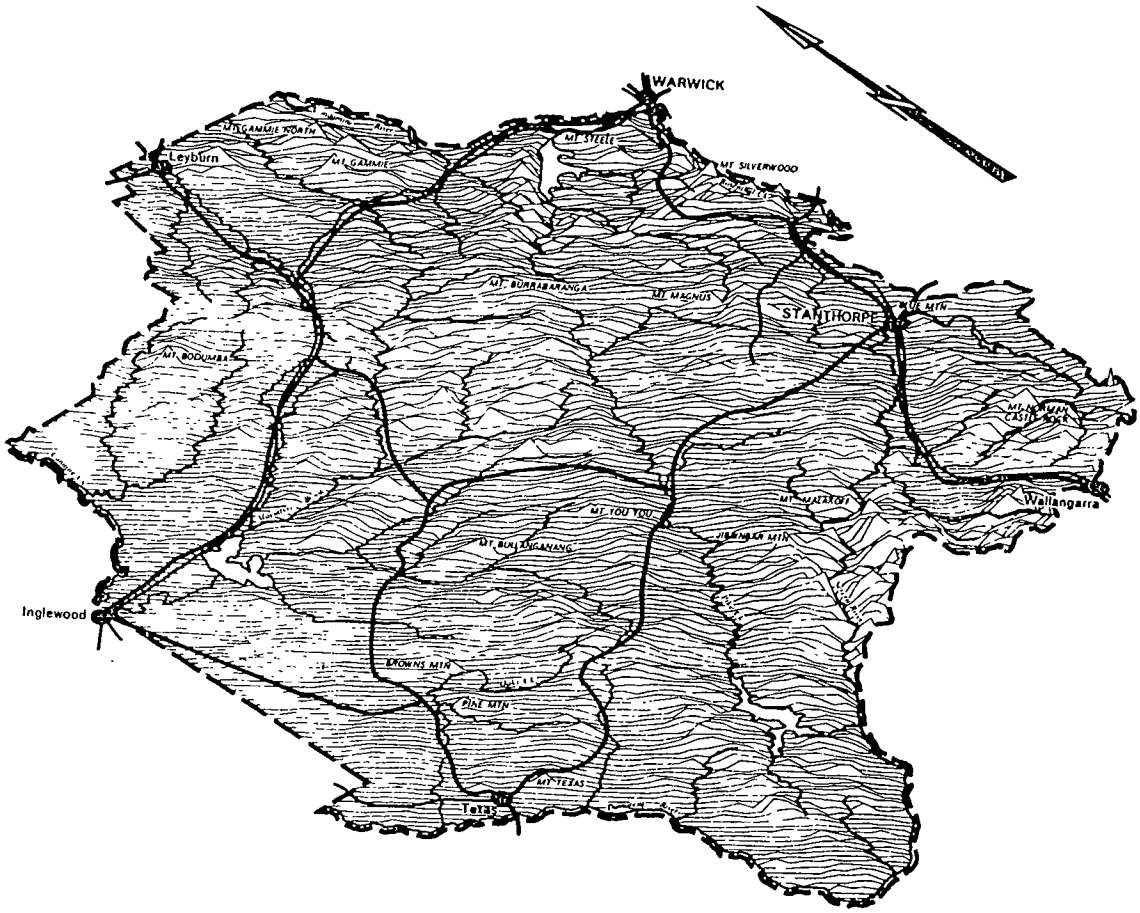
THE GRANITE AND TRAPROCK AREA OF SOUTH EAST QUEENSLAND

A LAND INVENTORY AND LAND UTILISATION STUDY

PART II – LAND UTILISATION

COMPILER AND MAIN AUTHOR A.K.WILLS



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QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

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10 SUMMARY OF LAND UTILISATION

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

10 SUMMARY OF LAND UTILISATION

A survey of existing land use was carried out in 1973-74 and the results are portrayed on MAP 7. Agriculture, horticulture, pastures, livestock populations, apiculture and forestry were the topics covered.

The map shows the concentration of horticulture on the Granite Belt, and crop divisions within this area. Land use in the remainder of the area is predominantly grazing of native pastures, the relative concentrations of beef cattle or sheep over this area being shown both by the livestock symbols and by the small supplementary map.

The area's importance to apiculture is also highlighted around Warwick, Eukey and in patches from Durikai State Forest southwards to Glenlyon and Ballandean. This is seen in greater detail on MAP 9.

Areas of importance to recreational land use are the Girraween National Park and the main water storage sites. The demand for recreational facilities is increasing at a rapid rate.

Since about 1967, there has been a marked shift out of sheep into beef cattle in all three shires of the study area due mainly to changing market conditions. Over the ten years to 1971/72, there has been a net increase in stock of the order of 70 to 80,000 DSE (dry sheep equivalent) per shire.

There have been no major changes in the horticultural land use patterns of the Granite Belt since 1960, but statistics show a marked decline in new plantings of pome fruit in recent years. Stonefruit and grapes show a steady increase.

The land capability concept recognizes that there is a definable upper limit to land use intensity, which has to be observed if output from that land is not to decline in the longer term. Land capability classification for agriculture (Rosser *et al.* 1974) has been used at the broad scale to produce MAP 8 - Land Capability. Predictably, the better classes of land are found on the major flood plains. The narrower flood plains are slightly restricted due to surface structure, microrelief or effective soil depth restricted by layer compaction. Other areas suitable for cultivation are restricted mainly on degree and length of slope. Surface structure and stoniness increase in severity as slope and relief increase, until grazing potential becomes nil. There are three main areas in this final category which would be best left undeveloped as reserve land for wildlife, recreation and maintenance of water quality.

10.1 Primary Production

Sheep and Wool - The traprock country is probably best known for its wool production. Most successfully run properties have extensive improved areas and can sustain breeding enterprises. Stocking rates tend to be related to rainfall and property improvement. Dry winters

with heavy frosts cause lack of protein and wool-growers have to employ winter supplementation to maintain flocks in sound condition at summer stocking rates.

Wool production is concentrated in Inglewood and Stanthorpe Shires. There are only eight specialist wool producers in Rosenthal Shire. The study area enjoys a reputation for high quality wool and consignments frequently top Brisbane wool sales.

Market forces induced a major swing from sheep to beef cattle in the nineteen-sixties. Sheep and cattle populations are presently well spread over the study area, although a distinct core area is evident in the centre (see Land Use MAP 7 - inset). The long term grazing impact of sheep-cattle combinations is not clear at this time, but can be expected to differ from traditional grazing patterns.

Diversification opportunities are few in this area since the wool and beef markets are equally unpredictable in the short-term, and since the land cannot sustain a significant increase in grazing pressure.

Beef Cattle - The area is divided into four distinct land types for beef production - the 'wetter' and 'drier' parts of the Granite Belt, and the traprock country, with and without significant areas of river frontage. Each of these types is discussed in terms of a 'typical' property which is considered to be of average size, development and management.

On both the 'wetter' and 'drier' parts of the Granite Belt, the predominant cattle enterprise is breeding and turning off stores at 10 to 18 months. Interest in intensive methods of fattening in the eastern Downs districts means that local demand for stores may increase in time. Semi-intensive operations will be required to meet this demand, with corresponding higher levels of organisation and management.

The traprock country with negligible frontage land is dominantly a sheep area, but most properties run 80 to 200 head of cattle - frequently about 120 head. This is considered a satisfactory level of cattle production as environment limitations are against expansion.

Although small in area, the high carrying capacity frontages of the Dumaresq and Condamine Rivers, Canal Creek and Macintyre Brook are important, being mainly used by cattle. There are opportunities in these areas for crop fattening of all turnoff cattle and, with irrigation water available, the effects of drought are likely to be slight.

Overall, breeding is the cattle enterprise most suited to the study area, with nearby markets for store cattle in the eastern Downs and New England. Nutritional problems and the long hard winters are the main limiting factors to beef cattle production.

Dairying - In the study area, only Rosenthal Shire produces a significant dairy output, but this is still small relative to other dairying areas on the Downs. Dairying in other Shires has been allowed to decline in importance, with only three dairy farms remaining around Inglewood and one near Stanthorpe.

Although there is suitable land, production costs relative to returns and the present capacity of plant at Warwick factory present limitations to expansion in dairying.

Pigs - As with dairying, pig raising has contracted to the Warwick area and to selected spots near grain-growing areas. Increasing costs of inputs are likely to prevent any reversal of this trend.

Poultry - The area does not support a significant poultry industry. Local needs are catered for, but economic and institutional restrictions rule out any major expansion.

Horticulture - Horticulture in the study area is concentrated on the Granite Belt with some exploratory plantings found in the traprock, on the scrub soils south-west of Warwick and between Inglewood and the Coolmunda Dam.

Apple trees occupy by far the highest proportion of land area but markets have been either static or depressed and some growers are contemplating taking advantage of the Fruitgrowers' Reconstruction Scheme. The position on stone fruit is rather better, with the area planted on the increase.

The Granite Belt has about 80 per cent of Queensland's vineyards and the marketing situation is quite favourable. Wine grapes are an uncertain prospect at the moment, but could develop into a major new industry for the area. Trials are in progress and indications of suitable wine grape varieties are now emerging. Wines made from table grapes, and apple or pear wines are already in production and selling.

Vegetables from the Granite Belt have lost their dominance in Queensland's summer vegetable market, but the area is still competitive with other vegetable growing areas. High prices are obtained when lowland, coastal areas experience extremes of summer weather.

Irrigation is important to all forms of horticulture in the study area and the area irrigated has increased steadily since the 1957 drought. The combination of trickle irrigation and close planting should result in economies and higher yields in the long term.

Other advances such as bulk handling and controlled atmosphere storage also contribute to efficiency and reduce wastage, although the establishment of a cannery has been considered uneconomic.

Outside of the Granite Belt, the traprock is mostly unsuited to any form of intensive use, but the flatter country around Inglewood is more amenable and has shown some suitability for stone fruit and table grapes. With irrigation and a more secure marketing and distributional organisation, horticulture

in this district could be expanded.

Agricultural Crops - This section includes discussion of pastures and forage crops in addition to grain and oil seed crops and tobacco.

Native pastures in cleared timber country carries 2 DSE/ha on average. It is good summer grazing but its dormancy in winter produces a major gap in feed programmes. Regrowth of timber species and low phosphorus levels are further hindrances to production. Improved pastures are essential supplements to winter grazing but can be satisfactorily established only in areas above 750 to 800 mm mean annual rainfall, depending on soil type. In these wetter areas, temperate pastures do well, but in the drier parts of the study area, the main pasture is lucerne on granitic soils and a lucerne/medic combination on traprock. In these latter areas, insufficient arable land, shallow soils and high fertilizer requirements all restrict successful introduction of improved species.

Irrigated lucerne is found mainly on the flood plains in the west of the study area, over 300 hectares along Macintyre Brook from Oman-ama to Inglewood and over 500 hectares around Limevale and near the Dumaresq River in Bonshaw LS. Hunter River lucerne is the main type grown, yielding about 15.0 t/ha under specialist hay production conditions. Water requirements for irrigated lucerne are estimated at 12 Ml/ha/annum. Much of the lucerne hay produced is sold to neighbouring districts, particularly to northern New South Wales.

Winter fodder cropping is very important because of the winter gap in native pasture production. Conversely, summer forage crops are of minor importance due to native pastures normally being adequate at this time. Further, few properties have sufficient cultivable land to plant both summer and winter grazing crops. Oats is the most popular winter forage crop but requires high rates of fertilizer on the traprock or granitic soils. Plantings start in early February and many continue as late as July or August to provide feed into late spring.

Hybrid sorghum varieties make up the majority of summer forage crops planted but it is considered that a change in emphasis towards leguminous crops would be beneficial, as a protein supplement to native pastures.

Some grain cropping is found in the study area on alluvial areas and adjacent country, but it is not important except along the Condamine River in the north-east. Wheat and barley are the main winter crops but only small areas of summer crops are sown, including maize, navy beans, soybean and sunflower.

On the Condamine alluvials, wheat, barley, maize, soybean and sorghum are grown. Barley is the main crop in recent years due to its less demanding climatic needs and its grazing value in the event of crop failure.

The tobacco crop in the study area is centred along the

Dumaresq River and east of Inglewood. Technological advances have enabled a reduction in labour inputs in recent years, and the availability of irrigation water has caused a shift to lighter soils which result in higher quality leaf.

Apiculture - The study area produces at least 40 per cent of Queensland's honey, mostly in the higher grades. The most important flora are yellow box, mountain gum and winter-flowering eucalypts on the Granite Belt.

The industry is highly mechanised and mobile, involving considerable capital investment and a generally high level of management.

Overseas and domestic demand for honey is encouraging. The industry's income earning prospects and favourable environmental impact should secure it above-average priority in future land use planning decisions.

Mining - Most of the mineral finds, which made the study area famous for its mines, have been worked to the stage that they are uneconomic. Quarries for brick clay and road metal are still productive and marble is mined at Limevale.

Forestry - The main forestry assets of the area lie in the cypress pine stands in the west and the exotic pine plantations on the Granite Belt.

The cypress pines are sufficient to support a sawmilling industry at Inglewood and any landholder with well spaced stands of this species has a valuable asset. However grazing in these areas prevents stand replacement by natural regeneration.

The climate of the Granite Belt induced a naturally dense, high quality stand of saw log timber which is now largely cleared. Plantations of exotic pines are grown in the area and have a ready market in the manufacture of fruit cases. A number of small plots is scattered around on farms providing an added source of wealth to landholders.

The remainder of the study area is mainly woodland of cleared timber or open forest in the Herries Range-Leyburn-Pratten area. Income prospects from these areas are limited but they can cater for local farming needs, if grazing is managed with timber requirements in mind.

10.2 Supporting Services

Irrigation - Irrigation is very important to primary industries in the study area. At the small scale, irrigation is carried on from farm dams and from groundwater reserves. The shattered nature of the traprock and jointing in the granite can cause problems in dam siting and water retention.

Groundwater availability can be classified according to parent rock type. It depends on the depth and porosity of depositional and weathered layers overlying the parent rock.

The only significant areas for groundwater are along the Condamine and Dumaresq Rivers. Bore yields from the Condamine alluvial deposits are usually in the range 8 to 15 l/sec. Water quality is suitable for domestic or stock use but bicarbonate concentrations may make it doubtful for irrigation. On the Dumaresq alluvium, a yield of 15 l/sec would be achieved only at favoured sites. Water quality is variable, depending on position in the flood plain, and occasional areas produce groundwater which is unsuitable for either irrigation or domestic purposes.

There are three major irrigation projects in the study area. While the dam catchments are wholly within the study area boundaries, most of the land on which the stored water is used lies outside.

The Leslie Dam, near Warwick, was completed in 1965 to supply both town water, and water for riparian irrigation along about 200 km of river downstream of the site. The capacity of the dam is 47 million m^3 and this is currently over-committed. A second stage of construction is planned which will increase capacity to 107 million m^3.

The Coolmunda Dam, east of Inglewood, was completed in 1968 to enable tobacco growers to diversify into mixed farming pursuits using irrigation. The storage capacity is 75 million m^3.

Under construction at the moment, the Glenlyon Dam is part of a joint States and Commonwealth project to develop the water resources of the Border Rivers area for agricultural production. It has a planned capacity of 260 million m^3 and its impact will be felt almost 500 km downstream of the dam at Mungindi Weir.

Soil Conservation - Soil conservation measures are recorded as having started in the study area in the early 1950's. Over 7 000 ha of land are protected by soil erosion control measures in the three shires but much more is required. The three shires are scheduled for declaration as Areas of Soil Erosion Hazard by 1978.

Most of the study area's soils are abnormally erosion-prone under cultivation or excessive grazing, and this problem is aggravated by dry seasons and the rabbit population. The most common cultural practices which contribute to severe erosion include summer fallows without stubble mulching, overworking the surface soil, working around paddocks, and up and down slope rows in orchards. Overgrazing of pastures is a predisposing cause of erosion in grazing lands.

For many situations a recommended soil conservation structure is the level contour bank, which is designed to retain the infrequent rainfall receipts on the land and has demonstrated favourable results in the form of improved crop or pasture cover and improved soil workability. A slope of between 1 per cent and 2½ per cent is desirable for banks in horticultural areas. Numerous other soil conservation measures are available and may be more appropriate to an individual farmer's situation. Advice on soil conservation and farm planning is readily available at the Warwick Office of the QDPI.

Research - There are three research stations in or near the study area.

At Applethorpe, the Granite Belt Horticultural Research Station is the centre for all research into fruit and vegetables for the Granite Belt and minor horticultural areas near Warwick and Inglewood. Apples receive most attention and studies are being conducted into close planting, water use, nutrient requirements, disease and breeding of early maturing varieties. Other crops studied include wine grapes, stone fruit, strawberries and tomatoes.

Hermitage Research Station lies east of Warwick and is actually outside the study area. It concentrates on plant breeding and agronomy but livestock studies on pigs, beef cattle and sheep are also carried out. Fauna research and apiculture also form an important part of activities at the station. Although much of the work is oriented towards the grain production of the Darling Downs, studies into grazing crops, pasture grasses and legumes are being conducted which affect the bulk of the study area.

Until recently, the Inglewood Field Station concentrated on tobacco research but is now diversifying, with trial plantings of wine grapes and other horticultural crops. A number of different forms of trickle irrigation is also under trial.

10.3 Agroclimatology

Long-term decision-making on land utilisation for agricultural purposes is dominated by consideration of the prevailing climate. The agroclimatology section of this report attempts to draw attention to optimal climatic regimes and critical climatic parameters for the primary products of the area. Only a selection of topics is covered but it is hoped that this will encourage a flow-on of this type of work.

The major climatic influence affecting livestock production is that of rainfall regime on native pasture growth during months of favourable temperature expectations. The most critical period for pasture growth is considered to be October/November which, if below normal, could frequently be the start of a rainfall deficit spell which affects pasture production for the remainder of the growing season.

Horticultural products are extremely sensitive to variations from an optimal regime. Agroclimatological studies are complex due to the varying importance of different weather factors throughout the growth cycle of each year's crop. For the deciduous fruit industry, quite clearly, the overriding climatic factor is the cool season which usually provides the necessary chilling requirements. Although chilling is not required for vegetables, the lower average temperatures of the Granite Belt mean that heatwaves are not the threat they are in the rest of Queensland. With irrigation, hail and out-of-season frosts are the major threats to horticultural crops.

Wine grapes have been studied in detail and the main hazards to quality production are seen as high temperatures and hail, assuming that irrigation is employed and mildews are controlled.

Grain cropping is not a major industry in the study area. Workers on the Darling Downs are currently engaged in water balance and crop growth modelling and this research should ultimately contribute significantly to an understanding of the climatology of grain crops in the Darling Downs area. The main threats to winter grain crops are excessive rain and humidity around the harvest period. Summer crops experience peak growth at the height of the hail season and hail is therefore their main problem.

Weather modification was attempted in the study area during the mid 1950's when silver iodide rockets were used to disperse hail. Cloud seeding from aircraft is currently the accepted means of either rainfall enhancement or hail suppression. Although it is doubtful that a hail suppression operation would be economic at the moment, there appears to be a potential demand, in the study area, for rainfall enhancement operations. Some factors favour experimentation in this area and the three main dams ensure that additional water would not be wasted.

10.4 Recreation

The study area contains numerous natural and man-made attractions which give it increasing significance as part of Brisbane's recreational hinterland. Its landscapes and climate distinguish it from Brisbane and the Moreton Region, and these are enhanced by man-made features such as lakes, pine forests, farmland and orchards.

Girraween, near Wallangarra, is the only National Park in the area and is a big attraction, with facilities for walkers, campers and picnickers. There are large areas of land throughout the study area, which are relatively untouched. As environmental parks these would accommodate the increasing demand for open-space recreation and the 'wilderness' experience.

Other main attractions are the major lakes at Leslie and Coolmunda. Water sports and picnicking take place there and they are centres for waterfowl populations. Glenlyon Dam will provide more scope for those activities when it fills.

Ideally, an integrated plan for development of open-space recreational possibilities would be desirable to avoid clashes of interest as pressure for recreational land use increases.

References

Rosser, J., Swartz, G.L., Dawson, N.M. and Briggs, H.S. (1974). - A land capability classification for agricultural purposes. *Div. of Land Utilisation Tech. Bull. No. 14,* Qd Dept of Primary Industries, Brisbane.

11 LAND USE AND LAND CAPABILITY IN THE GRANITE AND TRAPROCK AREA

by A.K. Wills

APPENDICES

FIGURES

MAPS

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

11 LAND USE AND LAND CAPABILITY IN THE GRANITE AND TRAPROCK AREA

by A.K. Wills*

11.1 Definitions

The term 'land use' is used here to mean existing land use at a point in time. It is distinct from 'land capability' which is an assessment of a land area's potential for a given purpose, judged according to specified criteria. Unless otherwise stated in this report, land capability refers to agricultural land capability, the classification of which is fully explained in section 11.3.

'Land utilisation' encompasses both of the above concepts and is not necessarily equivalent to 'land use'. In this report, it is taken to mean *land use and trends in land use, viewed in the context of agricultural and other land capabilities.*

In practical terms, an account of land use in an area would be relatively clear cut; but an account of land utilisation for the same area would be longer and complex, incorporating considerable discussion, judgement and areas of uncertainty.

11.2 The Land Use Survey

A land use survey was carried out in 1973-74 by QDPI officers based at Warwick, Stanthorpe and Inglewood. A record of current land use is seen as an essential element in land use planning in the study area. It represents the human factor imposed on the natural landscape and it provides an objective base level or starting point necessary for sound recommendations on any future land use changes.

While this section should be of immediate use to any QDPI officers new to the study area, it will also prove of value to other governmental and semi-governmental bodies, planning authorities, primary producers and educational bodies.

11.2.1 Survey Aim and Methodology

The aim of the survey was to map all land uses in the study area, at a scale and level of generalisation which would highlight significant variations. Agriculture, horticulture, pastures, livestock populations, apiculture and forestry were all included. Mining was excluded as this is already mapped satisfactorily in an earlier publication (Robertson 1972). Neither was recreational land use mapping attempted as suitable techniques for this are still being developed.

Initially, it was hoped that the survey could conform as closely as possible to the methodology used by the Geographic Section of the Commonwealth Department of National Development in 1971. However the finer scale of mapping and a number of minor constraints caused considerable divergence from their techniques. Where possible their rules of thumb on generalisation and aggregation have been used and should permit some degree of comparability between this and other surveys.

The criteria used for mapping are described in Appendix 11.2. It cannot be overstressed that the mapping units and symbols shown on Map 7 are generalisations and refer only to the dominant land uses. Reliability may be assessed by referring to the relevant section of Appendix 11.2.

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* Division of Land Utilisation, Department of Primary Industries.

11.2.2 Patterns of Land Use

The most obvious feature of Map 7 is the concentration of horticultural activities north and south of Stanthorpe. Within this concentration a division is evident between the pomefruits which, with their high winter chilling requirements dominate the higher country north of Stanthorpe, and the stonefruits and grapes which are suited to the slightly warmer conditions and are found mainly on the slopes south of Stanthorpe.

Equally obvious is the dominance of grazing on native pastures over the rest of the study area. This is a reflection of the generally poor soils and rough terrain. The forestry lands and unthinned timbered areas tend to be in the least favoured areas, characterised by either infertile sands and gravels or extremely shallow lithosols on steep, irregular slopes. Only on the major floodplains are any extensive areas of agriculture found; and the minor areas of agriculture and improved pastures which are found elsewhere are usually close to a creek or minor floodplain.

Other points to note are the small patches of tobacco under irrigation, along the Dumaresq River and below Coolmunda Dam, and the stonefruit areas on scrub soils near Warwick.

Intense apiculture is concentrated in the forested area of the Herries Range between Durikai and Mt. Burrabaranga and in the area of undulating, red scrub soils south-west of Warwick. Apiculture is dependent on the availability of a sufficient quantity of suitable flora, particularly tree species; but it is also limited by access for movement of bee-hives, which explains the correlation between roads and some of the patterns of apicultural land use.

The only large area officially set aside for recreational land use is the Girraween National Park north of Wallangarra, although water based activities at the Coolmunda and Leslie Dams are important, as no doubt they will be at the Glenlyon storage.

11.2.3 Trends in Land Use

One of the aims of this survey is to discern trends in land use. Using what information is available comparisons of historical trends have been made for the two major land uses in the study area.

(a) Trends in Livestock Numbers - Eleven years of data (1961/62 to 1971/72, Bureau of Census and Statistics*) were examined for the three complete shires of Stanthorpe, Rosenthal and Inglewood. The results are shown in Fig. 11.1 on following page.

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* Now Australian Bureau of Statistics.

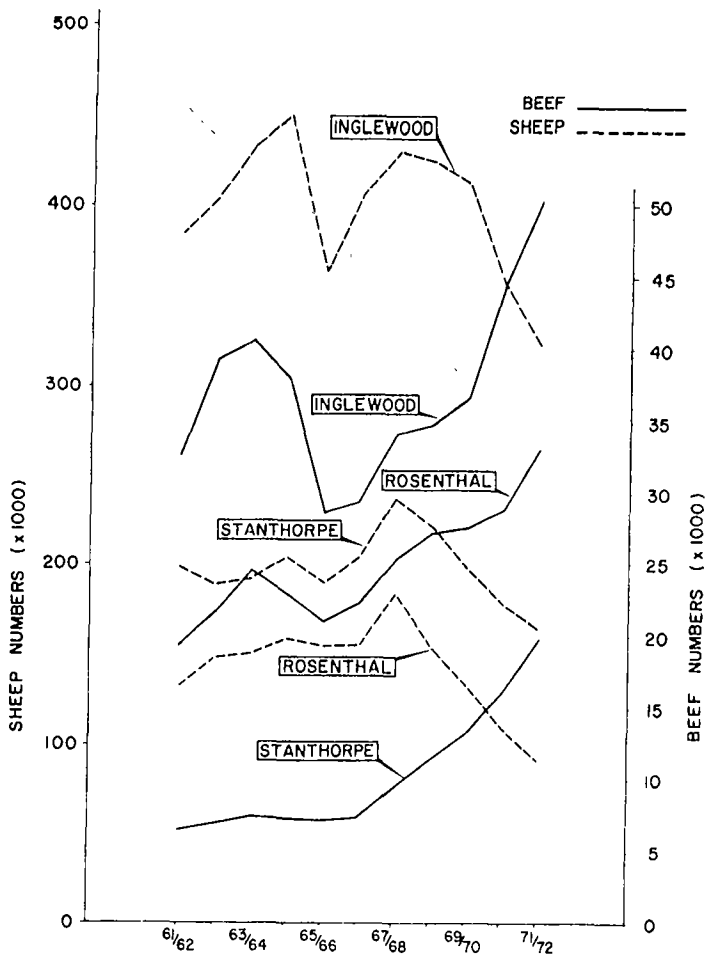

FIG. 11.1 - TRENDS IN LIVESTOCK NUMBERS, 1961/62 TO 1971/72

For the purpose of assessing grazing pressures over time eight sheep are regarded as equivalent to one beef animal.

The most noticeable features on the graphs are the drops in the larger population totals during the drought of 1965/66. This has had a major effect on the highest population levels and a negligible effect on the lowest indicating that high stock numbers had been induced by favourable seasons.

Since then, it appears that sheep numbers were allowed to build up naturally after the drought and then fall away without replacement in the face of a determined effort to build up beef cattle numbers. The transition started around the 1967 period and the shift out of sheep into beef cattle is clear for all three shires.

Overall, there has been a net increase in stocking pressure of the order of 70 to 80 000 DSE (dry sheep equivalent) per shire over the ten year period.

The reasons for these changes are primarily found in changing markets. The 'wool slump' and the 'beef boom' are extensively documented elsewhere and this change of emphasis between sheep and beef cattle may well continue in response to market fluctuations.

One factor favouring beef cattle over sheep is the relatively lower labour component associated with beef production.

(b) Trends in Horticultural Land Use - Although there are small areas of orchards and vines around Inglewood and Warwick, this section will deal solely with the Granite Belt as the only fruit growing area of substance within the study area at present.

A previous survey of land utilisation in the Granite Belt was examined (Birtles 1960) and, allowing for differences in scale of mapping, no major land use change was noted over the intervening thirteen years. Only in the area east and west of the State Forest between Amiens and Bapaume does there appear to have been a slight tendency to go from pome to stone fruits. Other classifications have remained static in their locations as shown on Map 7.

In more recent years, trends in aggregate areas (Bureau of Census and Statistics, 1963-73) show a marked decline in non-bearing pome fruits (new plantings), although the areas of pome fruit in bearing still increase, indicating that old trees are not being uprooted at the same rate as new planting. (See Fig. 11.2 below.) The only other points of note are the slow but steady increase in stone fruit and grape areas and the steady rate of replanting (non-bearing stone fruit and grapes).

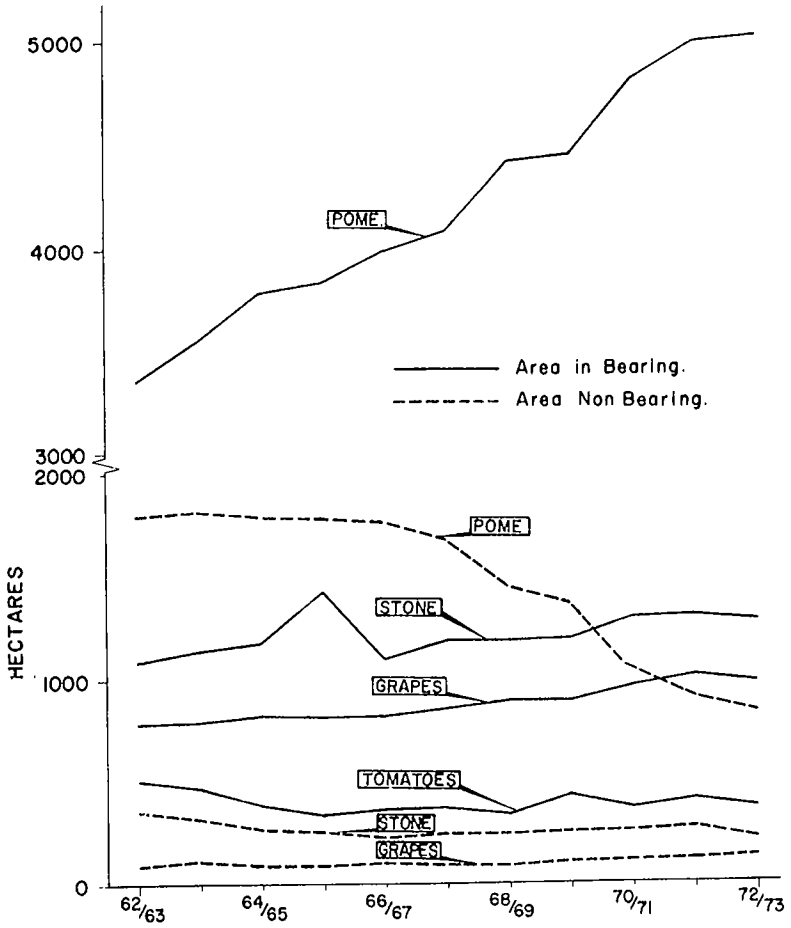

FIG. 11.2 - TRENDS IN AREAS OF SELECTED HORTICULTURAL CROPS, 1963 TO 1973

11.3 Land Capability

The concept of land capability is fundamental to rational land use planning. It is the realisation that a given area of land has a recognizable limit to its potential. Given a fixed state of technology and a land use aim, for example, agriculture, recreation or urbanisation, an upper limit to the intensity of land use can be derived from an assessment of a number of relevant limiting factors.

For the purposes of this report, the main land use aim is assumed to be that of dryland agriculture including animal production. For irrigation farming, some adjustment to the classification will be necessary, although land capability units should usually retain their relativity. In the case of the horticultural land uses of the Granite Belt, the overriding importance of the climate and the small scale or detailed nature of the cultivation operations make the classification, for these purposes, inappropriate to some degree. For recreational land use or other non-agricultural use, the classification can only be of general assistance, insofar as the activity is sensitive to land surface characteristics, e.g. flat land for camping, stable soils for building, rugged terrain for scenery, etc.

The basic text for this work is that of Rosser *et al.* (1974) which is the land capability classification adopted as standard and used by DLU. This is adapted from the classification used by the United States Department of Agriculture and has eight basic classes. The descriptions of each of these classes and a table of the fourteen limitations, and their descriptions are given in Appendix 11.2. This classification system has been developed primarily for arable land.

11.3.1 Methodology and Mapping

Land capability assessment was carried out as a routine part of the field survey work which resulted in the Land Systems map (Map 1). At each site visited, an assessment of the limiting factors was made, and quantified where possible, by the principal author and by other QDPI officers who were present. A consensus evaluation was recorded. Following definition of land unit characteristics a modal land capability class was assigned to each land unit.

This approach has resulted in a number of intermediate land classes, such as II-III, VI-VII, etc. It is also the reason why the limiting factor abbreviations, given in the land unit descriptions of Section 3.2.3 are not graded numerically, as described in Appendix 11.2. Such gradings are only appropriate to farm planning and not to broad scale mapping as attempted here.

Map 8 is the result of aggregating all land units of the same modal land capability class and adjusting boundary lines to suit the reduction from the original mapping scale of 1:126 720. Fig. 11.3 opposite is a further reduced and simplified map of the study area showing the three main classes of land - land with negligible direct agricultural value, land for grazing only and land with some cultivation potential. It is estimated for the latter category that only some 30 per cent of its area could be cultivated safely.

II to IV-VI (land with some cultivation potential)

VI to VII-VIII (grazing land)

VIII (land with negligible direct agricultural value)

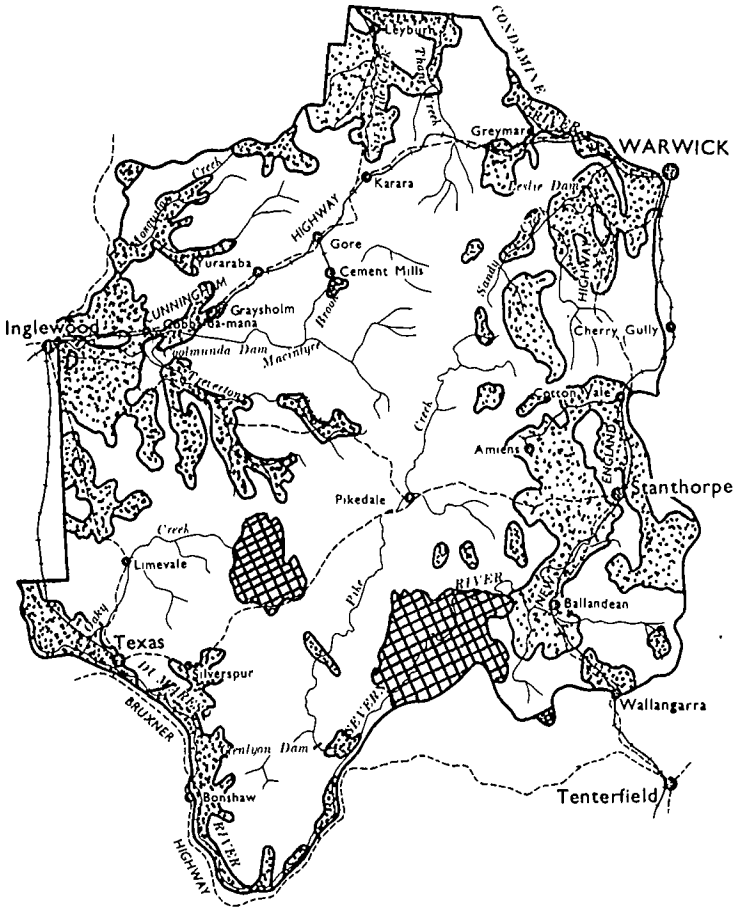

FIG. 11.3 - SIMPLIFIED LAND CAPABILITY

11.3.2 Patterns of Land Capability

The intention of this section is to highlight and explain the main variations in land capability within the study area.

Starting with the Class II land, it is concentrated mainly on the floodplains of the Condamine River, Canal Creek, Canning Creek and Macintyre Brook. The only restrictions on cultivation are occasional wetness and flooding.

The Class II-III areas are mainly on the Dumaresq floodplain with a few minor alluvial strips along Oakey, Nanny and Bracker Creeks. These areas are also prone to flooding but the erodible surface structure of the soils combined with some relief make them slightly erosion prone and they are therefore downgraded. Short alluvial strips, in the depressions of Washpool and Ironpot LSs, have equivalent limitations and may also be restricted by effective soil depth, the lower layers of granite-derived alluvium often being severely compacted.

Class III country is similar in its limitations to the previous category. Erosion risk is the main limitation arising out of slightly steeper slopes, long slopes which allow runoff to concentrate, and poorly structured surface soil. The main areas are north-east of Stanthorpe, east-north-east of Inglewood and along a number of watercourses.

The main units of Class III-IV are in the Eukey and Ironpot LSs but substantial areas are found in other parts of the study area. Surface structure and length or degree of slope are again the most common limitations, but most of this class of land has further limitations such as stoniness or risk of flash flooding. An added limitation in granitic areas is rock outcrop.

The main Class IV unit lies north of Stanthorpe, with smaller areas scattered throughout the southern two-thirds of the study area. Erosion risk due to poor surface structure is again the major limitation, but stoniness and soil depth are also significant.

Class IV-VI is the last unit in which there is any chance of successful cultivation which is confined to the small pockets of Class IV land, where large scale ('broad acre') farming is not practicable. The special conditions of irrigation and intensive husbandry of horticultural crops permit the utilisation of relatively small areas within a region of largely Class VI land. This tends to be a special case in the land capability classification system. At the mapping scale employed it is not feasible to map out these small areas and hence the joint classification of IV-VI is employed. These areas are in the stone fruit and vine growing areas of the Granite Belt and on the sandstone derived soils east and south-east of Leyburn, with other areas near Warwick, Wallangarra, Warroo and Limevale. The main hazard is again erosion through poor soil structure, but occasionally complicated by long slopes, and location relative to steeper land units which discharge concentrated runoff on to these lower units. Soil depth, stoniness and poor moisture holding characteristics are also limitations in some areas. Flooding, stoniness and gilgai formation account for pockets of Class V land but these are too small to map out individually.

Class VI land is found in the sandstone country north of Coolmunda. This is the better class of grazing land and is limited by the erosion potential of its shallow, stony, poorly structured soils. The lower grazing Classes VI-VII, VII and VII-VIII are successively more restricted for, mainly, the same reasons. The major units of these classes are somewhat arbitrarily divided on the map, due to the

application of the modal land capability class value. Those main delineations may best be regarded as transition zones, and the areas as complexes of land facets producing a modal land classification value as shown.

The final Class VIII category refers to only three areas which have negligible potential for agricultural purposes. The land is inaccessible and rugged but each unit is in the headwaters of important water supply catchments. The vegetation therefore should be preserved to maintain water quality and a further appropriate and compatible use for these areas would be as national parks, environmental parks or wildlife reserves.

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APPENDIX 11.1

METHODOLOGY USED IN MAPPING LAND USE FOR THE GRANITE AND TRAPROCK AREA

The criteria used for mapping the different forms of land use are described below in the order in which they appear in the map legend.

Livestock - Raw data were extracted from Stock Returns for 1st January, 1972. Livestock numbers were then related to block descriptions on a 1:126 720 scale land tenure map. Certain gaps and anomalies due to absence of or inaccuracies in Stock Returns were resolved in consultation with informed QDPI officers. The values for each sheep and beef cattle symbol were selected to correspond to a simple conversion ratio of .8:1 so that a broad visual indication of variation in grazing pressure over the area would result. Due to reduction to the final scale, aggregation of balance livestock figures between blocks and inaccuracies inherent in the raw data, the mapped livestock figures should not be used to infer stocking levels for individual properties. The livestock symbols have to be viewed as a distribution to demonstrate broadscale spatial variation, and each individual symbol can only be approximate in location and in value.

The inset map showing relative dominance of sheep to beef cattle is based on Stock Return figures and the conversion ratio of 8:1. Dominance of sheep or beef is indicated if one or other has more than two-thirds of the converted total of livestock units. This gives two dominant categories and one mixed. Another category of 'insignificant stocking' is included where livestock data are low and scattered in areas of mainly non-pastoral land uses.

Apiculture - A survey of beekeepers was conducted by Fauna Conservation Branch during 1973/74. This provided a unique opportunity to map land use with respect to apiculture. Beekeepers were asked to indicate, on 1:63 360 scale land tenure maps, where they located their hives and, on questionnaire forms, to state the average number of hives and the average duration in months per year that they were at each location. A value of 'hive•months' was then calculated for each location (number of hives x number of months) and the location ringed by a 1.61 km radius circle, this being considered the mean radius of activity of a bee around its hive. A number of these circles overlapped to form aggregates. Finally the areas of all such aggregations or single circles were measured. This provided the figures necessary to calculate an intensity value for apicultural land use, and the most convenient unit transpired as *hive•months/km*^{2}. These values fell into five grades of intensity and this formed the basis for the mapping of apicultural land use.

Forestry - Areas under the control of the Queensland Department of Forestry were copied directly from their map of South East Queensland showing Areas under Forestry Control, 30 June 1971. This was checked for currency at Forestry Department in mid 1974.

Grazing Land and Agricultural Crops - Areas of lucerne or sown pastures and agricultural crops have been delineated by officers of Agriculture Branch at Warwick and Inglewood. The mapping units indicate areas where the particular activity is concentrated and they do not imply that the whole area is covered in that particular crop.

The balance area is classed as timbered grazing land or thinned timber. This is a very generalized break-up since the boundary is usually quite diffuse. Hence the broken line used to distinguish these two classes of timbered country.

Horticulture - This part of the survey was carried out mainly by Horticulture Branch officers at Stanthorpe, although tobacco areas and western grape areas were delineated by Agriculture Branch officers at Inglewood. To achieve a comprehensible map of the different horticultural crop activities on the Granite Belt, it was first necessary to decide on what were the typical crop combinations found there. The six categories shown (excluding tobacco) were those finally decided upon, and the few striped mapping units found on the land use map were the less common combinations to which it would have been inappropriate to allot a separate colour.

Dominance was again assessed, as in the case of the livestock inset map, on the basis of over two-thirds of the area planted to one class of horticultural crop or crop combination. However, the legend has to be explained further in that 'pome fruit' can normally be disaggregated into about 90 per cent apples and 10 per cent pears, while 'stone fruit' is understood to imply over two-thirds of an area occupied by peaches and plums. In future years it may be necessary to distinguish between table and wine grape areas.

APPENDIX 11.2

LAND CAPABILITY CLASSES AND LAND USE LIMITING FACTORS, EXTRACTED FROM ROSSER *et al.* (1974)

CLASSES

The classification contains eight classes based on a decreasing adaptability and freedom of choice of uses.

Class I - Land suitable for all agricultural and pastoral uses.

(a) It is suited to a wide range of crops and is highly productive.

(b) It presents no limitations to use of machinery or choice of implements.

(c) Wind and water erosion hazard is low even under intensive cultivation.

Class II - Land suitable for all agricultural uses but with slight restrictions to use for cultivation in one or more of the following categories:

(a) Land with some limitation to the choice of crops and/or slight restrictions to productivity.

(b) Land with some impediment to the use of cultivation machinery which limits the choice of implements or restricts the conditions for successful operation.

(c) Land which under cultivation requires simple conservation practices to reduce soil loss to an acceptable level. (Simple practices include contour working, strip cropping, stubble mulching.)

Class III - Land suitable for all agricultural uses but with moderate restrictions to use for cultivation in one or more of the following categories:

(a) Land with moderate limitation to the choice of crops and/or moderate restrictions to productivity.

(b) Land with moderate impediment to use of cultivation machinery which limits the choice of implements or restricts the condition for successful operation.

(c) Land which under cultivation requires intensive conservation practices to reduce soil loss to an acceptable level*. (Intensive conservation practices include contour banking systems and intensive residue management involving specialised implements.)

* The interim standard adopted in Queensland is a maximum loss of 12.5 tonnes per hectare (5 tonne/acre/annum). This is equivalent to an annual loss of 1.5 mm depth of soil.

Class IV - Land primarily suited to pastoral use but which may be safely used for occasional cultivation with careful management. Limitations arise from one of the following categories:

(a) Land on which the choice of crops is severely restricted and/or conditions are such that productivity under cropping is severely limited.

(b) Land with severe impediment to the use of cultivation machinery which limits the choice of implements or severely restricts the conditions for successful operation.

(c) Land which cannot be used safely for permanent cultivation. (If cropped, a pasture phase must be the major component in the cropping programme to limit soil loss to an acceptable level.)

Class V - Land which in all other characteristics would be arable but has limitations which, unless removed, make cultivation impractical and/or uneconomic. (Limitations are usually g, r, f or w.)

Class VI - Land which is not suitable for cultivation but is well suited to pastoral use and on which pasture improvement involving the use of machinery is practicable.

Class VII - Land which is not suitable for cultivation but on which pastoral use is possible only with careful management. Pasture improvement involving the use of machinery is not practicable.

Class VIII - Land which has such severe limitations that it is unsuited for either cultivation or grazing.

NOTATION

The classification is recorded as a formula indicating the limiting factors present and the degree of limitations attributable to each factor. For example, if surface microrelief is a limiting factor to the extent that all use of machinery for cropping is impracticable this is recorded as Class Vg5 the subscript g5 denoting that the land is placed in Class V on the basis of limitation g.

All limiting factors are shown so that those not mentioned can be assumed to be absent; e.g., III d3e2 is interpreted as (a) Class III due to limiting effective soil depth 'd'; (b) susceptibility to rainfall erosion 'e' is also present and would place the land in Class II if this were the only limiting factor present; and (c) the twelve other possible limiting factors listed in Appendix 11.3 are of no consequence.

In most cases the most severe limiting factor will determine the class, but a combination of factors might indicate a class more restrictive than indicated by any one limitation, e.g., d3r3 (where 'r' is the limitation due to rockiness) could be classified as Class IV at the discretion of the planner.

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES LAND CAPABILITY CLASSIFICATION FOR AGRICULTURE (BASED ON MAINTENANCE OF LONG TERM AGRICULTURAL PRODUCTIVITY (JULY 1974))

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
FACTORS LIMITING CHOICE OF CROPS OR CROP PRODUCTIVITY	Climatic limitation other than rainfall 'c'	Slight restriction to choice of crops or slightly restricted production potential.	c2
		Moderate restriction to choice of crops or moderately restricted production potential.	c3
		Severely restricted choice of crops and severely reduced production potential.	c4
		Climatic limitation too severe to allow cropping.	c6
	Moisture availability for crop growth 'm'	Occasional limitation to crop production; 7-8 crops possible in 10 years.	m2
		Regular limitation to crop production; 5-7 crops possible in 10 years.	m3
		Occasional cropping possible. Less than 5 crops possible in 10 years.	m4
		Moisture availability too unreliable to allow cropping.	m6
	Effective soil depth 'd'	Effective soil depth > 60 cm.	d2
		Effective soil depth 45 - 60 cm.	d3
		Effective soil depth 25 - 45 cm.	d4
		Effective soil depth < 25 cm.	d6
	Soil physical factors affecting crop growth 'p'	Degree of limitation imposed on crop production from soil physical factors affecting the growth of crop plants e.g. surface crusting, hard pans, cementation etc.	
		Slight restriction.	p2
		Moderate restriction.	p3
		Severe restriction.	p4
	Soil nutrient fertility 'n'	Moderate deficiencies which may be economically corrected with careful management.	n2
		Severe deficiencies, difficult to correct and which require special management practices.	n3
		Very low fertility; continuous cultivation precluded by structural decline.	n4

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
FACTORS LIMITING CHOICE OF CROPS OR CROP PRODUCTIVITY	Soil salinity or sodicity 's'	Soil water availability slightly restricted or slight structural decay affecting crop production.	s2
		Soil water availability moderately restricted or moderate structural decay with some toxic effect on crops.	s3
		Soil water availability severely restricted or severe structural decay with moderate to severe toxicity.	s4
		Salinity or alkalinity too severe for crops. Tolerant improved species available.	s6
		Salinity or alkalinity too severe for pasture improvement; tolerant herbage available.	s7
		Bare salt pan; not practical to vegetate.	s8
FACTORS LIMITING THE USE OF AGRICULTURAL MACHINERY	Topography 't'	Severe relief or major gullies preclude contour cultivation. Occasional cropping possible.	t4
		Slopes 15 - 20% or severe relief or gullying preventing cultivation.	t6
		Slopes 20 - 45% or extreme gullying but accessible to grazing animals.	t7
		Slopes on topography too severe to grazing animals.	t8
	Soil workability 'k'	Soil properties affecting machinery and thus reducing average production potential e.g. stiff clay, columnar structure, compaction, narrow moisture range for working.	
		Slight restriction.	k2
		Moderate restriction.	k3
		Severe restriction.	k4

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
FACTORS LIMITING THE USE OF AGRICULTURAL MACHINERY	Rockiness or stoniness 'r'	Tillage restricted with some types of machinery.	r2
		Tillage restricted with most types of machinery.	r3
		Tillage difficult with all machinery; occasional use possible.	r4
		Use of all machinery for cropping impractical.	r5
	Surface microrelief gilgai and gullying 'g'	Tillage restricted with some types of machinery.	g2
		Tillage restricted with most types of machinery.	g3
		Tillage difficult with all machinery; occasional use possible.	g4
		Use of all machinery for cropping impractical.	g5
	Wetness 'w'	Use of implements delayed occasionally and slightly reduced production potential.	w2
		Use of implements delayed regularly and moderately reduced production potential.	w3
		Use of implements very difficult and occasional crops only possible.	w4
		Permanently wet; cultivation impractical.	w5
FACTORS CONTROLLING LAND DETERIORATION	Susceptibility to water erosion 'e'	Simple practices required to reduce water erosion under cultivation to the acceptable level.	e2
		Intensive practices required to reduce water erosion under cultivation to the acceptable level.	e3
		Requires inclusion of a pasture phase to reduce average water erosion losses to the acceptable level.	e4
		Continuous pasture required to reduce water erosion losses to the acceptable level.	e6
		Special practices or grazing restrictions required to reduce water erosion losses to the acceptable level.	e7
		Under grazing water erosion losses are in excess of the acceptable level.	e8

Type of Limitation	Limiting Factor	Degree of Limitation	Sub-Class
	Susceptibility to flooding 'f'	Subject to occasional overflow flooding.	f2
		Subject to regular overflow flooding.	f3
		Subject to severe overflow flooding; permanent cultivation not possible.	f4
		Flood frequency and/or severity precludes any cropping.	f5
	Susceptibility to wind erosion 'a'	Slightly susceptible to wind erosion.	a2
		Moderately susceptible to wind erosion.	a3
		Severely susceptible to wind erosion.	a4
		Potential for wind erosion too severe to allow cropping.	a6-8

12 PRIMARY PRODUCTION IN THE GRANITE AND TRAPROCK AREA

1 *Beef Cattle Husbandry Branch, QDPI, Goondiwindi*

2 *Beef Cattle Husbandry Branch, QDPI, Toowoomba*

3 *Dairy Cattle Husbandry Branch, QDPI, Toowoomba*

4 *Horticulture Branch, QDPI, Applethorpe*

5 *Horticulture Branch, QDPI, Stanthorpe*

6 *Agriculture Branch, QDPI, Whetstone Field Station*

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

7 Agriculture Branch, QDPI, Warwick
8 Agriculture Branch, QDPI, Inglewood
9 Entomology Branch, QDPI, Brisbane
10 Entomology Branch, QDPI, Warwick
11 Development Planning Branch, QDPI, Brisbane
12 Queensland Geological Survey, Department of Mines

TABLES

13 Soil Conservation Branch, QDPI, Warwick (now Ipswich).

Page

TABLES (continued)

FIGURES

MAPS

12.1 Sheep and Wool

Sheep have been grazed throughout the Granite and Traprock area for over a century. The traprock country in particular is commonly regarded as 'sheep country' and the opportunities for diversification into other forms of primary production have proved few.

Successful sheep husbandry depends on an understanding of livestock and their needs, and also upon an intimate knowledge of the environment. Thus, most successfully run properties are in the hands of third or fourth generation owners or managers. These have extensive improved areas, the results of early timber clearing, and can sustain breeding enterprises.

Internal parasites are the main problem in the higher rainfall parts of the study area, while nutrition is the problem in the areas of lower rainfall. Of external parasites, the blow-fly affects the whole study area and, in abnormally wet seasons, blow-fly waves can repeatedly harass flocks. The recent introduction of mulesing when the lambs are marked will give added protection to those treated weaners during their most vulnerable stage.

Stocking rates depend on feed available, which is a function of rainfall and property improvement. Harsh dry winters with successions of heavy frosts can cut feed quality back until sheep are not able to maintain body condition. They thus lose live body weight, until spring or summer rains revive pastures.

Lack of winter protein has forced growers to consider winter supplementation to maintain the highest possible stocking rates, yet still keep stock in a strong, sound condition. Breeding sheep and young sheep are particularly prone to loss of condition. Three forms of supplementation may be employed by growers - protein licks, grain or hay supplements and pasture supplementation. Trial work and research are still required in this field.

12.1.1 Background

The industry is described by local authority areas and comparison is made with other wool-producing areas.

(i) Inglewood Shire - Most of the flocks are run on the traprock and shallow solodic soils of the eastern part. Thus, much of what is said here applies to the Inglewood part of the study area. Wool production is the main aim but breeding assumes greater significance in the more developed areas or on the brigalow country and alluvial areas.

Most property sizes lie between 1 600 and 3 600 hectares with stocking rates varying between 1 DSE:0.8 ha on undeveloped traprock to 1 DSE:0.4 ha or better, on improved brigalow or alluvials. Sheep are run mainly on native pasture, but lucerne, oats or protein licks are used as supplements.

Lamb marking percentages vary from 85 per cent on better country to 60 or 65 per cent on marginal breeding country. The average weight of a fleece is between 3.8 and 4.0 kg greasy. The traprock soils generally produce lighter wool weights, of good quality tending towards fineness, in comparison to the better soils where fleeces tend to be heavier but carry vegetation faults and dust.

(ii) Stanthorpe Shire - The average weight of fleece over the period 1963 to 1970 increased slightly from 4.0 to 4.2 kg greasy. Over the same period, lambing percentages varied around the 76 per cent mark although severe drought in 1965/66 caused a drop to 50 per cent in that year. A QDPI survey of 22 growers in 1969 indicated that sheep numbers had increased from an average flock size of 3,875 sheep per holding in 1959, to 4,700 sheep per holding in 1969. Improved pastures affect wool production mainly through allowing increases in stocking rates. At trials around Texas and Karara, fleece weights were unaffected; but at Karara, the percentage of skirtings increased significantly.

Informed estimates of potential stocking rate increases, by establishing improved pastures on ringbarked country, are of the order of 500 per cent on granite country, above 750 mm mean annual rainfall, and 300 per cent below this limit. On traprock, an increase is considered unlikely as sown pasture performance has been poor to date.

Worms are a continual problem, especially in young sheep, and their severity varies with seasonal conditions. Routine drenching is the only answer. Blow-flies are also greatly influenced by the weather, and therefore vary in their impact from season to season (see section 13.1). Lice can be a further problem, if annual dippings at shearing time and dipping of newly-purchased sheep are not carried out.

Pregnancy diseases in breeding flocks are best avoided by carefully organizing a supply of quality feed in late pregnancy.

The main predator is the fox and this is best controlled by poisoning campaigns just prior to the lambing season. Native predators are of only minor importance.

Rockfern *(Cheilanthes sieberi)* is the main poisonous plant threat. This is usually the first green feed available after a dry season. Only hungry sheep will eat rockfern and the results can be fatal.

(iii) Rosenthal Shire - There are only about eight livestock enterprises in Rosenthal Shire which specialize in wool production. They are located in areas where supplementary feed cannot be grown and property development is restricted to timber thinning.

The major form of enterprise on the traprock and the drier granite and sandstone country, has been sheep and beef cattle with the former numerically dominant. Trends in recent years have tended to reverse this situation and it is quite clear that, in terms of animal equivalents, beef cattle are dominant in the Shire.

Development has centred around fodder cropping followed by lucerne, the former being used mainly to fatten cattle and the latter used as a strategic protein supplement for breeding sheep and cattle.

The average weight of fleece over the period 1961 to 1969 increased from 3.8 to 4.1 kg greasy. Over the same period, lambing percentages increased from 70 to 76 per cent with a drop to 64 per cent after the 1965/66 drought.

A QDPI survey showed that average flock sizes increased from 1,700 in 1959 to 1,900 in 1969 on traprock properties. On granite, the comparable figures were 3,000 and 3,300 respectively.

(iv) Regional Comparisons - The study area is classified as part of Australia's wheat-sheep zone, although it is slightly atypical. Most properties in this zone also produce cereals and run beef cattle, but in the study area, very little cereal cropping is possible due to lack of suitable land. The Queensland sub-zone is largely the Darling Downs and 1.4 per cent of Australia's sheep numbers are found here (as at 31 March, 1969). This compares with 10.2 per cent in Queensland's pastoral zone (Lawrence, 1971). It is estimated that the study area contains about 0.5 per cent of Australia's sheep and 4 per cent of Queensland's total.

Flock sizes - Figures of sheep carried per property are considerably higher than the average for Australia's wheat-sheep zone as a whole. In 1969/70, 1,650 sheep was the mean, compared to figures given above, which range from 1,900 to 4,700 sheep per property.

Wool cut - Figures for the study area are consistently around 0.2 kg per head below the mean figures for the entire wheat-sheep zone. Higher wool prices tend to compensate for this and consignments of wool from the study area frequently top the Brisbane wool sales.

Lambs marked - Although directly comparable figures are not available, it appears that lamb marking percentages for the study area are close to those for the whole wheat-sheep zone, namely around 75 per cent.

12.1.2 Land Use

The swing away from wool and into beef production, which started in the mid sixties, has tended to continue. In a recent article, Hoogvliet (1973) describes how wool producers have adjusted to a changing economic and technical environment by diversifying into cropping and beef enterprises. This trend has been evident in the study area and is discussed in section 11.2.3.

The aspect of land use called into question is the effect of these changes on grazing pressure and therefore on the maintenance of a stable land surface. Numerous factors complicate the issue, including:

(i) the pre-existing condition of the land surface, some areas being more eroded or exposed than others

(ii) the different grazing habits of sheep and cattle and the net effect of different proportions of them in the grazing population

(iii) whether they graze together or separately and, if the latter, the manner in which they are separated, as it affects pasture stands

(iv) the lack of explicit soil conservation guidelines on soil loss tolerance, minimum cover and maximum stocking rates for grazing lands

As Wills and Lloyd (1973) state, 'In the sheep-cattle grazing system it is neither logical nor practical to ignore important interactions between the sheep, the cattle and the pasture ... Production of sheep product depends directly on the number of sheep grazed, the time of year and the rate of pasture consumption by the sheep. However, since the sheep and cattle share the pasture, it also depends indirectly on the number of cattle grazed and the rate of consumption of pasture by cattle and the effects of this grazing on pasture production and composition within the same time period.'

In their study of sheep-cattle combinations they conclude that:

(i) due to the different grazing preferences, increased pasture utilisation is attained. This is recognized in the fact that, in southern Australia, graziers run cattle to control rank pasture growth and eat some of the species undesirable to sheep

(ii) grazing pressure, defined as the ratio of livestock feed requirements to feed available, increases and reduces the benefit of the increased pasture utilisation mentioned in (i)

(iii) sheep and beef cattle do not compete for labour during some periods of the year

These add up to the conclusion that the substitution rate between sheep and cattle, with respect to pasture, is not constant and this constitutes a major difficulty in determining the optimum combination. Although Wills and Lloyd are referring to an economic optimum, their conclusion applies equally to optimal conservation of the land resource.

12.1.3 Economics and Marketing

Both these topics are dealt with in detail in section 14. Comment here is confined to general discussion of some of the main problems affecting wool producers. They can be summed up in the one word - uncertainty. This breaks down into a number of areas.

Primarily, there is the uncertainty associated with demand levels for wool and the consequent prices received at auction. Even at the best of times, the auction system is steeped in uncertainty but recent wild fluctuations in the world market have resulted in the establishment of the Australian Wool Corporation and a 'floor price' for wool which ensures a degree of stability for graziers' receipts. The outlook for wool is one of cautious optimism over the long term, particularly when the dependence of synthetics on petro-chemicals is considered.

The physical environment is the other major area of uncertainty, particularly the vagaries of the weather. Drought is the main weather hazard and efficiency measures for the 1965/66 drought period show, quite clearly, the effect drought can have on production and ultimately on graziers' incomes.

Although nothing is yet possible in the weather modification field to end droughts, recent availability of percentile analyses of rainfall records (Robinson and Mawson 1975) means that farmers can at least obtain an objective idea of climatic risk. A major development on the horizon is the likelihood that reliable long range weather forecasting could be a fact within a decade or two. This carried enormous implications for all forms of agriculture and would significantly reduce risk and uncertainty.

An additional uncertainty factor applies to wool growers who have diversified into beef production. McKay (1973) points out that pastoralists who have gone into beef, to take advantage of (until recently) the relative price differential against wool, are likely to suffer increased variability of

property income, because cattle are more susceptible to variability and extremes of climate. Although he refers to the pastoral zone, as defined by Lawrence (1971), it is considered that the study area is to a large degree similar to the pastoral zone in this respect.

12.1.4 Trends and the Future

At time of writing, the wool industry, in common with most rural industry, is still assimilating the direct and indirect effects of world inflation and the energy crisis. Looking beyond the immediate phase of *ad hoc* adjustments, it is reasonable to be cautiously optimistic about the future for wool. Improvements in marketing techniques, such as the classing of wool for sale by objective measurement, and advances in agrostology and sheep husbandry should improve efficiency, while synthetic materials will possibly become less competitive.

For wool growers in the study area, one problem will become increasingly evident in the not too distant future. This is the problem of soil erosion, loss of pasture cover and general deterioration of the land resource. There are already many areas of cleared country which show evidence of erosion in the form of sheet erosion, gullying and scalds. Other parts have regrown a dense shrub layer with little or no pasture cover. This must eventually be reflected in declining productivity and the only way to come to grips with this situation is for farm managers to recognize the limitations of the land and plan for sustained productivity, based on sound land use principles, and rehabilitation where necessary.

Recognizing this, it is inadvisable that sheep numbers increase significantly in the future, although some individual properties may still have unrealised potential.

Another aspect to be considered is the fact that the study area largely consists of three major dam catchments. Any jump in grazing pressure would be reflected in increased siltation rates, a drop in water quality and possibly even contamination.

It would be preferable for graziers in the study area to concentrate on eliminating variability of income rather than on intensification of grazing enterprises beyond the capability of the land resources. The present state of the land surface is far from stable and it is in nobody's interest to let it deteriorate further. Ways in which income can be boosted include (i) possible diversification (ii) buying neighbouring blocks or (iii) catering for tourists' recreational needs. The latter has proved a lucrative sideline for farmers overseas and more information on this is found in section 15.2.

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12.2 Beef Cattle

For the purpose of this section the area can be divided into two broad land types. The granite country, running along the Dividing Range into Queensland, extends from Wallangarra in the south to Dalveen on the range and then in a north westerly direction in a lobe extending into Rosenthal Shire to Greymare some 30 km west of Warwick. The granite country extends in a belt about 15-25 km west of the Dividing Range in the Stanthorpe Shire where it runs out into traprock. All told there is an estimated 1970 square kilometres, including small areas of traprock and sandstone country.

The traprock is the second land type in the area. It is by far the bigger area, taking in the major portion of the study area. In all, the traprock comprises an estimated 6 680 square kilometres.

Included in the granite and traprock lands are small areas of sandy soils on the western fringes of the area (Canal, Devine, Bundella and Magee LSs) and also small but important alluvials along the frontages to some of the streams in the area, principally the Severn, Dumaresq and Condamine Rivers, Bracker and Canal Creeks, and the Macintyre Brook. With the exception of these alluvials the soils are shallow, infertile and poorly productive in their natural state.

12.2.1 The Granite Belt

This area has a widely differing suitability for pasture improvement, rainfall and altitude being major determinants. The higher areas along the top of the range receive more rain than the western edge of the granite. This wetter area is well suited to pasture improvement involving heavy applications of superphosphate and sowing of pasture species, principally medics, with some grass species such as fescue and lotus majors. On the drier areas, pasture improvement possibilities are limited to the growing of grazing stands of lucerne on small pockets of suitable land.

This differing suitability for pasture improvement is a major factor to bear in mind when considering granite belt properties. The discussion will therefore be in terms of 'wetter' and 'drier' areas. The borderline is about the 840 m altitude level. In broad terms, the 'wetter' area lies east of the New England Highway and therefore coincides approximately with the Norman (eastern unit) Eukey and Summit LSs. The 'drier' part of the area includes Evandale, Ironpot, Washpool, Pikedale (northern unit), Magnus, Severn, Norman (western unit), and Roberts LSs.

Much of the information also refers to a hypothetical 'typical property' which is thought to be about the average of its class, in size, development, management and so on.

(a) General - (i) Property sizes - on the wetter areas, properties range from 300 to 1 800 ha with a typical size of 1 400 ha. The size range in the drier areas is from 800 to 2 000 ha with a typical size of 1 600 ha.

(ii) Carrying capacity - where cattle only are run, the properties at their present stages of development run approximately 1 beast to 3.2 ha in wet country and 1 beast to 5.7 ha on drier country. This represents a capacity of about 440 head on the typical wetter block and 280 head on the drier block.

(iii) Stock waters - almost without exception, all the granite area is well supplied with stock water mostly from surface sources. No problems are experienced such as stock bogging in dams, or long distances between feed and water.

(b) Development - (i) Tillable area - this term includes areas which have been cleared sufficiently to allow minimum tillage implements (such as sod seeders) to be used for pasture improvement work. The range of areas available is from nil to 120 ha and a typical property has about 80 ha.

(ii) Pasture improvement - areas range from 40 to 240 ha. The improvement may be carried out by either removing all timber with machinery, minimal cultivation, then sowing, etc, resulting in relatively rapid establishment; or alternatively, if finance is limiting timber may be merely killed with a herbicide and the seed and super aerially sown. The big disadvantage of the second method is the much longer period before maximum production is achieved because of slower establishment.

Results of pasture improvement work in the drier areas have been quite disappointing. Low fertility and long intervals between effective falls of rain are possibly the most important limiting factors.

(iii) Fodder crops - there is a tendency to grow less fodder crops in the wetter areas. Improved pastures provide a preferable source of feed, being available longer, cheaper to produce and less hazardous in terms of soil erosion.

(iv) Irrigation - is restricted to some small areas.

(v) Fertilizers - application of superphosphate is common, being essential for pasture improvement. The rate of application is generally about 125 kg per ha annually with heavier applications in the wetter areas.

(vi) Timber treatment - usually timber treatment is a regular feature of property programmes. Approximately one third to two-thirds of a property might still be green timber. After clearing the biggest problem is to control regrowth. Cost of treatment varies but the following is a typical breakdown of costs:-

* Herbicide treatment $15-$30 per ha or ringbarking $25-$30 per ha. Herbicide treatment will probably need retreatment after about 5-6 years. Ringbarked country will need treatment again after 8 years. Pasture sowing will cost a minimum of $25 per ha for clover seed, 100 kg of super and aerial spreading.

* The common treatment is with picloram, marketed under the trade name of Tordon.

(vii) Valuation - the range of values varies from $50 to $60 per ha for drier areas up to $75 to $85 per ha.

(viii) Equity - landholders in the area are thought to have about 70 per cent to 80 per cent equity in their enterprise.

(c) Beef cattle industry - (i) Type of enterprise - the predominant cattle enterprise is to breed and turn off stores at ages from 10 to 18 months. The preference is to hold the cattle for the better prices available for older cattle. The typical wetter property would carry 400 head of Herefords turning off yearling steers with carcass of 120 kg. Branding percentages of 70 per cent and mortalities of 2 per cent to 4 per cent are normal. On the drier property the stock would typically comprise 2,000 wethers plus 100 head of Herefords turning off 18 month old stores with an estimated 110 kg carcass. Branding rates are 70 per cent and mortalities are about 5 per cent of breeders.

Breeds run are Herefords (80 per cent), Angus (15 per cent) and other breeds (5 per cent).

(ii) Cattle numbers - cattle numbers are still increasing slightly in wetter areas, but are stabilising in the drier parts. The increases in numbers have been largely due to removal of some sheep. Further increases will depend on the balance in value of wool and beef, but generally it is anticipated that any further increases will be as development allows rather than as sheep are removed.

(d) Husbandry and management - (i) Weaning - virtually all properties practise weaning, usually in April-May.

(ii) Mating - about 70 per cent of properties practise bull control. The usual calving period is August to November with a tendency to earlier calving in the wetter areas.

(iii) Pregnancy testing - used by very few graziers.

(iv) Parasites - almost all graziers treat herds for worms and lice. In the wetter country fluke are also a problem.

(v) Supplements - urea-based supplements are universally used, either home-make or commercial lines. Inclusion of phosphorus in licks is not universal even though this is an area of acute phosphorus deficiency.

(vi) Fodder conservation - almost all producers buy in a little hay each year for winter supplements for horses, house cows, etc. Some provide extra for first calf heifers, but generally, large quantities of fodder are not conserved.

(e) Potential - (i) Improved pastures - increased areas can be expected up to about 75 per cent to 80 per cent of the total property size. The balance is unsuitable because of topography or inaccessibility.

(ii) Fodder cropping - although this may be physically possible in some of the wetter country, it is unlikely that big increases will be seen because of competition with improved pasture. In the drier country limited expansion of fodder cropping is expected.

(iii) Carrying capacity - this is capable of significant expansion by means of pasture improvement in the wetter areas. In the drier parts, timber treatment and fodder cropping allow some further expansion.

(iv) Irrigation - although this may have feasibility physically it is not considered a likely development for economic reasons. Water harvesting has been tried, and could have some application in favourable sites.

(f) Comments - Should there be a resurgence of interest in intensive methods of fattening on nearby Downs areas there is potential to further develop the Granite Belt for store production. Stores from the area are sought after at Warwick auctions, and advantage could be taken of this demand. A semi-intensive type of operation is envisaged with breeding herds being run on well sub-divided areas of improved pastures to gain the maximum benefits from the pasture in terms of stocking capacity, consistent with a high reproductive rate.

For such an enterprise to become successful several factors need careful attention:-

(i) pasture improvement and subdivision;

(ii) nutrition of heifers in their first two winters to make a success of mating at 15 months. This will involve the use of supplements where native pastures only are available to heifers;

(iii) phosphorus supplements for all stock throughout the year;

(iv) pregnancy testing of all breeders as a means of achieving high calving rates;

(v) further adoption of seasonal calving

(vi) priority to females when limited good feed is available.

12.2.2 The Traprock Area

The traprock country varies in quality from hard stony ridges, supporting only sparse growth of grass, to gentler slopes carrying a shallow cover of soil of low fertility but capable of producing a moderate volume of native pasture.

Along the Dumaresq and Condamine Rivers, Canal Creek and pockets on other frontages, soils derived from slopes and ridges have formed deeper alluvial type soils which have quite good agricultural qualities and are relatively fertile. Often these alluvials are irrigated from the streams. This section of the report will deal with properties having no frontages, i.e. mainly the Thane, Gore, Pikedale (main unit), Jibbinbar and Arcot LSs, and the higher parts of Warroo, Texas and Glenlyon.

(a) General - (i) Property sizes - most properties fall within the range of from 400 ha in the better areas where some stream frontage is available, up to 4 000 ha in the areas of more broken topography. A typical property which will be used as an illustration through the section would be 2 000 ha.

(ii) Carrying capacity - allowing one beast per ten sheep the carrying capacity over the whole area averages one beast per 5.7 ha. On the typical property a herd of 360 cattle could be carried but the stock actually carried are 2,500 sheep run as a self-replacing flock and 120 head of cattle.

(iii) Stock waters - most of the water sources are surface types such as springs and dams. Small dams of about 400 to 1 500 m^3 capacity are found - adequate for sheep but often proving inadequate for cattle. This is a problem due to the traditional 'sheep only' development pattern up to recent years.

(b) Development - (i) Tillable area - this ranges widely from nil to 400 ha depending on the class of country and soil. The typical property has 100 ha.

(ii) Pasture improvement - grazing lucerne is the only pasture which has stood the test of time. Medics have been used successfully on some better traprock areas. Areas range from nil to 80 ha with 40 ha on the typical property.

(iii) Fodder crops - there is little confidence in fodder crops. Oats are grown with varying success with 40 ha as a typical area. The harsh winters force graziers to attempt any means of alleviation which seems feasible.

(iv) Irrigation - is rarely feasible.

(v) Fertilizers - where fodder crops are grown, the use of superphosphate is universal.

(vi) Timber treatment - an average of one-third of most holdings comprises green timber. This figure applies to the typical property.

(vii) Valuation - typical block $35 per ha. Range in the traprock is $20-$54 per ha.

(viii) Equity - some landholders could be in financial difficulty. Being a traditional wool growing area, the recent wool slump has forced financial stringency. Average equity is probably about 75 per cent.

(c) Beef cattle industry - (i) Type of enterprise - an occasional property runs cattle only. Where cattle and sheep are run together on a property, better results are obtained by the cattle if they have their own section of the property. Most properties run between 80 and 200 head. The breeds vary from Herefords (75 per cent), Angus (10 per cent), Crossbreeds - including infusions of Bos indicus blood (15 per cent). The typical property has 120 head.

The cattle project breeds stores to turn off at 16-18 months of age with estimated carcasses of 120-135 kg. Few properties attempt to fatten any cattle although fodder crops are sometimes used to this end. A limited interest in lot feeding in small lots is to be seen on the fringes of the downs to the north and east of the area.

Breeding herds produce about 75 per cent calves at branding time. Mortalities average about 8 per cent of breeders.

(ii) Cattle numbers - cattle numbers have increased over the last decade due to the changing relationship of values of wool and beef. The swing seems to be levelling out at the present stage, and sheep numbers are now holding. The expected future trend is uncertain being governed very largely by relative market values of the produce. Harsh winters are a deterrent to cattle production in the area and big increases in cattle numbers seem unlikely.

(d) Husbandry and management - (i) Weaning - is universally practised.

(ii) Mating - bull control is used. Calving is timed usually from September to December.

(iii) Pregnancy testing - not widely practised.

(iv) Parasites - lice and worms are controlled in most herds.

(v) Supplements - urea-based winter supplements are universally used. Usually no phosphorus is included.

(vi) Fodder conservation - there is virtually no opportunity to make hay in the area. Small amounts, averaging 5-8 tonnes, are purchased and used through the winter for first aid requirements and for horses, house cows and special animals.

(e) Potential - (i) Improved pastures - there are limited possibilities in this field. On hard ridgy country virtually no prospects are in sight. Where softer country is available, prospects are better and increases in grazing lucerne area, and possibly other species, could eventuate. New technology is needed to allow scope in improvement.

(ii) Fodder crops - the area used for fodder crops is almost at its limit at present. Erosion hazards are too great to advocate risking the little soil available in the area.

(iii) Carrying capacity - increased pasture improvement and timber treatment could increase carrying capacity but the scope is limited with present technology.

(iv) Irrigation - it is physically possible to catch water in water harvesting projects, but suitable arable areas limit the prospects for such ventures. Economic considerations make feasibility of this practice seem even more remote.

(f) Comment - Because of its natural suitability for sheep and the difficulty of harsh winters for cattle production, cattle could not be expected to become a major enterprise in the area. However, small cattle herds do perform quite satisfactorily. The difficulties of wintering and paucity of forage crops preclude fattening enterprises.

The main prospects for cattle in the area seem to lie in breeding and selling stores. The stores could be sold off at any age from weaning to 18 - 20 months depending on markets. Because of its lower capacity and potential the industry could tolerate a lower standard of efficiency than indicated for the granite belt. However, the following points would be important considerations:-

(i) Heifer nutrition for first two winters

(ii) Pregnancy testing of heifers to remove shy breeders

(iii) Careful culling of cows before age predisposes cows to suffer in the harsh winter

(iv) Phosphorus supplements for all properties

(v) When limited good feed is available, females should have priority.

12.2.3 Frontage Blocks

(a) General - the frontage country is very small in area in the overall picture but some is used for cattle only. This fact, together with its quite high carrying capacity, makes it quite significant. Frontages occur on the Dumaresq and Condamine Rivers, Canal Creek and Macintyre Brook. They are all frontages running back into traprock country in the reference areas. Significant frontage areas are found in the Leslie, Canal, Glenlyon, Bonshaw, Texas and Warroo LSs.

(i) Property sizes - range from 120 to 5 000 ha with 1 600 ha as typical.

(ii) Carrying capacity - 1 beast: 2 ha on alluvials, 1 beast: 3 ha on fringing black soil flats, 1 beast: 5-6 ha on traprock.

(iii) Stock waters - adequate, usually creeks and dams.

(b) Development - (i) Tillable area - about 320 ha average.

(ii) Pasture improvement - 160 ha is common, mostly grazing lucerne.

(iii) Fodder crops - 140 ha is typical usually about 100 ha oats, 20 ha of summer forage and 20 ha of lucerne for hay.

(iv) Irrigation area - 20 to 40 ha usually.

(v) Fertilizers - not used on Dumaresq but some used on Condamine and creek frontages.

(vi) Timber treatment - about one-third of the back country on properties is still green timber. Frontages are generally kept well treated.

(vii) Valuations - a wide range occurs, but generally alluvial flats are sold at about $150 per ha, black wash flats $150 per ha and traprock country $35.00 per ha.

(viii) Equity - stability and diversification of product in these areas have allowed most owners to increase their equity to about 85 per cent.

(c) Beef cattle industry - (i) Type of enterprise - The cattle enterprises are relatively diverse - including breeding for store production, breeding and fattening and buying in stores to fatten. A typical herd could include 250 breeders turning off fats at 2½ years at 240 kg carcass. Branding percentages are high at 85 per cent. Mortalities also are high at 12 per cent, being increased sharply by bloat, particularly in some seasons.

(ii) Cattle numbers - numbers are still increasing as property development increases. Further increases may be expected as development progresses with possible increases due to intensification of enterprises.

(d) Husbandry and management - Weaning, bull control and pregnancy testing are all practised. Parasite problems include worms and lice. Fluke are suspected of being a pest of economic significance. Urea-based supplements are used in most years. Fodder conservation is also gnerally practised with home produced hay.

(e) Potential - (i) Improved pasture - natural medics are available on the better areas. In the hills the prospects are poor.

(ii) Fodder crops - the areas of fodder crops could rise by up to 400 ha on some properties.

(iii) Irrigation - the area could be increased. The Glenlyon Dam could make more water available along the Dumaresq.

(iv) Carrying capacity - could be raised by 20 per cent.

(f) Comment - Breeding herds could be run very successfully using the hills for summer feed and bringing cows in to winter on better areas. High standards of breeding efficiency and growth rates are attainable on these properties. Intensification can be considered up to a high degree, including crop fattening of all turn off cattle. These enterprises should be entirely drought proof due to irrigation potential. In fact opportunity is present to set up for capitalising on drought to the extent of fattening cattle when other areas are unable to, and also to buy in drought-stricken stock for later resale. Topping off with grain as a supplement to crop, or in the feedlot is also practised when price ratios are favourable.

The scope of possibilities is very wide, breeding or dealing in cattle should be safe enterprises; and intensification should enable astute managers to achieve very high carrying capacities with reasonable safety.

12.2.4 Conclusions

The beef cattle enterprises in the area are severely limited and handicapped by nutritional problems. Management factors need review to allow better utilisation of available feed, and the provision of more appropriate supplements. All these factors are necessary to achieve improved reproductive rate of breeding herds.

Fattening enterprises are limited to those frontages where feed standards are high enough to allow economical fattening with rapid rate of turnover. Limited fattening may be envisaged for the future where improved pastures on the wetter granite areas permit; however, care must be taken here to ensure that the efficiency of the basic breeding enterprise is not unduly put at risk for the sake of fattening turnoff cattle.

Breeding is a viable enterprise in the area, using present technology, and the area is ideally situated geographically to provide store cattle to intensive fattening enterprises on the nearby Darling Downs and New England area. The present enterprises require careful reassessment of the whole broad area of winter nutrition, with particular emphasis on heifers, and the selection and use of supplements. Advance in pasture improvement is the most promising long run prospect for mitigation of this problem.

The long hard winters with subsequent limitations to the useful life of breeding animals, emphasise the need for getting heifers into production early, and for efficiency in the breeding cow while she is kept.

12.3 Dairying

In the Granite and Traprock area, the only significant production in 1972/73 came from Rosenthal Shire. Dairying in Inglewood Shire has declined in importance, and in Stanthorpe Shire is virtually non-existent.

The following table allows comparison of dairy production for the Rosenthal and Inglewood Shires.

TABLE 12.1 - DATA RELATING TO DAIRY FARMS IN ROSENTHAL AND INGLEWOOD SHIRES, 1972/73

	Farms	Area (ha)	Cows	Butterfat Total (kg)	Butterfat Production (kg/ha)		(kg/cow)	
					Mean	Range	Mean	Range
ROSENTHAL								
Total Shire	30	6780	1690	137840	26.3	5.4-91.0	81.5	43.7-144.5
Mean per Farm		226	56	4600				
INGLEWOOD								
Total Shire	5*	1840	200	10340	5.6	3.1-12.1	51.7	35.0-62.4
Mean per Farm		369	40	2070				

* Note: At time of publication only three dairymen remained in operation in the Inglewood area.

12.3.1 Rosenthal Shire

By comparison with many other Shires on the Darling Downs, dairy farming activities in the Rosenthal Shire are fairly limited. At the end of June 1973 there were 30 properties, the income from which was derived principally from the sale of dairy produce. In good seasons, additional income is obtained from the sale of small quantities of surplus grain.

These farms range in area from 50 to 760 hectares and carry a population of approximately 2,500 dairy cattle.

All dairy produce is marketed in the form of bulk milk for both the market milk trade and for manufacture purposes, with the exception of one farm which still operates on a cream economy.

The return to the farm from the sale of dairy products in 1972/73 was $248,963 gross.

The dairy industry in the Shire is reasonably stable at the present time - only two farmers have left the industry during the past five years. Most properties are family operated, having been handed down from one generation to the next.

The majority of dairy farms is situated in the Cunningham, Pratten and Wheatvale areas. The country is generally slightly undulating, interspersed with river and creek flats where black soil predominates.

Although dryland farming is practised on a large proportion of the cultivatable area within the Shire, many farmers are able to take advantage of irrigation, the water being obtained from the Condamine River and from bores.

Both native and improved pastures fulfil the basic feed requirements of dairy cattle. Where irrigation is available, the more common species include Lucerne, Rye, Fescue, Ladino clover and *Phalaris tuberosa*. For dryland establishment, the main species are Lucerne and Gatton Panic.

On most farms grain, usually barley and sorghum, is grown for the supplementary feeding of dairy stock. Generally large quantities of hay are conserved. These consist mainly of lucerne, barley and sorghum stubble.

Dairy cows are commonly given supplementary feed in the milking shed. This generally consists of cracked grain together with extra protein usually in the form of urea. A daily average of 2.7 kg of concentrate is fed to milking cows depending on production and stage of lactation.

The potential for the expansion of dairying activities in the Shire is limited because of the intensity of development in areas where the industry is currently established. Some of the land immediately west and south-west of Warwick could be adapted for dairying purposes, but this area consists mainly of the lighter forest soils progressing into granite country. There would be very little opportunity to utilise irrigation so that any development would necessarily be based on dryland pastures and crops. The area is, however, within a radius from the processing factory which would ensure that the economy of pick-up of dairy produce was kept within acceptable limits.

Any expansion of the dairy industry in the Warwick district at the present time would necessarily have to be based on a cream economy which at current prices for butter is not likely to be soundly based. The Board of the Warwick Co-operative Dairy Association has placed some restriction on the number of milk suppliers it can accept due to the capacity of the factory, which currently is limited to a maximum throughput of approximately 90 920 litres/day. Maximum receival during 1972/73 was 79 555 litres/day.

With a possibility of expansion of the Brisbane milk market in future years and a corresponding increase in the quotas allotted to country factories, there could be an incentive for existing dairymen in the Shire to increase their production.

12.3.2 Inglewood Shire

The Inglewood Shire was once a large dairying area with butter factories at Inglewood and Texas. Records indicate that there were up to 25 active dairy farmers in the Shire prior to 1967/68. Dairy cattle numbers have dropped from 4,243 in 1957 to 1,125 in 1968 and by 1972/73 the number had been further reduced to 200.

There are now only three active dairymen in the Shire and their properties are located within a 16 km radius of Inglewood township. Cream only is supplied to the Warwick factory by road transport. Cartage costs are maintained at a reasonably low level of 1.8 cents/litre by use of the factory truck on its return journey from Goondiwindi to Warwick after delivery of dairy products to centres en route.

The return to farmers from the sale of cream in 1972/73 was $9,639.

Although the dairy income from these properties is supplemented by returns from the sale of pigs and vealers, there is no additional income from agricultural source such as grain.

The country generally is very flat with a predominance of sandy loam soil. Dryland farming only is practised, but each property could utilise irrigation on small areas of land particularly for grazing crops. Some lucerne is grown for summer grazing and oats is the basis of winter feeding.

Only natural pastures are presently available for the grazing of dairy cattle, but there is scope for pasture improvement by the use of such species as Buffel, Gatton Panic and Lucerne.

With improved husbandry practices the level of dairy production from existing dairymen could be increased substantially. These farmers, however, do not appear inclined to expand their dairy enterprises.

There are additional areas of land within the Shire which have a potential for dairying, more particularly because of the availability of water from Coolmunda Dam. However, any new dairy ventures would necessarily have to be based on a cream economy which, under present conditions, would make them economically unsound.

At present prices for pig meats, any increase in pig numbers could help to stabilise the dairy industry. Additional cows could be maintained if more feed were available, and the increased quantity of skim milk could provide pigs with a cheap source of protein.

There is little possibility of dairymen in the Inglewood Shire having access to a milk market in the foreseeable future. As the Warwick factory is situated up to 70 miles from existing and potential dairy farms, the cost of cartage would prohibit milk collection from a small number of farms. It is estimated that the factory is currently operating on an overall pick-up of 132 litres per mile and with the current cartage rate of 0.44 cents per litre irrespective of distance between factory and farm, the quantity of milk collected per mile could not be allowed to fall below that level.

In any consideration of milk collection from outlying farms, a minimum requirement would be the availability of sufficient milk to fill a 18 184 litre tanker every 3 days. This would necessitate a cartage rate of 0.66 cents per litre or 16.5 cents per kg butterfat. At the present average price of $1.37 per kg paid for manufacture milk this would give a producer a net return of approximately $1.21 per kg butterfat.

Substantial capital costs would be incurred in initiating a dairy enterprise. Typical outlay would include up to $5,000 for a dairy shed depending on labour content; $1,500 for dairy plant and, if produce was marketed in the form of milk, a bulk milk tank would cost about $3,000.

Other farm machinery which may be required such as an irrigation plant would probably cost at least $5,000. Good quality dairy stock would be priced at a minimum of $200 per head.

12.3.3 Stanthorpe Shire

Dairying is now virtually non-existent in the Stanthorpe Shire. Dairy farms that once operated in the Eukey district have converted to beef production.

At the present time one dairyman with a property of 87 hectares milks ten cows and supplies raw milk to consumers in Stanthorpe. This farmer is likely to cease dairying in the foreseeable future. The property consists of natural pastures only, with no areas under cultivation.

Much of the Stanthorpe Shire consists of country which has little development potential for dairying purposes.

The establishment of improved pasture species may be possible in certain locations, but costs associated with the use of fertiliser and irrigation would be prohibitive in relation to the returns from butterfat on a cream supply basis.

The cost of transport of bulk milk to the Warwick factory would be within acceptable limits, providing sufficient milk was available to fill a tanker on the basis of every other day pick-up.

12.4 Pigs and Poultry

12.4.1 Pigs

Pig raising within the study area is mainly confined to the environs of Warwick, and the northern strip west to Inglewood and in the south-west section, where properties involved are either in or close to sections of country which support growing of grains. Pig raising moved westwards as grain growing was extended into these areas.

A number of small piggeries has been running in the past on Granite Belt orchards as a means of utilising unmarketable produce. Poor returns and competition for labour during periods of high labour demand caused closure of these ventures.

It is considered that any appreciable development of pig raising in the study area south of the railway line to Inglewood is not likely, due to one or more of the following reasons.

Little farm-produced food would be available. An assured supply of good quality water capable of providing an average of about 25 litres per head daily is required for drinking and manure handling purposes. Establishment costs are high. There would be an early peak debt, with a waiting period of several months to a year from establishment to first returns. Modern intensive pig sheds are specialised buildings which would require expensive or wasteful modification for other purposes should pig raising fail.

Some specific problems should be noted.

In the closely settled fruit growing areas in many instances it would not be possible to locate piggeries outside the minimum distances from neighbours' dwellings, and other facilities, likely to be required by local government authorities. Disposal of piggery effluent could also be a problem.

The wide range between maximum and minimum daily temperatures, and low winter temperatures, would require provision of expensive insulated and temperature controlled buildings to ensure success.

12.4.2 Poultry

The area does not support a large poultry industry. Several commercial producers are established in the Warwick and Stanthorpe areas. There is a limited consumer population locally.

Problems regarding quotas and marketing would arise with the attempted establishment of additional poultry farms. Further development of the industry would also entail introduction of feed into the area and transport of products to markets outside the area boundaries, both of which increase production costs.

Modern poultry raising requires extensive capital for establishment and special skills for successful operation. For these reasons, and others outlined previously, the extension of additional poultry farms as an alternative means of increasing farm income is not recommended under present conditions.

12.5 Horticulture

Practically all of the granite country is situated within the Stanthorpe Shire. Only a small portion is in the Rosenthal Shire stretching from the rabbit fence between Cottonvale and Dalveen to about as far north as Cherry Gully. Much of the traprock country is also within the Stanthorpe Shire. It joins the granite about 16 km west of Stanthorpe, stretching along the Severn River to Mingoola and Texas and then north to about 16 km east of Inglewood.

There are approximately 800 fruit and vegetable farms on the granite country and only two orchards of early maturing stone fruits and grapes on the traprock country, totalling about 20 hectares.

Latest available figures of value of rural production in the Stanthorpe Shire are for the year 1973-74 which was a record with a gross value of $16,172,760. The gross returns from orchards and other agricultural crops in the same year were also a record of $14,110,028. Grazing of sheep and cattle is the next most important industry in the Shire with a value of $1,938,098 in 1968-69.

12.5.1 Fruit

Deciduous fruit production figures for the Stanthorpe and Rosenthal Shires for the year ended 31st March, 1972, as supplied by the Government Statistician are given in Table 12.2. Apples are the main crop grown and production for 1972 was well down on the record year, 1971, when 43 900 t (2,298,998 cases) were produced.

TABLE 12.2 - AREA UNDER CROP AND PRODUCTION OF FRUITS IN THE STANTHORPE AND ROSENTHAL SHIRES 1972

Crop	Bearing (ha)	Non-Bearing (ha)	Total (ha)	Production (tonnes)
Apples	4 480	820	5 300	35 050
Pears	399	117	516	3 820
Peaches	585	103	688	3 720
Plums	517	126	643	3 430
Apricots	176	29	206	1 115
Nectarines	137	49	186	885
Grapes	1 012	111	1 123	4 490

Plantings of apples have decreased considerably since the 1950's when the annual acreage planted was slightly in excess of 200 ha. During the last four years they have levelled out to an average of about 60 ha planted each year. The delicious and its red sports have headed the list of varieties planted in recent years followed by Granny Smith and Jonathan.

Pears planted took a sharp rise in the 1950's but have lost favour due to consistent low prices. Stone fruit plantings have taken a sudden drop because of the introduction of a total ban on importation of stone fruit trees from Victoria to Queensland in 1971 due to the presence of a more virulent strain of Brown Rot disease in Victoria.

The local Deciduous Sectional Group Committee (of the Committee of Direction of Fruit Marketing) and two privately owned nurseries are increasing their supply of stone fruit trees for planting to meet the demand. The shortage should soon be overcome and plantings should then continue as before - sufficient to replace acreage destroyed and cause a steady increase in the overall production.

About 80 per cent of the vineyards in Queensland are established in the Granite Belt. New plantings over the last 20 years have caused production to almost double in that time.

Table 12.3 shows areas planted under fruit trees in selected years since 1961.

TABLE 12.3 - FRUIT TREE PLANTING FIGURES - STANTHORPE SHIRE

Crop	1961 (ha)	1962 (ha)	1964 (ha)	1968 (ha)	1969 (ha)	1970 (ha)	1971 (ha)	1972 (ha)
Apples	215	319	127	105	59	80	63	61
Pears	58	57	21	21	19	19	14	10
Peaches	26	32	35	48	17	53	28	24
Plums	24	18	14	31	25	20	12	5
Apricots	8	9	5	14	5	3	3	4
Nectarines	9	13	8	17	7	3	3	-
Cherries	-	1	-	2	1	-	1	1
TOTAL	340	449	210	238	133	178	124	105

Trends - Table 12.4 sets out estimates of apple production until 1979. The figures are calculated from numbers of trees planted since 1950, with no allowance made for adverse weather conditions which can appreciably reduce the size of crops.

TABLE 12.4 - ESTIMATED APPLE PRODUCTION FOR THE GRANITE BELT, 1976 TO 1979

Year	Tonnes
1976	52 000
1977	53 000
1978	54 000
1979	54 500

Production of pears and stone fruit is expected to remain stable, while areas of table grapes are presently expanding at about 100 ha per annum or about 5 per cent per annum. The present level of wine production is approximately 360 000 litres and by 1979 is expected to reach 540 000 litres.

Cannery - With the inevitable increase in production of all fruits, uneconomic prices on the fresh fruit market, Britain's entry into the European Common Market, and rising costs in production, growers in the Granite Belt formed a Cannery Committee. The growers, through this Committee, have made several approaches to the State Government for assistance in the form of a grant for building a cannery in Stanthorpe.

Feasibility studies to see if it would be economic to have a cannery in the district were made by officers of the Department of Primary Industries in 1965 and again in 1970. It was found in 1970 that a cannery for the manufacture of fruit juice would be a worthwhile proposition, but not for solid pack (pie pack), or for canning fruit.

The Golden Circle factory at Northgate, Brisbane, takes a quantity of apples, pears, stone fruits and tomatoes from the district for processing each year.

Table 12.5 gives the amount of fruits processed mainly by the Golden Circle Factory in 1968-69.

TABLE 12.5 - GRANITE BELT FRUITS PROCESSED IN 1968/1969

Fruit	Variety	Use	Tonnes
Apples	Red varieties	Concentrate juice	3 030
Apples	Granny Smith	Beverage juice	3 262
Apples	Granny Smith	Pie grade	1 070
Apricots	Various	Juice	72
Peaches	Yellow Cling	Canning	47
Peaches	Elberta	Juice	314
Pears	William's Bon Chretien (WBC)	Canning	525
Pears	Various	Concentrate juice	61
Plums	Various	Jam	359
Tomatoes	Roma and Other Varieties	Tomato sauce, etc	507

In 1972 about 100 tonnes of apples were sent from this district to Griffith, New South Wales, and Victoria for processing. This season PDS (Producers' Co-operative Distributing Society), the Summit, has so far forwarded about 100 tonnes of apples to Victoria for processing. The price of $5.00 a bulk bin of cannery apples paid to growers does not pay cost of harvesting and should this outlet for mainly hail marked apples be available in future years, a higher price to growers will be necessary in order to obtain supplies.

Apple juice and wine making - Commercial apple juice manufacture commenced in 1970 and plant enlargement and increased output have occurred each year since. About 90 000 litres of apple juice and wine were produced in 1972 and further increases to about 80 000 litres of apple and pear wine, and 100 000 litres of apple juice are expected. So far no difficulties have been experienced in selling total output from one enterprise. Competition from other businesses of a similar type seems likely.

Over the years, local Italian grape growers have produced wine from reject table grapes for their own requirements and to sell to other Italians. The amount is approximately 230 000 litres annually. However, interest in producing table wines from reputable wine grape varieties has been stimulated in recent years and the Department of Primary Industries has established wine grape variety trials at Stanthorpe, Ballandean, Inglewood and Warwick for this purpose. Interest in this project is district-wide and a large amount of wine grapes is expected to be planted in the district as trial results become known and planting material becomes available. Introduction of wine varieties into Queensland has been a slow process because of past rigid quarantine regulations, but conditions have been eased recently.

Irrigation - The area of fruit and vegetables being irrigated by sprinkler system has increased each year since the record drought in 1957. Irrigation of fruit trees is mainly supplementary because of the limited water available. The small percentage of farmers with orchards and vegetables growing on land adjacent to creeks and gullies irrigate direct from dredge holes in the creeks, from weirs constructed, or fill dams from the creeks by pumping.

Sprinkler irrigation is also being used for prevention of frost damage to fruit. Its use for this purpose is limited.

Where sufficient water is available for irrigation, sod culture will increase.

Keen interest was shown by growers and officers of the Department of Primary Industries in trickle irrigation from the time of its introduction. Installation in orchards is proceeding at a steady rate. Its main advantage is that it will allow plants to grow without suffering periods of water stress while using approximately half of the water required by sprinkler systems.

Trickle irrigation has also 'speeded up' close planting of fruit trees, which could develop into the most important change in growing methods since the industry started in the district 100 years ago.

Close planting - The old system of planting with 20 feet square spacing of fruit trees, with its low yields, high cost of production and extravagant use of land, must eventually be replaced by close planting where water is available for irrigation.

The advantages of close planting over wide spacing are greatly increased yields per acre, earlier cropping and greater efficiency through more economic water usage and reduced costs.

Herbicides - Interest in herbicides started about seven years ago and their use has now become a standard practice with many fruit, grape and vegetable growers in the district. New herbicides are being investigated by trials, and it is hoped that firm recommendations for their use in all crops will be possible in the near future.

The use of herbicides in close and contoured plantings is even more desirable because cultivation is recommended and usually only possible one way.

Bulk handling - Bulk handling of fruit started in the district in 1958. The use of fork lifts on tractors, bulk bins drawn on tractors, and pallet loading of packed cases and cartons is the standard practice in practically all orchards, packing sheds and cool stores today.

Handling of the greatly increased production of fruits would not have been possible within the limited time without the advent of bulk handling. The main delay now occurs with the manually operated harvesting. There was a shortage of labour in 1973, and if some mechanical means of harvesting were possible it would overcome this problem.

Apple disorders - As a result of trials and investigations by research officers of the Department of Primary Industries on apple disorders, a soil testing service for pH analysis is now given at the Granite Belt Horticultural Research Station. Recommendations are made of the amounts of agricultural lime or dolomite to apply to soil if needed. Now due to the more general application of lime or dolomite the severe disorders in apple trees (mainly Delicious) known as measles and scaly bark have been considerably reduced.

Export - Export of apples and pears to other countries from the Granite Belt have not been sufficient to relieve local markets and thereby improve prices. Quantities of apples exported each year since 1959 varied from 1 900 tonnes in a light crop or bad hail damage years to 4 800 tonnes in 1964. There could be a further reduction in exports to Britian since she entered the European Common Market. Exports to Hong Kong, Singapore and Indonesia in recent years have increased for mainly Delicious, and it is hoped this will continue and that Japan will soon accept our apples and pears.

Cool storage - Cool storage capacity in the district has increased each year since 1946. From a few stores, it has grown to fourteen commercial and about 60 privately owned stores with a total capacity of about 19 000 t. Controlled atmosphere (CA) storage is a comparatively recent introduction and there are now seven commercially operated CA stores with a total capacity of about 2 360 tonnes.

Cool storage space is still being increased. PDS intends building two more cool stores later this year with a capacity of 570 tonnes (30,000 cases) each.

Fruitgrowing reconstruction scheme - Britain's entry into the European Common Market will mean a considerable reduction of their imports of fresh and canned fruits from Australia. In 1972, the Commonwealth Government decided to introduce a scheme to pay compensation to apple, pear and canning peach growers for pulling out all or some of their areas in order to reduce production in Australia. Many growers have obtained application forms to complete and forward to the Rural Reconstruction Board which administers the scheme.

Should the amount payable for pulling out fruit trees be sufficient, it is expected that reduction of apple and pear trees in the district would be fairly substantial.

12.5.2 Vegetables

Due to increased production of vegetables grown under irrigation in other parts of the State during part of summer in recent years, this district has partly lost its reputation as being the summer vegetable bowl for Brisbane and other parts of Queensland.

High temperatures, heavy rains and sultry conditions during summer in other parts of Queensland cause a big decline in their vegetable production and hence leave a barer market for vegetables grown in the Stanthorpe district. This has happened in recent years and Stanthorpe vegetable growers have received high prices for their products. Main vegetables grown in early summer, summer, autumn and early winter are tomatoes, cabbage, cauliflowers, lettuce, beans, peas, celery, brussels sprouts and capsicums.

Table 12.6 gives the area and production of the main vegetables grown in the 1972 season. Tomato production was well above that in previous years due to increased yields. Production of other vegetables was mainly above the average.

TABLE 12.6 - PRODUCTION OF VEGETABLES IN THE STANTHORPE SHIRE 1972

Crop	Area (ha)	Production
Tomatoes	415	3 850 t
Beans	74	196 000 kg
Cabbage and cauliflowers	189	131,139 dozen
Peas	29	79 300 kg
Celery	36	1 130 t
Cucumbers	12	60 t

Area under vegetables for sale in Rosenthal Shire totals 69 ha.

Celery growing from a small beginning by one grower in 1945 has increased each year and now four growers in different parts of the district have increased the total area under celery from 19 ha in 1968 to 38 ha in 1971 and 36 ha in 1972. This area could be increased if demand increases and prices continue to be high.

Practically all of the vegetables, such as celery, tomatoes, cabbages and cauliflowers grown in the district are now grown under sprinkler irrigation.

12.5.3 The Traprock Area

Three growers have approximately 12 ha of early maturing nectarines and peaches growing on part of Araluen Station about 16 km west of Stanthorpe. They also have several hectares of grapes planted with more land cleared for planting. The country is hilly and thickly timbered with pebbly, shaly stone covering the surface and mixed with a deep red or dark coloured soil. It is therefore different from the average run of traprock country and there is only a limited area of about 80 ha of this type of country on that and adjoining properties.

A 68 Ml capacity dam is used for supplementary sprinkler and trickle irrigation of the stone fruit trees and grape vines on Araluen. Runoff water from this country is less than from granite and some difficulty could be experienced in catching sufficient quantity of water which is necessary since average rainfall is a few inches less than in the granite country.

The rest of the traprock country is mainly undulating and sparsely timbered in its virgin state. Most of it has now been ringbarked. The soil surface is typically hard with a shallow stony profile. It is difficult to cultivate and not very suitable for growing crops, and it is considered that there is little likelihood of much of its being used for other than grazing sheep.

Some areas of limited extent along creek banks, where water could be stored for irrigation, would be suitable for growing vegetables and fruit trees.

12.5.4 The Inglewood District

Although existing plantings are small in area, climate and soils favour the district for the production of apricots and grapes. Table grapes, especially, have indicated promise, due to an earlier harvest than the main production area of Stanthorpe.

In 1974, two properties commenced vineyards of wine grapes, but the future of this industry will depend upon the establishment of a winery in the region.

Prices in 1974 indicate gross margins for table grapes in excess of $2,500 per hectare, whilst those for apricots were in excess of $1,200 per hectare.

Two properties with vineyards totalling an area of 4 ha, one apricot orchard of 1.5 ha, one peach orchard of 1 ha, together with the new wine vineyards, represent the horticultural area within the Inglewood district. Small areas of Pecan Nuts have been established just outside the study area.

These 'investment' type crops, although indicating considerable potential, are not expected to expand dramatically in the immediate future, because of lower economic stability on the smaller farm sizes, particularly in the Inglewood area.

All future expansion will probably include trickle irrigation for efficiency and labour saving.

Green beans are a recent introduction to the district and are becoming increasingly important. Yields for 1974/75 averaged 5 000 kg/ha. All crops are grown under contract to processing companies.

12.6 Agricultural Crops

12.6.1 Native Pasture

The principal native pasture species on the traprock, sandstone and granite soils at lower elevation are:- Queensland blue grass *(Dichanthium sericeum)*, pitted blue grass *(Bothriochloa decipiens)*, slender bamboo grass *(Stipa verticillata)*, love grasses *(Eragrostis* spp.*)*, slender rat's tail grass *(Sporobulus elongatus)* and spear grass *(Stipa* sp.*)*.

On the more elevated granitic soils, especially within the Stanthorpe Shire the principal species are spear grass (an undescribed *Aristida* sp. 1972), love grasses, plume grass *(Dichelachne crinita)*, wallaby grass *(Danthonia racemosa)*, slender rat's tail grass, summer grass *(Digitaria ramularis)*, and forest hedgehog grass *(Echinopogon ovatus)*.

Many species are common to all elevations, but the most obvious difference is that neither of the blue grasses is common on the higher elevated granitic soils.

Native pasture on open country produces 600 to 1000 kg DM per ha and carries an average of about 2 DSE (dry sheep equivalent) per hectare, the best native pastures support up to 3 DSE per ha. On heavily timbered country, carrying capacity may be 0.5 DSE per ha or less.

When timber is killed, carrying capacity increases for a few years but may revert to the original carrying capacity, or lower, unless regrowth is effectively controlled. Sheep grazing and 'sucker bashing' are the most general regrowth control measures.

Native pasture supplies good quality grazing during the summer months, but almost invariably becomes dormant from May to September thus producing a protein drought, and during late winter, a shortage of forage of even low quality.

Good sheep grazing can be expected about mid September and, when rains are well spread, it extends into April. The cattle grazing period is shorter, good cattle feed being expected in late November and extending to April if rainfall is suitable. Dry feed is useful when cattle are fed non-protein-nitrogen supplements, especially in the early part of the winter.

Phosphorus levels in grass are believed to be only moderate during summer and very low during winter. It is desirable to supply cattle on native pasture with phosphorus supplements, especially on the granite soils.

12.6.2 Improved Pasture

There is a vital need for introduced pasture in all areas to supplement grazing during winter, but suitable pastures cannot be satisfactorily established on some soils.

In the high rainfall area of the eastern granite temperate pastures are successful. The lower limit of the high rainfall area is usually taken as the 750 mm isohyet, but there is no clear demarcation because of different soil types. On the coarser sands the rainfall should be at least 800 mm per year.

Good temperate pastures are stocked at 5 to 10 DSE per ha. They are mostly used for beef cattle grazing and produce good feed in both summer and winter when there is sufficient rain.

On the drier soils developed on granite, the main pasture is lucerne but there is a large range in productivity. The best lucerne pastures are on the geological margins of granite and traprock and east of Severnlea. Good lucerne pasture has similar total production to that of temperate pastures in the higher rainfall areas but is less productive in winter. However, the winter grazing that it does supply is vital to property grazing programmes.

On the developed soils on traprock the only pasture species which perform well are lucerne and medic. It has become normal to use both species in new pasture sowings. Pasture development on the traprock is restricted by the small areas of arable land on many properties and by the poor pasture production. The present trend in the traprock of the Inglewood Shire is not to engage in full land preparation for pasture development, but rather a sod-seeding, once-over operation which is very economical and reasonably successful. The technique avoids the weed and erosion problems associated with seedbeds and allows the farmer to develop country well beyond the arable category.

Pasture sowings on some shallow soils have not increased property stocking rate but by supplying some good quality winter grazing have allowed diversification from wool production. There are areas such as at Wobur and Pikedale where lucerne growth is comparable to that on suitable granite soils.

Fertilizer requirements for pasture are high on all soils. The standard recommendation is 500 kg per ha of Mo superphosphate at planting and 125 to 250 kg per ha superphosphate annually. In practice, lower rates are frequently used. This may account for some failures but there are probably situations where pasture growth potential is too low to justify these rates.

The main problems with lucerne pasture is that replant stands are generally inferior to the original pasture.

12.6.3 Irrigated Lucerne for Hay

Lucerne is the largest single crop under irrigation in the study area; it represents 65 per cent of the total area sown to lucerne (approximately 1 160 ha) under irrigation in the Inglewood Shire.

The crop is situated in two main areas;

(a) Devine LS, Unit 5 east from Inglewood, adjacent to the Macintyre Brook, extending slightly into Gore LS (east of Omanama) on Unit 4, comprising of colluvial and alluvial flats. The area of lucerne in these land systems has been estimated at 328 ha.

(b) Bonshaw LS, Units 4 and 5, situated adjacent to the Dumaresq River and also Texas LS on Unit 4, around Limevale. The area of lucerne in these land systems is estimated at 548 ha.

Levels of phosphorus and potassium in these soils are adequate, but, under intensive irrigation, applications of these nutrients, particularly phosphate, is warranted. Almost all new stands are sown with superphosphate containing molybdenum at approximately 250 kg per hectare of Mo_{24} superphosphate.

The water requirements for irrigated lucerne are high and it is estimated to be 12 megalitres per ha per annum. Most of the lucerne is irrigated by the spray system (hand shift, 'tow-line' or 'end tow' and 'travelling irrigator'). Only 20 ha are under flood irrigation.

The main variety grown is Hunter River and is well adapted to the local conditions and yields (15.0 tonnes/ha) are basically comparable with other recognized lucerne growing areas.

Whilst individual stands have persisted for over 30 years, the average is significantly lower. Some poor persistence in lucerne crops can be attributed to poor management, rather than natural decline. However, there are areas on the southern side of the Macintyre Brook, in Devine LS, where the physical nature of the soil affects both production and persistence. This problem also continues farther downstream on the Macintyre Brook. In these areas, the management of lucerne for satisfactory production calls for greater expertise.

Other factors which sometimes cause substantial reductions in plant stands are Witches Broom and various root-rots.

Insects, namely jassids and leaf rollers, cause minor damage but rarely are sufficient to warrant chemical control. Good crop management can overcome some of these. One insect which can be troublesome, especially in the Dumaresq River Irrigation Area, is the White-Fringed Weevil. Young lucerne stands can be seriously depleted if infestations are not treated.

Lucerne is mainly grown for hay production, but may also be used in supplementary grazing when high quality feed is in short supply.

The bulk of the hay produced is sold, either by contract or individual sales to feed merchants and stud properties in neighbouring districts, particularly in Northern New South Wales. The remainder of the hay produced is generally stored on the property for winter feeding and drought periods.

12.6.4 Winter Forage Crops

Winter fodder cropping is much more important to the annual feed programme than summer fodder crops, as this is the period of the year when high quality feed is at a premium. Native pasture production is also at a low ebb.

The area sown is restricted because of limited suitable land on the individual properties. However, a greater area is sown to winter fodder crops than any other form of cropping The area sown fluctuates from year to year, depending on the season, but is estimated at 6 400 hectares (75 per cent situated in the Inglewood Shire).

Oats is by far the most popular crop for grazing purposes. The late maturing varieties (Algerian, Cooba and Camellia) make up the bulk of annual plantings, with smaller areas sown to Belar, Benton, Bentland and Saia. Many other varieties are grown, but the area is relatively small. Availability of seed often determines the selection, rather than any recognized difference in grazing yield potential.

Planting commences in early February, particularly in the eastern section, and late February to late March in the western areas. It is important to sow early in the more elevated granite area to obtain good growth before the onset of cold weather in May.

Further plantings, depending on the rainfall, available land and property need, will be made in May and even as late as July and August. Late plantings will often provide feed into the late spring.

The fodder produced annually from oats, largely depends on seasonal conditions, soil fertility, variety and presence of weeds. Crops sown on the more fertile soils near Inglewood, in average seasons, are highly productive, whereas under similar climatic conditions, crops on the traprock and granite are often lower in yield, due to low soil fertility. With an estimated four years in ten failure rate, stockmen are generally reluctant to use high rates of fertilizer. An indication of the level of response when fertilizer is used, is summarized in the following table:-

TABLE 12.7 - FODDER CROP (WINTER) - GRANITE SOIL (GLEN APLIN 1971) FAIR, WINTER RAIN - PLANTED 21 APRIL 1971

Crop	Date of Harvest	No Fert. Yield	(% Protein)	P (22.5 kg/ha) Yield	(% Protein)	P (22.5 kg/ha) + N (59 kg/ha) Yield	(% Protein)
Cereal Rye	1/7	2464	(17.5)	3485	(16.6)	4498	(21.0)
Oats (Bentland)	5/8	2652	(12.9)	3800	(11.2)	5985	(15.6)
Oats (Camellia)	31/8	2070	(9.2)	5000	(9.4)	10555	(12.0)
Barley (Cape)	5/8	1800	(16.1)	2625	(20.5)	5806	(20.1)
Oats (Algerian)	10/9	2052	(8.3)	3100	(8.1)	4811	(10.7)
Golden Tares	10/9	1523	(25.5)	2168	(30.0)	2330	(28.6)

Leaf and Stem Rust rarely become a significant problem.

12.6.5 Summer Forage Crops

The role of summer forage crops in the Granite and Traprock grazing areas has been a relatively minor one.

Two reasons for this are:-

(a) The main growing period of the native pasture species is during the summer period, and only on rare occasions do the pastures fail to meet requirements.

(b) Cultivation areas are relatively small on individual holdings, and the area available for annual cropping is invariably diverted to winter forage crop production.

More summer fodder cropping, particularly leguminous types, could play a useful role in supplementing the native pastures as well as assisting in alleviating gaps (late summer/early winter and spring) in the feed year programme.

A change in emphasis of types of summer fodder crops could also be beneficial. Approximately, 70 per cent of the 2 700 ha sown to summer forage crops is planted to hybrid sorghum varieties. Whilst hybrid fodder sorghums have a place, the diversion of some of this area to Dolichos Lablab or Caloona Cowpeas is warranted.

Strategically placed summer leguminous crops could alleviate protein shortages in the later summer/early winter period and provide a better means of maintaining body weight and/or milk supply in cattle, until early sown oats crops are available for grazing.

The remaining area sown to summer fodder crops is evenly divided to grazing millets, cowpeas and Dolichos Lablab. However, whilst the area sown is still relatively small, the popularity in these crops is increasing and gradually, they should make up a greater percentage of the area sown annually.

Summer forage crops are scattered throughout the survey area, with greater areas congregated on the smaller holdings such as adjacent to Inglewood.

The soil types on which these crops are grown vary from relatively fertile Brigalow scrub soils in the north-west to the poorer shallower soils of the Traprock and Granite.

Generally, the non-leguminous fodder crops require both phosphorus and nitrogenous fertilizers. Leguminous crops respond to phosphorus in almost all situations.

A summary of the response to phosphate and nitrogen is contained in the following table:-

TABLE 12.8 - FODDER CROP YIELDS*AND FERTILIZER EFFECT

Fodder Crop (Summer - Granite Soil - (McDonnel 70-71) Rosenthal Shire (Wet Summer)

Crop	No Fert.	N (85 kg/ha) + P (22.5 kg/ha)	P Alone	N Alone
Dolichos (Rongai)	6720	4928	11200	4928
Cowpeas (Caloona)	1680	4256	5824	1792
Sudan (Sweet)	2912	8624	2912	2688
Sudan (Hybrid)	5600	16464	7504	9856
Millet (Japanese)	3136	7428	4480	2912
Millet (Siberian)	3472	6720	4032	6272
Millet (Kath Pearl)	3920	11536	3136	9856

*Yield expressed in kg/hectare.

The types and varieties of summer fodder vary. Forage sorghums, as mentioned early, form the bulk of the area sown and can be divided into two types:-

(1) Special purpose crops such as sugardrip, sown mainly for standover feed for autumn and early winter grazing.

(2) Hybrid fodder sorghums, for all-season grazing.

Fodder sorghums are often not fully utilized; this is due to the management practices of set stocking rather than controlled grazing.

Millets form the second largest group of summer forage crops and indications suggest there is increasing interest in these crops in preference to forage sorghums.

12.6.6 Grain Crops

Grain cropping is not a major industry in the main part of the study area. A number of factors, such as topography, soils, machinery and predators, limit expansion into grain enterprises. It is therefore confined mainly to the river alluvials and some of the gentler slopes and deeper soils bordering these flats.

Small areas of the granite-derived soils also lend themselves to a cash-crop role, but this is primarily as a prelude to pasture establishment. Overall this practice has limitation in adaptability.

There is no clearly defined farming system associated with grain cropping in this area. Rotations also include grazing crops. A lucerne cycle is operated on the alluvial flats particularly where irrigation is available.

On valley floors and the adjacent bordering hillsides, grain cropping is very limited and may be disregarded as part of a recognised system.

Cropping is integrated with animal enterprises.

(a) Winter grain crops - Wheat and barley are the only winter crops of importance. Oats are sown as a grazing crop and a grain harvest is opportunist and can be regarded as a bonus.

(b) Wheat - Wheat yields average from 1.25 to 1.60 tonnes per hectare over a range of soil types and conditions. Irrigated crops produce much higher yields, of the order of 3 tonnes per hectare.

Grain quality can be variable and is governed by soil fertility and climatic conditions. Down-grading is usually due to mottling, weed seed, weathering or low grain protein.

On the alluvials, Mexican poppy *(Argemone Mexicana)* is a troublesome weed. Wheat containing seed of this weed is rejected. Other weed pests include turnip-weed, radish, climbing buckwheat and wild oats.

Planting times do not vary greatly from the accepted periods of the main grain belt; but planting rates are slightly lower at 28 to 38 kg per hectare. Frost damage is an ever present danger and this factor is magnified by the climatic conditions prevailing in some of the higher areas of the region, particularly the Granite Belt.

Fertiliser requirements are governed by the results of soil analyses; the main elements in limited supply are nitrogen and phosphorus.

Grain is delivered to the State Wheat Board depots at Texas, Inglewood or Yelarbon.

(c) Barley - Barley is a relatively minor crop. It has a dual purpose role, the grain harvest being opportunist and secondary to grazing.

Clipper is the principal variety and grain is also delivered to the State Wheat Board depots.

Grain yields are comparable to wheat and with ungrazed crops would fall within the average range of 1.3 to 1.8 tonnes per hectare. When the crop has been grazed the grain yield is closer to 0.7 tonne per hectare.

As in other districts, powdery mildew is the most prevalent disease.

(d) Oats - Of all the winter crops, by far the highest area is sown to oats, but oat grain harvesting is not an important aspect.

If the opportunity is presented and harvesting machinery is available, some farmers may harvest seed. This is primarily to cover their own needs with any surplus being available for sale.

A wide range of varieties is grown. Availability of seed supplies and seed price appear to be the major factors, rather than potential yield, which govern the variety sown.

(e) Summer grain crops - The total area of summer grain fluctuates but follows a similar geographic distribution to the winter grains.

(f) Grain sorghum - Only small areas are sown and, generally, performance is variable. Yields of dryland crops are low and many fail at flowering. Irrigated grain sorghum on the river flats have yields up to 5 tonnes per hectare.

The later plantings in December/January have more chance of success, as they flower after the main heat wave conditions. However they are more prone to severe sorghum midge infestation. Bird damage can be excessive on these small areas.

Grain is often sold on an inter-farm basis with consignments on local markets. The depressed stock and wool markets have led to an interest in grain cropping on gentler sloped country.

(g) Maize - This crop is relatively unimportant with only small areas planted for farm use; these are mostly grown on the granite soils.

(h) Navy bean - The area fluctuates and yields are equally variable. The irrigated river alluvials have produced returns in excess of 1.5 tonnes per hectare.

(i) Soybean - In the Granite on granitic soils, the role of soybean is mainly that of a pioneer phase, preliminary to the establishment of permanent pasture. The crop is grown mainly on the wetter fringe of the granite soils. Yields of 0.8 tonnes per ha have been recorded. In the event of a grain crop failure the soybean plant is valuable for grazing. The stubble also has considerable grazing value.

The drier western sections of the granite soils and the traprock soils are unreliable and crop failures are common. Small areas are sown under irrigation and their performance to date has been considered fair, with yields averaging 1.9 tonnes per hectare.

(j) Sunflower - A very small area of sunflower is grown commercially in the Texas district. This is grown as a dryland crop with the accompanying degree of risk. Birds are a major problem; but disease and insect infestations have not raised serious difficulties.

Condamine alluvials - A narrow floodplain of black soil river alluvials on the Condamine River is also included in the study area. Compared to the area of traprock and granite soils, this black soil section is relatively small. However, it is highly productive and is worthy of separate treatment.

This area is ideally suited to grain growing, the deep black soil being highly fertile and the use of nitrogen fertilisers promotes high yields.

Trends in cropping, in this area of the Condamine alluvials, are illustrated in the following table:-

TABLE 12.9 - GRAIN PRODUCTION ON CONDAMINE ALLUVIALS

	Wheat		Barley		Maize		Sorghum	
Year	Area (ha)	Prod. (t)	Area (ha)	Prod. (t)	Area (ha)	Prod. (t)	Area (ha)	Prod. (t)
1951	1583	1222	92	95	61	71	89	129
1960	775	987	552	692	25	18	305	405
1970	513	518	1018	1062	140	200	182	338

The increasing area planted to barley is mainly due to the higher yield potential than wheat, the economic return, the crop's less demanding climatic requirements and its value for grazing if adverse seasonal conditions develop.

Soybean is grown under irrigation, yields in excess of 3 tonnes per ha having been harvested. An average yield of over 2.5 tonnes per ha has been harvested from over 40 ha.

Maize yields, under similar conditions, have been recorded at 10 tonnes per ha.

This subregion is not typical of the study area as a whole, and crop production would parallel the major black soil regions of Darling Downs.

12.6.7 Tobacco

Commercial tobacco has been grown in the area since before the turn of the century, when air-cured varieties were produced, primarily by the Chinese.

Depression in the industry then persisted until flue-cured tobacco varieties were introduced in 1931, and area planted, mainly under sharefarmer culture, increased dramatically to 983 ha in 1960/61.

The district ranked second in importance to Mareeba-Dimbulah in tobacco production for at least 30 years before 1959/60.

The industry was concentrated on the alluvial flats of the Dumaresq River and the Macintyre Brook, as irrigation is essential in a dry climate for economic production.

In 1968, the Coolmunda Dam was constructed on the Macintyre Brook, improving both supply and quality of water available for irrigation. Glenlyon Dam is presently being constructed on the Dumaresq River.

Severe marketing problems in 1960/61 culminated in a dramatic decrease in area from 983 ha to 120 ha, but the introduction of a stabilization scheme to the industry in 1965 increased district tonnage to approximately half of the peak district production of 945 t - this being produced from approximately 280 ha and satisfies stabilization quota requirements. Existing property quotas are fixed by legislation.

This revival has seen a substantial reduction in the sharefarming system - itself a consequence of large property sizes with major grazing interests. Technical advances, such as weedicides, desuckerants, and specific machinery have reduced labour requirements substantially, thus allowing for larger individual crop sizes. Spray irrigation has largely replaced the flood method.

Where possible, cropping has been transferred from hardsetting silty and fine sandy loams to sandier types on which crops average 16 per cent higher prices.

Economics of production is forcing a modernization of the industry. Antiquated, labour-demanding systems, reintroduced temporarily during the revival, now require replacement and major changes in production methods within the district are imminent. The scarcity and cost of suitable labour is a major consideration in this change.

Nut grass *(Cyperus rotundus)* is a persistent weed throughout the irrigation areas of the whole Shire. Herbicidal suppressants, rotation of crops and efficient cultivation methods permit the culture of tobacco in infested soils.

TABLE 12.10 - INGLEWOOD SHIRE TOBACCO STATISTICS

	1973/74	1974/75
Official basic quota (kg)	481 043	481 043
Number of quotas	46	42
Estimated area (ha)	243	283
Estimated production (kg)	409 000	400 000
Number of growers	60	50

(Approximately 100 tonnes of over-quota leaf was held on farms in 1974 and none in 1975.)

TABLE 12.11 - TOBACCO SALES FIGURES (SOUTH-WEST QUEENSLAND ONLY)

	1972/73	1973/74
Total weight sold (kg)	487 291	506 577
Total value ($)	1 031 778	1 268 812
Average price (c/kg)	216.7	250.5
National average price (c/kg)	300	334
Yield (kg/ha)	1 408	1 796
Return ($/ha)	2 995	4 499

(Source: Tobacco Leaf Marketing Board, Brisbane.)

(In 1974, a 14.4% increase in price was negotiated i.e. 36 c/kg and in 1975 a 13.2 per cent increase i.e. 34 c/kg. This is materially assisting in the present mechanization of farms.)

Approximately 114 ha, or 40 per cent of the total tobacco area is grown within the survey limits, in two district sub-areas:-

(1) Tobacco Road, east of Inglewood on the Macintyre Brook, (32 ha = 11 per cent district area).

Within the last five years, this area has undergone change as 30 per cent of the area grown is on sandy soils. The older, tighter silty loams have low water penetration and nutritional problems. Conversion to spray irrigation has also assisted crops of which the majority are grown by property owners.

(2) Texas east or Riverton area on the Dumaresq River (82 ha = 29 per cent of district area).

Crops in this area are grown on fertile alluvial flats of a sandy loam texture (Unit 5 Bonshaw) the fertility of which may sometimes be a disadvantage. Very limited areas of traprock sand (Unit 4 Bonshaw) are used and potentially, these are the best tobacco soils in the Shire.

Spray irrigation has become popular of recent years. Quotas in this area are larger and the sharefarming system has predominated, although a trend towards mechanisation and owner culture is developing. Prices from crops in this sub-area are invariably higher than those from the other sub-areas.

12.7 Apiculture

The granite and traprock area is one of Queensland's more important honey producing areas. It is estimated that the area produces at least 40 per cent of the State's total honey production, most of which is of the higher grades.

The industry is capital intensive and most apiarists using the study area are full-time operators carrying out concentrated bee husbandry practices, including inter and intra-district shifts for the various honey flows which occur at different localities throughout the year. Areas of major importance within the study area are centred on Warwick, Durikai State Forest, Cement Mills, Pikedale, Glenlyon and Eukey. The most important flora are yellow-box and mountain gum (also known as tumble-down gum or hill gum) which are common to all of the above centres except Eukey. At Eukey, winter-flowering eucalypts are the major attraction as support species for colonies during this period of low activity.

The market for honey has been favourable in recent years and demand is considered likely to be maintained. The industry is firmly established and well organized, and is one of the more stable forms of primary production in the study area.

12.7.1 Honey Production

An estimated 820 000 kg[1] was produced in 1973/74 compared to 1 768 000 kg for the whole of the State[2]. Average production per productive hive is significantly higher with 57.5 kg/hive[1] in the study area and 39.2 kg/hive[2] for Queensland. These data are not strictly comparable due to different collection procedures, but are the only figures available for regional comparison.

Honey quality in the study area is also above average. It is estimated that about 80 per cent of production is of the lighter, higher-priced grades of honey which are worth 4 to 8 c/kg more to the producer than are the darker grades.

The beekeeping industry in Queensland became largely mechanised during the nineteen-sixties. Before this, labour inputs to beekeeping operations were a high cost factor. Nowadays, it is rare to find a beekeeper who employs full-time labour. To employ one full-time labourer, a beekeeper would normally operate more than 1,000 hives. However, most full-time beekeepers employ casual labour for a few weeks each year.

Major capital costs for beekeepers are land and buildings, equipment and transport. The latter usually includes a 4 or 7 to 8 tonne truck and a utility vehicle. Also becoming popular are light motor-cycles for 'scouting'. Processing equipment tends to be built up gradually as the beekeeper's operation expands. A typical range of equipment would cost

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1 C. Roff and J. Rhodes, Beekeeper Survey, Qd Dept of Primary Industries, 1973/74. A further 10 or 20 per cent could be added to this figure as a rough estimate of the proportion of honey which is harvested by NSW beekeepers.

2 Australian Bureau of Census and Statistics, Brisbane.

between $6,000 and $9,000. Buildings required include a hot room, which may cost about $1,000 to adapt from a normal farm building, and a garage and workshop to handle vehicle maintenance, carpentry and painting.

Systems of management vary from the 'let alone' systems of small beekeepers to those used by progressive apiarists who manage colonies intensively in accordance with bee husbandry practices. These include migrations for spring build-up, followed by progressive shifts to the various nectar flows through summer and often during winter. For the study area, this involves intra and inter-district movements to take advantage of both pollen and nectar availability in different localities.

12.7.2 The Honey Industry

The major beekeeper organisation is the Queensland Beekeepers' Association, with branches in Brisbane, Maryborough, Caboolture and Warwick, which aims at protecting the interests of beekeepers and the industry, promoting demand for honey, facilitating marketing and encouraging research, flora protection and co-operation on governmental legislation and disease control. The Australian Honey Board controls overseas marketing of honey.

Almost all the beekeepers using the study area are full-time operators. The migratory character of their work means that they do not confine their activities to a zone around their residence or base of operations. Thus, for the study area, only 12 of the beekeepers surveyed were residents - seven from Warwick and five from Stanthorpe. The remainder came from elsewhere on the Downs (six) and the Moreton District (seven).

Financial arrangements between beekeepers and landowners are generally on an informal basis. The most common rate of payment for use of sites is one 27 kg (60 lb) tin of honey per annum per property, but this may vary between 14 kg and 54 kg depending on the number of sites and area of land involved. Fees in State Forest areas at the time of beekeeper-survey were $9 per annum per site. In orchard areas, the landowner may pay the beekeeper to locate his hives for pollination of a particular crop. A major risk in using bees in this way is that nearby pesticide spraying may kill off large numbers of them. At present there are discussions between the Warwick Branch of the Queensland Beekeepers' Association and the Deciduous Sectional Group Committee (of the Committee of Direction of Fruit Marketing), aimed at co-ordinating orchardists' and beekeepers' activities.

The honey industry is one of the few primary industries today which has an encouraging demand pattern. Demand is well balanced between overseas markets, about 36 per cent of total output, and the domestic market. In recent years, demand has strengthened, as indicated by rising prices shown graphically on the following page. This is partly due to rising affluence in 'third world' countries and the demand for 'natural' foods in developed countries.

A further demand facet which is insignificant now, but may expand as society's tastes change, is the production of mead. At present, demand is confined to home producers, a few commercial 'meaderies' in the southern States and one at Pozieres on the Granite Belt.

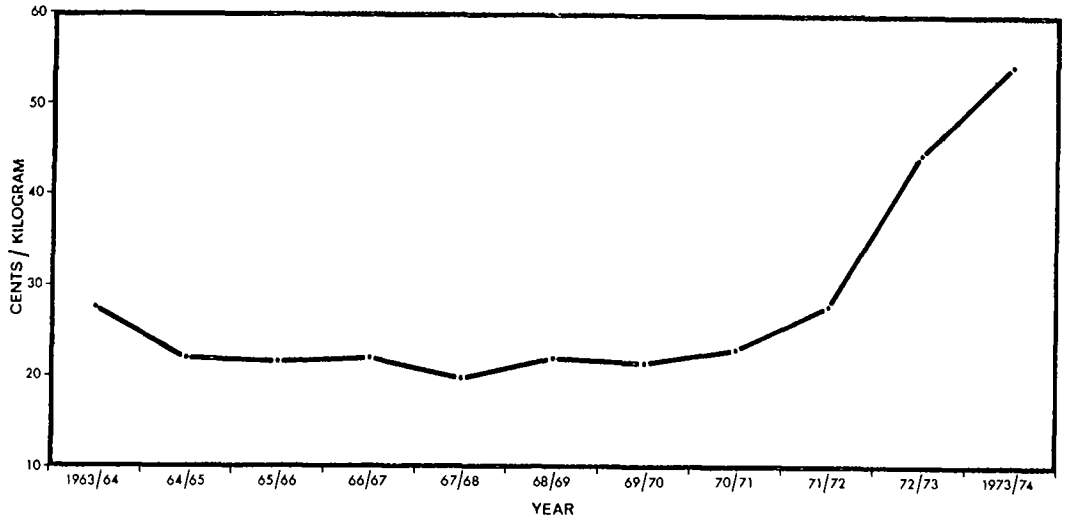

FIG. 12.1 - AVERAGE PRICES FOR HONEY AND HONEYCOMB, ALL GRADES, QUEENSLAND 1963/64 TO 1973/74

12.7.3 Apicultural Land Use

The beekeeper survey, mentioned earlier, has afforded an opportunity to collect data suited to the mapping of apicultural land use intensity. The methodology of this is discussed in Appendix 11.1. This is believed to be the first time that apiculture has been mapped and further data are required. Nevertheless, the patterns shown on MAPS 7 and 9 do give a crude indication of the distribution of apicultural activities in the study area and the relative importance of different areas.

MAP 7 which shows general land use, indicates major areas for apiculture, i.e. areas where intensity is equal to or in excess of 50 hive.months per square kilometre. This is of interest when comparing apiculture with other land use classifications, such as timbered areas, or with competing land uses such as grazing, which requires removal of trees, and with seasonally symbiotic land uses such as orchards.

MAP 9 shows apicultural land use intensity broken into five categories. The classification and mapping disregard the flora aspects of beekeeping activities i.e. the varying importance of areas depending on the flowering of key species at different times during a year, and also the variability of the same factor between years. What follows is an attempt to enlarge on these qualitative factors in relation to the areas highlighted as quantitatively important.

(a) Areas in excess of 90 hive.months/km^2 - (i) Warwick - actual intensity of use in this area, as indicated by the survey, is about 180 hive.months/km^2. This concentration of activity is related mainly to the agricultural cropping on the Condamine flats. Both the spring and autumn flowering of crops, and weeds at other times, are suited to queen breeding; while communities of mountain gum *(Eucalyptus dealbata)* on the upper hillslopes, and yellow box *(E. melliodora)* and brown box *(E. microcarpa)* on the lower slopes in the area produce major nectar flows.

(ii) Durikai and south towards Mt. Burrabaranga - the actual intensity in this area is about 100 hive.months/km^2. The popularity of this area is related to its having been one of the first localities used in intensive migratory beekeeping. A wide range of flora is found and the area is conveniently located.

(b) 50 to 90 hive.months/km^2 - (i) Pikedale, Cement Mills and Glenlyon - the areas centred on Pikedale and Glenlyon have intensities of use of about 70 hive.months/km^2 and the two concentrations at Glenlyon are about 55 hive.months per km^2. The three areas are grouped because they have similar characteristics. Honey production is normally above average and is related to the mountain gum communities and the yellow box/brown box communities on lower hillslopes.

The Glenlyon area also contains a significant population of silver-leaved ironbark *(E. melanophloia)* and this may be the reason for its lower intensity figure. Silver-leaved ironbark is an important cropping species but its nectar flows are erratic from year to year. The period of the beekeeper survey unfortunately coincided with off-years for silver-leaved ironbark flows, and long term use of the south-western part of the study area is consequently underrated.

(ii) Eukey - Intensity of use in this area is about 55 hive.months/km^2. The main attractions here are the winter-flowering species, broad-leaved stringybark *(E. caliginosa)*, New England blackbutt *(E. andrewsii)* and New England peppermint *(E. nova-anglica)*. These are major support species for overwintering in what is a dearth period for the remainder of the study area.

As mentioned above, the poor performance of silver-leaved ironbark during the period of the survey has introduced a bias against the south-western part of the study area. This is a major reason for the apparent non-use of the Dumaresq/ Severn pocket, south of the 6 800 000 m N line. Silver-leaved ironbark is the key species for beekeepers in this area and this did not perform during the survey period. Another element contributing to this area's apparent non-use, is its relative remoteness for Queensland beekeepers, and proximity for New South Wales beekeepers who use the area but were not included in the survey.

Other areas which are considered more important than the intensity figures indicate, are the State Forest areas on the study area's western boundary and a broad band of country between Limevale and Yuraraba. The former contain blue-top ironbark *(E. nubila)* and broad-leaved ironbark *(E. siderophloia)* which are valuable, but erratic, honey producing species which also performed poorly during the survey period. The second area mentioned is reputed to be good yellow box country. Although not intensively used, this area is important to beekeepers. Under-utilisation is possibly related to large property size, widespread tree clearing and poor access.

12.7.4 Physical Factors

(a) Flora - The tree species of major importance to the honey industry in the study area may be divided into four groups.

(i) Mountain gum and yellow box - These have been referred to above and they are prominent in major honey producing areas. These two species in combination are of prime importance in the study area, their characteristics of reliability and high nectar output being highly valued.

(ii) Brown box, white box *(E. albens)* and Caley's ironbark *(E. caleyi)* - These species are important but less so than the previous pair, having a fair degree of reliability at moderate production levels.

(iii) Mugga *(E. sideroxylon)*, silver-leaved ironbark, blue-top ironbark, broad-leaved ironbark, narrow-leaved ironbark *(E. crebra)* - These species are very important to beekeepers. Their production from season to season is very erratic but, during good seasons, they are very productive and beekeepers will move to them at those times.

(iv) New England blackbutt *(E. andrewsii)*, New England peppermint, river red gum *(E. camaldulensis)* - These are important support species, valued for their pollen production. The former two are important in the Eukey area and beekeepers move to these areas in winter. The river red gum usually does not cause beekeepers to move, but is of supplementary value in honey production areas.

Shrubs are also valuable to beekeepers in the support role. *Acacia* spp., *Dodonaea* spp. and peach bush *(Olearia elliptica)* are important pollen sources. These are common throughout the study area.

Also of importance are commercial crops such as lucerne *(Medicago sativa)*, corn *(Zea mays)*, sunflowers and sorghum. In cultivated and otherwise disturbed areas, Mexican poppy *(Argemone ochroleuca)*, mintweed *(Salvia reflexa)*, turnip weed *(Rapistrum rugosum)*, purple-top *(Heliotropium amplexicaule)* and carpet or mat weed can become useful sources of honey and/or pollen.

(b) Climate - Rainfall is the climatic factor which affects honey production most critically, followed by wind and then the temperature/sunlight combination.

(i) Rainfall - Regularity in seasonal rainfall and a total of 200 to 250 mm during the January/February period is desirable to give most major species a growth stimulus. This synchronises with the plants' annual growth cycle and abnormal rainfall receipts upset this cycle. Particularly harmful is persistent rain during flowering time, as this damages flowers and suppresses bee activity. Thunderstorms are generally welcome since they maintain a moist environment, without seriously diminishing sunshine or lowering temperatures.

During spells of heavy rain, floods may prevent access to beehive sites and disrupt beekeepers' movements.

(ii) Wind - Depending on its strength, wind may remove buds and flowers, prevent bees from flying and have a general drying effect. A common threat in autumn is southerly winds which can cause large areas of ground flora to dry up suddenly, making any in-migration of hives a costly and time-wasting exercise.

(iii) Temperature and sunlight - Hard, frosty winters are preferred to mild winters. They are considered to be conducive to better honey flows in the spring, more suited to the bee's life cycle; and they mean a better survival rate in bee colonies over the winter since less work is done.

In summer, heat waves of over 35° C daily maximum can interrupt honey flows, e.g. silver-leaved ironbark flowers turn brown and drop at these temperatures. At maximum daily temperatures of 38° C or more, damage in colonies may occur due to wax melting down. Sunlight is limiting only in winter when, combined with temperature limitations, bees are active for a maximum period of only about four hours between 10 a.m. and 2 p.m. each day.

Bushfires are a threat, mainly in October, and damage can only be averted by thorough clearing of firebreaks and litter around sites.

12.7.5 Pests, Diseases and Other Hazards

Currently, there are no major pest or disease problems affecting the honey industry. The main cause of bee deaths is the increasing use of insecticides and herbicides.

American foulbrood - This disease has considerable potential to become a serious problem. It is a bacterial infection which affects larvae and causes bee colonies to die out. The infected hive may then be robbed by other colonies and thus the disease is spread. A more common way of spreading the disease is by the beekeeper transferring infected combs to other hives. A detailed examination is necessary to discover the disease and, among beekeepers, a constant awareness of the threat is to be encouraged. Some outbreaks of American foulbrood were reported in the study area in 1974/75.

Other miscellaneous problems include *Nosema* disease which causes premature deaths of adult bees and weakens colonies; ants which may take over hives, particularly in drought years; and wax moths which cause destruction of combs in storage.

Insecticides are the main cause of adult bee mortalities. The increased use of herbicides and tree killers, in particular 2,4-D, 2,4,5-T and picloram, is also a problem since it has sharply reduced bee forage.

12.7.6 Future of Apiculture in the Study Area

Encouraging market prospects and the high quality of honey which is produced in the study area indicate a promising future for apiarists who work the study area.

Mechanization has produced a high level of efficiency in the industry and significant further technological advances are not foreseeable in the near future. The use of plastics and fibre glass, instead of wood, for hives and combs is at an experimental stage, but general adoption of these materials will progress slowly.

Some beekeepers have formed groups to co-operate in the use of sites and equipment. This is aimed at cutting costs and should improve efficiency in the industry generally.

The reduction of areas of honey flora is a problem which is said to be becoming more acute. Unfortunately, empirical evidence on this topic is scarce. It is obvious that tree clearing reduces production potential, but the net loss of flora to an area is not so clear when one considers substitute ground cover (crops, weeds and shrubs) and possible regrowth from earlier tree clearing in nearby areas. Beekeeping in the study area became established in an already disturbed environment and it is not evident whether the divergence from this level of flora

availability has been positive or negative overall. Added to this is the problem of determining whether an area is being fully utilised by honey bees or not.

12.8 Mining by A.D. Robertson*

Tin has been the main economic mineral won from the Warwick-Stanthorpe-Texas Area. Although gold (1863) was the first mineral to be worked, alluvial tin (1872) soon took precedence. Silver, lead, zinc, copper, arsenic, wolfram and molybdenite have also been worked from time to time. Around the turn of the century sandstone and granite were quarried for building material. Quarries for brick clay and road metal are still productive.

12.8.1 Tin

Both alluvial and lode tin have been mined in the Stanthorpe district. The deposits are confined within the boundary of the granites. By far the greater production of this mineral has come from alluvial workings. Between 1872 and 1880, 30 649 tonnes of concentrate were recovered. Since 1886 annual production of tin concentrate has rarely exceeded 400 tonnes and in the last 25 years has exceeded 50 tonnes on only 5 occasions.

The alluvial deposits are confined to the Severn River and its upper tributaries (Robertson 1972). The deposits occupy the present stream channels and swampy flats at the heads of the drainage system. Hydraulic sluicing and dredging have been applied to most available ground and most of the old ground has been reworked. As a result, the reserves of the field are very largely depleted.

The only known tin lodes of any consequence occur in the Ballandean district between the Severn River and the New South Wales border. They lie in rough, precipitous country 32 km south-west of Stanthorpe, where an intrusive mass of Ruby Creek granite has been exposed along Red Rock Creek. These lodes are confined mainly to the periphery of the granite.

Between 1893 and 1925, 274 tonnes of concentrate were recovered from the Sundown Tin mine.

Several small ill-defined ore bodies have been worked at Kilminster 9.5 km west of Ballandean but these are considered to be sub-economic. At the headwaters of Pike Creek, Sugarloaf Creek and Quartpot Creek, 'lode type' tin is mainly restricted to numerous small deposits associated with greisenized joint planes and quartz veins. No deposits of economic importance have been found, although extensive prospecting has been carried out.

Total recorded production of tin concentrate from the Stanthorpe Warden's district has been 48 202 t.

12.8.2 Gold

Gold was first discovered at Lord John's Swamp (Lucky Valley) in 1852 followed by Canal Creek in 1863. By 1877 gold had been discovered at Talgai, Thane's Creek, Pikedale, Leyburn and Palgrave. Canal Creek was an alluvial field only while Thane's Creek, Pikedale and Leyburn were primarily areas of reef mining.

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* Geological Survey of Queensland, Department of Mines.

The period of principal production was prior to 1905. During the 1930's attempts at revival of reef mining in the various fields met with only moderate success. Any further prospects appear to be in further development of known reefs below the shallow workings.

The total recorded gold production for the Warwick-Stanthorpe area has been 878 kg of bullion.

12.8.3 Silver and Lead

The largest producer of silver and lead was the Silver Spur Mine, 10.5 km east of Texas. Between 1893 and 1920 an estimated 64 311 kg of silver and 1 473 t of lead were produced. Silver ore shipped to Europe totalled 928 t. In 1952, 162 t of ore sent overseas as a trial shipment returned 290 kg silver and 8.7 t lead.

Mines at Pikedale have produced 852 kg silver and in excess of 10.9 t lead. Other silver and lead producing mines were the Silver King, 3 km north-north-west of Silver Spur and the Silver Queen Mine, 12.9 km by road west of Ballandean. Minor amounts of silver were recovered from gold from the various goldfields. The total recorded production of silver is 70 059 kg and for lead 1 493 t.

12.8.4 Copper

As for silver and lead, the largest producer of copper was the Silver Spur Mine with 1 067 t recovered between 1893 and 1926. In the Sundown area the Sundown Mine worked intermittently between 1898 and 1924 to produce 51 t of copper matte and 225 t of copper concentrate. Since 1924 several unsuccessful attempts have been made to reopen this mine.

Various other mines have produced small amounts of copper in the past. These mines are mainly in traprock country. These mines include the Texas Copper Mine 4 km west of Silver Spur; the Silver Crown Mine 6.5 km east of Silver Spur; the Tolliambi Mine 7 km north-north-east of Silver Spur; the Commodore Mine on the old Warroo Run; and the Ashton Mine on Treverton Creek 64.5 km west of Stanthorpe. In more recent times small parcels of copper ore have been extracted from the Silverwood Copper Mine on Rosenthal Creek 1.6 km west-south-west of Ormoral rail siding on the Warwick-Stanthorpe railway line.

12.8.5 Arsenic

Between 1917 and 1927, the entire arsenic production in Queensland came from the Jibbinbar and Sundown-Red Rock areas. The largest of the arsenic mines was the Jibbinbar Mine 38.6 km south-west of Stanthorpe. The mineralisation at Jibbinbar appears to have been controlled by shear zones in the granulites adjacent to the Ruby Creek Granite. From 1919 to 1924, 1 653 t of arsenic were produced.

The Sundown group of mines occur in strongly metamorphosed sediments and tuffs (traprock) adjacent to the Ruby Creek Granite. The Beecroft Mine was the largest producer of the group. To 1928, 1 179 t of arsenic were produced from the Sundown group of mines.

Small arsenic lodes also occur in the old Kilminster mining area and in portions 9v and 4v, Parish of Moynalty 7 km west-south-west of Gore.

The total arsenic production from the Stanthorpe-Warwick area was 2 879 t. Little or no arsenic has been mined since 1928 and there appears little likelihood of further large deposits being discovered.

12.8.6 Manganese

Numerous small deposits occur in the Palaeozoic sediments (traprock) in the Warwick-Stanthorpe-Inglewood District. Most deposits have been proved to be uneconomic. Manganese has been worked at Mount Gammie, The Glen, Mount Devine, Mount Fuller and Bracker Creek. Total recorded production of manganese has been 805 t.

12.8.7 Molybdenite

Molybdenite occurs as an accessory mineral in many of the vein and fissure type ore deposits. This mineral has been worked near Wallangarra, at Carpenter's Gully near Sundown and in the Kilminster area west of Ballandean. These deposits are now considered to be sub-economic. Recorded production of molybdenite from the Stanthorpe area is 0.5 t.

12.8.8 Wolfram

Wolfram occurs as an accessory mineral in many of the mineral deposits associated with the Ruby Creek Granite and as a minor accessory in alluvial tin deposits. Little mining for wolfram has taken place and there appears to be little likelihood of large deposits being discovered.

12.8.9 Limestone

In the southern border district limestone deposits are restricted to the traprock country between Warwick and Texas. These deposits are grouped in three areas (Siemon 1973). In the Warwick district the deposits at Silverwood and Elbow Valley are generally small and of limited economic importance. In the Gore-Pikedale area limestone deposits were once worked at Cement Mills but those remaining are small and have access problems.

In the Limevale-Riverton area large reserves of limestone and marble occur. The deposits near Limevale are at present being worked on a limited scale. Those deposits towards Riverton are less easily accessible, and no attempt has been made to develop them. The limestones at Craigie and around the Texas Caves will be flooded by the proposed Pike Creek dam.

TABLE 12.12 - RECORDED LIMESTONE PRODUCTION SINCE 1901

Warwick District	30 498 t
Gore-Pikedale (Cement Mills)	1 138 957 t
Limevale-Riverton Area	38 444 t
	1 197 799 t

12.8.10 Coal

Jurassic coal has been reported from a number of localities. The only commercial production has been from Clifton (prior to 1883) and from Mount Colliery, 5.6 km east of Tannymorel. Mining commenced at Mount Colliery in 1887 and ceased early in 1968. The coal recovered was predominantly a bright (perhydrous-clarain) poorly cleated, brittle, pitch-like, high volatile bituminous, non-coking coal, with an ash content of 10 to 20 percent. Diamond drilling (Department of Mines 1960-61) suggested general deterioration of the Mount Colliery seam eastward of the workings. Closure of this mine was brought about by decreasing local demands. No records of production are available for the years 1887 to 1907 inclusive. From 1908 until its closure 1 217 865 t of coal were produced.

12.8.11 Building Stone

Both sandstone and granodiorite have been quarried in the Warwick district. Sandstone has been worked at several sites in the vicinity of Warwick and Yangan for architectural purposes. Near Greymare railway siding 'granite' was quarried for the construction of buildings both in Warwick and Brisbane. The marble deposits at Lucky Valley and Limevale have produced a limited tonnage of material, the bulk of current production being used for terrazzo.

12.8.12 Ironstone

Ironstone crops out 10.5 km north of the Silver Spur Mine. The greater part of the deposit was reported as being brown limonite with some crystalline magnetite and a little free silica. Material from this deposit was used as a flux in the Silver Spur smelters. The deposit is considered to be of little economic significance.

12.8.13 Clay

Brick clay is produced south of Warwick near the Stanthorpe-Warwick highway and processed in Warwick to produce building bricks, paving tiles and agricultural pipes. Other clay deposits have been reported from Dalveen, Emu Creek, Gladfield, Mount Leslie (Killarney), 'The Glen' near Warwick and Wheatvale.

To 1972, 29 423 t of brick clay had been produced from the Warwick district.

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12.9 Forestry

12.9.1 Introduction

Unlike most farming enterprises, forestry is a long term project but, within fairly wide limits, has the advantage that the products can be withheld from sale in times of adequate income and sold when other forms of primary production are giving low returns.

However, the natural forest estate in the study area is not of high quality. It has provided adequate supplies of timber for rural purposes, e.g. fencing, sheds, etc, limited quantities of sawn hardwood, mostly spotted gum *(Eucalyptus maculata)* and narrow-leaved ironbark *(E. crebra)*, and sufficient sawn cypress pine *(Callitris columellaris)* to cater for local needs and a not insignificant export trade.

The study area is broken up into four main subdivisions for descriptive purposes, as follows:

- Spotted gum forest, Herries Ra., Leyburn-Pratten Hills
- General distribution of Cypress Pine Forests
- Granite Belt
- Remainder (Savannah Woodland)

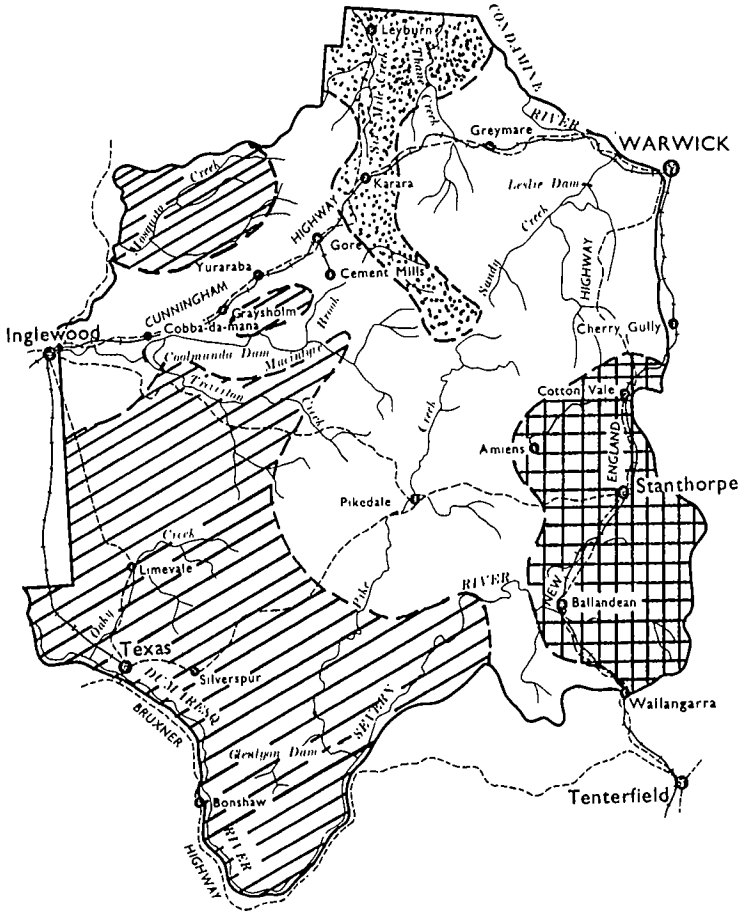


FIG. 12.2 - FORESTRY SUBDIVISIONS

12.9.2 The Herries Range, Leyburn-Pratten Hills Area

The Herries Range, Leyburn-Pratten Hills support a typical dry sclerophyll forest the main types being broadleaf red ironbark *(E. fibrosa* s.sp. *fibrosa)* in pure stands, various admixtures of spotted gum and smaller intervening areas of savannah woodland.

Very little of the more valuable forests in this area remain in private lands but, where they do, adequate espacements will provide a steady if unspectacular income in the future, without detracting markedly from grazing values.

12.9.3 The Cypress Pine Forests

Cypress pine forests occur naturally in a broad arc in the southern and western sections of the study area. These cypress pine forests are confined in the main to the rougher, hillier areas through the savannah woodlands.

The cypress pine commonly grows in association with silverleaved ironbark *(E. melanophloia)* and mountain gum *(E. dealbata)*.

These cypress pine forests are of lower than average site quality and, in their natural state, tend to be grossly over stocked. However, where such stands were thinned to wide espacements early in the century fine stands of large sized trees have resulted. Unfortunately due to associated land use most of such areas are without adequate regeneration to effect stand replacement. With State Forests supporting a cypress pine sawmilling industry in the general area indefinitely, any landholder fostering such well spaced stands of cypress pine will develop a financial asset which can be realized at need.

12.9.4 The Granite Belt

The Granite Belt due to its elevation and somewhat higher rainfall was originally covered with a higher quality moist sclerophyll forest particularly along the fringe of the Great Dividing Range. These forests have in the past supplied quantities of saw logs mainly New England blackbutt *(E. andrewsii)*, white mahogany *(E. triantha)* and white stringybark *(E. wilkinsoniana* and *E. phaeotricha)*. Due to land clearing and intensive land utilisation, future forest productivity will always be low. The naturally occurring species although commonly used on the Granite Belt are among the less sought after timbers as far as general trade preferences are concerned. They have proved to be quite satisfactory for general farm purposes.

The Granite Belt is the exception to the general position in the study area in that intensive forestry work in the form of plantations of exotic pines is not only possible, but an assured market exists for industrial wood (fruit cases) and in later phases for saw logs to the local sawmilling industry.

Provided labour costs can be kept low, e.g. by utilising off-season labour, exotic pine plantations can also be profitable. Pine trees will do well on land that is too rocky for cultivation. However, it should be borne in mind that pine trees will not grow on rock or very shallow soils. Further, no substantial return is possible before 20 to 25 years.

Most farmers can devote small areas of say 3-10 acres of good but uncultivatable land to pine woodlot. Not only does this benefit the individual orchardist but in the aggregate it would eventually provide a substantial resource of case material which could be drawn on in times of need.

As an example, if 500 orchardists each had 5 acres of 20 year old *Pinus radiata* the standing volume would be sufficient to package all Granite Belt production for three years.

12.9.5 The Remainder of the Study Area

Apart from areas discussed already, the predominant tree cover in the study area is a typical savannah woodland, much altered of course by settlement. The main species are narrowleaf ironbark on the intermediate slopes and higher country with various boxes e.g. poplar box *(E. populneum)*, white box *(E. albens)*, yellow box *(E. melliodora)*, and occasional patches of river red gum *(E. camaldulensis)* on the lower flats and stream banks.

Given a prudent balance between timber production and grass production this savannah woodland will provide small but continuous supplies of hardwood saw logs and more than adequate supplies of farm timbers.

12.10 Research and Extension Activities

12.10.1 Granite Belt Horticultural Research Station

This field research station is situated at Applethorpe, 5 km north of Stanthorpe on the New England Highway. It was originally opened by CSIRO in 1934 to undertake work on apple and pear root-stocks.

In 1962, the station was taken over by QDPI. Staff was increased, facilities enlarged and investigations have been widened. It is the centre for all research work in horticultural crops (fruit and vegetables) in the Granite Belt and for adjoining horticultural areas such as Warwick and Inglewood.

There are eight graduate personnel attached to the station, comprising horticulturists, plant physiologists, plant breeders, entomologists and a pathologist. As apples are the major horticultural crop, they receive the most attention. Investigations are on an applied regional basis and at present major lines of study include:-

(a) Close planting trials - to determine the correct root-stock, spacing distance and pruning system for high density plantings of apples and pears.

(b) Water usage - the study of plant water relationships and their effect on growth and yield. This is a necessary corollary to close planting but applicable to other management systems. Trickle irrigation is being used in the experimentation.

(c) Determinations of major nutrient requirements of apple trees through fertiliser trials, foliar analysis and survey methods.

(d) Apple measles complaint - effect of boron, manganese and calcium on its development and incidence.

(e) Soil pH studies - movement of liming agents through the soil profile.

(f) Deciduous fruits breeding - the production of early maturing quality red apples and yellow fleshed peaches through cross pollination of selected parents.

(g) Propagation trials - induction of striking of hardwood cuttings through bottom heat and indole butyric acid (IBA).

(h) Plant introduction - (i) Wine Grape Varietal Trials.
(ii) Strawberry Introduction.

(i) Soil management - weedicide screening.

(j) Plant protection - continually recurring pest and disease schedule trials to test timing and concentration rates of established and introduced insecticides and fungicides.

(k) Tomato Variety Trials.

As the station is of limited area (8 hectares) many trials are laid down on co-operative growers' properties under close supervision of station staff.

12.10.2 Hermitage Research Station

The Hermitage Research Station is located 6 km east of Warwick. The Station has an area of 230 ha and is one of the larger plant breeding and agronomy centres conducted by the Queensland Department of Primary Industries. In addition, facilities are provided for livestock research, especially pig breeding and beef cattle nutrition in feed-lot and field conditions. There is a fauna research section and studies are conducted in apiculture and sheep husbandry.

The Hermitage Research Station was established in 1898 and has provided technical data in agriculture and animal industries applicable to southern Queensland. Although the plant breeding investigations in wheat, oats, barley, linseed, sorghum, soybean, sunflower and maize have greater significance to the grain producing areas of the Darling Downs, related work in grazing crops and testing of pasture grasses and legumes has been undertaken to deal with problems of the granite and traprock region of the southern Downs.

The experimental programme based on Hermitage is being continually expanded by use of district sites, serviced by mobile plant, to more accurately define and overcome the problems faced by primary producers.

12.10.3 Inglewood Field Station

The Inglewood Tobacco Experimental Station site was acquired by QDPI in 1953, with funds provided by the tobacco industry, to investigate agronomic problems in the tobacco industry within the Inglewood Shire.

Experimental work in tobacco proceeded until 1962, after which, as a result of marketing problems, the area of the district crop was reduced by almost 90 per cent. Station activities were subsequently reduced to maintenance only, until 1968, when management of the Station reverted to Agriculture Branch, and the name changed to Inglewood Field Station.

The present function of the station is to investigate the research problems of irrigated crops particularly within the Inglewood Shire. Specific areas being researched are:-

(a) Amelioration of the low penetration and crusting alluvial soils which occur within the shire,

(b) irrigation techniques for the above-mentioned soils,

(c) varietal and agronomic investigations into potential district crops, namely navy bean, soybean, wine grapes and winter cereals.

Research results will apply to both the Coolmunda and Glenlyon Dam areas.

12.10.4 Extension Services

Information and advice on primary production can be obtained from the following officers of QDPI in or near the study area.

WARWICK, P.O. Box 231, Q, 4370: Tele. WARWICK 611733
STANTHORPE, P.O. Box 298, Q, 4380: Tele. STANTHORPE 811900
INGLEWOOD, P.O. Box 47, Q, 4387: Tele. WHETSTONE 381

12.11 Soil Conservation

According to available departmental records, soil conservation measures have been applied in the Granite and Traprock area only since the early 1950's.

The total area protected by contour banks or contour guidelines for the Rosenthal, Stanthorpe and Inglewood Shires stands at 7 135 ha at the end of February 1974. In general it can be said that these measures have worked very satisfactorily. Much more has to be done, however, and it is hoped to boost the application of further soil conservation treatment. The three shires are scheduled for declaration as Areas of Soil Erosion Hazard by 1978.

The maintenance of sufficient soil surface protection is an extremely important factor in the prevention of erosion in the area.

Since 1965, until 1975, climatic conditions in much of the area have been harsh with low amounts of effective rainfall and high evaporation caused by extreme temperatures.

The switch from sheep to cattle on many properties could have a beneficial effect on the density and quality of surface cover because of their different grazing habits. The return of medics into some paddocks is already evident.

12.11.1 Erosion

Soils in the area are very susceptible to erosion once the original grass cover is removed and the soil surface disturbed. Broken topography and steep slopes aggravate this problem in many parts of the area.

The brigalow/belah soils in the west of the study area (Soil Mapping Unit MUg-D) are erosion prone under cultivation. Cultivated areas are typically large with long slopes. High amounts of runoff can therefore result in serious damage.

Drainage line erosion is a commonly occurring feature of the area and can become severe in areas of greater soil depth, e.g. as in the Evandale, Glenlyon, Texas, Gore, Warroo and Canal LSs.

Uncultivated land - Over-grazing of native pastures can result in severe erosion. During dry years since 1965 when native pasture growth failed to reach graziers' expectations, grazing pressure automatically increased. Where this situation continues for some time there is a likelihood of grazing lands becoming more prone to soil erosion because of lack of adequate plant cover.

An overpopulation of rabbits can also cause considerable damage to the soil surface in addition to accentuating any tendency to overgrazing.

Cultivated land - Some practices used when soils are cultivated for grain cropping or fodder crops are detrimental to the soils and cause erosion problems in the absence of special measures.

Some of these practices are:-

- The use of a bare ground summer fallow.
- Overworking of cultivations.
- The use of disc implements which encourage surface sealing, excessive runoff and soil erosion.
- Working around a paddock, which contributes to the erosion problem, particularly in the 'finish outs' and in the 'up and down the slope' workings and plantings.
- The 'six weeks' method of grazing lucerne, which results in extreme overgrazing during the last two weeks.
- Severe overgrazing of mixed grass pastures.

Horticulture - Two common orchard practices that can result in damage are:-

- Clean spring/summer cultivation in between trees.
- Up and down slope tree rows.

Forestry - Badly located logging tracks severe gully erosion.

12.11.2 Soil Conservation

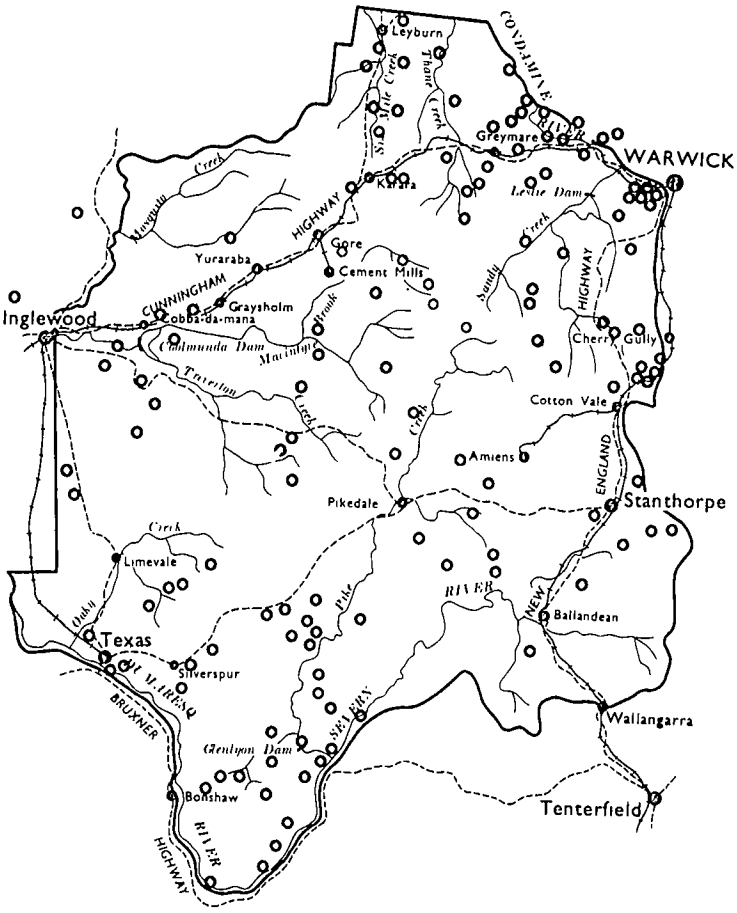
Statistical records - In May, 1960 the number of landholders co-operating with Soil Conservation Branch in erosion was 33. By early 1974 these had increased to 164. By 1970 some 6 200 ha of land in the area had the benefit of soil protection measures and this had increased to over 7 000 ha in early 1974.

The approximate location of each co-operator is shown in Fig. 12.3. The total number of co-operating landholders per land system is shown in Table 12.13.

TABLE 12.13 - SOIL CONSERVATION CO-OPERATORS BY LAND SYSTEMS

Land System	No. of Co-operators	Land System	No. of Co-operators
Roberts	0	Canal and Leslie	37
Norman	3	Thane	14
Eukey	5	Evandale	3
Summit	1	Gore	10
Magnus	0	Warroo	8
Severnlea	1	Arcot	0
Washpool	3	Bonshaw	7
Jibbinbar	0	Texas	7
Glenlyon	22	Magee	1
Pikedale	12	Bundella	1
Ironpot	10	Devine	6

The previous figures do not equal the total 164 co-operators in the three shires. This is because some of the co-operators are outside the area covered by the survey.



o Approximate Locations of Soil Conservation Co-operators

FIG. 12.3 - SOIL CONSERVATION CO-OPERATORS

Soil conservation measures - (a) Structures - Because of the frequent dry seasons of long duration the general approach has been to survey and construct mainly level banks. This is an effort to keep as much water on the paddock as possible and let it soak into the ground. The effect is often clearly visible in the improved stands of pasture or crop in a strip below each bank. A further advantage is the improved workability of the entire bay between banks. All banks in the area are on 'double spacing'.

After construction, one or both of the outlets can be left open until the structure has settled. After settlement, the outlets can be blocked off to pond water.

Because of the erodibility of the soils the use of gapspreader banks has not been recommended. However, one grazier has been trying a type of gap bank with apparent success.

In orchards or vineyards it is often desirable for bank gradients to be at least 1% to prevent waterlogging of tree roots. To keep tree rows parallel, gradients up to 2.5% can be used. These steep gradients do not cause wash in the channels because the length of the banks is usually very short.

(b) Grass strips - The use of grass strips has not been favourable. The reason for this is again the climatic conditions that can result in the grass strips being as bare as the cultivated bays they are supposed to protect.

(c) Guidelines - Level guidelines are quite often used on low sloping areas of up to 4 per cent so that cultivation on the contour can be carried out during establishment of improved pastures.

(d) Agronomic measures - The following measures should be standard practice:-

Use of tyned implements.

Rough tillage and reducing fine seedbed preparation to a minimum.

Contour working and planting following properly surveyed level guidelines (particularly on long slopes on brigalow/belah soils).

Crop residue retention in case of grain or fodder crops to prevent raindrop splash and surface crusting, and to increase water penetration.

Strip cropping (alternate winter crop and pasture strips) on long slopes where feasible.

(e) Grazing management - Overgrazing of native and improved pastures should be avoided as far as possible.

(f) Drainage lines - When new areas are being cleared of timber and broken up for the planting of improved pastures the existing drainage lines should be left undisturbed, unless the drainage lines themselves are eroding; in which case the recommended soil conservation practice may be clearing of timber in the drainage line and sowing to permanent pasture.

Actively eroding drainage lines should be fenced off and an attempt made to introduce kikuyu grass. Normally this type of work will need regular attention and is time consuming. However, the successful end result is very rewarding. Under carefully controlled grazing these stabilised drainage lines can then become a source of excellent fodder. This type of work is particularly applicable in Glenlyon and Evandale LSs.

12.12 Irrigation and Water Supply

12.12.1 Farm Dams

The types of farm storages designed and constructed in this area are:

(i) Gully dams - These are built using a compacted clay core and cut-off trench, with earthfill or rockfill batters.

Gully dams have been constructed in both traprock and granite areas.

(ii) Concrete weirs - These are constructed as unreinforced concrete mass gravity structure on rock foundation.

Weirs have been constructed in granite areas.

Some examples of the above types of storage are given in the table below.

TABLE 12.14 - EXAMPLES OF FARM DAMS AND WEIRS

	TRAPROCK		GRANITE		
	1	2	3	4	5
Storage type	dam	dam	dam	dam	dam
Industry	wool growing & fattening		fruit and vegetable growing		
Usage	irrigation of pasture	spray irrigation	spray irrigation	spray irrigation	spray irrigation
Storage volume (Ml)	115	22	31	19	24
Cost/ Ml	$65	$290	$110	$340	$245
Material classification	SC/CL, CH, SM	SC/CL, CL, SC	CH, CL, SC/CL	SW/SM, SC, SC/CL, CL	granite foundation
Location of borrow	within storage	within storage	within storage	outside storage	-
Completion date	1964	1972	1962	1973	1972

SC sandy clay
CL low plasticity clay
CH high plasticity clay
SM silty sand
SW sand

Each type of catchment and structure has presented different design and construction problems which in the case of the traprock areas include difficulties in obtaining suitable cut-off due to the broken nature of the rock and in estimating runoff from the catchment.

In the granite areas the most suitable sites topographically are usually remote from supplies of clay. Limited use of impervious membranes is sometimes possible. In other instances where the granite is shallow, rock joints are sometimes difficult to handle.

The construction of weirs in the granite area are more common than in other areas, as good clean rock foundations are more readily located, although deep joints and faults are sometimes difficult to avoid and require grouting.

12.12.2 Groundwater

The groundwater potential of the area is described on the basis of a rock type classification. The groundwater resources of the region are contained in alluvial sediments, granite and metamorphic rock areas (fractured rocks) and the sandstone-shale sequences bordering the Great Artesian Basin (porous rocks).

(a) Unconsolidated rocks -
Unconsolidated rocks show little cementing between grains; compaction is negligible, and open space between grains or porosity is very obvious. Included in this group are the alluvial deposits of the main streams in the area, viz. the Condamine River, the Dumaresq River and Macintyre Brook. A few minor streams are also considered.

Aquifers in the alluvia often produce high yields of a quality suitable for irrigation and town supply purposes.

(i) Condamine River alluvium - There is only a short section of the Condamine River within the study area i.e. from Warwick downstream to about Ellangowan. The alluvium associated with this section averages 2.5 kilometers in width, but varies from 0.5 kilometers at Warwick to a maximum of 8 kilometers at Ellangowan.

Depth varies between 16 metres with an average of about 20 metres. Unconfined sand and gravel aquifers of reasonable uniformity and extent persist throughout most of the section. However towards the downstream end (Talgai-Ellangowan) semi confined aquifer conditions occur. For the most part the sands and gravels are 10 metres thick and are located near the base of the alluvium. In deeper areas of the downstream end an upper aquifer 4-9 metres thick is encountered at depths ranging to 10 metres below the surface.

As can be expected in an alluvial deposit, bore yields vary considerably from 0.3 litres per second to 40 litres per second but are usually in the range 8-15 litres per second.

Water quality is fairly constant throughout the section, with most waters containing 500-800 milligrams per litre of total dissolved salts. In most cases the water is suitable for domestic and stock use but suitability for irrigation purposes is sometimes in doubt because of excessive bicarbonate concentrations.

(ii) Dumaresq River alluvium - The alluvium of the Dumaresq River varies in width from very narrow river channel deposits at the headwaters to flood plains 5 kilometres wide at Texas and averaging about 2 kilometres. Depth of unconsolidated sediments varies from 30 metres to 80 metres as a result of the alluvial infilling of an old valley. However the base of the productive zone is usually about 10 to 12 metres below the surface. The underlying deeper sediments are mostly claybound and yield small supplies.

The shallow productive alluvium contains unconfined sand and gravel aquifers 4 to 9 metres thick of which about half the thickness is saturated. Available drawdown is therefore small and large diameter bores (or wells) are necessary to extract water at reasonable pumping rates. Yields of up to 15 litres per second could be available at favourable locations from large bores or wells. A favourable site may require extensive test drilling to find a spot where aquifer thickness is adequate or where the local permeability is high enough.

Water quality is suitable for most purposes over the greater part of the alluvium. There are occasional areas where the water is unsuitable for domestic use. In addition the bicarbonate concentration sometimes gives rise to high residual alkali values thus making the water unsuitable for irrigation use. In the upper reaches total dissolved salts content ranges from 250 to 900 milligrams per litre and decline downstream where at Texas the range is 130 to 340 milligrams per litre. Samples from bores close to the edge of the alluvium sometimes show total dissolved salts up to 1 100 milligrams per litre. Average quality for the area is 400 milligrams per litre of total dissolved salts.

(iii) Macintyre Brook alluvium - On the whole the alluvial deposits associated with the Macintyre Brook are relatively narrow and extent to a depth of about 15 metres. Semi-confined aquifers occur at the junction of Macintyre Brook and Bracker Creek, but elsewhere there is no evidence of significant aquifers.

The irrigation potential of the alluvium associated with this stream is low.

(iv) Treverton, Thane and Canal Creeks - The alluvial deposits along Treverton Creek are up to 700 metres wide and 20 metres thick. It is thought that the alluvial development of Treverton Creek offers good prospects for obtaining up to 5 litres per second from properly constructed bores.

The alluvial development of Thane Creek appears to be irregular. Some good local gravels exist which produce stock and domestic supplies, but useful irrigation supplies have not been recorded.

The alluvium associated with Canal Creek is highly variable in depth and width. In some areas the main water beds are struck at about 30 metres. Usually the aquifers are unconfined and produce low yields. These aquifers are not considered to have any irrigation potential.

The alluvial aquifers associated with these minor streams are generally suitable for stock and produce water suitable for crops with medium salt tolerance. Some waters are suitable for domestic use. However wide quality variations do occur and total dissolved salts up to 7 000 milligrams per litre have been recorded in extreme cases.

(b) Consolidated rocks - Consolidated rocks exhibit considerable bonding between the grains composing the rock mass. In addition compaction is a noticeable feature. In the study area consolidated rocks do not yield large quantities of groundwater. Most bores which tap these reserves are used for small stock and domestic supplies and irrigation use is insignificant. As previously indicated the group can be divided into fractured rocks and porous rocks.

(i) Fractured rocks - This subgroup includes igneous, metamorphic and those sedimentary rocks in which the chief mechanism for water storage and transmission is by means of fractures such as cleavages, joints, bedding planes, solution cavities etc. Voids or pores between grains are absent or are of minor importance.

The subgroup includes the Mesozoic granites of the Granite Belt, as well as the Palaeozoic metasediments and volcanics of the 'traprock' country between Leyburn and the Queensland/New South Wales border.

The granite is jointed and often weathers to a sandy clay. Where the weathered zone is reasonably well developed, unconfined fractured aquifers are produced. Although these joint systems do hold small amounts of water suitable for domestic and stock purposes, these are poor prospects for obtaining large, long term supplies.

The metasediments and volcanics of the traprock area do not normally produce good supplies of water. The quality of the water is often poor, and the rocks are usually very hard to drill. Useful stock supplies have been located where the rock is highly fractured locally, and is in a suitable location to receive recharge, that is close to major gullies.

To the south-west of Warwick is an area of Mesozoic sandstones and shales yielding good stock water supplies from fractures and joints within the rock mass. The same applies to the sandstones and shales in the vicinity of Leyburn. Near Inglewood the same rocks become porous and are discussed in the following sections.

(ii) Porous rocks - Porous rocks are able to store and transmit water readily through inter-granular voids.

In the north-west portion of the study area near Inglewood some Mesozoic sandstone aquifers thin out against the traprock basement.

The water quality is generally good, although high in bicarbonates, but yields are usually 0.4 to 0.5 litres per second. The supplies are suitable for domestic and stock purposes but are inadequate and of unsuitable quality for irrigation.

(c) Bore and well licence requirements - Licences under the Water Act 1926-1973 are required for all artesian and sub-artesian bores throughout the study area. Bores or wells solely for domestic purposes do not need licences.

A bore licence sets out conditions relating to the construction of the bore, the manner in which water can be used, and the quantity of water which may be used.

The main purpose of licencing is to ensure equitable distribution of the available groundwater supplies and to prevent their over-development. It is also a useful means of obtaining technical data on the occurrence, quantity and quality of supplies and the extent of water use.

12.12.3 Irrigation Projects

(a) Upper Condamine Irrigation Project - The purpose of the Irrigation Project is to supply water to both the City of Warwick and to irrigators along some 196 kilometres of river from Leslie Dam situated on Sandy Creek to Cecil Plains on the Condamine River.

Water is diverted by private pumping onto land adjacent to the supplemented section of Sandy Creek and the Condamine River, and includes the privately operated Condamine Plains Water Board, which is a group irrigation scheme using water released from Leslie Dam.

(i) Leslie Dam - Stage I of this dam, situated on Sandy Creek 8.5 kilometres from its confluence with the Condamine River was completed in 1965.

The capacity of Stage I is 47 119 megalitres, and by the addition of crest gates in Stage II this can be increased to 107 000 megalitres.

The dam is a mass concrete gravity structure with an overall length of 399 metres, and its height above stream bed to fixed spillway crest is 23.77 metres.

As the dam is founded on coarse grained granite in which a number of defects were present in the form of fault zones, four of the monoliths are anchored by stressed cables situated in holes drilled through the base of dam, and up to 21 metres into rock.

The surface area of Stage I of the reservoir at Full Supply Level is 708 hectares, and the length of shore line is 33.8 kilometres. Catchment area of the storage is 585 square kilometres, and the average annual rainfall on the catchment is 660 millimetres.

(ii) Water availability - The original estimate of assured annual yield from Stage I of the dam was 15 170 megalitres for irrigation after allowing for an annual supply of 3 200 megalitres for the City of Warwick. However, as a result of actual operational behaviour since the completion of the Project, the estimated assured annual yield for irrigation has been reduced to 12 950 megalitres.

Water is released for irrigators as required, but generally irrigators are not permitted to exceed their individual allocations.

(iii) Allocations and licences - Currently there are 72 licences issued to 61 irrigators for the diversion of 14 380 megalitres for irrigation on the section of river supplied from Leslie Dam, in addition to the 3 200 megalitres allocated to the City of Warwick. It is obvious therefore that the water available from this project is currently over-committed.

All supplies are metred. Charges for irrigation water are currently $2.43 per megalitres.

(iv) Water use - The water supplied to farms is used to irrigate pastures, soybean, cotton and summer grains. The availability of water has allowed expansion of the cotton industry and resulted in the establishment of a cotton ginnery at Brookstead.

(b) Macintyre Brook Irrigation Project - Coolmunda Dam was built to provide an assured supply of irrigation water in Macintyre Brook to enable an area of up to 3 200 ha to be irrigated, thus permitting existing landholders, forced out of tobacco cropping, to convert to other farms of irrigated production. These include lucerne, grain and fodder crops, irrigated pastures for fat lamb raising and beef fattening, together with some horticultural crops such as apricots and grapes, on suitable soils.

The water is diverted by private pumping from Macintyre Brook along which there are some 8 500 ha of alluvial soils suitable for irrigation.

(i) Coolmunda Dam - Constructed between 1963 and 1968, the dam is 2 286 metres long with a maximum height of 18.9 metres to the crest of the bank above stream bed level, and has a storage capacity of 75 242 megalitres.

The structure is comprised of a zoned earth and rockfill embankment, and has a gated spillway some 107 metres in length on the left bank of the stream. This spillway is fitted with seven automatic, counter-balanced, steel, radial gates each 12.8 metres wide by 11.12 metres high. When the reservoir level rises more than a few centimetres above Full Supply Level the automatic gates are activated by the change in the water level on weights in chambers installed in the gate piers. No external power is required to open or close the gates.

To provide for the remote possibility of a larger flood, an emergency 'fuse plug' spillway has also been designed at the left hand end of the embankment 1.22 metres lower than the balance of the dam.

The surface area at Full Supply Level is 1 730 ha and the shore line is 30.6 kilometres. The catchment area is 1 735 square kilometres with an average rainfall of 615 millimetres.

(ii) Water availability - Water from the dam is released to Macintyre Brook for irrigation by private pumping from the stream. Distribution is assisted by the four weirs which had already been constructed along the supplemented section of river, prior to construction of the dam.

The assured annual yield in the stream including the yield from the weirs, is 18 400 megalitres.

The supplemented section of the river is some 78 kilometres in length and extends from the dam to the junction of Macintyre Brook with the Dumaresq River.

(iii) Allocations and licences - Currently there are 94 licences issued to 56 irrigators for the supply of 4 530 megalitres A number of amendments to licences and new licences now being processed will bring this total to 72 irrigators and 14 800 megalitres allocated for irrigation. The remaining water is either already allocated to the town of Inglewood or is reserved for further town use or development of irrigation on adjacent areas.

All supplies are metred, and charges for irrigation water are currently $2.40 per megalitre.

(iv) Water use - To date this has been low in comparison with available supplies and has been used mainly on tobacco and horticultural crops. With a recent upsurge in interest it is now expected that water use will increase and crops grown diversify.

(c) Dumaresq-Barwon Border Rivers Project - The project is being implemented to supply water to farms on alluvial flats along Pike Creek, the Dumaresq, Macintyre and Barwon Rivers on the Queensland/New South Wales Border extending from Glenlyon Dam on Pike Creek in Queensland to Mungindi Weir on the Barwon River some 500 kilometres downstream.

The scheme is being undertaken by the Border Rivers Commission on behalf of the States of Queensland and New South Wales.

Glenlyon Dam is the first stage of an extensive scheme envisaged ultimately to develop fully the natural water resources of the Border Rivers area, and to stabilise and expand agricultural production in the region.

(i) Glenlyon Dam - Currently being constructed on Pike Creek, this dam is situated 6.4 kilometres from the junction of the creek with the Dumaresq River.

Its capacity will be 261 500 megalitres which gives an assured yield for irrigation in excess of 90 000 megalitres.

The dam will consist of a zoned earth and rockfill embankment some 466 metres in length at the crest and 60.3 metres above the creek bed. At full supply level the water will be 48.5 metres deep.

(ii) Water availability - Water from the dam is to be shared equally between Queensland and New South Wales. On the Queensland side of the border, water will be supplied to irrigators downstream as far as Goondiwindi, 218 kilometres downstream of the dam, while on the New South Wales side the water will be used in conjunction with that from Pindari Dam on the Severn River and will be available downstream as far as Mungindi Weir, 498 kilometres from Glenlyon Dam.

(iii) Allocations and licences - Water will be allocated to the irrigators along the stream in proportion to areas suitable for irrigation. It is expected that the number of licences issued will increase because supply has been restricted for several years to the present licences.

All supplies will be metered and water charges levied. While these have not yet been determined they are anticipated to be of the order of $2.50 per megalitre.

It is expected that the assurance of supply to riparian landholders will give the region a much needed security by enabling them to engage in cropping with some protection from drought.

(iv) Water use - Initially water use is expected to be for tobacco production which is presently restricted because of the inadequate water supply. The growing of fodder and possibly fruit is expected to expand as the project becomes established.

13 AGROCLIMATOLOGY OF THE GRANITE AND TRAPROCK AREA

by A.K. Wills

TABLES

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

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TABLES

FIGURES

13 AGROCLIMATOLOGY OF THE GRANITE AND TRAPROCK AREA

by A.K. Wills*

Agroclimatology is the study of climate as it affects agriculture. This definition generally extends to include silviculture. The field covers effects of weather on yields and incidence of disease, plant growth parameters, microclimatology and weather hazards. Its applied side is in the recognition of adverse climatic situations and in the avoidance or modification of them.

A section on 'Climate' is included in the land inventory section of the report. This is aimed at describing the natural climate of the study area, with only limited reference to its effects on human activities.

The aim of this section is to highlight some of the more important climatic elements which can be critical to agricultural output. Although climate or weather has always been regarded as an important determinant, considerable agricultural research has either ignored climatic variation or treated it as a constant. This section is an attempt to document the optimal and limiting climatic factors affecting agricultural enterprises in the study area, and to present the information in the context of the prevailing climate and its variability characteristics.

The task was approached by relating the specialist knowledge of local QDPI officers to detailed meteorological data, which are collected at the three research stations serving the study area. It is considered that the findings would be applicable within the climatic subdivisions (section 4.2) surrounding each station, while interpolation would be feasible for the other subdivisions. Questionnaires on climatic requirements and limitations for each product were completed by specialist officers. An example of the blank questionnaire form is attached as Appendix 13.1. Information obtained through the questionnaire was assessed and the most critical parameters selected. From the daily weather records of each station frequencies of occurrence, dates and durations of relevant phenomena were assessed. This assessment is presented with comments on the suitability of the area for the various crops.

While incomplete knowledge of optimum requirements and unavailability of data have limited the scope of this study it is hoped that these examples may create an awareness of the type of climatological data which is available and stimulate more profound studies. These should ultimately help the primary producer to determine the relative climatological risks associated with different enterprises.

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13.1 Livestock

The most serious direct threat to livestock is from abnormally cold weather conditions accompanied by wind, especially if the animals are already in poor condition. Sheep are particularly affected if the cold snaps occur in the lambing and shearing months from August to October.

Livestock are climatically vulnerable in the indirect sense mainly through the effects of climatic variation on the state of pastures. The temperatures analysis for dairy production given in a following section (section 13.1.2) will also give some indication of the cold weather threat to the wool and beef industries, but a detailed analysis would examine frequencies and durations of combinations of factors such as temperature minima, average wind strength, rainfall and humidity.

One further threat applies to sheep during the warmer months of the year. Conditions of prolonged rain, for about two weeks or more, cause fleece-rot and predispose sheep to blow-fly strike, which can be fatal if not treated in time. With good management, serious losses can be averted but they are most likely when flooding prevents access to the flocks. This type of prolonged flooding is uncommon in the study area and blow-fly is somewhat less of a threat than in the more extensive and low-lying wool-growing areas of Queensland.

Warm weather in the study area is seldom excessive for beef cattle and there is generally sufficient shade available for shelter when temperature peaks are reached. High temperatures are therefore not considered a direct threat to beef cattle.

13.1.1 Beef Cattle and Sheep

Native pastures are the main source of forage for grazing livestock in the study area. The main pasture production problems are the lack of growth due to low temperatures and lack of soil moisture during prolonged dry periods. Most improved pastures, irrigation and fodder conservation strategies are aimed at overcoming these deficiencies.

The key parameters given below are estimates of the needs and limitations of a typical native pasture mix for the study area, as indicated in section 12.6.1. Although temperatures, sunlight and rainfall are treated separately below, the condition is essentially an integrated one.

Information from the questionnaire indicated that temperatures are most critical in the October to April period and heatwaves can seriously deplete soil moisture reserves, especially on the shallow soils so typical of much of the area. Optimal daily maxima and daily minima for this period are estimated at around 32° C and 21° C respectively. Native pasture production may be reduced when daily maxima reach 40° C for one day, 38° C for three consecutive days or 35° C for seven

consecutive days. From April to October, low daily minima reaching 2° C for two days or 3° C for seven days are also considered to affect pasture production adversely.

Sunlight is fundamental to plant growth and it is estimated that native pasture growth could be retarded if sunshine hours fall below 6 hours per day for a period of 2 to 3 weeks or more. In summer an optimum figure would be around 8.5 hours per day. Sunlight is generally not a limiting factor.

Soil moisture is the main control on pasture output and, taking Pikedale as an example, the following graph shows monthly rainfall needs compared with reasonable expectations. The former values are derived from the questionnaire and the latter values from two Bureau of Meteorology sources (1966 and 1968). Shading on the graph lies between the optimum line and a mean of the latter two, and highlights the periods of deficit and surplus rainfall which can be expected.

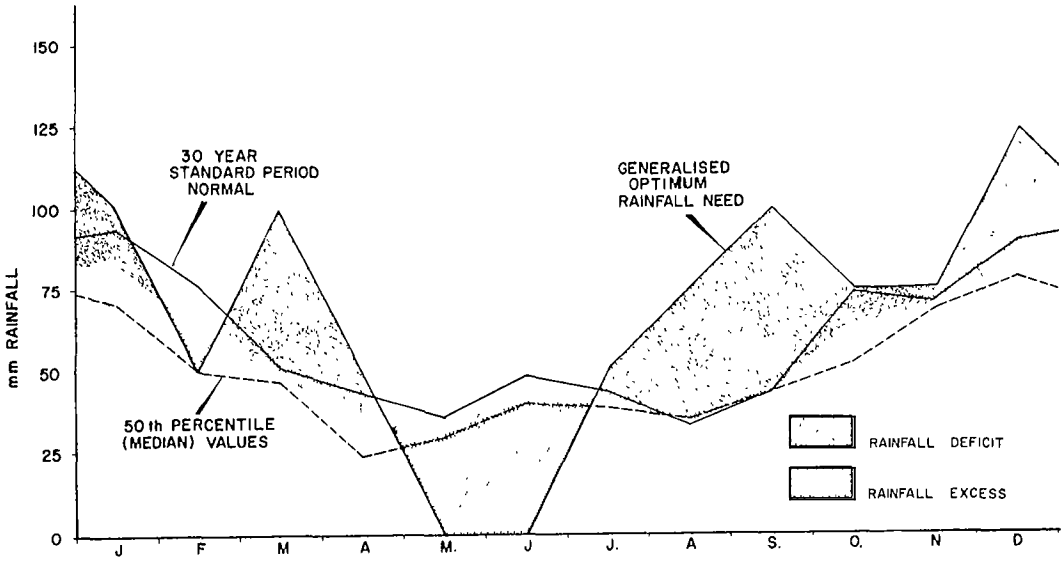


FIG. 13.1 - OPTIMUM RAINFALL NEEDS FOR NATIVE PASTURES COMPARED TO EXPECTED RAINFALL AT PIKEDALE

The main divergence is in the winter months where May and June rainfall is usually significant and the requirement is zero to prevent 'blacking off' of existing pasture. This surplus is probably less of a problem than the rainfall deficits during the rest of the year, the major one being in the August-September period before the start of the wet season. This is followed by an expectancy very close to the actual rainfall needs during October-November. Subsequent major deficits can be expected until April, with the minor exception of February.

On an annual basis, Pikedale shows a slight moisture deficit according to the standard Thornthwaite model. It could therefore be that the most critical period for pasture growth is the October-November period. If rainfall in this phase does not come up to expectations, there is little chance of optimal growth rates being attained during that season.

13.1.2 Dairying

Production of milk and cream is sensitive mainly to the rainfall regime, although low temperatures also affect it adversely.

Rainfall - Ideally, dairy pastures require a relatively even distribution of rain throughout the year. The periods March/April and October/November are critical, with at least 25 mm per month being an essential minimum and with 50 mm per month optimal in March/April and 75 mm per month optimal in October/November. Rain in excess of 150 mm per month is a possible threat in the January/March period. The following table indicates, for selected stations, their climatic suitability for dairy production, with respect to rainfall regime. It is derived by extracting the following parameters from monthly rainfall percentile information (Australian Water Resources Council, 1968) and assessing their deviation from the optimal rainfall regime:

(a) percentage chance of attaining optimum for the month

(b) percentage chance of exceeding upper limits

(c) percentage chance of not attaining minimum requirements

Parameters were given double weight in months where their value is particularly critical to production:

TABLE 13.1 - CLIMATIC SUITABILITY OF SELECTED CENTRES FOR DAIRY PASTURE PRODUCTION WITH RESPECT TO RAINFALL REGIME

Station	Suitability as a Percentage of Maximum Attainable Figure
Dalveen	68
Wallangarra	65
Stanthorpe	58
Pikedale	51
Warwick	39
Inglewood	36
Texas	34

It is quite evident from the concentration of dairying around Warwick, as seen on the Land Use Map, that location of the dairy industry is less sensitive to the rainfall regime than it is to such factors as availability of suitable land for cultivation, availability of irrigation water and proximity to markets.

Temperature - Growth of dairy pastures can be interrupted by single days with minima of 0° C or lower, and by 3 or more days with minima 5° C or lower. The following data on cold spells as they affect dairy production are extracted from records at Whetstone Field Station (WFS) near Inglewood and Hermitage Research Station (HRS) near Warwick.

(a) Typical cold season - For both centres, a typical (or median) cold season from May through September would include about 100 days with temperature minima of 5° C or lower. These would be disaggregated as follows:

Temperature Range	Approximate Number of Days	
	WFS	HRS
2.5 - 5.0° C	40	26
0 - 2.5° C	25	22
-2.0 - 0° C	25	25
less than -2.0° C	10	27

(b) Duration of frosts - The probability of a spell of frost with minima less than 0° C lasting for the number of days stated below is as follows:

Duration (days)	Probability WFS	Probability HRS	Duration (days)	Probability WFS	Probability HRS
1	100%	100%	5	31%	19%
2	69%	68%	6	24%	12%
3	51%	39%	7	17%	8%
4	40%	27%	Greater than 7	13%	5%

(c) Coldest period of the year - The most frequent date for daily minima stated is as follows:

Daily Temperature Minimum	Date WFS	Date HRS
5° C or less	7 July	22 August
2.5° C or less	7 July	30 July
0° C or less	27 July	19 July
-2° C or less	11 July	17 July

(d) Start and end of cold season.

	Mild Cold Spells (5° C daily min. or less) of 3 days or more		Cold Spells (0° C daily min. or less) of one day or more	
	WFS	HRS	WFS	HRS
Earliest ever starting date	22 APR	28 MAR	1 MAY	24 APR
Median starting date	29 APR	4 MAY	20 MAY	20 MAY
Median last date	1 OCT	3 OCT	18 SEP	25 SEP
Latest ever last date	21 OCT	29 NOV	9 OCT	25 OCT

The above data are based on records for 1957-1972 at Whetstone and 1955-1974 at Hermitage, the latter excluding missing records from 1968 to 1972 inclusive.

13.2 Horticulture

The agroclimatology of horticultural crops has considerable economic significance because the relatively high value of each crop per unit area makessome climatic modification measures feasible. Consequently irrigation is practised where water is available and it is usually only in horticultural areas that growers combat frost by lighting fires, launch rockets to disperse hail, construct windbreaks and use polythene covers to induce favourable growth conditions, either in the soil/root complex or in the atmospheric space immediately around the plant.

One other characteristic of most horticultural crops is that the climatic year is often broken up into distinct seasons during which different climatic conditions are desirable to suit the particular phase of crop production.

13.2.1 Pome Fruit

The key factor affecting apple and pear production, and underlying the existence of a pome fruit industry on the Granite Belt, is the existence of a cool season which usually meets the chilling requirements of those fruit trees, namely an average temperature of 9° C or lower for 2 to 3 months.

Given this basic climatic requirement, temperatures are most critical in the period from about October to near fruit maturity which, for the most important varieties, is February or March. Optimal daily maxima and minima during this period are 30° C and 10° C respectively. Daily maxima of 40° C for only one day or 35° C for 3 days or more can adversely affect production, while a minimum of -2° C or colder for one day can severely restrict flowering around October.

Due to the small areas of farm dam catchments, irrigation water is inadequate on most Granite Belt orchards. The most important period for water need is considered to be

mid September to mid October - the period of fruitlet development - when rainfall of 45 to 70 mm or its irrigation equivalent is optimal. Water inputs of around 90 mm per month are also needed from December to fruit maturation (usually February/March).

Pome fruit production is also vulnerable to excess rain throughout most of the year. Over about 100 mm per month is considered excessive during October flowering and also from May to August (inclusive) - the dormant period - when evapotranspiration is minimal and root systems may rot in poorly drained sites. Harvesting can also be restricted from February to about the middle of April if rainfall exceeds about 250 mm per month. Average monthly rainfall is well below these limits but the vulnerability period is so extended that the probability of receiving excessive rain in any one critical month is quite high for any given season. There are therefore very few seasons when an optimal rainfall regime is experienced.

The following diagram (Fig. 13.2) summarizes the optimal regime for rainfall receipts and the upper limits compared to the 30-year mean and the median values for Stanthorpe.

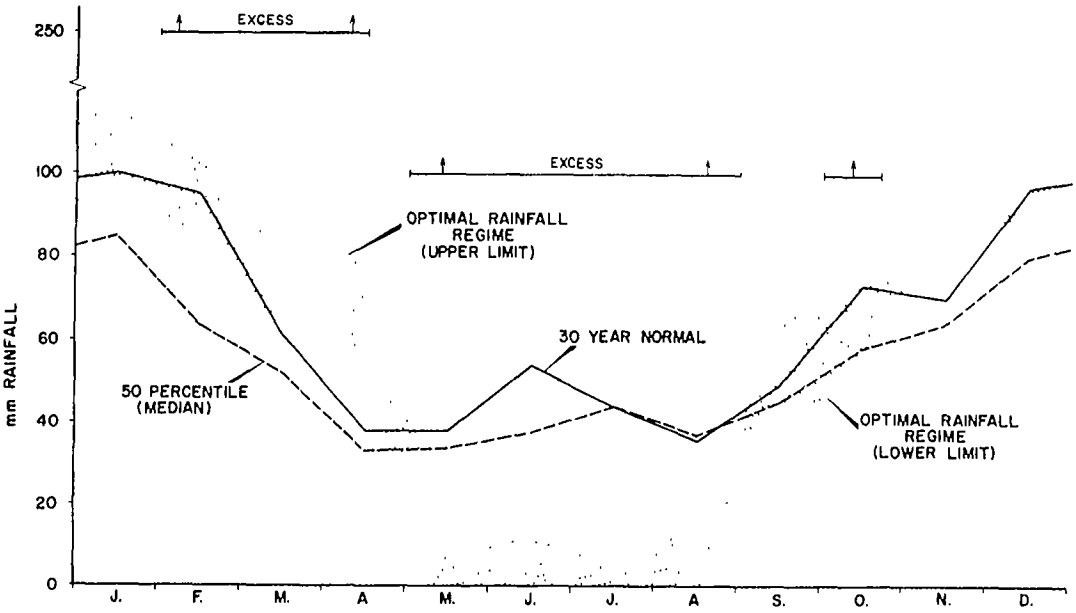


FIG. 13.2 - OPTIMUM AND EXCESSIVE RAINFALL FOR POME FRUIT COMPARED TO EXPECTED RAINFALL AT STANTHORPE

For Stanthorpe, the major threat from excessive rain would appear to be in October where the expected rainfall comes closest to the maximum limit. In the following month there is the poorest chance of attaining the optimum rainfall level. An early start to the wet season followed by a dry break would therefore have disastrous results for the pome fruit crop.

A study of irrigation needs and plant:water relationships in apple trees has been carried out by Chapman (1968). He points out that the moisture retention properties of the granite soils are generally low and, in almost every growing season, crop yields and tree growth are restricted to some extent by inadequate soil moisture. Rainfall effectiveness is also diminished by the typically high intensities of falls and high evaporative losses, while rainfall variability alone is enough of a problem. Adequate irrigation is seen as eliminating this production hazard, leaving only hail and perhaps frost as uncontrolled variables.

Nevertheless, with only 7% of the pome fruit area under irrigation, natural rainfall is the main determinant of yield. Soil moisture is of particular importance to the apple crop during the spring and early summer period. Between mid September and mid October, adequate soil moisture is necessary to ensure successful blossoming and pollination followed by fruitlet development. Moisture availability during November-December determines fruit size in the current crop; but, of more importance, moisture stress disrupts bud differentiation, having an adverse effect on the number of fruit formed in the following season's crop.

Preliminary investigations show a tendency for apple yields in season t/t + 1 to increase with December rainfall in year t and October/November rainfall in year t - 1, up to approximately decile 8 after which it decreases (Wills unpublished).

Apple scab, *Venturia inaequalis* (Cooke) Wint, is the most serious apple disease of the Granite Belt. Over two-thirds of the varieties planted are susceptible to the disease. The first infection period in each season is usually in late September and is related to duration of leaf wetness after rain and the prevailing temperature. Regular spraying after the first rains is recommended as a routine disease control measure, since treatment of an established infection entails considerable expense. It is estimated that a typical grower, whose orchard experiences a moderate apple scab attack, could lose about $7,500 total gross margin or $300 per ha in one year, compared to a situation in which the disease is successfully controlled.

The September/October/November period is clearly of great significance to apple and pear producers with regard to both temperature and rainfall. Other climatic hazards are sunburn, due to excess solar radiation, hail and high winds which can break branches and cause loss or down-grading of fruit. The economic impact of hail is most severe just prior to harvest. A very severe hail storm at this time can wipe out any expected profit margin from the area affected.

13.2.2 Stone Fruits (Peaches, Plums and Apricots)

A variety of stone fruit is grown in the study area, mainly on the Granite Belt. Because of different growing cycles, it has been necessary to generalise to a degree and it is considered that the following information will apply to the bulk of stone fruit production.

The stone fruit crop is most vulnerable to climatic factors in the period just before harvest, which may be any time from November to January. It requires optimal rainfall receipts in this period of 25 to 40 mm per week, although excess humidity is harmful. Also in this critical phase high temperatures and excessive solar radiation are detrimental. A temperature of 40° C for one day or 35° C for 3 days or more can reduce production. Further, a severe hailstorm at this time of year can completely eliminate profits.

Other problems are excessive humidity in mid-winter and in the flowering phases, intense rain which may split fruit, and strong winds which can break branches, cause fruit to drop, or mark fruit.

Rainfall - The following table shows indices of climatic suitability for stone fruit growing with respect to rainfall regime. It is derived by using the same technique as used for dairying (section 13.1.2).

TABLE 13.2 - CLIMATIC SUITABILITY OF SELECTED CENTRES FOR STONE FRUIT GROWING WITH RESPECT TO RAINFALL REGIME

Station	Suitability as a Percentage of Maximum Attainable Index
Dalveen	70
Wallangarra	62
Warwick	53
Pikedale	50
Stanthorpe	47
Texas	37
Inglewood	31

Stone fruit growing in the study area is located mainly above the 54% mark and is therefore probably quite sensitive to rainfall regime as a production control.

Temperature - Temperatures are most critical to stone fruit production during the blossoming period and close to harvest. From late August to late September, single days with a -3° C or lower minimum temperature can inhibit blossoming. High temperatures just prior to harvest can also affect production e.g. a single day with maximum 40° C or over, or 3 days or more with maxima 35° C or over. During these periods, an optimal diurnal range would be 30° C maximum and 10° C minimum.

As harvesting may extend through to January the five-month temperature regime from September to January has been examined for four stations. Average daily maxima and minima were compared with the above optima on a basis of

(i) deviations external to the optimal temperature range and (ii) deviations internal to the optimal temperature range. These were calculated in terms of C° days and tabulated (Table 13.3 below). Indexation was attained by allotting 100% to the maximum deviation in each of the four categories and an average index was then calculated. It follows that the area showing the lowest mean index has the most favourable temperatures for stone fruit production.

TABLE 13.3 - C° DAYS DEVIATION AND INDEX OF DEVIATION FROM OPTIMAL DIURNAL TEMPERATURE RANGE FOR STONE FRUIT SEPTEMBER TO JANUARY

Station	C° DAYS DEVIATION								Mean Index
	External to Optimum Diurnal Temperature Range				Internal to Optimum Diurnal Temperature Range				
	+MAX	(%)	-MIN	(%)	-MAX	(%)	+MIN	(%)	%
Warwick	9	(6)	102	(51)	358	(37)	548	(32)	32
Stanthorpe	-	(0)	199	(100)	774	(80)	336	(20)	50
Wallangarra	-	(0)	188	(94)	957	(100)	290	(17)	53
Inglewood	154	(100)	-	(0)	303	(32)	1722	(100)	58

Optimal District - A consideration of both rainfall and temperature indices indicates that for these two climatic criteria, an optimal district for stone fruit growing lies in the area north and east of a curved line through Cotton Vale, Mt. Magnus, Valhalla Homestead and Cunningham. In fact, while some stone fruit orchards are found in this area, the concentration lies west and south of Stanthorpe. This is presumed to be because of locational advantages through proximity to other orchard activities and the unsuitability of many of the soils in the climatically optimal district described above.

13.2.3 Grapes

As in the example of stone fruits above, the grape is represented by a number of varieties in the study area, all with differing growth phase timing. The following notes on table grapes therefore refer to Muscat Hamburg table grapes which constitute about half of the varieties planted on the Granite Belt. However the main part of this section deals with the fledgling wine industry and discusses the climatic environment as it might affect the quality of wines produced.

(a) Table Grapes - Excessive rain and humidity is more of a threat to grape growing than drought. Rain is most needed at budburst (October) and at half berry size (early December to early January). February and March are the months when the grape crop is most vulnerable to excess rainfall. Humid weather lasting longer than 4 or 5 days can encourage mildew diseases and fruit rot, while high intensity rain, which is common in this season, causes berry splitting.

High temperatures and radiation near to fruit maturity will cause sunburn on bunches which are not shaded. Low temperatures of the order of 1° C minimum for one day, from about mid-September to mid-October, can restrict the vegetative growth phase and necessitate repruning; but early winter frosts are not a threat to grapes at maturity.

As with pome and stone fruit, both strong winds and hail are weather hazards which can wipe out profits in severe cases.

(b) Wine Grapes - The rise of a new wine industry around the Stanthorpe area has aroused some speculation as to how wines produced there are likely to compare with the products from other Australian wine regions.

The existence of a table grape industry, in the area where wine grapes will be grown, indicates that the vine will grow satisfactorily. The point for debate is the likely quality of the final product. Winkler (1962) quotes European opinion on the effects of climate on wine grapes. Cool weather during ripening is said to foster acidity and good colour, which lead to optimal aromatic and flavouring characteristics in the mature fruit. The warmer the weather during ripening, the less delicate and well-balanced are the aromatic qualities of the grape. Hot regions usually produce only common, dry table wines but abundant heat is ideal for dessert wines such as port, muscatel and sherry.

Winkler correlated climatic factors and wine quality and concluded that the factor of predominant importance was temperature. This led him to use heat summation as the criterion for splitting up the grape-producing areas of California into five climatic regions. Heat summation was taken as the sum of the number of Fahrenheit degrees in excess of 50° F (10° C) for each day of the seven month growing season. For the purposes of this report, all the figures are converted to metric.

Heat summations have been calculated for centres in the study area and for Australian wine grape growing centres. The following table, arranged for comparison purposes, shows how Australian centres compare with those in Winkler's original table of Californian, European and African wine areas. The assumed growing period for Australian centres is from October to April inclusive.

On degree days alone, the study area is in good company. Stanthorpe's heat summation being equivalent to that of the Barossa Valley area and close to California Region III - an area producing 'better quality naturally sweet table wines'. Warwick is located squarely between the two Hunter Valley centres.

One fundamental difference between the climate of the study area and the climates of the areas discussed in the table is seen in rainfall distribution. Most of the overseas centres mentioned had a 'Mediterranean' type climate i.e. warm with relatively dry summers. The study area, by contrast, has dry and cool winters, with warm to hot summers during which about two-thirds of the annual rainfall is received.

TABLE 13.4 - COMPARISON OF HEAT SUMMATIONS AS DEGREE-DAYS FOR WINE GRAPE GROWING SEASON (AFTER WINKLER 1962)

Location	Degree-Days above 10° C
Asti, Italy	1660
Wallangarra, Queensland	*1740*
Livermore (California, Region III)*	1810
Calistoga (California, Region III)	1870
Stanthorpe, Queensland	*1890*
Kapunda, South Australia	*1890*
Florence, Italy	1960
Lodi-Stockton (California, Region IV)	1990
Roseworthy, South Australia	*2020*
Davis (California, Region IV)	2210
Naples, Italy	2230
Palermo, Italy	2300
Cessnock, New South Wales	*2350*
Warwick, Queensland	*2380*
Maitland West, New South Wales	*2490*
Fresno (California, Region V)	2600
Bakersfield (California, Region V)	2790
Algiers, Algeria	2890
Inglewood, Queensland	*3110*

* Climatic regions of California, based on heat summation above 10° C.

The differences are clearly seen in Figure 13.3 (opposite) which depicts hythergraphs, showing the average monthly trends of rainfall and temperature for a selection of the above centres. Each hythergraph is plotted on standard axes for comparison purposes and the numbers at each point represent months. The thicker lines represent the assumed growing season for wine grapes.

The following points are worth noting:

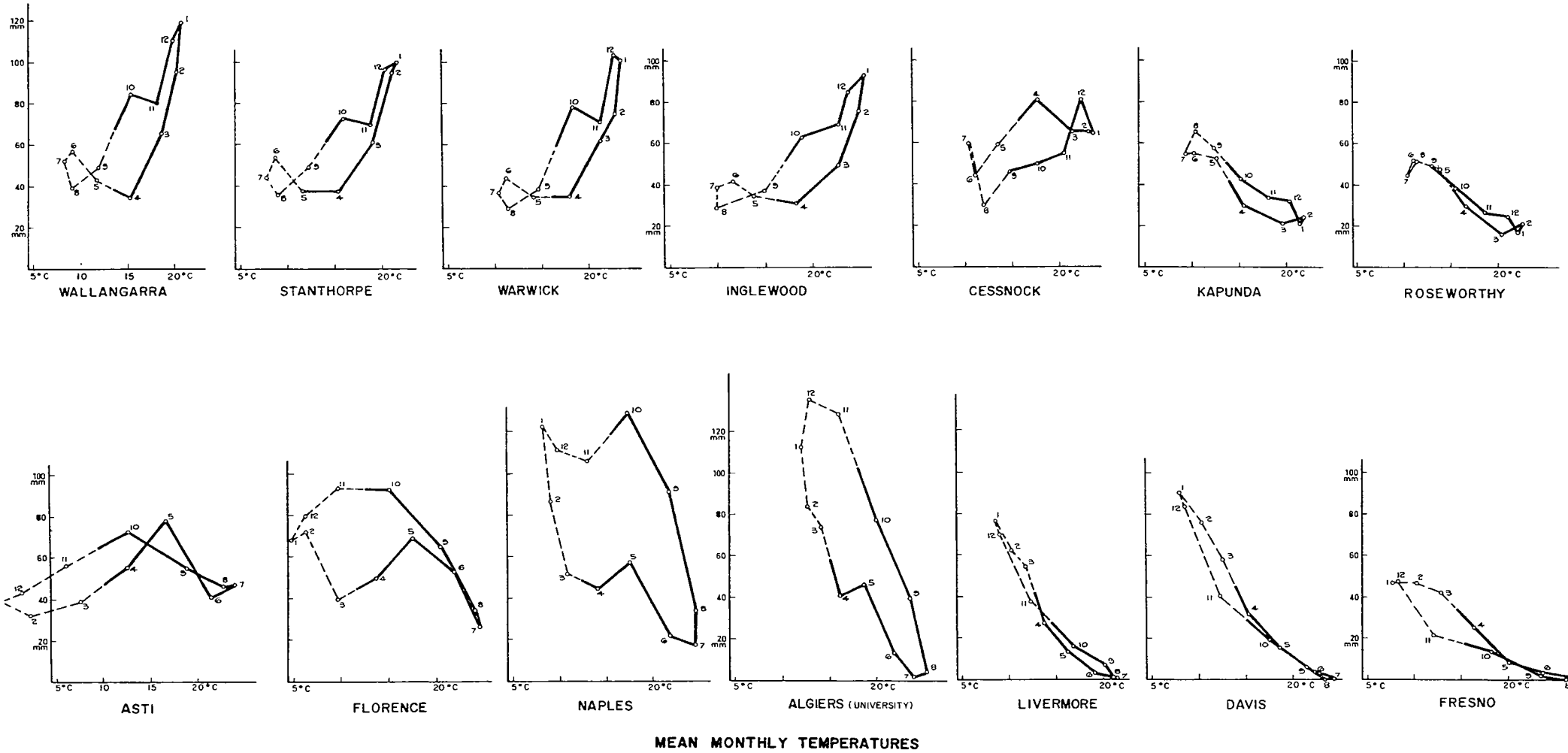
(i) Hythergraphs for the study area stations are all similar, although left to right displacements indicate the different temperature ranges. This is to be expected for stations so close together and can be seen also for the South Australian and Californian groups of centres.

(ii) The months of near zero rainfall in Californian wine areas would, no doubt, be alleviated by irrigation. This would bring these stations closer to the natural South Australian rainfall regime.

(iii) The more open hythergraph patterns of the Mediterranean stations are not found in either the Australian or Californian wine producing areas. The main point to observe, however, is that the middle of the growing season is warm and relatively dry.

FIG.13.3-HYTHERGRAPH COMPARISON FOR SELECTED WINE GROWING CENTRES AUSTRALIA AND OVERSEAS

(Numbers at each point indicate months – e.g. 3 = March)



Boehm (1970) criticises the heat summation approach on the basis of detailed studies of vine development and temperature in the Barossa area of South Australia. He points out that differences in the selection of the seven month growing period can mean significant changes in heat summation totals, while the totalling of degree-days above the 10° C limit is an oversimplification of the relationship. His conclusion is that differences between grape growing districts are best expressed in terms of mean monthly temperatures over the days from budburst to maturity of the more common grape varieties. Prescott (1965) also points out similar deficiencies in comparing heat summations measured over a fixed calendar period.

On the water requirements of wine grapes, Claassen (1970) considers that soil moisture should be close to field capacity at the beginning of the vegetative growing season. Available moisture should be over 50% until berry set has been completed but a figure lower than 50% is desirable after the rapid swelling stage to ensure a high sugar content. Using Claasen's figures on a sand of 1 metre depth, this would imply a moisture availability of 83 mm at the beginnings of growth, about 45 mm or more until the berries have swollen and about 40mm until harvest. However, he points out that soil moisture conditions alone do not ensure a good quality grape.

Thornthwaite moisture index calculations, using mean monthly data, indicate that the Stanthorpe area's situation is marginal to adequate, while the Warwick area is only marginal. However the showery, intense character of the rainfall during summer may mean that less rain penetrates than the model assumes. This possibility and the natural variability of the rainfall means that insurance, in the form of some irrigation, is necessary.

Further findings include those of Buttrose (1970), who in laboratory tests evaluated fruitfulness (i.e. the mean number of bunch primordia formed per bud) in different grape cultivars. Of relevance to the study area are the findings that Shiraz is particularly tolerant to a wide range of temperatures up to 35° C, but is dependent on high light energy receipts; and that Rhine Riesling appeared more flexible, being the most fruitful cultivar at low light intensity and therefore at an advantage in cloudier areas.

Finally Rankine *et al.* (1971) have concluded that soil type has no significant effects on wine quality but that the year of vintage (= each season's weather) has a strong influence. They also noted that wines from irrigated grapes were generally of somewhat lower quality than those made from the same variety of grape, unirrigated in a cooler area.

It is quite clear that success in wine grape growing is dependent on a number of interrelated climatic factors and not on a single dominant influence. The comparisons made above with overseas data are relatively crude and some varieties of wine grape are quite likely to adapt successfully to the Granite Belt conditions. The main hazards are high temperatures and hail, if mildews are controlled by systematic spraying. The current trials at four centres in or near the study area could profitably be expanded to other sites and coupled with a climatic year analysis of temperature regime and soil moisture status. This would provide reliable guidelines for expansion of wine grape plantings.

A recent article suggests that variable grape-growing conditions give rise to more intriguing wines. Wagner (1974) draws a distinction between the Mediterranean wines, which result from the typical two-season climate, and the wines grown in a band of country covering north-western Iberia, Central France, Germany, the wine-producing areas of Central Europe north of the Alps, and stretching eastwards beyond Hungary. The latter region, because of its variable four-season temperate climate and associated variability of soils, is said to produce subtler, more delicate wines and, according to Wagner, this agrees with the consensus view among experts that most of the truly fine wines are temperate climate wines. Despite this, he is optimistic about the development of Franco-American hybrids and their success in unlikely areas of the USA, including Texas and Utah.

As in USA, the Granite Belt wine producer caters for an average consumer with no experience of temperate climate wines. Thus the main thrust of development in this young industry may best be directed towards selection and proving of varieties, climatically suited to the area, and capable of producing a marketable wine with distinctive features which may eventually evolve into a regional character.

13.2.4 Vegetables

Over half of the area under vegetables in the Granite Belt is occupied by tomatoes, and over half of the remainder by cabbages and cauliflowers. Only these crops are discussed in detail below. Vegetables are generally so sensitive to weather fluctuations and there are so little firm data available that a highly definitive climatology of vegetable crops is impossible for this report.

Tomatoes - Tomato plantings are staggered from September through to early January. Flowering usually commences one month after planting and harvesting starts at about the end of December, going on until the first frosts in April or May. Because of the staggered plantings one can only comment generally on how the climatic regime affects the tomato harvest as a whole.

Optimal rainfall receipts are of the order of 100 mm per month, received regularly through the growing cycle, but humid periods of low intensity rainfall for more than 3 or 4 days at fruit maturation induce disease and can cause fruit cracking. High intensity rain may cause fruit splitting.

Temperature fluctuations also have an adverse effect on tomato production. Daily maxima of 18° C or more for one day or 14° C for 3 days can restrict growth, and a daily minimum of 2° C or less for only one day is equally detrimental. Soil temperatures are as important as screen temperatures, for example a soil temperature of 9° C over 7 days results in impeded growth.

Tomatoes are extremely vulnerable to strong winds, hail and extremes of sunlight.

The tomato is clearly very sensitive to weather fluctuations, small variations resulting in reduced plant performance, increased susceptibility to disease and impairment of fruit quality. Major departures from the optimum can lead to complete crop failure.

Cabbages and Cauliflower - Cabbages and cauliflower are less sensitive to the climatic environment than are tomatoes, although curd formation and development in cauliflower makes it a more vulnerable crop than the cabbage. The growing season is similar to that for tomatoes, but it is important that cauliflowers mature as the season cools off, since curd development in the summer heat is usually unsuccessful.

Once again regular receipts of rainfall of about 80 to 100 mm per month are optimal, although humid spells of 7 days or more can adversely affect head or curd formation. High temperatures are detrimental to curd development while low temperatures, shortly after transplanting, can result in losses.

Strong winds may lead to plant moisture stress, but may also help in disease control by reducing humidity. Hail is particularly damaging if it strikes seedbeds or affects heads or curds near maturity.

13.2.5 Tobacco

Tobacco is a crop which is grown most conveniently in a relatively dry environment under irrigation. In the study area, it is fully irrigated although natural rainfall, not in excess of 50 mm per day, is useful. Tobacco is adversely affected by excessive soil moisture at all stages of growth although humid atmospheric conditions are beneficial to the leaf. Rainfall is considered most useful during the months of high evapotranspiration from about November to March inclusive.

Leaf damage is a risk at extremes of temperature. A daily maximum of 35° C or more for one day usually coincides with scorch and sunburn; while daily minima of 2° C, for 7 days or more, may cause frost damage and can harden leaf, making curing difficult. Temperatures are most critical from December to April with optimal daily limits around 32° C maximum and 15° C minimum.

Strong winds, combined with high temperatures, can aggravate sunburn and break leaf. Hail is a major threat to tobacco as appearance of the leaf is very important.

13.3 Agricultural Crops

The decision on whether or not to plant annual crops is very much affected by the weather situation, with particular emphasis on soil moisture status. The moisture storage situation and the rains leading up to the planting phase are crucial to this decision and there is usually a cut-off date beyond which it would be unwise to plant, due to adverse consequences when the crop is reaching maturity. Under these circumstances harvesting difficulties are frequently encountered.

Yields are greatly affected by weather conditions. Numerous studies have been conducted in this area of research. Workers on the Darling Downs are currently developing a water balance model which simulates soil water balance and crop growth over time, while presenting soil moisture stress index data from which crop yields may be estimated. The model uses actual weekly rainfall and covers alternative winter and summer crop options. The crop selection is based on a consideration of soil moisture storage and planting rain. Given the adequacy of these the programme then considers whether falls are likely to preclude operation of the planting machinery.

Because of this on-going research and the fact that grain cropping is not a major industry in the study area, winter and summer grain crops are dealt with only briefly and at a general level below.

13.3.1 Winter Grain Crops

The minimum soil moisture storage requirement for planting of wheat or barley in the study area is of the order of 125 mm, with a minimum rainfall requirement of about 250 mm distributed during the growing cycle. The May/June establishment phase and September/October grain-filling period are the most critical in relation to rainfall. Forty to 50 mm per month is optimal in the former and about 70 mm per month in the latter. Excessive rain is seldom a problem except during the harvest period around November. Falls in the order of 150 mm per month can prevent harvesting at that time. In addition, humid weather in the last month or two before harvest can be detrimental by encouraging disease. Intense rainfall may cause some lodging in grain crops, as well as creating a soil erosion hazard.

Temperatures are most critical in the September/October period, an optimal daily range being about 27° C maximum and 13° C minimum. Production is affected if daily maxima reach 38° C for one day, 35° C for 3 consecutive days and 32° C for a period of 7 or more days. Frosts are uncommon in the grain growing parts of the study area during September or October but do not normally restrict yields.

Strong winds of the order of 65 km/h are capable of damaging crops and cause lodging; while hail may also cause losses. Recovery from hail damage in early growth is possible.

13.3.2 Summer Grain Crops

Summer grain crops require a minimum of about 125 mm stored soil moisture before planting and about 700 mm of rain during the growing period. The period of maximum growth rate and of water use is December-January with a peak rainfall demand of about 200 mm in January. A deficiency at this time restricts crop development.

Temperatures ranging from 22° C minima to 30° C maxima are considered optimal for the growing part of the crop cycle. Yields may be reduced if daily maxima exceed 41° C for one day, 38° C for 3 days or 35° C for 10 days or more, in the December/January period. Low temperatures in the October/ November planting and establishment phases can also affect yields e.g. 3 days with minima colder than 4 or 5° C.

Strong winds cause lodging and leaf stripping but light breezes are beneficial at flowering. Hail has a major impact on summer grain crops as the peak of the hail season coincides with the peak growth phase. One severe storm can defoliate a crop and restrict growth to the extent that the crop is unprofitable.

13.4 Weather Modification

The science of modifying the weather has developed considerably since the first successful field experiments in the atmosphere were carried out in 1946. The most intensively studied aspect has been rainfall enhancement, or 'rainmaking' as it is popularly known, although considerable effort has also been expended on hail suppression, fog dispersal and hurricane amelioration. In the strict sense, weather modification also takes places when irrigation is practised, polythene mulch is spread, windbreaks used and trees are cleared.

A rush to apply the early scientific findings resulted in a number of weather modification operations being launched in various parts of the world, most of which failed to achieve any proof of success. The result was a backlash of scepticism which carries through to the present day. Research has continued and a deeper appreciation of the physics of weather has evolved. This should eventually provide a considerably stronger base from which to plan future weather modification efforts.

In the study area during the mid 1950's, hail rockets were employed in an attempt to suppress hail, and thus reduce hail damage to Granite Belt horticultural crops. Their use was confined to the area north of Stanthorpe.

The rockets were designed to explode at 1000 m or 1500 m above ground level (AGL). Some were purely explosive while others also contained silver iodide, a nucleating agent used in rainfall enhancement techniques.

No attempt was made to evaluate the hail rocket technique and its popularity wained after about three years of using the rockets. It is unlikely that hail rockets achieved any significant effects because of:-

(a) the negligible amounts of energy released (Bowen 1955)

(b) the fact that most hail forming zones would have been higher than 1500 m AGL and therefore beyond any immediate seeding effect

(c) the presence or absence of a hail threat and its location would have been guesswork and a considerable proportion of launches would therefore have been complete wastage

In the light of more recent knowledge and experience, it is apparent that the study area has certain attributes which make it suitable as a site for either an experimental or operational weather modification project. These attributes are discussed below.

13.4.1 Potential Benefits

The area contains two major dams with another soon to be completed. These storages are all intended to provide water for intensive agricultural areas downstream, mainly beyond the limits of the study area. In addition the pastoral industry, which is dominant within the area, would often benefit greatly from more rain as the common skeletal soils have little moisture holding capacity.

The horticultural areas could also benefit from increased rain totals but timing becomes much more important here. There is a likelihood of conflict when farmers have different weather requirements in the same area at the same time. The elevated horticultural parts of the area have more to gain if modern techniques of hail suppression can be applied with confidence. The target is compact, the crops are of high value and hail has no economic attraction at any time. Subject to an economic feasibility study and preliminary experimentation, a future hail suppression operation could result in reductions in crop damage.

Other beneficiaries of rainfall enhancement include town water supplies, forestry, apiculture and wild life.

13.4.2 Climatic Characteristics

The area comes under the influence of both southern temperate and northern tropical influences. This is evident seasonally, but is also seen in the short term as passing weather systems deviate north or south with fluctuations in global weather patterns.

It also lies astride the zone of change from the moist sub-humid climate of the coastal belt to the dry sub-humid of the near inland. Once again in addition to seasonal variations, significant short-duration changes may occur.

This overlapping of two sets of complementary pairs of weather influences could cause preliminary difficulties in the planning of operational techniques, but the variety of weather situations to be expected would provide a wider range of modification opportunities, especially if the equipment were available to cope with a range of possibilities.

Associated with the transitions described above is a steep climatic gradient which is partly caused by weather systems but is also the result of the topographic variation from east to west. This means that while the higher eastern part of the study area normally has a cool, moist sub-humid regime the western extremities often experience hot, semi-arid conditions (Dick 1964).

This transition zone is represented in the north-eastern, central and far south climatic subdivisions (see section 4.8.2) which, on average figures, show an overall moisture deficit. However this probably breaks down to some years of severe deficit, some of average deficit close to the long term means, and occasionally, during abnormally wet years, a few of positive moisture status. It is in just such a zone that rainfall enhancement techniques, applied over the long term, could have a major spatial effect in pushing the line of zero moisture balance westwards and northwards.

13.4.3 Evaluation Aspects

Before instituting a weather modification programme, it is essential to carry out comprehensive cost:benefit and feasibility studies, including simulation of crop responses to increased water availability. This can then be followed by randomised field experimentation designed to reliably ascertain the physical difference between a 'with modification' and a 'without modification' situation. This would necessarily lead to a definition of the most suitable conditions for modification and their frequency of occurrence. When this is known, the assumptions used in simulation can be adjusted and a final decision made on the viability of regular operations.

The Granite and Traprock Area Land Inventory and Land Utilisation Study provides the necessary first step to feasibility studies. It is in effect a detailed regional study incorporating land use and agroclimatic appraisals. Elsewhere, water balance studies into horticultural crops of the area have been carried out (Chapman, 1968) and a variety of grain cropping and pasture growth models are available from which a suitable simulation model could be evolved. The detailed meteorological recording carried out at the three research stations, in or near the study area, could also be of value in providing data not normally available for broad area studies of this nature.

For a hail suppression experiment, the evaluation picture is less optimistic. Although the Stanthorpe area is one of the worst affected by thunderstorms in Australia (Wheatley 1969) and frequency of occurrence of hail at any one site may be up to once per year (see Fig. 4.3), this would provide insufficient events for a firm result in anything but a very long-term experiment. In addition, for hail suppression experiments more ground based recording equipment and personnel are required than for a rainfall enhancement experiment.

However a recent report indicates that overseas claims of success in hail suppression, although not statistically proven, 'have sufficient physical plausibility and the reported results are sufficiently striking to conclude that, for the realization of the possibility of ameliorating hail damage to agricultural crops and property, well designed and controlled hail modification experiments should be conducted'. (National Research Council, U.S.A., 1973.) With hail damage figures of up to $500,000 quoted as a result of extensive severe storms in 1971 and larger figures in the wheat growing districts, Queensland may be approaching the position where the high initial costs of an experiment could be justified.

13.4.4 Suitability of the Study Area for Weather Modification

Although markets are uncertain, the overall picture of primary production in and around the study area is one of long term growth, based on intensification of land use, within the study area and in external areas dependent on its irrigation storages.

Excess capacity may exist now, but experience has shown that stored water resources are eventually fully utilised by primary producers. Thus, one of the more important requirements for a weather modification operation is fulfilled - namely that runoff water does not go to waste (Rapp 1971; Wills 1973). Even when storages are full, the peculiar conditions of primary production inside the study area would probably be against a cessation of operations. Briefly, these are:

(i) the low water holding capacity of most of the soils, which means that pastures are usually under stress, and

(ii) the lack of sufficient catchment areas for small scale irrigation of horticultural crops on the Granite Belt (Chapman 1968).

The above factors combined with the existence of a detailed land use data base, the compactness of the target area and the proximity to a major meteorological centre at Brisbane suggest that the Granite and Traprock area is suitable for future long term weather modification projects.

13.5 Acknowledgements

The author is indebted to the QDPI officers who completed climatic analysis questionnaires, and gave specialist advice particularly Messrs B.C. Dodd, J.B. Heaton and C.W. Winks at the Granite Belt Horticultural Research Station for their assistance with orchard and vine crops. Mr J.H.G. Johnson's assistance in extracting raw data from Hermitage Research Station's records is also much appreciated.

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APPENDIX 13.1

EXAMPLE OF FORMAT OF QUESTIONNAIRE SURVEY OF CLIMATIC REQUIREMENTS AND LIMITATIONS

GRANITE AND TRAPROCK AREA LAND CAPABILITY AND LAND USE STUDY

CLIMATIC ANALYSIS Questionnaire Survey of Climatic Requirements and Limitations

Instructions:

(1) Please fill in all replies with either (a) the exact answer, (b) an estimated figure, giving degree of variability e.g. 100 pts (of rain) ± 20 pts, (c) not known (NK) or (d) insignificant factor (IF).

(2) Determine whether a climatic factor is significant or not by your assessment of whether a producer's income is likely to be sensitive to changes in it or not.

****

Name of Officer completing questionnaire .....

Appointment ..... Centre .....

PRODUCT UNDER CONSIDERATION .....

QUESTIONS

1. Rainfall

(a) Indicate an ideal rainfall regime (pts) for this form of production:

J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	
...	....	....	....	....	....	....	....	....	....	....	....	pts

(b) Is a certain volume of rain (+ stored soil moisture) necessary for this activity to take place? .....

(c) If answer to (b) is yes, how much (i) rain ..... pts

(ii) stored soil moisture

..... pts

(d) If answer to (b) is yes, when (i) is an optimal time for it to be received

..... date ..... month

(ii) is the latest time for it to be useful

..... date ..... month

(e) When is excessive rain considered to be most harmful

..... date ..... month

(f) How much rain (+ stored soil moisture) would be considered excessive at this time? ..... pts

(g) Apart from essential rain as indicated in (b), during what period(s) would rainfall receipts be most useful?

..... to .....

..... to .....

(h) How long a spell of humid weather would be needed to be detrimental to this form of production?

.....

(i) During what period would the effects of a long humid spell be most detrimental?

..... to .....

(j) Apart from erosion aspects, does rainfall intensity have any effect on this form of production? If so how?

.....

.....

2. Temperature (indicate °C or °F)

(a) High Temperature

(i) give lowest daily maxima which will be detrimental to production over a continuous period of:

(1) one day .....°

(2) 3 days .....°

(3) 7 days .....°

(4) 10 days .....°

(ii) during what period(s) are high temperatures most damaging?

..... to .....

..... to .....

(b) Low Temperatures

(i) give highest daily minima which will be detrimental to production over a continuous period of:

(1) one day .....°

(2) 3 days .....°

(3) 7 days .....°

(4) 10 days .....°

(ii) during what period(s) are low temperatures most damaging?

..... to .....

..... to .....

(c) During what period(s) are temperatures most critical?

..... to .....

..... to .....

(d) During the period(s) mentioned in (c) what are optimum daily maximum and daily minimum temperatures?

max ..... ^{o} min .....^{o}

3. Wind

(a) Are strong winds detrimental to this form of production?

.....

(b) If so how and in what way? (Indicate strength and duration of winds if this is relevant.)

.....

.....

(c) Is wind in any way beneficial to this form of production?

.....

.....

4. Hail

(a) Does hail affect this form of production? .....

(b) If so, how? .....

.....

(c) How much hail (indicate in number of hailstorms during a given period or as duration of one hailstorm) is likely to cause losses such that gross margins (gross revenue less variable costs) are cut by

(i) 100% .....

(ii) 50% .....

(d) Indicate periods when production is likely to be most vulnerable to hail damage.

..... to .....

..... to .....

5. Sunlight

(a) Does variation in sunlight affect this form of production?

.....

(b) If so, indicate whether excess or inadequate sunlight is the problem and what amounts over what periods are unsatisfactory.

.....

.....

(c) Indicate periods when production is most vulnerable to excess or inadequate sunlight and state an optimum daily rate for this period.

.....

.....

6. General

Please mention any interactions of the above five factors which you feel may be important and any other aspects which you feel have been omitted.

****

14 ECONOMICS AND MARKETING OF FARM PRODUCE IN THE GRANITE AND TRAPROCK AREA

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

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TABLES

14 ECONOMICS AND MARKETING OF FARM PRODUCE IN THE GRANITE AND TRAPROCK AREA

This section is divided into two major parts. The first deals with major farm enterprises in the study area and is extracted from studies made by Mr B.S. Alcock (1975), Agricultural Economist of Economic Services Branch, Toowoomba when he was based at Warwick. Much of his tabulated data is excluded from this summary and readers requiring details of the background material should refer to the appropriate Economic Services Branch Bulletin. The second part covers the marketing situation for the main farm products of the area. This is a collation of work prepared by officers of Marketing Services Branch and compiled by Mr D. Fouras, Marketing Officer of that Branch.

14.1 Economics of Major Farm Enterprises in the Granite and Traprock Area

Alcock's aims were to provide guidelines for efficient resource use in the study area and to summarize existing economic data about the area. His approach was to determine costs and returns of the major enterprises, related to a representative property, and evaluate property development alternatives.

The enterprises studied were:

(1) grazing enterprises
  (a) sheep - woolgrowing
    - breeding enterprises
  (b) cattle

(2) agriculture

(3) horticulture

Apiculture and forestry were not included due to lack of data, but high priority should be given to comparative economic studies of these industries in the area.

Gross margins analysis was used to determine costs and returns of each enterprise. A gross margin is the difference between gross revenue (output) from sale of produce and the variable expenses incurred in producing and selling that output.

Property assessment was made using whole farm profit statements and cash statements. The profit statement indicates the return to capital and management.

Development was assessed by calculating return to extra investment using discounted cash flow analysis.

Actual property performance data were used to indicate efficiency of resource use.

14.1.1 Grazing Enterprises

In section 14.1.1.1, the economics of a representataive traprock property are discussed, ignoring differences between land systems. A traprock property is chosen, as the major proportion of the study area consists of traprock country.

In the next section (14.1.1.2) the differences between the various land systems are briefly discussed. Then, as most economic information available for the area applies to Gore LS, this system is treated in detail (section 14.1.1.3).

Finally, the results of section 14.1.1 are summarized (section 14.1.1.4).

14.1.1.1 Property enterprises and development in the traprock area

The typical traprock property has an area of about 2 000 ha, the usual range being from 800 to 6 000 ha. There are a few larger properties in the range 12 000 to 20 000 ha. Degree of property development varies considerably, but in most cases timber has been killed on 60 to 100 percent of the property. Areas untreated are usually so because the terrain is too steep or too stony so that the proportion of the property area treated depends to some extent on the characteristics of the land system. On properties in Gore LS, average area treated is about 70 percent of the property, with some properties consisting mostly of green timber. In Pikedale LS and Glenlyon LS, average area treated is about 90 percent of the property, while many properties have completed the ringbarking of virtually all trees.

Most properties have small areas of grazing crops (mainly oats) while a very small number have cash crops or crops harvested for stored fodder such as lucerne hay.

About half the properties have some area of improved pasture, although in many cases the area involved is very small ('trial' areas). Lucerne is the most popular sown pasture plant but medics and clovers are also being used.

The number of grass paddocks per property commonly range from 10 to 20. The most common paddock size ranges between 120 and 160 ha.

Almost all properties in the area carry sheep, and most also run some cattle. However there are few properties which carry a high proportion of cattle, or cattle only. Wethers are run on most of the sheep properties, while about half the holdings carry ewe flocks. While woolgrowing is the major enterprise, it has decreased in importance in recent years.

Stocking rates in the area range from 0.3 to 0.7 sheep per ha on timbered country and from 1.6 to 2.0 sheep per ha on ringbarked country. A typical property of 2 000 ha would carry about 3,000 sheep.

Studies using multiple regression analysis have found a high correlation between Dry Sheep Equivalents (DSE's) carried and the three factors of total property area, area of timber treated and area of improved pasture.

Woolgrowing - Wether flocks on native pasture - In this section, gross margin (GM) per wether from woolgrowing on native pasture is calculated. Using this GM, the profitability of the representative property is assessed. Three wool prices are chosen for use in the budgets.

Gross Margins for the wether enterprise are set out below for the three different wool prices. These and all subsequent gross margins were calculated at January 1975.

TABLE 14.1 - GROSS MARGINS PER WETHER ON NATIVE PASTURE

Greasy Wool Price (¢/kg)	Gross Margin ($/wether)
120	2.82
160	4.46
200	6.11

The representative property is 2 000 ha, initially carrying 3,000 wethers, and with the only development being 1 500 ha timber treated. The returns to capital are - 2.8%, 2.5% and 7.4%, for the three selected wool prices in ascending order.

At the long term expected price for traprock wether wool of 160 ¢/kg a return to capital of 2.5% is obtained. Thus the owner would be earning enough to continue indefinitely, provided he is free or nearly free of debt and is satisfied with little return to his capital and no reward for his management. He would earn sufficient to cover normal capital replacement and living expenses, provided the latter are not too high, for example due to education or health costs. The capital value of his property would increase slowly, if at all. Asset value would be eroded if equity is very much below 100%.

At 160 ¢/kg, very little is left over for new investment, loan repayments and interest. At 120 ¢/kg, even normal capital replacement is impossible.

The above assessment could be slightly improved by running a small number of cattle, which could be added without affecting sheep numbers.

Timber treatment on woolgrowing properties - Killing of timber may be done by ringing or poisoning - the latter is now the most common method. There is large variation in cost per hectare, depending on thickness of timber, species, percent initial kill and other factors. In this section it is assumed that trees are poisoned at a cost of $30 per ha.

Analysis of stocking rates in the traprock suggests that timber treatment raises the carrying capacity by approximately 1.3 wethers per hectare treated. Thus at the 160 ¢/kg wool price, a gross margin of $5.80 per ha can be expected. In addition to the timber treatment cost of $30 per ha, an extra sheep investment of $7.80 per ha is included for the assumed increase in stocking.

The extra returns, calculated as a percentage of extra investment, are given below for the three wool prices:

TABLE 14.2 - PROFITABILITY OF TIMBER TREATMENT

Greasy Wool Price (¢/kg)	Return to Timber Treatment (%)
120	10.2
160	15.3
200	20.0

The return may be higher if other benefits besides extra sheep (e.g. increased wool cuts, body weights) were obtained.

There are 500 ha of green timber on the representative property and it is assumed that terrain, thickness of stand, species etc allows the treatment of this area at the cost used above. Property assessment before and after the treatment shows that treatment gives a small improvement in property performance (see Table 14.3). However, it should be remembered that on many properties, the remaining timbered areas will be the roughest and least productive on the property, and thus cost of treatment may be higher than assumed above, and production response to treatment may be lower. Assumed greasy wool price is 160 ¢/kg.

TABLE 14.3 - ASSESSMENT OF THE REPRESENTATIVE PROPERTY AT TWO LEVELS OF TIMBER TREATMENT

		75% Treated	100% Treated
Sheep carried	No.	3 000	3 660
Capital investment	$	94 000	112 960
Gross margin	$	13 389	16 334
Return to management	$	- 5 131	- 3 703
% return to capital	%	2.5	4.7
Cash surplus	$	5 589	8 534

Pasture improvement on woolgrowing properties - Costs of establishing improved pasture are assumed to be clearing of dead timber from ringbarked country ($25 per ha) and land preparation, planting, seed and fertilizer ($12 per ha).

Benefits of improved pasture may be increased wool cut,

increased price for culls, higher stocking rate and the option of changing over to another type of enterprise.

In a grazing trial at Texas (Cassidy *et al.* 1973 and Lee *et al.* 1966), there was virtually no difference in wool cut and body weight between native pasture and more highly stocked lucerne plus native pasture, except where the increase in stocking rate was very large, when wool and body weight decreased. Budget evaluation of the trial results, with respect to these increases in stocking rate of 7.5 and 14.7 sheep per hectare of lucerne planted, shows gains of $14 and $30 per hectare of lucerne planted. It is extremely doubtful that increases of this magnitude could be obtained under commercial conditions and the cost of supplementary feeding in some years, when more highly stocked, could also be prohibitive.

Thus, pasture development will hereafter be evaluated on what graziers' stocking policies have actually been. There is some evidence that after establishing improved pasture, managers feel able to revise upwards their estimate of 'safe' carrying capacity by, on average, 3 to 4 extra DSE for each hectare of improved pasture (compared to 7.5 - 14.7 in the trial).

At an assumed greasy wool price of 160 ¢/kg budgets show that property income will decrease by about $1.50 for each hectare of pasture established, if an assumed increase of 3.5 DSE is the only benefit.

However there are likely to be other benefits besides this moderate increase in stocking rate. Cull sheep would probably be sold off lucerne, bringing a higher price. There may be an increase in wool cuts, although this would be negligible with small proportions of lucerne. Overall, pasture development on a fairly large scale gives only a small improvement in property performance.

Breeding flocks on native pasture and lucerne - Costs and returns for two types of sheep breeding enterprises were examined. The first enterprise was a breeding ewe flock where all wether lambs were sold. The second was a self-replacing wether-ewe flock. Both enterprises utilized lucerne.

Breeding ewe flock - It was assumed that 1,000 ewes could be run on 600 ha of ringbarked country, including 80 ha lucerne. In Table 14.4, gross margins at 3 wool prices are given, and compared with those obtained earlier, for woolgrowing only. In the breeding enterprise one ewe plus followers is about equal to 1.4 DSE.

Thus $GM/DSE = \frac{GM/ewe}{1.4}$

TABLE 14.4 - EWE AND WETHER GROSS MARGINS

		Pessimistic	Mean Expected	Optimistic
Wether flock wool price	¢/kg	120	160	200
Ewe flock wool price (average)	¢/kg	105	140	175
Breeding ewes:				
GM	$/ewe	3.77	6.64	9.51
GM	$/DSE	2.69	4.74	6.79
Wethers:				
GM	$/DSE	2.82	4.46	6.11

There is little difference in GM/DSE between ewes and wethers. With ewes, GM is more responsive to wool price, as an increase in wool price also means an increase in returns from sheep sales. This causes the seemingly paradoxical result of the most profitable enterprise being woolgrowing at low wool prices and breeding flocks at high wool prices. Note that the gross margin does not take into account the extra labour and management required for ewes.

To properly compare woolgrowing and breeding, interest on sheep and lucerne must be taken into account. Assuming mean expected wool prices, the benefit from substituting ewes for wethers is about $700 on a 600 ha block, which is quite small when the extra labour and management involved is considered.

On the 2 000 ha example property, about 2,500 ewes could be run, using 200 ha of lucerne (about 250 wethers would also be carried to use the virgin country). Property assessment under ewes is compared to that under wethers, assuming no extra labour is required.

TABLE 14.5 - ASSESSMENT OF RETURNS UNDER EWES AND UNDER WETHERS

		Woolgrowing	Breeding Flock
Gross margin	($)	13 389	17 721
Return to management	($)	- 5 131	- 2 447
Return to capital	(%)	2.5	5.9
Cash surplus	($)	5 589	9 921

Return to management is $2,684 higher with ewes. However it is likely that an extra man would be required to handle the ewes, costing much more than this extra return. Thus wethers are still likely to be more profitable.

It is emphasised that this is the average situation and that in some parts of the study area there will be a definite advantage in favour of ewes, and in other parts in favour of wethers.

Self-replacing wether-ewe flock - It was assumed that 1,000 ewes and 1,500 wethers were carried on the representative property of 2 000 ha, including 80 ha lucerne. Mean expected wool prices were assumed.

Below, property assessment under this enterprise (assuming no extra labour required) is compared to that of wethers only on native pasture.

TABLE 14.6 - ASSESSMENT OF RETURNS UNDER WETHERS ONLY AND UNDER A WETHER-EWE FLOCK

		Wethers Only	Wether-Ewe Flock
Gross margin	($)	13 389	14 642
Return to management	($)	- 5 131	- 4 570
Return to capital	($)	2.5	3.6
Cash surplus	($)	5 589	6 842

This shows virtually no difference between the two enterprises. Thus, when the extra labour and management required for ewes is taken into account, wethers only would be the preferred enterprise.

Cattle - The basic cattle enterprise (store production on native pasture) was compared with the basic sheep enterprise (woolgrowing on native pasture), on the assumption that it is usually not possible to fatten on native pasture. In certain areas, some producers have been able to turn off fats regularly, so this possibility was also examined. Finally, the role of improved pasture and fodder crop in cattle production is discussed.

Store production on native pasture - To minimize numbers carried during winter, turnoff stock are usually sold in autumn (April-May). Progeny may be turned off as weaner stores (7-10 months), yearling stores (18-20 months) or 2 to 3 year old stores (30 months).

There is generally little difference in profitability between the three enterprises, provided the property is fully stocked. The exception to this is where graziers feel unable to stock fully with breeders when selling younger cattle, due to the increased risk. For example, a grazier carrying 100 cows when turning off yearlings may still only carry 100 cows when turning off weaners. This appears to be true for traprock properties, and thus yearlings would be much more profitable than weaners. Since yearling stores is the most common cattle enterprise, it is the one examined here.

Three levels of cattle prices were used (see Table 14.7). The 'mean expected' prices are roughly equivalent to those of 1970-1972, and are midway between the 'boom' prices of 1973 and the 'bust' prices of 1974-75.

TABLE 14.7 - LONG TERM PREDICTED CATTLE PRICES (GROSS)

	Cattle Prices ($/head)		
	Pessimistic	Mean Expected	Optimistic
18 month steer stores	60	85	110
18 month heifer stores	50	70	90
Aged cull cows	65	90	115
Bulls: purchases	400	500	600
Bulls: sales	200	250	300

The results are presented below (Table 14.8). GM/DSE assumes that 1 cow plus followers is equivalent to 14 DSE.

TABLE 14.8 - GROSS MARGINS FOR STORE PRODUCTION ON NATIVE PASTURE

Prices	GM/Breeder ($)	GM/DSE ($)
Pessimistic	20.34	1.45
Mean expected	36.79	2.63
Optimistic	53.24	3.80

With 1 cow plus followers rated at 14 DSE, the representative property (3000 DSE) can carry 214 breeders. The cattle enterprise will involve additional assets (e.g. yards) and stored fodder, as well as extra capital tied up in livestock. Property assessment, in an average year at each level of cattle prices, indicates that the level of profitability in store production is extremely low. This can be seen by comparison with property assessment results for woolgrowing on native pastures (Table 14.9).

TABLE 14.9 - COMPARISON OF ECONOMIC EFFICIENCY MEASURES FOR WOOLGROWING AND STORE CATTLE PRODUCTION, BOTH ON NATIVE PASTURES

Efficiency Measures (Unit)	Woolgrowing			Store Production		
	Pessim	Mean	Optim	Pessim	Mean	Optim
Gross margin ($)	8454	13389	18321	4353	7873	11393
Net farm income ($)	1454	6389	11321	-2897	623	4143
Return to management ($)	-9706	-5131	-559	-15471	-12636	-9801
Return to capital (%)	-2.8	2.5	7.4	-6.4	-2.9	0.1

The previous analysis is based on a constant substitution rate between sheep and cattle of 1 cow + followers for 14 wethers. Since this substitution rate is likely to vary under different conditions, a better way of comparing cattle and sheep is to calculate a breakeven substitution rate. To do this, we first calculate enterprise returns.

The enterprise return is GM less interest on livestock and interest and depreciation on any special assets. The following returns are calculated for mean expected prices:

(a) sheep enterprise return = $3.98/wether
(b) cattle enterprise return = $20.77/cow

From these we can see that if 5.2 wethers have to be removed to make room for each extra cow, the producer will just breakeven, i.e.

Gain in income from 1 cow = $21 approximately

Loss in income from 5.2 wethers = 5.2 x $3.98
= $21 approximately

The figure of 5.2 is the breakeven substitution rate. If more than 5.2 wethers must be removed for each cow added, it is more profitable to stay with sheep; if less than 5.2, cattle are more profitable.

If the actual rate is 14, as suggested above, then sheep are much more profitable. However, a small increase in cattle numbers may be worthwhile. At low numbers of cattle, sheep and cattle may complement each other. Thus on the representative property, with 3,000 wethers, 20 to 30 cows could possibly be added with no decrease in sheep numbers, i.e. actual substitution rate = 0. Perhaps 40 to 50 cows could be added before the actual substitution rate exceeded the breakeven rate of 5.2.

Breakeven substitution rates at different wool and cattle prices are given in Table 14.10. This indicates that only at pessimistic prices for wool and optimistic prices for cattle does the breakeven rate approach the suggested actual rate of 14. However if, for example, it was possible to add 70 cows before the actual rate exceeded 8 wethers/breeder, then this would be worthwhile doing if one were mildly pessimistic about wool and mildly optimistic about cattle.

TABLE 14.10 - BREAKEVEN SUBSTITUTION RATES UNDER DIFFERENT PRICE REGIMES

(Figures are wethers per breeder; actual rates must be less than these for cattle to be more profitable.)

Wool Prices	Cattle Prices		
	Pessimistic	Mean Expected	Optimistic
Pessimistic	3.1	8.4	13.8
Mean expected	1.9	5.2	8.5
Optimistic	1.4	3.8	6.2

As ewes are similar to wethers in profitability, similar conclusions result from a cattle-ewes comparison as from a cattle-wethers comparison.

Breeding and fattening - In certain areas, some producers have been successful in fattening cattle on native pasture. In such a case, mean expected prices received would be similar to the optimistic prices assumed for store production. Approximate indicators of the profitability of this enterprise include GM = $53/cow, return to capital = 0% and a breakeven substitution rate = 8.5. Greater expansion of cattle than before would be justified, although it would probably still be unprofitable to change over completely to cattle.

The profitability of improved pasture with cattle depends on its benefits, and as there are little data on these, it is only possible to speculate about returns. Benefits may include a higher proportion sold as fats, increased carrying capacity, increased branding rate or a combination of these.

Considering each of these in turn,

(1) More fats - with an area of improved pasture it may be possible to sell some yearlings as fats rather than stores. For example, with 250 - 300 ha of lucerne or medics on the representative property, perhaps 50% of yearlings, on average could be turned off as fats. If there were no other benefits, then the extra return would not cover the cost of the pasture. If it were possible to grow an area of oats to fatten the remaining 50% as well, then extra returns may almost cover the cost of pasture and oats.

(2) Increasing carrying capacity - if an increase of 3 to 4 DSE per ha pasture established was the only benefit of the pasture, the return from extra cattle would not cover its cost.

(3) Increase in branding rate - this alone would certainly not justify improved pasture.

(4) Combination of these - as an example, an area of 260 ha carrying 35 breeders and turning off yearling stores is used. Assume the whole area is planted to pasture and that the following benefits accrue:

(a) can now carry 100 breeders

(b) progeny turned off as fats rather than stores; mean expected steer price increases from $85 to $120/head

(c) branding rate increases from 80 to 90%.

The result is a breakeven, i.e. extra returns just cover extra costs. This example indicates the required magnitude of benefits for improved pasture to be profitable.

Note that this example only breaks even compared to store production. Compared to wethers, the cattle enterprise is still unprofitable.

Summary - traprock enterprises and development - The financial results of the various ways of operating the representative property discussed previously are presented in Table 14.11 (on the following page). In addition, two other property plans are considered. Plan (7) is a combination of sheep and cattle, where cattle have been added up to the point where the substitution rate exceeds the breakeven rate. Plan (8) involves an increase in property size of 50%, (i.e. from 2 000 to 3 000 ha), resulting in a 40% increase in sheep numbers, 25% increases in improvements and fixed costs, and no increases in plant or labour.

The general conclusion from Table 14.11 is that all plans are of low profitability, and no plan gives a return very much greater than the basic situation of woolgrowing on native pasture (Plan (1)). Rates of return on additional investment are very low. While breeding ewes appear most attractive, the data presented assumes no increase in labour, and this would mean a very heavy work load for the operator. If extra labour must be employed when ewes are run, as is likely, then plans (4) and (5) would be much less profitable than plan (1).

Expansion of property size is probably one of the best ways of improving profit, especially if sheep numbers can be increased in proportion, rather than less than proportionately as assumed in plan (8). Apart from this, a sheep-cattle combination is probably the wisest course; besides providing slightly higher returns than sheep alone, it gives greater flexibility and stability of income. This latter is important when the uncertainty of the wool and beef markets is considered.

14.1.1.2 Comparison of land systems

Section 14.1.1.1 did not distinguish between different areas within the traprock. In this section, data collected in two surveys are used to show the differences between properties in different land systems, and also between these and the 'representative' property described in the previous section.

The land systems are those described in section 3 except that some are excluded because of lack of economic data, and others are aggregated (Pikedale and Glenlyon).

Sources of data - Data in Table 14.12 were derived from a 1969 development survey (Walsh *pers. comm.*). This gave areas and proportions developed, livestock numbers and stocking rates. Table 14.13 is based on a drought survey (Alcock 1973) and gives the same data plus subdivision details and wool cuts.

The drought survey used a stratified random sample and personal interviews, but the development survey used mail-in questionnaires, and as a result there was an extreme response bias towards larger properties. If all properties to which questionnaires were sent were divided into categories based on size, then percentage response increased steadily from 0% to 100% as property size increased. This can be seen by comparing average property area for the same land systems in Tables 14.12 and 14.13. (The exception is Thane LS, where only a small number of properties was surveyed in both cases.)

TABLE 14.11 - AVERAGE YEAR ASSESSMENT OF THE REPRESENTATIVE PROPERTY WITH VARIOUS PROPERTY PLANS AT MEAN EXPECTED PRICES

Property Plan	1	2	3	4*	5*	6	7	8
Plan Description (NP = Native pasture IP = Improved pasture)	Wethers on NP 75% r-barked	Wethers on NP 100% r-barked	Wethers on NP & IP	Breeding ewes on NP & IP	Wether-Ewe Flock on NP & IP	Store Cattle Production on NP	Sheep-Cattle Combination on NP	Wethers on NP Property 50% larger
No. wethers	3000	3660	3945	250	1500	0	2900	4200
No. ewes	0	0	0	2500	1000	0	0	0
No. cows	0	0	0	0	0	214	50	0
Area improved pasture ha	0	0	270	200	80	0	0	0
I. PROFIT STATEMENT	$	$	$	$	$	$	$	$
A. Capital investment	94000	112960	113120	114595	102650	115740	102600	130200
B. Property output	21822	26622	30826	34013	25769	12786	24082	30551
C. Variable costs	8433	10288	14550	16292	11127	4913	9300	11806
D. Gross margin (B - C)	13389	16334	16276	17721	14642	7873	14782	18745
E. Overheads	7000	7000	7000	7000	7000	7250	7050	8438
F. Net farm income (D - E)	6389	9334	9276	10721	7642	623	7732	10307
G. Unpaid labour allowance	4000	4000	4000	4000	4000	4000	4000	4000
H. Return to capital & management (F - G)	2389	5334	5276	6721	3642	-3377	3732	6307
I. 8% interest on investment (0.08 x A)	7520	9037	9050	9168	8212	9259	8208	10416
J. Return to management (H - I)	-5131	-3703	-3774	-2447	-4570	-12636	-4476	-4109
K. % return to capital ($\frac{H}{A} \times \frac{100}{1}$)	2.5%	4.7%	4.7%	5.9%	3.6%	-2.9%	3.6%	4.8%
II. CASH SURPLUS	5589	8534	8476	9921	6842	73	6982	9995

* Plans 4 and 5 assume no extra labour required for breeding ewes.

Because of this bias, the data in Table 14.13 are more reliable.

In Table 14.13 the characteristics of the representative property used in the previous section are also given, to show how it differs from the properties in each land system. The property is in its original state, that is, all wethers, no cattle, no more than 75% ringbarked, no improved pasture or crop.

Property size and degree of development - The larger properties are found in Gore LS and Pikedale-Glenlyon LS, while areas are smaller in Ironpot LS. Properties are most highly developed in the Pikedale-Glenlyon LS and Ironpot LS and less developed in Gore LS and Warroo LS, with respect to areas treated, pasture and crop and subdivision.

Livestock numbers - Sheep grazing is the most important enterprise in Gore, Pikedale-Glenlyon and Warroo. In Ironpot and Thane sheep and cattle are of about equal importance, while in Canal and Bonshaw, beef is the major enterprise. There is more emphasis on wethers in Gore than in the other land systems.

Stocking rates - Stocking rates are given in DSE's per hectare and DSE's per RHE (ringbarked hectare equivalent). RHE's reduce all parts of the property to a common basis, just as DSE's reduce different types of stock to a common basis. DSE/RHE is equivalent to stocking rate on country where all timber has been killed.

By using these two measures to compare the land systems, it is seen that much of the variation in stocking rate is explained by differences in degree in development. However, the DSE/RHE figures indicate that Ironpot LS is more productive in terms of carrying capacity on similarly developed country than the other land systems. Stocking rates are lowest in Gore LS.

TABLE 14.12 - PROPERTY CHARACTERISTICS BY LAND SYSTEM - 1969 DEVELOPMENT SURVEY

Degree of Development, Stock Numbers, and Stocking Rate. All data are average per property.

Land System	Ironpot	Pikedale-Glenlyon	Gore	Warroo	Thane	Canal	Bonshaw
Property area ha	1898	3445	2960	6821	1408	1165	2480
Area timber treated ha	1628	2573	2036	4493	1043	656	2293
Area improved pasture ha	166	90	47	227	70	44	349
Area grazing crop ha	47	36	12	122	28	67	209
No. sheep	3152	4349	3303	9336	1592	491	2600
No. cattle	296	97	107	307	152	224	740
Total DSE's(1)	5225	5177	4052	11488	2656	2059	7780
% timber treated	84	76	71	65	76	60	93
% pasture	6.6	2.4	1.6	1.9	6.4	3.3	16.9
% grazing crop	2.0	1.9	0.7	1.6	2.4	5.0	10.06
DSE/hectare	2.67	1.58	1.51	1.85	2.15	1.78	3.43
DSE/RHE	2.72	1.95	1.90	2.52	2.20	2.40	2.59

(1) All sheep at 1 DSE and all cattle at 7 DSE.

TABLE 14.13 - PROPERTY CHARACTERISTICS BY LAND SYSTEM - 1970 DROUGHT SURVEY

Degree of Development, Subdivision, Stock Numbers, Stocking Rate, and Wool cut for each land system (average per property) and Representative Property

	Repr. Property	Ironpot	Pikedale-Glenlyon	Gore	Warroo	Thane
Property area (ha)	2000	1527	2113	2750	1742	2499
Area timber treated (ha)	1500	1169	1876	1796	1153	1646
Area pasture (ha)	0	58	59	38	0	45
Area grazing crop (ha)	0	27	22	19	17	28
No. paddocks	12	15	15	11	8	n.a.
Average paddock size (ha)	167	142	142	303	175	n.a.
SHEEP NUMBERS						
Ewes	0	565	864	391	800	0
Wethers	3000	923	1598	2171	744	1467
Other	0	95	354	217	342	0
Total Sheep	3000	1583	2816	2778	1886	1467
CATTLE NUMBERS						
Breeders	0	114	71	45	52	139
Other	0	101	54	28	47	101
Total Cattle	0	215	125	73	99	240
Total 'Adjusted' DSE's (1)	3000	3112	3708	3506	2594	3193
% timber treated	75.0	77.5	90.4	68.4	66.1	69.0
% pasture	0	3.6	3.1	1.8	0.8	1.5
% grazing crop	0	1.8	1.3	0.8	1.5	1.0
DSE/hectare	1.50	2.08	1.80	1.28	1.63	1.38
DSE/RHE	1.85	2.25	1.85	1.61	2.10	1.78
Wool cut (kg/head)						
- normal	4.50	4.31	4.72	4.63	4.08	n.a.
- last shearing (2)	4.50	4.40	4.45	4.17	3.72	n.a.

(1) Ratings for 'adjusted' DSE's - 1 ewe + followers = 1.4 DSE
1 cow + followers = 14 DSE

(2) Prior to September 1970 (time of survey).

14.1.1.3 Economics of the Gore Land System

Since 1969 several graziers in the Gore LS have been recording in the Farm Management Accounting Service provided by the Department of Primary Industries. Properties in the group are larger than is usual for the traprock area or the Gore LS. Main enterprise is wethers, with small numbers of cattle. Breeding ewes are run on some properties.

The main assets are land (about $15/hectare), structures ($7/hectare) and livestock. Capital tied up in livestock fluctuates according to the wool and beef markets. Plant and machinery represent a very small proportion of total assets.

There were vast changes in farm output as wool price changed. Except during the wool slump, wool accounted for 90 to 100% of gross income.

Major expense items are shearing, selling costs, rent, rates and taxes, and administration costs.

The group average return to capital ranged from -5.5% in the slump to 17.3% during the following rise in wool prices. Variation on some individual properties was much greater. The disadvantage of depending on wool for 90 to 100% of income is apparent.

TABLE 14.14 - PROPERTY DESCRIPTION AND FINANCIAL PERFORMANCE, TRAPROCK FMAS MEMBERS - 1969/70 TO 1973/74 (Data are Average per Property)

	1969-70	1970-71	1971-72	1972-73	1973-74
No. of properties recording	5	5	6	4	4
Property area (ha)	2819	4231	4067	3645	3833
Sheep: Av. no. during year	3065	3430	4049	4002	4166
Wool cut kg/head	3.76	3.87	3.84	3.83	4.26
Cattle: Av. no. breeding cows	15	23	30	31	36
Av. Capital Investment $	96275	131726	118007	103333	140423
INCOME					
Sheep and wool income $	11395	9584	16085	38959	42617
Cattle income $	1132	1636	1982	1617	1628
Other income $	556	273	235	193	-176
Farm Output (Gross Income) $	13083	11493	18301	40769	44069
Total farm expenses $	10437	14061	14265	16988	23988
Operating profit (net income) $	2646	-2568	4037	23781	20081
Return to management $	-8074	-15597	-7834	12839	4299
Return to capital %	-1.0	-5.5	-0.2	17.3	10.8

14.1.1.4 Conclusion - grazing enterprises

In section 14.1.1.1 it was shown that in general in traprock areas:

(a) Returns from grazing enterprises are very low.

(b) Returns from development (timber treatment, pasture) are also quite low.

(c) Woolgrowing will most often be the most profitable enterprise.

(d) Ewes will only be more profitable than wethers if no extra labour is required, except in certain areas more suitable for breeding flocks.

(e) In most of the traprock area, cattle are quite unprofitable. However a small to medium size cattle herd can be justified to gain greater flexibility and income stability, provided the cattle can be added without removing very many sheep.

(f) Expansion of property size is possibly one of the best ways of increasing profit, especially if sheep numbers can be increased in the same proportion.

Section 14.1.1.2 showed the differences in the land systems, and thus demonstrated that the above conclusions only apply to the traprock country as a whole. For example in certain areas large cattle herds may be a proposition.

Section 14.1.1.3 dealt with Gore LS in detail, and demonstrated how wool price is the overwhelming influence on property performance in that district.

14.1.2 Agriculture

Crops are of minor importance in the traprock and granite areas, being used principally as a developmental phase between land clearing and pasture establishment. The most common crop is grazing oats, while some cash crops are also grown.

The main cash crops are wheat and barley in winter (both traprock and granite), and grain sorghum and soybeans in summer. Sorghum is only grown in isolated pockets in the traprock, and soybeans are restricted to the higher rainfall granite area.

Under suitable conditions some grazing of the winter cereals may also be possible.

No attempt is made here to set out costs and returns because of the lack of data on yield, the main determinant of crop profitability. Gross margins per hectare for cash crops range from $40 to $100/hectare, with the summer crops returning more than the winter crops.

14.1.3 Horticulture

The main horticulture area is the Granite Belt with some fruit also being grown on the sandstone soils near Warwick.

14.1.3.1 Fruit

Only a small proportion of growers specialize in a single crop. Most orchards contain several varieties of apples and stone fruits or alternatively stone fruits and grapes. Where the apple is the main crop, the size of the orchard varies from 6 to 60 ha, the average being about 12 ha. Orchards which mainly produce stone fruits seldom exceed 16 ha, while the largest vineyard in the district is 16 ha.

A wide range in returns is possible through price and yield variations. Generally, fruit crops will give a gross margin of $200 to $700 per ha.

14.1.3.2 Vegetables

A wide variety of vegetable crops is also grown in the area. The most important crop is tomatoes and the other main ones are cabbage, cauliflower and French beans. There is a number of specialist growers with 8 ha or more and many who treat vegetables as a sideline to fruitgrowing. Again gross margins are variable, but on average would range from $400 to $1,500 per hectare.

14.1.3.3 Farm performance

From 1965/66 to 1968/69 a number of orchardists participated in the Farm Management Accounting Service.

Average results for the four years do not show the wide fluctuations that are possible. For example, for each year, return to capital varied from minus 30% to plus 50% for various farmers. Individual farmers experienced similar fluctuations from year to year. Overall profitability during the period was poor by non-farm standards but reasonably high compared to other farming activities.

14.1.4 Conclusion

The profitability of grazing activities in the area is low in terms of returns to capital and management, and the return to funds invested in developing these activities is also low. Agriculture is a minor activity because soil types are generally unsuitable. Horticulture provides more reasonable, but fluctuating, returns to capital and management. However, this activity is restricted to a small area. At this stage the study is incomplete as not all land use alternatives have been explored. Apicultural and/or forestry activities are valid alternatives to grazing enterprises. With the low returns to current land use, research into these alternatives should have a high priority.

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14.2 Marketing

14.2.1 Wool

The wool market has displayed a volatile pattern over the last ten years with the result that incomes of wool producers have also fluctuated markedly over this period. This situation is reflected in the table below.

TABLE 14.15 - BRISBANE WOOL MARKET - 1965/66 TO 1974/75

Year[b]	Sales No.	Bales Sold No.	Wool Sold[a] ('000 kg)	Average Price per kg cents
1965-66	10	630 688	90 042	106.92
1966-67	10	636 883	92 316	103.47
1967-68	11	705 823	101 780	95.89
1968-69	11	768 041	111 483	99.71
1969-70	11	605 174	87 305	82.68
1970-71	10	502 638	72 857	60.84
1971-72	8	539 782	79 176	73.37
1972-73	8	417 287	61 610	178.30
1973-74	9	363 643	54 761	176.43
1974-75	10	410 191	61 220	126.80

(a) Including wool received from New South Wales.

(b) Twelve months ended 30th June.

(Source: Australian Bureau of Statistics.)

As can be seen, a downward trend was evident in prices from 1965/66 to 1970/71. A number of factors led to this situation but probably the major factor was the strong competition which wool received from the rapid expansion in production of synthetic fibres during this period.

In 1972 and 1973, however, a turnabout occurred on the market and prices rose appreciably. A complex of factors both locally and internationally led to this situation of which the following are probably most important:-

(i) A fashion swing away from synthetic fibres back to natural fibres such as wool;

(ii) A rundown of world wool stocks from earlier years and generally limited supplies of wool as a result of lower world production;

(iii) A general recovery from recession in the world economy with particular recovery in the wool textile section;

(iv) International currency instability encouraged large trading houses to hold their assets in the form of commodities such as wool to minimise potential loss from exchange rate fluctuations.

During 1974, however, prices again began to weaken as major world economies entered the worse recession since the war. Towards the end of 1974, the Federal Government agreed to financially back the operations of the Australian Wool Corporation (AWC) to maintain a reserve price based on a value of 250 ¢ per kg for 21 micron wool on a clean basis.

The Australian Wool Corporation maintained this floor in the market, but only at the expense of accumulating a wool stockpile in excess of 1.8 m bales and outlaying over $300 m.

Towards the latter part of 1975 and early part of 1976, demand for wool had gradually improved and the AWC was able to curtail much of its market support operations and had begun to resell part of its stockpile as prices gradually increased.

14.2.1.1 Market outlook

The fortunes of the wool industry, as with most textiles, has been closely tied to the general level of economic activity in the main consuming countries. The immediate outlook for wool, therefore, is largely bound up with the prospects for a renewal of economic activity in the major industrialised countries.

Recovery is now well under way in the USA and it is hoped that this should lead Japan and Europe out of recession, although recovery in the latter two areas may not be fully evident until the latter part of 1976. Demand for wool then is likely to continue to increase in the next twelve months if the world recovery is maintained, although the extent of the AWC stockpile and its disposal could tend to dampen the extent of price rises.

The longer term future of wool is open to greater speculation. One of the major factors which has handicapped wool in the past, namely, competition from synthetics, is not likely to pose as great a problem in the future. It appears that there will be no major technological innovations with synthetics while synthetic fibre producers have achieved already major economies of scale. Hence, it appears unlikely that synthetic fibre prices will change significantly in real terms over the next five years and therefore wool prices are unlikely to suffer any further significant falls in price due to competition from synthetics.

Assuming that the same trends in population growth and real income per head occur in our major markets over the next five years, as have occurred over the previous fifteen years, then some increase in demand and consequently some price increase can be expected.

By 1979/80, the Bureau of Agricultural Economics has estimated that an equilibrium level of prices and supply should apply with prices at about 300¢ per kg (clean basis) in terms of 1974/75 prices, while world supplies will increase by about 3 per cent to that time. Of course, this prediction is fairly sensitive to changes in the underlying factors determining wool prices and many of these factors are quite volatile.

14.2.1.2 Conclusion

Wool has always been a very volatile commodity and attempts to predict its future course must be treated with caution. However, based on the previous factors plus a continuation in the future of the current market support policies of the Australian Wool Corporation, it would appear that the wool industry may enjoy more stable market circumstances in the future than it has over the recent past.

Although wool production in the future may not be as profitable as it was say during the 1950's, it should nevertheless provide a fairly assured income providing current levels of production are not greatly increased.

14.2.2 Prime Lamb

The prime lamb industry in Queensland is relatively small and does not produce enough lamb to satisfy Queensland's requirements. However, any major expansion of the industry in the near future seems unlikely.

There is little specialisation in prime lambs in Queensland and production is mainly a sideline to cereal cropping, chiefly in the Darling Downs area.

Lamb production is very dependent on a specialised environment. Three essential conditions for the development of the industry are:-

(i) reliable rainfall to produce an annual feed supply during the last two months of pregnancy and until the lamb is marketed at approximately 7 months old;

(ii) a climate which does not subject the ewes and lambs to high temperatures and humidity which inhibit growth;

(iii) availability of markets and proximity thereto.

Parts of the study area would probably satisfy conditions (ii) and (iii). However, as with other likely lamb production areas in Queensland, the greatest handicap is the variability and unreliability of rainfall which, in turn, cause variability in production of feed.

14.2.2.1 Marketing

Prices for lambs have shown wide variations over the years (see Table 14.16) and it is hard to predict future trends.

TABLE 14.16 - LAMB PRICES AT CANNON HILL - 1970/71 TO 1974/75
(13-16 kg, 1st and 2nd Export Quality: Estimated Dressed Weight)

Period	¢ per kg
Av. 1970/71	35.0
Av. 1971/72	32.3
Av. 1972/73	62.5
Av. 1973/74	90.2
Av. 1974/75	58.7

A major reason for this instability is that lamb prices are greatly influenced by events in the wool and beef industries. When the wool industry was depressed and large numbers of sheep were being liquidated during 1971 and early 1972, lamb prices also were very depressed. However, with the recovery in wool prices in late 1972 and 1973 and a desire to rebuild flocks, there was a strong demand for lambs for restocking in addition to the regular demand for lambs for meat and prices rose. However, when prices in the beef industry crashed during 1974 and 1975, then prices of other red meats such as lamb were also dragged down.

14.2.2.2 Conclusion

In view of the instability of the lamb market and the problems associated with production, it is difficult to recommend entering into lamb production.

Future demand for lamb would appear to be mainly for local consumption and will only expand with population growth. The lamb industry in the future will continue to be heavily influenced by the wool and beef industries.

It is probable that those lamb producers who have mastered the production difficulties could make a profitable living meeting this demand, but it would be unwise to recommend lamb production on a wide scale basis.

14.2.3 Beef

For the ten years up to the end of 1973, the beef industry had demonstrated rapid growth allied with very attractive prices due to a worldwide shortage of red meat (see Table 14.17). Up to this time, the beef industry appeared to have among the best prospects of any rural industry and there was considerable movement of resources into the industry.

TABLE 14.17 - QUEENSLAND BEEF AND VEAL PRODUCTION AND PRICES - 1965/66 TO 1974/75

Year	Beef and Veal Production[a]	Av. Saleyard Price[b]
	'000 tonnes	¢ per kg
1965/66	319	53.22
1966/67	301	57.02
1967/68	316	58.21
1968/69	346	58.29
1969/70	315	60.30
1970/71	302	65.00
1971/72	345	65.90
1972/73	384	77.60
1973/74	349	82.40
1974/75	419	32.20

(a) Source: Australian Bureau of Statistics.
(b) Average yearly prices of bullocks 301 to 320 kg estimated dressed weight 1st and 2nd export quality at Cannon Hill.

(Source: Australian Meat Board.)

However, in late 1973, the situation suddenly changed when saleyard prices dropped rapidly and the industry entered a period of severe depression which persisted through most of 1974 and 1975 and only began to abate in late 1975 and early 1976. The collapse in prices was caused mainly by a rapid weakening in demand from Australia's three chief overseas markets - the USA, Japan and the EEC. The Queensland beef industry is highly dependent on export markets with some 70 to 80 per cent of production exported in a normal season and hence suffered badly during the downturn.

A complex of factors contributed to the downturn. These included unfavourable exchange rate variations; adverse consumer reaction to high meat prices; a domestic meat glut in the USA and generally increased domestic production of beef in most of the countries that Australia supplied; general government and private demand restraint in the face of economic recession and inflation which began to afflict the industrialised countries.

During the depths of the beef depression in early 1975, saleyard prices for cattle were only 25 per cent of the peak levels enjoyed in 1973. Many producers were faced with bankruptcy and they had to drastically curtail their operations and many turned to institutions such as the Rural Reconstruction Board for emergency 'carry on' finance.

Towards the end of 1975, the situation began to gradually improve with tentative increases in demand from the American and Japanese markets, while saleyard prices started to edge up. At the beginning of 1976, the industry appeared to be through the worst of the beef recession but it had suffered great damage and was likely to take many years to recover, even assuming reasonable markets.

14.2.3.1 Beef market outlook

A cautiously optimistic outlook applies to the short term future of the beef industry. It appears that there will be some expansion in the volume of Australia's exports in 1976 while export prices should also strengthen. However, any price rises are likely to be moderate due to the pressure of supplies from the present record Australian cattle numbers. Thus while they will be above those in 1975, they are still expected to be below the trend level of prices for the ten years up to 1972/73. The gross value of production for 1975/76 has been estimated by the Bureau of Agricultural Economics to be 30 per cent above the low level of 1974/75.

In the longer term, in the period toward the end of this decade, world supply and demand should tend towards balance with trade prices generally higher than current levels. However, world demand, while it is likely to exhibit a rising trend, will be critically sensitive to relatively minor changes in supply/demand balances in importing countries.

Given the present uncertainty of the timing of a general market strengthening in the medium term and the likely continuation of no more than relatively low profits from cattle raising in the shorter term, the Queensland beef industry seems destined to curtail its long term growth and perhaps even contract over the next few years.

14.2.4 Fruit and Vegetables

14.2.4.1 Pome fruit

Prices obtained for apples and pears at the Brisbane Wholesale Market have increased only marginally in the last ten years but, in real terms, prices have effectively

decreased. There has been no appreciable yield increase to counteract this situation and the pome fruit industry is suffering from a 'cost-price' squeeze.

Furthermore, the removal of the sales tax exemption on non-alcoholic carbonated beverages containing not less than 5 per cent by volume of Australian Fruit Juice has adversely affected apple growers in two ways.

Firstly, there is the immediate loss to growers of the returns from apples which would have been processed but for the removal of the tax exemption. This loss is more severe in a bad hail year. Secondly, if these apples are then placed on the fresh fruit market, prices could well be depressed, lowering still further the returns from apple growing.

However, another processing outlet for red apples appears a distinct possibility, following experiments into the production of apple crisps. One firm is intending to produce apple crisps at Thulimbah utilising the COD cold store there. A nine-month processing period is envisaged and it is estimated that up to 2 050 tonnes of Delicious and Jonathon apples might be required.

Increasing freight charges are likely to be a bigger hindrance than high tariffs in determining future fruit exports to the EEC. So far as Queensland is concerned, the principal fruit affected is apples. Although the ultimate duty on apples will be only 8 per cent, the present freight rate per box is $4.88, and there is every indication of further substantial increases in freight rates. Queensland apple exports, which have been steadily declining for some years, are likely to continue to do so.

The Tree Pull Compensation Scheme is having only a marginal effect on production. To date, 42 applications for assistance have been approved, totalling about $180,000. There are five applications pending and 55 have been declined or withdrawn. Less than 6 per cent of the area under apples and pears has been from the most marginal orchards. Thus, the scheme will only affect the volume of pome fruit production slightly, but as the alternate use of the land will be mainly vegetable production this will add to diversification in this area.

14.2.4.2 Stone fruit

Stone fruit production is of minor importance. It is not likely to grow appreciably and processing outlets are very limited. Prices on the fresh fruit market have decreased in real terms over the last five years.

14.2.4.3 Grapes

(a) Table grapes - The market price for table grapes has increased appreciably in the last decade. In the 1968 season a half box of Stanthorpe Muscats averaged $2.53, in 1970 $3.64, and in 1975 $5.54. It appears that supply is well tailored to demand and satisfactory returns should continue.

(b) Wine grapes - The prospects for the Queensland wine grape industry are uncertain at this stage. Some Australian wine grapes face an oversupply situation within a few years, whereas the prospects are good for those wine grapes producing high quality wines. Research is continuing in QDPI in order to ascertain which wine grape varieties respond best to the region's soil and climatological features.

14.2.4.4 Vegetables

Overall, in the last few years, the vegetable producer has been experiencing better returns than has the fruit grower. Tomatoes averaged $1.63 green and $2.36 colour per half box in 1966, whereas in 1975 these prices increased to $3.70 and $4.85 respectively. Yields have also improved.

Two major processors have shown interest in the setting up of tomato processing plants in Queensland. Processors in the south are having difficulty in contracting enough growers for their requirements. There is a tremendous potential for Queensland penetration of the Japanese markets with fresh vegetables during the Japanese winter, say between October and March each year. There have been some on-the-spot negotiations and these could lead to trial shipments of vegetables to Japan.

In the last few years increased vegetable production in the Stanthorpe area has occurred as a means of augmenting poor returns from apple crops. The likely continuation of unfavourable market trends for deciduous fruits would suggest diversification into vegetable growing.

14.2.4.5 Annual average prices

Table 14.18 (over) details price variations for various fruit and vegetables on the Brisbane wholesale markets over the past twelve years.

14.2.5 Agricultural Crops

Future prospects for most of Australia's agricultural products depend, in the main, on the availability of acceptable export markets. This will continue to be the case because of the relationship of Australia's small population relative to its production potential.

During recent seasons export prices have soared to record levels. This has resulted from crop failures in the USSR which has required that country to import massive quantitites of grain to meet local market requirements. In fact, during 1975/76, the USSR imported an estimated 25 m tonnes.

In the immediate future export market returns will depend on the level of grain production in the USA and the USSR. However, in the long term, it is expected that new markets will emerge, provided that Australian rural export marketing policies are finely attuned to the opportunities available.

14.2.5.1 Wheat

Australia ranks seventh in the world as a wheat producer, but is the third largest exporting country after the United States and Canada. However, Queensland, on average, accounts for only about 7 per cent of Australia's production.

TABLE 14.18 - FRUIT AND VEGETABLES, ANNUAL AVERAGE PRICES - BRISBANE WHOLESALE MARKETS, 1964 TO 1975

Product	Unit	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Apples - Delicious	$ per box	3.48	3.75	4.62	4.10	5.28	4.19	5.14	3.29	5.32	4.62	6.89	5.23
- Jonathan		3.40	3.57	3.56	3.31	4.19	3.13	3.75	2.93	4.22	3.46	4.86	4.10
- Granny Smith	(18 kg)	3.19	2.87	4.04	2.87	3.33	3.13	3.54	2.63	3.74	3.17	4.21	4.27
Pears		3.13	3.91	3.77	3.48	3.66	3.82	3.61	3.62	4.20	3.50*	4.29*	5.09*
Apricots	$ per half box	2.77	3.76	3.53	3.97	3.75	5.54	3.64	3.68	4.49	4.49	5.74	6.53
Peaches		1.94	2.11	1.87	2.16	2.27	2.80	2.12	2.40	2.70	3.27	4.05	3.95(e)
Plums	(10 kg)	3.06	2.04	2.58	3.48	3.04	4.75	2.81	3.43	3.01	4.20	5.11	5.04
Grapes (Stanthorpe-Muscats)	$ per half box (10 kg)	2.21	2.53	2.12	2.72	2.62	2.88	3.64	3.70	3.62	4.07	4.38	5.54
Tomatoes - Coloured	$ per half box	2.32	2.93	2.36	2.88	2.67	2.90	2.96	3.66	3.63	4.32	4.82	4.85
- Green	(10 kg)	1.71	2.29	1.63	1.88	1.82	2.07	2.07	2.55	2.59	3.31	3.56	3.70
Cauliflowers	¢ each	21.4	24.0	20.1	25.5	20.8	22.0	24.0	25.4	24.0	31.1	41.3	41.2
Cabbage - Drumhead	$ per box	11.6	14.8	12.7	17.4	15.6	13.0	17.3	19.9	18.3	27.2	32.5	18.4
Cabbage - Sugarloaf	(20 kg)	n.a.	n.a.	0.95	1.42	1.27	1.18	1.53	1.21	1.55	1.58	1.91	1.88
Lettuce	$ per box (9 kg)	1.03	1.16	0.87	1.46	1.17	1.26	1.43	1.57	1.74	2.02	2.56	2.49
Peas	¢ per kg	26.9	28.0	23.1	29.1	24.9	23.4	29.1	28.0	28.7	36.2	47.7	49.8
Beans		22.3	24.9	22.1	24.9	24.4	22.8	26.2	31.5	28.2	32.9	46.0	41.8
Cucumbers - Green	$ per half box	1.41	1.67	1.18	1.29	1.59	1.31	1.55	1.92	1.93	1.90	3.19	2.51
- Apple	(10 kg)	2.49	2.06	1.46	1.66	2.01	1.77	2.69	1.96	2.32	3.19	2.87	4.00(e)

Note: For apricots, peaches, plums and apple cucumbers, year column refers to selling season commencing in that year ie. 1964 represents season 1964/65.
Source: Marketing Services Branch.
(e) = estimated figure. * $ per ctn (18 kg) n.a. Not available.

As a result of the worldwide wheat shortage, wheat delivery quotas were suspended in all States beginning with the 1975/76 season. It is expected that wheat quotas will not be reintroduced in the near future because of the continuation of the wheat shortage and the need to build up carryover stocks to a reasonable level.

Returns to growers in the near future are expected to approximate those of recent seasons of $100 per tonne, f.o.r., ports, for Australian Standard White. In addition, Queensland produces a high proportion of prime hard wheat which finds a ready outlet on local and export markets at premium prices. These premiums are expected to average $10 per tonne in the immediate future.

The market outlook for wheat, therefore, in the immediate future remains bright and growers can expect to receive satisfactory returns.

14.2.5.2 Barley

Barley production has more than doubled in recent years and reached 460 000 tonnes in 1975/76. This expansion can be mainly attributed to higher returns compared with competing crops and the relatively quick finalisation of pools by the Barley Marketing Board.

Returns to growers have averaged $90 per tonne ex farm gate in recent seasons as a result of buoyant export markets. In the immediate future returns are expected to continue at the same levels.

It is expected that little difficulty will be experienced in disposing of all barley produced in Queensland in the near future. New markets have been developed in the USSR, Taiwan and Korea. In addition, good quality malting barley has found a ready market in the Japanese food industry.

14.2.5.3 Grain sorghum

Since 1969 production of grain sorghum in Queensland has progressed rapidly and is now of the order of 650 000 tonnes. In the initial stages this expansion was mainly due to poor seasonal conditions for winter crops, which caused growers to increase their production of summer crops. The introduction of wheat delivery quotas in 1969/70, coupled with good export returns from grain sorghum, also encouraged increased plantings.

Returns to growers during the past two seasons have been of the order of $70 to $80 per tonne, f.o.r., ports. It is expected that returns will remain at about this level in the immediate future. The bulk of the crop will continue to find a ready market in Japan.

14.2.5.4 Vegetable oilseeds

While each of the vegetable oilseeds has its own special characteristics, improved processing methods have made the different oils largely and increasingly interchangeable. Thus it is not realistic to consider market prospects

for a specific oilseed in isolation from the market for other competitive oilseeds.

The market for oilseeds is probably the most complex for all agricultural commodity groups and is subject to fairly rapid changes. When considering market prospects for oilseeds, there are three areas which have to be considered - the oilseed itself, the oil and the meal.

Soybean - The future market for soybean is likely to be in the supply of high protein supplements for livestock feeding.

Production of soybean has expanded rapidly in recent years and is now of the order of 30 000 to 40 000 tonnes. This rapid increase in production can be mainly attributed to improved varieties and improved returns.

Soybean prices reached a peak of $190 per tonne, delivered processor's plant during 1975. However, since then, prices have steadily fallen to $140 per tonne during early 1976. This price fall has been brought about by increased availability of competing protein meals, especially meat and bone meal.

The soybean market is not likely to show any recovery until the buildup of competitive protein meals is reduced. This is not considered likely until a noticeable improvement occurs in the beef market.

Sunflowerseed - The demand for sunflowerseed has increased in recent years due to improved demand for the use of the oil by the edible trade, especially in margarine manufacture.

As a result of this improved demand and increased prices, production of sunflower reached a peak of 80 000 tonnes in 1975. Returns to growers are expected to average $200 per tonne delivered processor's plant.

Prices for sunflower are expected to decline in the near future because of increased competition from other oils, especially palm oil and the price of sunflower meal is expected to decline.

Linseed - Production of linseed has declined in recent years because of poor seasonal conditions and relatively lower prices in most seasons. Production is now about 2 000 tonnes.

The low production in 1975 caused prices to rise to $240 per tonne, delivered processor's plant. However, since then, prices have fallen to $140 per tonne and are not likely to improve in the immediate future.

Increased production of acrylic-based paints and floor coverings is now competing with the linseed oil based products. As linseed oil is not acceptable for edible purposes it is clear that any increased demand will develop from the industrial sector and, on current indications, this is considered unlikely.

14.2.5.5 Navy beans

The market outlook for navy beans for the next three to four years continues to be one of opportunity and optimism.

In its 30 year history the industry has yet to fulfil Australia's domestic requirements. However, with greater attention being paid to varieties and generally improved farming techniques, the industry has continued to improve the quantity and quality of its product. Domestic demand is about 6 500 tonnes. This year's crop would have probably fulfilled domestic requirements had it not been for the floods on the South-West Downs.

Prices are negotiated annually by the Navy Bean Marketing Board with the various canners. The price to growers for the 1976 season could rise to 46 cents per kg. In the South Burnett, the gross margin for navy beans compares favourably with the gross margin of any other dryland summer crop.

15 RECREATIONAL LAND USE IN THE GRANITE AND TRAPROCK AREA

by A.K. Wills

TABLES

The Granite and Traprock Area of South-East Queensland - A Land Inventory and Land Utilisation Study, Division of Land Utilisation, Technical Bulletin No. 13, Queensland Department of Primary Industries, Brisbane, 1976.

15 RECREATIONAL LAND USE IN THE GRANITE AND TRAPROCK AREA

by A.K. Wills*

The Granite and Traprock area is mainly known for its fruit and quality wool production. The names of the main centres are also well known in weather reports as frequently having the lowest, daily temperature minima for Queensland. In contrast, its qualities as a recreation area or tourist draw are not widely recognized. This has probably been due mainly to the evident preference of the bulk of the urban population for coastal recreation, and to past inadequate road communications, although this latter situation is now rectified.

The study area's physical attractions are discussed in detail below. Although it is unlikely that the area can compete with the coastal resorts for tourist volume, several factors make it appear inevitable that tourism and demand for open-air recreation will rise steadily in the near future.

In common with other parts of the world, the growth of Brisbane's population and the urban sprawl must increase the demand for recreation in sparsely populated rural areas. Demand can also be expected to increase due to greater disposable incomes and more leisure.

Mercer (1970) has outlined the concept of the urban recreational hinterland, viewing the city as both a centre for recreational demands in the rural area and an attraction exerted upon the rural area. Within this hinterland, it is possible to define a 'Day Trip Zone', 'Weekend Trip Zone' and a 'Vacation Zone'. His suggestion, that both countryside and resorts are simply ecological extensions of the city, is close to present day reality with respect to South-East Queensland's Moreton Region and could eventually extend to the study area. Its north-east corner is well within the 'Day Trip Zone' from Brisbane and the remainder within the 'Weekend Trip Zone'. Intensifying interaction with the Brisbane centre can therefore be expected as the hinterland region expands.

These influences can be expected to manifest themselves in changing demand for land uses such as picnicking, camping and hiking rather then for land uses based on ownership (Smith 1972). Land managers may find it profitable to consider multi-purpose use of the land and to take on more fully the role of 'caretaker' of the countryside. If landscapes are to remain attractive such aspects as single purpose clearing of land, application of pesticides and location of roads will have to receive very careful consideration. Smith viewed the 1971-72 period of improvement in markets as only a breathing space, during which it would be possible to plan for an ecologically satisfactory agriculture in the years ahead. His forecast has proved depressingly accurate but it is unlikely that any significant agricultural land development will occur in today's inflationary environment.

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If anything, the incentive to diversify should be stronger and multipurpose land use is one way of achieving this.

Another phenomenon which has emerged, as a result of urban society's affluence, is the trend towards 'rural retreats'. A rural retreat may be defined as 'a small holding in a rural setting, whose owners have chosen it as an alternative to the metropolitan environment ... the owners may live there permanently or ... on weekends; they may or may not use it as a "hobby farm"'. (Wagner 1975.) These retreats have sprung up around all of Australia's major cities and have caused social and economic disruption through their effects on land valuation in rural areas. They have also placed heavy demands on local authorities. On the other hand they fulfil a legitimate demand of the urban population, inject funds into the rural economy and, in some measure, bring urban and rural groups closed. Wagner recommends that differential rating should be introduced to distinguish full-time primary production land from miscellaneous other uses including rural retreats, hobby farms and speculation. Other recommendations are that zoning should aim to keep the best agricultural land in production and that owners of rural retreats should be prepared to pay the full costs of urban-type services.

A potential exists for expansion of tourism and for ownership of rural land not necessarily for primary production. This could become an increasingly significant sector of the area's economy. Hopefully, these trends can develop in a way acceptable both to the visitor and the resident. With this in mind, it is well to remember that recreational land use is amenable to planning as are other forms of land use.

15.1 Natural Attractions

15.1.1 Granite Landscapes

Without doubt the isolated tors, tor clusters and inselbergs are the most ubiquitous and well known scenic features in the granite area. The greatest area of this type of country would be in the Girraween National Park but dramatic outcrops can be found from the Leslie Dam to Wallangarra and in isolated areas of granite scattered through the traprock as far west as Texas.

The nature of the country is such that economic primary production is not feasible. Its ruggedness and inaccessibility make it ideal for those in search of fauna and flora in natural surroundings, for rock-climbers, campers, bushwalkers and for those who seek isolation or wilderness.

15.1.2 Traprock Landscapes

Superficially the Traprock appears to be composed of a monotonous series of harsh, sparsely grassed ranges populated by sheep and beef cattle. Many areas are devoid of trees and many others show the evidence of ring-barking in days gone by and the subsequent recolonisation by xerophytic shrubs on the thin exposed soils.

Yet not far from the main roads, there are pleasant and unusual spots to be found. The incised meanders of Pike Creek produce a number of cliff faces and shaded waterholes. Macintyre Brook has longer stretches of water, reportedly of interest to fishermen. High relief is confined to granitic plugs of which the most prominent are Mt. Bullanganang and Jibbinbar Mountain.

A distinctive limestone feature is the Pinnacle, situated in scarp country just west of 'Emu Park' about 40 km from Texas. This sharp limestone peak is situated in a small area of intense relief, which has low economic potential but would be appreciated by picnickers and naturalists if developed for that purpose.

One major attraction remaining is the Severn or Dumaresq River which forms the border between Queensland and New South Wales, from Mingoola westwards. This is a large river and provides a number of picnicking, swimming and fishing spots.

15.1.3 Climate

For Queenslanders looking for a change, the climate of the Granite Belt from Dalveen south certainly caters for their needs.

Usually warm days and pleasant nights characterise the summer weather while, in winter, the weather is sharp and may be described as 'numbing' or 'invigorating' depending on one's disposition.

It is interesting to note a view from a less sophisticated age (Saint-Smith 1914):

> 'The splendid cool climate, elevated situation, accessibility to both Brisbane and Sydney, scenery, and the suitability of the soil for orchards and gardens combine to make this region an ideal resort for tourists and those who wish to live comfortably in a mild climate after a lengthy sojourn in the tropical portions of the State.'

As the country falls away north and west of the Granite Belt, the climate takes on the characteristics of the typical Darling Downs or Western Queensland regimes. The traprock can be an unpleasant area at times - usually in dry phases - and, for the traveller, Spring or Autumn are probably the best periods in which to see it.

15.1.4 National Parks

The Girraween National Park, south of Stanthorpe, is the only National Park in the study area. Comments made previously (15.1.1 Granite Landscapes) apply to this area. The Park is renowned for its outstanding display of wildflowers in the Spring. The superb lyrebird and the smooth-nosed wombat both occur here, near the northern limit of their range. In addition to the natural attractions, the Queensland Forestry Department has provided attractive picnic and camping grounds, barbecues and toilets.

Extension of this Park to link with the Bald Rock National Park in New South Wales would be a desirable development. This extension should include South Bald Rock which features a sheltered ravine carrying rainforest tree species and a considerable range of ferns.

Other areas which could be best used as National Parks or 'environmental parks' are mentioned below (15.1.5 Native Forests). In particular, the spectacular relief of the Severn River Valley and some of its eastern tributaries, such as Red Rock Gorge, could become a major attraction. A population of superb lyrebirds is found in the Sundown-Red Rock Gorge area in an inhospitable environment of lower fertility and lower rainfall than that of their normal habitat.

15.1.5 Native Forests

Much of the study area's vegetation has been cleared or partly cleared for agriculture, pastures or timber; but there are some inaccessible and rugged areas which have evidently been uneconomic to exploit. These include parts of the western edge of the Granite Belt from about 'Utopia' southwards, the Roberts Range on the State Border, the Jibbinbar Mountain-Rats Castle-Berchtesgaden area, Mt. Bullanganang and the dissected hills west of the upper reaches of Bracker Creek. Some of the State Forest country north of Coolmunda Dam seems relatively untouched and could be included in a 'semi-wilderness' category.

With the anticipated increase in demand for recreation land, the need for 'semi-natural' reserves, or 'environmental parks' to take the pressure off National Parks, will become more obvious. While National Parks are much appreciated by visitors, the ever increasing rate of use is likely to cause deterioration or destruction of the more fragile features. To maintain the prime aim of these parks, permanent preservation of their natural conditions, it is desirable that a substantial proportion of the public demand be diverted to 'environmental parks' providing a form of second-level wilderness experience. Parts of the areas mentioned above are suited to this function.

15.1.6 Wild Life

The fauna of the district includes an attractive range of birds and mammals, some of which have a potential as a tourist attraction but at present represent only an attraction to the serious student of nature. Even in this context, other nearby areas have more to offer. Of greatest zoological interest is the country between Ballandean and Wallangarra, which is inhabited by the only populations of the common wombat and the superb lyrebird in Queensland, but both species occur much more abundantly in southern States. The pretty turquoise parrot, generally uncommon, is found commonly in some parts of the district and represents an attractive visual reward to the dedicated observer.

There is, of course, the presence of such attractive species as the crimson and the eastern rosellas along roadsides during early morning and late afternoon - species in no way limited to the district but which represent an attraction to the traveller at these times.

The fallow deer was released at Pikedale about 1890, and has spread from this centre to adjoining areas. Generally

speaking, persistent effort is required to observe this species, but there are many properties including and surrounding Pikedale on which groups of fallow deer may be seen.

Species which have potential for development as tourist attractions include the several macropod species (kangaroos) and waterfowl (ducks). Those animals have a potential in that it would be possible to 'develop', carefully and over a long period, areas naturally inhabited so that populations build up and allow public viewing during daylight hours. The rock wallaby, particularly, would have this potential as it allows fairly close approach, and is limited in distribution by topography. There are other areas in Australia, however that have a greater potential both from the availability of species and human populations.

Overall, the fauna of the district cannot be considered as representing more than a minor attraction.

15.1.7 Gemstones and Mines

Gemstones are mainly confined to the stanniferous gravels in the Stanthorpe district. Topaz and small zircons have been recovered from stanniferous alluvium along Spring Creek, Cannon Creek, Quartpot Creek, the head of the Broadwater, Funker's Gap, Bald Rock Creek, Ten Mile Creek and Swiper's Gully. Sapphire is less common, but has been recorded from Spring Creek, Kettle Swamp, the Severn River and to a lesser extent from Sugarloaf Creek, Lode Creek, Arbonuins Gully and the smaller tributaries of Sugarloaf Creek.

Quartz crystal, cairngorm and amethyst occur in all the tin-bearing gravels although amethyst is rare. Double-terminated quartz crystals have been found in weathered pegmatite veins near Ballandean Head Station.

Beryl is rare. This mineral has been reported from Dolcoath Creek and Swiper's Gully. Semi-transparent crystals of beryl occur in small pegmatite dykes in the old Kilminster mining area west of Ballandean.

Diamonds have been recovered from Kettle Swamp, Spring Creek and the head of the Broadwater but are of no economic significance.

Agate, chalcedony, opalite and petrified wood occur in minor deposits along the Main Range. Chalcedony, opalite and common opal have been worked semi-commercially from deposits along Emu Creek and the upper parts of the Swanfels Valley.

Small deposits of rhodonite have been worked in the past on portions 95V, 96V and 3V Parish of Rosenthal, 6 miles south-west of Warwick.

Most of the mines in the traprock area of south-east Queensland would hold little interest to the general public. These mines are either too dangerous or too difficult to locate. For those interested in mineral collecting, old mine dumps situated in and around the edge of the granite batholith would be most profitable. Good mineral specimens can still be collected in the old Kilminster mining area, west of Ballandean; the Sundown-Red Rock-Rats Castle area and to the east of Stanthorpe along the Queensland-New South Wales border.

The old State Arsenic Mine at Mount Jibbinbar may be of historical interest to some, although access is difficult.

A full description of mines and their locations in the Warwick-Stanthorpe-Texas area is given in Report No. 64 of the Geological Survey of Queensland (Robertson 1972).

15.2 Man-Made Attractions

15.2.1 Lakes

There are two major lakes, Leslie and Coolmunda, and two small lakes, Silverwood and Storm King, within the study area. In addition, the Glenlyon Dam, when it is completed, will provide over 1 600 ha of water surface.

In the USA, Green *et al.* (1972) identify outdoor recreation as a new economic sector with potential, in the Arkansas economy. He points to public investment in multi-purpose dams between 1944 and 1965 as the stimulus for water-based activities, followed up by complementary activities such as sightseeing, picnicking and camping. This in turn has constituted a favourable environment for private investment in recreational facilities. However, certain obstacles to development are recognized and they recommend establishment of (a) a rural design centre to handle architectural design and overall environment planning and (b) a planning and development committee to overcome business problems.

The lakes in the study area provide similar opportunities for most water-based recreational activities. Vehicle counts at Irrigation and Water Supply Commission storages show a rising trend over recent years as indicated in the following table.

TABLE 15.1 - VEHICLE COUNTS AT WATER STORAGES IN THE STUDY AREA

	Leslie	Coolmunda
1969-70	17593	12728
1970-71	9840	6100*
1971-72	15344	15700*
1972-73	26789	12704
1973-74	29011	13951

* Indicates records not complete for the whole year.

In the 1972-73 financial year, over 100 new permits were issued by the Irrigation and Water Supply Commission for use of power boats on these two storages. Recreational use of the dams can be expected to continue, as growth factors increase in their impact.

15.2.2 Exotic Forests

'Natural vegetation and landscapes are not always beautiful. Farm land need not be ugly ...' (Smith, 1972). Nor do forestry plantations need to be ugly and a visit to the Passchendaele State Forest would confirm this view.

On a drive through the area, the dark pine forests look impressive enough, but in the interior, accessible only by rough tracks, there are landscapes of rugged terrain,

dense tree cover and a thick soil cover of pine needles which, in combination with the frequent cool conditions, are reminiscent of Alpine or Black Forest scenery. While conservationists and naturalists rightly emphasize the need to look after the native ecosystems of Australia, these man-made systems also deserve some appreciation as a refreshing change for the holiday-maker who has absorbed all the natural environment available in National Parks.

The attractions of Passchendaele are probably not widely known and perhaps this is best for the moment, as the fire risk at certain times of the year is acute. A permit is required to enter these areas. In time however, the provision of facilities with some measure of control will probably become desirable. The remarks in favour of 'semi-natural' reserves (15.1.5 Native Forests) to ease the pressure on National Parks would apply here also.

15.2.3 Orchards and Vineyards

Although they would not be considered unusual in more temperate regions, orchards and vineyards are a novelty to most Queenslanders. They therefore constitute a moderate attraction, especially during spring flowering.

Associated with the industries are the roadside fruit stalls for which the tourist in transit on the New England Highway forms a major portion of the clientele. A more recent commercial enterprise and tourist attraction is the wineries at Ballandean and Pozieres, imitative of the Hunter and Barossa Valley establishments.

15.2.4 Rural Environment

Novelty of environment is an attraction in itself, and the study area's modified rural landscapes would still constitute an attraction to a large proportion of city based tourists. The increasing recreational value of rural lands close to cities has become evident all over the world and has been the subject of numerous studies.

Wallace (1971) sees new patterns of rural resource use emerging Economic analysis of these trends is difficult, since city dwellers' requirements in the countryside are intangible and hard to quantify in a conventional supply:demand relationship. Nevertheless multiple use of rural land is becoming a more important consideration and there are already a number of cattle or sheep properties in Queensland which cater for tourists.

Farm-house holidays are popular in Britain and, according to Harvey (1972), open up fresh opportunities for the farmer. A 1970 survey in England's West Country showed that farmers who provided holiday accommodation earned on average $A1,470 (at 1970 exchange rates) per annum from the enterprise.

In Australia, Molnar (1973) has drawn attention to the shortage of outdoor recreation space within Melbourne's 'day trip zone'. One of his suggestions is to develop non-viable farming areas for recreation purposes, as a possible means of rural reconstruction.

15.3 Unattractive Features of the Area

15.3.1 Roadside Erosion and Billboards

Although the upgrading of roads serving the area has been an essential improvement to communications, the progress has had its adverse effects. The most obvious is the disfigurement to parts of roadside reserve areas by removal of soil, roadside gully erosion, and general debris left by construction gangs. This is a major scenic detraction as it is in the immediate foreground of most views available to the motorist in transit. Although beautification would add significantly to the cost of road-building, it is a necessary follow-up activity which could, with imagination, turn the highways into attractions in their own right. Increased effort and expense is already being put into environmental improvements on roadsides. The success of these efforts will ultimately depend on mutual co-operation among landholders and all official bodies carrying out works in road reserves.

Another unharmonious factor is the proliferation of roadside signs and billboards. These are most common on the New England Highway and clash with the otherwise attractive rural hillscapes. The recent action by the Rosenthal Shire Council in banning unnecessary roadsigns is to be commended.

15.3.2 Vandalism and Littering

The adverse effects of vandalism and littering are not unique to the study area. Eyesores such as broken glass, tins and used cartons disfigure the landscape. Depending on the seriousness with which local authorities view the importance of recreational land use, these anti-social activities can be controlled by an approach at two levels. First would be a combination of policing the bylaws related to dumping and littering, and organising clean-up operations at suitable intervals. The second would be to encourage local retailers to market goods in reusable or biodegradable containers.

15.4 Conclusions

The natural and man-made landscapes of the study area and the invigorating climate contrast favourably with the increasing sophistication, heat and overcrowding of some of the coastal resorts. As the Brisbane recreational hinterland expands and intensifies, the recreational use of land in the study area must assume increasing importance. With foresight, imagination and planning changes can be incorporated into the present rural environment to meet this demand and be of mutual benefit to the local populace and urban-based visitors.

15.5 Acknowledgements

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16 RECOMMENDATIONS ON FUTURE LAND USE

16 RECOMMENDATIONS ON FUTURE LAND USE

One historical and one locational factor favour land use planning in the Granite and Traprock area. The first is the fact that the area was one of the earliest settled in Queensland and much of the land has been developed for a considerable period. A stage of secondary equilibrium has been reached. This means that planning can proceed from a relatively stable base. Secondly, the study area is just far enough away from Brisbane to be largely clear of the influences which are presently causing such major land use changes in the Moreton Region.

This distance factor provides a breathing space which was not applied to existing metropolitan hinterlands. The latter have simultaneously experienced an unprecedented demand by city dwellers for open-space freehold land coupled with an increasing public awareness of environmental quality. The reaction of real estate developers to this situation has tended to outstrip land use planning activities of the relevant authorities.

It is only a matter of time before the Granite and Traprock area becomes a part of this increasing tempo and there is a demand for land not only as a medium from which basic primary goods are derived, but as an environment to which the city dweller can escape in his leisure. During this breathing space, it is hoped that this study will be of assistance to the appropriate authorities in making sound land use planning decisions.

The recommendations presented below deal with the major land uses presently exemplified in the study area. They are offered as guidelines or suggestions to land use planners and decision makers.

16.1 Livestock Industries

It is difficult to envisage any further major increase in livestock numbers in the study area. The better areas were developed long ago and the only land with real potential is in small areas of the eastern Granite Belt where temperate pastures do well. Both the wool and beef industries have experienced price recessions during the past decade, because of dependence on export markets. A sound aim for the grazier may be the attainment of a suitable mix of beef cattle and sheep which would minimize market and climatic vulnerability. Keeping grazing pressure below an acceptable level is a prime consideration in future erosion control programmes. Overall, a significant increase in livestock numbers for the study area as a whole is seen as undesirable, as it would place pressure on the land resource without necessarily improving the financial position of the grazier.

Dairy farming is relatively small in the study area and the present economic environment is against any expansion. It should be borne in mind for the long term that there is a considerable amount of land which could be used for dairy production, should the present demand situation change.

Pigs and poultry are also small industries in the area and their direct demands on the land are insignificant. Pig raising has to be located close to grain-growing areas. Its scope for expansion in the study area is therefore limited. The poultry industry is heavily institutionalized and any expansion in the study area would be irrational because of distance from the major market and sources of feed. Should similar concentrated livestock enterprises, for example beef feed-lotting, be suggested for the study area, their location should take account of the associated problem of effluent disposal and its possible effect on contiguous landholders and watershed characteristics.

16.2 Horticulture

On the Granite Belt, the pome fruit industry has been in a slow economic decline in recent years and there is no indication of an upswing. The stone fruit industries appear to be stable. Technological innovations such as close planting and trickle irrigation are likely to cause more efficient land use and marginally reduce costs of production; but there impact can only be gradual.

The future seems brighter for vegetable growers and grape growers, especially if it can be shown that marketable table wines can be produced from wine grape cultivars at present under trial. Suitable land on the Granite Belt is rather limited for a major expansion into these activities, but if the incentive were there, a certain amount of substitution would probably take place and it is unlikely that unavailability of land would be a permanent obstacle.

A long term possibility is the establishment of horticultural activities around Inglewood. A combination of factors could lead to this:-

(i) the availability of irrigation water from Coolmunda Dam

(ii) the desirability of diversification

(iii) the diminishing sources of horticultural products around the Brisbane area and the improved road link with Brisbane

(iv) products come on the market earlier than their equivalents on the Granite Belt

At present, economies of scale discriminate against horticultural products from Inglewood being profitable on the Brisbane market, but this could be overcome with organisation. The crucial question is whether aggregate demand justifies a major expansion in horticultural production.

16.3 Agriculture

Apart from the Condamine flats in the north-east of the study area, grain cropping is only a minor industry. This is mainly because of an unsuitable climatic environment and a lack of suitable land. Many sowings intended for grain end up with the crop being grazed. The most important form of cropping is for winter fodder, mainly oats; and even oats experiences a failure four years in ten on traprock soils. Irrigated lucerne is grown too and, in the form of hay, makes an important contribution

when conserved for winter feed programmes or drought periods.

Irrigated lucerne for hay would therefore appear to be the main type of agricultural crop worth developing, especially when the Glenlyon Dam comes into operation. There is a market for lucerne hay both in the study area and northern New South Wales. This market would, however, tend to fluctuate with seasonal conditions. A possible restriction on expansion of irrigated lucerne is the variability of the Dumaresq alluvial soils, some areas of which display structural and/or chemical shortcomings.

16.4 Apiculture

This industry is unique in producing a desirable product for a favourable market, while having a beneficial effect on the environment. It should be encouraged to expand by discouraging further clearing of important tree species and improving access to forested areas. This could be done in conjunction with plans for regeneration of eroded land in water supply catchments and plans to set aside areas for conservation and recreation.

16.5 Mining

Mining activity is at a very low level in the study area although it was an important element in the area's early development. Only limestone and marble around Limevale are of any significance at the moment, other mineral workings having become uneconomic. No significant developments in mining are expected in the foreseeable future.

16.6 Forestry

The long term nature of forestry investment makes it unattractive to the average farmer. However, there are areas of land on most blocks which have negligible grazing value, either because of rock outcrop or the extreme shallowness of the soils. Depending on the native tree species found there, it could be in the interests of farmers to encourage regeneration, in order to have either a marketable asset or a supply of timber for farm use. Side benefits such as prevention of soil loss and better water quality would accrue.

16.7 Recreation

The study area already provides considerable amenities for open-space recreation. As the Brisbane/Ipswich complex grows, its recreational hinterland must also expand and an increasing overspill of tourists will be attracted to the area as a change from the coast.

A major impetus to tourism in the district will be felt when the lake forms behind the Glenylon Dam. This will attract boaters and sightseers farther into the study area than before, with consequent economic spin-off elsewhere in the district.

Opportunities for expansion into the field of open-space recreation are limited only by the imagination. Experience overseas and in southern states has shown how rapidly this type of demand can develop. Government at State and local levels can contribute significantly by expansion of National Parks and provision of Environmental Parks, camping and picnic areas, tourist information centres and more park rangers or guides. There is also ample scope for private enterprise in the provision of picnic and camping grounds, accommodation and farm holidays and horse riding. Obviously an integrated approach to such a plan would be desirable so that all interests are catered for and clashes avoided.

Open-space recreation is not a primary product but can provide opportunities for primary producers to supplement their incomes. Its main value is in its use of land which may generally be regarded as unusable. Where recreation encroaches on land with agricultural value, it is often compatible with the other land uses being carried out. Overall it is seen as an activity which is non-competitive in terms of land requirements and which has considerable potential for regional income.

16.8 Conclusions

The traditional activities of the Granite and Traprock area - wool, beef and pome and stone fruit production - seem to have little potential for further growth although, with rationalisation and some new technology, their long-term viability at current levels seems fairly assured.

Growth potential is seen for vegetables and wine grapes on the Granite Belt; and, depending on a number of interacting demand factors, a variety of horticultural activities under irrigation could eventually develop around Inglewood. Lucerne hay production can be expanded when Glenlyon Dam comes into operation, although demand will be variable.

Apiculture is profitable and likely to remain so. Although some of the direct income accrues outside the study area, it is an important and non-destructive land use, deserving more consideration than it gets. Forestry, as a separate enterprise, could not be classed as having growth potential, but when its indirect benefits are considered, it emerges as a land use which should be encouraged on both public and private land.

The demand for open-space is likely, in the near future, to have a major impact on land use in the study area. Catering for open-space recreational activities, in accordance with a well thought-out land use plan, is likely to be lucrative for both individuals and the region as a whole.

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