffel grass (*Cenchrus pennisetiformis*) and Birdwood grass (*C. setiger*), both introduced in the Cloncurry area in 1926, are now naturalised over some areas of Gulf Country river frontage.

MITCHELL GRASS

Mitchell grasses are the characteristic plant cover of extensive cracking clay plains and valley floors in the northern semi-arid region with a summer wet season and an average annual rainfall of 250–500 mm. These areas are generally treeless or, as in their southern extension into New South Wales, with a very open tree cover. The predominant species varies regionally but is always one of the drought-resistant perennial Mitchell grasses (*Astrebla* spp.), which grow in discrete mid-height tussocks up to 250 mm in diameter and about 500 mm apart (see Figure 12).

In the summer wet season the normally abundant growth of annuals, mostly forbs but notably including Flinders grasses (*Iseilema* spp.), provide more palatable and nutritious feed than the Mitchell grasses which, however, provide valuable fodder in the long dry season when the annuals have disappeared. These pastures respond rapidly to rain, even when light, and the self-mulching property of the clay soil conserves moisture well.

Mitchell grasslands provide most of the best grazing for beef cattle in the northern semi-arid region, with stocking rates of one beast to 12–16 ha. Further south, on the extensive plains of central Queensland and northern New South Wales, sheep are grazed at one to 2–3 ha.

XEROPHYTIC TUSSOCK GRASS

This type contains a mixture of tussock grass species and is mostly developed on clay soils on plains or rolling downs where the annual rainfall is generally less than 250 mm, most of which falls in summer. Of the perennials, Mitchell grasses (*Astrebla* spp.) are the most widespread but many other xerophytic tussock grasses such as species of *Eragrostis* and *Enneapogon* are locally as common. However, the real value of these pastures, which are more productive than adjacent pastures on shallow or more sandy soils with a similar climate, lies in the annuals that grow during the summer wet season.

Much of the broad, inland-draining flood-plains of the Channel Country of south-west Queensland has these pastures. Their composition varies with the timing, extent and persistence of flooding; floods in mid to late summer are most common and can persist well into winter. Winter growth (dominated by forbs, notably Cooper clover, *Trigonella suavissima*) is generally highly nutritious so that beef fattening is possible. Summer growth (dominated by annual grasses, notably pepper grass, *Panicum whitei*; small Flinders grass, *Iseilema membranaceum*; and channel millet, *Echinochloa turnerana*) is more abundant and, even though less nutritious than the winter growth, maintains cattle condition well. However, when the flood-grown pastures dry off, the remaining vegetation (such as canegrass, *Eragrostis australasica*; lignum shrubs, *Muehlenbeckia cunninghamii*; and various low *Sclerolaena* shrubs) is mostly unpalatable and has a low carrying capacity.

In the small areas near Port Hedland in Western Australia, naturalised buffel and Birdwood grasses (*Cenchrus* spp.) are dominant in some places.

The xerophytic tussock grass pastures are predominantly grazed by beef cattle at rates varying from one beast to 50 ha in the poorer parts to one beast to 15 ha on the Channel Country flood-plains after a good flood.

SALTBUSH–XEROPHYTIC MID GRASS

This type mostly occurs on saline or calcareous soils in areas of low relief, predominantly in southern arid and semi-arid areas where the annual rainfall is less than about 300 mm.

The characteristic plants are perennials belonging to the Chenopodiaceae family, predominantly species of *Atriplex* (saltbushes) and *Maireana* (bluebushes— previously named *Kochia*). Trees are either absent or sparse and grass cover between the saltbushes is variable and generally ephemeral. Perennial grasses (*Eragrostis, Danthonia* and *Stipa* spp. in the south and Mitchell grass in the north) occur on heavier soils, while on lighter soils on higher ground seasonal fluctuations are great but the pastures commonly include *Stipa* and *Enneapogon* grasses, various native burrs (*Sclerolaena* spp.—previously named *Bassia*—of the Chenopodiaceae family) and a great variety of daisy-like herbs.

The grass–forb component is the most important and is grazed preferentially when available but the saltbushes provide most of the feed in dry periods. Because saltbush is susceptible to overgrazing and trampling, much of this pasture is in poor condition.

In the south, sheep grazing predominates at rates ranging from one sheep to 1–2 ha on cracking clay plains in the Riverina of New South Wales to one sheep to 12–16 ha in drier areas.

Figure 6. *Saltbush–xerophytic mid grass, Channel Country of south-western Queensland.*

NATIVE PASTURES GENERALLY WITH TOP COVER

MONSOON TALL GRASS

This type occurs in northern areas where the annual rainfall is greater than about 700 mm, with a typical monsoon regime of very wet summers and almost completely dry winters. It is characterised by a number of tall annual and perennial grasses, such as *Sorghum, Themeda* and *Heteropogon* species, which grow rapidly and prolifically in the wet season in open eucalypt and melaleuca woodlands. However, most are palatable only in the early growth stages, becoming progressively less palatable and of sharply declining nutritional value later in the wet season. Also present are shorter grasses more characteristic of the semi-arid areas to the south (for example *Aristida* spp.); although mostly unpalatable, they provide some feed in the dry season.

Controlled burning in the late wet season and at times during the dry season, as with the bluegrass pastures, improves the accessibility of younger and more palatable growth and encourages regrowth. Beef cattle, the only livestock grazed on these pastures, lose weight and condition in the dry season so they are not marketed until 5–7 years old. Stocking rates are governed by the long dry season and are low, at around one beast to 50 ha.

Exotic legumes such as *Stylosanthes, Neonotonia* and *Desmodium* and grasses such as *Brachiaria, Panicum* and *Setaria* are sown over small areas.

Figure 5. *Xerophytic tussock grass fresh and green after summer rains and local flooding, Channel Country of south-western Queensland.*

Figure 7. *Monsoon tall grass drying off at the end of the wet season, Kimberley region, Western Australia.*

MONSOON MID GRASS

This type occurs in the same climatic zone as monsoon tall grass but is characterised by an assemblage of mainly perennial mid grasses of the *Eriachne, Aristida* and *Schizachyrium* genera which are mostly wiry, unpalatable, and of low nutritional value even in the summer wet season. Controlled burning at the end of the wet season encourages regrowth.

Stocking rates are low, generally less than one beef beast to 50 ha and commonly one to at least 100 ha. The combination of poor nutrition in the wet season and weight loss in the dry results in high annual mortality and low turn-off rates (usually less than 10% of total herd numbers). Cattle are mostly turned off for fattening elsewhere although some are turned off for slaughter after 6–8 years.

TROPICAL TALL GRASS

Most of the area occupied by this type—the coastal hinterland of eastern Queensland—has a tropical climate with a summer wet season and winters which are not so consistently dry as in the monsoon region.

The characteristic perennial species is bunch speargrass (*Heteropogon contortus*). Kangaroo grass (*Themeda australis*) and species of *Bothriochloa* and *Aristida* are also common. Kangaroo grass was probably more abundant in the past but has been replaced by speargrass as a result of grazing.

Speargrass provides good grazing in early summer but later becomes rank and unpalatable with a low nutritional value. As in all other tropical pastures, controlled burning in the late wet season and at times during the dry produces a limited regrowth of young shoots. The initially more nutritious pasture and a shorter and less severe dry season allow higher stocking rates than on monsoon tall grass. Clearing of the original timber (eucalypt woodland and brigalow, *Acacia harpophylla,* forest) has increased and improved the pasture. Speargrass in cleared areas can carry one beef beast to about 6 ha and fat cattle can be turned off in 4–6 years. This pasture is generally unsuitable for sheep: it is too tall, its poor nutrient value in the dry season affects wool yield, and the speargrass seeds affect fleece quality.

Figure 8. *Tropical tall grass (speargrass) in brigalow country, Central Highlands of Queensland.*

In central Queensland, particularly in cleared brigalow country, large areas have been sown with Rhodes grass (*Chloris gayana*) and green panic grass (*Panicum maximum* var. *trichoglume*).

NORTHERN XEROPHYTIC MID GRASS

This occurs in the northern semi-arid region on country intermediate between the Mitchell grass cracking clay plains and the semi-arid hummock grass growing on higher land with shallow soils. It extends into adjacent more humid regions where the soil is shallow.

Various perennial species of wiregrass (*Aristida*) characterise these pastures, mixed with other drought-resistant, mid-height grasses, notably *Bothriochloa, Eriachne* and *Sehima* in the north and *Chloris, Paspalidium, Enneapogon* and *Eragrostis* in the south. In places shrubs such as supplejack (*Ventilago viminalis*) provide useful browse feed. The *Aristida* grasses are generally unpalatable and stocking rates are accordingly low. Beef cattle predominate except in southern Queensland, where sheep are locally more important. Cattle are grazed at about one to 15–30 ha at best and sheep, in the south, at one to 2–3 ha on cleared land but one to 5–10 ha in timbered country.

In southern and central Queensland this pasture type generally occurs on the drier edge of brigalow areas and where these are cleared it is commonly replaced by buffel grass (*Cenchrus ciliaris*), allowing stocking rates of one beef beast to 3–5 ha.

SEMI-ARID HUMMOCK GRASS

This type is an extension of the arid hummock grass pastures of the interior into northern semi-arid areas where shallow or sandy soils diminish the effectiveness of the higher rainfall. It is characterised by evergreen perennial grasses of the *Triodia* and *Plectrachne* genera, commonly called spinifex, which have a distinctive circular hummock growth form and tightly rolled hard leaves formed into unpalatable spikes. The softer young shoots are more palatable but cattle will eat older plants during severe droughts when there is nothing else available.

The grazing value of these pastures is low and is largely determined by the mixture of mainly annual grasses that grow between the spinifex hummocks in the summer wet season. These include species of *Aristida, Chrysopogon, Bothriochloa, Eriachne,* and *Cymbopogon.* Controlled burning at four or five year intervals, during or shortly after the wet season, promotes edible spinifex regrowth although other, more palatable, plants may be destroyed.

Tree and shrub cover is generally sparse and unpalatable. Heartleaf poison bush (*Gastrolobium grandiflorum*) makes livestock management difficult in parts of Queensland.

Cattle predominate, at stocking rates ranging from one beast to 25 ha in the wetter parts of central Queensland to much lower rates in drier areas further west.

ARID HUMMOCK GRASS

Most of the arid sand-dune country of the interior has a sparse hummock grass cover, composed of various species of spinifex (*Triodia* and *Plectrachne* spp.) already described above. Any grazing value lies in the growth of other plants, mostly annuals, in response to the sporadic rain. These are most commonly *Eragrostis, Chrysopogon* and *Aristida* grasses and a wide variety of forbs, which grow far more sparsely than in the semi-arid hummock grass pastures. Controlled burning induces regrowth of young and more palatable spinifex shoots.

Figure 9. *Arid hummock grass (spinifex) with mulga trees. Past fires have burnt out the centres of the spinifex hummocks.*

Most of this spinifex desert country is unused. Where it is grazed, predominantly by beef cattle, stocking rates are about one beast to 100 ha.

ACACIA SHRUB–SHORT GRASS

This type occurs over most of the southern arid and semi-arid regions except on sand-dune country (hummock grass) and on saline or calcareous soils (saltbush).

It is characterised by an open upper stratum of low trees or tall shrubs which are predominantly acacias (notably mulga, *Acacia aneura*; and in the east, gidgee, *A. cambagei*). The ground cover is a scattered mixture of forbs and mainly short grasses, including woollybutt grass (*Eragrostis eriopoda*), mulga oats (*Monachather paradoxa*) and *Eriachne* and *Aristida* species, which grow in response to the brief and erratic rains and make up the bulk of the feed.

Figure 10. *Acacia shrub–short grass pasture in south-western Queensland, typical of large areas of the semi-arid inland.*

Mulga foliage is palatable and provides valuable reserve fodder in times of drought, when the mulga can be pushed over or branches lopped to make it available to livestock. While clearing mulga is necessary to increase pasture area, particularly in the wetter areas where the cover is denser, sufficient are usually left standing for drought feed.

These pastures are grazed predominantly by sheep in the wetter south and by cattle in the drier centre and north. Stocking rates range from one sheep to 2 ha at best to one to 8–12 ha over large areas. Cattle are grazed at rates ranging from one to 40 ha to much lower rates on the desert margins.

SOUTHERN XEROPHYTIC MID GRASS

This type is confined to the south-eastern semi-arid and sub-humid regions where rain falls mainly in winter or is fairly evenly distributed. As in its northern counterpart, the relatively unpalatable *Aristida* grasses form a fairly constant component, but in declining proportions southward. Other, generally more palatable, perennial grasses, notably species of *Stipa, Chloris* and *Danthonia,* are usually more common locally than *Aristida.* Overgrazing has led to increases in *Aristida* in the north and some less palatable wiry leafed *Stipa* species in the south.

Figure 11. *Southern xerophytic mid grass in central New South Wales. Once tree covered, as at the top of the picture, most is now cleared. Ring-barked dead trees still stand in this paddock and many unvegetated 'scalds' can be seen.*

On the edge of the wheat belt, this pasture is much altered by naturalised species. Annual medics (small Mediterranean leguminous species of *Medicago*) greatly improve the carrying capacity as does the winter-growing annual barley grass (*Hordeum leporinum*), although the mature seeds of this grass can injure sheep and affect fleece quality. Overgrazing in these wetter areas leads to an increase in unpalatable naturalised weeds such as saffron thistle (*Carthamus lanatus*).

This pasture is predominantly grazed by sheep at better than one to 2 ha on the wetter margins to one sheep to 6–8 ha in drier areas.

TEMPERATE SHORT GRASS

This pasture type originally extended in an arc broadly coincident with the eastern wheat belt, extending from the Darling Downs in southern Queensland to eastern South Australia. Over much of this area the native pasture has been replaced by crops and sown pastures and the original open eucalypt tree cover has been extensively cleared. The structure and composition of the remainder have been much altered by a long history of grazing.

Originally, warm-season perennial grasses, notably *Themeda australis* (kangaroo grass), *Poa poiformis* (blue tussock grass) and *Stipa aristiglumis* (plains grass) were abundant but they have been severely reduced by grazing, except locally in northern New South Wales.

The perennial grasses *Danthonia carphoides* (short wallaby grass), *D. auriculata* (lobed wallaby grass), *Enneapogon nigricans* (niggerhead grass), *Stipa falcata* (slender spear grass) and *Chloris truncata* (windmill grass) are now characteristic over much of the area. Of these only the niggerhead and windmill grasses make warm-season growth.

The present pastures largely reflect past overgrazing and strong contrasts exist even between adjacent paddocks. The first effect of overgrazing is the disappearance of native perennial grasses starting with *Danthonia.* These are replaced by annuals, mostly introduced species such as summer-growing stinkgrass (*Eragrostis cilianensis*), winter-growing barley grass (*Hordeum leporinum*) and legumes (medics and trefoils). Further overgrazing reduces the annual grasses and increases the legumes. Paradoxically this change actually increases the carrying capacity as long as rainfall is average or better but the lack of perennials causes problems in dry periods. Continued overgrazing reduces the legumes and encourages the growth of herbaceous weeds, mostly accidentally introduced and of little or no fodder value, such as Paterson's curse (*Echium plantagineum*), capeweed (*Arctotheca calendula*) and saffron thistle.

These pastures are predominantly grazed by sheep although cattle are locally important, particularly in northern New South Wales. Stocking rates, which are high though variable depending largely on the proportion of naturalised legumes in the pastures, range from about 2–3 sheep per hectare to about one sheep to 2 hectares.

TEMPERATE TALL GRASS

Occupying the more humid coastal plains and uplands of the south-east, this type was the understorey of eucalypt forest and woodlands now largely cleared on all but the most rugged land. It also occurred or still remains on ridges and hilltops in moister parts of the adjacent temperate short grass areas.

In wetter areas the perennials kangaroo grass (*Themeda australis*) and blue tussock grass (*Poa poiformis*) are common. In drier inland areas silvertop wallaby grass (*Danthonia pallida*)—a coarse tussock grass of low grazing value—is more common. As these common perennial grasses are warm-season plants they provide poor winter feed.

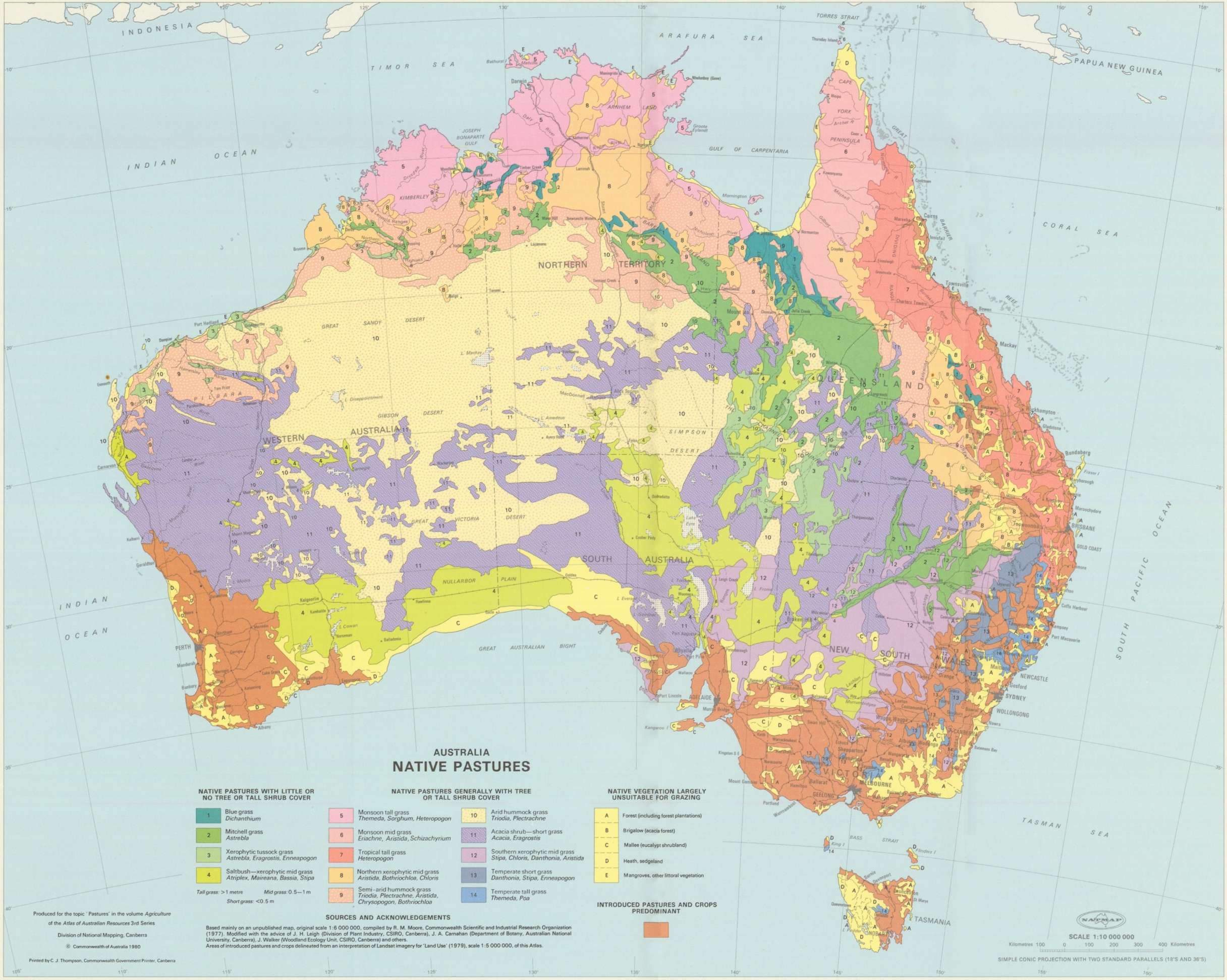
On the better land native pasture has been largely replaced by sown pastures of ryegrass and white clover in the wetter and cooler areas or phalaris grass and subterranean clover in the drier parts. In coastal New South Wales its composition has been much altered by invasive naturalised species such as paspalum (*Paspalum dilatatum*), kikuyu (*Pennisetum clandestinum*) and carpet (*Axonopus* spp.) grasses.

In their unaltered state these pastures have a low carrying capacity considering the high rainfall of the areas in which they occur. Stocking rates are about one sheep to 1–2 ha or one cattle beast to 10–15 ha. They are grazed mostly by beef cattle in the wetter areas and beef cattle and sheep in the drier inland extensions.

MAPS FOLLOWING

Native Pastures

Sown Pastures and Fodder Crops



AUSTRALIA
NATIVE PASTURES

NATIVE PASTURES WITH LITTLE OR NO TREE OR TALL SHRUB COVER

1	Blue grass	*Dichanthium*
2	Mitchell grass	*Astrebla*
3	Xerophytic tussock grass	*Astrebla, Eragrostis, Enneapogon*
4	Saltbush—xerophytic mid grass	*Atriplex, Maireana, Bassia, Stipa*

Tall grass: >1 metre *Mid grass:* 0.5—1 m
Short grass: <0.5 m

NATIVE PASTURES GENERALLY WITH TREE OR TALL SHRUB COVER

5	Monsoon tall grass	*Themeda, Sorghum, Heteropogon*
6	Monsoon mid grass	*Eriachne, Aristida, Schizachyrium*
7	Tropical tall grass	*Heteropogon*
8	Northern xerophytic mid grass	*Aristida, Bothriochloa, Chloris*
9	Semi-arid hummock grass	*Triodia, Plectrachne, Aristida, Chrysopogon, Bothriochloa*
10	Arid hummock grass	*Triodia, Plectrachne*
11	Acacia shrub—short grass	*Acacia, Eragrostis*
12	Southern xerophytic mid grass	*Stipa, Chloris, Danthonia, Aristida*
13	Temperate short grass	*Danthonia, Stipa, Enneapogon*
14	Temperate tall grass	*Themeda, Poa*

NATIVE VEGETATION LARGELY UNSUITABLE FOR GRAZING

A	Forest (including forest plantations)
B	Brigalow (acacia forest)
C	Mallee (eucalypt shrubland)
D	Heath, sedgeland
E	Mangroves, other littoral vegetation

INTRODUCED PASTURES AND CROPS PREDOMINANT

SOURCES AND ACKNOWLEDGEMENTS

Based mainly on an unpublished map, original scale 1:6 000 000, compiled by R. M. Moore, Commonwealth Scientific and Industrial Research Organization (1977). Modified with the advice of J. H. Leigh (Division of Plant Industry, CSIRO, Canberra), J. A. Carnahan (Department of Botany, Australian National University, Canberra), J. Walker (Woodland Ecology Unit, CSIRO, Canberra) and others.
Areas of introduced pastures and crops delineated from an interpretation of Landsat imagery for 'Land Use' (1979), scale 1:5 000 000, of this Atlas.

Produced for the topic 'Pastures' in the volume *Agriculture* of the *Atlas of Australian Resources* 3rd Series

Division of National Mapping, Canberra

Printed by C. J. Thompson, Commonwealth Government Printer, Canberra

SCALE 1:10 000 000
Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP77/180.1

AUSTRALIA
SOWN PASTURES AND FODDER CROPS

SOWN PASTURES
31 March 1976

• 10 000 hectares

FODDER CROPS
1975-76

• 10 000 hectares

Mainly cereal crops grown for hay and green feed

Agricultural land (rural holdings)

Non-agricultural land (vacant Crown land, State forests, nature conservation reserves etc.)

SOURCES

Sown pastures and fodder crops based on statistics for local government or equivalent areas from the Australian Bureau of Statistics and plotted with the aid of 'Land Use' (1979), scale 1:5 000 000, in the volume *Soils and Land Use* of this Atlas.

Produced for the topic 'Pastures' in the volume *Agriculture* of the *Atlas of Australian Resources* 3rd Series

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SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP 77/180.1

LIVESTOCK

INTRODUCTION

This topic maps and describes the geographic distribution of pasture-dependent livestock and some broad measures of their productivity. The four main livestock industries—wool, sheep meat, beef and dairy production—generate about half the total value of Australian agricultural production. Livestock are economically important virtually everywhere within the area used for agriculture. Even in the extensively cropped wheat belts they provide nearly half the total farm income. Only in some small areas of intensive cropping are they unimportant or absent.

The role of livestock in Australian farming and their relationship with cropping are described in the final topic, 'Farms', of this volume. Pigs and poultry, which are not dependent on pasture but are mostly grain-fed, are also covered in the final topic.

GRAZING DENSITY

The pastures described in the preceding topic were grazed by about 150 million sheep and 33 million cattle in 1976.

Cattle, because they are larger, need more food than sheep so numbers of each must be converted to a common standard to make a nation-wide comparison of intensity of pasture use. To compile the 'Grazing Density' map, a sheep-equivalent *livestock unit* was adopted based on ratios at present used by the Bureau of Agricultural Economics for similar purposes of standardisation. In this system a sheep equals one livestock unit, a beef beast equals 8 units and a dairy beast equals 12 units.

Different ratios have been applied in the past and other ratios may be more appropriate to some local conditions. For instance, a ratio of 10 sheep to one beef beast was applied in the map 'Distribution of Stock' (1954) in the First Series of this Atlas and 5 sheep to one beef beast is applied by some State authorities in the more arid areas.

The broad pattern of grazing density closely reflects average effective rainfall, ranging from very low densities on the fringes of the unused deserts and in the monsoonal north through a progression of higher densities coastward towards the south and east, culminating in the highest densities on the temperate and relatively well watered coastlands of Victoria and northern Tasmania.

This general pattern is disrupted by differences in soils and terrain. The Mitchell grasslands support higher densities than surrounding country with poorer soils in northern Australia, as do the flood plains of the Channel Country in south-western Queensland. In higher rainfall areas of the south and east, relatively low densities occur in areas of rugged terrain and, on the border of South Australia and Victoria, in relict sand-dune country.

Sharp breaks in density occur on the drier edges of the wheat belts, notably in Western Australia and western South Australia, where improved pasture on wheat-sheep farms is much more productive than the adjacent poor native pasture.

The most densely grazed pasture (more than 8 livestock units per hectare) covers only about 3% of Australia's grazed land. However, although small in area, it supports about a quarter of all livestock including nearly all dairy cattle. Most of this land is under perennial sown pasture and is almost exclusively confined to the wetter coastal lowlands and adjacent uplands of the south and east together with irrigated pastures further inland.

The second highest class (2–8 units per hectare) covers about 10% of the grazed land but supports about 40% of the nation's livestock. This land is largely confined to the more temperate humid and sub-humid regions of the south and east with fragments extending north in Queensland along the coast and in the Central Highlands. It is predominantly sown pasture, much of which is based on subterranean clover or, in Queensland, is sown perennial grasses such as panic and Guinea grass.

These two most densely grazed pasture classes, in combination, mark the areas over which the inherently poor native pastures have been successfully replaced by more productive ones. Whilst still only covering about 13% of the total grazed area, they support about two-thirds of the livestock.

On the drier fringes of the wheat belts, where subterranean clover pastures are less easily maintained (notably in Western Australia and South Australia), grazing densities are in the middle class (½–2 units per hectare). This class also includes, towards the bottom of its range, the Mitchell grasslands, the Channel Country flood plains and some of the better saltbush country in the Riverina of southern inland New South Wales. This middle class covers 16% of the grazed land and supports about 20% of the livestock.

The next class (⅛–½ unit per hectare) covers 20% of the grazed land but supports only about 9% of the livestock. It is associated with a variety of poor native pastures, notably acacia shrub–short grass in semi-arid New South Wales and Queensland, the drier areas of southern xerophytic mid grass, inferior Mitchell grass and some saltbush.

The most sparsely grazed country (less than ⅛ unit per hectare) covers the largest area of any class (41% of the grazed land) but supports only about 5% of the livestock. It occurs mostly in the arid zone and in areas of poorer soils in the semi-arid zone, where it is associated with spinifex (hummock grass), saltbush and acacia shrubland. There are also large areas of monsoon tall grass, higher rainfall spinifex and *Aristida* pastures in the north, and saltbush and uncleared mallee in the south.

CATTLE

The 'Cattle' map shows the very wide distribution of cattle from the monsoonal north to the desert fringes inland and the moist temperate areas in the south. The only large area of grazed land virtually devoid of cattle occurs in the southern semi-arid region of Western Australia, where only sheep are grazed. The spatial variations in density reflect the carrying capacity of the pastures and the local importance of cattle relative to sheep, shown in the 'Livestock Type Ratios' map overleaf.

Beef Cattle

Throughout the history of European farming in Australia, cattle numbers expressed as livestock units have been less than or about equal to sheep. Because wool was historically more profitable than beef, cattle were restricted to land unsuitable for sheep or unprotected by dingo fences. This led in many places to sharp differentiations between cattle and sheep grazing land.

Up to the 1950s little beef was exported, unlike wool. Major changes then occurred when a 15-year meat export agreement with the U.K. improved market prospects and, more importantly, exports to the U.S.A. grew substantially in the late 1950s.

The American demand for lean hamburger beef revitalised development in the northern beef areas, which were well suited to supply this new market. After 1961 the Commonwealth Government's beef roads program greatly improved the condition of key northern roads, previously a major handicap to development. Pasture improvement began in a small way, with Townsville stylo sowings in suitable areas of the wetter monsoonal north, and improvements in animal breeding and management advanced more rapidly. Despite these changes, cattle grazing in the north and centre remains much more extensive in terms of land and labour than in the south.

In the late 1960s and early 1970s beef prices rose steadily while wool prices were low and fluctuating. Accordingly beef cattle numbers increased dramatically to almost 30 million in 1976 (Table 2) and sheep declined (see Figure 16, page 11). Much of the increase in beef cattle occurred in what had been predominantly sheep country, notably in Queensland and northern New South Wales, where many marginally viable sheep farms changed to beef. Further south a large number of wheat–sheep and high-rainfall sheep farms were diversified to include small beef herds made possible by increases in improved pasture. This raised the carrying capacity and therefore enabled graziers to introduce cattle without necessarily decreasing their sheep flocks.

Table 2. Beef Cattle Numbers, 1966, 1976 and 1980

State	*1966* '000	*1976* '000	*1980* '000
Queensland	5 829	10 844	9 957
New South Wales & A.C.T.	2 983	8 529	5 625
Victoria	1 458	3 996	2 725
Tasmania	239	691	493
South Australia	429	1 683	910
Western Australia	1 042	2 487	1 938
Northern Territory	1 007	1 602	1 730
AUSTRALIA	12 987	29 833	23 378

Sources: Australian Bureau of Statistics–*Rural Industries 1969–70*, Bulletin No. 8; *Livestock Statistics, Australia: 31 March 1978; Livestock: Australia: 31 March 1980.*

Thus in New South Wales between 1966 and 1976 cattle increased from 3 million to over 8 million (Table 2); 85% of this increase occurred in the high-rainfall sheep country and the wheat belt, where sown pasture development has been greatest, while sheep in these areas decreased by only 16%. Even on the western plains, which in 1966 were grazed almost exclusively by sheep, beef cattle increased to make up a quarter of the livestock units by 1976 despite an increase in sheep over the same period.

The increase in beef cattle in sheep country has resulted in more widespread and uniform distribution of cattle. Even the recent decline in cattle, due to lower beef prices since 1974, has not altered this new situation.

Historically cattle derived from British breeds (*Bos taurus*) have formed the bulk of the national beef herd. Today this is still the case in the south, where Herefords (including Poll Herefords) and Shorthorns are still the most numerous group. In the tropical north, however, much beef breeding in recent years has been based on Zebu stock (*Bos indicus*), which are better suited to the environment than British breeds so that in Queensland, for example, more than half the beef cattle are now pure or crossbred tropical breeds.

In 1975–76 about 8 million cattle and calves were sold for slaughter (Table 3). The variation of beef productivity is shown on the 'Cattle' map by the turn-off ratio, the percentage of animals turned off for slaughter during the census year to the number remaining on farms at the census date. The ratio also generally indicates the length of time animals need to graze before they reach slaughter weight: it is low where cattle gain weight slowly on poor tropical and arid pastures and high where cattle fatten quickly on high-quality pastures in more humid and temperate areas. It is highest where 'store' cattle are brought in from other areas for fattening.

Table 3. Cattle Turn-off, 1975–76

State	*For Slaughter* '000	*For Fattening* '000	*Total* '000
Queensland	1 841	734	2 575
New South Wales & A.C.T.	2 406	651	3 058
Victoria	1 797	902	2 698
Tasmania	249	95	344
South Australia	708	105	813
Western Australia	635	129	764
Northern Territory	106	43	149
AUSTRALIA	7 742	2 658	10 400

Source: Australian Bureau of Statistics, unpublished statistics for year ended 31 March 1976.

PHOTOGRAPH ABOVE: A merino ram—the foundation of Australia's fine-wool production.

All photographs in this topic by Australian Information Service.

Figure 12. *Mustering beef cattle in the dry season on Mitchell grassland, Barkly Tableland, Northern Territory.*

Figure 13. *Beef cattle grazing sown Guinea grass pasture, eastern Queensland.*

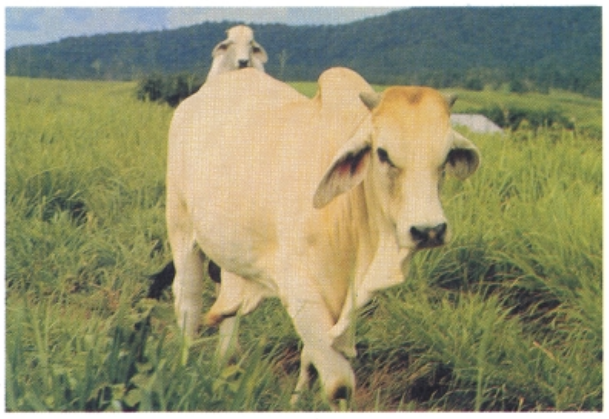
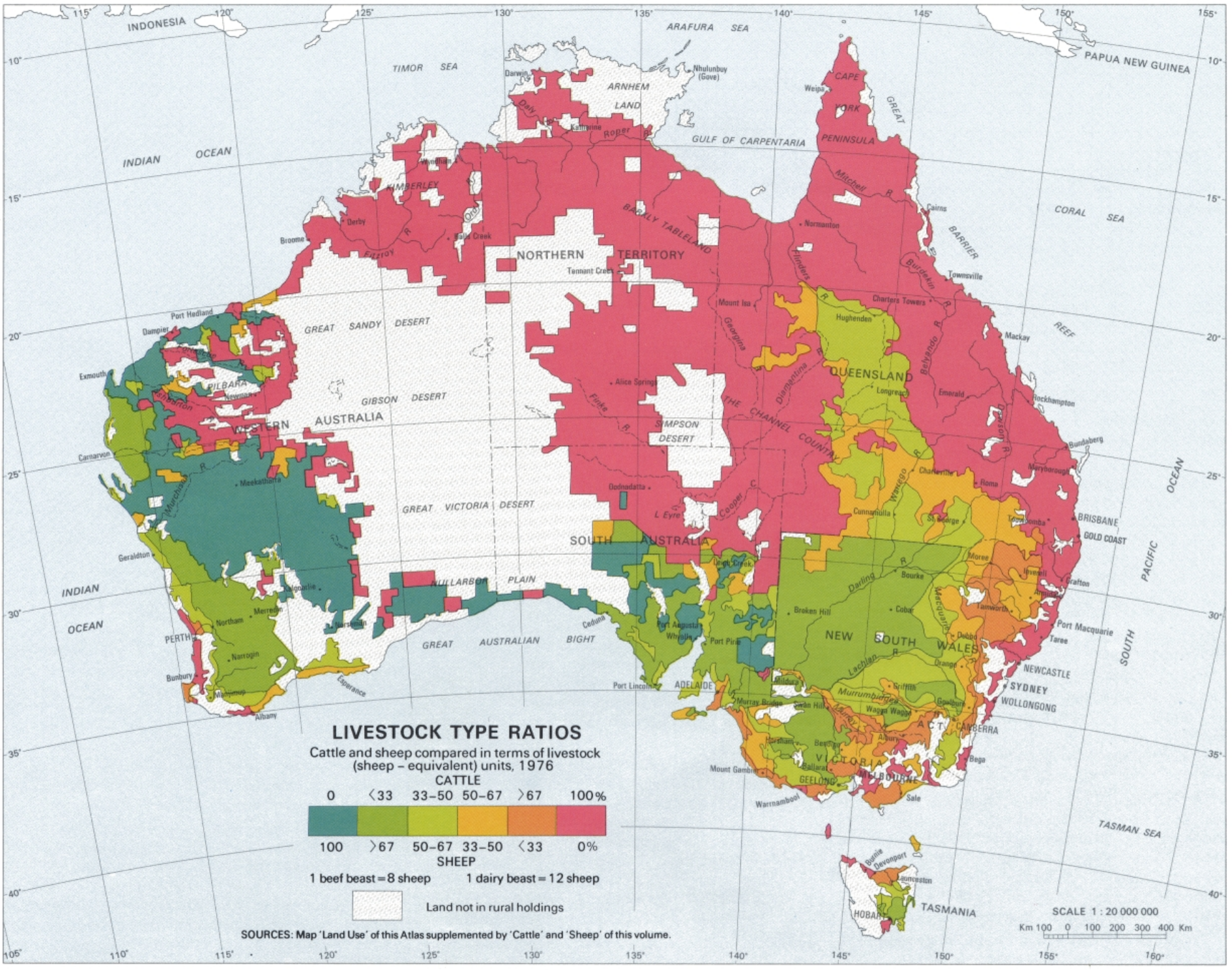


Figure 14. *Zebu cattle in north-eastern Queensland.*

Thus turn-off ratios are highest in the wetter parts of the wheat belts and in coastal areas close to major urban markets. Lot-feeding beef cattle on grain, which has the highest possible rates of turn-off, is rare in Australia, in contrast with the U.S.A. Turn-off ratios are lowest in the large areas of extensive and exclusive beef grazing of the north, where they are generally less than 10%. However, they are marginally higher in areas of better pasture such as the Mitchell grasslands and in the Channel Country of Queensland.

Despite the widespread distribution of beef cattle and the vast areas of exclusive beef grazing in the north, almost half the cattle sold for slaughter come from the south-east (southern New South Wales, Victoria, south-eastern South Australia and Tasmania). Tasmania, for example, produced more than twice as much beef in 1975–76 as the Northern Territory.

In addition to those turned off for slaughter, about 2.7 million cattle in 1975–76 were sold for fattening elsewhere. The trade in cattle before they reach slaughter weight varies greatly from year to year depending on local pasture conditions and current and anticipated changes in beef prices.



LIVESTOCK TYPE RATIOS

Cattle and sheep compared in terms of livestock (sheep – equivalent) units, 1976

CATTLE

0	<33	33–50	50–67	>67	100%

SHEEP

100	>67	50–67	33–50	<33	0%

1 beef beast = 8 sheep 1 dairy beast = 12 sheep

Land not in rural holdings

SOURCES: Map 'Land Use' of this Atlas supplemented by 'Cattle' and 'Sheep' of this volume.

SCALE 1 : 20 000 000

Km 100 0 100 200 300 400 Km

Table 4. Dairy Cattle Numbers and Milk Production, 1966, 1976 and 1980

State	*Numbers* ('000)			*Milk* (million litres)		
	1966	*1976*	*1980*	*1965–66*	*1975–76*	*1979–80*
Queensland	937	503	375	1 005	683	520
New South Wales & A.C.T.	1 100	632	486	1 372	983	875
Victoria	1 867	1 872	1 527	3 414	3 518	3 151
Tasmania	244	218	156	400	435	315
South Australia	245	209	157	447	397	329
Western Australia	204	168	128	281	232	222
Northern Territory	1	1	..	..	..	..
AUSTRALIA	4 598	3 602	2 830	6 919	6 248	5 412

Note: Dairy cattle numbers at 31 March, milk production for years ended 30 June.

Sources: Australian Bureau of Statistics—*Rural Industries 1969–70*, Bulletin No. 8; *Livestock Statistics, Australia: 31 March 1978; Livestock: Australia: 31 March 1980; Dairying and Dairy Products: Australia: 1978–79*; and *Livestock Products, Australia: May 1981.*

Dairy Cattle

Only a very small proportion of Australia is climatically suitable for dairying, which ideally requires a constant supply of good pasture. In 1976 the 3.6 million dairy cattle were concentrated in the more humid coastal areas (mostly in the temperate south), in some uplands and valleys near the coast, and on some inland irrigation areas where water is sufficiently cheap and abundant for the maintenance of perennial pastures. More than half the dairy cattle are now in Victoria (see Table 4), in three major concentrations: West Gippsland, the more coastal areas of the Western District, and the north-central irrigation areas (see the 'Cattle' map).

The main dairy breeds are Jersey, Friesian and Ayrshire. Red Poll and Dairy Shorthorn cattle are widely used as dual-purpose breeds for milk and meat. Other dairy breeds are Guernsey and Illawarra Shorthorn and recently, in more tropical areas, the Australian Milking Zebu (a Sahiwal/Jersey cross).

Figure 15. *Dairy cows grazing perennial sown pasture, Gippsland, south-eastern Victoria.*

Dairy areas contracted and dairy cattle numbers declined as increasing production costs and overseas competition forced marginally productive areas and less efficient farms in more productive areas out of the industry.

This process began as early as the 1930s and 1940s in Queensland and northern New South Wales and has accelerated over the last two decades. As a result dairy cattle are now heavily concentrated around the larger coastal cities, where they are locally needed to supply fresh milk, and, in larger numbers, on areas of good perennial pasture in the more suitable humid temperate climates of Victoria and Tasmania where high milk yields are possible.

By 1980, 62% of the national dairy herd was in Victoria and Tasmania compared with only 30% in 1939. Over the same period the percentage of the national herd declined dramatically in Queensland (31% to 13%) and New South Wales (31% to 16%) and remained static in South Australia and Western Australia.

The continuing decline in numbers has been to some extent offset by increases in average milk production per cow, which rose from about 1800 litres in 1957 to nearly 3000 litres in 1980. This has been due to improvements in breeding and management and to more sown pasture and irrigation. On dairy farms between 1963–64 and 1973–74 improved pasture doubled to reach an average of 60% of pasture area nationally but ranged from almost 100% in Tasmania and Victoria to only about 20% in Queensland and northern New South Wales. Accordingly stocking rates on dairy farms in Victoria and Tasmania are almost double those in Queensland and milk yields are about 50% greater. The national average stocking rate is about one dairy beast per hectare.

SHEEP

In the past, because sheep have generally been more profitable than cattle, they have tended to occupy the better grazing land wherever the climate and pastures are suitable. The Australian wool industry—for many years the mainstay of the national economy and still an important part of it—has been based on the merino breed since the early days of European settlement. This breed, of Spanish origin, produces a high yield of fine wool and is ideally suited to the dry conditions of much of Australia. Today pure-bred merinos make up three-quarters of the national flock.

At the peak of pastoral expansion in the late 19th century sheep were tried in all climatic regions, even the tropical north. It was soon discovered that sheep did not thrive in the north, although sheep grazing persisted until recently in the west Kimberley area of Western Australia. Less than 3% of sheep now graze north of the Tropic, on the Mitchell grass plains of Queensland and the better country in the northern Pilbara (W.A.). In the south sheep are widespread but are virtually absent from the coastlands of New South Wales and Queensland, where the climate and pastures are unsuitable for a variety of reasons mostly related to high summer humidity. Inland, sheep give way to beef cattle on the desert margins where the area of land required to run a profitable flock becomes too large to manage or water adequately. Specially constructed fences enclose sheep country in southern Western Australia, South Australia and Queensland and run along the State boundary of western New South Wales, protecting sheep from attack by dingoes (wild native dogs) living in uncontrolled areas beyond.

Sheep numbers reached a peak of 180 million in 1970 but declined to 136 million in 1980 (see Table 5 overleaf and Figure 16). The decline began during the beef boom of the early 1970s but has since continued, although at a lower rate.

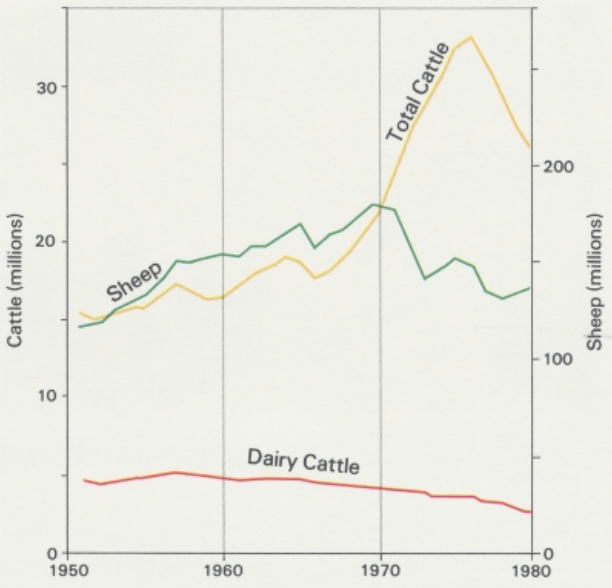


Figure 16. Cattle and Sheep Numbers, Australia 1951–80
Based on totals at 31 March from various publications of the Australian Bureau of Statistics, with some estimation of dairy cattle numbers up to 1963.

Within the sheep grazing country three broad zones are recognised by the Bureau of Agricultural Economics: the High Rainfall Zone, the Wheat–Sheep Zone and the Pastoral Zone. Almost half the national sheep flock is in the Wheat–Sheep Zone, which is broadly coincident with the wheat belts shown in Figure 1. Here the sheep are mostly grazed on sown pasture, grown in rotation with cereal crops, at an average stocking rate of about two sheep per hectare. Although pure-bred merinos make up about 80% of the zonal flock, about a third of all lambs are sired by British-breed rams for sale as fat lambs. However, there is a marked variation between States in this zone. In Western Australia and South Australia more than 95% of the sheep are pure-bred merinos and less than 15% of the lambs are sired by British breeds while, in this zone in Victoria, only about 65% are pure-bred merinos and 65% of lambs are sired by British breeds. This is reflected in the 'Sheep Turn-off for Slaughter' map, which shows high turn-off rates in the Victorian Wheat–Sheep Zone.

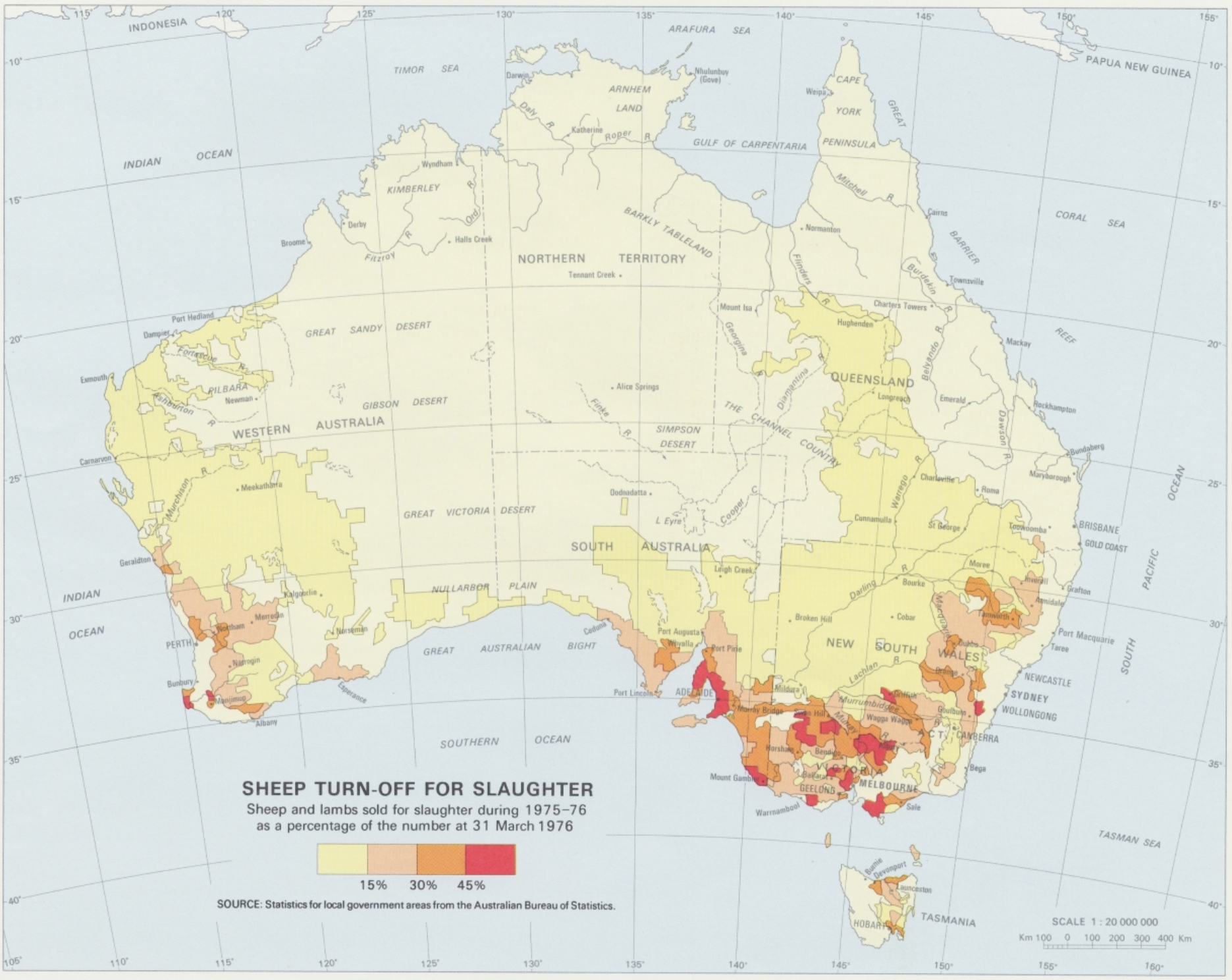


Figure 17. *Sheep grazing sown pasture in the Wheat–Sheep Zone, central New South Wales.*

Table 5. Sheep Numbers and Wool Production, 1966, 1976 and 1980

State	*Numbers* ('000)			*Wool* ('000 tonnes)		
	1966	*1976*	*1980*	*1965–66*	*1975–76*	*1979–80*
Queensland	18 384	13 599	12 163	87	66	59
New South Wales & A.C.T.	61 654	53 348	48 698	264	241	233
Victoria	30 968	25 395	24 400	166	138	147
Tasmania	4 127	4 249	4 245	19	28	20
South Australia	17 993	17 279	16 046	105	106	96
Western Australia	24 426	34 771	30 431	112	184	158
Northern Territory	9	1	1	..	..	..
AUSTRALIA	157 563	148 643	135 985	754	754	713

Note: Sheep numbers at 31 March, wool production for years ended 30 June. Total wool production in 1979–80 was composed of 84% shorn from sheep, 6% shorn from lambs and 10% unshorn wool on skins.

Sources: Australian Bureau of Statistics–*Rural Industries 1969–70*, Bulletin No. 8; *Livestock Statistics, Australia: 31 March 1978; Livestock: Australia: 31 March 1980; Wool, Australia: 1979–80.*

Wool yield per adult sheep tends to be highest in those areas where the merino is the predominant breed since it produces a heavier fleece than British breeds. However, the percentage of sheep and lambs turned off for slaughter is greatest where the merino percentage is least, since British breeds produce a type of lamb preferred by the domestic market. Thus there is an inverse relationship between wool yield and turn-off for slaughter, which can be seen by comparing the wool-yield component of the 'Sheep' map with the 'Sheep Turn-off for Slaughter' map.

The High Rainfall Zone lies along the wetter edge of the wheat belts and has generally better pasture, predominantly sown perennial grass and clover, which make up 80% of all pasture grazed by sheep in this zone. It contains about one-third of the national sheep flock at an average stocking rate of about four sheep per hectare. Pure-bred merinos make up about 60% of the flock, the lowest proportion of all three zones, since there is a strong emphasis on the production of fat lambs from British breeds. Although much fine merino wool is produced in this zone from high-yielding animals, the average yield is depressed by the higher proportion of lower yielding British breeds.

The Pastoral Zone, lying on the drier side of the wheat belts, is the largest of all three zones but provides grazing for only one-fifth of the national flock. With little or no sown pasture, it is grazed almost exclusively by merinos at an average stocking rate of about one sheep to 5 ha. Despite the extensive nature of the grazing, dictated by low rainfall and correspondingly poor productivity of the native pastures, fleece weights are comparable with those of merinos grazed in wetter areas. They are particularly heavy in South Australia, where a locally developed strain of larger bodied merinos produces a longer and slightly thicker fleece. However, where pastures have severe seasonal deficiencies, as during the winter dry season in the north, even merino fleece weights can be affected. Thus wool yields per sheep are low in the northern Pilbara and central-western Queensland.

Figure 18. *Rounding up ewes and fat lambs in high-rainfall sheep country.*

Table 6 shows the distribution, by States, of sheep and lambs sold for slaughter. Most lamb (about 80%) is eaten in Australia but about 80% of mutton is exported. The export of live sheep (mostly merinos) to the Middle East is a new and growing trade to satisfy local preference for fresh, lean meat slaughtered in accordance with Islamic custom. From small numbers in the 1960s, this trade has grown to almost 6 million sheep in 1980, supplied mainly by Western Australia and South Australia.

Table 6. Sheep and Lambs turned off for Slaughter, 1975–76

State	*Sheep* '000	*Lambs* '000
Queensland	619	138
New South Wales & A.C.T.	4 063	5 549
Victoria	3 074	3 464
Tasmania	359	519
South Australia	3 088	2 224
Western Australia	4 239	1 677
Northern Territory	..	..
AUSTRALIA	15 442	13 571

Source: Australian Bureau of Statistics, unpublished statistics for year ended 31 March 1976.

MAPS FOLLOWING

Grazing Density

Cattle

Sheep

AUSTRALIA
GRAZING DENSITY

Livestock Units per Hectare

0.125 0.5 2 8

8 2 0.5 0.125

Hectares per Livestock Unit

Livestock Units per Animal

Sheep : 1 Beef cattle : 8 Dairy cattle : 12

Non-agricultural land

SOURCE

From the map 'Land Use', scale 1 : 5 000 000, in the volume *Soils and Land Use* of this Atlas (based on 1976 statistics for local government or equivalent areas supplemented by statistics for pastoral leaseholdings in S.A., W.A. and N.T. and an interpretation of Landsat imagery).

Produced for the topic 'Pastures' in the volume *Agriculture* of the *Atlas of Australian Resources* 3rd Series

Division of National Mapping, Canberra

Printed by C. J. Thompson, Commonwealth Government Printer, Canberra

NAUMAP

SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP 77/180.1

AUSTRALIA
CATTLE
NUMBERS AND TURN-OFF

NUMBERS
As at 31 March 1976

• 5000 Beef cattle
National Total: 29 830 000

• 5000 Dairy cattle
National Total: 3 600 000

Land not in rural holdings

Rural land where cattle are insignificant or absent

TURN-OFF
The number of cattle disposed of for slaughter in 1975-76 as a percentage of total cattle at 31 March 1976

7.5% 15% 30%
Range: 2-162%

SOURCES AND ACKNOWLEDGEMENTS

This map is based on statistics for local government or equivalent areas provided by the Australian Bureau of Statistics. These statistics were supplemented by cattle numbers in 1975 on pastoral leaseholdings in South Australia, Western Australia and the Northern Territory specially provided by the S.A. Department of Lands, the W.A. Department of Lands and Surveys and the former Commonwealth Department of the Northern Territory.

Cattle areas and numbers and land not in rural holdings were plotted with the aid of Land Use (1979, 1:5 000 000) of this Atlas.

Produced for the topic 'Livestock' of the *Atlas of Australian Resources* 3rd Series

Division of National Mapping, Canberra

Printed by C. J. Thompson, Commonwealth Government Printer, Canberra

SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP 77/180.1

AUSTRALIA
SHEEP
NUMBERS AND WOOL YIELD

NUMBERS
As at 31 March 1976

* 40 000 Sheep and Lambs
National Total: 148 640 000

Land not in rural holdings

Rural land where sheep are insignificant or absent

WOOL YIELD
Average fleece weight per adult sheep shorn for the three years 1973-74 to 1975-76

3.0 4.4 5.0 5.6 7.0 kg

National average: 5.0 kg

SOURCES AND ACKNOWLEDGEMENTS

This map is based on statistics for local government or equivalent areas provided by the Australian Bureau of Statistics. These statistics were supplemented by sheep numbers in 1975 on pastoral leaseholdings in South Australia and Western Australia specially provided by the S.A. Department of Lands and the W.A. Department of Lands and Surveys.

Sheep areas and numbers and land not in rural holdings were plotted with the aid of 'Land Use' (1979, 1:5 000 000) of this Atlas

Produced for the topic 'Livestock' of the *Atlas of Australian Resources* 3rd Series

Division of National Mapping, Canberra

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NATMAP

SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP 77/180.1

CROPS

INTRODUCTION

In 1975–76 cash crops were grown on an area of 13.7 million hectares—a total which excludes the million hectares of fodder crops mapped and described above in the 'Pastures' topic. By 1979–80 the area of cash crops had reached a record of 16.8 million hectares (see Figure 19). A wide variety of temperate and tropical crops are grown but the bulk of the area, 80–90% in recent years, is sown to the winter cereals—wheat, barley and oats—of which wheat occupies by far the largest area. The crop area has more than doubled since 1950, largely due to increases in cereal cropping.

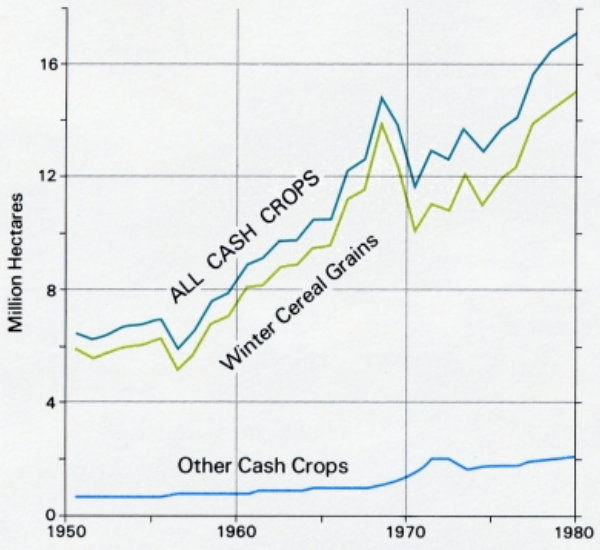

Figure 19. Crop Areas, Australia 1951–80

Based on statistics from various publications of the Australian Bureau of Statistics. Excludes lucerne and crops mostly grown to feed livestock on the same farms (hay, green feed and other fodder crops, which totalled 1.2 million hectares in 1979–80).

Cropping can be broadly classed as either intensive or extensive (see the 'Croplands' map). Intensive cropping is carried out on small blocks of good and expensive land; irrigation is common and costs of production per hectare are high. By contrast, extensive cropping is carried out on large blocks of cheaper land; irrigation is rare and costs of production per hectare are low.

The wheat belts are the main areas of extensive cropping and lie in zones where the average rainfall during the winter growing season is between 150 and 500 mm. The drier inland edges are generally determined by the arid limit for wheat growth and the wetter edges by the prevalence of humidity-related crop diseases, such as rust, and the greater profitability of livestock grazed on perennial sown pastures.

Intensive cropping occurs in scattered and mostly small irrigation areas close to the arid edge of the eastern wheat belt (notably fruit, grapes, rice and cotton) and also in small, widely scattered areas with favourable soils and climate in wetter upland and coastal areas in the south-east and south-west (notably fruit and vegetables). Intensively grown tropical crops, predominantly sugar cane but also bananas and pineapples, are grown along the frost-free coasts of Queensland and northern New South Wales.

PHOTOGRAPH ABOVE: Ripening wheat—Australia's premier crop—in northern New South Wales.

This photograph and Figures 21 and 22 by F. T. Bullen; Figures 20 and 23–25 by Australian Information Service.

Fertiliser Use

Much of Australia's extensive cropping is in areas of poor soils and even some of the best soils are deficient in phosphorus and nitrogen. Deficiencies in soil fertility have been largely overcome by the use of artificial fertilisers and the rotation of crops with nitrogen-fixing legume pastures.

About three-quarters of Australia's croplands are fertilised annually (see map overleaf). Most cropped land, with the exception of the cracking clay soils of Queensland and northern New South Wales, is phosphorus-deficient, so superphosphate makes up about two-thirds of the total amount of fertiliser applied annually to crops. While nitrogen deficiencies in the wetter parts of the wheat belts are largely counteracted by the rotation of crops with nitrogen-fixing pastures of subterranean clover, nitrogenous fertilisers are now applied where such pastures are hard or impossible to establish (such as on the northern plains of New South Wales, in Queensland and at the drier margins of the Western Australian wheat belt). This has been the main factor in the recent large increase in nitrogenous fertiliser usage, which more than doubled between 1972 and 1979. Wheat is now the largest single recipient of nitrogenous fertiliser, which was previously mainly applied to intensive crops such as sugar cane and cotton.

Irrigated Cropping

About 600 000 ha of crops were irrigated in 1975–76, which was only about 3% of the total crop area. Comprehensive irrigation data have not been collected since 1975–76. Most of the irrigation areas are fed by the Murray–Darling river system and the largest concentrations of irrigated cropping are in the Murray and Murrumbidgee irrigation areas of southern New South Wales (see map overleaf). Here rice, which occupies the largest area, has increased from 75 000 ha in 1975–76 to 116 000 ha in 1979–80. Orchard fruit, grapes and vegetables cover over 10 000 ha in the Murrumbidgee Irrigation Area centred on Griffith. Irrigation areas lower down the Murray are devoted almost entirely to orchard fruit and grapes. Cotton is the main crop in smaller and newer irrigation areas in central and northern New South Wales and at St George and Emerald in Queensland.

About a fifth of all sugar cane is irrigated (about 74 000 ha in 1975–76). Of this, 33 000 ha were in the Burdekin delta where, despite suitability in all other respects, the rainfall is insufficient for cane growth so that the whole crop has to be irrigated. Supplementary irrigation of cane occurs near Mackay and Bundaberg.

About 150 000 ha of cereals other than rice are irrigated, mainly in southern New South Wales, where irrigated wheat forms part of the rice rotation system, and to a lesser extent in northern New South Wales and south-eastern Queensland, where irrigated sorghum, wheat and oats are grown. In the Ord irrigation area in northern Western Australia small areas of irrigated sorghum and rice were grown in 1975–76. Here irrigated cotton was grown from 1963 until 1974, when rising costs of pest control and the removal of a government cotton bounty made it uneconomic.

More than half the area of vegetables grown is irrigated (about 65 000 ha in 1975–76). This includes inland areas entirely dependent on irrigation and wetter, more coastal areas where irrigation supplements rainfall, particularly in drier seasons.

Other crops that are especially dependent on irrigation are soybeans in northern New South Wales and south-eastern Queensland; and tobacco in the Ovens and King Valleys of north-eastern Victoria, near Texas and Inglewood in southern Queensland, and at Mareeba on the Atherton Tableland in northern Queensland.

WHEAT

Wheat, the most important single crop in Australia, has in recent years been grown on about 10 million hectares, or over 60% of the national crop area, and has contributed about 40% of the total value of all cash crops. The map shows the distribution of the 8.5 million hectares harvested in 1975–76 and the average yield for the three-year period 1973–74 to 1975–76.

Wheat is generally sown between April and June for harvest in October or November in the north and December or January in the south. It is therefore heavily dependent on winter rainfall and is grown where the April to October rainfall is usually between 150 and 500 mm.

The area of wheat increased sharply during the 1960s from about 5 million hectares in 1959–60 to nearly 11 million hectares in 1968–69. Production quotas were introduced in the following year and a temporary decline in area resulted. Quotas were suspended in 1975–76 and the wheat area rose to exceed 11 million hectares in 1979–80.

The greatest increase has occurred in Western Australia (see Table 7), where wheat farming has expanded greatly to reach the arid limit in many places. A less marked expansion has occurred in the eastern States, notably into the drier areas of northern New South Wales and northward in Queensland.

Wheat yields are strongly dependent on winter rainfall, although the relationship is non-linear—too much rain can also depress yields. However, today little wheat is grown in areas where the rainfall is above the optimum for maximum yields, for the reasons given above, so that most wheat is grown in areas where there is a direct positive relationship between winter rainfall and yield. The highest yields are obtained in the wetter areas of the wheat belts with better soils, for example the Liverpool Plains around Gunnedah in New South Wales and the Darling Downs around Dalby in Queensland. Yields tend to be lowest along the dry margins of the wheat belts except where wheat is irrigated in the Murrumbidgee Irrigation Area around Griffith, New South Wales.

In general, yields have progressively increased since the turn of the century as a result of plant breeding, fertiliser use and rotation with nitrogen-fixing pastures. However, the expansion of wheat cropping into low-yielding drier areas has lessened the increase of State average figures, notably in Western Australia (Table 7). Widespread severe droughts such as the most recent one in 1980–81 have also had marked, although temporary, effects on wheat yields. Table 7 shows the effect of recent severe droughts on yields in the 1978–79 period compared with the higher yields of the more drought-free 1974–77 period.

Most of the grain is of average quality, termed Australian Standard White. Premium quality 'hard' wheats, producing high-protein grain of good baking quality, are grown mainly in Queensland, northern New South Wales and South Australia. 'Soft' wheat with the low protein content needed for biscuit making is mostly produced in the south, notably in Victoria.

Table 7. Wheat for Grain—Area and Yield

State	*Area ('000 hectares)*				*Average Annual Yield (tonnes per hectare)*			
	1950–51	*1965–66*	*1975–76*	*1979–80*	*1949–52*	*1964–67*	*1974–77*	*1978–80*
Queensland	226	386	576	733	*1.13*	*1.59*	*1.90*	*1.41*
New South Wales	1 347	1 852	2 774	3 415	*1.10*	*1.51*	*1.92*	*1.55*
Victoria	1 107	1 244	1 073	1 457	*1.30*	*1.49*	*2.24*	*1.64*
South Australia	748	1 111	958	1 424	*1.09*	*1.17*	*1.63*	*1.15*
Western Australia	1 289	2 489	3 171	4 121	*0.94*	*1.02*	*1.04*	*1.15*
AUSTRALIA (*a*)	4 720	7 088	8 555	11 153	*1.10*	*1.31*	*1.60*	*1.36*

(*a*) Includes the Australian Capital Territory and Tasmania (no production recorded for the Northern Territory).

Sources: Australian Bureau of Statistics—*Rural Industries 1969–70*, Bulletin No. 8; and *Wheat: Australia: 1979–80.*


AUSTRALIA
CROPLANDS
For the year ended 31 March 1976
EXTENSIVE CROPPING
• 5000 hectares
Wheat, barley, oats, sorghum, maize harvested for grain
Sunflower, linseed, rape, safflower, lupins
INTENSIVE CROPPING
• 2000 hectares
Sugar cane, cotton, rice, peanuts, soybeans
• 1000 hectares
Fruit, grapes, vegetables, tobacco
SOURCES
Based on statistics for local government or equivalent areas from the Australian Bureau of Statistics
and an interpretation of Landsat imagery for 'Land Use' (1979), scale 1:5 000 000, of this Atlas.
Produced for the topic 'Crops' in the volume Agriculture
of the Atlas of Australian Resources 3rd Series
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NATMAP
SCALE 1:10 000 000
Kilometres 100 0 100 200 300 400 Kilometres
SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)
INDONESIA
TIMOR SEA
ARAFURA SEA
TORRES STRAIT
PAPUA NEW GUINEA
INDIAN OCEAN
GULF OF CARPENTARIA
CORAL SEA
SOUTH PACIFIC OCEAN
TASMAN SEA
SOUTHERN OCEAN
GREAT AUSTRALIAN BIGHT
BASS STRAIT
JOSEPH BONAPARTE GULF
ARNHEM LAND
KIMBERLEY
NORTHERN TERRITORY
WESTERN AUSTRALIA
SOUTH AUSTRALIA
QUEENSLAND
NEW SOUTH WALES
VICTORIA
TASMANIA
A.C.T.
CAPE YORK PENINSULA
GREAT SANDY DESERT
GIBSON DESERT
GREAT VICTORIA DESERT
NULLARBOR PLAIN
SIMPSON DESERT
BARKLY TABLELAND
THE CHANNEL COUNTRY
PILBARA
GREAT BARRIER REEF
GREAT DIVIDING RANGE
Darwin
Port Hedland
Carnarvon
Geraldton
PERTH
Bunbury
Albany
Kalgoorlie
Esperance
Alice Springs
Mount Isa
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
GOLD COAST
Broken Hill
Port Augusta
Whyalla
Port Lincoln
ADELAIDE
NEWCASTLE
SYDNEY
WOLLONGONG
CANBERRA
Mount Gambier
Ballarat
Bendigo
GEELONG
MELBOURNE
Launceston
HOBART

NMP/77/151.1

Figure 20. *Harvesting wheat in central New South Wales. Many newer machines, like the nearer one, have fully enclosed, air-conditioned cabs.*

The average wheat farmer grows about 250 ha, so the scale of farming is large and all operations are fully mechanised. However, few wheat farmers are totally dependent on this crop. Most grow wheat in rotation with sown pasture and rely on livestock to contribute nearly as much income as wheat.

Apart from a small volume of private and mostly local sales, all wheat is bought by the Australian Wheat Board. The grain is received at numerous storage silos strategically located throughout the wheat belts, mostly at rail sidings. Then it is moved to flour mills and grain-handling terminals at the ports. Drought has caused production to vary in recent years but a peak of 18 million tonnes was achieved in 1978–79. About 70% of the total production is normally exported, making wheat one of Australia's main export commodities.

OTHER GRAIN CROPS

Barley

After wheat, barley for grain is grown on a larger area (recently, about 2.5 million hectares) than any other crop. A winter crop, it is grown throughout the wheat belts as well as in some areas which are marginally too cool or too wet for wheat.

Barley grain is used for malting and animal feed. Malting barley (mostly used for brewing beer) needs a relatively high and dependable winter rainfall and a long, mild ripening period, and is best grown on light soils of medium fertility. Barley for animal feed can be grown more widely throughout the wheat belts. The best malting barley conditions occur in South Australia and Victoria and, prior to the 1950s, when barley was mostly sold on the domestic market for malting, 90% was grown in these two States. Since then export markets have expanded and the use of barley for animal feed has increased. This led to a large increase in crop area and expansion throughout the wheat belts (see Table 8). Despite large increases in other States, South Australia is still the largest producer although its relative importance has declined.

Table 8. Barley for Grain ('000 ha)

State	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Queensland	11	137	236	195
New South Wales	3	96	486	445
Victoria	88	78	344	325
Tasmania	1	8	11	11
South Australia	310	444	832	984
Western Australia	24	167	419	523
AUSTRALIA	437	930	2 329	2 482

Sources: Australian Bureau of Statistics—*Rural Industries 1969–70*, Bulletin No. 8; *Crop Statistics, Australia: Season 1975–76*; and *Crops: Australia: 1979–80*.

In the five years 1975–76 to 1979–80, Australia produced 3 million tonnes of barley a year, of which two-thirds was exported. About 40% of barley for domestic use is of malting quality while most of the remainder is used for animal feed.

Oats

Like barley, oats for grain are grown as a winter crop throughout the southern wheat belts. In northern New South Wales and Queensland, oats are mostly grown for green fodder. Even when sown for grain, oats are often grazed once or twice during the winter. Since oats do not require a well-prepared seed-bed and have a low nitrogen requirement, they can be sown directly into wheat stubble.

Table 9. Oats for Grain ('000 ha)

State	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Queensland	7	18	12	12
New South Wales & A.C.T.	135	418	290	349
Victoria	213	391	243	256
Tasmania	9	11	4	7
South Australia	110	184	119	129
Western Australia	237	502	320	370
AUSTRALIA	711	1 525	988	1 123

Sources: As for Table 8.

Table 9 shows that the area of oats for grain increased between 1950 and the mid-1960s but then decreased as more land was needed for wheat cropping.

Of the one million tonnes of oat grain produced annually in the period 1975–76 to 1979–80, about 30% was exported. Domestically, most was used for animal feed and only about 7% used for human consumption, mainly as breakfast cereal.

Grain Sorghum

Grain sorghum occupies the largest area of all summer-grown cereals, amounting to about 500 000 ha in recent years (Table 10). The greatest increase occurred during the early 1970s, when wheat cropping was restricted by the quota system; the peak area of about 700 000 hectares was grown in 1972–73.

Table 10. Summer Cereals and Lupins for Grain Australia ('000 ha)

Crop	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Grain sorghum	69	75	504	519
Rice	15	64	75	116
Maize	69	80	47	54
Lupins (*a*)	24	n.a.	139	106

(*a*) Mainly for grain (processing or feed).

Sources: Largely as for Table 8; lupins 1950–51 from *Statistical Register of Western Australia for 1950–51*.

Grain sorghum is heavily concentrated in Queensland and northern New South Wales, where it is grown, to a large extent, in rotation with wheat and oats, notably in the Darling Downs (see map overleaf). It is the characteristic crop in cleared brigalow land in central Queensland and is also grown in the more coastal areas of that State. It is grown to a small extent in the Ord irrigation area in northern Western Australia and occasionally on a few pastoral leases in the Northern Territory.

Over the five-year period 1975–76 to 1979–80 about one million tonnes of sorghum grain were produced annually, of which between a half and three-quarters was exported. In Australia almost all is used for animal feed.

OATS, SORGHUM, LUPINS

Area of oats and sorghum harvested for grain and area of lupins grown for processing or feed, 1975–76

- Oats 5000 hectares
- Sorghum 5000 hectares
- Lupins 5000 hectares

SOURCE: Statistics for local government areas from the Australian Bureau of Statistics.

Lupins

Although lupins (a leguminous crop) have been grown in Western Australia for many years for soil improvement and grazing (see Fodder Crops in the 'Pastures' commentary above), it is only since the early 1970s that larger areas have been grown to produce seeds for processing into animal feed and oil.

Lupins are grown in winter in the wheat–pasture rotation system and, in 1975–76, were almost exclusively confined to the northern wheat belt in Western Australia, where 120 000 ha out of the total area of 140 000 ha were grown. Since then the area in Western Australia declined to 46 000 ha in 1979–80 but increased in the eastern States (30 000 ha in New South Wales, 15 000 ha in Victoria and 14 000 ha in South Australia), where this crop is grown along the wetter margins of the wheat belt extending from central New South Wales to South Australia.

Seed grain production has risen over recent years to 78 000 tonnes in 1979–80 and is mainly processed into animal feed.

Rice

Rice growing on a commercial scale began in 1924 when 62 ha of rice were grown in the Murrumbidgee Irrigation Area. By the early 1950s this area had increased to 15 000 ha and rice growing had spread to other irrigated areas in the Riverina of New South Wales. Since then the rice area has increased to over 100 000 ha (Table 10).

Figure 21. *Seedling rice in the Murrumbidgee Irrigation Area, New South Wales.*

Rice is not mapped separately, its distribution being clearly shown on the 'Croplands' map by the blue dots in south-central New South Wales, where 95% of the crop is grown. The only other area of significance is the Burdekin delta, where rice growing began in 1966 and covered 5000 ha in 1980. About 500 ha of rice are also grown in the Ord irrigation area in northern Western Australia.

In the main areas in southern New South Wales, rice is grown in irrigated bays in rotation with wheat and pasture. The crop is sown in late September or early October, flooded and drained intermittently until established, then grown in 50–150 mm of water until ready for harvest in the period March to May. The bays are then drained to allow mechanical harvesting. Because rice has a very high water requirement the area sown is regulated, to a large extent, by the amount of water allocated by State water authorities in consultation with organisations representing the industry.

Current annual production is about 600 000 tonnes, of which about half is exported. Long-grain rice now forms more than 40% of the crop and is being increasingly grown in response to rising overseas demand.

OILSEEDS

The crops grown specifically for the oil they contain are shown in Table 11. Vegetable oil is also a by-product of cotton, maize and lupins. The oilseed area has increased considerably since the 1950s and 1960s, with the sharpest increase in the first two years that wheat quotas were imposed (1970 and 1971), when oilseeds—particularly sunflowers—were grown as an alternative to wheat.

Sunflowers now occupy over half the area of all oilseed crops. They are grown throughout the eastern wheat belts, although mainly from central New South Wales northward, predominantly as a dryland summer crop. In northern areas such as the Darling Downs sunflowers are a useful change-over crop in the rotation system because of their short growing period (about four months) and because they can be sown earlier (late August–September) than most other summer crops. The seeds are crushed to produce a high-quality salad and cooking oil which is also used to make margarine.

Table 11. Oilseeds, Australia ('000 ha)

Crop	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Sunflower	2.5	4.3	137	221
Safflower	..	24.0	40	54
Peanuts	6.9	23.0	27	32
Soybeans	..	..	26	57
Linseed	19.0	10.0	16	17
Rapeseed	..	..	16	42
TOTAL	28.0	62.0	262	422

Sources: Australian Bureau of Statistics—*Primary Industries: Part I—Rural Industries 1950–51; Rural Industries 1969–70*, Bulletin No. 8; *Crop Statistics, Australia: Season 1975–76*; and *Crops: Australia: 1979–80.*

Safflower, a relatively new crop to Australia and belonging to the thistle family, is mainly grown as a winter crop in the wheat belts of northern New South Wales and Queensland, although it is also grown as a spring or early summer crop as far south as north-central Victoria. Growing is concentrated in the Central Highlands of Queensland but, since the map was compiled, increases have occurred in central and northern New South Wales in the Coonamble, Moree and Walgett areas. The oil produced is used for cooking, margarine manufacture and industrial purposes.

Figure 22. *A young soybean crop near the Macquarie River west of Dubbo, New South Wales.*

Peanuts are a summer-grown sub-tropical legume crop. The seed pods mature underground so the crop requires a well-drained sandy loam soil for efficient harvesting. The crop is restricted to Queensland, particularly the Kingaroy area. The area cropped, in contrast with other oilseeds, has remained relatively stable over the last decade. Most of the crop is marketed as nuts while the remainder is crushed to produce an oil used in cooking and in the manufacture of margarine.

Soybeans are also summer-grown but restricted, because of susceptibility to frost damage, to northern New South Wales and Queensland. While they can be grown in moister coastal areas, they are mostly grown in irrigation areas inland. Since the map was compiled the area of soybeans doubled to 57 000 ha in 1979–80, increasing in all areas shown on the map as well as in the Macquarie irrigation area of central New South Wales. Crushing produces oil for cooking and industrial purposes and a high-protein meal for stock feed.

SUGAR AND COTTON

Sugar Cane

Sugar cane ranks second only to wheat in value of production. However, it occupies a much smaller area (about 350 000 ha in recent years) and is completely restricted to small areas of mostly alluvial soils along the wetter tropical coastlands of Queensland and, to a lesser extent, northern New South Wales.

Sugar cane is not mapped separately, but its distribution is clearly shown on the 'Croplands' map by the clusters of blue dots close to the coast from Grafton to north of Cairns. All these areas, except the Burdekin delta near Townsville, have a summer rainfall greater than 750 mm, which is essential for growth. A frost-free winter dry season is also necessary for building up the sugar content of the stalks and drying the foliage for burning prior to cutting. Although the irrigation of cane is increasing, most is still rain-grown except in the Burdekin delta, where irrigation is essential.

Cane is planted in early winter in the north and late winter in the south. In the north it is cut after a year's growth but in the cooler south growth is slower and two years are usually needed before the cane is ready for cutting. An average cane farm grows about 50 ha, under contract to supply a local sugar mill. A quota system of 'assigned land' operates to regulate production in accordance with domestic requirements and international sugar agreement obligations.

Figure 23. *Cutting sugar cane in Queensland. The harvester removes the unwanted upper stalks, cuts and chops the useable cane and loads a field bin hauled by an accompanying tractor.*

Sugar cane produces a greater weight of vegetation per hectare than any other field crop, one hectare producing about 80 tonnes of stalk and about 25 tonnes of foliage. Crushing and processing 80 tonnes of cane produces 22 tonnes of plant fibre ('bagasse'), which is used to fuel the mill boilers; 2 tonnes of crude molasses, used to make rum, ethyl alcohol, fertiliser and stock feed; and 11 tonnes of raw sugar. About 3 million tonnes of raw sugar are produced annually, of which about 70% is exported.

Cotton

Cotton has been grown without irrigation for over a hundred years, mostly in Queensland. However, modern irrigated farming of cotton, which gives much greater yields, began in the 1960s and is largely centred in new irrigation areas. The distribution of the 30 000 ha grown in 1975–76 is shown by the clusters of blue dots on the 'Croplands' map in central and northern inland New South Wales, and around St George and Biloela and on the Darling Downs in Queensland. By 1979–80 the area of cotton had increased to 75 000 ha and the growing area in all centres shown on the map had increased and, in addition, about 3000 ha were grown in the Emerald irrigation area in central Queensland. Almost half the crop is grown on the Namoi River downstream from Narrabri in northern New South Wales.

Cotton is a summer crop, planted in October–November and harvested by mechanically picking the opened bolls from the chemically defoliated bushes between March and June. It is very susceptible to insects, particularly caterpillars of the *Heliothis* moth, so that frequent insecticide treatments form a major proportion of production costs.

After picking, the raw crop is transported to local gins, sited close to growing areas because of its bulky nature. Here the cotton lint is separated from the seeds, which make up two-thirds of the weight of the unprocessed crop. The seeds are crushed for oil and the residue used for stock feed. In 1979–80 about 80 000 tonnes of cotton lint were produced, of which about 60% was exported.

Figure 24. *Cotton picking in northern New South Wales. The bushes have been chemically defoliated.*

FRUIT, VEGETABLES, TOBACCO

Orchard and Tropical Fruit

Fruit growing occupies about 100 000 ha or only about 0.5% of the total cash crop area (Table 12). However, the value of production per hectare is high so that fruit contributes nearly 10% of the total crop value. Fruit growing is markedly concentrated in a number of small areas where local conditions are particularly suitable.

The area under fruit has declined in the last few years (see Table 12), particularly where the bulk of the production was exported (for example, apples in Tasmania and peaches and pears for canning in Victoria)—see also Table 13. This has been largely due to the decline in Australia's share of the British market since that country joined the European Economic Community. Domestic demand for fresh fruit has remained steady while demand for fruit juices has increased.

Table 12. Fruit, Grapes, Vegetables and Tobacco Australia ('000 ha)

Crop	*1950–51*	*1965–66*	*1975–76*	*1979–80*
Fruit	111.0	127.0	100.0	98.0
Grapes	55.0	57.0	70.0	70.0
Vegetables	118.0	117.0	106.0	106.0
Tobacco	2.6	9.5	9.2	7.5

Note: Fruit and grapes include areas not yet bearing.

Sources: As for Table 11.

Table 13. Orchard Fruit ('000 trees)
Trees bearing and not yet bearing for 1975–76 (States) and 1979–80 (Australia only)

Crop	*Qld*	*N.S.W.*	*Vic.*	*Tas.*	*S.A.*	*W.A.*	*AUSTRALIA (a) 1975–76*	*AUSTRALIA (a) 1979–80*
Citrus—								
Oranges	219	2 426	669	..	1 460	284	5 059	5 532
Lemons and limes	43	366	132	..	136	43	720	651
Mandarins	224	147	58	..	80	47	556	n.a.
Grapefruit	24	143	70	..	92	16	346	n.a.
Pome—								
Apples	1 099	1 293	1 167	1 380	583	994	6 520	6 113
Pears	116	205	1 212	61	169	90	1 853	1 601
Stone—								
Peaches	136	477	822	2	346	61	1 844	1 570
Plums incl. prunes	141	419	127	3	73	73	835	n.a.
Apricots	48	89	223	29	394	16	798	718
Cherries	1	323	145	7	61	8	544	n.a.
Nectarines	46	42	48	2	25	10	172	n.a.
Other Types (b)	247	135	223	..	799	15	1 417	n.a.
Area of all orchard fruit incl. edible tree nuts (hectares)	*11 500*	*25 500*	*20 700*	*3 600*	*16 400*	*6 900*	*84 600*	*81 600*

(a) Includes very small numbers and total areas published for the Australian Capital Territory and the Northern Territory.

(b) Includes avocadoes, custard apples, figs, mangoes, olives and almonds, macadamia nuts, walnuts but not quinces (pome fruit—Australian total, 8 000 trees in 1975–76).

Sources: Australian Bureau of Statistics—*Fruit Statistics, Australia: Season 1975–76* and *Fruit: Australia: 1979–80.*

Although the distribution of fruit growing is very patchy, a broad, climatically induced pattern exists. Temperate fruit, mainly apples but including pears, plums and cherries, are grown in moister areas of the cooler southern coastal regions and hill and tableland country extending, in eastern Australia, as far north as the Stanthorpe area of southern Queensland. In these uplands, frosts at flowering time are a danger so orchards are generally located on slopes with good air drainage to minimise this hazard.

The main apple growing areas are in the Huon Valley (Tas.), around Donnybrook (W.A.), in the Adelaide Hills (S.A.), around Batlow and Orange (N.S.W.), and in the Stanthorpe area (Qld). The best climatic conditions for apple growing are in Tasmania, where tree densities and yields per tree are twice those of the Stanthorpe area, at the northern extreme of commercial growing. The area around Young (west of Goulburn, N.S.W.) has the largest concentration of cherries and prunes.

Further north, on the warmer central coast of New South Wales, oranges and other citrus fruit are grown between Sydney and Newcastle.

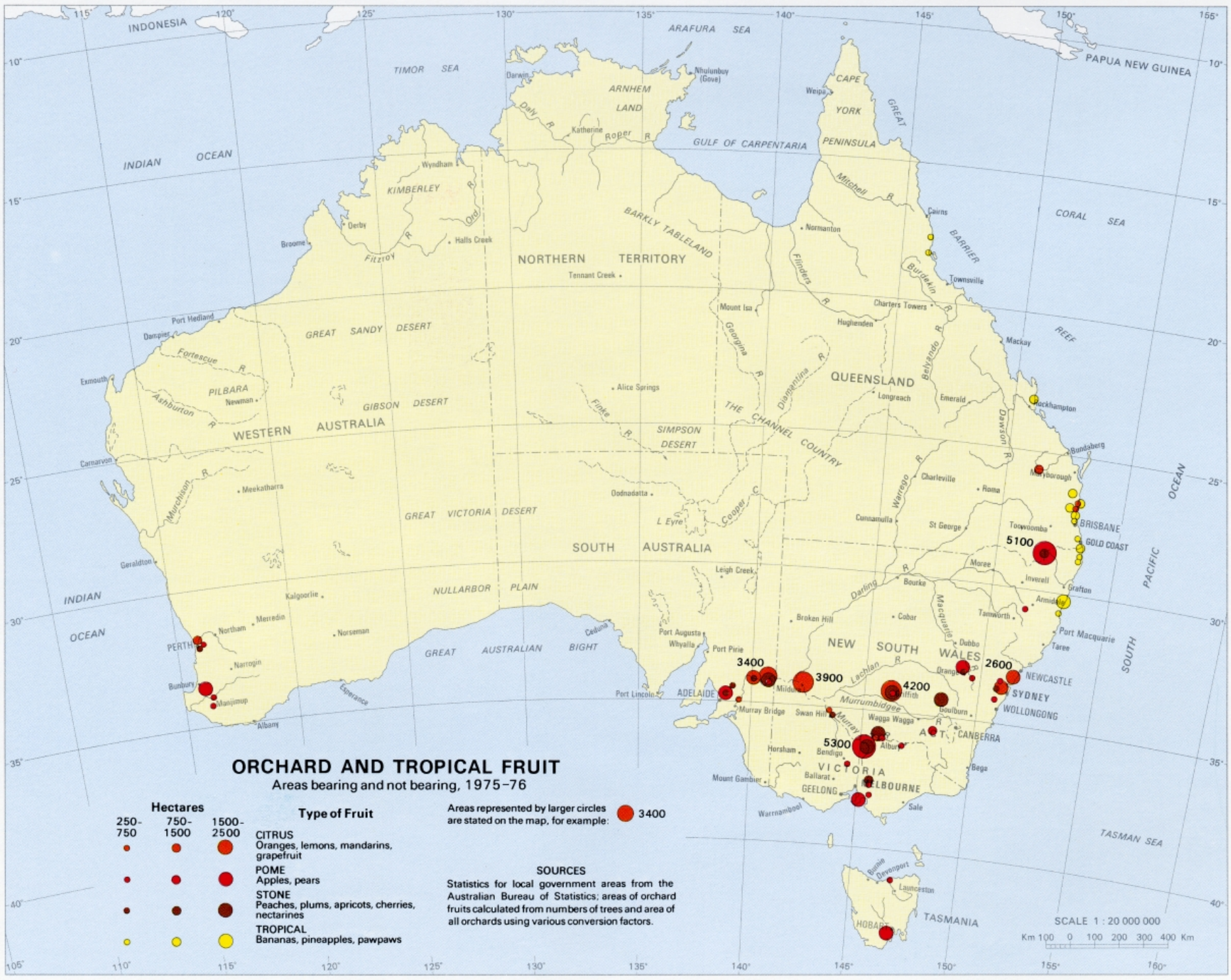
Further north again the frost-free climates of the coasts of northern New South Wales and Queensland allow the cultivation of tropical fruit, of which bananas and pineapples occupy the largest area. Bananas are predominantly grown in New South Wales, which had 4900 bearing hectares in 1975–76, while smaller areas (700 ha around Brisbane and 1000 ha around Innisfail and Cardwell) are grown in Queensland. Pineapples are virtually restricted to Queensland in localities with a northerly aspect and highly fertile, well-drained acidic soils. Most of the 3800 bearing hectares in 1975–76 were concentrated in the Yeppoon area near Rockhampton, near Gympie and between Nambour and Brisbane. Avocadoes, pawpaws and mangoes are also grown in this coastal region but occupy very small areas.

The relatively large areas of orchard fruit along the Murray and Murrumbidgee rivers in the much drier south-eastern inland are completely dependent on irrigation. Here oranges and other citrus fruit, peaches, apricots and pears are the main fruit. Much of the citrus fruit is grown for juice making while most peaches, pears and apricots are canned, particularly the peaches and pears grown around Shepparton in the Goulburn Valley of Victoria.

Grapes

In contrast with other fruit, the area of grapes has increased over the last two decades due to increased domestic wine consumption (see Table 12). Recently about two-thirds of the production has been for wine making, one-third for drying and less than 3% for table use.

The largest concentrations of vineyards are in the Murray and Murrumbidgee irrigation areas. Most of the dried grape production of sultanas and currants is concentrated around Mildura (Vic.) and in other



ORCHARD AND TROPICAL FRUIT

Areas bearing and not bearing, 1975–76

Hectares

250–750	750–1500	1500–2500

Type of Fruit

- CITRUS — Oranges, lemons, mandarins, grapefruit
- POME — Apples, pears
- STONE — Peaches, plums, apricots, cherries, nectarines
- TROPICAL — Bananas, pineapples, pawpaws

Areas represented by larger circles are stated on the map, for example: 3400

SOURCES

Statistics for local government areas from the Australian Bureau of Statistics; areas of orchard fruits calculated from numbers of trees and area of all orchards using various conversion factors.

Figure 25. *Mechanically picking grapes. Highly specialised machinery has replaced much hand labour in Australian fruit farming.*

irrigation areas further down the Murray in South Australia. Here the summers are hotter and drier than in other grape-growing areas, producing fruit with a higher sugar content and providing excellent drying conditions. The grapes grown in these areas are also particularly suitable for making brandy. Grapes for wine are produced throughout these and other inland irrigation areas.

Away from the inland irrigation areas smaller but important areas of vineyards are located in the Hunter Valley inland from Newcastle (N.S.W.); in north-eastern Victoria; in the Barossa and Clare valleys north of Adelaide, around Adelaide itself, and in the Coonawarra area of South Australia; and in the Swan Valley (W.A.). In these wetter areas the grape yields per hectare are much lower than in the fully irrigated areas, but flavour is superior and high-quality wines are more easily made. Grapes grown in the Stanthorpe area of southern Queensland are grown almost exclusively for table use.

Vegetables

Historically, vegetable growing was mostly restricted to areas of good soil on the edges of towns and cities, as close as possible to the larger markets. Recent urban expansion into areas of market gardening and a great increase in vegetable processing, making proximity to markets less important, have led to a wider dispersal of growing areas.

The 100 000 ha currently used to grow vegetables has remained relatively stable for many years (Table 12) because production is almost entirely for the domestic market. Indeed the area has decreased slightly because higher yields, resulting from increased irrigation and improvements in cultivation practices, have more than offset the increasing requirements of the growing population.

Those vegetables grown on areas totalling more than 2500 ha are given in Table 14, which shows the wide variety grown in all States and the lack of concentration of types in any one State except for melons and pumpkins in Queensland and sweet corn in New South Wales.

The map shows the dispersion of vegetable growing in the humid zone and south-eastern inland irrigation areas. However, there are some notable areas of concentration such as those on the alluvial soils of the Lockyer, Fassifern and Beaudesert areas near Brisbane and on basaltic soils in southern Victoria and northern Tasmania.

The areas in the south-east produce the bulk of the supplies for the large urban markets while those in Queensland supplement these with winter-grown early produce. Notable outlying areas at Bowen on the north Queensland coast and a smaller one at Carnarvon in Western Australia produce out-of-season vegetables, mainly tomatoes.

Potatoes, which occupy the largest area, are heavily concentrated in southern Victoria and northern Tasmania, where the cool, moist climate and deep, friable basaltic soils provide ideal growing conditions. These areas supply much of the increasing demand for processed potatoes (frozen and cooked chips and instant potato flakes). Potatoes grown in Queensland and northern New South Wales provide early crops for south-eastern markets.

Of the other vegetables, peas occupy the largest area and have a similar distribution to potatoes although more than half the area is now in Tasmania. Almost the entire crop is processed in factories located close to the main producing areas so there is no need for growing areas to be close to major urban markets.

Tobacco

Tobacco, a summer crop needing a frost-free period of at least five months, is grown mainly at two widely separate locations: the Mareeba district of north Queensland and the Ovens and King valleys in north-central Victoria. Smaller areas are grown around Bundaberg and Inglewood (Qld) and around Texas (Qld and N.S.W.). Most of the area is sprinkler irrigated. The tobacco produced is mostly Virginia type and is flue-cured on the farms.

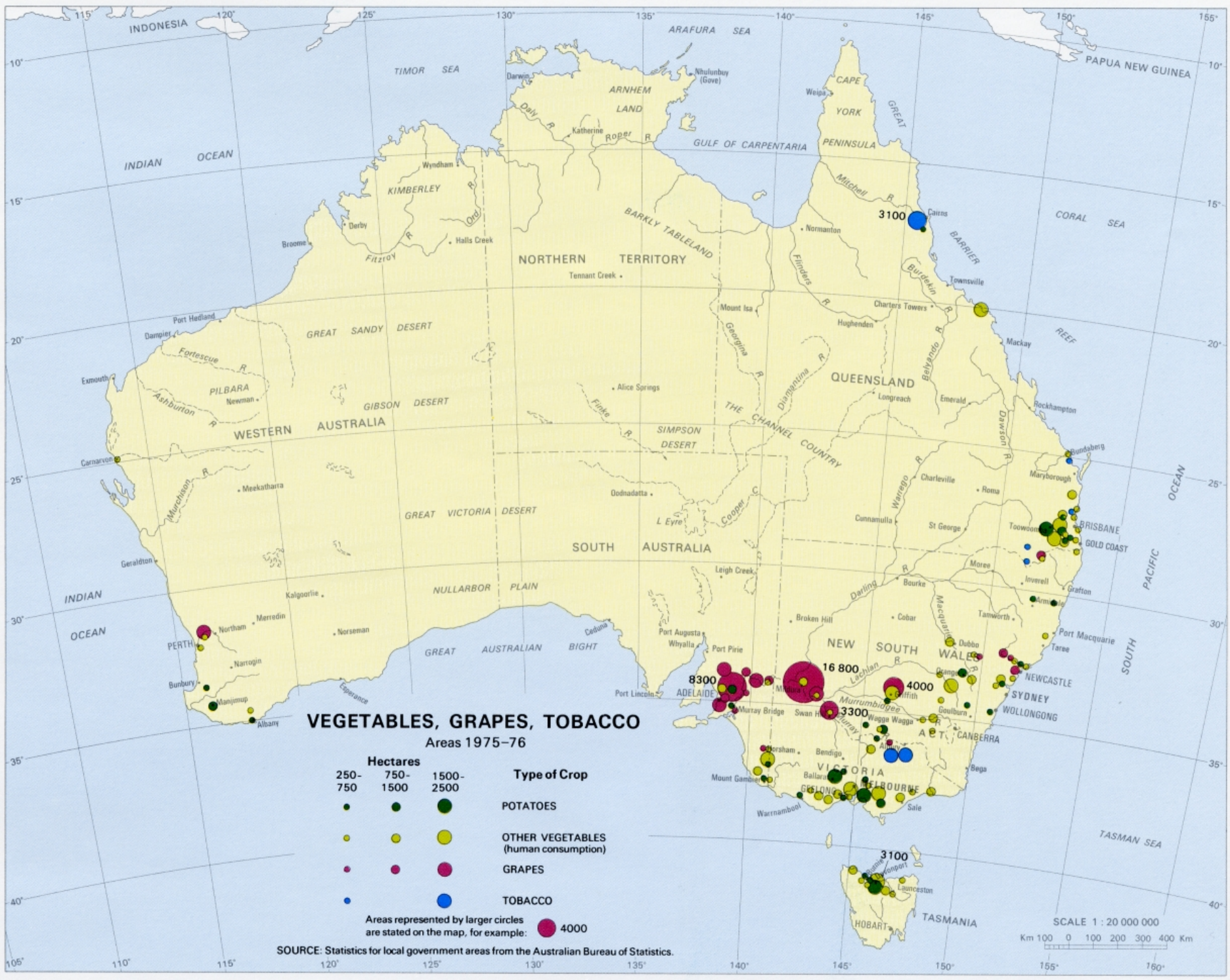
A very high-value crop, tobacco is grown over a relatively small area of about 7500 ha (Table 12). Although the area has declined, increases in yield have maintained production at 15 000 tonnes in recent years.

Table 14. Vegetables for Human Consumption (ha)
1975–76 (States) and 1979–80 (Australia only)

Crop	Qld	N.S.W.	Vic.	Tas.	S.A.	W.A.	AUSTRALIA (a) 1975–76	AUSTRALIA (a) 1979–80
Potatoes	6 000	8 300	10 600	3 400	2 800	2 300	33 400	36 700
Peas, green	1 600	2 500	5 200	5 500	3 200	900	19 000	14 500
Tomatoes	2 400	2 400	2 400	..	400	200	7 900	8 400
Beans	2 900	2 000	1 400	1 100	..	300	7 600	7 100
Pumpkins	4 100	1 500	900	100	400	400	7 300	6 700
Onions	1 000	1 000	800	300	800	200	4 000	4 000
Melons	2 100	800	300	..	100	300	3 700	4 800
Carrots	800	900	900	100	300	200	3 300	3 600
Sweet corn	200	2 100	400	..	400	..	3 100	2 900
Cabbages and brussels sprouts	500	600	900	200	300	100	2 700	3 000
Cauliflower	200	700	1 000	200	200	300	2 600	3 300
Lettuce	300	800	800	100	200	200	2 300	2 900
Other and not specified	2 400	3 300	1 700	400	400	300	8 600	8 600
TOTAL	24 600	27 100	27 100	11 300	9 500	5 700	105 600	106 500

(a) Includes small areas in the Australian Capital Territory and the Northern Territory.

Sources: Australian Bureau of Statistics—*Crop Statistics, Australia: Season 1975–76* (somewhat revised) and *Crops: Australia: 1979–80.*




AUSTRALIA
CROPLANDS
For the year ended 31 March 1976
EXTENSIVE CROPPING
5000 hectares
Wheat, barley, oats, sorghum, maize harvested for grain
Sunflower, linseed, rape, safflower, lupins
INTENSIVE CROPPING
2000 hectares
Sugar cane, cotton, rice, peanuts, soybeans
1000 hectares
Fruit, grapes, vegetables, tobacco
SOURCES
Based on statistics for local government or equivalent areas from the Australian Bureau of Statistics
and an interpretation of Landsat imagery for 'Land Use' (1979), scale 1:5 000 000, of this Atlas.
Produced for the topic 'Crops' in the volume Agriculture
of the Atlas of Australian Resources 3rd Series
Division of National Mapping, Canberra
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SCALE 1:10 000 000
Kilometres 100 0 100 200 300 400 Kilometres
SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)
NATMAP
INDONESIA
TIMOR SEA
ARAFURA SEA
TORRES STRAIT
PAPUA NEW GUINEA
INDIAN OCEAN
GULF OF CARPENTARIA
CORAL SEA
SOUTH PACIFIC OCEAN
GREAT AUSTRALIAN BIGHT
SOUTHERN OCEAN
TASMAN SEA
BASS STRAIT
WESTERN AUSTRALIA
NORTHERN TERRITORY
QUEENSLAND
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA
A.C.T.
GREAT SANDY DESERT
GIBSON DESERT
GREAT VICTORIA DESERT
NULLARBOR PLAIN
SIMPSON DESERT
BARKLY TABLELAND
ARNHEM LAND
KIMBERLEY
PILBARA
CAPE YORK PENINSULA
THE CHANNEL COUNTRY
GREAT DIVIDING RANGE
GREAT BARRIER REEF
Darwin
Port Hedland
Carnarvon
Geraldton
PERTH
Albany
Kalgoorlie
Alice Springs
Mount Isa
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
GOLD COAST
Broken Hill
Port Augusta
Whyalla
ADELAIDE
NEWCASTLE
SYDNEY
WOLLONGONG
CANBERRA
Wodonga
Bendigo
Ballarat
GEELONG
MELBOURNE
Mount Gambier
Launceston
HOBART

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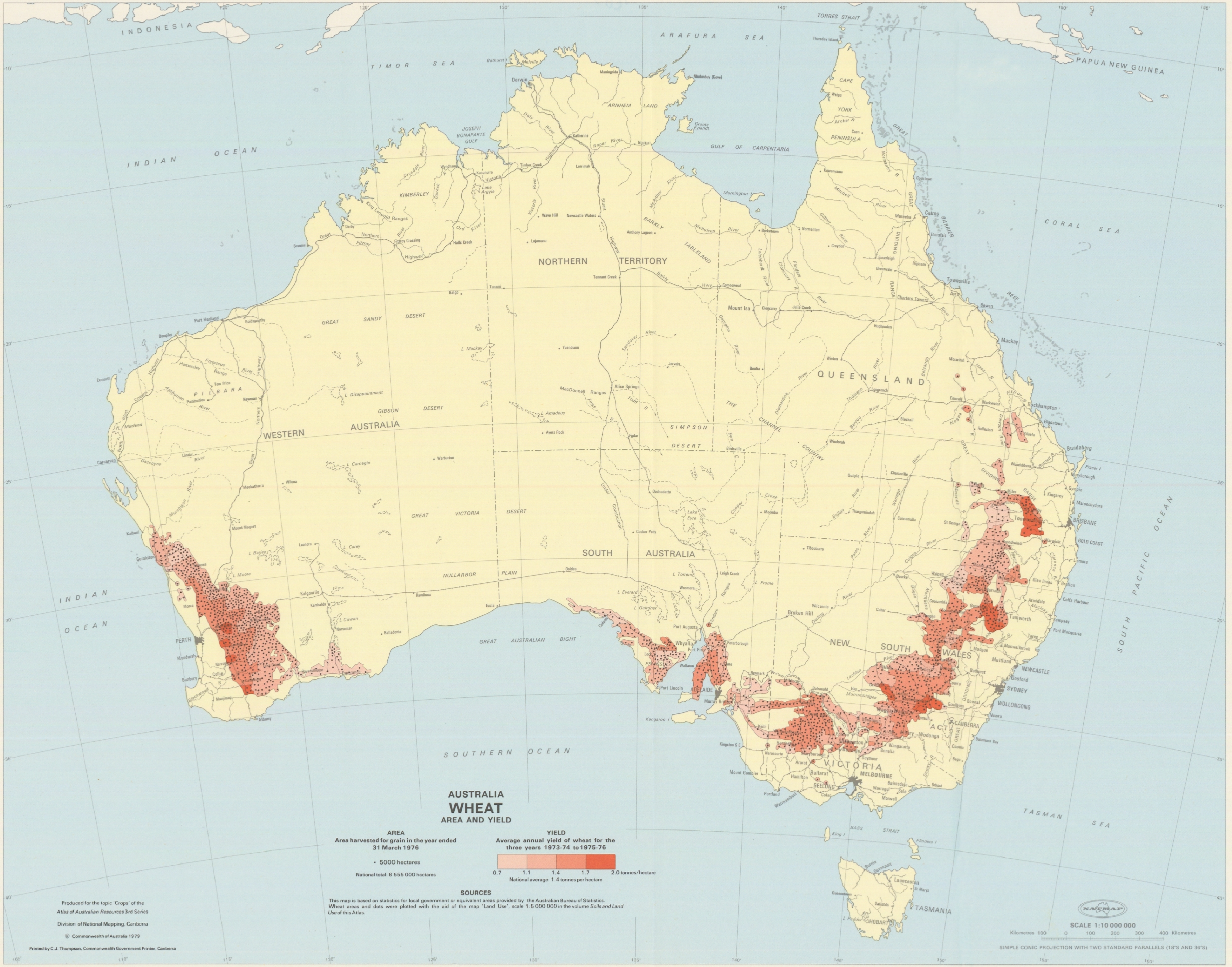
AUSTRALIA
WHEAT
AREA AND YIELD
AREA
Area harvested for grain in the year ended 31 March 1976
• 5000 hectares
National total: 8 555 000 hectares
YIELD
Average annual yield of wheat for the three years 1973-74 to 1975-76
0.7
1.1
1.4
1.7
2.0 tonnes/hectare
National average: 1.4 tonnes per hectare
SOURCES
This map is based on statistics for local government or equivalent areas provided by the Australian Bureau of Statistics. Wheat areas and dots were plotted with the aid of the map 'Land Use', scale 1:5 000 000 in the volume Soils and Land Use of this Atlas.
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SCALE 1:10 000 000
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NORTHERN TERRITORY
SOUTH AUSTRALIA
QUEENSLAND
NEW SOUTH WALES
VICTORIA
TASMANIA
ACT
PERTH
ADELAIDE
MELBOURNE
SYDNEY
BRISBANE
CANBERRA
HOBART
NEWCASTLE
WOLLONGONG
GEELONG
GOLD COAST
Darwin
Kalgoorlie
Geraldton
Albany
Bunbury
Alice Springs
Broken Hill
Port Augusta
Whyalla
Port Lincoln
Wagga Wagga
Tamworth
Toowoomba
Rockhampton
Townsville
Cairns
Mackay
Mount Isa
GREAT SANDY DESERT
GIBSON DESERT
GREAT VICTORIA DESERT
NULLARBOR PLAIN
SIMPSON DESERT
ARNHEM LAND
KIMBERLEY
PILBARA
CAPE YORK PENINSULA
BARKLY TABLELAND
GREAT BARRIER REEF
GREAT DIVIDING RANGE

NMP 77/151.1

INTRODUCTION

In this commentary attention is focussed on the economic units of Australian agriculture—their size, relative productivity and type. The statistics from the Australian Bureau of Statistics which are mapped and described are for 'agricultural establishments' (see notes to Table 16 and the legends of the maps). However, the word *farm* is used, for simplicity, although with this more restricted meaning.*

Australian farms are freehold or held as Crown leases issued and administered by State government authorities. In the cropped and more densely settled regions of the south and east, freehold predominates. Elsewhere, throughout the extensively grazed pastoral regions, leasehold predominates and freehold is rare except in the Mitchell grass plains of central Queensland. The terminology and conditions under which leases are issued differ between the States but the most common is termed a pastoral lease, which is usually issued with conditions covering length of tenure, improvements to be made and, in some cases, maximum and minimum stocking rates.

Historically, land settlement policies have aimed at an egalitarian division of land into blocks sufficient for the economic maintenance of a family. In recent years there has been a general trend towards fewer but larger farms as smaller and now less economic farms have been assimilated by more efficient ones, in many cases by the formation of partnerships and by an increase in corporate ownership. Even so, more than 90% of farms are still family enterprises.

Australian farms are highly mechanised and most are operated only by the farmer and his family with a minimum of hired help, often casual labour employed at times of peak farm activity.

Machinery of increasing power and sophistication has entered almost every branch of farming. Larger and more powerful tractors can now perform three tasks faster than earlier tractors could do one. Aircraft spread fertilisers, sow crops and pasture, and carry out pest and weed control. Helicopters are used for mustering cattle in the extensive grazing lands of the centre and north. Specialised fruit picking machinery and sugar cane harvesters have replaced itinerant hand labour. These and many other less spectacular forms of mechanisation have made Australian agriculture one of the most mechanised and labour-saving in the world.

FARM SIZE AND AGRICULTURAL PRODUCTIVITY

A characteristic feature of Australian farms is their large size. The present average farm area is nearly 3000 ha, very much larger than in Europe and fifteen times the U.S.A. average of 200 ha. This large average area is inflated by a few extremely large pastoral leases of more than 50 000 ha in the interior and north, which make up less than 1% of all farms yet occupy about 60% of the agriculturally used land (Table 15). However, the average area of the remainder is still almost 1000 ha; and about one in four farms is larger than 800 ha compared with about one in twenty in the U.S.A.

Farm size is largely dependent on land productivity which, in Australia, is inherently low due to the combined effects of low and unreliable rain and generally poor soils. Despite great improvements in pasture quality and crop yields, land productivity is still low in comparison with Western Europe and North America. The average livestock carrying capacity is still only about one-fifth of the U.S.A. average, and wheat yields are only about a quarter of those of north-western Europe and about half those of the U.S.A. So, to achieve the same production as its American and European counterparts, an Australian farm has to be considerably larger.

Within Australia there is a close inverse relationship between farm size and land productivity, as shown by a comparison of the maps 'Size of Farms' (overleaf) and 'Value of Agricultural Production'†, both of which are based on statistics for local government areas. The values mapped are based on averaged prices for the three years 1973–74 to 1975–76 applied to the quantities of agricultural produce recorded for 1975–76, with allowance made for crop failure and the like. Hence this map shows *relative productivity*, not gross income for a particular year.

Productivity in areas of livestock grazing is closely related to stocking rate with allowance made for turn-off rate, wool clip or milk yield depending on the type of farm activity. In cropped areas it is related to the type and intensity of cropping and to variations in yield where one crop predominates over broad areas, as in the wheat belts.

The largest farms are in the arid interior and monsoonal north, where beef cattle are grazed on poor, sparse native pastures at very low stocking rates with a low percentage turn-off producing an annual income of only a few cents per hectare. These farms average more than 50 000 ha and some exceed a million hectares. At the other extreme, market gardens in well watered coastal areas producing vegetables worth more than a thousand dollars per hectare may occupy only a few hectares.

Between these two extremes there are general trends coastward and southward of progressively smaller farms occupying increasingly more productive land. Sharper changes occur at the drier edges of the wheat belts, notably in Western Australia and western South Australia, where the combined income from wheat and sheep grazed on improved pastures is much greater per hectare than that derived only from sheep grazed on poor native pastures on adjacent uncropped areas.

In the east and south-east there is generally a more gradual sequence of decreasing farm size, related to increasing productivity, as the effective rainfall increases coastward. Notable disruptions to this general trend are the relatively high productivity and smaller farm sizes of the Mitchell grass plains of central Queensland and the very high productivity and small farms in the south-eastern inland irrigation areas, where intensive cropping and dairying is independent of local rainfall.

Within the wheat belts, productivity is greatest where wheat yields are high and subterranean clover pastures can be easily maintained. These areas most commonly occur towards the wetter edges of the belts in areas of better soils but are not everywhere associated with smaller farm sizes.

Coastward from the wheat belts, agricultural productivity varies greatly from place to place, reflecting the wide variety of topography and soil quality in these upland and coastal regions. Small, intensive crop and dairy farms, usually on fertile valley floors, form areas of very high productivity adjacent to poor hill country occupied by larger beef farms. On the tablelands of New South Wales and in south-western Victoria and south-eastern South Australia, areas of intermediate productivity result from prime lamb and beef production from high-quality sown pastures.

TYPES OF FARMS

The 'Farm Types' map is based on the Australian Bureau of Statistics' classing of farms ('agricultural establishments') in 1975–76 according to the Australian Standard Industrial Classification (see notes to Table 16). Although there has been significant diversification on farms in the last two decades, almost 75% have only one main purpose and only three dual-purpose categories account for nearly all the remainder. Although over 20 farm types are shown in Table 16, the seven covering livestock grazing and cereal growing include three-quarters of all farms and occupy all but a small fraction of the farmland.

Table 15. Farm Types classified by Size, Australia 1973–74 (per cent)

Type	*Size Class* (hectares)							
	<10	10–50	50–200	200–800	800–3 200	3 200–12 500	12 500–50 000	>50 000
Livestock Farms—								
Beef cattle	..	4	31	36	17	7	3	2
Dairy cattle	1	19	62	17	1	..	..	..
Sheep	..	1	16	45	22	7	6	2
Pigs	19	31	30	17	3	..	..	..
Poultry	59	25	10	5	1	..	..	..
Livestock and Crop Farms—								
Sheep–cereal grains	..	..	5	48	41	5	..	..
Crop Farms—								
Cereal grains	..	1	13	50	32	4	..	..
Sugar cane	1	38	51	10	1	..	..	..
Grapes	30	61	7	2	..	..	..	..
Fruit	28	51	18	3	..	..	..	..
Potatoes	7	34	45	12	1	..	..	..
Other vegetables	42	32	18	7	1	..	..	..
Tobacco	5	43	41	8	3	..	..	..
All Farms	5	13	27	32	16	4	2	1
% Total Farm Area	..	..	*1*	*5*	*9*	*8*	*15*	*62*

Notes: These percentages were calculated, with some estimation, from the last such statistics prepared by the Bureau of Statistics. The statistics used (for 'commercial holdings') had a different basis to the statistics in Table 16 but nevertheless excluded a broadly comparable number of rural holdings of little or no economic significance (60 000 holdings totalling 12.5 million hectares, leaving 180 000 totalling 488 million hectares).

Source: Australian Bureau of Statistics, *Classification of Rural Holdings by Size and Type of Activity: 1973–74.*

PHOTOGRAPH ABOVE: Farms growing orchard fruit, grapes and rice in the Murrumbidgee Irrigation Area, New South Wales.

This photograph and Figures 26, 27 and 29 by Australian Information Service; Figure 28 by F. T. Bullen.

* In the previous commentaries *farm* refers to the statistical units from which the Bureau collects agricultural information. Beginning in 1975–76 the definition of these units, then still called rural holdings, was revised and their name changed to 'establishments with agricultural activity'. The result was the omission of a large number of hobby farms and the like, mainly due to the introduction of an economic cut-off (see notes to Table 16). These changes do not invalidate the comparisons made so far in this volume with earlier statistics for pasture areas, livestock numbers and crop areas—the holdings excluded in 1975–76 and subsequently do not contribute significantly to overall agricultural activity. However, the statistics given in this commentary for before 1975–76 (Table 15) and the comparisons over time in the text and Table 16 have all been kept broad because of the significant changes in the statistical definition of agricultural establishments that the Bureau has made.

† The meaning of the title of this map is as defined by the headnote and footnotes of its legend; the map is not based on statistics for gross or local values of agricultural commodities (also prepared by the Australian Bureau of Statistics).

Figure 26. *The head station of one of the larger pastoral leases, covering more than a million hectares, in the Barkly Tableland, Northern Territory. These are usually run by companies and employ many more people than the average Australian farm.*

Livestock Farms

BEEF FARMS

Farms predominantly used to produce beef cattle are now the most numerous type, having doubled since 1965–66 to 34 000 in 1979–80 (Table 16), and occupy half the total farm area. Beef farms occur in all major climatic zones but only predominate in areas environmentally or economically unsuitable for sheep, crops or dairying. They are the only farm type over most of the extensive grazing land of the centre and north.

Because of their broad climatic range, beef farms differ greatly in size (see Table 15) and many other characteristics. They include extremely large, company-run pastoral leases in the arid interior and small, family-run freehold properties in the more humid coastal regions.

In the former the cattle graze extensively over the large expanses of sparse native pastures and are mustered usually only once a year, when new calves are branded and a small proportion of the stock is turned off for slaughter or as store cattle for fattening in areas of better pasture. Mustering teams work from outstations or temporary camps. Helicopters are increasingly used in this type of work. For the rest of the year the cattle roam wild, their movements regulated only by widely separated fences and watering points that are usually bore-fed, since naturally occurring surface water is rare and ephemeral.

On the much smaller beef farms in more humid regions the cattle are grazed on sown or naturalised exotic pastures at higher stocking rates. Many farmers grow small areas of fodder crops to supplement the pasture. The stock are closely managed and fatten rapidly so that annual rates of turn-off for slaughter are high.

Feed-lot fattening of beef cattle is uncommon, in contrast with the U.S.A. It is restricted to areas with abundant local supplies of cheap fodder grain, such as the Darling Downs and Liverpool Plains, and is only profitable when grain prices are low and beef prices high.

DAIRY FARMS

Once the most numerous of all farm types, dairy farms have halved in number over the last two decades and dairying districts have contracted to areas of optimum productivity in the more humid coastal lowlands, and inland have persisted only where cheap irrigation water is available. High milk production is dependent on year-round growth of high-quality pasture, a condition most often met in the cool, humid, coastal lowlands of Victoria and Tasmania and in the irrigation areas of north-central Victoria.

There used to be a clear distinction between farms producing liquid milk and those producing milk for manufacturing into dairy products, most of which were exported. The former were mainly concentrated close to urban centres—a concentration reinforced by legal zoning of milk 'catchment' areas in each State and a quota system for farms in those areas. The decline in competitiveness of Australian dairy produce on world markets, which began in the 1950s, severely affected the manufacturing sector and caused a restructuring of the whole industry.

Many marginal farms changed to beef cattle, particularly in Queensland and northern New South Wales, or were amalgamated with other dairy farms to form larger and more efficient units. This process was financially assisted by the Commonwealth Government's Marginal Dairy Farm Reconstruction Scheme of 1970.

The liquid milk zoning and quota arrangements are now broader and more flexible, and urban markets are supplied from much wider areas by larger and faster refrigerated tankers. The proportion of farms supplying milk both for liquid consumption and manufacturing has also increased.

Table 16. Number of Farms by Type, Australia

Type	*1975–76*	*1979–80*
Livestock Farms—		
Beef cattle	30 550	34 150
Dairy cattle	26 950	20 850
Sheep	20 150	20 200
Sheep–beef cattle	13 650	12 550
Pigs	3 550	3 300
Poultry for meat	560	680
Poultry for eggs	1 460	1 150
Livestock and Crop Farms—		
Sheep–cereal grains	23 000	23 350
Beef cattle–cereal grains	4 850	5 250
Crop Farms—		
Cereal grains	18 950	19 650
Peanuts	420	460
Other oilseeds	470	(*a*)
Cotton	100	220
Sugar cane	6 650	6 400
Grapes	4 750	4 900
Tropical (plantation) fruit	2 050	2 150
Orchard and other fruit	7 250	7 250
Potatoes	2 180	1 850
Other vegetables	5 300	5 050
Tobacco	1 040	940
Nurseries	1 340	1 680
Other—		
Unspecified single-purpose	4 650	7 000
Multi-purpose	550	(*b*)
TOTAL FARMS	180 400	179 100

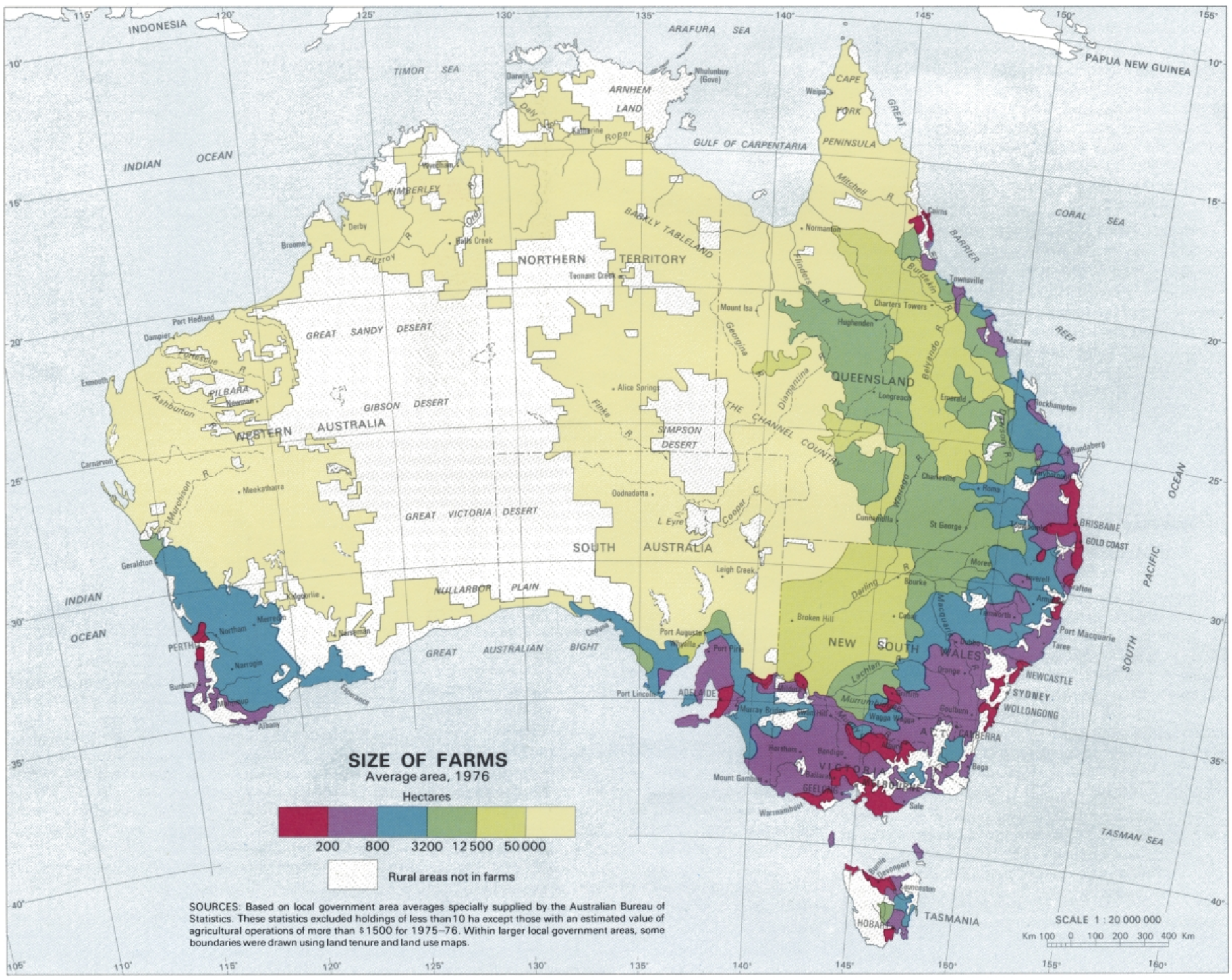
Notes: The cut-off for inclusion of agricultural establishments (establishments whose predominant type of activity is agriculture) in these statistics differed between one year and the other—the minimum 'estimated value of agricultural operations' (see legend of the map 'Farm Types') was $1500 in both years but, in 1975–76, holdings of 10 ha or more with a lower value were also included.

Farms were classified as having one main purpose if the value of a single activity was predominant and exceeded 50% of the total for the farm. Farms were classified in one of the three duplex categories only if the combined value of the two activities exceeded 75% of the farm total and neither was more than four times the other. (The legend of 'Farm Types' is misleading on these rules of classification.)

(*a*) Included in the cereal grains category.

(*b*) Multi-purpose farms were not distinguished in 1979–80. Farms which would, in previous years, have been classified in this group were classified according to their predominant activity.

Sources: Australian Bureau of Statistics, *Agricultural Sector: Part 1—Structure of Operating Units, 1975–76* and *Agriculture Sector: Australia: Structure of Operating Units 1979–80.*



The contraction of dairying has resulted in fewer but larger farms (the average size is about 150 ha compared with 80 ha in 1965–66) with larger, more productive, herds (now averaging 150 head per farm) grazing mainly on sown pastures. Sales of milk make up about three-quarters of farm income, the remainder coming from sales of veal and beef animals sometimes supplemented by pigs.

SHEEP FARMS

Once the archetype of Australian agriculture, farms solely or predominantly dependent on sheep have decreased greatly in recent years. Although partly due to the overall trend towards fewer and larger farms, this decrease has mainly resulted from diversification into supplementary activities such as wheat cropping or beef farming.

Sheep farms today predominantly occur in two distinctly different climatic regions on either side of the wheat belts. The larger area of sheep farms is in the southern semi-arid pastoral regions adjacent to the drier inland edges of the wheat belts. Here fine-wool merinos are grazed on native pastures at low stocking rates on large pastoral leases averaging, nationally, about 30 000 ha and running about 6000 sheep. Lease areas differ considerably between States, ranging from 5000–10 000 ha (in parts of New South Wales adjacent to the wheat belt) to 150 000 ha in drier areas of Western Australia.

Sheep farming is also the major activity adjacent to the humid edge of the wheat belts and in the drier parts of south-eastern Tasmania. Here high-quality sown pasture can carry about 4 sheep per hectare so that farms are much smaller than in the drier pastoral zone, averaging about 700 ha. While wool produced from merinos is still important in these more humid areas, fat lambs sired by British-breed rams are, on many farms, the greater income earner.

SHEEP–BEEF CATTLE FARMS

Discrete areas of sheep–beef farms are largely confined to a discontinuous chain of pastoral leases along the boundary between sheep and cattle country in the dry inland regions of Western Australia and South Australia. A much larger number of farms of this type are scattered within country that until recently had been predominantly sheep farming land in the pastoral zones of Queensland and New South Wales, where many traditional sheep farmers diversified to include beef cattle in the early 1970s. Smaller areas in the Riverina and north-central New South Wales have a longer history of combining the two activities. In the pastoral zone sheep–beef farms average about 20 000 ha and carry about 5000 sheep and 500 cattle grazed almost exclusively on native pasture.

The largest number (about 60%) of sheep–beef farms are in the higher rainfall sheep farming country adjacent to the wetter edges of the wheat belts, particularly in the tablelands of New South Wales. Here beef cattle integrate well with prime lambs since both exploit complementary sections of the meat trade. Farms average about 800 ha with about 2000 sheep and 200 cattle grazed on improved pastures supplemented by small amounts of fodder crops.

PIG AND POULTRY FARMS

Originally pig raising was an important sideline to dairying, the pigs being fed on the skim milk remaining after the cream was separated on the farms and sent to local butter factories. This changed with the factory processing of whole milk. Today pigs are mostly grain-fed on farms on the wetter edges of the cereal belts where grain is locally plentiful and comparatively cheap. Pig farms are notably concentrated in such areas in south-eastern Queensland, where more fodder grain is produced than elsewhere in Australia. While the majority of pig farms are inland some remain in coastal dairying areas.

The number of pig farms rose during the late 1960s and early 1970s, when cheap over-quota wheat was available for pig feed. However, this cheap source of feed has largely disappeared with the relaxation of wheat quotas and the number of pig farms has recently declined in response to rising production costs.

In specialist piggeries today the animals are kept indoors in carefully regulated environments with closely controlled feed regimes. Most pig farmers, however, have ancillary activities such as dairying, other livestock grazing or cereal cropping.

Poultry farms today are highly specialised indoor operations producing eggs or meat birds, with hatcheries supplying young birds. Careful environmental and genetic control and automated feeding have improved production efficiency, making poultry increasingly more competitive in price compared with other meats. This has led to a marked increase in poultry consumption and to an increase in the number of farms producing poultry for meat. However, the number of egg-producing farms has decreased as small farms have been unable to compete with larger ones in this capital-intensive industry.

Poultry farms have a similar distribution to pig farms, either close to the larger urban markets (particularly egg farms) or close to supplies of cheap grain on the wetter edges of the wheat belts (particularly meat birds).

Figure 27. *Broiler chicken houses—a most intensive type of animal farming.*

Livestock and Crop Farms

SHEEP–CEREAL GRAINS FARMS

Sheep–cereals farms are the typical and still the most numerous farm type of the wheat belts despite the recent increase in wheat cropping, which has led to a reclassification of some as cereals farms (Table 16).

They are mostly family properties, on average running 2000 sheep on 1200 ha and with 500 ha of sown pasture and 250 ha of wheat. Many now have small cattle herds of 50–100 head. Most farms grow wheat but barley in South Australia, rice in the irrigated areas of southern New South Wales, and sorghum in northern New South Wales and Queensland are locally important. Oilseeds—notably sunflowers—have also entered the rotation, particularly in northern New South Wales and Queensland. Sown pasture is mainly based on subterranean clover, which provides good stock feed while cheaply fixing nitrogen in the soil for the benefit of the ensuing crop.

The sheep are mainly merinos kept for their fine wool but towards the wetter edges of the wheat belts, where pastures are more productive, fat lambs sired by British-breed rams are produced on many farms.

Figure 28. *A wheat-sheep farm in central New South Wales. Typically, wheat (shown by the pale yellowish triangle to the left) occupies only about a quarter of the farm area.*

BEEF–CEREAL GRAINS FARMS

Beef–cereals farms mainly occur in comparatively small areas of Queensland which are climatically suitable for wheat and sorghum but better suited to cattle than sheep. Their recent increase in number has been largely due to brigalow clearance in central Queensland, which has enabled the introduction of cropping in areas previously grazed only by cattle. Isolated concentrations of this farm type also occur in the Northern Tablelands and Riverina of New South Wales, where historical preferences for cattle rather than sheep have been locally maintained.

Crop Farms

CEREAL GRAINS FARMS

Cereal farms are largely a variant of the sheep–cereals or beef–cereals types since almost all keep some livestock although grain is their main source of income. They have increased in number since the mid-1960s, when most sheep–cereals farms began to grow more wheat, so many more are now classified as cereal farms.

Even though cereals farms are scattered through much of the wheat belts, particularly in the eastern States, discrete areas of predominance occur only on the drier margins and, at the other extreme, in areas of higher rainfall and soil fertility where wheat yields are high. The largest example of the former occurs on the dry margin of the Western Australian wheat belt. Here subterranean clover pastures are difficult to maintain during the hot, dry summers; sheep stocking rates are accordingly low in comparison with the wetter parts of the wheat belts so that most income comes from wheat, despite its low yield. Examples of the predominance of cereals farms where wheat yields are high occur in the Darling Downs and in northern New South Wales. Here sown pasture is largely replaced in the rotation cycle by fallowing and fodder oats, so livestock are a minor income earner compared with the high-yielding premium quality wheat grown in these areas.

The rice farms of the irrigated areas of the New South Wales Riverina belong to this type but do not form sufficiently large concentrations to be mapped as discrete areas.

PEANUTS AND OTHER OILSEEDS FARMS

This group consists of two relatively dissimilar types: the specialist producers of intensively grown peanuts and soybeans and those producing less intensively grown sunflowers and safflower.

Peanut farms are largely confined to the Kingaroy district of south-eastern Queensland, in a local concentration that has existed for many years under tariff protection and State-controlled marketing. Soybean farms are scattered within recently irrigated areas of central and northern New South Wales and south and central Queensland.

The main concentration of farms obtaining most of their income from sunflowers and safflower is in the Central Highlands of Queensland. Here the oilseeds are grown in rotation with wheat and sorghum and in conjunction with beef cattle. With all these options open, the number of oilseed farms fluctuates according to the market price of oilseeds relative to these other commodities and with seasonal conditions; indeed, the Bureau of Statistics does not now distinguish them from farms growing cereals for grain.

COTTON FARMS

Cotton farms are confined almost entirely to irrigated areas of inland northern New South Wales and Queensland, with the greatest concentration along the Namoi River below Narrabri (N.S.W.). The initial impetus to the upsurge in irrigated cotton farming in the mid-1960s was given by large companies, with overseas experience in cotton growing, that were able to afford the high capital costs of gin construction and specialised mechanical pickers as well as the high recurrent costs of aerial spraying against insect pests.

Cotton is virtually the sole enterprise of these company farms, which still form the hub of the industry. However, as local understanding of cotton cultivation has grown, it has been taken up by nearby sheep–cereals or cereals farmers with irrigable land and, for some, cotton has become the major income earner, particularly in northern New South Wales.

SUGAR CANE FARMS

Sugar cane farms are predominant in tropical and subtropical areas of well watered and fertile soils on the coastal lowlands of Queensland and, to a lesser extent, northern New South Wales. The farms are small, averaging about 120 ha, and at any one time at least a third of the farm is under cane. The continuing productivity of the cane monoculture is maintained by heavy applications of nitrogenous fertilisers and rotation with a leguminous manure crop about once every fourth year. The area of cane grown on each farm is 'assigned' by the local sugar mill to regulate production.

Australia pioneered the mechanisation of cane farming and today almost all cane is mechanically planted and harvested. The crushing mills are located within the cane-growing areas to minimise the distance that the bulky cane has to be transported, often by narrow-gauge tramways.

While cane growing is the sole enterprise of the majority of farms, some also run small cattle herds, mainly for beef.

Figure 29. *A sugar cane farm in northern Queensland. The cane is grown on the alluvial flats in the foreground.*

INTENSIVE CROP FARMS

This grouping consists of a variety of farm types with income derived from a number of intensively grown crops, predominantly fruit or vegetables. They all have in common high gross values of production per hectare with equally high costs of cultivation, pest and weed control, and mechanisation or labour. Most are small farms of less than 100 ha and many are less than 10 ha. Some are larger, notably potato, tobacco and some other vegetable farms, combining intensive cropping with other, more extensive, agricultural activities (Table 15). A problem common to most farms in this group is the high cost of hand labour but much is now done by machines. Considerable advances have been made in mechanisation and in breeding crop varieties more amenable to mechanical harvesting.

Intensive crop farms in coastal areas are mainly market gardens and small fruit farms growing fresh produce for nearby major urban centres. In coastal areas further away from the major cities, intensive farming occurs in small pockets of land well suited to a particular enterprise. Thus potatoes and other vegetables preferring a moist temperate climate are grown in areas of good soils in coastal Victoria and northern Tasmania; and tropical fruit such as bananas and pineapples and early vegetables are farmed in the coastal areas of Queensland and northern New South Wales, and at Carnarvon in Western Australia.

Intensively cropped farms in upland areas mainly produce temperate fruit (principally apples, cherries and plums) and, to a lesser extent, vegetables (particularly potatoes in the Central Highlands of Victoria and the Southern Tablelands of New South Wales). Vineyards producing high-quality wine grapes and tobacco farms are located on upland fringes; the main producing areas have been described in the 'Crops' commentary.

Intensive crop farms in the inland irrigation areas mainly produce fruit (particularly oranges, peaches, pears and grapes) and, to a lesser extent, vegetables for processing.

Most intensive crop farms have decreased in number over the last two decades—only vineyards have significantly increased, due to increasing domestic wine consumption. Orchards have declined due to the sharp fall in most fruit exports. The common trend towards fewer but larger farms is only evident amongst this group in vegetable farms which, since 1965–66, have declined in number although the average size has more than doubled. This has been due to the loss of many small market gardens to urban expansion and an increase in much larger vegetable farms in inland irrigation areas.

FURTHER READING

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Maps on agriculture in the earlier series of the *Atlas of Australian Resources*:

First Series	Distribution of Stock (a single map showing livestock numbers averaged for 1951–53 and pasture types)
	Croplands (four maps based on averaged statistics mainly for 1953–54 to 1955–56, two on wheat area and yield and two on areas of other crops)
	Agricultural Production (a single map based on averaged statistics for 1945–46 to 1950–51 showing percentage area under crop and estimated annual gross value of specific crops)
Second Series	Grasslands (four maps showing: native pastures; introduced pasture zones; and area for 1968–69 of sown pastures and of pastures fertilised)
	Livestock (a single map showing livestock numbers averaged for 1965–67 and livestock density by local government areas)
	Sheep and Wool (several maps showing sheep numbers 1965, annual wool clip per animal shorn averaged for 1963–64 and 1964–65, etc.)
	Croplands 2nd edn (four maps based on area statistics for 1967–68 showing percentage area cropped, wheat for grain, and other crops)
	Crop Production (two maps showing estimated annual gross value of specific crops averaged for 1963–64 and 1964–65, and storage facilities and exports)

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MAPS FOLLOWING

Farm Types

Value of Agricultural Production

AUSTRALIA
FARM TYPES

This map is based on statistics of the estimated value of agricultural operations for the types of farms (agricultural establishments) named below. The map shows the type or types locally predominant in value of operations in 1975-76.

- Beef cattle
- Dairy cattle
- Sheep
- Sheep-beef cattle
- Beef cattle-cereal grains
- Sheep-cereal grains
- Cereal grains
- Sugar cane
- Peanuts and/or other oilseeds
- Cotton
- Intensive cropping types
  Grapes, tropical fruit, orchard & other fruit, potatoes, other vegetables, tobacco, nurseries

AREAS WITH MIXED TYPES
Large areas with two or three types inseparably mixed and with their value of operations within the ratio 1:3. Examples:

- Sheep farms & sheep-beef cattle farms
- Cereal grain farms & sheep-cereal grain farms

Rural Areas without Farms

SMALL-AREA CONCENTRATIONS
Areas too small to delineate in which the predominant farm type or types had a total value of operations of more than $1 million.

- Dairy cattle
- Pigs
- Poultry for meat and/or eggs
- Sugar cane
- Cotton
- Intensive cropping

Estimated Value of Agricultural Operations: Estimated by the Australian Bureau of Statistics from the total agricultural production of each establishment in 1975–76 (fat cattle sold, wheat harvested etc.) using three-year weighted average prices.

Agricultural Establishment: A rural holding of 10 hectares or more operated by one enterprise; also includes smaller establishments with an annual value of agricultural operations of over $1500.

Types of Agricultural Establishment: Establishments were classified by the Bureau by the activity contributing more than 75% of value of operations. For combined types (sheep-beef cattle etc.) neither activity contributed more than four times the value of the other.

Sources: Local government area statistics for the year ended 31 March 1976 specially supplied by the Bureau; statistics interpreted using the map 'Land Use' (1979), scale 1:5 000 000, in the volume *Soils and Land Use* of this Atlas.

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SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

NMP77/158

AUSTRALIA
VALUE OF AGRICULTURAL PRODUCTION

Estimated value of agricultural operations on farms, 1975-76

$ per Hectare

3 6 25 50 100

Rural Areas without Farms

Estimated Value of Agricultural Operations: Estimated by the Australian Bureau of Statistics from the total agricultural production of each farm (fat cattle sold, wheat harvested etc.) using three-year weighted average prices.

Farm: An agricultural establishment (rural holding) of 10 hectares or more operated by one enterprise; also includes smaller farms with an annual value of agricultural operations of over $1500.

Sources: Local government area statistics for the year ended 31 March 1976 specially supplied by the Bureau; statistics interpreted using the maps 'Grazing Density' (1979) and 'Farm Types' (1980), scale 1:10 000 000, of this volume.

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NAT MAP

SCALE 1:10 000 000

Kilometres 100 0 100 200 300 400 Kilometres

SIMPLE CONIC PROJECTION WITH TWO STANDARD PARALLELS (18°S AND 36°S)

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