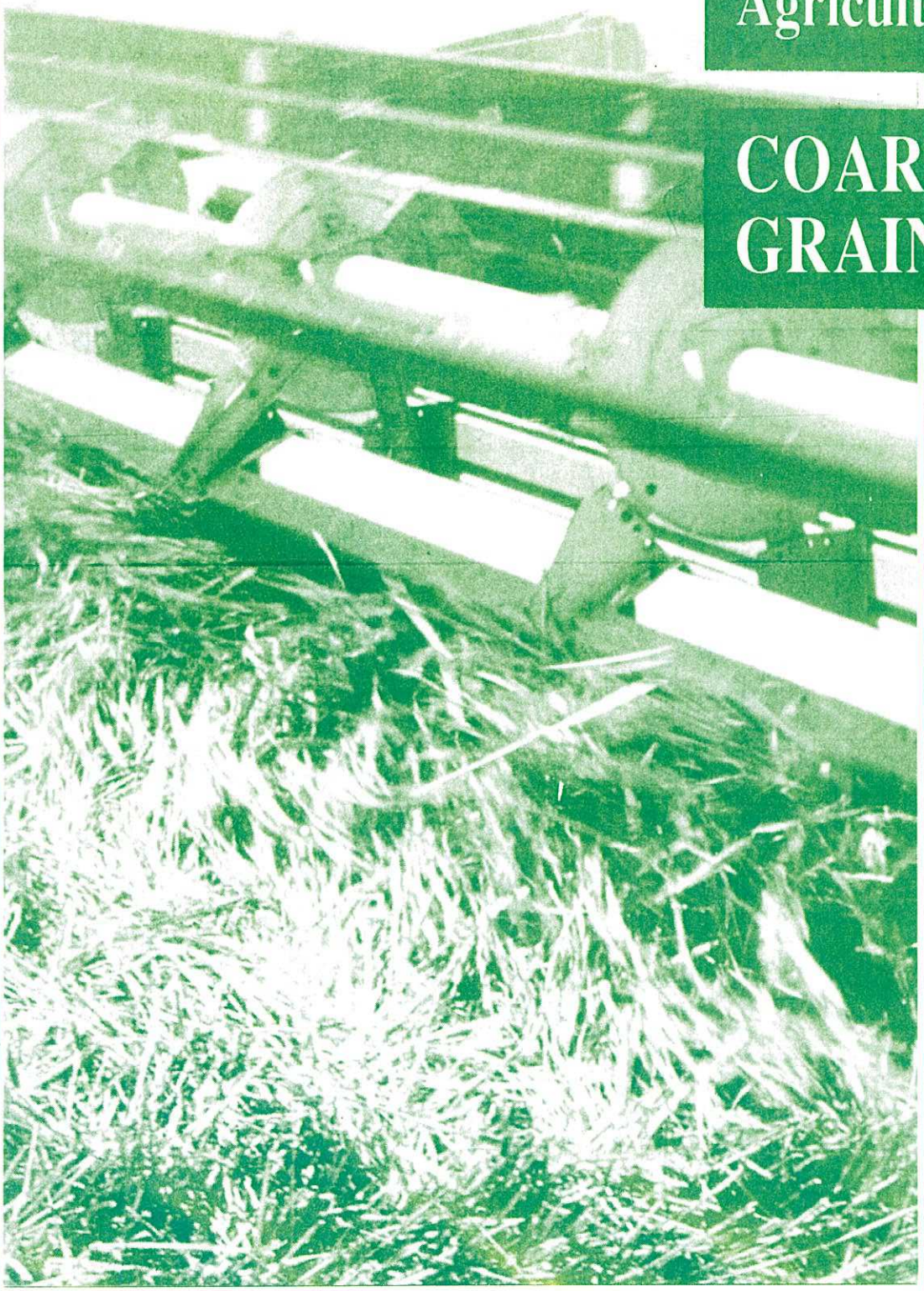
AGDEX 110

South Australian Agriculture

COARSE GRAINS



DEPARTMENT OF AGRICULTURE

January, 1992

COARSE GRAINS IN THE 1990's

A Strategic Plan for the Development of the South Australian Barley, Oats, Triticale and Cereal Rye Industries

FOREWORD

This strategic plan is one of a series which has been developed for the principal South Australian agricultural industries and the services provided by the Department of Agriculture.

Agriculture contributes a greater proportion of returns to the State's economy than that of virtually any other state in Australia. It is therefore important to review the potential for the further development of agriculture in South Australia. These plans have been prepared by the staff of the Department of Agriculture in association with representatives of the respective agricultural industries and farmer organisations. The aim has been to identify the production potential and the market potential for the respective commodities and to thereby evaluate the opportunity which the state has to further develop its agricultural industries. At the same time, consideration has been given to identifying the most important issues to be addressed in the coming years to enable the state to achieve its maximum economic potential from agriculture. These plans will be valuable for determining the future provision of services to the rural community.

I should like to acknowledge the hard work and creative thought which both departmental staff and participants from industry and the farming community have put into the preparation of these plans.

John C. Radcliffe

(John C Radcliffe)
DIRECTOR-GENERAL OF AGRICULTURE

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1. SUMMARY

1.1 Industry Status

The coarse grains industry is of major importance to South Australia. Returns from barley, oats, cereal rye and triticale have been close to $200m across recent seasons with almost 90% of this from barley.

The area sown to barley, the total production and the yield per hectare have all increased over the past decade. With oats, despite a fall in the area sown yield per hectare and to a lesser extent total production have also increased. Areas sown to triticale and cereal rye are both relatively small and particularly in the case of rye fluctuate markedly with season and price.

Of the barley produced, in excess of 95% is exported as malting grain, malt or feed. The majority of oats produced in S.A. is used on farm although an increasing amount, principally from Eyre Peninsula is exported and some is used for milling. Neither cereal rye or triticale is exported.

1.2 Industry Potential

There are significant opportunities for increases in production of all four coarse grains particularly barley and oats where the use by farmers of available technology could result in a 50% yield increase in some situations. At the same time there is potential to increase the quality of the grain produced. Particularly with malting barley better quality will be essential if S.A. is even to maintain its current share of overseas markets. To fully exploit increased production efforts need to be made to investigate value added products which can be manufactured in S.A. from these cereals.

1.3 Barriers to Achieving Industry Potential

A total of 48 barriers have been prioritised within a total of 9 categories. The most important of these include the following (* indicates highest priority).

* * control of weeds, pests and diseases in rotations
* * lack of reliable climatic forecasting
* * fertility status of soils and fertiliser practices
* . lack of specific adaptation in crop genotypes
* . limited knowledge base on soil parameters in relation to evolving practices
* * declining terms of trade
* * poor understanding of the economics of farm management systems
* . increasing fixed and variable costs relative to returns
* * the impact of overseas government policies
* . high off farm costs
* * the lack of a suitable malting quality barley variety
* . inadequate evaluation of new malting varieties
* . the relatively poor quality of current oat varieties

* the inadequate validation of some technology in terms acceptable to some farmers
* poor long term planning of some farming practices
. a lack of strategic planning for extension services
. poor understanding by financial advisers of the impact of some technology
* limited identification of value-added opportunities

1.4 Current Resources

The estimated cost of all S.A. Department of Agriculture activities in the coarse grains industry has been provided and the projects externally funded have been listed as have those relevant projects being funded in other research organisations in South Australia. At this time no breakdown has been provided of the estimated $2.336m provided by State Treasury. This will be provided in the future review of this plan.

1.5 Proposed Initiatives

While the research and development activities of the Department of Agriculture are likely to have little effect on several of the barriers identified some initiatives need to be considered which could result in greater returns to growers and the State. Many of these initiatives, if taken up, would require additional resources or at least the prioritising of those currently available. The initiatives include the following (not in priority order).

. a coordinator for the integrated field crop evaluation program and expansion of the activities of the program
. increased use of biotechnology to assist in and speed up breeding activities
. better coordination and integration of improvement activities in relevant crops
. development of improved quality types in all coarse grains to meet current and likely future market requirements
. initiation of research and development to ensure that information is available to farmers on optimum agronomic practices
. assistance in the development and commercialisation of field equipment through the provision of machinery experts who could liaise with and work with the farming community
. initiation of programs to highlight the need to build up soil organic matter
. development of improved soil and plant tests and the marketing of those services to growers
. promotion of the benefits and costs of good soil management while ensuring that data are available to support this
. provide additional emphasis on research and development which emphasises alternative methods of weed control while at the same time increasing input into the study of the biology and ecology of weeds
. stress needs to be placed on the role of resistant varieties and management options in the control of a range of crop diseases especially in terms of sustainable systems

- a pathologist is required to oversee mycological research and to organise relevant disease surveys
- an entomologist is required to monitor development of insecticide resistance in grain pests
- increased effort needs to be put into integrated control of insects in legume based pastures
- establishment of a series of simple, long term experiments based on that at Tarlee should be considered
- there is need for a market intelligence officer
- there is a need to at least maintain current extension programs associated with grain hygiene and pest traceback
- communications within and between all facets of the coarse grain industry from research to end use must be increased.

2. INTRODUCTION

Production of coarse grains (barley, oats, triticale and cereal rye) is a well established agricultural industry in South Australia with total production and income often rivalling that of wheat. The industry provides valuable export income for the State and supports a significant social infrastructure and a range of manufacturing, marketing and agribusiness agencies. The barley industry in S.A. remains the largest in Australia.

During the process which led to the development of this Strategic Plan a review was undertaken of the coarse grains industry (Chapter 3), assessment made of its potential (Chapter 4) and the barriers to achieving that potential considered and listed (Chapter 5). The most significant of those barriers were identified and prioritised by members of the commodity group following initial input from Departmental district agronomists and research leaders. During this process the barriers considered in a recent District Needs Analysis were also summarised (Appendix A). The major objectives of the previous Barley Research Council and Barley Research Committee for South Australia which funded a large proportion of the research and development for the coarse grains industry in South Australia were also considered (Appendices F & G).

High priority research and extension initiatives were then developed to achieve the indicated potential of the coarse grains industry in S.A. (Chapter 6). Within these initiatives consideration will need to be given to pursuing collaborative research and extension programs with other research and agribusiness organisations to achieve that potential.

The plan was discussed with representatives of a wide range of agribusiness and research oriented organisations including:

Mr A. Glover	United Farmers & Stockowners of S.A. Inc.
Mr P. Gurner	Incitec Ltd
Mr B. Marshall	Australian Barley Board
Dr D. Marshall	Waite Agricultural Research Institute
Mr G. Patten	S.A. Pea Growers Co-operative
Mr C. Rowe	Barley Research Committee for S.A.
Mr G. Schulz	Advisory Board of Agriculture
Mr D. Winn	Top Australia Ltd

The Strategic Planning Group comprised: Andrew Barr, Matt Benson, Ian Black, Nick Brooks, Tom Davidson, Trevor Dillon, Bob Hannam, Terry Heard, Steve Jefferies, David Ragless, Robert Rees, Doug Reuter.

3. INDUSTRY STATEMENT

3.1 Characteristics of the South Australian Coarse Grain Zone

The cereal-sheep zone of South Australia comprises about 15% of the State's land area, and is confined to that area receiving between 250 and 500 mm of annual rainfall. The climate is Mediterranean with effective growing season rainfall being, that received between April and October. Climatic conditions vary appreciably from year to year and across this large agricultural zone. A cooler maritime climate prevails along the S.A. coastline which assists ripening of cereals during spring, and contrasts with the warmer and drier conditions further inland. Frosts can occur during winter and spring.

The soils of the cereal zone are predominantly old, weathered and naturally infertile in their virgin state. Their physical state and texture vary widely which in turn affects their water retention capacity. The nutritional status of the soil profile is low by world standards and highly variable between soils. Single and multiple nutrient disorders are common. The sub soils are typically less fertile and can be structurally poorer than the surface horizons. The surface soils are fragile due to excessive cultivation and often vulnerable to wind and water erosion.

Mixed enterprises dominate the S.A. cereal zone and commodity diversification has been a feature of land use practised in the 1980's, especially in the higher rainfall areas.

The rotations practised tend to be flexible (being related to forecast market prices) and vary appreciably both between and within regions. In the more favoured areas more grain legume and cereal cash crops are grown, whereas in the lower rainfall areas the less intensive ley farming rotations are the most prevalent form of land use.

During the late 1980's, about 35% of the barley in S.A. was sown within the Yorke and Lower North statistical division. This zone produced 46% of the State's barley (Table 3.1). The Murraylands (23%) and Eyre (27%) regions are the other major zones, which produced on average 18% and 20% respectively of the State's production.

Table 3.1: Barley Area and Production in South Australia by Statistical Division

STATISTICAL DIVISION	AREA				PRODUCTION			
	1986/87	1987/88	1988/89	1989/90	1986/87	1987/88	1988/89	1989/90
	ha				tonnes			
Adelaide	1591	1498	1770	2000	3081	2402	3082	3000
Outer Adelaide	45091	40537	35939	43900	88394	65713	60896	78100
Yorke & Lower North	3406312	313435	279495	316900	727358	608604	442760	697700
Murraylands	11335	202330	200263	230600	257971	186237	233215	222800
South East	22053	19229	20579	26200	33730	22428	30805	47600
Eyre	259694	237286	228109	237300	343684	263157	164993	326900
Northern	75031	61981	70485	86700	138077	111980	100175	174200
South Australia	955425	876298	836641	941800	1592296	1260520	1035927	1547600

Within the cereal zone, wheat and barley interchange depending on forecast commodity prices and other management factors. Traditionally, malting barley follows wheat in the rotation sequence to minimise the chances of harvesting grain with high protein levels. However, the production of feed barley (cv. Galleon) now dominates the S.A. industry (56% of area sown), and this variety is also sown as a strategy for reducing the impact of cereal cyst nematode (CCN). Thus, in recent times, wheat has sometimes been sown immediately after Galleon barley.

Barley is susceptible to boron toxicity, but has a reputation of being better adapted to lower soil fertility than wheat. As a consequence, barley is often sown on the poorer paddocks of farms: wheat is the preferred cereal in the lower rainfall areas and is often reserved for the finer textured soils. For example, in the Murraylands and Eyre regions barley has been traditionally grown on sandy and calcareous soils of low fertility status (e.g. calcareous sands and deeper sandy duplex soils). In the dune-swale areas of both regions, barley or cereal rye are often, but not universally, planted on the rises and slopes of the dunes and wheat is sown on the loamy flats between the dunes. On most farms wheat is sown first and then barley.

Malting barley is also widely grown along the coastline to enhance the likelihood of favourable ripening conditions. Most current varieties, with the exception of Skiff, are susceptible to head loss arising from strong warm winds during grain ripening. On Yorke Peninsula windrowing is widely used to avoid head losses.

Late sowing and unfavourable spring conditions result in very poor quality malting barley. Such conditions were encountered in 1987 and 1988 which contributed to the loss of potential malting barley market growth areas.

About 45% of the oat area in S.A. is on Eyre region which in the period 1987-1989 produced 18 to 31% of the State's production (Table 3.2). The bulk of production (53 - 60%) is derived from the higher rainfall areas (Outer Adelaide (Mt Lofty Ranges), Yorke & Lower North and the South East zones). Areas and production from Murraylands and the Northern divisions are smaller. In addition approximately 30,000 ha of oats are cut for hay and 10,000 ha are grazed.

Table 3.2: Oats for Grain Area and Production in South Australia by Statistical Division

STATISTICAL DIVISION	AREA				PRODUCTION			
	1986/87	1987/88	1988/89	1989/90	1986/87	1987/88	1988/89	1989/90
	ha				tonnes			
Adelaide	203	176	142	-	284	239	378	-
Outer Adelaide	12415	12661	15125	11900	23978	21345	24216	17600
Yorke & Lower North	16167	19949	21413	21300	24945	29633	28256	34200
Murraylands	13617	16473	19361	18500	14039	12802	18204	13400
South East	14511	15900	15639	11300	29483	27465	26424	17700
Eyre	48455	58849	73620	73800	46446	33500	23158	52100
Northern	7264	7744	10212	9600	9937	9590	10790	12800
South Australia	112631	131752	155513	146400	149114	134574	131426	147800

Oats have the reputation of being reasonably tolerant of waterlogged acidic soil conditions and have been sown in the higher rainfall areas of S.A. both for hay and as a grazing fodder. In the cereal zone, it is sown as a break crop in rotation sequences (especially with the recent release of CCN resistant oat cultivars) and as a mixed fodder crop with vetch. In general, the level of inputs and standard of management for oats, triticale and cereal rye tends to be less than that used for wheat and barley.

The areas sown to triticale and cereal rye are minor by comparison to other cereals, but both crops have potential to increase (Table 3.3 and 3.4). Triticale, as a stock feed grain, is mainly confined to areas close to intensive livestock industries. It is used as a break crop when feed wheat prices are high. Cereal rye is grown in the drier areas of the Murraylands and Eyre Regions primarily to stabilise sandy rises.

Table 3.3: Triticale Area and Production South Australia and Australia

	AREA ('000 ha) SOUTH AUSTRALIA/ AUSTRALIA		PRODUCTION ('000 tonnes) SOUTH AUSTRALIA/ AUSTRALIA	
1984-85	12	140	16	190
1985-86	8	137	10	222
1986-87	11	148	15	238
1987-88	9	133	11	205
1988-89	11	137	12	222
1989-90	10	91	15	163

Table 3.4: Cereal Rye Area and Production South Australia and Australia

	AREA ('000 ha) SOUTH AUSTRALIA/ AUSTRALIA		PRODUCTION ('000 tonnes) SOUTH AUSTRALIA/ AUSTRALIA	
1984-85	20	31	7	14
1985-86	32	48	13	24
1986-87	41	75	22	55
1987-88	20	42	6	21
1988-89	19	40	6	22
1989-90	10	30	7	15

Both of these cereals are well adapted to low soil fertility conditions. Triticale is tolerant of soil acidity, alkalinity, drought, waterlogging and boron toxicity, attributes that would prove beneficial on many problem soils within the S.A. cereal zone.

Management practices also vary considerably within the cereal zone, being mainly a reflection of the soils, climate and the rotations practiced. From the mid 1970's a discernible trend towards more intensive cropping occurred, together with a wider adoption of reduced tillage and trash retention systems for land preparation. The evolution of herbicide resistant weeds is a recently recognised phenomenon and followed the wider use of selective grass herbicides in the cereal zone. The distribution and impact of cereal diseases became widely recognised requiring changes in rotations and the use of disease resistant cultivars.

Fertilizer practices also altered during the 1980's: imported high analysis NP & P fertilizer products partially replaced the traditional use of single superphosphate. Little if any fertilizer was applied to pasture leys, which also became increasingly legume deficient.

3.2 Production Statistics

The coarse grains, barley, oats, triticale and cereal rye, play an important but secondary role to wheat in the Australian and South Australian economies. Over the four years to 1989/90, the average gross value of barley produced in S.A. was $197 million, oats $21 million, cereal rye $2 million and triticale $1 million (Table 3.5). These figures compare with wheat at $360 million.

Table 3.5: Gross value ($ million) of cereal crops grown in South Australia

CEREALS FOR GRAIN	1986/87	1987/88	1988/89	1989/90	Average 4 years
Wheat	335	304	293	511	360
Barley	184	153	171	281	197
Oats	16	19	21	27	21
Rye	3	1	1	1	2
Triticale	1	1	1	2	1

3.2.1 Barley

Nationally, barley is the second most widely grown grain crop. Over the last five years Australian barley production averaged 3.7 million tonnes, compared with 14.5 million tonnes for wheat. The gross value of the national barley crop over the same period averaged $547 million, or 15% of the gross value of all cereal production.

In 1990 South Australia and Victoria produced 56% of the barley grown in Australia. South Australia is consistently the largest barley producing State, accounting for 42% of national production (Table 3.6) in 1990/91. Victoria produces principally malting barley; South Australia principally stockfeed barley. The success of the feed grade variety Galleon has had a marked effect on the proportion of malting barley produced in South Australia.

Table 3.6: **Australian Barley Production ('000t)**

	1984	1985	1986	1987	1988	1989	1990
South Australia	1,836	1,709	1,618	1,277	1,053	1,750	1548
Victoria	638	476	438	538	552	700	541
New South Wales	915	821	622	755	735	700	899
Queensland	704	810	290	260	404	300	394
Western Australia	1,431	1,024	603	625	551	600	752
Tasmania	30	28	22	23	6	25	24
Australia	5,554	4,888	3,611	3,477	3,301	4,075	4,158

Between 1984 and 1988 barley production in South Australia fell from 1.8 million tonnes in 1984 to just over a million tonnes in 1988 (Table 3.6). This trend is viewed as a short term reaction to the unfavourable world prices during this period and not indicative of a long term trend away from barley production as evidenced by production over the following 2 years.

Better prices, together with an excellent growing season, resulted in 1989 production of 1.75 million tonnes in South Australia worth $281 million or 43% of the Australian total, more in line with the long term average.

As with wheat there are considerable annual fluctuations in barley production and yield for the same climatic reasons.

For the 25 year period shown in Figure 3.1 the area sown and production of barley in South Australia has trended upwards despite the short-term mid 1980's slump referred to above and there has been a strong upward trend in yields

(Figure 3.2) since 1980 due principally to the widespread introduction of the Galleon variety. Whilst areas sown in individual counties show a similar pattern average yield patterns reflect significant individual differences (Figures 3.3).

Along with the fluctuation in average annual barley production there is also a marked difference in the quality of barley produced in the two States. In South Australia 25% of deliveries are classified into the malting grade, compared with 80% in Victoria. The proportion of malting barley in South Australia has declined in recent years whereas the proportion in Victoria has risen. This is a reflection of seasonal conditions and the varieties grown.

Figure 3.1 Annual trends in the area sown and production of barley in South Australia (1965-1990)

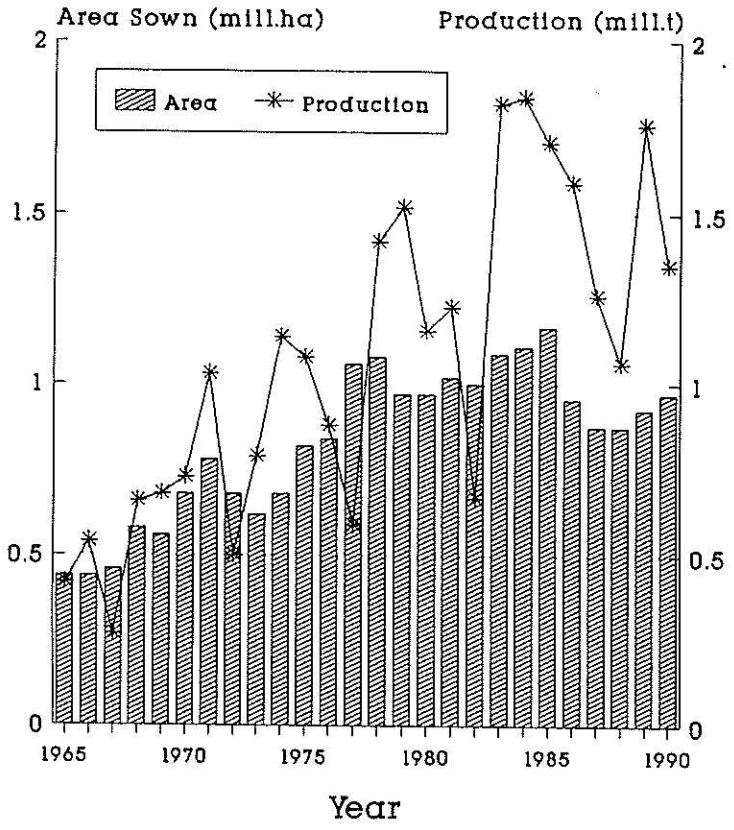
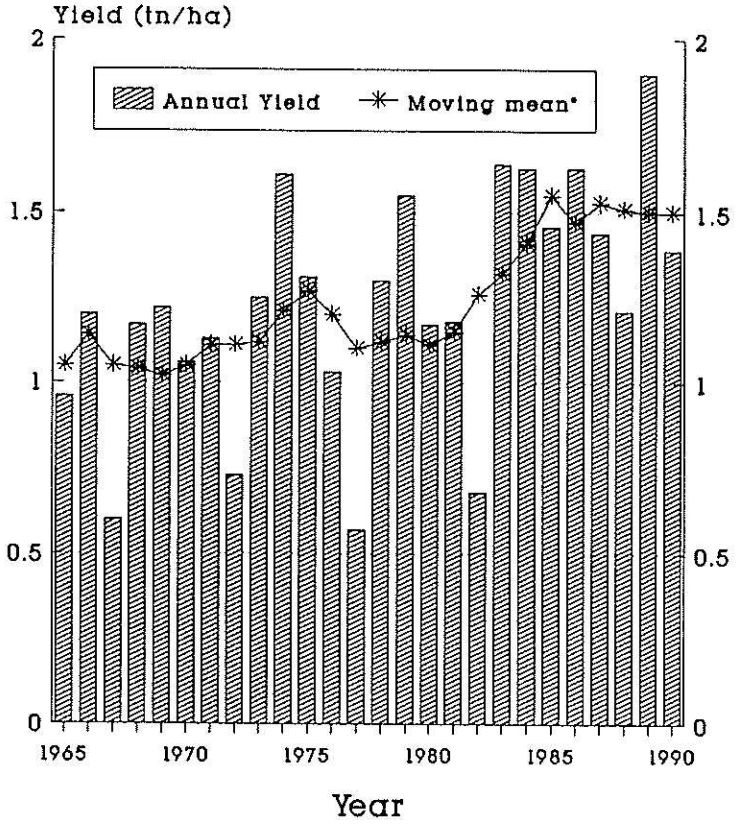
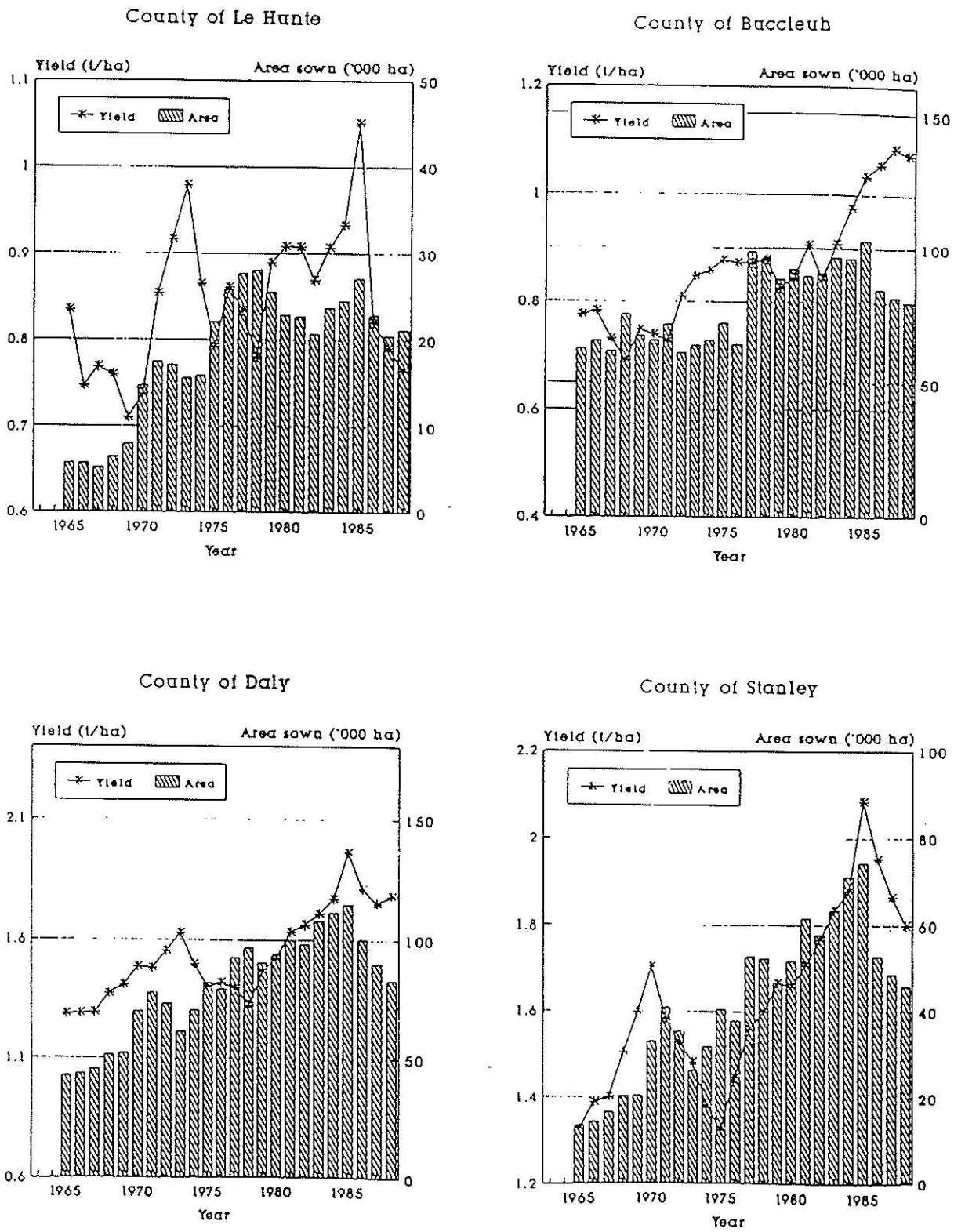


Figure 3.2 Annual trends in the average yield (t/ha) of barely grown in South Australia (1965-1990)



*5 year moving mean

Figure 3.3 Annual trends in the area sown and average yield (t/ha)* of barley in four counties in South Australia. (1965–1988)



* Average yields expressed as a 5 year moving average

3.2.2 Oats

In 1989 area and production of oats in S.A. reached 180,000 ha and 328,000 tonnes respectively (Table 3.7). This was due to several factors: a drought in USA in 1988/89, profitable feeding of sheep during 1987-1989 when wool prices were at an all time high and an increased demand for oats in human diets. As for other crops the yield of oats depends on climatic conditions. Australian area and production figures do not reflect the same increases as S.A. (Table 3.7).

For the longer period (1965-1988) as indicated in figures 3.4 and 3.5 the area sown to oats in S.A. has tended to decline although production has been at least maintained and average yield has increased.

Table 3.7: **Oats Grain Area and Production South Australia and Australia**

	AREA ('000 ha)		PRODUCTION ('000 tonnes)	
	SOUTH AUSTRALIA	AUSTRALIA	SOUTH AUSTRALIA	AUSTRALIA
1980-81	105	1093	96	1128
1981-82	127	1388	96	1617
1982-83	124	1212	65	848
1983-84	153	1772	180	2296
1984-85	128	1041	132	1367
1985-86	108	1068	110	1330
1986-87	117	1129	150	1619
1987-88	125	1376	142	1738
1988-89	175	1439	155	1780
1989-90	180	1154	328	1738

3.2.3 Triticale

An increase in wheat prices in the last two-years promoted an increase in the area sown to triticale in South Australia from an average 8,000 ha to an estimated 15,000 ha in 1990/91. Yields are similar to wheat and the newer varieties provide an effective disease break. The area sown in Australia has remained steady between 1984/85 and 1988/89 (Table 3.3).

3.2.4 Cereal Rye

The area sown to cereal rye in South Australia is concentrated in the Mallee region and on eastern Eyre Peninsula primarily for stabilising sandhills. Yields are very low relative to other cereals because of the drier climatic conditions, lower soil fertility and lack of an improved variety. Average cereal rye yields in other states are higher than in South Australia (Table 3.4).

Figure 3.4 Annual trends in the area sown and production of oats for grain in South Australia. (1965–1988)

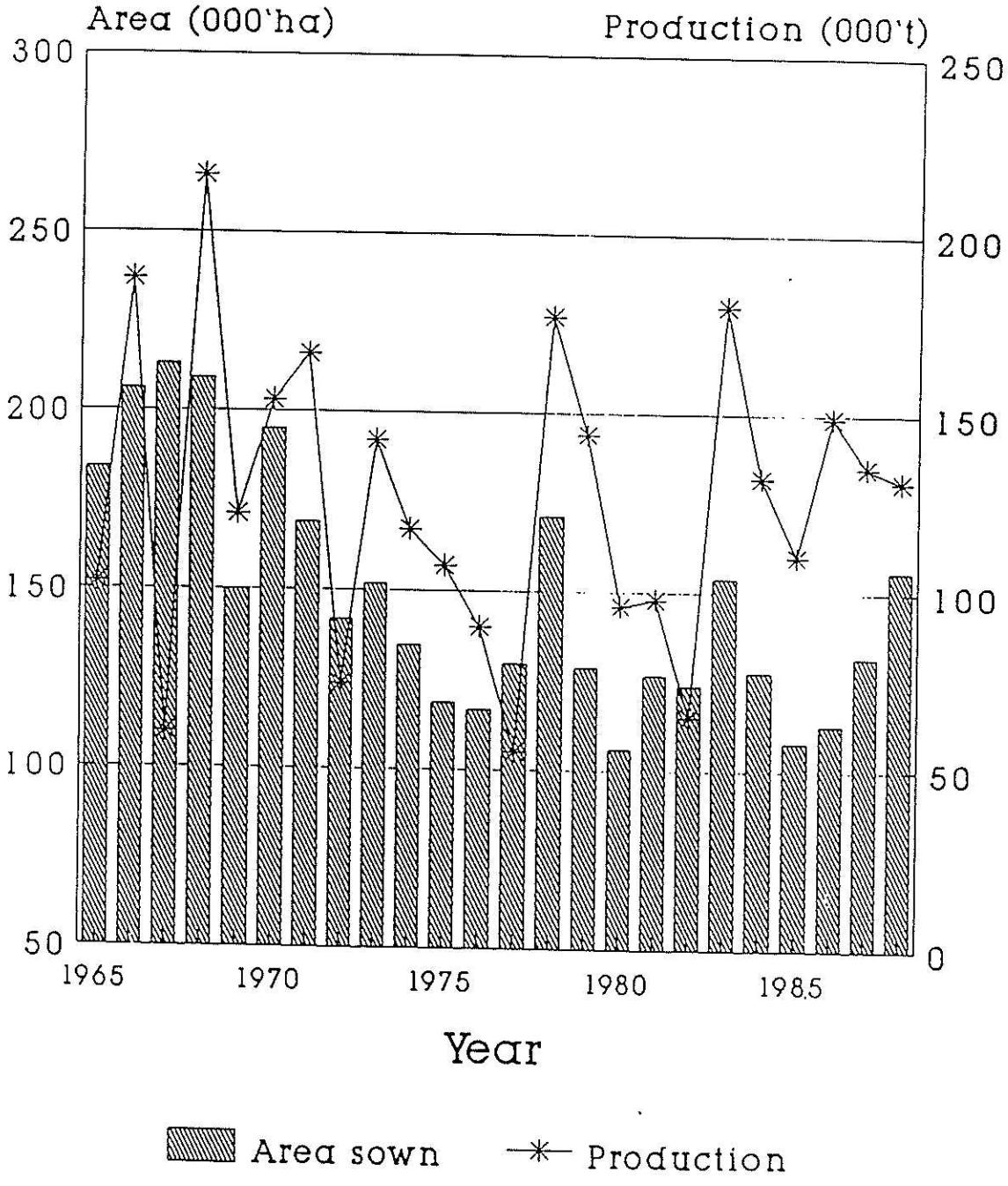
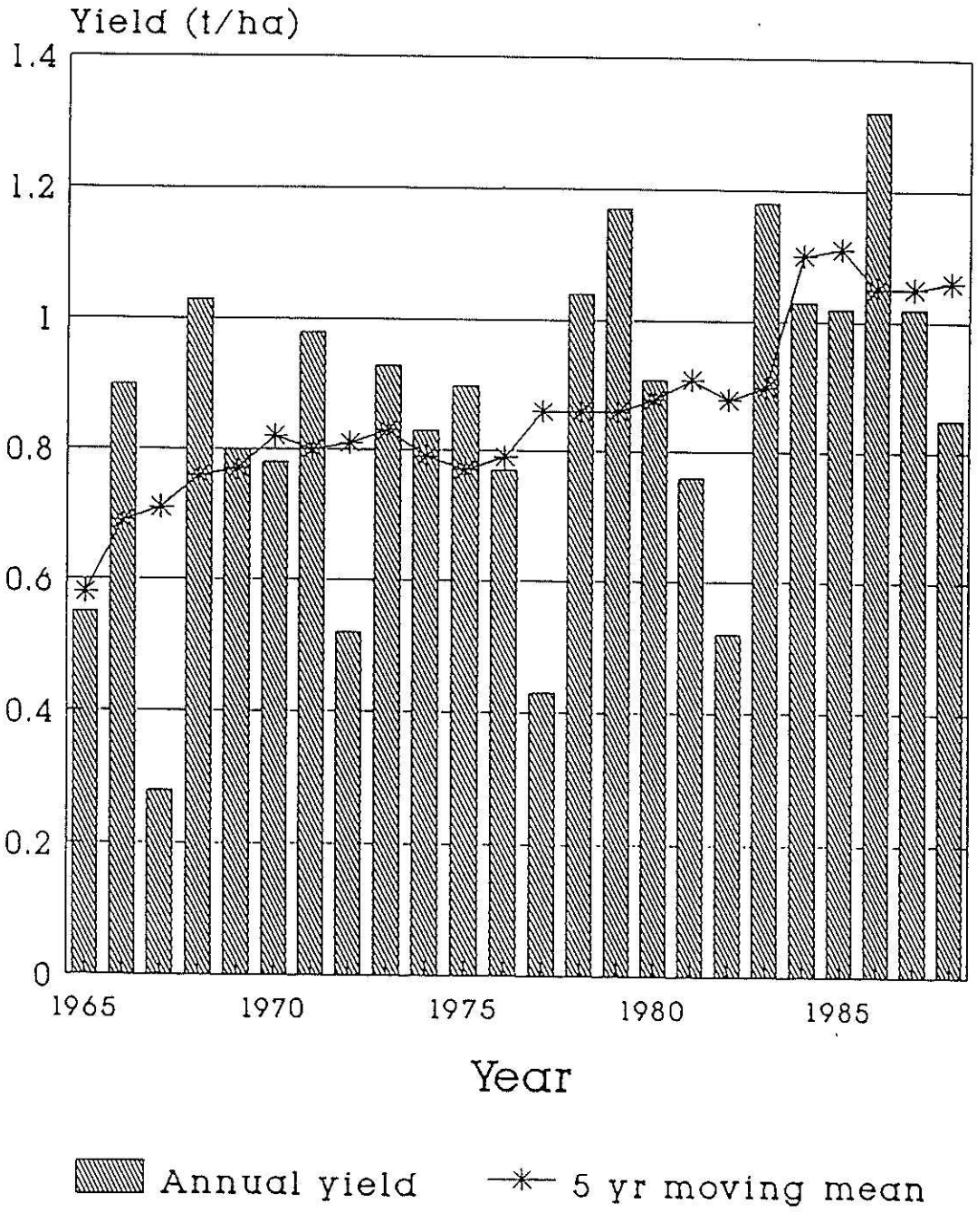


Figure 3.5 Annual trends in the average yield (t/ha) of oats for grain grown in South Australia. (1965–1988)



3.3 Market Specifications

3.3.1 Barley

In 1989 the Australian Barley Board received a range of grades of barley, the major ones were 2 Row Malting (at $188/t), Schooner No. 3 (at $148/t) and 2 Row No. 3 (at $138/t). The premiums paid vary from year to year and are dependent on market realisations. Table 3.8 indicates the minimum specifications for each of these grades in 1990. Limits are also set on some other parameters.

Table 3.8: Maximum grade specifications for barley delivered to ABB 1990/91 in three grades.

	2 ROW MALTING	SCHOONER NO. 3	2 ROW NO. 3
Variety	specified	specified	not specified
Protein %	11.8	13.0	not specified
Screenings %	28	40	70
Weed units/100 g	13	13	16
Foreign grains %	4	4	6
Skinned %	18	18	no limit
Green barley %	3	3	10

In 1990 Clipper was accepted at certain delivery points into the malting classification. An additional $10 per tonne premium above Schooner malting was paid.

Weeah is no longer segregated as a malting variety in S.A.

Since the introduction of the variety Galleon (a high yielding CCN resistant feed barley) in 1981/82, the area sown to the lower yielding malting varieties Clipper, and Weeah has fallen markedly in South Australia (Table 3.9).

The increase in the area sown to Galleon is a result of increased farmer awareness of the value of controlling CCN and the high yield potential and ease of management of this variety.

Table 3.9: Percentage of area planted to each Barley Variety

SOUTH AUSTRALIA									
Season	Skiff	Clipper	Weeah	Schooner	Dampier	Galleon	Forrest	Six-Row Varieties	Other
1978/79		64.5	17.5		8.1			0.9	9.0
1979/80		62.5	19.0		10.3			0.6	7.6
1980/81		62.0	19.0		12.5			0.5	6.0
1981/82		60.4	21.9		12.0	0.4		0.5	4.8
1982/83		45.5	23.4		10.7	15.3	0.5	0.5	4.1
1983/84		31.0	22.3	0.1	7.7	29.2	5.5	0.7	3.5
1984/85		18.5	11.8	3.6	2.7	38.6	22.2	0.3	2.3
1985/86		6.8	5.9	18.1	0.9	40.0	26.5	0.2	1.6
1986/87		4.0	3.1	22.1	0.5	46.0	23.1	0.2	1.0
1987/88		2.6	1.7	33.9	0.3	46.1	13.9	0.1	1.4
1988/89		1.9	0.9	38.6	0.2	47.3	9.5	0.2	1.4
1989/90	0.3	1.0	0.8	32.1	0.2	55.8	8.3	0.1	1.4

VICTORIA									
Season	Skiff	Clipper	Weeah	Schooner	Research and Lara	Parwan	Galleon	Six-Row Varieties	Other
1978/79		30.1	48.1		21.4			0.1	0.3
1979/80		38.4	42.1		18.5			0.1	0.9
1980/81		35.4	42.7		15.4	5.8		0.3	0.4
1981/82		25.8	52.5		10.0	11.0		0.1	0.6
1982/83		17.5	57.9		14.0	8.9	0.2	0.4	1.1
1983/84		15.4	60.2		5.5	13.8	2.1	0.7	2.3
1984/85		12.1	55.4	1.8	4.5	15.4	8.4	0.1	2.3
1985/86		7.7	41.9	18.7	2.9	15.5	9.6	0.1	3.6
1986/87		4.3	35.3	29.2	2.5	16.9	8.9	0.2	2.7
1987/88		2.6	27.3	51.2	0.6	12.3	4.9	0.1	1.0
1988/89		1.3	23.8	57.1	0.3	10.4	5.8	0.1	0.6
1989/90		1.5	22.7	56.6	0.1	7.3	9.6		1.4

In Victoria the situation is different. Schooner has replaced Clipper and only a small area is planted to Galleon (Table 3.9). The probability of achieving malting grade is higher in Victoria where cooler finishes occur in most seasons. Table 3.10 shows the receival and disposal of barley for malt and feed purposes for both States and totals for Australian barley marketing authorities.

Table 3.10 Receivals and disposals ('000 tonnes) by the Australian Barley Board and for all Australian Barley marketing Authorities

	Domestic disposals					Exports		
Year	Receivals	Domestic Malt	Export Malt	Feed	Sundry	Malting Barley	Feed Barley	Food
Australian Barley Board - Victoria								
1984/85	551	45	83	12	0	182	226	0
1985/86	323	55	124	7	0	32	105	0
1986/87	349	65	174	2	0	36	72	0
1987/88	423	50	234	43	0	61	34	0
1988/89	393	70	198	30	0	46	49	0
1989/90	628	85	229	42	0	242	30	0
Australian Barley Board - South Australia								
1984/85	1,811	16	85	27	0	142	1,482	32
1985/86	1,634	15	82	33	0	210	1,293	0
1986/87	1,512	13	88	24	0	183	1,204	0
1987/88	1,118	12	109	80	0	152	965	0
1988/89	870	11	102	50	0	42	665	0
1989/90	1,675	11	72	30	0	346	1226	0
Total Australian Barley Marketing Authorities								
1984/85	4,830	179	224	124	10	649	3,519	67
1985/86	3,762	215	275	113	5	407	2,746	0
1986/87	2,599	221	360	107	5	343	1,563	0
1987/88	2,370	257	408	182	6	475	1,043	0
1988/89	2,252	350	370	239	6	362	925	0
1989/90	3,354	282	372	213	5	992	1500	0

3.3.2 Oats

The Australian Barley Board receives 3 grades of oats in South Australia Table 3.11 indicates the minium specifications for each of these grades in 1990 while Table 3.12 indicates receivals over the 3 seasons 1986 - 1988.

Table 3.11: Specifications for oats delivered to ABB in SA 1990

	NO. 1	NO. 2	NO. 3
Variety	Specified	Any	Any
Density (min)	52.5 kg/hl	50 kg/hl	47 kg/hl
Wild Oats (max)	50/0.5 l	100/0.5 l	no limit
Other Cereals (max)	1%	5%	10%
Screenings (Max. under 2 mm)	5	15	no limit

Table 3.12: Oats Delivered in S.A. to ABB (Tonnes - % by grade)

GRADE	SEASON				
	1986/87	1987/88	1988/89	1989/90	1990/91
No. 1	14,664 (40.0)	19,481 (45.2)	14,602 (29.6)	42,787 (39.7)	3,796 (13.0)
No. 2	19,302 (54.0)	17,481 (41.3)	20,352 (47.1)	52,873 (49.0)	16,644 (57.0)
No. 3	2,044 (6.0)	5,817 (13.5)	8,271 (19.1)	12,184 (11.3)	8,700 (30.0)
TOTAL	36,010	43,138	43,225	107,844	29,200

In 1987 and 1988 more oats were downgraded to the No. 3 grade, due primarily to higher screenings attributed chiefly to hot dry spring conditions which hastened crop maturity. In the more recent seasons seasonal factors plus tighter receival standards have shifted receivals into lower grades.

Table 3.13: Percentage of area planted to each Oat Variety

SOUTH AUSTRALIA										
Season	Swan	Avon	Echidna	Marloo	West	Wallaroo	Dolphin	Mortlock	Coolibah	Others
1980/81	58.1	8.4			19.0				1.3	13.2
1981/82	58.1	6.9			21.4				1.5	12.1
1982/83	61.5	8.4			19.4				0.9	9.8
1983/84	59.7	7.1			19.6				1.6	12.0
1984/85	55.3	7.0	1.2		21.1		0.6		1.6	13.2
1985/86	52.0	3.8	15.3		17.9		2.5		1.0	7.5
1986/87	41.5	5.0	27.4		15.2		2.0	0.8	1.2	6.9
1987/88	36.8	4.7	38.8		9.9		1.1	2.1	0.7	5.9
1988/89	30.2	2.9	47.8	1.5	8.1	0.2	1.0	2.9	0.7	4.5
1989/90	25.5	2.0	46.4	9.2	4.6	4.7	0.7	3.7	0.7	2.5

In South Australia, Echidna has continued to gain acceptance by growers and now accounts for approximately one half of the total area sown to oats (Table 3.13). Wallaroo, Marloo and Swan are other important varieties.

The S.A. Department of Agriculture oat breeding program is now directing its activities towards:

- selecting semi-dwarf lines which have improved grain size, plumpness and protein content compared with present varieties.

- breeding semi-dwarf lines which are resistant and tolerant to cereal cyst nematode.

- evaluating the field performance of naked grain types.

In recent years there has been a stronger demand from Japan for oaten hay exported in double dumped form.

3.3.3 Triticale

There are no receival standards for triticale in South Australia as the grain is used primarily in stockfeed rations as a substitute for wheat.

3.3.4 Cereal Rye

There are no receival standards established for cereal rye as the entire crop is marketed domestically without regulation. If the Australian Wheat Board continues as a marketeer of cereal rye, grain receival standards will be developed and introduced.

3.4 Current Markets and Marketing Arrangements

3.4.1 Domestic Feed Markets

The size of the domestic feed market in S.A. and Australia has been rising in the last few years as increases in poultry and pig production and rising sheep and cattle numbers have created more demand for alternative sources of energy and protein.

3.4.2 Outlook for World Coarse Grains

The international outlook for cereal crops including coarse grains in 1991 is mostly favourable. The production estimate for 1991/92 and that for the previous two seasons is given in Table 3.14.

Table 3.14: World Cereal Production for 1988-1990

	1988	1989	1990 estimate	1991 forecast
	(million tonnes)			
Wheat	508	541	595	560
Coarse Grains	744	823	842	850
Rice (paddy)	491	516	521	-
TOTAL	1,743	1,880	1,957	-

Increased production is anticipated in 1990-91 from North America, USSR and China.

FAO's forecast of world trade in coarse grains in 1990/91 is now put at 84 million tonnes, 19 million tonnes or 18 per cent less than the previous year's trade and the second lowest since 1977/78.

Imports are forecast to fall to 12m tonnes in USSR compared with 23m tonnes for 1989/90. Total imports into eastern Europe are also expected to decline due to economic problems.

As production of coarse grains by the major exporters is now forecast to reach only the level of the previous year, world stocks of these grains are forecast to decline for the fourth consecutive year to their lowest level since 1983/84. They are currently estimated at 125 million tonnes by the end of the 1990/91 crop year.

3.4.3 Trends in Long Term Prices for Coarse Grains

The price of coarse grains is dominated by the price of United States maize (corn). In the USA over the past 20 years the average price of feed barley has been only 74% of that of feed corn.

Corn, sorghum and barley are highly substitutable as livestock feeds. However, the substitutability is not perfect because the grains have different nutritional and digestibility characteristics. Feed values averaged across all livestock classes and expressed as a proportion of corn feed value are approximately:

Sorghum 95
Barley 90
Oats 90
Wheat 105

As the U.S. is the dominant international exporter of coarse grains, U.S. price linkages are transferred into the world market, particularly for corn and sorghum. However, for barley, internal regional supply and demand conditions relative to other feed supplies often override the export market conditions. Thus U.S. barley prices are often too high to be competitive in the world stockfeed market.

In years when barley supplies have been restricted, the inflexible demand from the malting industry tends to increase the premiums paid for quality barley relative to feed barley but also increases the prices paid for feed barley. Table 3.15 indicates prices paid for various grades of barley by the ABB in South Australia in recent years.

Table 3.15: Payments ($/t) to South Australian Growers by Australian Barley Board

YEAR	NO. 1 GRADE	NO. 2 GRADE	NO. 3 GRADE	NO. 4 GRADE	SIX ROW FEED
1982/83	153	148	136	131	123
1983/84	161	156	141	136	128
1984/85	139	136	124	119	116
1985/86	121	121	116	111	103
1986/87	130	130	105	100	92
1987/88	145	-	107	102	94
1988/89	181	-	143	138	130
1989/90	179	-	135	130	122

3.4.4 Barley markets and Marketing Arrangements

The international barley market is principally for stockfeed and the major buyers are Saudi Arabia, USSR, Eastern Europe and Japan. Given the small volume of barley traded internationally (Table 3.16), Australia is a price taker on world markets, the final returns to growers depending on prevailing world prices and the exchange rate of the Australian dollar.

Table 3.16: World barley trade (m.t) by country (1985-86 to 1989-90)

	1985-86	1986-87	1987-88	1988-89	1989-90(p)
Exports:					
Western Europe					
European Community	7.3	6.2	7.0	9.6	7.3
North and Central America:					
Canada	4.8	6.0	3.5	3.4	4.3
United States	0.8	3.0	2.9	1.7	2.0
Oceania:					
Australia	4.5	2.6	1.9	2.0	2.6
TOTAL	17.4	17.8	15.3	16.7	16.2
Imports:					
European Community	0.1	0.1	0.3	0.3	0.3
Eastern Europe	3.3	1.3	1.6	2.2	1.7
Soviet Union	2.9	3.0	2.3	3.2	4.0
South-West Asia:					
Saudi Arabia	6.6	9.0	4.8	4.6	3.5
South, South-East and East Asia:					
Japan	1.5	1.2	1.3	1.3	1.4

(p) = preliminary

Around 10% of global production is traded annually with Australia providing around 15% of that global trade, usually ranking third behind the EEC and Canada. Approximately 50% of Australia's barley production is exported, making it a significant crop in the Australian economy.

Australian exports of malting barley over the period 1984/85 to 1989/90 have ranged between 360,000 and 830,000 tonnes with the major buyers being China, Taiwan and South America (Table 3.16). Due to adverse seasonal conditions affecting both the quality and availability of Schooner malting barley in recent years, the ABB has been unable to maintain its previous share of these markets.

Table 3.17: **Major Buyers of Australian Barley (1986-87 to 1989-90)**

1986/87 - 1988/89				
Year	**Malting Barley**	**'000 t**	**Feed Barley**	**'000 t**
1986/87	China	190	Saudi Arabia	755
	Brazil	122	Japan	418
	Taiwan	93	Taiwan	214
	Total	**589**	**Total**	**1602**
1987/88	Taiwan	63	Japan	488
	Peru	36	Taiwan	165
	Japan	35	Saudi Arabia	161
	Total	**367**	**Total**	**1093**
1988/89	China	99	Japan	436
	Brazil	95	Taiwan	234
	Taiwan	76	Saudi Arabia	191
	Total	**478**	**Total**	**1031**
1989/90	China	469	Saudi Arabia	639
	Japan	81	Japan	421
	Taiwan	82	Taiwan	138
	Total	**830**	**Total**	**1546**

The marketing of the Australian barley crop is highly regulated, but fragmented, between four State-based statutory marketing authorities. Under complementary South Australian and Victorian legislation the ABB exercises a marketing monopoly on barley grown in both States and the export of oats from South Australia. Queensland and New South Wales each had separate Barley Marketing Boards but they have moved towards establishing a grain co-operative and a grains board respectively whilst the Grain Pool of Western Australia, has a monopoly to market the W.A. barley crop, and other grains.

Export sales are negotiated on a "free on board" (FOB) ship basis. Prices are negotiated with international buyers. Prices achieved are relative to world prices for barley of similar quality at the time of negotiation. For Japan, the ABB places a competitive tender for shipments of various qualities of barley to the Japanese Food Agency, the sole importer of barley.

Pricing

The price paid for malting barley used for the manufacture of malt for local consumption is equal to the export price plus a premium paid to recognise that maltsters and brewers have first call on available supplies. Additional charges are added to cover interest and storage costs for the spread of delivery of barley between the 1st of January and the 7th of November in the year of delivery.

The offer price of barley used for the manufacture of export malt is based on the price at which the ABB can sell malting barley for export. Deliveries are determined by the requirements of the purchaser but must be completed by November 7 in the year of purchase or additional charges will be incurred.

The price of feed barley for local consumption is set on a daily basis, and relates to the availability and price of substitute grains. Sales of large quantities of feed barley are by direct negotiation between the ABB and the purchaser.

More than 80% of South Australian barley deliveries are exported. Major buyers are Saudi Arabia, Japan, Taiwan, China, Middle Eastern countries and the USSR.

In recent years international barley prices, together with wheat prices, have fallen because of the pricing policies of the USA, and the EEC. These depressed prices triggered South Australian growers to substitute alternative enterprises for barley resulting in the greatly reduced area in the early 1980s.

There is only a limited domestic market in South Australia for both feed and malting barley although in recent years there has been some increase in the export of manufactured malt. South Australia exported 124,000 tonnes of malt in 1989/90 primarily to Philippines, Japan and South America.

There are currently problems with the Philippines market which are of concern to the industry. The loss of shipping services from Adelaide and Melbourne has led to maltsters having to find alternatives.

There are four malting companies in South Australia with an average annual capacity of some 170,000 tonnes. In recent years reduced sowings of malting quality varieties have created a shortfall which has been made up from Victoria. Although the ABB has a responsibility to meet the reasonable requirements for local consumption the geography of South Australia and its high internal transport costs has meant that malting barley has still been exported from S.A. in these seasons of shortfall.

Local consumption of feed barley in S.A. over the last five years has varied between 24,000 and 80,000 tonnes. The volume of sales depends mainly on price, availability, and cost of alternative feed grains.

Unlike Queensland and New South Wales there is only a small demand for barley for intensive feeding of livestock, the major demand being confined to a few intensive piggeries near Adelaide. The geography and limited domestic demand for stockfeed make South Australia a natural exporter of large quantities of feed barley.

Regulation of Barley Marketing in South Australia

The ABB has a monopoly to compulsorily acquire and market all barley produced in Victoria and South Australia for both domestic and export markets. Exceptions to this monopoly include barley retained by a grower, barley traded interstate and barley sold with ABB approval.

In 1989 South Australia introduced "permit trading" of barley for stockfeed purposes, modelled on the provisions of the Wheat Marketing Act (1984). With an ABB permit, buyers of barley for stockfeed can negotiate directly with growers and these sales are outside the normal pooling scheme. In proposed legislation there will be no volume limits for each permit though there is currently a limit of 500 tonne.

The Barley Marketing Act in South Australia specifies that the ABB can appoint licensed receivers to store and handle grain on its behalf and over 50% of grain is handled by road.

The South Australian Co-operative Bulk Handling Ltd has contractual arrangements with the ABB which set out separate storage and handling agreements. The ABB has the option of using rail or road transport to transfer grain from country silos to port terminals in South Australia.

Pooling

The "pooling" of barley of like quality has been a central feature of barley marketing in S.A. since the inception of the ABB. In each season, the ABB forms pools of barley of uniform, specified quality which are sold on both domestic and export markets. Growers are paid an average price for deliveries to a particular pool through the pooling of receipts from all sales in different markets and at different times. The final return to growers is the gross pool return minus ABB marketing and administrative costs.

At present the ABB accepts barley into two major pools, malting and feed. However, as seasonal or marketing conditions warrant, additional pools may be declared before harvest. Payments to growers are made relative to the market realisation of the specific quality of barley received into these pools.

Pooling provides growers with a share of the returns achieved on all markets. However, there can be a large differential between the pool price and the market value of the barley quality in greatest demand. In a pooling system it is almost impossible to reward growers who grow a quality of barley which is in demand in the market place or, conversely, discount barley which is not in demand in the market. The ABB recently introduced a contractual system whereby growers can receive premiums for particular grades of barley.

Following amendments to the Barley marketing Acts in 1971 the pooling concept was varied by the introduction of State accounting. This acknowledged the geographical advantage Victorian growers have in supplying the domestic malt market in Melbourne. At the time South Australian malting barley supplied to Victorian maltsters incurred freight costs and reduced returns to S.A. growers.

Under State accounting growers in each State gain the benefit of supplying local markets and pay the costs involved in meeting that market. Income from the sale and export of barley of a common grade from either state is averaged over the total quantity of that grade exported from both States.

Payments to Growers

Growers usually receive three payments for grain delivered to ABB pools. The first payment, or "first advance", a large proportion of the estimated net pool return, is made shortly after delivery of the grain and well in advance of the barley being sold. The ABB deducts storage, handling and transport charges and the Federal research levy from this payment. The first advance is financed by ABB borrowings on commercial markets. The second payment is normally made in the August following delivery and the final payment some 16-18 months after delivery.

To provide greater financial flexibility and assist with the cash flow of barley growers a discounted pool payment is made available, usually in June of the year following delivery. This scheme enables growers to receive a discounted cash payment for their residual equity remaining in the pool. The payment is calculated by estimating the residual expected to be available for distribution, less the cost of funding the earlier payment, plus a margin to safeguard against adverse changes in the market. Historically, this offer has been accepted by only a small percentage of growers.

Finance

(a) **Futures and Options Markets**

The international exposure of the ABB in both its borrowing and marketing activities puts it at risk from movements in international barley prices and exchange and interest rates. Adverse movements could affect the final return paid to growers. The ABB recently has been given the legislative authority to use futures markets to hedge against possible adverse financial and price movements. The use of futures is subject to guidelines jointly approved by both State Governments and to internal control exercised by the Corporate Risk Management Committee of the Board.

(b) **Reserve Fund**

The present barley marketing legislation only makes provision for the ABB to create a reserve fund from a small residual income from each pool, but this cannot be used to assist on-going operations.

This has the effect of making the finalisation of pools virtually dependent on the payment of the last account and/or receival of the last receipts which can delay grower payments. It also means that the "cash-out" option now available to growers is conservatively calculated and has the potential to create inequities. Proposed legislation will create a suggested fund of $6m and will be used for the early finalisation of

individual pools, underwriting early payment of any remaining farmer equity, underwriting self insurance by the Board, financing product development, special research and joint venture operations.

3.4.5 Oat Markets and Marketing Arrangements

Australia produces on average about 1.5% of the global oat production of 41 million tonnes. World trade in oats averaged 1.8 million tonnes in the three years 1987 to 1989 which is only 4% of world production. Major exporters of oats in 1989 were Canada (933,000 t), Argentina (130,000 t, an erratic supplier) Sweden (266,000 t), France (128,000 t) and Germany DR (91,000 t). Australia's share was 260,000 t or 11% of the total.

Major buyers of oats in 1989 included the USA, Japan, Switzerland, Italy, Netherlands and Belgium. In 1989/90 Australia exported 218,000 tonnes of bulk oats worth $32 million. Major buyers were the USSR 75,000 tonnes, Japan 48,000 tonnes, Ecuador 23,000 tonnes and the Federal Republic of Germany 18,000 tonnes. South Australia exported 72,000 tonnes, mainly to USSR.

Of the 236 thousand hectares sown to oats in SA in 1990/91 126 thousand hectares or 53% was sown on the Eyre Peninsula. Another 53 thousand hectares or 22% was grown in the mid north and Yorke Peninsula. Of the oats not used on-farm much of that from Eyre Peninsula is exported through Port Lincoln and Thevenard while a significant proportion of the production from the mid north and Yorke Peninsula is used for local feed consumption.

Local milling usage is small with few buyers - Johnsons, Blue Lake Milling Co and Laucke Bros. The Uncle Toby's Company, Australia's biggest miller, is located at Wahgunyah in N.E. Victoria.

The major use for oats grown in South Australia is in the ruminant feed industry as a supplementary feed or drought fodder.

Export prices for oats are based principally on the relative feed value of corn, and are generally 10% lower. Since 1970 oats prices have exceeded the price of feed wheat on only one occasion, (July 1988), as a result of drought in the USA and Canada which severely affected oat crops.

In 1977 the ABB became the marketing authority for South Australian oats. It has powers to acquire all oats produced in South Australia, except those retained by growers, purchased for livestock feed, or sold to feed manufactures or oat millers for conversion into other products.

The Australian Barley Board pools oats into 3 grades and pays growers on a similar basis to barley.

As with barley, the ABB now has the legislative authority to use futures markets to hedge against adverse currency, interest and price movements.

The oat export hay market is now serviced by 4 buyers - J.T. Johnson, Balco Australia, Charlick Trading and Pegasus. This is the best market situation presented to growers in the short (and turbulent) history of this trade.

3.4.6 Triticale Markets & Marketing Arrangements

There is no recorded world trade in triticale and it is probable that all grain is used within the producing country.

Historically triticale marketing has been dominated by stockfeed manufacturers who have developed this to avoid the legislative constraints surrounding regulated domestic marketing of wheat. With deregulation of the wheat market there is less interest in triticale and discounts of $10-$15/t now apply relative to feed wheat.

The use of triticale as a break crop (CCN resistance), its nutritional value and in some years prices well in excess of feed barley provides farmers with a valuable crop option.

3.4.7 Cereal Rye Markets & Marketing Arrangements

World trade in cereal rye averaged 0.8 million tonnes in the three years 1987 to 1989 which was 2.4% of total average world production of 33.6 million tonnes for the same period. Major international buyers in 1989 were Japan (200,000 t), Poland (110,000 t), Germany FR (60,000 t), Norway (41,000 t), Finland (37,000 t), Netherlands (28,000 t) and Sweden (18,000 t).

Australian cereal rye production is negligible and is concentrated in the Mallee regions of South Australia and Victoria. Since 1984/85 production has varied between 14,000 tonnes and 55,000 tonnes.

There are two major buyers, Goodman Fielder and George Weston Foods -who use the rye for human consumption. The major end uses are for flour in bread, biscuits and crackers, coffee substitute and breakfast cereal. The size of the domestic food market is approximately 25,000 tonnes and has risen from 15,000 tonnes in the early 1980's.

A major limitation to expanding the cereal rye industry is the absence of a developed stockfeed industry. It is only occasionally that there is an exportable surplus large enough to consider for use in stockfeed and as yet little effort has been made to develop an export market.

Of the 19,250 ha grown in SA in 1990/91 79% was grown either in the northern or southern Murray mallee divisions.

Freight costs are usually high, with deliveries to Gulgong (NSW), Sydney, Melbourne and Adelaide by road. These costs can be as high as sea freight plus quarantine costs from Canada.

Prices for cereal rye have tended to be volatile, rising above import parity in times of shortage to well below import parity in times of surplus. The main benchmarks are wheat for stockfeed and barley or triticale prices.

The introduction of the Australian Wheat Board into marketing of cereal rye may broaden the number of market outlets for cereal rye and reduce the quantities traditionally held on farm for up to 2 years.

World cereal rye prices are largely determined by the exports of Canada and USA (157,000 t and 84,000 t respectively in 1989) whilst Western Europe (269,000 t) has a significant volume of intra European trade which may increase in the next few years as Eastern Europe increases consumption e.g. Poland imported 110,000 t in 1989.

3.5 Processed Coarse Grain Products

3.5.1 Processed Barley Products

Human Food Uses

The major human use for barley produced in SA is in the malting process for beer production. Over the period 1984-85 to 1989-90 almost 20% of the barley grown in SA has been used locally or exported for malting purposes.

Barley has great potential for the prevention of hyper-cholesterolaemia and heart disease, presumably due to the high concentration of ß-glucans. Barley has traditionally been unpopular for human consumption because of poor texture and food technology has been unable to improve this.

Research has found that barley is better than oats, rye, triticale and wheat for concentrations of beta glucans, substances which help lower cholesterol levels in the blood. CSIRO in cooperation with the Waite Institute has found that beta glucans comprise 4%-10% of barley grains, compared to about 3% of oat grains. The beta glucans in barley are more evenly distributed throughout the entire grain, which means that pearl barley and barley flour are just as beneficial to eat as barley bran. By comparison the beta-glucans in oats are mainly concentrated in an area just inside the bran layer. This gives barley a big advantage because it means a wider range of products can be made that have the potential to be promoted as health foods.

CSIRO suggests that the concentration in breeding programs on malting barley varieties which have low beta-glucans runs counter to the need for waxy strains of barley which have higher beta-glucans levels than most varieties presently grown in Australia. The varieties O'Connor and Grimmett are among suitable existing commercial varieties.

Coopers brewery has made a successful entrance to the home brewery market selling kits for the brewing of beer, ale, lager, bitter and stout. The market is expanding rapidly with exports to New Zealand, Sweden, U.K., Canada and U.S.A. As much as 70% of Coopers' production is in home brewing kits. The

target market is primarily limited income families where substantial savings can be made.

Barley flour is widely used in many countries in a number of products such as noodles.

Animal Feed Uses

The use of barley or oats has produced substantial reductions in plasma cholesterol compared with diets based on maize. There is potential for the export of ready mixed feeds including barley especially to south east Asian countries where cereal supplies are limited. This is particularly important in South Australia where there is ready access to a range of feed ingredients which have least cost ration potential for several markets.

Non Food Industrial Uses

Glucose made with thermophilic/thermostable X-amylase in barley is promising and there is a possibility of finding other useful enzymes.

Effective uses have been tried in cosmetics, skin care, dental polishing and for healing inflammation of bruises and sprains.

The alkalinity characteristics of barley are being researched for brewing and producing new types of alcoholic drinks.

Secondary processing of by products can be used as organic fertiliser.

3.5.2 Processed Oat Products

The major use of oats is as a feed for ruminants. Milled oats are mainly used in porridge, muesli bar products, biscuits and oat bran. There has been an increase in consumption of oat products for cholesterol reducing purposes.

In addition, dehulled oats are sold into weaner pig rations and bird seed.

Double dumping or reducing the size of oaten hay bales for bulk shipment to the Japanese ruminant market is a value added industry. Subsidies paid to the Japanese livestock industry and a shortage of natural feed products enables South Australian oaten hay to compete favourably with other substitutable products such as rice straw, sudax, timothy grass.

3.5.3 Processed Triticale Products

A range of potential food uses have been outlined in a recipe book produced in South Australia by Dr K. Cooper but these uses appear to have been poorly utilised by food processors. There is no reason why flour, biscuit or breakfast food ingredients could not be developed using this cereal.

3.5.4 Processed Cereal Rye Products

Expansion of cereal rye as a food product is dependent on the involvement of the larger bakers in supplying a healthier product and being assured of a constant supply of quality grain. Over 13,000 tonnes of cereal rye was imported in 1983/84 and around 10,000 tonnes is expected to arrive in 1990/91.

Bread

In bread manufacture, the key nutritional emphasis is on high fibre, wholemeal, and whole grain breads. Rye, in the form of kibbled rye or cracked grain is seen as providing the high fibre, taste and colour desired in 'health' bread. The emergence of specialty rye bread suppliers has put pressure on the more traditional suppliers to provide more innovative loaves containing rye. As a consequence sales of kibble rye, rye-meal and rye flour have increased and with more public exposure could lead to further increases in demand. Sandwich bread sales, eroded by the emergence of alternative fast food outlets, are linked to the provision to the public of more healthy alternatives.

Biscuits

In addition to the traditional Ryvita wafer biscuit other 'wafer' health low calorie content biscuits have appeared on the market including rye kruskit and rye thins.

Breakfast Foods

Cerebos, a major muesli manufacturer, has indicated that they may consider using cereal rye as an ingredient. Kelloggs have introduced 'Just Rite' a mixture of rye, bran and sultanas. Purina's rye flakes is also a relatively new product and Sanitarium has developed a product called 'Good Start' which contains wheatbix, rye and rice.

Vegetarian Coffee

Rye is used as a substitute, no caffeine, instant coffee ingredient.

4. INDUSTRY POTENTIAL

4.1 Potential for increased Production

It has been estimated that 11.3 million ha of S.A. is suitable for cropping to cereals in any year.

The total area sown to crops in South Australia in recent years has been at record levels (up to 3.03 million ha). The areas sown to wheat, barley and oats have all increased markedly (see Chapter 3) over recent seasons largely as a result of higher returns relative to those from sheep.

Barley

Barley tends to be grown in more favoured rainfall areas rather than in marginal situations where wheat predominates. This may buffer future fluctuations in the area sown but the relative gross margins for wheat and barley will have the major effect. If wheat prices continue to decline there could be a big swing to barley. While the price of feed barley is related to that of other feed grains and wheat, it has little relationship to the price of malting barley.

The area sown to malting barley over the next 10 years could increase significantly if a new higher yielding, good quality, CCN resistant variety is produced, market share is at least retained, and premiums continue at about the current level.

The total area sown to barley in SA could increase significantly beyond the 1.17m ha sown in 1985.

There is potential for major increases in barley yields/ha over the next 10 years. While many growers have the potential to achieve substantial yield increases from improved management practices others that have adopted improved technology have a smaller potential.

Improvements in barley yield could be achieved through:

- varieties with increased yield potential;
- varieties with specific adaptation, i.e. improved yield potential in a specific environment;
- varieties with resistance to diseases such as CCN and leaf scald;
- improved rotations for control of disease and improved nutrition;
- improved weed control for earlier sowing and less crop loss;
- improved use of fertilizers (rate, timing, type);
- achieving optimum sowing time and sowing rate;

. utilization and development of improved machinery technology e.g. press wheels, rhizoctonia points etc.

Oats

Over the next 10 years there is potential for an increase in the area sown to oats in SA for traditional uses. This is more likely to be after 1995 and will depend on relative grain prices and the continued use of oats for sheep feeding. Oats are used for a variety of other purposes and given strong market development potential expansion could occur in some categories viz:

hay - area sown dependent on Japanese or alternative markets.

forage - potential for an increased area replacing other cereals and grasses.

grain - on-farm, very little increase is anticipated unless present sheep and wool prices change.

- off farm, some increase in area sown is possible dependent on better quality grain.

Naked-grain oats provide potential to increase the off-farm use of oat grain and, in time, this could result in a significant increase in area sown in more favoured regions of South Australia.

There is considerable potential for increasing the yield/ha of oats in SA. Many farmers could obtain a 50% increase in yield over the next 10 years, through sowing improved varieties and adopting correct management practices.

Major areas for potential increase in some environments in some seasons in yield/ha are envisaged as:-

.	varieties	through use of dwarf types and incorporation of CCN and foliar disease resistance.
.	weeds	through control of grass weeds in particular.
.	disease	through better management of current varieties and increased inputs into oat plant pathology.
.	nutrition/tillage/ agronomy	a large but undefined potential: very little research has been undertaken.

Triticale

Prior to 1990, the area sown to triticale remained fairly static at 8,000 -10,000 ha. The area sown in 1990 was more than 15,000 ha. Given the attributes of this crop which could provide advantages in any one of several environmental niches the relative lack of farmer interest is surprising. The attributes include:-

- yield equivalent to wheat in some environments
- better head retention than some barley varieties
- tolerance to acid soils
- nutrient efficiency
- resistance to a range of diseases provides benefits to triticale and following crops
- tolerance to both drought and waterlogging
- tolerance to boron toxicity

It appears that the lack of receival points and of high profile buyers for the grain are major disincentives to growth in SA. The lack of export markets also poses a problem.

There is potential for an increase in both the area sown and the yield/ha over the next 10 years but the extent is difficult to quantify.

Cereal Rye

The area sown to cereal rye in SA in 1990 was 19,000 ha. Twice that amount has been sown in some previous seasons with fluctuations related largely to price.

There is potential for a larger area particularly as the current production is unable to satisfy the national market requirement. There is also potential for a significant increase in yield particularly as genotypes emanating from the WARI breeding programme have shown considerable promise. A new variety could be released in the next 2-3 years if there was minimal additional input to this programme but the growing of such a variety, more suited to better environments, could eventually lead to an oversupply with increasing cereal rye production in new areas, both in S.A. and interstate.

4.2 Potential for improved quality

Internationally the physical quality of South Australian coarse grains is regarded as generally good. To a large extent this is due to conditions at and immediately after harvest leading to low moisture content grain free from weather damage and relatively few insect problems. Grains which are stored and marketed by a central authority also benefit through the expertise and standards of those organisations. These standards need to be maintained with particular attention paid in deregulated markets.

Barley

Large grain of low protein content, high carbohydrate, malt extract and diastase activity are desirable in malting barley.

For many years, South Australian barley varieties held a reputation as some of the most superior malting quality varieties in the world. In recent years, however, overseas competitors have succeeded in developing superior malting quality types. Standards currently set by these Canadian and European varieties must be achieved if Australian malting barley is to remain competitive in the more discriminating malting barley markets.

Environmental factors have an important role in determining the relative malting qualities of barley. These factors and their subsequent effect however, are not well understood and need further research. Continued improvement in the range, type and quantity of routine malting quality evaluation is paramount to the development of improved malting varieties and a better understanding of the factors, both environmental and genetic, affecting malting quality.

Agronomic factors affecting malting quality such as seeding time, rate, type and timing of nitrogen application, sowing rate etc. requires further research to assist in the development of improved management procedures for malting barley production.

While there remains little premium for superior quality in the feed barley market, breeders and producers have no incentive for improvement. Protein and lysine content could be increased through breeding. Naked barley types specifically for the monogastric feed market could be developed.

Barley varieties with improved human nutrition qualities should be developed to satisfy the growing human health food market. Waxy varieties and varieties high in ß-glucans could be developed as the genetic potential exists.

Hulless barley with low ß-glucans content suitable for monogastric animals are currently being researched. These would have advantages of greater energy content, lower transport and milling costs than normal barley.

Oats

There is large potential for increasing the quality of oats for most end uses.

There is large potential for improvement in the milling quality of oats through lower screenings losses and increases in grain size, kernel percentage and protein content. In the short term these improvements would be at the expense of grain yield though in the longer term improved quality would be achieved at current yield levels. Some processors have asked for a lower fat variety - decreases of 1.5% are possible in varieties close to release.

There appears to be little potential, or need for, improvements in oat hay or forage quality in the near future. The more important issue is the appearance rather than the chemical quality.

There is potential for genetic increases in the protein content of feed oats On-farm feeding to ruminants constitutes the major use of oats in this state. Improvement in protein content is desirable as this may fall below the minimum maintenance levels for sheep in high rainfall areas where protein content is often low. On the world market oats compete with other feed grains such as maize, sorghum and barley on an energy basis. There is some evidence that the digestibility of oat varieties is highly variable and needs definition of the key determinants of feed quality.

Naked oats provide a major opportunity for future entry into a new market niche. The SA oat breeding programme is close to releasing a naked oat which could provide local growers with an advantage in the high energy/high quality feed market and, with additional breeding, naked oats may be suitable for human food. A strong market development effort is required for naked oats.

Triticale

In view of the relatively small input to date into triticale breeding, quality evaluation and market research there is considerable potential for quality improvement. Triticale has potential for quality improvement in 3 areas.

forage	-	In colder areas recent cultivar releases have provided early winter grazing and sheep growth rates equivalent to that of oats.
feed grain	-	in general the protein content of triticales is higher than that of wheat and also has superior amino acid balance.
food grain	-	Potential exists for substituting triticale for wheat, rice and maize in diets especially in under developed countries where nutrition is inadequate.

Cereal Rye

In Australia cereal rye grain is used almost exclusively for human consumption. It's use is increasing largely in health foods. The quality requirements of local and export markets need to be taken into account by breeders and producers.

4.3 Opportunities for Market Development

Barley

The proposed Barley Marketing Act will provide the Australian Barley Board with a charter and financial resources to seek out value added opportunities for barley which in the past have been restricted.

South Australian barley is marketed for a range of end uses for both human and animal foods, with the latter dominating.

The major portion of barley sold for human consumption is used in the production of malt and the brewing industry. Other much smaller uses include pearled barley, pasta, cookies, breakfast foods and noodles. The major potential for market development appears to be for malt production.

Currently there is a major concern throughout Australia, and in SA in particular for the future sales of malting barley and malt. Japan has indicated reluctance to purchase Schooner barley and malt. Australia is at a disadvantage in the more price conscious markets e.g. South America against subsidised grain and malt. Offsetting this there is a major, increasing market in China which needs servicing.

There appears to be major potential for expansion of home brewing kits not only in Australia but also in a large range of overseas countries.

Markets for food barley, other than for malting, need to be investigated.

On average 80% of barley produced in SA is used for animal feed with the majority being exported principally to Japan, Taiwan and the Middle East. Buyers and users of feed barley appear to have few, if any, specific requirements for which they are prepared to pay premiums and price appears to be the most important factor in choosing between grains in feed rations. Prices for the various grains tend to reflect their energy content.

The breeding and production of hulless (naked) barley offers potential for developing a market particularly for higher energy feeds and malting end uses. Breeding should be increased to produce grain of this type which could be ideally suited for pig and poultry feeding.

Oats

Domestic demand for milling quality oats has increased in recent years and there is potential for further increase. At the same time there is some potential to increase milled oat sales to South East Asia, Japan, Europe and South America.

Quality is a major determinant in selling milling oats. European buyers have listed the following as attributes of Australian oats:-

- bright, large grain, low screenings, low moisture content, very low pesticide levels

but have also indicated that protein content and kernel percentage will need to be improved if additional markets are to be developed.

As the major use of oat grain is as feed, particularly on-farm, the fate of the SA oat industry is tied to the state of the ruminant industries. On the basis of energy content, oats do not compete well with other feed grains for intensively reared animals and prices generally reflect this.

New markets are required to expand the options available to oat growers and, as with barley, naked grain may provide this. These oats will provide a high energy, high quality feed which could penetrate markets previously unavailable to conventional oats. These markets are very large even on the domestic scene and include pigs, poultry, dog food, fish food, race horses and perhaps stud stock. Potential prices for naked-grain oats in these intensive animal industries appears to be 20-25% above those for conventional feed grains but this will be necessary as the yield of current naked-grain oats is significantly lower than that of conventional oats.

The potential market for hay to Japan and elsewhere is very large but significant effort will be needed by growers, processors and marketeers to increase current levels of exports. Recent developments appear to be consolidating this trade.

Triticale

Deregulation of the wheat industry and acceptance by the AWB of triticale as a quality feed grain, the advantages of triticale as a cereal disease break crop and the price linkage to wheat have all increased the potential of triticale as a stockfeed in least cost ration formulations on both the domestic and export markets.

The potential for expansion is good but will require major market development work by the AWB in association with nutrition specialists. While there may be some food market niches largely as an alternative to current food grains these are probably small.

Cereal Rye

The domestic food market for cereal rye is increasing (currently 25,000 t) and in some seasons demand exceeds supply. The domestic market for feed rye is unlikely to expand. Potential export markets are unclear although Canada annually exports approximately 300,000 t and Australia could gain a share of this especially if quality were improved.

4.4 Processing Opportunities

The barley industry already has one of the most highly developed processing operations, with the conversion of malting barley to malt, relative to those of other coarse grain industries. Expansion will be strongly linked to economic growth in the newly industrialised countries, particularly China, and the consumption of barley malt based alcoholic beverages. One of the major deterrents to capitalising on this growth potential is the lack of a malting barley variety in South Australia equivalent to some available overseas and the inability to produce sufficient quantities of malting barley for conversion to malt.

The development of higher ß-glucan barley varieties is linked to the growth of products perceived as reducing the health risk from cholesterol in the human diet. R&D is required to indicate the unique dietary benefits of the various grains (eg. the role of oat and barley bran in human cholesterol levels). The domestic development of barley varieties with higher ß-glucan levels has been

largely driven by the Kellogg company who have maintained an effective campaign for barley muesli products. However there is a range of food products including noodles, bread, pizza, pasta, cakes, biscuits etc. which would have potential to specialist food manufacturers. Interest by Japanese manufacturers could lead to the development of joint venture operations. There is also a major requirement in the food processing industry for a natural starch to replace chemically modified starches. Barley is considered to have a specific type of starch which could match this need and this could be easily enhanced through genetic manipulation.

Potential exists for processing oats for human consumption. Products such as oat cakes, rolled oats, biscuits, muesli etc have not been exploited fully particularly in overseas markets. Triticale and cereal rye could also be incorporated into such products.

With increasing beer consumption in many areas (eg. Asia and South America) there is increasing potential for the production and export of malt. However local maltsters are having great difficulty obtaining malting barley suitable for overseas sales and the potential for new sales, at favourable prices, may not eventuate unless new varieties are available.

Most animal feed grain is traded on overseas markets as single grains. The only opportunity for value adding appears to be if cereal and protein sources which are cheap and in plentiful supply in South Australia e.g. barley, peas, faba beans, lupins, meat meal can be combined and joint venture or direct marketing opportunities examined with stock feed manufacturers particularly in South East Asia.

There are strong value added niches for cereal rye products in Australia. However the lack of suitable varieties and consequently the absence of a consistent high quality surplus prevents Australian manufacturers from exploiting South East Asian markets.

On the domestic market some opportunity exists for feed grains to be processed into compound mixtures for a range of purposes.

5. BARRIERS TO ACHIEVING INDUSTRY POTENTIAL

The major barriers to achieving the industry potential identified in Chapter 4 have been prioritised by the strategic planning group within each of nine categories.

5.1 Production Constraints

1. Ineffective, or variable control of pests (insects, snails, vertebrate pests), crop diseases and the changing weed spectrum in rotations.

2. Lack of reliable climatic forecasting effecting farming decisions, yield, quality and hence income.

3. Low, variable and declining fertility status of cereal soils and inefficient fertilizer practices.

4. Lack of specific adaptation in crop genotypes suitable for the range of climatic, soil and biotic conditions in SA. Production may be maximised by breeding, testing and recommendation of varieties with specific adaptation to distinct ecological zones.

5. Limited or variable knowledge base on the chemical and physical stability of soil resources for evolving sustainable tillage systems, rotations and crop husbandry practices.

6. Adverse short and long term impact of herbicide use in relation to herbicide resistance, changing weed populations disease and crop nutrition.

7. Lack of diversity of crop genera grown in SA to spread financial risk. There are ecological and biological reasons why the range of crops and enterprises should be expanded. Too much reliance on wheat, barley and sheep is not sustainable.

8. Lack of efficient and effective farm machinery including seeders, spray applicators, tillage implements harvesters for evolving farming systems.

9. Availability of an adapted, high yielding cereal rye cultivar.

10. Poor definition of the position of Triticale in rotations and the inputs required for its successful culture.

5.2 Economic Constraints

5.2.1 On-farm constraints

1. Declining terms of trade for coarse grain production.

2. Poor definition and use of costs, benefits, returns and risks associated with farm management systems including rotation sequences, tillage systems methods of handling and using stubbles, and with growing legume-based pastures, grain legumes in rotation with coarse grain crops.

3. Increasing fixed and variable costs relative to returns including land, machinery purchase and repairs, fuel, fertilizer, chemicals and interest rates.

4. Variable yield, quality and price expectations both between and within seasons influencing the marketability and profitability of the crop.

5. Lack of intelligence on market opportunities to enhance flexibility in planning farm rotations, diversifying farm income and identifying financial options for insuring against risk (commodity price, interest and exchange rates).

6. Lack of decision support mechanisms to aid decision processes on farms.

5.2.2 Off-farm constraints

1. Impact of overseas government policies on market access and volatility of global grain supply and demand affecting export prices.

2. High off-farm costs (including transport, handling, storage, shipping, regulatory and borrowing charges).

3. Lack of legislative charter and impetus for a more comprehensive marketing approach to value adding for coarse grain crops.

4. Lack of options for additional segregation of coarse grains to cater in the future for a wider range of grain types.

5. Lack of funding for research on triticale, cereal rye and oats.

6. Inconvenience and cost of transporting triticale and cereal rye grain to specific buyers.

7. Restrictive quarantine barriers for exporting oats to U.S.A. related to concern over wheat flag smut.

5.3 Grain Quality Constraints

5.3.1 Barley

1. Lack of suitable malting cultivars to satisfy both producer and processor requirements.

2. Inadequate evaluation and characterisation of new malting cultivars to satisfy processors.

3. Inadequate knowledge of the effects of management factors and environmental conditions on malting and other quality parameters.

4. Lack of specific quality types for niche markets e.g. waxy/high ß-glucans, pigment free.

5. Lack of a model for predicting quality segregation and enhancing forward market arrangements for barley.

5.3.2 Oats

1. As the volume of conventional oat types in international trade is small quality of produce must be excellent to enable us to compete successfully and obtain good prices.

2. Sub-optimal grain size in oat cultivars, especially the new dwarf genotypes. Large grain is required for human consumption.

3. Low protein levels in grain grown in higher rainfall areas for ruminant consumption.

4. Lack of a model for predicting quality segregation and enhancing forward market arrangements for oats.

5.3.3 Triticale

1. Inadequate knowledge on the milling characteristics of triticales.

5.3.4 Cereal rye

1. Poor quality of Australian cereal rye and high volume imports of quality ryes from Canada.

5.4 Constraints to Adoption of Proven Technology

1. Inadequate validation of improved technology in terms acceptable to farm managers.

2. Poor long term planning of rotation sequences and farming practices which leads to an inability to react to forecast changes in commodity prices.

3. Lack of strategic plan for Departmental extension services and agribusiness staff.

4. Lack of understanding by financial advisers and agribusiness of the financial impact of new technology.

5. Inadequate staffing of Departmental extension services.

6. Poor usage of formal training programs for farmers, and/or lack of awareness of training courses already existing.

7. Poor use of existing services by some producers to integrate and adjust their farming inputs and decisions.

8. Inadequate use of farm business recording systems and farm business management practices often resulting in inadequate forward planning of farm businesses.

9. Poor motivation or financial backing for some producers to change their farming practices and to initiate farm improvements.

10. Limited or irregular use of formal surveys to identify constraints in different regions and to monitor producer's attitudes and to assess economic risks associated with adopting new technology.

11. Inadequate reporting to other relevant staff by Departmental staff who attend national conferences, workshops and study tours.

12. Poor adoption of hygiene procedures for on-farm storage of grain and grain handling equipment.

5.5 Constraints for Value Added Products

1. A limited number of new opportunities have been identified.

2. Poor evaluation and analysis of potential opportunities.

3. Poor response from local industries dominated by overseas interests.

4. Lack of market intelligence.

6. OBJECTIVES AND OUTCOMES OF THE STRATEGIC PLAN

6.1 Existing Programs

6.1.1 Department of Agriculture Programs

The information below shows the estimated cost, by source and function, of Department activities in the coarse grains industry, 1989/90. The estimate is derived from computer records for projects coded for field crops.

ESTIMATED COST OF DEPARTMENT ACTIVITIES IN THE COARSE GRAINS INDUSTRY*, 1989/90

Source	$M
State	2.336
Rural Industry Research Funds	1.083
Commonwealth	0.677
Deposit Accounts for payment of services rendered	0.257
	4.355
Function	
Research	1.363
Extension	1.267
Regulation	1.183
Diagnostic	0.044
Administration	0.395
Industry Development	0.103
	4.355

* Excludes costs of support from research station infrastructure and from the Economics Unit.

Most Plant Service Division State funded research staff and regional research and development specialists initiate, develop, supervise and participate in rural industry research funded projects. Appendix B details the research projects related to coarse grains that are supported by rural industry research funds in 1990/91.

A considerable research centre infrastructure exists within the Department to support research related to growing coarse grains. In addition to Northfield Research Laboratories, regional research centres where these activities are located are Minnipa, Wanbi, Turretfield, Struan and Flaxley.

A significant proportion of the time of Department District Agronomists, Plant Protection Agronomist, Soils Advisers and Regional Economists is involved in

Specific research- and extension- related services offered by the Department of Agriculture include grain quality and plant tests by the State Chemistry Laboratories, the SA Soil and Plant Analysis Service (SASPAS), the Agricultural Chemicals Evaluation Scheme, the Annual Ryegrass Toxicity diagnostic service, and plant, disease, insect and nematode identification.

Department regulatory activities that impact on coarse grains production include those of the plant quarantine service, the grain's export inspection service, the seed certification scheme, the registration of pesticides and the Animal and Plant Control Commission.

The Department Economics Unit and the Agricultural and Market Development Group, both based in Adelaide, generate economic and farm management analyses and marketing activities that support the coarse grains industries.

6.1.2 Other Programs

Other organisations that carry out major research activities supporting the SA coarse grains industries include the University of Adelaide, WARI campus and Roseworthy campus and CSIRO Division of Soil Science. Lists of 1990/91 projects supported by rural industry research funds related to growing coarse grains that are carried out by these institutions are shown in Appendixes C, D, and E respectively.

6.2 Objectives of Rural Industry Funding Agencies

From April 1986 until September 1990, under terms laid down in the Rural Industries Research Act 1985, barley research, extension and marketing projects were funded by the Barley Research Council (BRC) funding programs of national significance) and the Barley Research Committee for S.A. (BRCSA) funding projects of specific importance to S.A.). This dual structure recognised the wide diversity of environments associated with the Australian barley industry.

Funding was provided from grower levies and matched by Commonwealth Government grants. In S.A., an additional voluntary grower levy was introduced in 1983 (Statutes Amendment (Wheat & Barley Research) Act to increase the level of funding available for S.A. projects. No funding agencies were established to resource R&D in oats, triticale and cereal rye, although historically small projects for these crops have been funded by the barley and wheat funding agencies, and by industry.

From October 1, 1990, the BRC and BRCSA ceased to exist and were superseded by the Grains Research and Development Corporation (GRDC) established under the Primary Industries & Energy Research & Development Act. A single Grains R&D Committee established in S.A. to fund cereal projects of importance to S.A. and provide regional advice to the nationally focussed GRDC. The establishment of these committees at national and state level will provide the potential for the more equitable distribution of funds for research and development on a greater range of field crops.

Because the GRDC is in its infancy and has yet to develop its objectives and (long term) strategies, at least initially it will be guided to some extent by the five year development plans of the BRC (1989-1994) and the BRCSA (1986-1991). These are summarised in Appendices F and G.

6.3 Priority Issues and Proposed Initiatives

6.3.1 Crop Improvement

Plant breeding can improve yield, quality (and therefore price of the commodity) and reduce inputs required for crop production and thus will have a major impact on farm income. Plant breeding may also reduce dependence on pesticides and enhance the reputation of our agricultural systems as among the "cleanest" in the world.

The cost benefit ratio of investment in plant breeding has been shown to be excellent. Furthermore, adoption of new varieties is usually very rapid and has high market penetration, making a variety release package an ideal vehicle to extend new technology. Adoption of appropriate new varieties is often the most cost efficient management decision that farmers can make.

Hence, plant breeding is and will continue to be a high priority in agricultural research in the coarse grain industries.

6.3.1.1 Barley

6.3.1.1.1 Breeding

The current barley breeding programme in South Australia commenced in 1955 at the Waite Institute. Varieties from this programme have dominated Australian barley sowings since 1968. Since 1955, breeding has improved the yield potential of varieties grown in South Australia by more than 40%. In addition varieties with resistance to CCN and leaf scald and improved malting quality characters have been developed.

Genetic potential exists for improvements in most aspects of barley growth and yield. The overall priorities for barley breeding are shown in Table 6.1.

6.3.1.1.2 Variety Evaluation

Evaluation of barley varieties has been conducted by the South Australian Department of Agriculture for more than 30 years. Currently this evaluation is undertaken as part of the Integrated Field Crop Evaluation Program. Improvements in the efficiency and coordination of field crop evaluation have taken place however the Department needs to support the management of this program to allow for continued improvement, maintenance of the high industry support and to facilitate important research into associated areas.

Priority issues include:

- A state-funded officer should be appointed to lead this program.
- Greater emphasis needs to be placed on determining and understanding both genotype by environment interactions and the agronomic practices that are necessary to achieve optimum yield and quality for each newly released variety.
- The Integrated Evaluation Programme should play an increased role in pre- and early post- release evaluation of the processing quality of new varieties.
- The scope and efficiency of the variety trial databases and expert systems needs to be expanded.
- More extensive variety selection guides must be published.

Table 6.1: Barley Breeding Priorities for South Australia

	LOW RAINFALL <450 MM	HIGH RAINFALL >450 MM
Grain Yield	*****	*****
Disease resistance		
BYDV	*	***
Leaf rust	*	**
Powdery mildew	***	***
Leaf scald	***	****
Cereal cyst nematode	*****	****
Common root rot	**	
Plant type		
Semi dwarf		****
Tall	**	
Earliness	***	
Lateness		*
Resistance to lodging	***	****
Resistance to shattering	****	****
Quality		
Malting:		
- diastase	*****	*****
- extract	*****	*****
- ß-glucan	***	***
- protein content	****	****
Feed Grain:		
- high Lysine	*	*
- appropriate ß-glucan	***	***
Naked grain: for humans		
- waxy endosperm	****	****
- high ß-glucan	***	***
: for monogastrics		
- low ß-glucan	***	***
- high lysine	*	*
- high digestibility	****	****
Stress adaptation		
Low Manganese	***	***
Sandy Soils of low fertility	****	**
High Soil Boron	****	*
High Soil Al	*	**
High Soil Salinity	**	**
Drought	****	*
Waterlogging	*	****

Priorities: * Low
***** Mandatory

6.3.1.1.3 Grain Quality

It is imperative that South Australian barley breeders develop improved malting varieties in order to maintain/regain and possibly expand valuable export markets.

Priority issues include:

- The development of improved malting quality high yielding varieties.
- The malting quality evaluation of new varieties needs to be more extensive both on a micro-malting and industrial scale.
- The effects of the environment and agronomic practices on malting quality need to be determined and monitored.
- There is need for greater collaboration between breeding, evaluating, marketing, malting and brewing organisations to ensure improved evaluation and classification.
- The quality specifications of potential niche markets needs to be determined to enable selection of types with superior characteristics e.g. waxy barley, naked barley, high ß-glucans barley, high lysine barley etc.

6.3.1.1.4 Biotechnology

Plant biotechnology is a new area of science which will in the medium to long term contribute important advances and products to the barley industry. The true benefits of plant biotechnology will only be realised through continued research whereby we will obtain a more complete understanding of plant growth and development and of the structure function and expression of agronomically important genes.

Priority issues include:

- The identification, isolation and successful transfer of desirable genetic traits such as a gene for disease resistance, or for grain quality into a barley variety which is otherwise agronomically acceptable.
- To develop specific probes (nucleic acid or protein based to use in diagnostic testing for specific diseases (e.g. Takeall and Rhizoctonia).
- To assist the plant breeders in developing lines with particular genetic traits by monitoring its transfer during the crossing programme.

6.3.1.2 Oats

6.3.1.2.1 Breeding

The investment in oat breeding has understandably been considerably less than wheat and barley in SA this century and the standard of oat varieties reflects this lack of effort. Since oat breeding was re-started in 1977 large advances have been made with some varieties (Echidna, Dolphin) showing a 30% yield increase

over their predecessors (Swan, Avon, West) while others (Wallaroo, Marloo) are now resistant to CCN, the major disease of cereals in SA.

However, the genetic potential of the Avena genus is still largely under exploited and it should be possible to further improve yield, extend disease resistance and improve quality. The future of the industry depends on this. The key objectives are shown in Table 6.2.

Priority issues include:

- Co-operative breeding programmes with other States. This should enhance the adaptability of SA varieties by exposing them to a wider range of environmental and biotic challenges.

- Breeding naked oats, to launch oats into previously untapped markets such as high energy diets for pigs, poultry, dogs and race horses.

- Expanding efforts to select oats for low rainfall environments, to provide an alternative crop for growers reliant on wheat, barley and sheep where the promise of oilseeds and grain legumes has not materialised.

- Evaluation of advanced selections for hay and forage yield, now that an automated forage harvester is available. The aim is to select a multipurpose variety which will be suitable for grazing, hay and grain production.

- Selection of special purpose types for milling for human food with low fat, high dietary fibre and good physical milling characteristics.

Table 6.2: Oat Breeding Priorities for South Australia

	LOW RAINFALL <450 MM	HIGH RAINFALL >450 MM
	South Australia	South Australia
Yield		
Grain	*****	*****
Hay	***	**
Forage	*	*
Disease resistance		
BYDV	*	****
Stem Rust	**	****
Crown rust	*	**
Septoria	*	***
Spermospora	*	*
Bacterial blights	**	*
Cereal cyst nematode	****	**
Stem Nematode	***	**
Smut	*	*
Plant type		
Dwarf		***
Tall	**	
Earliness	***	
Lateness		**
Lodging resistance	***	****
Shattering resistance	****	***
Quality		
Milling	**	***
Export	***	****
Naked	*	***
Ruminant		
- High Protein	*	***
- High Oil	**	**
Stress adaptation		
High Soil Boron	**	
High Soil Al		**
Drought	****	
Waterlogging		***

Priorities: * low
***** mandatory

6.3.1.2.2 Variety Evaluation

In recent years variety evaluation has been undertaken by the Oat Breeding team in South Australian Department of Agriculture. Beginning in 1990, this function has been undertaken by the Integrated Field Crop Evaluation Program.

Priority issues include:

- Impartial evaluation of both S.A. bred genotypes and exotic material either from public or private sources.
- A more complete agronomic evaluation for each new variety resulting in the formulation of management packages.
- Greater emphasis on the study of genotype x environment interactions.
- Production of a cereal variety planting guide, encompassing all 5 winter cereals, for use by cereal farmers.
- Formation of Coarse Grains Variety Advisory Committee to oversee the variety trial system and variety recommendations.

6.3.1.2.3 Grain Quality

Priority issues include:

- Development of improved milling quality types. This is a small premium, market for oats with large, plump grain and a high kernel percentage. A proposed new Victoria-SA cooperative project will improve S.A.'s ability to select good milling types, through access to a small scale mill in Victoria.
- Development of better feeding quality types for ruminants. This requires selection of high digestibility (all environments) and higher protein (high rainfall environments). The success of the former will rely on the development of low cost assays, (e.g. NIR), for digestibility.
- Selection and commercialisation of naked grain types. The key attributes sought are high metabolisable energy, high quality and quantity protein and for the poultry industry, high fat content with high linoleic acid levels. Large grain types which are stain and rancidity resistant have potential for human markets.

6.3.1.2.4 Biotechnology

Since oats is a smaller crop than wheat and barley, with greatly reduced research resources, it is not appropriate for basic research into biotechnology to occur. Rather as techniques for gene isolation, transformation and cell/protoplast/gamete regeneration are developed in other crops, they should be adapted to the specific problems in the oat industry which have no immediate solution by classical techniques.

6.3.1.3 Triticale

Triticale was launched into Australian agriculture when feed wheat and barley were controlled by statutory authorities. Varieties, at that time, were seriously deficient in yield, quality and resistance to the important wheat diseases - stem rust and CCN. Since the inception of the feed wheat scheme which removed the market advantage for triticale, improved cultivars have been and will continue to be of paramount importance.

A national triticale breeding programme was underway at the Waite Institute but this has been scaled down considerably. New varieties for S.A. may come from this, the NSWDA or WADA breeding programmes.

6.3.1.3.1 Breeding

Priority issues include:

- Resistance to wheat diseases. Older varieties of triticale were either susceptible to wheat stem rust or were only protected by 1 (or 2) gene/s. This presented an unsatisfactory risk to the wheat industry and led to antagonism of many wheat industry leaders. The diversification of resistance to wheat stem rust is therefore vital.

- High levels of resistance to CCN. Varieties such as Tahara provide valuable alternatives to Galleon barley, Marloo and Wallaroo oats and Molineux wheat.

- Improved yield.

- Improved feed quality.

- Adaptation to edaphic/climatic conditions where traditional cereals perform poorly. Such environments include acid and trace element deficient soils, waterlogging and drought affected areas.

Breeding priorities for both triticale and cereal rye are summarised in Table 6.3.

Advanced breeding lines from the Waite Agricultural Research Institute show promise in long season environments where winter waterlogging is severe and on soils with high boron levels.

Table 6.3: Breeding priorities for triticale and cereal rye in S.A.

	CEREAL RYE	TRITICALE
Grain Yield	*****	*****
Disease resistance		
Stem Rust	***	****
Cereal cyst nematode	****	****
Plant type		
Lodging resistance, tall	***	**
Lodging resistant, semidwarf	***	**
Quality	****	***
Stress adaptation		
Sand blasting	****	***
Sandy soils of low fertility	***	***
Drought tolerance	***	***
Waterlogging	*	***

Priorities: * low
***** mandatory

6.3.1.3.2 **Variety Evaluation**

For a relatively small investment, an expanded evaluation of triticale can be included in the Integrated Field Crop Evaluation Program. This variety testing scheme is the least cost option for a thorough evaluation of new varieties.

Priority issues include:

- Emphasis in the variety evaluation phase should be placed on the whole farm role of the triticale variety.
- Better definition of the areas where triticale is superior to "traditional cereals".

6.3.1.3.3 **Quality**

The key aspects of triticale for feed markets are energy content and protein quantity and quality.

6.3.1.3.4 **Biotechnology**

The same situation applies to that for oats.

6.3.1.4 **Cereal Rye**

SA has relied on one variety of rye, cv "SA Commercial" for over 50 years. This variety has a number of very serious defects. The expansion of the industry is dependant on the selection and release of an improved variety.

S.A. Commercial rye has three redeeming features - it is resistant to cereal cyst nematode, very tolerant of sand blasting and tolerant to low levels of many plant nutrients. This makes it ideally suited to its traditional role of sand-dune stabilisation.

A small breeding programme was initiated in 1977 at Waite Institute but has lapsed just as a higher yielding, semi-dwarf line was entering widespread testing.

6.3.1.4.1 Breeding

The major breeding objectives must be to improve the yield and quality of rye. Several avenues have been explored by the Waite Institute programme - these include self-compatibility, semi-dwarfism and introducing the 6 row character. Modifications to the plant type of cereal rye should not be at the expense of its adaptation to sandy soils of low fertility.

Priority issues include:

- Higher yield.
- Resistance to lodging - shorter plant type.
- Resistance to wheat stem rust.
- Improved quality.

6.3.1.4.2 Variety Evaluation

The Integrated Field Crop Evaluation scheme undertakes at least two experiments on deep sand to evaluate barley genotypes. Cereal rye genotypes could be included in these experiments, at minimal cost, to provide performance data in the major target environment for this crop.

6.3.1.4.3 Quality

The quality of cereal rye produced in South Australia is generally poor - a function of both the variety and the area of production. The quality requirements of buyers must be considered.

6.3.2 Crop Production

The terms of trade for agricultural products and for coarse grains in particular have declined in recent years necessitating that production of these crops become as efficient as possible.

6.3.2.1 Optimum Genotype Performance

Throughout the range of coarse grains grown in South Australia, specific adaptation to many of the climatic, soil and biotic conditions encountered can be improved. Breeders recognise this and are endeavouring to overcome this deficiency.

In efforts to improve productivity farmers need to be particularly aware of and utilise the optimum sowing period for the range of coarse grains. In the case of triticale and cereal rye, because of the limited range of varieties available and other constraints, there is little potential for using alternative varieties depending on sowing time. There is more potential to do this with barley and oats but little effort has been made to define optimum sowing time for different varieties of these crops.

Priority issues include:

- Determine optimum flowering time and hence optimum seeding time for different varieties of barley and oats for a range of environments.
- Determine the relationship between time of sowing and a range of other farming practices and extend this information to farmers.
- A study of factors affecting the behaviour and architecture of root systems.

6.3.2.2 Optimum Machinery Performance

With changing farming practices e.g. trash retention, reduced tillage, tighter rotations, there is a need to develop new equipment, promote modifications to existing equipment and ensure the most efficient use of this by farmers.

Priority issues include:

- Ensure the commercialisation, as soon as possible, of the aerofoil-bluff plate spray applicator being developed at Loxton Research Centre. It is considered that this innovation has potential to increase the adoption rate of reduced tillage systems by reducing herbicide costs and improving herbicide efficacy.
- Develop suitable tillage implements for trash retention systems and promote modifications to existing seeders e.g. press wheels to ensure that cereal seed is sown at constant and correct depth.
- Development of a sowing point that will give maximum reduction in rhizoctonia.

These and other aims would be assisted if the Department could appoint one or more machinery experts within the cereal zone.

6.3.2.3 Nutrition

The chemical fertility of soils is a fundamental determinant of the production potential of crops, and also of the production of organic matter which is essential for nutrient supply and soil stability, and therefore the sustainability of production systems.

Essential nutrition issues confronting the production of grains are:

- Single and multiple nutrient disorders continue to restrict crop production on a diverse range of soils to varying degrees depending on site specific soil characteristics, growing conditions and farming systems used.

- Production loss can be severe (up to 50%) before plants display obvious symptoms of nutrient deficiency.

- The intensification of land use during the 1980's has induced a trend of exploitation of soil organic matter and nutrient reserves which must be reversed.

- Fertilizer costs continue to rise sharply in comparison to crop returns. Currently fertilizer expenditure comprises up to 50% of the total variable cost associated with cereal production.

Strong interactions occur between the nutritional status of crops (and soils) and their resistance to disease and the impact of chemical herbicides.

Priority issues include:

. Restoration of nitrogen rich organic matter reserves in soils.

. Developing and calibrating improved soil tests and plant tests for predicting the chemical fertility status of soils for coarse grain crops, and for diagnosing the nutritional status of crops.

. Providing and marketing to growers, comprehensive and professional soil and plant testing services supported by financially sound fertilizer advice aimed at providing balanced nutrition for crops. Computer based, fertilizer advice models will require on-going validation to account for changing farm practices.

. Improving fertilizer-use efficiency by:

  - evaluating the cycling of fertiliser nutrients in soils, and determining the efficiency of their uptake by crops.

  - improving timing, placement and accuracy of delivery of fertiliser inputs.

  - developing cereal genotypes with improved efficiency in acquisition and utilisation of soil and fertiliser nutrients with particular emphasis on phosphorus and nitrogen.

  - evaluating the contribution of enhanced seed nutrient reserves and nutrient coating of seed on fertiliser efficiency.

  - demonstration of the benefits of new advances in fertiliser technology.

- Determining the role and significance of crop nutrition in disease control.

- Determining strategies by which the input of herbicides on crop nutritional status is minimised.

A significant emerging issue for grain crops will be understanding the relationship between crop nutrition and its impact on key commodity quality characteristics which may provide competitive advantage particularly in niche markets.

Pro-active commitment and effort in this area could have significant impact on "value-adding" to contemporary commodity products.

Priority issues include:

- Identifying key contemporary and emerging quality parameters which are affected by nutrition of crops, and evaluating their interaction.

- Developing nutrition and crop management strategies to grow products to market specification.

6.3.2.4 Soil Structural Stability

The structural instability of the cereal zone soils is well known, but often insidious in nature. Protection of the soil resource from further degradation (e.g. wind and water erosion, soil sodicity, soil compaction, salinity and acidification) is now receiving increased community attention and government financial support. Where degradation has occurred, productivity can be markedly depressed (based on water use efficiency criteria), land access and farm income are reduced, and indeed the viability of farming itself becomes precarious.

During the Decade of Land Care, the Department has a clear obligation to support the Community Land Care programs in both a technical and advisory capacity.

Priority issues include:

- The benefits and costs associated with implementing sound land management and soil conservation structures need to be identified and continually promoted to landholders.

- Continued support must be applied to long term experiments which are assessing the consequences and sustainability of 'conservation farming' practices (tillage, stubble retention systems) and rotation sequences on productivity, grain quality, and amelioration and improvement of soil structure. Some of these experiments need to be located in the more marginal areas of the cereal zone.

- There is a need to develop or refine a reliable field test to allow farmers and advisers to assess the structural stability of soils and soil aggregates *in situ*.

- Determining the distribution of earthworm species, their activity and impact on nutrient cycling and soil structure.

- The potential role of green manure crops and specific recommendations for gypsum also need to be established as medium or long term ameliorants for structurally degraded soils.

- Minor effort should be directed towards monitoring farms which produce 'organically' grown products.

6.3.2.5 Agricultural Meteorology

Seasonal conditions dominate the yield and quality of cereals. Farmer skills and knowledge in how they manage their land largely determines how efficiently crops utilise available soil water in any given year. Improved knowledge is required in two areas to optimise water use efficiency by coarse grains, viz:

Priority issues include:

- Development of a model to predict the segregation of barley into various quality grades prior to harvest. The model would use seasonal rainfall and temperature and predicted rainfall. It would be validated from historical records.

  The outcome would allow forward planning of ABB marketing strategies.

- Development of better 1-3 month weather forecasts. This would greatly influence farm management decisions e.g. herbicide timing, N rate and timing, hay cutting time, fungicide applications, enterprise mix etc.

- Continue "adverse event" forecasts - wind damage, frost, grazier alerts etc.

6.3.2.6 Extension Packages

Most management decisions made by producers need to be planned in advance and integrated to optimise profitable outcomes. Successful cereal production therefore relies heavily on the promotion and adoption of an integrated system of appropriate land use and husbandry practices which are both relevant and cost efficient. The development of technical packages of information involves research and extension staff, individual farmers and producer groups working together and sharing experiences and observations. In such packages emphasis needs to be placed on clearly indicating the benefits and risks of the options.

Priority issues include:

- The Department must invest resources into providing technical packages including manuals where appropriate and into developing decision support software and expert systems and into training relevant officers to use these aids.

6.3.3 Crop Protection

At the farm level, minimising the impact of weeds, diseases and pests is crucial for maintaining productivity and profitability.

6.3.3.1 Weed Control

Weeds reduce yields, harbour cereal diseases, hinder harvesting operations and are a source of grain contamination. Studies and surveys have shown that poor weed control imposes a major constraint on crop yields in South Australia.

Except in the area of herbicide resistance, weed science research in cropping systems is under-resourced in S.A. in relation to the importance of weed control and in comparison to some other areas of applied research.

Priority issues include:

- The major contribution of herbicides to the efficiency and sustainability of agricultural systems needs continuing research and development. This includes research into mixtures, crop tolerance, the use of adjuvants, methods to reduce rates and herbicide-nutrient and herbicide-disease interactions.

- Ongoing research in the area of herbicide resistant weeds at the WARI needs continuing support.

- Continuing support for the commercialisation of the aerofoil-bluff plate spraying system is necessary.

- Support should be given to research programs on weeds that have proven difficult to control in S.A. cropping systems. Such studies should include the biology and ecology of particular weed species, where necessary.

- Unambiguous data on the disease host status of grass weeds should be derived and the benefits and risks of removing grasses from pastures prior to cropping should be documented.

- Continued Department support should be given to generation of appropriate, effective extension material such as the Cereal Weeds Spraying Guide.

- Continued research on economic threshold models for spraying selective herbicides in crops should be supported.

- Continuing research on biological control of weeds and environmentally responsible non-chemical control methods is supported.

6.3.3.2 Disease Control

The extent of rural industry research funding for Department research into disease control in barley is acknowledged. Disease control in other coarse grains needs to receive further consideration.

Priority issues include:

- Sophisticated tests and services for detecting pathogens of coarse grains should be initiated.

- Disease resistant cultivars of all coarse grains are required.

- Management options that minimise the impact of disease in barley and other coarse grains should be researched and extended.

- The use of diagnostic aids and tests should be extended.

- Establishment of economic thresholds that warrant control measures.

- Continued, regular surveys to establish the extent, severity and loss caused by cereal diseases in South Australia.

- Cause and effect relationships in disease x herbicide and disease x nutrient interaction should be investigated.

- Appointment of a pathologist to oversee mycological research and to organise disease survey work is needed.

- Continuing need for applied research and extension services to the coarse grains industry through the network of plant protection agronomists.

6.3.3.3 Invertebrate and Vertebrate Pest Control

Depending on seasonal conditions significant damage to coarse grain crops by insects occurs across South Australia during crop germination. The damage may require crops to be resown.

Several caterpillar pests (armyworms and cutworms) occasionally cause damage to coarse grain crops in South Australia. Control measures are available and no new research initiatives are needed for these problems.

Priority issues include:

- White and conical snails continue to represent a major contamination threat to export barley and growing crops and continuing Department and RIRF support for research in this area is necessary.
- There is a need to develop a chemical control recommendation for yellowheaded cockchafer (scarab).
- On farm storage of coarse grains necessitates that stringent grain hygiene procedures are adopted and maintained, and that insecticides are used correctly to avoid residue problems, both of which could affect the States' export markets.
- An entomologist is needed to monitor the development of insecticide resistance in grain pests and promote accepted codes and principles of correct grain hygiene in all stored grain produce.
- Continuing support is needed for research and extension of cost-effective, integrated control of insects in legume based pastures in cereal rotations.
- Continued support is needed for research to develop strategies for predicting mice plagues and to develop and register suitable rodenticides for mice control.

6.3.4 Farming Systems and Management

6.3.4.1 Longer Term Rotational Experiments

There is a lack of information on the long term consequences of rotations within the S.A. cereal zone and that which is available is restricted to a few environments and does not adequately represent the wide range of environments experienced across the cereal zone.

Priority issues include:

- There is a need to establish and support a series of simple long term experiments, based on the type of experiment established at Tarlee, but with a wider potential and a flexible design to enable interdisciplinary research and extension of findings to cereal producers.

6.3.4.2 Economics of Rotations

There is little information available on the costs, benefits, returns and risks of rotation sequences associated with currently used and potential husbandry practices in the S.A. cereal zone. These practices include rotation sequences with particular emphasis on grain and pasture legumes and the most appropriate cereal cultivar, tillage systems and stubble or pasture handling.

Priority issues include:

- There is need for a multidisciplinary team to develop models of these systems, along the lines of those developed interstate, which could be used by extension officers and producers as an aid to decision making.

6.3.4.3 Market Intelligence

A lack of market intelligence restricts the ability of producers particularly in more productive areas and their advisers to consider long term planning of rotation sequences and farming practices and react to changes in commodity prices. Availability of such information would increase flexibility and enable farmers to identify financial options and insure against risks.

Priority issues include:

- The Department of Agriculture needs to appoint a market intelligence officer.

  Special tasks for this officer would include:

  - monitor, interpret and alert producers to changes in forecast market prices both before sowing time and later in the season;

  - the development of decision support mechanisms to justify within season adjustments being made to farming practices to optimise farm returns in a range of situations in the cereal zone.

6.3.4.4 Tillage and Herbicide Interaction

The use of reduced tillage systems and herbicides have both increased significantly in recent years throughout the cereal zone. Despite this there is inadequate knowledge of the short and long term impact of herbicides used in rotations incorporating reduced tillage systems in relation to weed and disease populations and to the nutritional status of crops and productivity.

Priority issues include:

- Multidisciplinary research is needed in this area to indicate herbicide options which will enhance preferred rotations.

6.3.4.5 Legume Based Pastures

The incorporation of legume based pastures in rotations will assist in fertility build-up, reduction in cereal diseases and promotion of subsequent high yielding, high quality cereal crops.

Priority issues include:

- Extension programs are needed to emphasise that dense vigorous legume-based pastures are essential when cropping soils are spelled.

- Emphasis needs to be placed on the place of grain legume and green manure crops in cropping rotations.

6.3.5 Storage, Handling and Transport

It is essential that farmers supply clean grain to marketing organisations because an increasing number of markets are now demanding grain free from insects, pesticide residues and admixture. To achieve these objectives a high standard of on-farm grain hygiene management is essential. Proper storage facilities and prudent use of chemicals are needed.

Priority issues include:

- Extension campaign on grain hygiene and the appropriate use of chemicals needs to continue in association with SACBH, AWB and ABB.

- The grain pest traceback system needs to continue. This will help insure that grain is produced which meets market quality standards.

- Appropriate incentives and penalties for farmers should be enacted to ensure grain hygiene standards are maintained.

6.3.5.1 Segregation for Quality

With the increasingly specific market demands for quality coarse grains, a need will ultimately emerge to segregate grains at receival points according to specific quality standards. This would assist market development by helping have grain of defined quality more consistently available to meet specific market requirements. It would mean introducing segregation for cereal rye, oats and triticale and additional segregations for barley based on variety, freedom from contamination and nutritive value.

Priority issues include:

- The net benefits of segregation to justify the additional costs need to be established.

6.3.5.2 Export Hay

Despite the defined potential for export of oaten hay to Japan from southern Australia (average 3 years 1987-89 imports of baled hay 620,000 tonnes/year) South Australia has failed to develop exports for more than a few thousand tonnes a year.

A major factor inhibiting development of this market has been the lack of adequate capital to develop an adequate and efficient processing (double dumping) infrastructure. In addition confusion over quality requirements, high freight rates, non availability of suitable shipping containers and only one container port in South Australia and costs of fumigation have hindered development.

Priority issues include:

- The encouragement of major exporters to develop a market share for South Australia. To assist in this the Department has produced a bulletin on all aspects of growing oaten hay.

6.3.5.3 Facilities and Costs

The high port costs associated with export shipping of coarse grains are a major concern and cost. The institutionalised environment on the waterfront is hindering the process of deregulation and commercialisation of port services. Government needs to pursue effective reforms to establish a more efficient and lower cost handling system.

The adequacy of shipping ports in South Australia for exporting large volumes of coarse grains is of concern. Rationalisation of the ports, particularly shallow ports, needs to be examined and the most suitable ports developed to meet the requirements of the increasingly larger ships.

6.3.6 Product Research and Marketing

Most coarse grains research is undertaken by the public sector but with the introduction of Plant Variety Rights there will probably be increasing activity in private plant breeding, some variety development and more privately owned varieties being released to the coarse grains industry.

The weakness of public sector research is that fewer people are skilled in marketing and in processing and developing alternative end uses, particularly for human food.

The Australian Barley Board is currently limited by a lack of reserve funds (working capital) for:

- more flexible pooling operations
- cash trading
- product development, consumer research, product promotion
- pursuit of value added opportunities through pilot studies, with industry joint venture arrangements, vertical integration eg barley production to retail distribution. It is not clear to what extent new legislation will enhance the Boards role in this area.

The Report of the Review of Federal Statutory Marketing Authorities has recommended that if the SMA is not a trading organisation, the involvement of the SMA in commercial ventures relating to value adding or other marketing activities be limited to those instances where private sector investment is not supporting product and processing development and innovation, or market development or is not resulting in competitive and efficient markets. The AWB is regarded as a trading organisation as is the New Zealand Dairy Corporation which has in recent years vertically integrated to the extent of purchasing its own distribution networks.

In the case of the ABB it could be argued that private sector investment is not supporting breeding programs, for either malting barley varieties or for barley varieties which have higher beta glucan levels. Private industry in Australia is not supplying developing or researching appropriate barley milling equipment to produce barley flour or to work with Japanese industry to promote value added opportunities world wide in barley.

A recommendation for SMA's involved in commercial ventures is that there be a sunset provision with the aim of privatisation of each venture at the end of the prescribed period.

A principle of competitive neutrality for an SMA should also apply ie SMA's should not be given any commercial advantages over private sector counterparts in the form of government underwriting, guarantees for borrowing and exemption from taxation.

The issues of barley varieties with higher beta - glucan levels and organically produced products have not been translated into information which might usefully be incorporated into breeding programs or developed by marketeers. There is a need to more fully develop a joint venture proposal with the CSIRO, the ABB, researchers, Japanese industry and organic marketeers.

The two major components of a farmers profit are yield and price. Whilst research programs generally concentrate on yield the concept of price insurance is largely ignored. There are a range of financial options open to producers once the decision is made to plant a coarse grain crop. To insure that the price at harvest bears a close relationship to the expected price at sowing a number of concepts need to be explained and explored with producers, bankers and marketeers to make prices more certain.

Priority issues include:

- A program of seminars, initiated by the Department with the above three bodies is a high priority given the collapse of grain and livestock prices in 1990.

- A case study program should be developed by the Department to analyse farming practices and the extension to farmers of the best rotations and methods of achieving them. This would help emphasise the need to sustain the profitability of crop rotations.

- A Departmental program is required to develop the market potential for oats in particular naked oats, oaten hay and ultimately oaten and vetch hay mixes. A multi disciplinary team including breeder, economist and market development officer is needed to liaise with processors , marketeers, and DITT to remove any impediments to the development of these two products, generate revenue from naked oat seed multiplication and value added revenue from processing double dumped oaten hay for export.

- A broad integrated programme needs to be implemented involving breeding of new varieties, evaluation, promotion to growers and market and marketing development of triticale and cereal rye.

- There is a need for expansion of existing triticale varieties and development of feed outlets with organisations such as the Australian Wheat Board.

- There is a need to produce new cultivars of cereal rye, grow them on better country than existing areas, replace imports and develop feed and export outlets.

6.3.7 Communication and Training within the Coarse Grain Industry

Most coarse grains growers could achieve much better returns for their efforts if communications between them, researchers and extension workers were improved considerably. (See Chapter 5 "Barriers to Achieving Industry Potential").

There is also the need to foster good communications from the farmer level to the policy makers to ensure that farmer needs are alway considered.

Communication must also be aimed at the needs of agribusiness as it affects the farmer, those that buy or market his products, businesses that supply farm materials including seeds, chemicals and machinery, and those that supply services such as information, policies and finance. It must also take into account the needs of the farm family and the farming community.

It is essential that new technology is rapidly transferred to coarse grain growers to enable them to remain competitive by producing the amount, type and quality of product that the market wants, and to produce it economically with emphasis on the long term stability of the natural resources and the industry.

Farmers need to be able to communicate their fears, problems and ideas quickly and effectively to researchers and extension workers to help guide research and information dissemination into the most appropriate directions.

Lack of communications and training are important barriers to the adoption of new technology.

Priority issues include:

- Improving communications between research and extension workers - to ensure that extension material is disseminated as soon as appropriate, and to ensure that all research projects are practical and relevant to the farming community.

- The appointment of a Department of Agriculture specialist liaison officer to work closely with researchers, extension workers and farmers is considered a high priority.

- Establishment of a strategic plan for Departmental extension services and agribusiness staff.

- Additional extension officers are needed and should be appointed to the coarse grain growing districts to carry this formidable extension load. Assistants are also needed to train under experienced extension officers.

- A farm management economist is needed to evaluate research data, to monitor commodity prices and to assess economic risks associated with the adoption of new technology.

- Improved specialist and post graduate training programs for extension and research staff need to be introduced.

- Extension workers should be provided with adequate resources, finance, equipment and have ready access to specialists for preparing and presenting quality extension output.

- Formal surveys need to be introduced to identify constraints to production in coarse grain growing regions, and to monitor producers' attitudes to and knowledge of, current and emerging issues.

- Existing formal training courses for farmers need to be more widely publicized and new courses need to be developed to assist them to improve farm business skills.

- Farmers need more training in business recording systems, in forward planning farm operations, and in particular, long term rotation sequences allowing flexibility as market needs and prices change. Training needs to be tailored to the needs of each particular farming group to ensure motivation and adoption of relevant technology.

- Publications related to coarse grain production technology as identified by the above surveys need to be produced. This includes the need for data bases and other decision support software for farmers, extension and research workers to correlate all relevant data to assist with decision making.

- The system of reporting to peer groups by Departmental staff needs to be improved.

6.3.8 Legislation and Policy

New legislation is being developed for a 2 state Barley Marketing Board to operate in Victoria and South Australia to continue whilst a national debate inquires into the future of national grain marketing arrangements. A major feature of the new legislation will be to remove a range of legislative and other impediments to enable a more efficient marketing system to evolve.

Proposed objectives of the Board will include more flexible pooling operations, the possibility of trading in other grains (oats, grain-legumes, oilseeds), permit systems for stockfeed and malting barley, selection rather than election of board members and greater accountability to industry and to Ministers.

Currently, there is a Standing Committee for Agriculture Working Party reporting on a number of reviews of grain marketing currently being undertaken by the New South Wales, Queensland, Victoria, South Australia and Commonwealth Governments. The Working Party will report to the February 1991 meeting of SCA/AAC on the legislative and other impediments which might hinder the development of more efficient and grain marketing systems and recommend ways to overcome them.

The movement by the AWB and ABB into the marketing of crops other than their core activities will help to ensure that these crops are given more mainstream attention with respect to research and development. This would apply particularly to the grain legumes industry which has been expanding rapidly; will reduce the antagonism normally shown to triticale and be included as a normal stockfeed ingredient; will bring cereal rye into the mainstream of cropping rather than as a sandhill crop and eliminate imports and should promote the greater use of oilseeds, particularly canola (rapeseed) in South Australia.

Compulsory acquisition will remain for barley and oats for export, possibly for domestic malting barley and no acquisition powers for other crops.

7. REVIEW AND EVALUATION OF THE PLAN

The coarse grains strategic plan will be reviewed and evaluated regularly by the coarse grains commodity group. This will be undertaken in close consultation with representatives of those agribusiness and research oriented organisations involved in this original plan and following discussions with Divisional and Regional staff of the Department of Agriculture.

8. APPENDICES

APPENDIX A

SUMMARY OF DISTRICT NEEDS ANALYSIS

1. PRODUCTION CONSTRAINTS

* WATER USE EFFICIENCY

- How to achieve a crop's yield potential
  What are the limitations and how to overcome
- What is the optimum sowing time in various districts, soil types and how to achieve
- How to sow earlier to maximise use of available growing season moisture
- Use of rainfall decile data to predict seasonal risks in productivity and management options

* LOW SOIL FERTILITY

- How to satisfy a crop's nutrient requirements on deep siliceous sands
- Rate, timing, placement and economics of nitrogen application in relation to yield and grain protein
- How is soil fertility (especially organic carbon and nitrogen) most effectively and economically increased under various systems
- The effect of addition of gypsum and lime on amelioration of soil and on soil acidity
- Long term effects of D.A.P. and alternative fertilizers on soil acidity and availability of other nutrients
- Use and interpretation of soil and plant analysis to identify and correct nutrient deficiencies. Development of on-the-spot test kits
- Improving the reliability/credibility of soil analysis
- Managing water repellence soils to facilitate wetting and enable earlier sowing
- Improving the drainage of duplex soils with an impervious clay layer to improve yields
- Deep ripping to overcome compaction layers
- Boron toxicity on calcareous and/or on soils with high sodium levels
- Management options for raising grain protein levels in wheat
- Adequate levels of available phosphorus need defining on some soil types
- Responsiveness of different cultivars to nitrogen fertility
- Incidence and degree of severity of zinc deficiency
- Fertilizer placement and effect of placement at varying depths

* SOIL STABILITY/TILLAGE SYSTEMS/ROTATIONS

- Effect of stubble retention on soil organic matter and nitrogen levels in the short and long term
- Effect of stubble retention on wheat yields, root and leaf diseases, pastures and soil fertility factors
- Techniques for handling stubbles in stubble retention systems, especially these which don't require investment into high cost machinery
- Manipulation of rotations to improve yield and grain quality and to maintain adequate soil fertility and stability
- Rotations and plant resistance which enable disease control
- Long term effects of tillage practices and rotations on profitability and sustainability
- Effect of various tillage practices on yields, organic matter, soil erosion and disease and weed control (direct drilling/reduced tillage/conventional tillage)
- Control of wind erosion on water repellent sands
- Effect of intensive/continuous cropping systems on soil fertility, soil structure, yields and grain protein
- Intensive cropping systems resulting in declining soil fertility
- Benefit of conservation farming practices (eg direct drilling and stubble retention) on rainfall infiltration, soil stability and fertility
- How to improve crop establishment on hard setting red brown earths

* WEATHER FORECASTING

- Climatic/scientific data for making crop management decisions
- Improve accuracy and reliability of short and long range forecasting

* OTHER

- Determine coleoptile lengths of commercial cultivars

* FARMING PRACTICES PACKAGE

- Development of crop monitoring skills to assess wheat crop requirements and thereby improve yields - viz identification and effective control of weeds, disease, nutrient deficiencies

- Development of a system to enable objective decision making on selection of wheat varieties on basis of yield probability and disease probability

* HERBICIDE USE AND ITS IMPACT

- Effect of herbicides on nutrient availability, especially zinc, manganese and copper
- Effect of herbicide residues on severity of wheat root diseases and subsequent crops and pastures
- Effect of stubble retention on herbicide efficacy
- Complementary effective weed control methods to minimise weed genotypes with herbicide resistance and which are appropriate to soil conservation
- How to use herbicides in the farming system to ensure sustainable farming

- Tank mixes of herbicides to improve efficacy and cost: benefits
- Weedy grass control within the system

* DISEASES

- Management of deep siliceous sands to reduce severity of root diseases
- Wheat cultivars with improved resistance to septoria tritici
- Increased incidence of yellow leaf spot in stubble retention practices
- Optimum time for grassy weed control in pastures for control of root diseases in subsequent wheat crop
- Effects of grass dominance/legume dominance on soil nutrition and subsequent crop yields
- Most effective management strategy for control of Cereal Cyst Nematode
- Most effective strategies for minimising yield losses from rhizoctonia. The relative importance of weed control, timing of weed control and cultivation technique
- Increased root disease problems in direct drill crop establishment methods
- Effective and reliable management strategies for control of rhizoctonia
- Effectiveness of new seed dressings on foliar disease control
- Development of stem rust resistant varieties
- Determine herbicide phytotoxicity to crops infected from specific root diseases

2. ECONOMIC CONSTRAINTS

* HIGH MACHINERY COSTS

- How to most effectively finance machinery purchase
- Machinery ownership - Buy or Lease? When to replace. How to cope with machinery costs. Economics of machinery replacement versus repairs to existing. How to calculate operating costs/employing contractors
- Economics of cropping - Self or Sharefarmer

* RELATIVE GROSS MARGIN OF WHEAT vs OTHER ENTERPRISES (INCLUDING PASTURES)

- Gross margins analysis to assist with enterprise choice, cash flow budgeting and forward planning of finance
- Budgeting and financial management
- Financial analysis skills to assess enterprise and overall farm profitability
- Assessment of profitability of different farming systems
- How to cope with the cost: price squeeze and how to improve farm profitability
- Rising input costs, variable seasons and yields increase the need for effective risk management

* MARKET INTELLIGENCE FLEXIBILITY

- Improved market predictions to facilitate decision making
- Market forecasting - prices and trends
- How to develop local and overseas markets

* INVESTMENT RISKS - 'ON' AND 'OFF FARM'

- Sources of assistance on financial advice
- Independent sources of financial advice needed
- Short and long term off-farm investment advice

* MACHINERY

- Implement design needs to be more suited to sandy soils to minimise erosion

- Selection of machinery, size, matching
- How to improve fuel efficiency
- How to improve efficiency of machinery use
- Machinery design and modification of machinery to control seed placement and seed depth
- Modification of machinery to enable placement of high rates of nitrogen fertilizer at seeding such that emergence and establishment not severely affected
- Current machinery poorly adapted to handling trash in stubble retention - direct drill systems
- Share design needs improving to enable minimal soil disturbance, effective seed and fertilizer placement and disease control

* COST: BENEFITS OF TECHNOLOGY

- Research and extension needed to evaluate the financial benefits of technology in the farming system

5. CONSTRAINTS TO ADOPTION OF TECHNOLOGY

- Relevant, financially based and technically sound information on wheat crop and systems management is not reaching and/or being understood by farmers
- Decision making - to what extent will benefits be derived from various practices

DEPARTMENT OF AGRICULTURE

External Funding for Major Projects Directly Related to Growing Coarse Grains, 1990/91

1. CROP IMPROVEMENT (see also projects superscipted (1))	
Project	**Funding Source**
Commercial release and maintenance of wheat and barley cultivars.	BRCSA
Integrated field crop variety evaluation and services for South Australia.	BRCSA
The development of plant tissue culture techniques to aid disease resistance breeding in barley.	BRCSA
Developing wheat and barley efficient in the use of soil and fertilizer phosphorus.	BRCSA
Coordination of interstate wheat breeders trials and interstate barley breeders trials	BRC
TOTAL ALLOCATION, CROP IMPROVEMENT	**$360,383**

2. CROP PRODUCTION	
Project	**Funding Source**
Malting barley production in South East.	BRCSA
Nutritional status of mallee cereals.	BRCSA
Improved bases for predicting economic application rates of nitrogen fertilizer for increasing the yield and quantity of wheat and barley.	BRCSA TOP AUSTRALIA
Agronomic and genetic solutions to key limitations to oat-yield in S.A. (1).	BRCSA WRCSA
A study of seeder related crop establishment practices.	WRCSA
Nutritional status of mallee cereals.	WRCSA
Residual benefits of fertilizer zinc applied to S.A. soils.	WRCSA
TOTAL ALLOCATION, CROP PRODUCTION	**$270,221**

3. CROP PROTECTION	
Project	Funding Source
Incorporation of cereal cyst nematode resistance into barley (1).	BRCSA
Barley leaf diseases (1).	BRCSA
Investigation of resistance in cereals to root rots (1).	BRCSA
Biological control of white and conical snails.	BRCSA
Control of difficult weeds in barley rotations.	BRCSA
Upgrading field crop pathology field equipment.	BRCSA
Field screening for cereal eelworm resistance (1).	BRCSA
Isolation of genes controlling the barley/powdery mildew disease reaction.	BRCSA
Race monitoring of barley powdery mildew.	BRC
Application of monoclonal antibodies to the development of an assay for *Rhizoctonia*.	BRC
The impact of herbicides on the nutritional status of barley.	BRC
A molecular investigation of pathogencity in *Rhyncosporium secalis*, the casual agent of scald.	BRC
Management of *Rhizoctonia* bare patch using modification to tillage and sowing machinery and systems.	WRCSA
Root and crown diseases posters (7).	WRCSA
Strychnine residue levels in cereal crops.	WRCSA
Control of difficult weeds in wheat rotations.	WRCSA
Control of stem nematode.	WRCSA
Development of a diagnostic service for the detection of cereal cyst nematode (CCN)	WRC
Cereal leaf diseases book (7)	WRC
Design and evaluation of an air assisted bluff plate spray boom	WRC
TOTAL ALLOCATION, CROP PROTECTION	**$737,892**

4. FARMING SYSTEMS AND MANAGEMENT	
Project	Funding Source
Conservation tillage and stubble systems, improved rainfall infiltration, and sustainable crop production	BRC
The Tarlee Crop Rotation Trial	WRC
TOTAL ALLOCATION, FARM SYSTEMS AND MANAGEMENT	$24,745

5. STORAGE, HANDLING AND TRANSPORT

6. PRODUCTS

7. COMMUNICATIONS AND TRAINING
(See projects superscripted (7), above)

8. LEGISLATION AND POLICY

TOTAL ALLOCATIONS	$1,393,241
of which:	
BRCSA	897,003
BRC	194,095
WRCSA	200,986
WRC	86,215
TOP AUSTRALIA	14,942

NOTES

1. $ Value of new projects is subject to variation, mainly due to negotiations over 20% Salary on-costs claims, currently in progress.

APPENDIX C

WAITE INSTITUTE

External Funding for Major Projects Directly Related to Growing Coarse Grains, 1990/91

PROJECT	Funding Source
Molecular analysis of a rye chromosome	ARC
General selection markers for the transformation of Eukaryotes and their application to the winter cereals	ARC
Molecular interactions during the establishment of mycorrhizal infection	ARC
Biological chemistry of 'Takeall' and high performance electrophoresis	ARC
Induction of homoeologous pairing between wheat and barley chromosomes and isolation of wheat-barley recombinant lines	ARC
Improved Triticale cultivars	RIRDC
Amelioration of structurally degraded soils using calcium and organic materials	WRC
Annual ryegrass resistant to herbicides	WRC
Development of molecular markers for chromosome 6R of rye linked to CCN resistance	WRC
Genetic variation between populations of take-all fungus Gaeumannomyces graminis	WRC
Barley yellow dwarf virus in low rainfall wheatbelt of SA	WRC
Mechanisms of herbicide resistance in annual ryegrass and wildoats	WRC
Structurally amelioration using gypsum and/or line	WRCSA
Epidemiology of BYDV transmitting aphids in SA	WRCSA
The residual value of nitrogen fertilizer	BRCSA
Better legume pastures for more profitable cereal crops	BRCSA
Development of an improved digestion technique to enable the determination of nitrogen by ICP	BRCSA
Barley genotypes for manganese and zinc deficient soils	BRCSA
Boron tolerance in barley	BRCSA
Second barley breeder expansion of Waite Improvement Program	BRCSA
Barley improvement	BRCSA

PROJECT	Funding Source
Physiological basis of multiple herbicide resistance in annual ryegrass	BRCSA
Malting quality and evaluation of barley in SA	BRCSA
Development of a comprehensive linkage map of barley based on molecular and biochemical markers	BRC
Extract improvement in Australian malting barleys	BRC
Annual ryegrass resistant to herbicides	BRC
Transformation of barley via the particle gun and agrobacterium	BRC
Identification and use of polypeptide markers for CCN resistance in barley	BRC
Development of hulless barley varieties with improved nutritional status for monogastric animals	BRC

APPENDIX D

ROSEWORTHY AGRICULTURAL COLLEGE

External Funding for Major Projects Directly Related to Growing Coarse Grains, 1990/91

PROJECT	Funding Source
Biological Farming for Agricultural Production	NSCP WRC
Controlled Traffic Cropping Systems	BRC WRC

CSIRO DIVISION OF SOILS
(Adelaide Laboratories)

Major Projects Directly Related to Growing Wheat and Coarse Grains

PROJECT
Occurrence and management of boron toxicity and deficiency in Australian soils
Nitrogen cycling and soil organic matter turnover in agro ecosystems
Clay-organic complexes in cereal soils
Ultrastructure of soils and roots in relation to soil stability and root biology
Development of sustainable agriculture systems through control of root diseases
Soil physical factors and the ecology of soilborne root diseases
Control of soilborne diseases of cereals and horticultural crops using soil bacteria
Suppression of soilborne root diseases of wheat by crop and soil management
Management of earthworms to enhance the long-term productivity of soils in S.E. Australia
Soil and landscape processes affecting dryland salinity, waterlogging and abrasiveness

ACRONYMS

ARC	-	Australian Research Council
RIRDC	-	Rural Industry Research and Development Council
WRC	-	Wheat Research Council
BRC	-	Barley Research Council
WRCSA	-	Wheat Research Committee for South Australia
BRCSA	-	Barley Research Committee for South Australia
NSCP	-	National Soils Conservation Program
GLRC	-	Grain Legumes Research Council
ORC	-	Oilseeds Research Council

LONG TERM OBJECTIVES AND STRATEGIES OF THE BRC (BRC DEVELOPMENT PLAN 1989-1994)

OBJECTIVE 1 - TO INCREASE PRODUCTIVITY IN THE PRODUCTION OF BARLEY

Strategies

1A To identify the factors which limit productivity and develop appropriate control measures.

1B To increase yield potential via genetic and crop management techniques.

1C To encourage the development and use of integrated farm management packages.

OBJECTIVE 2 - TO PROTECT THE INDUSTRY'S PRODUCTIVE BASE

Strategies

2A To collaborate in, and support the development and acceptance by industry of, soil and water management practices which protect the soil's physical, chemical and biological fertility.

OBJECTIVE 3 - TO INCREASE MARKET DEMAND FOR BARLEY

This will be encouraged by supporting research in:

- the improvement of quality
- the development of new products or end uses for barley
- the development of new markets for the sale of barley

Strategies

3A To identify parameters which are important to increasing the malting quality and marketability of barley.

Sub-Strategy

3A(a) To increase the malting quality of barley to the following targets:

- increase percentage of extract to at least 82%

- grain size 90% > 2.5 mm and stable
- diastatic power > 260 wk

3B To develop specifications for other end uses of barley, communicate these specifications to all relevant bodies and support research in the area.

3C Increase the number of malting varieties available to growers.

Sub-Strategy

3C(a) To monitor and review the effectiveness and direction of current breeding programs.

3D To identify parameters which are important to increasing the feed quality for ruminant and monogastric animals.

OBJECTIVE 4 - TO MINIMISE OFF-FARM COSTS TO THE INDUSTRY

Strategies

4A To collaborate in and encourage the development of objective analyses of the costs and benefits of current and potential handling, transport and marketing systems.

OBJECTIVE 5 - TO ENHANCE TECHNOLOGY TRANSFER TO INDUSTRY

Strategies

5A To require research proposals to provide detailed plans of how the outcome of the project will be disseminated to relevant sectors of the industry.

5B To evaluate the effectiveness of the technology transfer process in order to improve the acceptance of research results by industry.

5C Circulate final results of research projects to relevant organisations and seek feedback.

OBJECTIVE 6 - TO ENHANCE COMMUNICATION TO AND WITH INDUSTRY

Strategies

6A To employ more effective means to strengthen and initiate the Council's communications with all sectors of the industry including:

- farmers
- farmers' organisations
- malting and brewing industry organisations
- the feed industry
- researchers and research administrators
- government

Sub-strategy

6A(a) To employ professional assistance via consultants to help strengthen communications.

6B To identify and promote the benefits of research and development funded by the Council.

6C To consult with State Research and Quality Committees and grantee organisations to:

- establish a common understanding about aims and objectives, and,
- ensure the Council, State Committees and grantee organisations are adequately informed on research programs.

6D To continue and expand consultation between all Grains Research Councils on issues of common interest.

To achieve the above objective, the Council will give greater priority to research coordination to ensure that broader issues which overlap the Council's barley industry charter receive adequate recognition. Accordingly, the Council intends to continue to strengthen co-ordination with State Research Committees and the other Grain Research Councils to develop uniform approaches where applicable for the smoother management and administration of research.

OBJECTIVE 7 - TO ENSURE TRAINING IN RESEARCH AND DEVELOPMENT

Strategies

7A To provide continuing support for post graduate, post doctoral and senior research fellowships.

7B To provide continuing support for industry development awards.

7C To provide funding for conferences/workshops, and travel to relevant conferences or for personalised study, where it can be shown to be of benefit to the industry.

OBJECTIVE 8 - TO EFFICIENTLY ADMINISTER COUNCIL'S RESPONSIBILITIES

Strategies

8A Develop and review the Council's Strategic Plan and research and development program.

8B Conduct project reviews.

8C Report to the Minister for Primary Industries and Energy and the Parliament.

8D Report to the Grains Council of Australia.

CATEGORIES OF PRIORITY FUNDING FOR BARLEY DEVELOPED BY THE BRCSA (SUMMARISED FROM THE BRCSA ANNUAL RESEARCH AND DEVELOPMENT PLAN, 1989-90)

1. CROP IMPROVEMENT

. Breed improved varieties for the environments of S.A. (yield, quality, disease resistance, and processing characteristics).

. Develop a high yielding, Mn efficient malting barley cultivar.

. Expand barley breeding program for Eyre Region conditions.

. Breed cultivars tolerant of boron toxicity.

. Development of barleys with specific responses to applied fertilizer nitrogen (e.g. Rank barley cultivars for their responsiveness to applied N fertilizer).

. Support the continuing release and maintenance of barley cultivars.

. Support grain legume and oat breedings and evaluation.

. Fund a PhD scholarship in the physiology of barley.

2. CROP PRODUCTION

Agronomy:

. Develop cost efficient, crop husbandry practices into integrated technology transfer packages. This includes:

- ascertaining the benefits and constraints of rotation sequences
- establishing the genotype x environment interactions for barleys grown in S.A.
- evaluating the performance of barley genotypes (especially on Eyre region)
- improving the agronomic performance of grain and pasture legumes (especially on Eyre region)

Soils:

. Rank Mn and Zn efficiencies in barley genotypes.

. Develop suitable tests for characterising the fertility status of soils.

. Develop sampling methods for identifying soil-borne diseases.

. Develop information on rotations which maintain economic productivity, and maintain or improve soil structure.

. Determine the effects of boron deficiency and toxicity on cereal yields.

Nutrition and Fertilizers:

. Develop suitable plant nutrient tests.

. Study interactions between trace element deficiencies and toxicities.

. Predict economic grain yield and quality responses to applied fertilizers.

3. CROP PROTECTION

Diseases:

. Study root pathogens and breed resistant barley genotypes.

. Support research on barley scald, powdery mildew and net blotch.

. Support agronomic and rotation research aimed at controlling root and foliar diseases.

Insect Pests:

. Support continued research in controlling white and conical snails (biological, chemical, agronomic measures).

. Identify insecticides for controlling yellowheaded cockchafer and cereal curculio.

Weeds:

. Chemical and agronomic practices (e.g. tillage) for controlling grass weeds in barley.

. Evaluate advantages of herbicide mixtures.

. Develop improved herbicide technology (e.g. timing, rates, mixtures and application methods).

Engineering:

. Support research aimed at improving tillage machinery, especially to reduce production costs.

4. FARMING SYSTEMS AND MANAGEMENT

. Support research in this area.

5. STORAGE, HANDLING AND TRANSPORT

. Support research in this area.

6. PRODUCT RESEARCH AND MARKETING

. Core fund an independent laboratory to evaluate malting quality (including capital items).

. Fund a workshop on malting quality evaluation.

7. COMMUNICATION AND TRAINING

. Support projects with a defined extension component.

. Support appropriate extension projects.

. Support publications and media bulletins.

. Support conferences and seminars relevant to research priorities.

8. COLLABORATIVE PROJECTS

. Support collaborative projects between research organisations.