DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

AGRONOMY BRANCH WORKSHOP

REVIEW OF RESEARCH/EXTENSION NEEDS OF THE MIXED FARMING AREAS OF SOUTH AUSTRALIA

Held at Hawker Conference Centre
Waite Agricultural Research Institute
August 24th and 25th 1977

Convenor: Murray V. Smith

Report No. 95

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE AND FISHERIES

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FOREWORD

The most productive agricultural area of South Australia is the mixed farming or cereal-livestock region. The interaction of production, economic, technical and sociological inputs into the farms of these areas may be defined as the "mixed farming system". The region with annual rainfalls ranging from 250-600mm is characterised by a wide range of production enterprises. To date research and extension efforts have generally been on an industry basis. A critical need was seen to review the needs of farmers in these areas on a regional and total system basis.

The Agronomy Branch of the South Australian Department of Agriculture and Fisheries conducted such a review at the Hawker Conference Centre of the Waite Agricultural Research Institute on August 24th and 25th 1977. The format of this review was a two day workshop with participation of about 60 persons directly concerned with the "mixed farming system of South Australia". About 50% of participants were Agronomy Branch Officers. Farmers, agribusiness, other institutions and other Department of Agriculture and Fisheries officers ensured that the range of factors affecting the system were considered from all points of view.

The factors considered to be of major impact on the system were reviewed on the first day. The second day was aimed at determining the research and extension needs for the system - to attain these objectives the mixed farming system was segregated into five land use classes. Thus the workshop had multi-purpose objectives of teaching/learning and problem/priority definition.

This publication as the proceedings of the workshop, aims at recording all papers presented on day one of the workshop and the discussion on the papers. Unfortunately time did not allow discussion of several of these papers. The methodology of the discussion groups and a summary of their deliberations are recorded on a land class basis. Reviews of individual papers and discussions and general floor discussion are included and finally the overall views of a policy maker. A listing is included of research and extension projects relevant to the "mixed farming system" that are currently being undertaken by the South Australian Department of Agriculture and Fisheries, C.S.I.R.O., Waite Agricultural Research Institute and Roseworthy Agricultural College.

The workshop successfully brought together a sample of those people concerned with the mixed farming systems of South Australia. The complexity of the system and the difficulty of integrating the various components of the system was highlighted. To date, integration of the mixed farming system has occurred at the farm level with aid from specialist inputs into various components of the system. Whether the research and/or extension workers can significantly aid this overall integration/evolvement process still appears the major challenge of the future. This document should provide a valuable basis for persons wishing to better understand the factors affecting the evolution of the "mixed farming system in South Australia".

The organizing committee for the workshop consisted of Mr. B. Rodda, Farmer and Member of the Advisory Board of Agriculture and Dr. A. Dube and Messrs. M.J. Catt, T. Dillon, M.V. Smith (Convenor) and G.D. Webber of the Agronomy Branch of the South Australian Department of Agriculture and Fisheries. Messrs. L. Nitschke and A. Barr of the Agronomy Branch recorded the proceedings of the workshop and assisted with the compilation of these proceedings.

The receipt of any comments on the contents of these proceedings or on the mixed farming system would be greatly appreciated by the convenor of the workshop.

Murray V. Smith
CONVENOR

LIST OF PARTICIPANTS AT AGRONOMY BRANCH WORKSHOP - AUGUST 1977

Name	Organisation/Specialty	Location
G.B. Baldwin	S.A.D.A.F.-Plant Protection Agronomist	Grenfell Centre
A.R. Barr	S.A.D.A.F.-Research Agronomist(Barley)	Northfield Labs.
R.N. Beach	Farmer and U.F.G. (Grains Section)	Glen Osmond
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P.R. Birks	S.A.D.A.F.-Entomologist	Northfield Labs.
N.M. Brooks	S.A.D.A.F.-Seed Production Agronomist	Grenfell Centre
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Dean Christophersen	Farmer	Booleroo Centre
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Robin Manley	Farmer	Avon
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Name	Organisation/Specialty	Location
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S.A.D.A.F. = South Australian Department of Agriculture and Fisheries
W.A.R.I. = Waite Agricultural Research Institute
R.A.C. = Roseworthy Agricultural College
C.S.I.R.O. = Commonwealth Scientific and Research Organisation (Soils Section)
U.F. & G. = United Farmers and Graziers of South Australia Inc.

OFFICIAL OPENING

James C. McColl

Director of Agriculture & Fisheries, South Australia

One of the important things about this conference is that it is widely represented, it is not just an Agronomy Branch Conference, but it is an Agronomy Branch Conference plus. I think this is a most important development, and one which I certainly strongly support.

In opening this conference, I felt it appropriate that I should make a few key points perhaps to set a little bit of background.

South Australia has developed a system of cereal-livestock farming or ley farming, based on annual legumes and superphosphate. This system has increased and stabilized production in a relatively arid climate. Those of you who have been in South Australia for a number of years recognise the situation that applied in many of these areas before this particular system was developed.

I think we also should recognise that this particular system is under considerable pressure from a number of factors. Firstly, there is the problem of insects, weeds and various diseases. Three of these insects that come to mind are the sitona weevil, the spotted alfalfa aphid and the blue aphid. All have potential to exert considerable impact on this particular system. The other thing that we are starting to realise too, is the tremendous expense involved in the machinery for this particular type of system and the sort of pressures that are on people to get bigger and into bigger machinery.

This leads to the broader consideration of the economic pressure which is being felt within this system as in most other agricultural systems in Australia. The general trend, of costs , prices received, prices paid for goods etc., exerts quite significant pressure against our farming system.

This Workshop aims at examining the repercussions of these factors on this particular system. Not only the physical and technical aspects but also the social and economic aspects. We are going to examine all the components of the system. Now I have mentioned that word "system" at least six or seven times, and I think it is a most significant word and one that I think we want to keep foremost in our minds, and certainly at this conference. I suggest that in the future, the Department and especially the Agronomy Branch and indeed the other people involved here today, need to think in terms of the total farming system when dealing with any particular aspect of the effects of a certain change in the system as a whole. I think you would agree we have tended to concentrate on certain parts of the system. The technical approach does naturally tend to identify and concentrate on certain parts of the system. I believe we have many of the parts of the system and we can now proceed to put them together. I am personally very keen for the Department to develop this systems approach. There are a number of aspects, a number of ways or levels in which the systems approach can be undertaken. One way is closely associated with new developments in computer modelling. I am not suggesting that the Department will become fully computerised, but I think we do recognise that the computer is a very powerful tool if used correctly. I certainly will be encouraging this development as it applies to the following three areas of particular interest.

The first area is the opportunities for having a means of analysing the problems of priorities for research and the allocation of scarce funds which are upon us and are likely to be with us for the future. Within a

modelling system, we have the opportunity to identify certain areas where we can concentrate our resources, staff and funds. The farm management and agricultural policy implications of this work are quite important. There are a number of reasons, I feel why this approach will and should be encouraged. The Department is in fact re-organising to suit the changed circumstances that I mentioned before, to take account of the somewhat different framework that agriculture will be working, in relation to the rest of the economy in the future. Mr. Tideman mentioned regionalisation and we are also undertaking a close study of our future research management.

An important recent development was the transfer of the Rural Industries Assistance to the Department of Agriculture and Fisheries and with that comes the responsibility for Drought Assistance. The amount of dust encountered at the Yorke Peninsula Field Days last week reinforced in my mind the importance of these added responsibilities.

Various marginal farming areas are, as I have said, under particular pressure. As I said to Glynn Webber the other day, South Australia seems to be in a permanent state of semi-drought. I think that this has a significant bearing on the way you look at things.

We have observed the effect of economic pressures on the various horticultural industries. Obviously there is a lot of work to be done there. Now these same sort of pressures are starting to bear upon our mixed farming systems.

This workshop is of some international relevance because, as you are aware we are involved in exporting our mixed farming technology to the semi-arid regions of Mediterranean type climates. We have a presence in Libya and we may have presence in Algeria in the not too distant future and I think one must recognise how important the features of this particular type of system are to the Mediterranean region. Whilst the economic and social circumstances are somewhat different, there are many common aspects.

I sincerely hope the outcome of this workshop will be a well structured series of guidelines for a realistic set of research and extension programmes for South Australia.

The period we will be considering in the future is likely to be a very testing time for both farmers and others and that of course has big implications in terms of the sorts of things the Department of Agriculture and Fisheries will be expected to do.

I wish you the best of luck and I am sure that the conference will be very successful. I have pleasure in officially opening the conference.

SECTION I

ACCOUNT OF THE PRESENT MIXED FARMING SYSTEM OF SOUTH AUSTRALIA WITH HIGHLIGHTED DEFICIENCIES

PRESENT MIXED FARMING SYSTEMS AND TRENDS

G.D. Webber

Acting Chief Agronomist - Department of Agriculture and Fisheries

Arable farming in the cereal zone of South Australia is mainly based on a rotation incorporating cereal crops and annual pastures. It is an integrated system of cereal and livestock production.

This system, which has been called ley farming, is based on growing annual pastures, i.e. cultivars of *Medicago* species or *Trifolium subterraneum* between cereal crops. The content of legumes in annual pastures varies quite considerably throughout the cereal zone as does the frequency of cropping, and combination of crops.

In broad terms, this system started in the late 1930's, developed in the 1940's and really got established in the 1950's. Prior to this period the cereal lands had been through an exploitive phase, with frequent cropping on fallow, i.e. the fallow-wheat system.

Under this system much of the soil's natural fertility was exhausted, soil erosion in some areas was acute, and soil structure had been broken down and disease, such as take-all, had become a serious problem.

With the development of the ley farming system came a reduction in fallow, increased use of superphosphate, increased barley acreage and an increase in the importance of livestock on cereal farms (see Fig. 1).

Much has been said about the impact of this period of our agricultural development and the increases in production that followed.

With the introduction of leys in the cereal areas, pasture legumes were sown or volunteered over a wide area.

These grew quite prolifically in many areas stimulated by higher phosphate applications. As well as supporting more sheep, these legume based pastures replenished depleted organic matter reserves and lifted soil nitrogen levels. The increase in soil fertility was reflected in increased cereal crop yields and higher stocking capacities (see Fig. 1).

However, attempts to establish and maintain legume pastures were not uniformly successful throughout the cereal areas. The most impressive results were achieved on the grey, sandy and loamy mallee soils, and the black earths (the medic areas). Here the medics, barrel and burr, established readily. Rotations were adapted and the alternate year cropping system was established with barley areas increasing. To some extent this short rotation system was developed out of necessity in areas, such as Yorke Peninsula, where water supplies were limited. Because of the ability of medics to set a high percentage of hard seeds, they regenerated readily after one or even two cereal crops.

It was not, however, all spectacular success - on the red brown earth soils of the north and transitional solonetz soils, volunteer pastures only contained sparse legume growth.

In these situations it was found necessary to sow early strains of subterranean clovers. These pastures were more difficult to establish and furthermore, they needed to be resown after each period of cropping. This lack of legume pasture development in the red brown earth zone was reflected in rate of soil fertility build up and subsequent affects on cereal yields as compared with the mallee soil areas.

In the red brown earth zone, there are many examples of individual properties where subterranean clovers have brought about increases in soil fertility and production at least equal to the gains made in the medic areas. The development of the ley farming system based on subterranean clover pastures has met with some setbacks over the years; unsuitable varieties in the early stages, proboems with establishment methods, and dry conditions in critical pasture resowing years. The redbrown earth zone still offers considerable scope for further developments.

It is now well established that with correct management and use of newer, more suitable clovers, the ley farming system in the subterranean clover areas can provide the same degree of success as the system in the annual medic areas, i.e. the mallee (alkaline) soil areas.

The specific advantages that have accrued from the ley farming system are:-

* increased soil fertility and farming stability,
* improved soil structure
* increased forage production, resulting in higher, better quality and more stable livestock output.
* a lengthened grazing season because of the provision of excellent quality dry pasture capable of carrying larger numbers of stock through the drier months of the year.
* increased cereal crop yields, often with improved protein levels and greater cropping flexibility.
* better soil erosion control, particularly when combined with contour banking in areas susceptible to water erosion.

Crop Rotations in Medic Areas:

Because of the hard-seeded nature of medics, optimum regeneration has been achieved where an alternate year cropping programme is practised. The basic crop-pasture-crop-pasture rotation has been used for many years in areas such as Yorke Peninsula. Better germination occurs after the crop year because:-

* more hard seeds are broken down by two summers of expos ure to temperature extremes at or near the soil surface.
* seed incorporated in the top few centimetres of soil is in a better environment for germination and establishment.

Whatever the cropping system used, it is important that seed reserves be maintained at a high level to promote vigorous medic stands in future years.

The concept of fixed rotations has tended to change in recent years. The build-up in soil fertility under legume-dominant pastures has allowed greater flexibility in the management of crops and pasture to maximise profits. Rotations in medic areas, although based on alternate year cropping, vary in relation to soil type, inherent soil fertility levels, seasons, density and vigour of pastures, and the relative prices of crop and livestock products.

As a general principle, the objective is to grow one or two cereal crops for every moderate to good medic crop. Less intensive cropping is wasteful because it allows poor types of annual grasses to become dominant on the increased fertility.

Some of the rotations used in conjunction with medic pastures:-

* barley-pasture-barley-pasture in the good medic areas suited to barley production.

* wheat-pasture-wheat-pasture where medic growth is regular on good loam soils of 350mm to 475mm rainfall. A modification would be wheat-pasture-barley-pasture, or fallow-wheat-pasture-barley-pasture.

* on lighter soils where rainfall is not so reliable, the crop year is followed by two or three seasons of pastures, depending on the medic growth.

* on heavier soils, particularly in the more favourable rainfall areas, where fallowing is likely to be necessary for maximum returns, a rotation of allow-wheat-pasture-barley-pasture or fallow-wheat-pasture is practised (see "Fallowing").

Wheatever rotation is used, it is necessary to assess soil fertility and seed reserves carefully. Seed reserves can reach low levels after poor pasture years, or when paddocks are cropped for two years or more in succession. Operations such as hay cutting can also reduce the quantity of seed set. If seed reserves are in doubt, resowing with medic seed should be undertaken.

Crop Rotations in Sub clover areas:

Unlike medics, subterranean clovers have fewer hard seeds and regenerate best in the year following seed set. They are therefore not as well suited to close rotations and tend to fit best into a system where there is a pasture phase followed by a cropping phase. That is, where subterranean clover is the basic legume in the ley farming system, the policy has been to build soil nitrogen levels and soil fertility over two, three or more years, and then crop for two or more successive years before going back to a clover pasture.

As a rule, subterranean clover seldom survives a cropping programme well. Geraldton and Clare are the most reliable in this respect but even their regeneration after cropping cannot be taken for granted. This means subterranean clovers need to be resown after each cropping phase and it is vitally important that they establish well and rapidly in the first year.

The system with subterranean clovers is also flexible when soil fertility is high enabling farmers to capitalise on opportunities to increase areas either for cereals or livestock production as prices fluctuate.

There is little doubt that more rapid progress could have been made in the subterranean clover areas with the use of higher seeding rates.

Fallowing:

Although the amount of land fallowed for wheat has been considerably reduced, there is still a significant amount of fallowing carried out in some areas. Fallowing is considered most effective in storing water in soils that o high clay content at 15cm to 30cm depth.

In general, fallowing is carried out under conditions where:-

* soils have relatively poor legume history and nitrogen build up, and where mineralisation under fallow would help make soil nitrogen available.

* soils have a good pasture legume history. Fallowing is then recommended only where:-

  ** clay subsoil is present
  ** July to August (winter) rains exceed 100mm
  ** average seasonal rainfall is below 450mm.

Fallowing is normally carried out in August to September when pastures are flowering.

Trends:

(1) The components of the system have tended to fluctuate with prices and other market forces, e.g.:- (see Fig. 2).

* increased cereal production when livestock prices were low and vice versa
* the big influx of cattle into cereal zone in early 1970's
* the lift in barley acreage in mid-1970's when prices high, and farmers had experienced problems with rust in wheat crops.

(2) Trend towards more intensive cropping in better soil areas, e.g. on black earths, where grain legume cash crops to some extent are replacing legume pastures.

(3) Problems with legume content of pastures:-

* as soil fertility rose greater problems with grass and weed competition and less legume content in pastures
* effect on sitona weevil
* a possible future effect of the alfalfa aphids.

(4) Greater need for resowing of pastures to optimise production:-

The ley farming system has changed, it has to be more flexible to meet new needs brought about by changing economic circumstances. With flexibility comes the need to maintain the best possible legumes pastures, to build soil fertility. This will mean resowing of legume pastures whenever seed reserves are in doubt.

FLOOR DISCUSSION

A. TIDEMAN suggested that the conference consider the effect of the following on present and future South Australian farming systems -

. decrease of stock numbers especially sheep in the cereal belt in the face of steadily increasing crop acreages in S.A. The impact of live sheep exports to the Middle East was mentioned.

. crop areas over the last 5 years have increased at approximately 2% per annum in the developed countries and nearly 50% p.a. in the developing countries.

J. POTTER pointed out that while beef cattle numbers had decreased

by 7% over the last 12 months and sheep numbers had decreased more significantly, the grazing pressure is still historically high.

J. HARRIS - sheep numbers have decreased to the point of becoming an "endangered species" in North America. One of the major problems is the coyote. Sheep prospects for Australia should therefore be outstanding.

FIGURE 1

CEREAL AND LIVESTOCK PRODUCTION FROM A TYPICAL SOUTH AUSTRALIAN MIXED FARMING AREA - COUNTIES DALY, GAWLER AND STANLEY

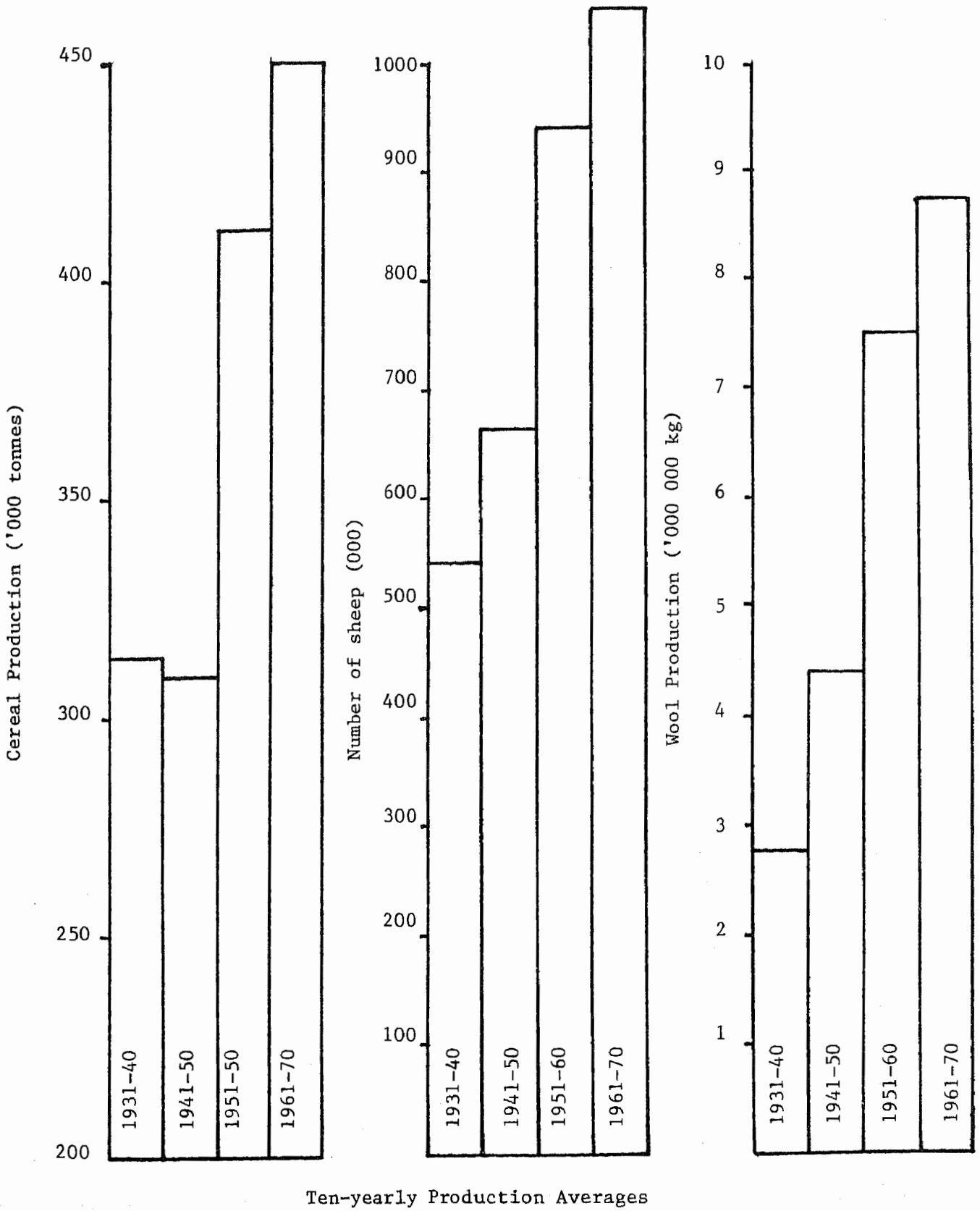
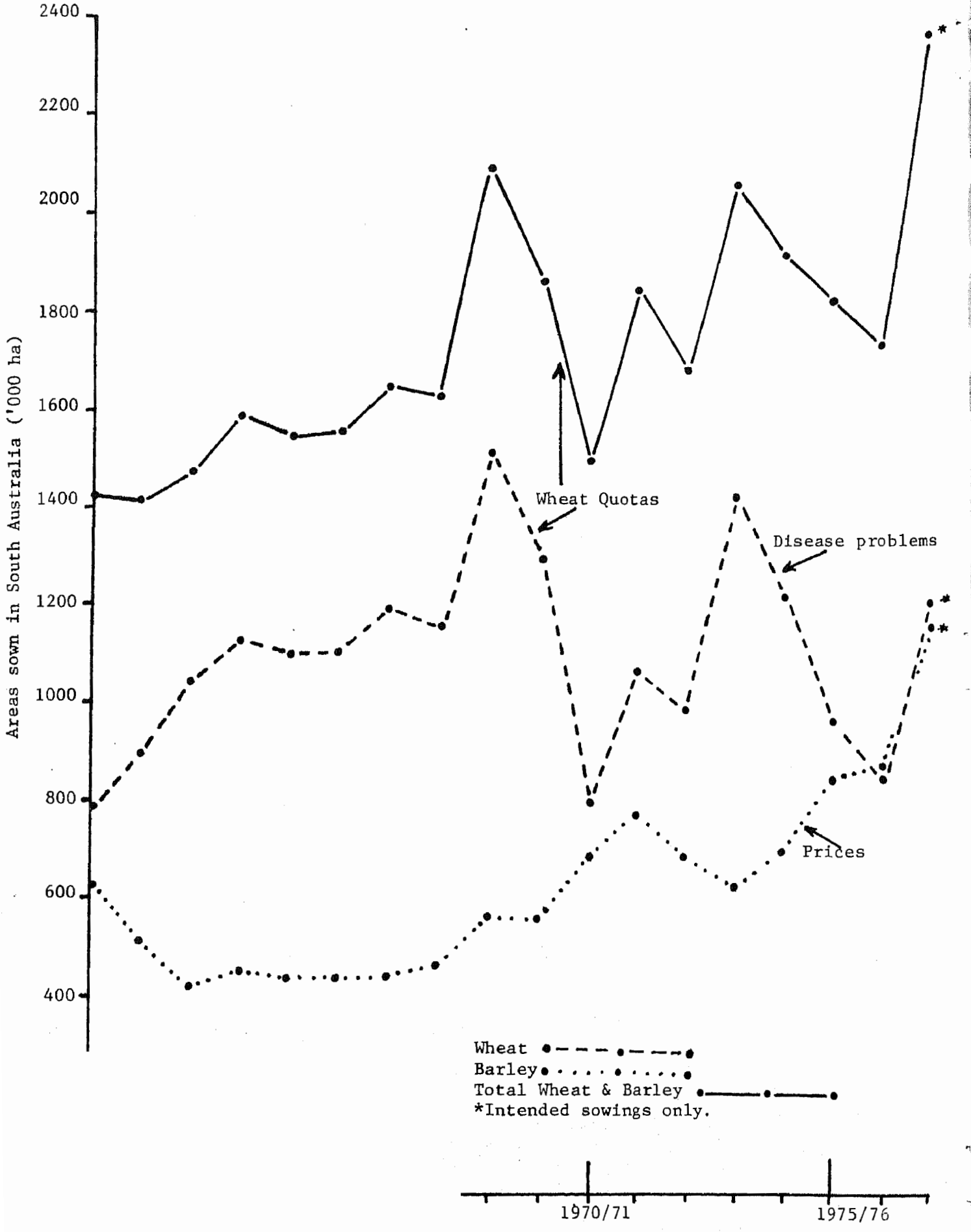


FIGURE 2

AREAS SOWN TO WHEAT AND BARLEY IN SOUTH AUSTRALIA
SINCE 1960



SOIL AND CLIMATIC LIMITATIONS TO MIXED FARMING

R.J. French, J.E. Schultz

Chief Soils Officer and Senior Soils Officer respectively, Department of Agriculture and Fisheries.

A farming system comprises physical, biological, economic and personal sub-systems. Soils and climate relate to the physical and biological subsystems.

The key features in assessing the value of soils for farming are -

(a) the presence of any barriers to root development

(b) the amount of water that can be stored in the top metre of soil

(c) the structure and erosion hazard of the cultivated layer

(d) the nutrient supply.

The soil types which best meet these needs in S.A. are loamy mallees, clayey red-brown earths and dark soils of heavy texture. These can store up to 150mm of available water in the top metre and can store 50mm or more through fallowing. They have friable topsoils which allow good germination of crops and pastures and there is little erosion hazard.

Other soil types have features which limit production. In general, management practices can only restore poor structure e.g. by applying gypsum, and improve the nutrient status.

Fertilizers supply the phosphorus and trace elements but nitrogen comes mainly through annual medic pastures. A good medic pasture of 4-5000 kg ha^{-1} D.M. provides from 80-100 kg ha^{-1} N. Medic growth however varies markedly with seasonal rainfall.

While medics contributed greatly to the yield increases in the 1950's, the area under crop and the total grain production since then has increased by about 30%, and the livestock numbers by 60% (County Daly). Many farmers are now harvesting medic seed and the nitrogen inputs may now not be adequate. The amounts of nutrients removed in different crops are shown in table 1.

Table 1: Nutrients removed in grain

	% N in grain	Amt. removed in 1 tonne (kg N)	% P in grain	Amt. removed in 1 tonne (kg super)
Wheat	2.1	21	.30	30
Barley	1.8	18	.28	28
Lupins	5.2	52	.55	55
Peas	4.1	41	.55	55
Rape	3.6	36	.75	75
Medic seed	6.4	64	.85	85
Medic pods	3.0	30	.31	31
Medic hay	2.8	28	.30	30

Grain legume and oil seed crops remove twice as much K and 1½-2 times S as do the cereals, and rape removes 5 times S. Oil seeds also remove twice as much Cu as the cereals.

In broad terms the aim in agriculture is to convert solar energy into food and fibre. Solar radiation affects plant development and yield. It is however measured in only a few places in S.A. and we need estimates of its using temperature and evaporation.

Crop development can be defined by temperature inputs. The accumulated day degrees of maximum air temperature for optimal development of crops and pasture are listed in Table 2. In an average season, the temperature values between tillering and flowering are reduced by 300°C, and by as much as 500°C with late sowing in a drought year.

Table 2: Accumulated day degrees of maximum air temperature (°C) for optimal development of crops and pastures.

	Sowing to				
	tillering	begin flowering	end flowering	soft dough	harvest
Wheat (Halberd)	1050	2200	2500	3000	3600
Barley (Clipper)	1080	2000	2200	2700	3300
Oats (Swan)	1050	2200	2500	3000	3600
Peas (Early Dun)	1100	1800	2700	3000	3600
Lupins (Unicrop)	1100	1800	2500	3200	3900
Rape (Oro)	1010	1700	2500	3000	3500
Linseed (Glenelg)	1100	1800	2600	3100	3600
Safflower (Gila)	1100	3500	4000	4500	5100
Medic (Jemalong)	500	1800	3000		
Barley grass (*H. leporinum*)		1900			
" " (*H. glaucum*)		2200			

These data enable one to predict the likely success of crops in different environments.

The yield of crops is also influenced by meteorological inputs. Potential yield is determined by

(a) how quickly a plant produces its first 1300 kg ha^{-1} DM at which it fully intercepts solar radiation and produces dry matter at a maximum rate.

(b) how long the plants stays on its maximum rate until it starts to senesce physiologically.

Actual yield is determined by factors which either reduce the growth rate below the maximum or cause premature senescence e.g. stress due to high evaporation, water or nutrient deficiency or restrictions from weeds or disease. Highest yields are obtained when the flowering stage occurs after the last frost and before the onset of evaporation stress.

For cereals, evaporation stress begins when the day degrees of maximum air temperature first reach 160°C in a week (or 40 mm class A evaporation). This week normally occurs from mid-September in the Mallee to 3rd week in October on Yorke Peninsula but may be extended by up to a month with late spring rains. For medic, stress begins in the week when the day degrees first reach 140°C (or 30 mm evaporation).

The relation between the plant's temperature system and the weather of a region determines the optimum seeding date and the likely yield of a crop. Wheat yields decline by 12% a week in County LeHunte, and 5% a week in County Fergusson for each week's delay in sowing after the 3rd week of May and mid June respectively.

Moisture supply has a major effect on actual yield and accounts for 62% of the variation in yield. Fallowing on soils with clay subsoils can increase moisture supply in the growing season by up to 30%. The probability of a given amount of rain in the growing season can be assessed from decile rankings of rainfall. Over the last 3 years, Sept.-Oct rainfalls have been in the 8-10th deciles.

The relation between the dry matter production of crops and pastures and the meteorological variables is shown in table 3.

Table 3: The amounts of dry matter produced per unit of meteorological variable at different growth stages.

	D.M. (kg ha^{-1})				
	per day	per Kj cm^{-2}	per mm evap^{n}.	per 10°C max.air temp	per mm water use
Early growth of crop or pasture					
0-1300 kg ha^{-1} DM	18	20	9	12	14
Excellent crops					
Sowing - Soft dough (150 days)	72	50	27	42	43
Max. growth rate between tillering and flowering	165	105	45	65	45
Grain only	21	18	6	12	13
Excellent medic pasture					
(1300-8100 kg ha^{-1} DM)	45	60	24	37	30

The above points will be discussed in relation to the analysis of yield trends in S.A. Hundreds, as measured by Cornish and French.

THE BIOLOGICAL ENVIRONMENT (INSECTS, WEEDS AND DISEASES) OF MIXED FARMING IN SOUTH AUSTRALIA.

G.B. Baldwin

Senior Agronomist, Plant Protection.

I am going to discuss and review the major plant protection problems that have become as much a part of our mixed farming system in South Australia as superphosphate has. Plant protection problems are obviously biological ones so the use of this word should at least please the originator of the title. These same problems as we all know are caused by organisms that are well adapted to our cereal annual medic or sub-clover rotations.

Having defined them, I will then attempt to look at the environmental factors that play such a leading part in making them biological problems here in South Australia.

No-one I hope is naive enough to think that we can consider each problem in isolation. The inter-relationship of weeds, insects, and diseases is there for all to see if we will only look. It is very much a part of the biological environment.

Major improvements have been made in the control of some of our biological problems in the last 20 years.

We have seen and will continue to see advances:

1. In the field of equipment design.

2. In the field of varietal resistance

3. In the area of loss assessment.

4. In the range and particularly in the selectivity of the pesticides available.

5. In the field of selection, rearing and management of biological control agents.

6. In our knowledge of the biology, ecology and physiology of the pests, diseases and weeds that concern us, and how our cultural practices and cropping programmes can be inimical to the build up and carryover of such organisms.

Two questions we might ask ourselves are -

1. Have we as a department been active in these fields?

2. Have the advances kept pace with the needs?

In some instances a change in our management has allowed an insignificant problem under one system, to find a much improved environment for its growth and reproduction under another. If this is the case we find ourselves with a new pest, or pest complex. Improvements made in controlling our biological problems in one field can in turn create

new problems in another. There will always be plant protection problems to manage in any agricultural system that we may devise. The key to success however is to find and manage a system which will give a minimum of biological problems with a maximum return.

If we seek a minimum of biological problems with our management systems then as agronomists we must clearly understand the biology, the ecology and the inter-relationships of the organisms that we may encounter.

Before turning to attempt to establish what are the major biological problems in this State, I would like to make it clear that in my mind the biological environment embraces not only the inter-relationships of organisms, but involves the soil, the plant, and climatic factors, as well as our cultural and management programmes. It is, as I see it, made up of a network of interacting factors.

Recently, a request came to the Department of Agriculture and Fisheries asking it to assess the annual losses from diseases, pests and weedy plants infesting the States field crops and pastures. The reply went back saying that little soundly based survey or experimental work was available and the estimates at best were just guesstimates. I have reproduced the figures supplied in the following table- and drawn a few conclusions:-

Loss in Crop Production due to Plant Diseases in South Australia

(Fungicide and other control measures being applied)

Crop	Disease	Freq. of occur.	% Total Crop Lost	Approx. Total Crop Value 1977 $ mill	Annual Value Crop Lost $ mill
Barley	Leaf scald	Reg.	12.5	100	12.5
Wheat	Septoria leaf blotch	Reg.	10.0	100	10.0
Wheat	Eelworm	Reg.	7.5	100	7.5
Wheat	Takeall	Reg.	5.0	100	5.0
Barley	Eelworm	Reg.	5.0	100	5.0
Barley	Takeall	Reg.	5.0	100	5.0
Wheat	Rust	1:20	60.0	100	3.0
Wheat	Septoria glume blotch	1:20	20.0	100	1.0
Peas	Blackspot	Reg.	25.0	4	1.0
Oats	Rust	Reg.	10.0	10	1.0
Oats	Eelworm	Reg.	10.0	10	1.0
Lupins	All	Reg.	10.0	2	0.4
					52

These figures suggest we are losing $52 million dollars annually due to the major plant diseases in our grain crops in our mixed farming system. Four problems stand out as being particularly important and these are eelworm, leaf scald, takeall, and Septoria diseases.

Losses in Crop Production due to Insect attack in South Australia.

(Insecticides and other control measures being applied)

Crop	Pest	Freq. of Occur.	% Total Crop, Lost	Approx. total crop value 1977 $ mill.	Annual value Crop lost $ mill.
Cereal + Pasture	Plague locust	5:20	0.25	700	1.7
Legume Pastures	Red mite) lucerne flea) Sitona weevil)	Reg.	Loss of N input only on 2 mill. ha 20 kg N/ha reduction N value 35¢/kg		14.0
Legume Pastures	Spotted aphid Blue aphid Pea aphid		Not known		?
Barley + Oats	Barley grub	1:5	1	110	0.22
					16.0

These figures suggest our losses due to the major insect pests are less than those caused by disease and the cereal part of our rotation has less problems than the pasture phase. It must be remembered however that more control is carried out with insecticides than with fungicides.

The figures for weed control are all cereal orientated. They tell me that although this facet of plant protection has the greatest input cost for agricultural chemicals per hectare, there is still some $24 million worth of production being lost annually due to weed competition with half of this being attributed to grassy weed competition.

Losses in Crop Production due to weeds in South Australia.

(Herbicides and other control measures being applied)

Crop	Weed	Freq. of occur.	% Total Crop Lost	Approx. total Crop Value 1977 $ mill.	Annual Value Crop Lost $ mill.
Wheat + Barley	Grasses	Reg.	6.0	200	12.0
Wheat + Barley	Oxalis	Reg.	4.0	200	8.0
Wheat + Barley	Broad leaf	Reg.	2.0	200	4.0
					24.0

The weeds that we have as biological problems today in our cereals are well adapted to our cultural environment and farming system, and posses such characteristics as:-

1. they are quick growing annuals
2. their emergence is not necessarily dependent on soil moisture
3. they may produce a percentage of seed with innate dormancy
4. they are autumn, or early winter germinators
5. they seed before crop maturity
6. they are small seeded, prefer fine seed beds and germinate in the top few cms of soil.

Many of our present day biological problems have virtually been with us since colonization. Eelworm came with the early settlers, take-all was known in 1852 and lucerne flea established itself around 1892. True, we have had new weeds and diseases from time to time and I am thinking of skeleton weed and kabatiella as examples. It would seem to me however that the legume component of our mixed farming system has been particularly fortunate until recent years in being relatively free of major insect pests.

I believe that it is only a matter of time before biological problems catch up with any crop that is removed and developed in a similar but isolated environment from its native one.

Recently we have seen the introduction of new insects pests of legumes into South Australia, and there are more to come. I am thinking of pea weevil, sitona weevil, spotted alfalfa aphid, blue alfalfa aphid and possibly in the future, pea aphid. These pests tend to be more specialised, and one attacks the very basis of the ley-farming system, the rhizobial nodule.

I believe as I have already said that there will always be biological problems to manage regardless of the agricultural system we devise. The questions that we must continually ask ourselves are:-

1. What are the most important problems for the State, for an area, for a farm. In the past there has been a tendency to play down a problem only to find in later years that it has become well recognised as being important in limiting yield.

2. Can we as extension officers accurately and rapidly assess when action to control a problem should be taken by the farmer. This judgement is important in integrated control programmes.

3. Do we understand enough about the biology and ecology of our biological problems. If not, which areas need research.

TECHNOLOGICAL FACTORS LIMITING PRODUCTION

B.S. Rodda

Farmer at Kadina, and Member of Advisory Board of Agriculture.

A farmers' viewpoint of the technological factors limiting the development of mixed farming in S.A., is in itself a huge subject. One could easily go into so many different aspects that it would tend to make the subject run much too long.

To hopefully overcome this possible happening I have written this paper around 7 different sections that I am sure are limiting development for us.

They are:- cereal diseases - nitrogen usage - weed control - continuous cropping - grain quality - machinery - livestock and our surplus stubbles.

Cereal diseases have been the big topic with individuals or groups over later years and so well it should be. Rust set back farmers financially by literally thousands of dollars over years 1973 and 1974. Generally most producers that were affected, realised their individual losses and then following on from rust came the added loss to many in septoria.

We have to give credit to Department of Agriculture andFisheries for giving urgent attention to help the rust situation over the recent years and also to research being given towards the septoria problem.

But from here on people tend to accept that other diseases namely haydie and eelworm are something we have to live with. Haydie in its usual light scattering through wheat crops must amount to substantial losses over the period of time. Farmers, well aware that it is present in many seasons do not stop to estimate their financial losses.

Why? - I believe that unless it is obvious that yields are dramatically affected we tend to accept it. Let's look at the eelworm situation.

Because of its immediate appearance to all it can initially create panic and indecision as to resow or not. In many cases, by the time plans are concrete, secondary roots appear and further growth develops.

Now, has anyone ever estimated the loss of the eelworm infected crop, as against the crop that has not been affected? So from these thoughts we see progress in diseases of rust and septoria but lacking in root diseases. If we can have rust resistance why can't we have root disease resistance?

Farmers have for years observed the fact that they grow better wheat or barley crops following crops of certain oat varieties. Apparently information is available to tie these results to eelworm levels but few farmers have heard of it.

Nitrogen usage and fertilizer. It is now widely accepted that we need legume pastures for build up of nitrogen levels. When we stop and analyse individual cases are we really sure that what we are doing is economically sound? Perhaps we should ask the question - is the information available to use, to help make economic decisions? I personally need answers to questions like - if I sow a medic crop on well prepared soil, graze it to 2" in height, later allow it to set seed and harvest the paddock with a return of 550 kg per hectare and then sow wheat on portion of the paddock and barley on the remainder. Why the wheat only yields 7 bush/ac. (470 kg/ha) as against barley at 24 bush/ac. (1350 kg/ha).

Does it need super at higher rates or is it perhaps not releasing nitrogen soon enough for wheat crops.

This is not an isolated case, in fact in the last 4 years on our property the lowest yielding wheat crops have been following dense medic stands that have been harvested.

Although I harvest my own seed and can sow high rates in following seasons, am I taking the correct procedure, as against selling medic seed and purchasing bag nitrogen?

What is the break even point - I need to know and so does every other producer if we must make every dollar count. Further to this, in having discussions with farmers using bag nitrogen I gather the impression that in many instances they also are confused when deciding what rates to apply.

Weed Control

Cereal farmers have widely accepted and are practising the use of chemicals for weed control in crops. However on occasions we have seen serious affects on crops. Numerous reasons for this may be argued.

Good results, as we progress, will give added confidence to expand our ideas for another season. I am sure that in our district pre-emergent herbicides have had their biggest year ever in terms of total hectares treated. But here is where it might steady and could even turn back in future years.

Hundreds of hectares this year have taken much longer to emerge through the chemical barrier and in many instances it has allowed soursobs to get started ahead of cereals. Because of slower emergence the cereal plants have been affected worse by disease, such as stem rhizoctonia. If you have areas that have ryegrass and soursobs in equal density then you will be aware of the situation that can arise. Add to this, areas in the state that cannot practise control of soursobs because of light sandy conditions. You then see how serious these weeds are in some districts.

I believe these two weeds are our most serious in cropping and pastures. Chemical control for each is available but ryegrass and soursob together with cost of treatment where it can be used, are costing producers thousands of dollars annually.

In 1968 we purchased land that had soursobs over the total area. On 8 hectares of heavy soil that can take chemical treatment this area has had 4 treatments for soursobs and in excess of 60 kg of medic seed per hectare up till last year. We are certainly getting good results but it has been expensive.

As we get more confident with our work we then get more intensive. Although becoming intensive may give greater returns in way of production and dollars, we will need to look at soil structure in large portions of our State. How much do we know about intensive cropping coupled with the constant chemical treatment we are coming to accept.

Continuous Cropping

Continuous cropping of cereals and other seed crops are being looked at by farmers to increase incomes in years of low stock returns due to seasonal conditions and market prices.

If ever you, the agronomists, within the Department of Agriculture and Fisheries will need all these answers it will be in 1978. Livestock numbers at about 2/3 of normal, very little cash to go to producers in way of grain advances from previous years and all farmers facing increased running expenses.

Where do we turn - extra barley, wheat, peas, oats, oilseed or other crops? I think in that order. The common ones barley, wheat and oats are straight forward to a farmer, but on many of the new type crops it will be a challenging task. Have you, within the Department of Agriculture and Fisheries, had enough experience with exotic crops to go into all cereal growing districts in the State and help make decisions for individuals - individuals that will need success to enable them to meet committments?

We have been growing wheat and barley for a very lengthy period and records over years help tremendously, but how much information has been recorded in relation to exotic crops grown under local conditions.

If we accept continuous cropping, then against burning of stubble we see new techniques being used for stubble mulching.

My knowledge on this is limited, but the little I do know I feel much of S.A. conditions may be lacking in rainfall. Added to this of course will possibly come a disease situation. But where does continuous cropping or intensive cropping leave a large part of agricultural area in our State?

Possibly 40-50% semi arid country could become subject to drift problems. In the red brown earth soils intensive cropping can cause serious problems with soil structure and may be erosion.

Grain Quality

Let's take the grain we produce at present. Until the rust scare Halberd was as common in cereal areas as it is for a grazier to have a dog.

Thousands of hectares were grown and produced very substantial yields. Against this was the A.W.B. requirement for good hard wheats or now, prime-hard. In our situation where we could grow reasonable crops of hard variety the small premium, of doing so, gave no incentive.

Currently we hear arguments that we should grow more Clipper as against variety Weeah but again the small difference in first advance per tonne will not persuade many growers in lower rainfall areas to attempt to go back to Clipper.

Then we can look at oats. Up till now there have been no marketing controls on this grain and provided you can grow them they are sometimes a good cash return. My own results are very hit or miss.

In 1973 we almost resowed a paddock, variety Swan, that had been attacked by every possible disease. Instead we had a very favourable finish to the season. We harvested 3 tonnes per hectare (66 bush/ac.). Since then in years 74, 75 and 76 sowing the same variety on well prepared soils, we have gained an average of (7 bush/ac.) 315 kg/ha. for these three years.

Just how far away is a reliable oat variety for the lower rainfall areas? We realise the lost production per hectare involved in failures, so have had to change to sowing a 6 row barley to maintain a grain supply for livestock.

Machinery:

Machinery, and what I think are some of its failings, is getting somewhat out of context for an agronomy conference, but I think it is worthy of some brief mention.

In the majority of cases today farmers purchase plant to use for periods covering say 7 -10 years and even longer. Bulk equipment (field bins, seed loaders etc.) would even extend into the latter category. Certainly, manufacturers have given us much to select from in designs, but in simplicity for cleaning they have left much to be desired. Bulk grain for seeding will naturally bring about some admixtures and increase the need to purchase clean seed more often.

However, much could be done to help this if equipment manufacturers allowed proto-types to be fully tested for a season before manufacture. Let's give you an example. A seed loader I have empties from 40 bags to approximately 1 bushel. After opening the trapdoor on the bottom and allowing some to run out you have to climb in and out three times to scape small amounts out each time because the bin outlet is only 2-4 ins. from tray of truck. It builds up and you get out, scratch it away and get inside again - hopeless. It also is not calibrated inside to give you a guide as to help in part fillings. With three sides sloping and one straight it is anyone's guess what you have in it till it is filled.

Harvesters, in recent years, are being made with cross augers and grain augers that open each end but with any auger running horizontal it is still difficult to completely clean. My brother tells me that his 45 bag box, on a P.T.O. header which was a current model till last year, would be the greatest grain mixer developed.

We have heard a tremendous amount over the last year or so from the Wheat Board stating farmers must control grain insects on farms. Possibly much should be done by farmers to improve their grain hygiene methods! To add to the confusion C.B.H. state that it must be left entirely to them, they claim that they can handle any grain insect problem in their silos. What is the attitude of the Department?

Stubble Utilisation

In all production we strive to achieve a top quality product that gives maximum return at the lowest possible input. In wool production we shear on the skin to get as close as possible to total wool yield. In pasture we aim to grow high quality feed, highly palatable to all stock and leaving no surplus after grazing.

In cereal we aim to grow large heads with good even grain samples.

In these examples we make maximum use of potential but when it comes to stubbles we waste most of it. At present we make little use of it for animal feed and only in rare cases is it used for secondary industry.

Here is where I want to make my point. Thousands of hectares of surplus stubble are burnt annually to allow for further cropping.

In South Australia livestock production is limited by the amount of conserved fodder that can be carried. Fodder conservation is only possible in approximately one year out of three. I feel that further research is urgently required into methods of using these thousands of tonnes of cereal stubble which is wasted every year.

I was very interested in reading an article on the 3rd straw utilization conference held at Oxford U.K. It gave some detail of latest research programme using caustic soda treatment of straw before feeding out to livestock.

I am also aware of a company that developed a urea feeding system to utilize roughage in cereal growing areas. Credit must be given to anyone attempting ideas such as these. We had experience with this type of feeding but I feel it left much to be desired.

The research and extension of the Department of Agriculture and Fisheries, W.A.R.I. and C.S.I.R.O. have produced significant advances in the agricultural scene. I feel that sometimes their priorities have been a little astray. After all that is why we are here today to try and sort out these priorities in the future.

FLOOR DISCUSSION

P. BIRKS - Grain insect problem likely to become more acute both on farm and at receival and export points.

A. RATHJEN - Do you intend to use artificial nitrogen next year and, if so, at what rate?

B. RODDA - No; neighbours are using artificial N but choice of rates has little rational basis.

E. HIGGS - Sought clarification of 7 bu/acre wheat yields following heavy medic stands. What was average farm yield.

B. RODDA - Long term wheat average 30 bu/acre on long fallow.

E. HIGGS - So really you are comparing yields, following a very long fallow and a yield following a short fallow i.e. autumn working following grazing or seed harvesting of a medic stand.

J. HARRIS - C.S.I.R.O. has undertaken a 3 year study of farming systems on Eyre Peninsula. It is clear that the annual medics have a very heavy demand on both trace elements and the major nutrients. Threshold sulphur deficiency was detected in cereals - sulphur deficiency was much more profound in the medic. As medics are not a cash crop they tend to be ignored in fertilizer allocation. When medics are under"nutrient stress" they will not fix significant amounts of nitrogen.

It was pointed out that Graham Wishart (Adelaide and Wallaroo) had achieved one of his biggest responses to N in cereals on Eyre Peninsula following a dense medic stand .

DOES GENETIC POTENTIAL LIMIT PRODUCTION AND DEVELOPMENT IN SOUTH AUSTRALIA's MIXED FARMING AREAS?

M.R. Krause

Principal Research Officer Agronomy, Department of Agriculture and Fisheries.

To maximise production from a mixed farming system the genetic potential of each component of that system must be fully exploited. In South Australia, these integrated components are crops, pastures and livestock and any inherent limitation such as disease susceptibility in a crop cultivar must be detrimental to the production potential of the system. Unfortunately the heritability of many economically important characters is low and this must be appreciated when evaluating possible genetic gains.

But there are clearly some genetic deficiencies in the plants and animals which are the components of our present mixed farming systems. In some cases these deficiencies can be overcome with germ plasm existing which can and is being used in breeding programmes, whilst in other cases the necessary germ plasm is not known or difficult to manipulate.

In other instances new genetic material in the form of new crops or hitherto little used pasture species present distinct possibilities for improved production particularly in a changing environment.

This leads to a review of any changes in the present system which could place different demands on the components and some of these are foreshadowed in the concluding section.

What are the chief genetic deficiencies in the crop plants, pastures and livestock of our present mixed farming systems and what are the prospects of overcoming them?

1. Crops

These are the main income earner of the system and for this exercise they are categorised as the traditional crops (wheat, barley, oats, peas); developing crops and new crops.

1.1 Wheat

In spite of considerable breeding efforts, genetic limitations still remain. Yield increases have not been comparable with some obtained overseas, but the full impact of the use of more exotic germ plasm (e.g. semidwarf genes) has not yet been realised whilst much effort has been directed toward improved quality, some aspects of which are negatively correlated with yield.

There has been strong concentration on breeding for disease resistance in Australia but this still remains the greatest genetic deficiency in wheat in S.A. Losses from diseases such as "take-all" (*Gaeumannomyces*) Septoria (*S. tritici* and *S. nodorum*) and rust (*Puccinia*) can be devastating under favourable environmental conditions. The two former pose a tremendous challenge due to a paucity of resistant germ plasm, whilst the latter, although effectively controlled, requires continual attention due to changes in fungal biotypes.

Further use of exotic germ plasm promises to raise yield potential, particularly if accompanied by environmental changes (see later).

1.2 Barley

Has fewer limitations. Whilst emphasis has been placed on malting quality, such quality and high yield are not inversely related so that quality need not limit productive capacity e.g. Clipper.

As a feed grain, barley is valued for its starch content and energy value. The need for a feed barley with high protein, which could be detrimental to yield, is less important than one with a more balanced protein which is genetically feasible.

Disease problems in barley are less acute, and prospects for genetic resistance to two of the more important, e.g. leaf scale (*Rhyncosporium*) and powdery mildew (*Erysiphe*) are good.

1.3 Oats

Current cultivars have serious genetic limitations. Rusts (stem and crown) and cereal eelworm cause serious losses, and germ plasm is available to produce resistant cultivars.

Improvement in grain yield by the use of exotic germ plasm (e.g. *Avena sterilis*) has been achieved overseas whilst agronomic characters such as weak straw and grain shedding which can be genetically improved frequently limit yields.

Inherent grain quality in many current cultivars is low and again there is genetic potential to improve highly heritable chatacters such as grain size, kernel percentage and oil content.

Oats for purely forage purposes may play a more important role in the future (see later). The concept of a dual purpose oat for grazing and grain should be discarded and attention given to the development of purely forage types for which there are also good prospects for genetic improvement.

1.4 Peas

Another conventional crop for which the genetic potential for improvemnt is substantial, and hitherto has been given little attention in this country. Disease losses, particularly from the black spot complex (*Ascochyta*) are high and germ plasm with resistance is available.

By overseas standards, pea yields are low with yield components pods per node and ovule per pod lower in the Australian used cultivars.

Improving plant structure by producing more erect growing plants with lignified stems would facilitate harvesting and when combined with reduced leaf area, could lead to lesser disease problems and greater drought resistance.

1.5 Developing Crops

Includes such crops as rapeseed and lupins. Both are now proven and established crops in selected mixed farming areas - rapeseed based on cultivars introduced from Canada and lupins on cultivars introduced from W.A. Genetic manipulation has effected tremendous improvement in rapeseed

cultivars - reduced erucic acid in oil and less glucosmolates in meal are examples. For S.A. add to these lack of resistance to the disease black-leg (*Leptosphaeria*), non-shattering pods and adaptability to the local environment as the main genetic deficiencies in introduced cultivars. Considerable genetic advancement is foreshadowed when Australian bred cultivars become available (expected in the next 5 years).

There has already been substantial genetic progress in the development of cultivars of narrow-leafed lupins (*L. angustifolius*) in a highly successful W.A.breeding program. Adaptable types with non-shattering pods and some disease resistance have been developed but the crop still has problems including ineffective nodulation, poor weed competition, lupinosis and other diseases and genetic improvement may assist with some of these.

1.6 Potential New Crops

Genetic material new to the mixed farming areas with potential include the grain legumes chickpeas (*Cicer arietinum*), field beans (*Vicia faba*) and the new cereal Triticales. A chickpea breeding programme at Wagga N.S.W. aims to improve the genetic potential of the crop for the drier parts of the wheat belt. Introduced field bean lines of Mediterranean origin show most promise but genetic limitations apparent include susceptibility to certain diseases and ineffective seed set and pod retention.

Many early genetic deficiencies of the "man made" crop Triticales such as sterility, shrivelled grain, late maturity, poor tillering etc. are slowly being overcome, and it has potential as a high yielding, disease and drought resistant feed grain cereal.

2. Pastures

Vital to the system, providing fodder for livestock, and in the case of legumes, making important contributions to soil fertility and structure. Reference is made only to the more important pasture species and in the generalised categories of annual medics, subterranean clover and annual grasses.

2.1 Annual medics

Until recent times, the main genetic deficiencies seen in the annual medics included lack of winter production, pod and seed production. appropriate levels of hard seededness for satisfactory regeneration and wide adaptability.

Widespread testing and selection of introduced lines in the Department's programme have revealed lines with genetic improvement in some of the above characters, particularly within the species *M. tornata* and *M. rugosa* and the release of new cultivars within each of these species was contemplated in the near future.

The appearance of sitona weevil some years ago, the very recent appearance of the spotted alfalfa aphid (SAA) and the anticipated appearance of the blue alfalfa aphid (BAA) has placed new demands on the annual medics and resistance to these pests has become a major objective.

For sitona weevil resistance or tolerance, lines of *M. scutellata* and *M. rugosa* have shown most promise with species of *M. truncatula* and *M. tornata* being more susceptible. Similarly preliminary work evaluating resistance to SAA and BAA again suggests that lines of *M. scutellata* and *M. rugosa*

have the best genetic resistance to attack.

There are genetic differences between medic species and between cultivars/lines within a species to resistance to attack by sitona weevil and the aphids. This could result in greater future use of species now less widely used in the mixed farming systems.

One of the main genetic limitations in the legumes at present is one adapted to the hard setting red brown earth soils. Lines within a group of *M. scutellata* material with some resistance to sitona weevil, SAA and BAA and good powers of regeneration, and lines within a group of *M. polymorpha* which regenerate poorly the year after seeding and are susceptible to sitona weevil and the aphids shows promise of overcoming this problem.

2.2 Subterranean clover

In spite of the wide range of cultivars available, there are still genetic limitations apparent, many of which are highly heritable, namely:-

- Maturity - many cultivars are too late especially in the sub-species *brachycalycinum*

- Excessive soft seededness and hence the need to re-seed after a period of cropping.

- High levels of oestrogenic compounds in several cultivars.

Breeding programmes are being directed to correct these limitations, and the impact of the blue alfalfa aphid has yet to be assessed.

2.3 Annual Grasses

Annual ryegrass and barley grass are the main grass components in the pastures of the mixed farming areas. Both have major deficiencies and with neither has much genetic improvement been achieved or even attempted. A major deficiency of barley grass is that it acts as an alternate host to the cereal disease "take-all" whilst the toxicity problem in annual ryegrass is serious and appears to be spreading. Ryegrass can also be very competitive in a cropping phase.

The possibilities of overcoming these deficiencies genetically within the species would appear remote.

3. Livestock

Reference is made here to Merino sheep and beef cattle only. Pigs, poultry and dairy cattle are considered outside of the systems under review. It should be pointed out however that a pig enterprise in particular which can be entered into and opted out of fairly quickly can make a handsome contribution to a mixed farmer's income.

3.1 Merino Sheep

The main genetic deficiencies are considered to be:-

- Rate of reproduction. There is genetic potential to improve this character and there are few cases where improved reproductive rate is not an advantage. But twins do have a lower body weight, cut less wool per sheep and are slower to finish.

Visual selection for other chatacters discriminates against twinning.

- Improved fertility i.e. avoiding barrenness. Present rate about 10%. A character of low heritability and there has been no success in selection against it so far.

- Wool weight. Annual rate of progress has slowly declined. Some progress still possible but limit unknown. Measurements of particular importance in studs producing rams. Of value in breeding flocks to cull poor ones.

- Disease resistance to fly-strike, fleece rot and worms. Work in progress hoping for genetic improvement.

- Growth rate in lambs for slaughter. Character of low heritability with potential unknown. Involves a complex series of factors such as milking ability of the ewe, contribution of the ram etc.

3.2 Beef Cattle

The main character for which genetic improvement is being sought and a major campaign is in progress, is increased growth rate. As in sheep it is a complex character of low heritability. Unlike lambs, a beef animal cannot be "finished" in one growth period of an annual pasture and must contend with at least one autumn trough. Again unlike sheep there is a wide choice of breeds available. These are being sorted out, pure-breds, cross-breds etc., Milk production of the dam is again most important.

4. Added demands occasioned by changes in the system

In the present economic climate, one can foreshadow increased emphasis on cropping, wider use of legume crops, and a shorter but highly productive pasture phase.

What genetic demands could this place on the components of the system?

The following are listed as possibilities for later discussion:-

4.1 Greater disease problems in crops, particularly root diseases in cereals - "take-all", Rhizoctonia, eelworm.

4.2 Greater demands for moisture in the cropping phase hence the need for drought resistance/drought escape.

4.3 Possible build up in soil nitrogen and a need to have crop cultivars which can utilise this fertility efficiently.

4.4 Short term high producing pastures which will be seeded at the commencement of each pasture phase.

Hence a) The need for legume cultivars with high seed yields and a minimum of hard seed.

b) Greater use of oats as the grass component of the pasture in the first year and the need for suitable cultivars.

4.5 Merino sheep with high levels of reproduction and a rapid growth rate of lambs for slaughter.

SOCIAL AND ECONOMIC CONSTRAINTS ON THE EVOLUTION OF MIXED FARMING (FROM THE "END-USERS" APPROACH)

B.L. Wigney

Consultant, Riverton

During the time in which I have been involved in consulting, the mixed farming system of my clients, and many of their counterparts have changed - the degree of slightly to radically.

The original system of many - long rotation, low stocking rates of grazing systems, in addition to which intensive enterprises were run. The major system of at least 90% of our clientele - short rotation, sheep of moderate to high grazing levels and no other enterprises.

The reasons for change and hence evolving of a newer system.

1) The need for survival in a high cost external world as a current production enterprise.

2) The need for future survival for the current family and the next generation.

3) The need to compete with other sectors of the economy and their socio-economic pressures.

The above factors which in fact summarise why change has and will continue to occur relate to one definite area - pressure, and this pressure lies within the enterprise and externally to it and as the pressure increases the correlation to rate of change is direct.

The system of farming today is exactly the same as that of 100 years ago excepting that it has been modified. The basics of production are the same.

I firmly believe that economic factors affecting the family farmer dictate the identification of a new system, the acceptance of that system and a change to the same. The economic factor may be dictated by correction or anticipation of a future event, but in nearly every case the cash position of the farmer or his "hip pocket" feeling has caused the evolution of the mixed farming system.

However social restraints will affect and have affected the rate of change of the system over the years.

If a farmer has to immediately correct his economic stability the social restraints tend to have a low significance. If the stability or need for Dollars is futuristic then the social restraints have greater bearing.

Before analysing the restraints, examine some generalisms in the values of the farming community;

1) Rural people tend to accept traditional attitudes.
2) Rural people are politically conservative.
3) Rural people are satisfied with the way of life syndrome.
4) Rural people oppose unionism and collectivism.
5) Rural people have a high regard to future, insecurity and family,
6) Rural people have a high regard for district mores.

The summary of the generalisms is that farmers can be categorised as conservative, individualistic in the work approach, and sceptical of any new ideas which could alter their future and create current insecurity.

Therefore where a cash crisis is not occurring in the farming enterprise then the above factors affect change in the system. Change under this set of circumstances will only occur at the satisficing level and therefore will in most cases be slow - no matter how effective the research or the change agent my be.

The satisficing level is generally established around the constraints of -

1) Social and economic attitudes of the district.

2) The effectiveness of the districts best farmer as the early adopter.

3) The economic stability of the farmer himself.

The Mixed farm evolution to better systems will continue at the rate dictated by the economy level of the industry and in turn the social restraints will also change to adapt to the economic need.

The systems currently classed "radical" will become the norm of the future and the rate of change will accelerate drastically in the light of current economics in the next decade.

FLOOR DISCUSSION

M. SMITH - What should be done to improve the service that we as agents of change can offer?

B. WIGNEY - Enough is known to increase productivity, per se, but the tie-up between "productivity advisers" and "economic advisers" is inadequate.

M. McKAY - Is farmer reluctance to be radical similar/related to non-farmer agriculturalist's reluctance to be innovators?

B. WIGNEY - Believes yes. Usually a whole peer group must move "up" in terms of adaption and adoption of new ideas before peer acceptance is achieved. Expects to see an increase in "radicals" in the future.

J. HARRIS - Do farmers need to be innovative/radical because extension/ research workers can not supply new ideas rapidly enough?

B. WIGNEY - No. Innovators generally do not make as much money as the very early adopter. One can categorise farmers into innovator, early -, mid- and late-adopters. The farming areas of the state can be characterised by the proportion of farmers who fit in each category.

P. GLOVER - In this world we seem to be striving to make money - what approximate economic return in terms of percentage return to capital do you see as the line between making it and going under?

B. WIGNEY - I don't talk about percentage returns because most farmers don't think about their farms in terms of percentage returns. Cash in the hand to replace plant, live as the farmer wants to and do things around the property is regarded as the return. There are some farmers making a high percentage return and some a low percentage return. I would think most farm percentage returns are down around the 1-2% but it all depends on the inputs. If the farm is valued at what it was bought for 30-40 years ago then the percentage return would be quite reasonable but if opportunity cost is looked at, or what the farm could be sold for now, then the percentage return would be very low.

There is still a lot of money to be made in farming in terms of cash but the gap between those making it and those struggling to survive is enormous. Farmers struggling to survive find it difficult because of high interest rates and high repayments. If farmers have enough cash to replace plant to some level, live as they would like to and supply family with enough cahs, then this is what farming is about today.

MARKETS AND MARKETING - THEIR INFLUENCE ON THE EVOLUTION OF MIXED FARMING IN SOUTH AUSTRALIA

D.R. Harvey

Senior Economist, Marketing

South Australian farmers should be more sensitive to market changes than producers in other Australian states. The reason for this is the limited area available for dry land farming plus the almost complete lack of any country for new land development. With the exception of such areas as the West Coast, land values in South Australia are higher and property sizes smaller than in the equivalent production areas of most other states.

From a purely economic point of view, the best advice to most wheat sheep farmers would be to advise them to sell their properties and move their families to another part of Australia. As this advice would obviously be unsatisfactorily received by most South Australian farmers, then the only alternative is to try and obtain the maximum return from their existing resources. This could be done by intensifying their production or by changing their mixture of enterprises to the best possible combination of crops and livestock enterprises at that given point in time, taking into account possible changes in market forces in the short and long term.

The evolution of mixed farming in South Australia

Traditionally most South Australian mixed farms have developed on a dry land system of sheep, wheat and barley. In the last 10 years there has been a greater input of beef cattle into the mixed farming scene, a change in the balance of wheat to barley, the introduction into some farms of new crops such as oilseeds, lupins and pasture seed and again on some farms an intensification of livestock production through the development of intensive pig and poultry enterprises.

In Appendix 1, these changes are reflected in the gross value of production in the period 1971-1976.

The relative importance of the various components of agricultural production is best demonstrated on a percentage basis as shown in Table 1.

TABLE 1: Gross value of production as a % of total agricultural production in South Australia.

	1971-72 %	1972-73 %	1973-74 %	1974-75 %	1975-76 %
Agricultural crops	29.5	16.5	36.5	42.0	35.1
Horticultural crops	19.3	18.7	14.4	19.4	19.8
Livestock slaughterings	21.5	25.2	21.3	14.6	18.8
Livestock products	29.7	39.6	27.8	24.0	26.3

The importance of crop income as a percentage of total agriculture income has increased dramatically from 1972-73, primarily as a result of the dramatic rise in the world prices for wheat and other grains due to a reduction in world grain production and so a greater demand from the consuming countries of the world.

If we look at the relative importance of the major agricultural crops grown in South Australia, we can see the dominance of the two major grain crops, wheat and barley - see Table 2 below.

TABLE 2: Gross value of certain crops as a percentage of total value of agriculture production

Cereal crops	1971-72 %	1972-73 %	1973-74 %	1974-75 %	1975-76 %
Wheat	59.8	53.7	69.8	55.2	49.2
Barley	31.7	33.1	24.1	40.1	44.0
Oats	4.3	4.8	2.9	2.6	2.5
Other (including hay)	3.9	8.4	3.3	2.0	2.3

The most significant change in this period has been the increase in the importance of barley, relative to wheat. While the imposition of wheat quotas would have resulted in farmers growing more barley, it has been more a factor of the good prices paid for barley which when combined with higher production per hectare has made the production of barley for many farmers, more attractive than wheat. This would have been to some extent due to the removal of price supports to the wheat industry that occurred with the implementation of the fifth and sixth wheat stabilization schemes.

There has been a significant growth in the area sown to barley, while wheat acreages have remained relatively stable over the last five years. These details are shown in Table 3.

TABLE 3: Comparison between wheat and barley production in South Australia

Year	Area		Prod[n].		Price	
	Wheat	Barley	Wheat	Barley	Wheat	Barley
	000 hectares		000 tonnes		ave export $/tonne	
50/51 to 59/60 (b)	630	436	744	526	48.96	54.73
60/61 to 64/65(b)	997	493	1 227	602	50.56	45.65
65/66	1 111	444	1 088	420	51.77	50.76
66/67	1 198	448	1 465	537	53.17	51.30
67/68	1 159	468	732	281	49.75	42.57
68/69	1 517	571	2 263	670	47.08(d)	39.14
69/70	1 299	560	1 610	691	48.54(d)	35.64
70/71	803	694	790	734	48.32(d)	48.13
71/72	1 069	748	1 407	1 407	48.17(d)	40.10
72/73	986	692	815	509	54.35(d)	59.83
73/74	1 432	627	1 795	793	125.02(d)	90.28
74/75	1 220	701	1 486	1 134	122.32(d)	108.54
75/76(p)	958	832	1 139	1 094	110.80(d)	97.06
76/77(e)	1 170	1 028	n.a.	n.a.	95.00(d)	n.a.

b: average
p: preliminary
e: estimate
d: f.o.b. basis
n.a.: not available

Other grain crops are of little importance in South Australia and the only other major crops grown are oilseeds, lupins and pasture seeds. While in 1973-74 oilseed crops were worth about $0.5m, their value increased in 1975-76 to $3m. The returns from pasture seeds have ranged from $1m to $3m.

It can be seen that mixed farming in South Australia has evolved around the production of wheat and barley with other crops being of only minor importance to most farmers. On certain farms however, these minor crops would be of major significance in the case of the specialist farmer.

What of the future!

In the short term, the slow rate of recovery of most countries in the world from the economic recession will lead to problems in the marketing of Australian products overseas with a depressing effect on prices. Consumption habits will still mean that there will continue to be a demand for the two major crops, wheat and barley, but at lower prices than those ruling in the last few years. The series of good harvests in the northern hemisphere has led to a build up in grain stocks, and in particular, wheat stocks. World wheat production is expected to exceed consumption in the coming season for the fourth successive year and stocks could reach record levels. With barley there have been bumper harvests in Europe, and France has forecast a surplus for export of 2 million tonnes of barley. Lupins and soyabean prices are holding firm in comparison with cereal prices although there is a record U.S. soyabean crop of 1 585 thousand million bushels being predicted for the U.S. this year. The general manager of the Western Australian grain pool has warned growers to begin budgeting for lower returns for oats and barley this year.

On the livestock scene wool returns will also be affected in the short term by the world textile recession and prices could be expected to fall. Beef prices have been improving during the last 12 months but while it is predicted that prices will continue to improve, it is very doubtful that prices will return in the short term to the 1973/74 era.

The likely drop in world grain prices will lead to greater pressures on farmers to search for alternative crops or other forms of production in order to maintain a reasonable standard of income. It is unfortunate that for most agricultural products, prices paid to the grower reflect world parity prices rather than a price that the consumer in Australia might be prepared to pay. There are a few products such as pigs, chickens and lambs that are primarily produced for the local market. Even in these cases their prices are affected by other products such as beef because of the substitution by the consumer of one product for the other. Low world prices for beef will also affect the price paid for beef for local consumption, which in turn will reflect in the prices paid for other meats.

In making a decision on the choice of enterprise there are two very important input factors that the producer must be aware of. These are the variations in yields and likely variations in price. While the prices paid for oil seed crops may be high the yield variability may discourage the farmer from growing the crop.

In the "Green Paper" on agriculture policy, a table was prepared setting out the variability of gross income as affected by price and yield variations. These figures are reproduced in Table 4 below.

TABLE 4: Variance in Gross Value of Production attributable to price and quantity changes

Series 1960-61 - 1972-73

Commodity	Price %	Quantity %
Grains		
Wheat	2.7	97.3
Barley	10.1	89.9
Oats	28.8	71.2
Oilseeds	1.2	98.8
Potatoes	90.9	9.1
Livestock Wool	94.3	5.7
Beef & Veal	27.6	72.4
Mutton & Lamb	66.6	33.4
Pigmeats	46.3	53.7

It is important to note that in the period covered, over 97% of the variance in the gross returns of wheat could be attributable to yield variations. For oilseeds this figure was even higher. In contrast potatoes were more affected by price variations.

Livestock did not show the same pattern as crops. Variations in returns from wool were more dependent on price than quantity, while for beef the reverse was the case.

A producer considering a change in enterprise would therefore not only be concerned with the market prospects of the products, but also of the risk of large variations in yield. Returns from enterprises with a high cost component are more sensitive to yield variations than those with a low production cost component. This would explain why the basic crops of wheat and barley have retained their importance over crops such as oilseeds and pasture seeds where costs of production are much greater.

In the marketing of these products the producer has little control over the final price that he receives for his product. In almost all cases the prices he receives are either determined by world parity price or by prices set by a statutory marketing authority. With some products however, prices are determined by demand on the local market and the farmer could improve his returns by negotiating directly with the buyer.

With some products, I believe the farmer has not gained the full market value of his product due either to high marketing costs or to a failure to fully exploit the home market. Meat classification is one example of a new technique that should go some way to reducing the costs of marketing.

Lupins are a crop that I believe could be developed further on the home market. They have a very important role in the formation of least cost pig and poultry rations, because of their high energy and protein levels. While lupins may be available at harvest time they are usually in scarce supply at other times of the year. The lupin grower appears to be content to obtain the export parity price rather than try himself to develop his own sales through the feed industry.

For most products the individual producer has little influence in determining the price paid for his product, but I do see the State Government having a market development role in searching out new markets for South

Australian producers. We are presently looking at export opportunities for such products as seed wheat and barley, breeding stock, chickens, pasture seed and fresh fruit and vegetables.

There could be a significant place for the specialist producer to supply under contract products of a specific type to a very well defined set of requirements. We could perhaps grow pasture seed or seed wheat of a variety not recommended for our own use, specifically under contract to an overseas buyer. The risks would be greater but so could be the rewards. These markets may only appear at intervals, and the producer would have to be able to change quickly from one form of production to another.

For most producers however, I cannot see an immediate change from the classical mixture of wheat, barley and sheep. These producers will have to be prepared to withstand the variations in market prices that are a reflection of supply and demand and economic conditions in the world market.

FLOOR DISCUSSION

B. ROLLBUSCH - How big a role do you see the S.A.D.A.F. in being an innovator in marketing?

D. HARVEY - A big role - it is the only independent body. For example stock firms will try and fill dairy heifer orders and if they can not be filled they stop at that. The S.A.D.A.F. can go further by communicating with farmers previously to find if they can produce that product. The Department should be involved in the seed wheat supply problems because the countries involved prefer to deal with government and because of global season variation making it necessary to organize orders before they are "shandies" in the silos. The Department then would work with grower organisations and can be innovators and co-ordinators. In the marketing sense I see the S.A.D.A.F. being far more innovative than in the past.

G. WISHART - With the Department backing the innovative farmers market wise are not we helping the innovative farmers at the expense of the majority of farmers?

D. HARVEY - At that stage I was only talking about market development for specialist crops that can only be grown by specialist people. But when talking about total industry we would be involved with total industry problems. For example John Pauley of Economics branch has put up a Wheat Stabilization plan in co-operation with Agronomy Branch that is best suited for the total industry. Hence there are two roles.

M. KRAUSE - It is not a practical possibility to write seed wheat contracts 16-18 months in advance.

D. HARVEY - This problem is overcome by contracts on varieties already grown in large quantities. It is a matter of presenting information on what we have and can do and then allowing the buyer to sign the contract knowing the full situation.

ESTIMATED GROSS VALUE OF PRIMARY COMMODITIES PRODUCED (EXCLUDING MINING), SOUTH AUSTRALIA

Particulars	1971-72	1972-73	1973-74	1974-75	1975-76p
			$'000		
Crops (including pasture):					
Cereals for grain;					
Wheat	76 381	44 588	r196 444	r163 922	118 337
Barley (2 and 6 row)	40 295	27 506	68 276	119 305	105 709
Oats	5 496	3 974	8 184	7 832	6 485
Other	326	253	187	155	248
Total	122 498	76 322	r273 091	r291 214	230 779
Crops for hay (excl. pastures and grasses)	4 753	6 709	9 276	5 944	5 115
Fruit;					
Apples	4 007	5 003	4 434	7 975	5 196
Citrus	12 885	12 995	12 400	14 865	16 806
Peaches	2 999	4 385	3 312	6 635	4 917
Pears	1 840	2 193	1 718	2 645	2 447
Other	7 031	8 790	8 928	8 098	8 398
Total	28 762	33 366	30 791	40 218	37 764
Vineyards;					
Fresh grapes for,					
Table use	506	384	340	654	417
Winemaking	15 988	18 167	19 119	33 802	31 886
Dried vine fruit	4 496	2 498	2 097	3 046	1 731
Total	20 990	21 049	21 556	37 502	34 033
Vegetables (for human consumption):					
Beans, french and runner	244	146	125	156	150
Peas, green	1 658	1 643	1 698	2 513	1 417
Potatoes (early and main crop)	4 393	5 796	11 172	9 285	10 259
Tomatoes	5 909	7 071	7 198	7 865	10 528
Other	10 810	10 686	16 157	16 757	18 828
Total	23 014	25 341	36 350	36 576	41 181
All other crops	5 060	4 836	6 321	(a) 9 148	(a) 9 277
Total crops (excl. pasture)	205 077	167 623	r377 384	r420 601	358 148
Total pasture and grasses	8 129	10 145	16 234	(a)14 106	(a)10 238
Total crops (incl. pasture)	213 206	177 768	r393 618	r434 707	368 386
Livestock slaughtering (b):					
Cattle and calves	43 664	63 325	82 153	43 415	63 547
Sheep and lambs	28 193	40 958	44 416	22 212	25 844
Pigs	14 146	14 739	26 123	23 435	21 562
Poultry	7 054	7 612	12 305	13 723	16 076
Total	93 057	126 633	164 997	102 786	127 029

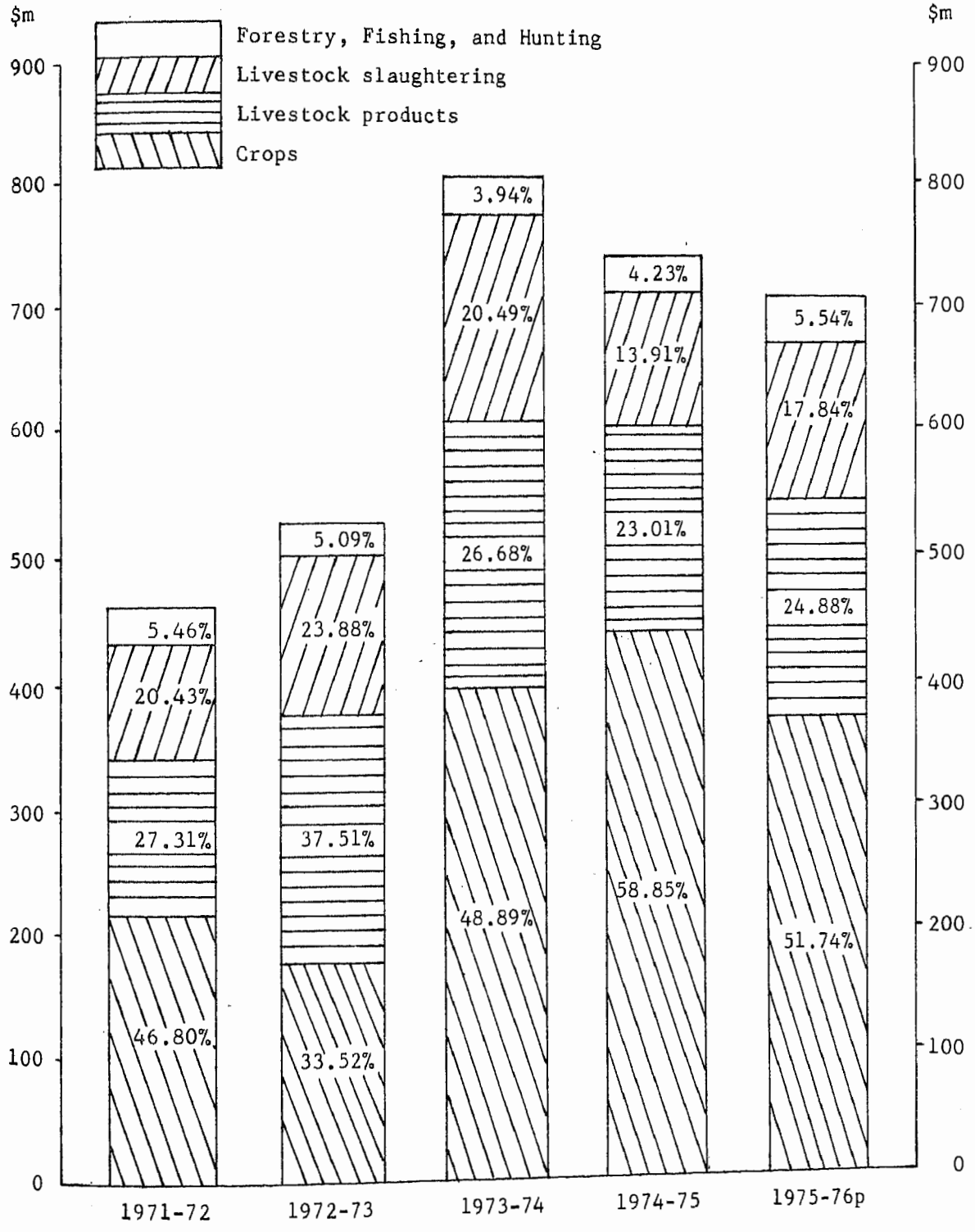
(a) Excludes crops for green feed or silage.
(b) Includes net exports.
p preliminary

ESTIMATED GROSS VALUE OF PRIMARY COMMODITIES PRODUCED (EXCLUDING MINING), SOUTH AUSTRALIA

Particulars	1971-72	1972-73	1973-74	1974-75	1975-76p
			$'000		
Livestock products:					
Wool;					
Shorn (incl. crutchings)	81 957	153 678	163 558	117 358	125 544
Dead	31	155	132	34	35
Fellmongered	-	-	-	-	-
Exported on skins	3 713	10 744	9 490	4 788	6 286
Total	85 701	164 577	173 180	122 180	131 865
Dairying;					
Milk used for butter	5 692	4 068	3 868	3 594	2 551
Milk used for cheese	10 570	9 357	10 503	12 942	11 222
Preserved milk products	281	460	298	295	260
Milk used for human consumption and other purposes	12 083	12 078	12 871	14 667	15 726
Total	28 627	25 963	27 541	31 498	29 759
Poultry;					
Eggs	8 749	6 662	11 409	14 043	13 618
Beefarming;					
Honey	1 287	1 656	2 542	2 094	1 818
Beeswax	77	56	107	129	123
Total	1 364	1 712	2 649	2 223	1 941
Total livestock products	124 440	198 914	214 779	169 943	177 183
TOTAL AGRICULTURE	430 704	503 315	r773 394	r707 436	672 598
Forestry	11 935	10 683	r 13 710	16 311	16 413
Fishing	12 379	15 758	17 442	14 084	22 474
Trapping	573	582	568	868	560
TOTAL PRIMARY	455 591	530 339	r805 114	r738 698	712 044

p preliminary

GROSS VALUE OF PRIMARY COMMODITIES PRODUCED (EXCLUDING MINING) 1971-72 TO 1975-76p



SECTION II

REVIEW OF ROLES OF VARIOUS COMPONENTS OF MIXED FARMING SYSTEMS IN SOUTH AUSTRALIA

THE ROLE OF CEREALS IN MIXED FARMING SYSTEMS

T.G. Heard

Senior Research Officer, Agronomy-Department of Agriculture and Fisheries

The Present Role of Cereals

In South Australia the major role of the cereal crop is to provide an annual cash return to the farmer. An examination of the figures for Gross Value of Agricultural Output in S.A. reveals that return from cereals has in recent years been the single greatest money earner for farmers. The current marketing arrangements with the three major cereals ensures a cash flow throughout the year.

While the majority of cereal grain is sold a proportion is retained on the farm as animal feed. This is particularly so with oats and over the past ten years an average of approximately 60,000 tonnes or almost 45% of the oats harvested have been used in this way.

In addition to the return from grain the cereal crop also provides a considerable amount of green feed. This may be fed directly to stock or retained as silage or hay. Each year over 100,000 hectares of cereal crop is used in this way. While most of this is oats, wheat and barley each contribute significantly.

The Distribution of Cereals

In general cereals are grown in South Australia in the region receiving between 250mm and 500mm of rainfall annually. Within this area barley tends to be grown on the lighter, more alkaline soils and has become the major cereal in some of the shorter season, low rainfall districts. However much of the Northern Mallee and Upper Eyre Peninsula regions are still predominantly wheat areas.

Oats on the other hand are regularly grown in areas receiving more than 500mm rain annually in addition to being grown through the cereal belt. A number of factors probably contribute to this relatively wider usage of oats, particularly in the wetter areas - these include -

* lower sensitivity to soil acidity
* somewhat better ability to withstand wet conditions
* relatively better ability under conditions of poor soil preparation
* reputation as a producer of green feed and grain for animal production.

Within these confines of moisture availability cereals are grown on a number of soil types. The major ones include -

* red brown earths
* solodized solonetz
* grey clays
* black earths
* solonized brown soils

Each of these assumes major importance in different areas of the state though as a rule the first and the last encompass the greatest area. Each of these presents different problems to cropping.

The Place of Cereals in the Rotation

In the past rotations have often been considered as a fixed entity to be laid down and rigidly adhered to. This has tended to change in recent years with seasonal prospects and envisaged paddock fertility playing a greater part in decision making.

In considering cereal rotations the basic differences between those based on medics and those based on clovers are well known. If successive cereal crops are included in either of these types of rotations then generally wheat will be the initial crop. The fertility build up with the legume is probably best utilized by the wheat with resultant increase in both yield and protein content anticipated. The use of barley as the first crop while leading to increased yield could with very high fertility result in lodging and excessively high grain nitrogen levels with consequent downgrading.

In some areas where production of low protein content wheat for biscuit manufacture is practised the sowing of successive wheat crops has distinct advantages. While the first crop after a leguminous pasture or crop will normally be of higher than desirable protein content for biscuits the following crop or crops would normally be acceptable.

Throughout most of the cereal growing areas oats are considered a minor crop in comparison with wheat and barley. They are normally seeded before wheat and thus may go in on relatively poorly prepared seedbeds. Alternatively they may be put in late on a quickly ripped up area if seasonal conditions appear likely to be favourable.

While oats have been considered the most useful of the cereals for grazing it is now agreed that at least for early feed production barley is superior. Recovery from grazing with a view to obtaining a grain harvest may be largely dependent on the stage of growth when grazed and generally with prolonged grazing oats will recover better.

Oats also have a place as a standing crop. Considerable feed is available through the autumn period from crops of oats left unreapt from the previous year. Varieties with good grain retention are particularly sought after in this respect.

Oats are often included as a cover crop in the establishment of legume pastures. At low seeding rates the oats provide valuable grazing early in the season and dependent on seasonal conditions may provide additional feed early in the following year.

Fallowing was once a major factor in rotations, almost exclusively in relation to the wheat growing enterprise. Figures indicate that in 1950 76% of the wheat crop in South Australia was sown on fallow - in 1973 this had been reduced to 21%. Movement away from the traditional long fallow has brought us to the "ley farming" system and more recently minimum and zero tillage. Evidence indicates that the use of these latter techniques can result in significant savings in costs and energy.

Cereal Diseases and the Rotation

The major diseases of cereals are specific to the family Gramineae. Because of this their incidence may often be considerably reduced through rotation of crops and use of resistant varieties. Rotations may reduce the incidence of the disease not only through the inclusion of a non host crop but also through employment of a period of clean fallow.

The cereal cyst nematode (*Heterodera avenae*) poses a major problem in all cereals in South Australia particularly on lighter soils of low fertility. Yield losses in excess of 50% have been reported with wheat.

None of our commercial wheat varieites appear to have any resistance and very little resistance appears available in overseas material. Within barley there appear to be a number of tolerant varieties and lines but many of them including Clipper are efficient hosts. Resistance is apparent within some oat varieties and this offers a means of breaking the disease cycle in predominantly cereal rotations. Again particular note should be taken of the difference between tolerant varieties and those which are efficient hosts.

Take-all (*Gaeumannomyces graminis*) can be particularly severe on wheat and less severe on barley. The inclusion of oats following several years of predominantly barley grass pasture has often proved a means of reducing the severity of take all in the following wheat or barley crop.

The resistance of cereal cultivars to some of the leaf infecting diseases is well documented - particularly in relation to stem rust of wheat. In this case on predeominantly wheat farms consideration should be given to the inclusion of several varieties with different sources of resistance to the disease.

Future Research and Extension

The significant movement from wheat to barley evident over the past ten years obviously indicates problems in the wheat growing industry. This cannot be attributed to a state wide yield advantage of barley over wheat suddenly arising,for in fact only once in the past 10 years has wheat outyielded barley. However through that same period the returns from wheat have generally been the higher. In recent years prices paid for wheat and barley have been similar and thus yield differences have assumed greater importance.

The following cereal research and/or extension programmes should be given consideration in relation to our mixed farming system. Some of them are already in operation.

* Examination of a wide range of potential rotations to include cereals, pastures and other crops (including legumes) taking into account all aspects both agronomic and marketability leading to maximization of returns.

* Further examination of minimum tillage techniques with extension where necessary to other soils and crops.

* Continuing monitoring of and research on the major diseases and where possible examination of cultural practises, crops and varieties which could be used to break the disease cycles.

* Evaluation of cereal varieties in relation to seasonal herbage production. The availability of a Clipper type with good early production enabling its exploitation of the poorer fertility sand soils could be a distinct advantage.

* Breeding of oat varieties, particularly for the South Australian situation.

* Increased education of farmers on the many and varied uses of oats currently available. The advantanges to be gained from sowing into a well prepared seedbed and at strategic positions in the rotation.

FLOOR DISCUSSION

N. MATZ - In some situations with barley it may be financially more desirable to go all out for fertility usage and produce say 60 bus/acre of feed grain than 25 bu/acre of malting grade.

T. HEARD - A further example in some areas would be with variety considerations e.g. Weeah vs. Clipper may also have an important effect on financial returns.

THE ROLE OF WHEAT, BARLEY, OATS IN MIXED FARMING AREAS OF SOUTH AUSTRALIA

Allan Glover

Farmer, Yeelanna.

The three main cereals are grown on mixed farms in S.A., firstly for cash, so necessary for business trading today. Depending on locality, cereals make up 70% or better of the average farms income, therefore any change, innovation, improvement in rotation, adapting, balance between cereals and livestock which can bring about an increase in that income must improve the lot of the farmer.

When considering which, or any combination of cereals to use, costs and the gross margin in money terms always has a bearing on the end result. For the purpose of this paper I will use a graph at the conclusion to help explain the cash income of each (given an average season).

Secondly, for balanced production, should livestock or other enterprises fail, cereals provide another source of income.

Wheat. Because wheat has high soil fertility requirements the cultivation and seed bed preparation receives more attention than the other cereals. Fallow is sometimes used, clean grazing and burning off residues before the opening rains are common practise, to give a clean trash free soil. Thorough and timely cultivations are essential to get a weed free friable loam to sow the wheat grain into.

In more recent times the use of "Treflan" particularly has lessened the number of cultivations needed to get this seed bed but in any case seeding should not be done less than 4 weeks from the initial cultivation to allow time for vegetation to rot down.

In the search for varieties to withstand the diseases, rust, septoria, gloom blotch, hay die, etc., we have seen a wide range of types tried and not very much progress made in higher average yields. S.A. 10 year average of 1.14 tonnes/ha is no better than in 1951-52. I feel more attention is needed to maybe use of improved soil fertility by higher yielding varieties - a tall order maybe. We all know that the market for wheat is becoming very sensitive to protein content and this also is a subject much more attention must be given in future.

As a general rule wheat is considered a safe crop to reap, given fair weather. Bad weather can still take its toll in shedding, sprouted grain etc. Moisture content of the grain can present frustration at harvest and those in constant trouble near the sea have grain drying or windrowing as a means to overcome this.

Grazing. Value of stubble is variable, but usually low. Mineral licks for stock can help to make more use of it but by mid March wheat straw has little use.

The wheat crop is being used increasingly as a cleaning crop for barley and oats as rotations are altered. Burnt wheat stubble ground achieves fair weed and insect control in one operation. Following barley and oat crops (where eelworm is not a problem) the ground requires far less preparation to achieve a good seed bed.

Marketing. From past experience the Wheat Board's record is good and I see no need to change. Certain standards in bushel weight and screening content are necessary and desirable to meet the market. Wheat is likely to continue as a major grain in S.A. and orderly marketing must be maintained for budgeting and forward planning purposes. Payment by the present pool system helps the cash flow through the year.

Because of rainfall and soil types wheat has a definite place on mixed farms for many years to come.

Barley. In all but the driest areas of our cereal growing land barley has a definite place. Because it has the ability to produce a reasonably high yield in a far shorter growing period than wheat, barley is becoming the principal grain on many cereal growing properties.

A clean weed free seed bed is a must for a good barley crop. Cultivation costs can be as high as wheat i.e. the number of workings needed depends on the weather. On grassland, in higher rainfall areas, Treflan again has proved to be a boon, not only to produce a clean weed free seed bed, but also suppresses wire weed in August-September. This weed suppresses germination of medics and clovers the following autumn and subsequently the good pasture we all look for following barley is not there. Barley sown into burnt wheat stubble usually requires no chemical weed control.

Because it covers in well early in the stooling stage weeds do not compete so well as in a wheat crop.

For many years Prior was the main variety planted. It still has a place as a feed grain. Low fertility soils produced a good yield so long as you reapt it before the wind. A weak straw is a feature of Prior along with a tendency to produce all straw on fertile soils.

Clipper was introduced and once acclimatised has met with wide acceptance both with farmers and the trade. It is particularly suited and produces well on fertile soils; the richer the better. Clipper has a stronger straw and a shorter growing habit than Prior but is still not wind proof. It responds to nitrogen well. Barley following clover based pastures, medics, peas, lupins or applied nitrogen give worthwhile increases in yields.

On our less fertile soils - sandy soils, Weeah has the ability to yield well with a particularly strong straw. Wind damage last year was far less in a standing crop than Clipper alongside. Weeah has a tendency to lodge but the head won't snap off.

Diseases have not plagued the barley grain to the same extent as wheat in recent times. Leaf scald is one I would like to know more about. "Patching Out" and other root diseases need further trial experimenting to find a good rotation to gain even further increases in yield.

Reaping barley has for too long caused "Barley Butterflies in the Belly". Since barley ripens early in the season and because winds are then more savage than later in Dec.-Jan., barley reaping develops into farmers trying to beat the weather. Far more use should be made of rolling and windrowing to slow down this rip-tear rush and reap the crop more carefully and get the maximum grown. We wait 12 months to grow it, take a little more time and trouble to get and not take what's left after the wind. Clipper, Weeah, Ketch etc. are still not 100% wind proof.

Barley has for many years been sold on classification. Growers are paid what the trade will pay and this system has much to commend it. The demand for barley grown in this state is good so I see a good future for higher production.

Barley stubbles usually provide good late summer and autumn grazing. Stubbles grazed hard and then lightly disced or rolled before the opening rains give a quick growing dense pasture.

In conclusion barley is adaptable to both acid and alkaline soils giving good yields, there is a good market for grain and stubbles are fairly useful so I see a good future for barley production.

Oats. Gone are the days when oats were grown only to clean up new ground and feed horses. For too long oats have also been the *Cinderella* of the grain industry.

Because oats are generally grown for "on farm" stock feed, usually less attention is paid to land preparation and general crop cleanliness than wheat or barley. I mentioned earlier that burnt wheat stubble ground provides an excellent start for a good oat crop. When sown early in the season this results in grain mixing at reaping and hence clean oat seed is difficult to maintain in these conditions.

Oats have 3 main uses as a -

1. Cleaning crop to break the cycle of root and other diseases carried with wheat and barley.

2. Grazing crop it has the capacity to respond after grazing and still produce reasonable grain and hay. Oats also provide a very good balance to pasture when sown into stubbles and medic cover.

3. Grain crop for "on farm" stock feed and on good years for export.

Marketing. I welcome statutory marketing because a better price is likely to be paid to the producer who delivers clean oats. Up till now oats have not been segregated and consequently the bulk sample has not been clean and sold accordingly. Better marketing may induce a larger acreage to be sown.

Varieties. A steady flow of varieties over the years has seen many new varieites introduced with outstanding features. The more common names of Swan, Irwin, Avon, West, all have a place. West variety has a tendency to host eelworm and Avon does not. Other varieties provide better hay qualities where this is a consideration. As with barley, much more attention needs to be given to reaping all that is grown so rolling and windrowing should be used far more widely.

Summary. All 3 cereals have a place in S.A. All 3 cereals respond to good clover or medic pastures previous to the cereal year. Lets hope our friend the sitona weevil has met his match in our medic pastures. All 3 cereals respond to nitrogen either in the soil or applied.

Some common rotations are -

Fallow, Wheat, Barley Pasture

Pasture, Wheat, Pasture, Barley
Lupins or Peas, Barley, Barley
Wheat, Lupins, Barley, Barley, Pasture.

Our area available to cereals is not likely to increase greatly. Increased production has to come from improved varieties and higher production per hectare.

Graph. Gross margins on wheat, barley, oats and the general trend in machine and operating costs compared with gross returns.

Tables of Gross Margins for - Wheat, Barley and Oats

Assumptions - Operations costed as per April 1977 Stock Journal

- Fertilizer at $70/t. is 1:2 super:sulphate of ammonia
- Harvesting Contractors. (Own plant may be cheaper)
- Yield 2 tonnes/ha or 3/4 tonne/acre base yield above or below in individual cases.

WHEAT

GROSS INCOME:	2.0 t/ha x $84.00/t		$168.00
VARIABLE COSTS:	Cultivation	2.50	
	Harrows	1.50	
	Cultivator	2.50	
	Cultivator	2.00	
	Seeding	2.00	
	Seed	8.00	
	Fertilizer 200kg/ha x $70/t	14.00	
	Weed control - Treflan	2.90	
	Harvesting	10.00	$ 45.00
			$122.00

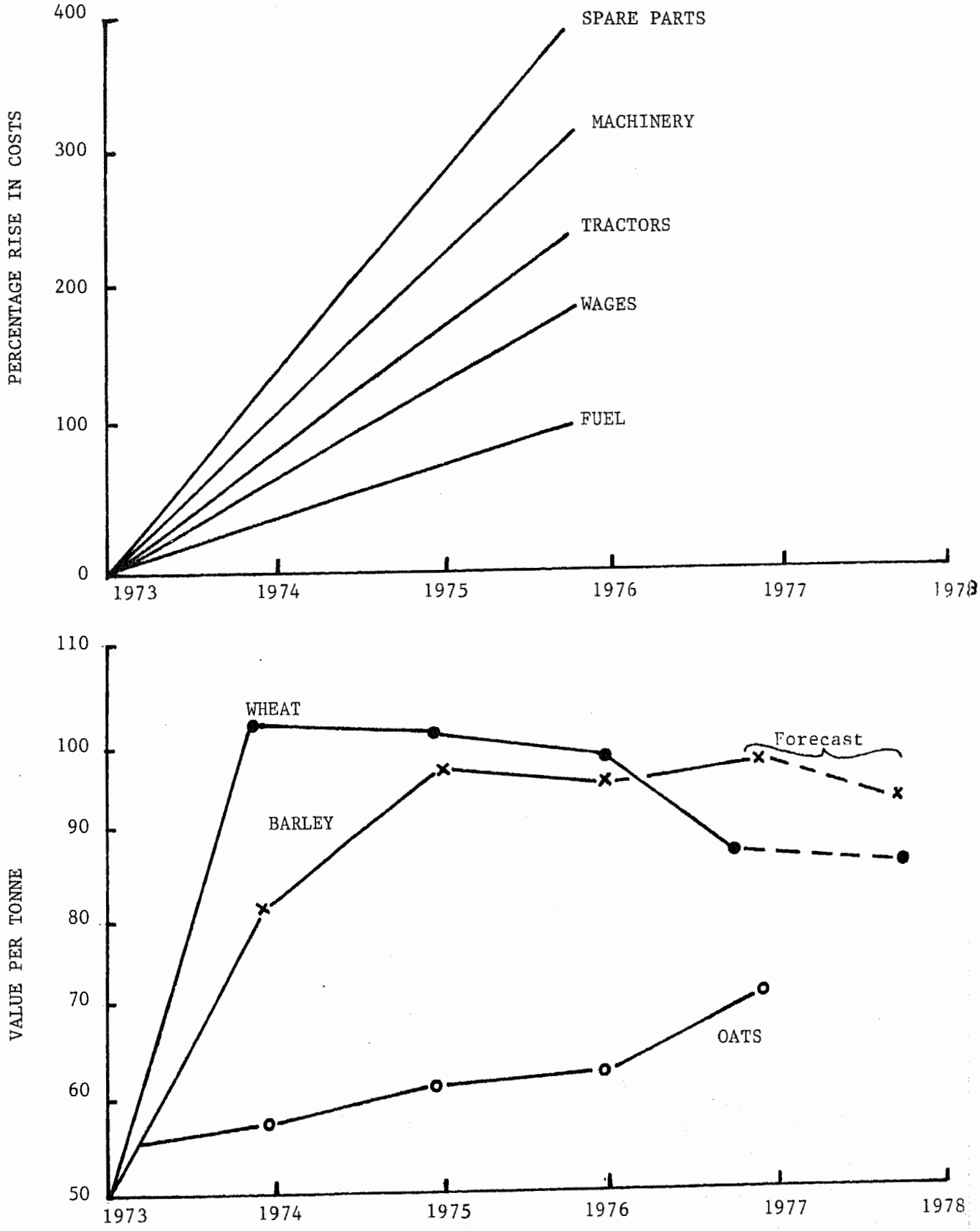
BARLEY

GROSS INCOME:	2 tonne/ha x $98.00/tonne		$196.00
VARIABLE COSTS:	Cultivation	2.50	
	Harrows	1.50	
	Cultivation	2.00	
	Cultivation	2.00	
	Seeding	2.00	
	Seed	8.00	
	Fertilizer	14.00	
	Weed control	2.90	
	Harvesting	10.00	$ 44.90
			$151.10

OATS

GROSS INCOME:	2.0 tonne/ha x $70.00/t		$140/00
VARIABLE COSTS:	Cultivation	2.50	
	Harrows	1.50	
	Cultivation	2.00	
	Seeding	2.00	
	Seed ($80/t clean)	4.00	
	Fertilizer 200kg/ha x $70/t	14.00	
	Harvesting	10.00	36.00
			$104.00

Figure 1 - Gross Margins of Wheat, Barley, Oats and the general trend in the Machine and Operating Costs compared with Gross Returns.



THE ROLE OF LIVESTOCK IN THE MIXED FARMING AREAS OF SOUTH AUSTRALIA

J.W. McMahon

Farmer, Booborowie

In the beginning I would like to ask the question -

"What are we farming for?'

1. To be our own boss
2. As a way of life
3. Because it's the only job we know
4. To make a dollar.

From 1950 until about 1968 I was what is sometimes known as a traditional Wheat-Sheep Farmer.

In 1967 a few more acres were purchased on a budget based on growing wheat. At this time "Wheat Quotas" were introduced. This wrecked the budget and a reassessment had to be made. It was suggested that I run more sheep, I was prepared to try anything. I became involved with some Agricultural Department officers and one Dave Thomas. Dave Thomas had for a number of years been involved in a heavy stocking programme. Without going into detail of how it happened I increased the stocking rate in excess of 100% in the first year, going from some 900-950 sheep comprising 400 ewes, 200 ewe hoggets and 350 lambs to 2400 sheep.

This caused new problems and also a change in management procedure. Since then the stocking rate has been increased to approximately 3 sheep per acre. Under various methods the D.S.E. rate is sometimes in excess of 3 D.S.E.

At present I am carrying approximately -

1300	ewes (mated)
600	" (unmated)
1300	wethers
560	hoggets (mixed sex)
40	rams
3800	

Approximately 400 have been sold this year. Approximately 200 died (120 died of ryegrass). This makes a total of between 4200-4400 carried in the immediate past 12 months on 1500 acres with a rainfall of 10.57 inches.

The rainfall was distributed thus:-

	Pts.		Pts.
Jan.	Nil	July	69
Feb.	118	Aug.	76
Mar.	Nil	Sept.	117
Apr.	Nil	Oct.	414
May	60	Nov.	121
June	70	Dec.	12

Because of rainfall only 35 acres were cropped if you can call the method cropping. Six row barley was sown in a stubble with just the sowing tynes on a combine in mid August with 40 pts of rain.

To date (July 20th) the rainfall this year is 342 Pts. distributed thus:-

Jan.	Nil	May	115
Feb.	15	June	153
Mar.	33	July(20)	Nil
Apr.	26		

This year another 746 acres have been purchased and because of the cost of stocking 740 acres have been sown to wheat and barley on ley land. The stocking rate will therefore be similar to last year depending on the lambing percentage.

Having progressed (if production can be judged as progress (about 33 lbs wool acre)) this far, one looks back at the changes that have taken place in the management etc., and one finds some very interesting changes.

In summing up these changes I tend to confine them thus and in this order:-

1. Changes to as well as in management
2. Changes to and with pastures
3. Changes to and in the habits of stock.

These changes I think, can best be outlined in answer to questions rather than going into details which people here may or may not want to become involved in.

At this stage, one comes to a problem of decision. Decisions always have to be made in all avenues of farming. None are easy. Some are easier than others. This particular decision happens to be a difficult one because at this stage the problems of management are of direction as well as method. In order to outline this problem I will have to be more specific.

A good pasture capable of carrying 3 sheep to the acre in my acre is a barley grass-clover pasture.

Don't laugh - without barley grass it may be possible but I don't know how.

Starting from a crop it takes up to 5 years to reach this good pasture.

This is where the problem arises. One cannot have a good pasture and an alternate, or a 1 in 3 cropping programme.

At the beginning of this paper a question was asked,

What are we farming for?

My answer combines various ideas none of which are possible without the making of a dollar.

Therefore in making this decision profitability is of prime importance.

We then have to write down some figutes which would look something like this:-

Returns per sheep		Cost per sheep	
Wool 5kg @ $2	= $10	1 bus. oats	= $1.00
Sales of sheep - assume sell 1 in 10 of total @ $8 per head	= 80¢	Shearing	= 53¢
		Dipping	= 4¢
		Crutching	= 17¢
		Sundry	= 26¢
	$10.80		$2.00

Nett per sheep = $8.80

Profit per acre @ 3 sheep per acre = $26.40

It is generally accepted that the cost per acre of growing a crop varies between $30 and $36 per acre. In the Hundred of Ayers the average yield per acre is 23 bushels. If then we allow an average yield of 8 bags per acre @ $8/bag (i.e. $96/tonne) we have a gross return of $64 per acre.

Therefore a gross return of	$64/acre
Less Costs (lowest costs)	30/acre
Nett profit	$34/acre

if every acre is cropped every year.

Using an alternate cropping programme we have a nett profit of $17/acre plus what we can get from the pasture year. Allowing a nett profit of $6.60 for 1st year pasture we get:-

Nett profit from crop/acre	$17
" " " pasture/acre	6.60
Nett profit per acre	$23.60

If a programme of 1 crop in 3 is used we get:-

Nett profit from crop/acre		$11.33
" " "	1st year pasture $6.60	
" " "	2nd year pasture $8.80	
	$15.40	
divide by 2		
	=$ 7.70	7.70
Nett profit per acre		$19.03

I have allowed for a carrying capcity of 3/4 sheep for 1st year pasture and 1 sheep for 2nd year pasture. You may disagree. I have not charged for resowing the pasture after crop. This would need examining. Also, the possibility of rather heavy feeding programme or purchase of sheep at wrong time regarding usual trends in prices.

The next part of the discussion is:-

1. What do I like doing?
2. What do I do best?

My answer based on profitability was easy. My answer based on habit was hard.

This was assisted last year by the type of year with 275 pts. of rain between the end of February and the end of August. I could not dig the ground up. Whether I made the decision or the decision was made for me I do not know. I no doubt will have some serious discussions with my consultant in the future.

I was invited to give a paper on "The role of livestock (sheep, cattle and pigs) in the mixed farming areas of S.A." and have arrived at a decision which I think belies the heading.

I have as you can obviously see, deliberately not mentioned cattle and pigs. I have had little to do with pigs and nothing to do with cattle (a point which pleases me).

I would not of course suggest that a programme like this could be carried out everywhere but would suggest that improved overall production can be achieved by seriously examining different ideas.

What I have put in front of you is a "Different Idea", which if it had been suggested to me 10-12 years ago I would have rejected.

How silly I was - am - or whatever!

FLOOR DISCUSSION

N. MATZ - Why did you look at stock instead of barley at the time of the wheat quotas.

J. McMAHON - At the time all alternatives were looked at and barley was not as profitable as sheep.

R. BEACH - Have you rethought thisprogramme in the light of present barley prices? Do you grow barley now?

J. McMAHON - I've got 600 acres in.

A. GLOVER - You have posed the question 'how silly I was'. Could you say if you have got out of the financial trouble you were in when wheat quotas were introduced?

J. McMAHON - I'll answer it this way: ten years ago we owned 1140 acres, we now own 2250 acres.

B. WIGNEY - Are you absolutely committed to this system or is it a form of a rotation? For example if sheep went to $20 would you sell and go into cropping.

J. McMAHON - I would change if I could make more money without upsetting my ability to change again or go back to the present system in future. However I would be very cautious about selling my assets.

E. HIGGS - What does the farm look like - for example it is undulating, do you grow lucerne or what type of clovers?

J. McMAHON - Lucerne will not survive, but we grow Geraldton sub clover and barley grass.

M. McKAY - Has the change created in you the ability to make a change a lot easier than it would have been made five years ago?

J. McMAHON - Yes. Once you have made the decision to change you become a little more critical of yourself and the things you do. You have to have a reason other than "thats what the old man did".

continued in part 2