Farming Systems in the Northern Cropping Region of NSW: An Economic Analysis

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Abstract

This report presents a description of the northern cropping region of NSW and of several identifiable crop-based dryland farming systems therein. Six whole-farm budgets are described based on subregional characteristics and the related farming systems. They include agronomic and agricultural production characteristics as technical parameters in a transparent financial framework, and use a computer spreadsheet format to allow analysis of alternative technologies and management scenarios. Alternative crop rotations in a whole-farm context were compared, relating to six sub-regions in northern NSW.

Keywords: farming systems, whole farm budgeting, NSW, crop rotations

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Acronyms and Abbreviations Used in This Report

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
DSE	dry sheep equivalents
GRDC	Grains Research and Development Organisation
ha	hectare(s)
lf	long fallow
LGA	Local Government Area
RLPB	Rural Lands Protection Board

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Executive Summary

This report presents a description of six important crop-based dryland farming systems in the northern cropping region of NSW. The northern cropping region has been described in terms of physical and financial characteristics. The trend in farming practices with respect to tillage, crop rotations and the role of pastures and livestock in recent decades is also described. From discussions with farmer groups and research and advisory staff, six farming systems were identified which differ in crop rotations and in the role of pastures and livestock because of soil and rainfall characteristics. These farming systems have been described in detail and representative farm models have been developed. These models are based on assumptions about the size of a typical farm and other resources such as labour, overhead costs, assets and liabilities and the nature of the cropping rotation used. The whole farm budgets were constructed from these assumptions and from information on enterprise gross margin budgets.

The whole farm budget provides a snapshot of the financial performance at a particular point in time of a farm with a particular set of resources. While the representative farm models presented in this Report may give a broad indication of the financial performance of many farms in the northern cropping zone, they may be misleading for farms with markedly different resources or enterprise rotations to those of the representative farms.

The six models are intended to be representative of six subregional areas which differ by characteristics of soil type, rainfall patterns, frost incidence and temperature. These include Western Clay (Walgett and Coonamble grey clays), Western Red (Coonamble red loams), Inner West (Moree Plains and west of Narrabri), Inner East (Yallaroi and east of Narrabri), North-East slopes (Inverell) and Liverpool Plains (Gunnedah and Quirindi). They vary in size from 1050 ha to 6080 ha. The main difference in crop rotations, influenced by soil type and rainfall, was use of lucerne in the rotation in the Western Red and North-East Slopes subregions, compared to continuous cropping in the other four areas. The returns to capital (business return on owner's equity) varied from 4.1 % in the North-East Slopes subregion to 8.2% for the Western Red subregion. These financial results were based on prices and costs prevalent in the early 2000s.

Apart from providing a broad brush picture of financial performance, the models were used to analyse an important farming issue in each subregion. The models allowed comparisons of alternative crop rotations in a whole-farm context rather than on the basis of enterprise gross margins, although they remain simple comparisons of before and after changes with little information about the timing and cost of changing rotations. The results presented show that in many cases there is little difference between rotations in economic terms except in the case of the Liverpool Plains. The rotations used by farmers in the northern cropping zone vary in many small ways hence it is not surprising that we observe little change in profit from minor variations in the cropping rotations analysed in these representative farm models.

The Liverpool Plains case study involved a comparison of long fallow wheat-sorghum strip cropping with a sorghum-wheat opportunity cropping rotation. In this case the latter strategy outperformed the strip cropping rotation substantially. The assumptions about cropping frequency deriving from the opportunity cropping management are important in this comparison, and the use of this model has allowed these details to be included in a whole-farm context. This demonstrates the potential advantages in using such an analytical tool.

An important objective of our work was to develop some tools which can help in assessing the change in farm profit from new ideas and technologies generated by the research and advisory activities of NSW Department of Primary Industries. The models can also be used to give an assessment of the impact on farm profit of policy changes with respect to the management of natural resources. Our work has been aimed at developing whole-farm representations or models that can be utilised, by researchers, extension officers and farmers, to assess potential changes. Such models can be used in at least two ways – as a sieve for technologies while they are being developed or prior to release, and as a tool to strengthen extension programs by demonstrating to farmers that there may be sufficient financial advantage in a technology that it warrants adoption. Of course we acknowledge that there are other aspects of new technologies (apart from the financial) that influence adoption decisions. We hope that economic analysis at the enterprise and farm level will provide information which supplements other issues bearing on the decision.

This work was completed prior to the formation of the NSW Department of Primary Industries (on July1, 2004) through an amalgamation of NSW Agriculture, NSW Fisheries, State Forests of NSW and the NSW Department of Mineral Resources.

1. Introduction

1.1 Introduction

The northern agricultural region of NSW has become a major agricultural production area. The northern cropping region (the focus of this report) is the crop-based areas of the northwest slopes and plains, and excludes the northern tablelands grazing industries. Crop (wheat, cotton, other cereals, pulses and oilseeds) and livestock (beef cattle, wool, lambs) production systems have developed on fertile soils in dryland and irrigated agricultural systems of this northern cropping region.

Our objective in this report has been to describe how farmers typically combine this range of crop and livestock enterprises in a whole farm context and to assess the financial performance of such farming systems. This is achieved by the development of whole-farm budgets for model farms thought to be representative of important farming systems in the northern cropping zone. The resulting whole-farm budgets are used to give a snapshot of the financial performance of the model farms and to analyse in a 'back-of-the-envelope' fashion, the financial implications of changes in cropping rotations. These models can be used to analyse changes in farm profit from other technologies or changes in policy with respect to the management of natural resources.

In the past 30 years there has been uncertainty as to why farmers and land holders in many countries ignore advice and technologies developed through research, development and extension (RD&E) processes to address perceived problems. Although there are a number of possible explanations, one school of thought has recognised that farmers may often have several competing objectives and operational constraints, and that they make decisions based on whole-farm and farm-family considerations. Another has acknowledged the interconnectedness between farm activities, the effect of limited farm resources, and particular institutional frameworks that complicate the decision. If advice and recommendations to farmers are based on RD&E which does not acknowledge the broader considerations that impact on farmers, then it may not be surprising if the recommendations are ignored. In this report we attempt to address some of these issues.

Farm decision makers may have several objectives which they try to achieve simultaneously. Economic evaluations of alternative technologies use profits as the primary incentive for decisions, because this is considered to be an important consideration for many farm decision makers. The farm models presented here assume the profit objective. However, we recognise that this is not the only possible motivation, and consider the results of such analyses to be only partial in providing information to farmers.

Financial budgeting can be used to estimate the change in profits from new technologies or management strategies. Profit changes can be considered at the enterprise level (eg gross margin budgets for alternative crops, partial budgets, cash flow budgets), for crop sequences (eg winter and summer crop sequence budgets, including animals grazing ley pastures), and at the whole-farm level. Enterprise and whole-farm budgets are presented in this report to represent some common farming systems in the region. These are simple and transparent financial models of the farms, which can be manipulated to undertake analyses. However, all models are simplified representations of reality. The value of a model depends on how it is used, and the results of analysis with models need to be interpreted carefully.

1.2 Use of Representative Farm Analysis

Whole farm budgets were developed and presented for each subregion. These are broadly representative of typical farming systems within the subregions, although we must be careful when interpreting the results for individual farms. We propose that the models be used as the basis for face-to-face discussions and interaction between researchers, advisors and farmers. This would include generating and analysing 'what if' scenarios. Section 4 also contains examples of applications of the models to particular farming system questions within each subregion. The results from such analyses, together with interactions between different people will hopefully lead to an improved understanding on the part of all participants. The models and model results are a means to the end of improved knowledge and communication, rather than an end in themselves.

This Report presents a description of farming in the northern cropping region of NSW and an indication of its profitability. The representative farm models and associated gross margin and whole farm budgets can be used as templates allowing variations from the representative farm model to be examined. Farmers may wish to adapt this template for their own farms.

The whole farm budget provides a snapshot at a particular point in time of a farm with a particular set of resources. Hence while this Report may give a broad indication of what is happening on many farms in the northern cropping region of NSW, it may be misleading for farms with markedly different soil type, climate and resources to those of the representative farm.

Additionally while the whole farm budget can be manipulated to indicate the change in farm income from a new technology or resource management strategy, again we only get before and after pictures. If the change in technology has an impact on soil fertility for example, that takes many years to work through the system, then a simple before and after comparison of whole farm budgets is an inadequate basis for such an important investment decision. More sophisticated budgeting tools that allow the impact of such changes over many years to be estimated and aggregated are required.

In writing this report and developing this representative farm model we have benefited greatly from discussions with northern NSW farmers and with the extension and research staff of the region.

1.3 Outline of Report

The northern cropping region is defined, described and divided into six subregions as shown in the next section. This division is based on characteristics considered to be important in separating the relevant farming practices. Implicitly this says that each subregion is relatively homogeneous in nature. The six budgets are intended to be representative of six subregional areas which differ by characteristics of soil type, rainfall patterns, frost incidence and temperature. These include Western Clay (Walgett and Coonamble grey clays), Western Red (Coonamble red loams), Inner West (Moree Plains and west of Narrabri), Inner East (Yallaroi and east of Narrabri), North-east slopes (Inverell) and Liverpool Plains (Gunnedah and Quirindi).Section 3 contains statistical information about the farm industries, farms and farm districts within the region. Section 4 outlines the general structure of the representative farm models and describes some of the key assumptions. Sections 5 through to 10 reports the

results from each representative farm model in turn and Section 11 presents some conclusions.

2. Agriculture in North-West NSW

2.1 The Region

This section contains a description of the northern cropping region of NSW. Crop-based industries are generally located on fertile soils with little or no slope. The region is also characterised by rainfall distributed throughout the whole year, allowing both summer and winter crops to be grown. Because NSW Department of Primary Industries is a state agency the northern boundary is drawn along the state border with Queensland, but some of the results from analyses in NSW are also likely to be appropriate for southern Queensland. Within the region though, there are a number of internal differences justifying specification of several distinctive subregions.

In defining the region a crop focus was considered important because of the size of the industry and the number of technology and agricultural resource use issues which relate to cropping practices. The main focus was on the crop areas in NSW with summer rainfall allowing cropping in both winter and summer. The geographical boundaries were in the south the latitude of Willow Tree (31 degrees South), in the north the latitude of the Queensland border (29 degrees South), in the west the longitude of Walgett (148 degrees East), and in the east the longitude of Inverell (151 degrees East). The soil types associated with successful cropping comprise the fertile clays and loams. Average precipitation levels range from less than 500 to more than 700 mm rainfall per annum in the region, with limits in the west being the 450 mm rainfall isohyet and in the east being the smaller areas of arable land with rising slope. Agricultural areas of the northern tablelands and parts of the north-west slopes of NSW were excluded because they do not include cropping enterprises.

This region contains both dryland and irrigated cropping areas. Irrigation water and infrastructure associated with dams on the Namoi and Gwydir Rivers, and from groundwater sources, allow irrigated cropping in the region. Cotton is the principal irrigated crop and the cotton industry has developed rapidly in the last 30 years. The main focus in this report is on dryland agriculture; however the management principles apply to all types of agriculture.

These regional characteristics fit into a statistical classification of NSW. The region is contained within the north-west slopes and plains topographical areas, and consists of parts of the Northern and North Western Statistical Divisions as defined by the Australian Bureau of Statistics (ABS). These can also be defined by Local Government Area (LGA) groupings. The region comprises the LGAs of Inverell, Yallaroi, Moree Plains, Bingara, Barraba, Manilla, Tamworth City, Parry, Quirindi, Gunnedah, Narrabri, Walgett, Coonamble and Coonabarabran. Figure 2.1 shows the defined region, including the main towns, roads and rivers.

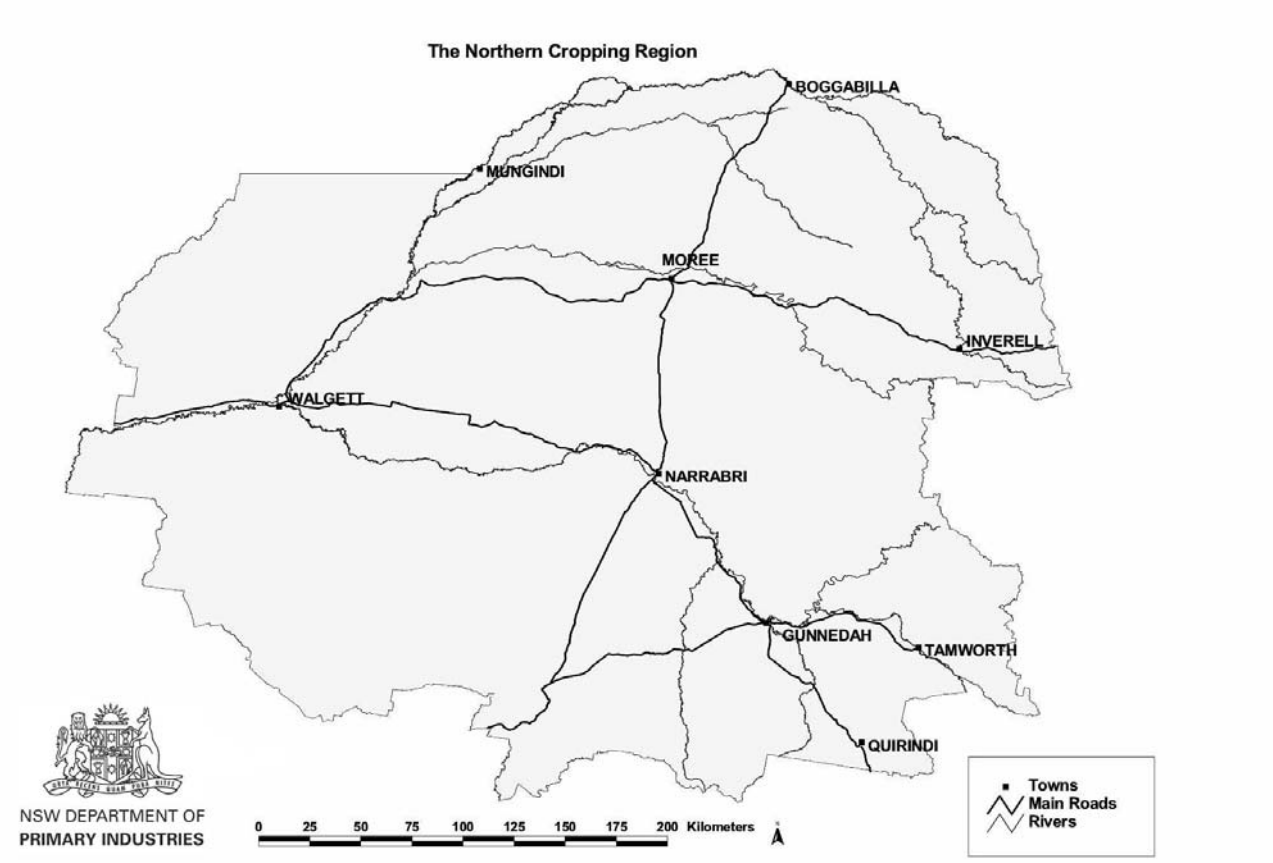


Figure 2.1 The northern cropping region of NSW

Regional soil and rainfall characteristics are shown in Figure 2.2. Between the 500 and 700 mm rainfall isohyets is a large area of relatively fertile soil with flat topography. Areas to the west with less than 500 mm rainfall become more marginal for dryland cropping.

About two-thirds of the rainfall in the region occurs between October and March. Rainfall increases in summer dominance to the north of the region. High intensity storms may occur during this period. The lowest and most variable rainfall occurs during autumn, which is the sowing time for winter crops. Planting times for both winter and summer crops are highly variable, and greatly affect potential yields (Holland *et al*. (1987); Marcellos and Felton (1992)). The region has traditionally produced high quality prime hard wheat, but other (durum) wheat, sorghum, oilseeds and pulse crops have more recently been produced.

The soil groupings in Figure 2.2 relate to the Factual Key classification (Northcote 1979). This classification includes sands; loams; dark, grey and brown clays; red and yellow massive earths; friable earths; and duplex soils classified according to soil and subsoil types. An amalgamation into five broad soil groups (clays, loams, massive earths, sands and duplex soils) is shown in Figure 2.2 based on suitability for agricultural and cropping activities. The clays and loam soil amalgamations are most favourable for cropping enterprises.

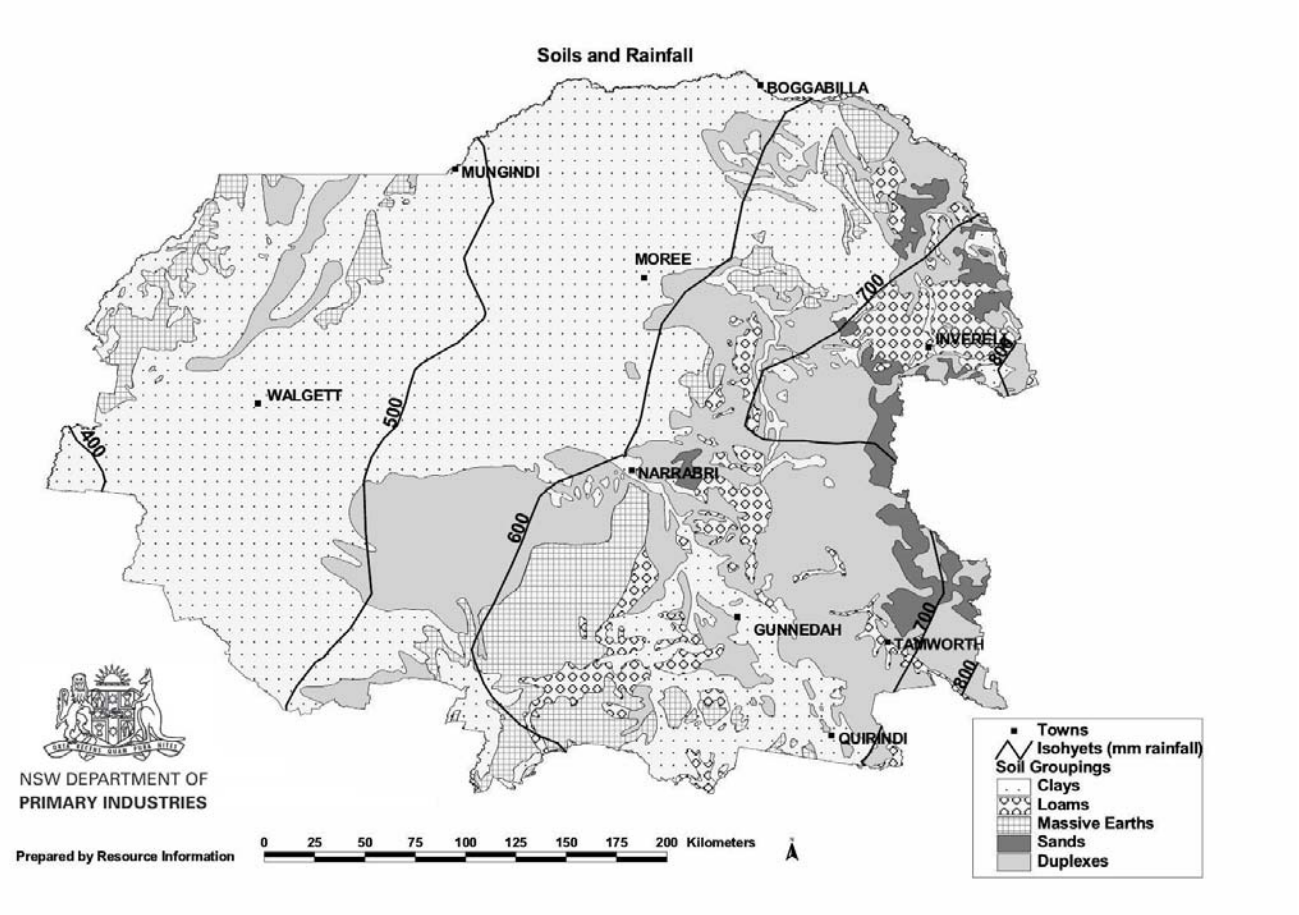


Figure 2.2 Soil and rainfall characteristics of the northern cropping region

There is a relatively new soil taxonomic classification which can be used for comparing and communicating about soils nationally, but not for mapping purposes. This is the Australian Soil Classification (Isbell 1996). Clay soils are called Vertosols in this classification. They have shrink-swell properties that exhibit strong cracking when dry. Australia has the greatest area and diversity of cracking clay soils of any country in the world. The best cropping soils in the region range from neutral to alkaline grey clays to black and red earths, often self-ameliorating due to their shrink-swell properties (Marcellos and Felton 1992). Large amounts of fallow rainfall can be stored in these soils for subsequent use by a crop.

Traditionally wheat has been the most widely grown winter crop, with sorghum the predominant summer crop (grown more in the south and east). Other crops (eg legumes, oilseeds) have not been widely adopted due to various pest, weed, disease and other agronomic (causing poor yield) problems, but some farmers have had success with them and have included them in their regular crop rotation.

The farming systems on vertosol soils have generally not developed as crop-pasture rotations because of the nature of the soil and problems with livestock grazing, especially when the soil is wet. Livestock are present and an important component of agriculture in the region, but sheep and cattle are often run on a separate part of the property where cropping is not practiced. Livestock infrastructure (internal fencing and water points) has generally been removed from cropping areas to maximise the efficiency of cropping operations. However

this also restricts opportunities to reintroduce pastures or forage crops into the cropping rotation due to the capital cost of reintroducing livestock infrastructure.

2.2 Cropping Activities and Representative Farm Areas

2.2.1 Past farming practices

Agricultural practices in the region have developed and become more sophisticated over the last 60 years. During the 1950s, tillage by shallow cultivation with disc ploughs and scarifiers drawn by low-powered tractors was the most common practice. 'Crop rotation' during this period usually meant continuous wheat with short fallow (i.e. summer fallow between each annual wheat crop). Some farmers occasionally grew lucerne, oats or sorghum or used long fallow (one wheat crop in two years). However, a widely practised pasture-crop ley farming system had not developed; although there had been a trend towards medic (mostly lucerne) based leys in western areas (Marcellos and Felton, 1992). Crop rotation with lucerne was also more common in the Inverell (north-east slopes) district (B. McGufficke, pers. comm., 2002).

In the 1960s cropping expanded rapidly as returns from grain increased relative to those from sheep, and tractor power increased. Large areas of native vegetation were cleared between 1962 and 1975 (Marcellos and Felton 1992). Conventional cultivation for seedbed preparation and weed control was traditionally practiced, but erosion was always a risk with this system.

During the 1970s tyned trash-working implements were introduced with large horse-power tractors. The implications of this were that stubble retention and reduced tillage practices became more practical. Reduced tillage practices were recommended because they were more efficient at storing water in the profile during fallow periods and lessened erosion potential during rainfall events. Weed control during fallow was achieved by spraying with herbicides. Fallowing was also important for soil fertility renewal via nitrogen mineralisation through break down of organic matter.

Strip cropping (growing crops in rotation in alternative strips) was more widely adopted in the Liverpool Plains during the 1970s to combat erosion damage caused by flood events. Fences were removed to avoid water channelling and runoff problems. The strips were between 20 to 100 metres wide and alternated between fallow, crop stubble and growing crop, using mostly wheat, sunflowers and sorghum.

In the 1980s a survey of crop rotation, tillage, fertiliser use and weed control was undertaken (Martin *et al*. 1988) covering the Shires of Moree, Narrabri, Yallaroi, Gunnedah, Inverell, Quirindi, Parry, Manilla, Bingara and Barraba. The survey found that adoption of new wheat varieties and herbicides was rapid, but adoption of the use of nitrogen fertilisers was slow. The study concluded that the change in crop rotation practices since the 1940s was only slight, meaning that cropping paddocks were mostly kept in continuous production, particularly in the more western shires. Eighty-one percent of farmers surveyed cultivated three to five times every year, implying a high cropping intensity and conventional fallowing. Rotations with pastures or with cereals grown every second year were more common in the eastern part of the area surveyed, which on average receives more annual rainfall.

The survey indicated that 74% of farmers in the northern wheat belt practised conventional tillage, 14% practised reduced tillage and used herbicides and 1% used no till. In the same survey, less than 30% of growers burned stubble. It was also found that 66% of farmers included sorghum, 28% lucerne, 20% grazing oats, 18% sunflower and 14% barley as

alternatives to wheat. About half of the farmers surveyed used fertilisers, but the more northerly shires used the least.

Hamblin and Kyneur (1993) observed that crop rotations with pastures, or with a cereal crop every two years, were more common in the higher rainfall areas in the north-east. Flavel and McLeish (1996) presented survey results for the Liverpool Plains and reported that 57% of respondents included pasture in a rotation. Fixed crop rotations were used by 56% of respondents, and 35% of respondents used response cropping. Only 5% reported continuous monoculture. Martin and Edwards (2001) reported results of a 1999 survey of cereal growers in the Warren/Narromine, Coonamble and Walgett areas of NSW. Average sizes of surveyed farms in the Coonamble and Walgett areas were 2917 and 6081 ha respectively. The mean percentage of farm area under crop was 45 and 20, and the mean percentage under sown pasture was 4 and zero percent respectively. These figures imply that pastures as part of crop rotations are less likely in the western part of the region.

By the early 1990s dryland chickpeas and cotton had become major crops. Generally in drier areas, the crops were limited to sequences including wheat, barley, sorghum and chickpeas. There had been a trend towards medic pasture leys in drier western areas where nitrogen fertiliser was not widely used. Lucerne plantings had increased in the older cropping areas to support more livestock (Marcellos and Felton 1992).

A survey undertaken in 1992 (Hayman and Daniells 1997) aimed to ascertain current rotation practices and the main reasons behind crop rotation decisions in order to enable more effective research and technology transfer. This study re-visited 49 of the 50 farms surveyed by personal interview in the Martin *et al*. (1988) study. Again weeds were the most important factor in deciding what crop to plant next, however, 38 percent considered price signals (i.e. commodity prices) at sowing to be an important factor. However, Nelson *et al*. (2002) reported a survey of farmers and extension professionals who rated financial return (gross margin) as the key factor in crop selection.

A formal measure of productivity growth in the general region was presented by Knopke *et al*. (2000). They reported annual growth in total factor productivity on crop farms from 1978-79 to 1998-99. Average rates of productivity growth for north-east NSW / south-east Queensland and north-west NSW / south-west Queensland were 2.7 and 3.7% per annum, respectively. The average for all northern farms was 3%.

2.2.2 Current cropping systems and key management issues

Developments in soil moisture measurement and opportunity crop sowing rules have been important in the growth of cropping activities and rotations in the region. With the ability to measure soil moisture content by simple mechanical probes or water budget estimation techniques, the practice of fallowing to fill a soil profile with moisture and then planting a crop in the next sowing window has improved crop management. This has been called opportunity or response cropping, and involves using the water when it is available. Both winter and summer crops can be grown, and although this is an intensification of land use it has also been considered to be an improvement in water use efficiency. Stubble retention, chemical weed control and minimum or zero tillage practices have continued to be important for erosion control. Crop disease management has become vital when using these practices.

Wheat is the principal dryland crop in the region, while barley, sorghum, chickpeas and sunflower are the major crops used in rotation with wheat. Cotton is the main irrigated crop.

For both dryland and irrigated crop production the control of weeds, insect pests and crop diseases have become increasingly important. Restrictions on chemical products and usage, as well as developing resistance to some pesticides has meant that rotating crops and using other management practices have increased the complexity of crop management. Integrated pest, weed and resistance management strategies are becoming increasingly necessary, as has the concept of area-wide management in irrigated cotton production to control insect pests.

Winter-summer crop rotations are subject to a number of constraints. For example, there is often overlap between the harvesting time of winter crops and the sowing time of summer crops. If dryland cotton is sown in October and wheat harvesting begins in November then it is not possible to grow a cotton crop immediately following wheat (because cotton has specific temperature and day-length requirements). It is possible to grow a wheat crop following a cotton crop, since cotton harvesting occurs in April/May and wheat is sown from late May until July. In dryland situations, soil moisture may limit this double-cropping practice. Other constraints include machinery and labour availability to conduct 'continuous cropping', and managerial complexity which may be important with existing levels of knowledge. Risk attitudes associated with fluctuating cropping income caused by climatic variation can also be important in these considerations.

Hamblin and Kyneur (1993) observed that the rotation of cereal crops with pastures (particularly lucerne) has been perceived for decades as less exploitive and more sustainable, but according to Martin *et al* (1988), only twenty-three percent of those surveyed grew pastures. Hamblin and Kyneur (1993) suggested that for many farmers, who have a mix of soil types and crop and stock enterprises, the management requirements of cereal crop, pulse crop and pasture rotations were too complex to be practical. In addition, low wool and cattle prices at the time were likely to have been a disincentive to increasing improved pasture areas or introducing pasture into a rotation system. In the western areas landholders tend to keep their crop and livestock areas separate, due to soil compaction by livestock. This is different from typical rotations in the Central West of NSW, where livestock are included in crop-pasture rotations (Patton and Mullen 2001).

2.2.3 Representative farm areas

Norman and Collinson (1986) discussed one function of the descriptive or diagnostic stage of farming systems research as classifying farming families into homogeneous groups or representative farm areas. 'Farmers within each specific group should have the same problems and development alternatives and should react in the same way to policy changes. Target groups should replace conventional frameworks as a basis for research and development planning (Norman and Collinson 1986, p. 20).

Within the region there are characteristics of soil type, rainfall patterns, frost incidence and temperatures that have implications for crop production in subregional areas. Figure 2.3 shows a classification of the region into six subregions that can be distinguished as relatively homogeneous areas.

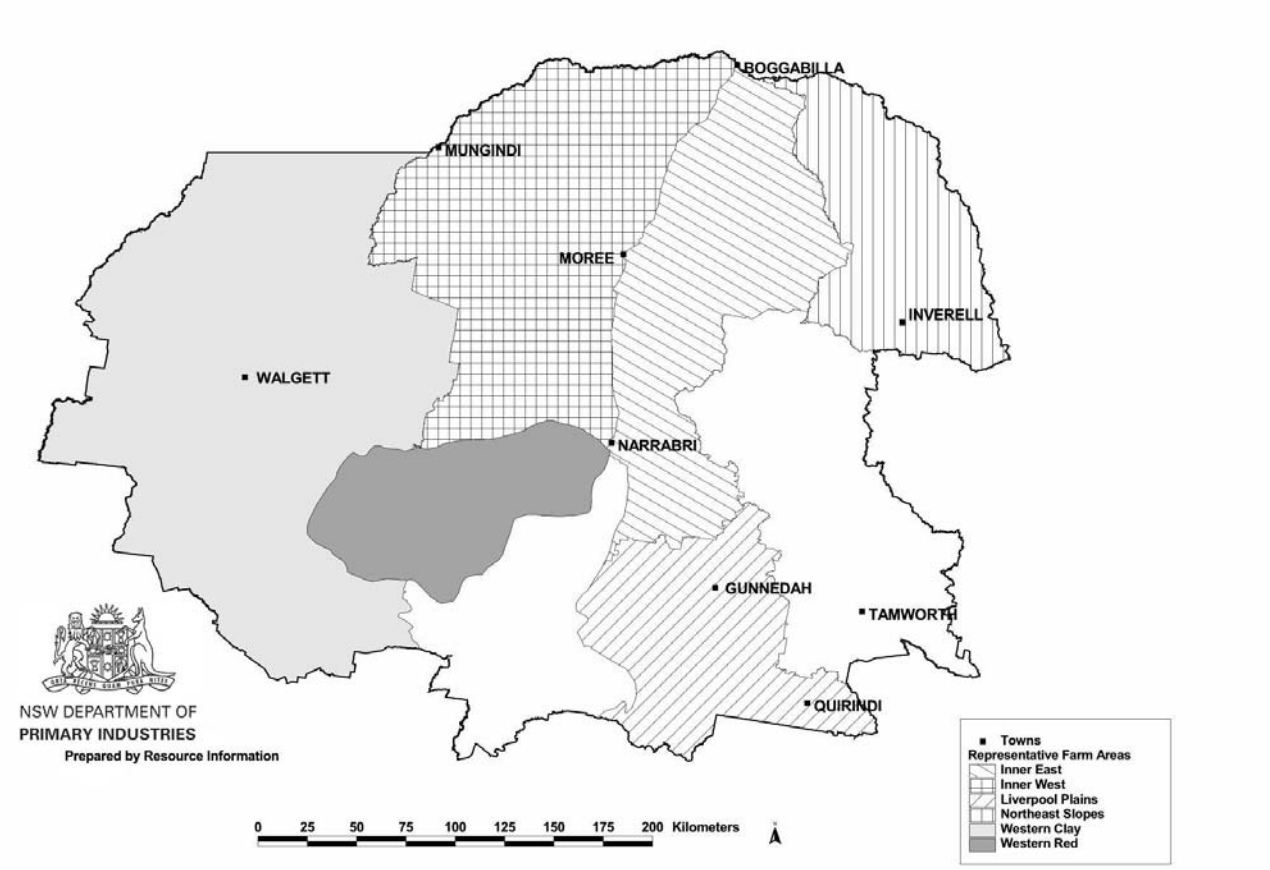


Figure 2.3 Representative farm areas in the northern cropping region

The six representative subregions can be described briefly as follows (John Kneipp, NSW Department of Primary Industries, and personal communication):

- The Western Clay subregion has moderate soil fertility. Initially these soils were highly fertile soils but have been run down over 30 years of cropping. Grain-growers are now adding nitrogen fertiliser or including chickpeas in the rotation to improve fertility. There is less rainfall and temperatures are higher in summer, so that management strategies to make the most of available moisture are followed, including earlier sowing. Relevant LGAs are Walgett and Coonamble;
- The Western Red subregion contains mixed red soils which were some of the earliest areas cropped. Soil fertility is moderate to low, and is suitable for rehabilitation with legumes, especially lucerne as a ley pasture in the rotation;
- The Inner West subregion has moderate soil fertility on the heavy clay soils with good water storage capacity. These soils are responsive to added nitrogen, and chickpea crops included in the rotations are working well. This area is mostly covered by the Moree Plains LGA and the western half of the Narrabri LGA;
- The Inner East subregion has a range of soil types, with moderately fertile black and grey cracking clays being the predominant type used for cropping. This area is covered by the Yallaroi LGA, the eastern half of the Narrabri LGA and the south-eastern part of the Moree Plains LGA;
- The Northeast Slopes subregion has similar soil and rainfall characteristics to the Inner East but there are more crop rotations with lucerne pastures and a superior summer cropping environment due to higher rainfall. This area is mainly the Inverell LGA; and

- The Liverpool Plains subregion has similar soil and rainfall characteristics to the Inner East, with moderately fertile black and grey cracking clays being the predominant type used for cropping. Because temperatures are not so high the crop yields are better than in other subregions. Some pastures are in the mixed cropping rotations. This area comprises the Gunnedah LGA, part of the eastern side of the Coonabarabran LGA and the northern part of the Quirindi LGA.

There are two areas in Figure 2.3 which have been excluded because cropping is not conducted on a large scale, this due to soil type and topographical constraints. The six subregions are homogeneous enough for a representative farm model or analysis to be valuable in analysing management alternatives.

3. Statistical Information for the Region

Statistical information from ABS and Australian Bureau of Agricultural and Resource Economics (ABARE) provides an idea of the scale of farm industries and performance characteristics of farm units in the region.

3.1 Regional Characteristics

Agricultural Census data for 2001 presented in Table 3.1 indicate the size and value of cropping industries in the region. Wheat and other cereal production were the largest cropping activities in terms of land area utilised. Irrigated cotton is a high-valued crop which was grown on a smaller area by fewer growers.

Census information for the sheep, wool and beef industries is shown in Table 3.2. There are substantial numbers of sheep and beef cattle in the region. An important farming systems question relates to whether these livestock and pasture activities are integrated into cropping systems, as is the case for Mediterranean climates in South Eastern Australia and Western Australia. From discussions with farmers and industry observers it appears that pastures and livestock are not generally incorporated into crop rotations on a wide scale. One reason for this would be that opportunity cropping requires flexibility that is probably incompatible with the need to keep pastures for a number of years. There is also the need to store soil moisture during fallow which is accomplished by chemical control of weeds, so that there is less grazing value for livestock in crop stubble. Another reason, already mentioned, relates to the potential compaction damage to wet clay soil surfaces caused by livestock.

Total value of production is shown in Table 3.3. This value varies from season to season, from $1.78 billion in 1996-97 (a bumper crop year) to $1.48 billion in 2000-01 (ABS 2001). Three years of survey data from ABARE are presented in Table 3.4. These relate to the industry classification of Wheat and Other Crops (i.e. predominantly cropping) and the North West Slopes and Plains region of NSW. Average farm size in those years was around 3500 ha, with cropping and livestock enterprises contributing to farm returns. Farm cash income and farm business profit varied greatly from year to year, including years of negative returns. The average equity ratio varied from 72 to 77%, indicating substantial farm debt levels to be serviced by the farm enterprises.

The average farm figures in Table 3.4 are consistent with the Agricultural Census information in Tables 3.1 to 3.3, in that there are crops (mainly wheat) and livestock on dryland farms. Substantial amounts of labour and capital are employed, and rates of return to capital are variable. The equity ratio of between 70 and 80% indicates a substantial farm business debt required to be serviced by farming operations.

Table 3.1 Northern cropping region dryland crop production, area and value, 2001

Crop type	Area ha	Production tonnes	Value $' 000
Wheat	1,149,926	1,489,615	286,622
Barley	158,017	254,318	45,568
Grain sorghum	222,414	652,719	87,409
Total cereals for grain	1,561,011	2,452,754	434,667
Mung beans	22,160	14,948	7,843
Soy beans	7,119	8,815	2,974
Chickpeas	112,621	70,635	32,686
Pulses (grain legumes)	174,563	118,392	48,997
Sunflowers	12,504	14,087	7,349
Oilseeds	35,946	40,861	15,714
Cotton – dryland	50,719	na	na
ginned lint	na	70,571	nc
Irrigated pasture	4,761	nc	nc
Irrigated cereals	24,437	nc	nc
Cotton – irrigated	207,618	na	na
ginned lint (includes dryland lint value)	na	304,366	635,372

Source: ABS Agricultural Census 2001 for Walgett, Coonamble, Moree East, Yallaroi, Inverell, Narrabri , Gunnedah and Quirindi LGAs. na = not applicable nc = not collected

Table 3.2 Northern cropping region livestock numbers and pasture areas, 2001

Livestock	Number	Production '000 kg	Value $ '000
Sheep and lambs (31 March)	2,729,837	na	nc
Wool	2,822,030	12,353	67,049
Beef cows/heifers	384,148	na	nc
Meat cattle	876,443	na	nc
Pastures	**Area (ha)**		
Native/naturalised	2,889,674	nc	nc
Sown (incl. pure lucerne)	342,173	nc	nc
Lucerne & other species	88,627	nc	nc
Lucerne (pure)	100,767	nc	nc

Source: ABS Agricultural Census 2001. na = not applicable nc = not collected

Table 3.3 Northern cropping region value of agricultural production, 2001

Category	Value $'000
Total value of fruit	4,418
Total value of crop (excl. pastures/grasses)	1,155,260
Total value of all crops	1,173,662
Total value of livestock slaughtered	234,799
Total value of livestock products	71,655
Total value of agriculture	1,480,117

Source: ABS Agricultural Census 2001

Table 3.4 Physical and financial performance indicators, North West Slopes and Plains of NSW, Wheat and Other Crops Industry, 1998-99 to 2000-01, average per farm

Year	Unit	1998-99		1999-2000		2000-01p	
Population	no	646		831		949	
Sample Contributing	no	18		19		27	
Area operated June 30	ha	3 349	(20)	2 426	(15)	3 437	(20)
Wheat sown	ha	851	(30)	840	(16)	760	(12)
Sheep June 30	no	1 955	(33)	604	(51)	905	(59)
Beef cattle June 30	no	244	(41)	506	(66)	218	(29)
Areas harvested:							
- wheat	ha	756	(33)	828	(16)	634	(10)
- barley	ha	187	(32)	86	(43)	69	(30)
- sorghum	ha	140	(29)	164	(26)	139	(20)
- grain legumes	ha	24	(77)	166	(41)	189	(22)
- oilseeds	ha	70	(73)	32	(68)	73	(35)
Total cash crop area harvested	ha	1 229	(21)	1 291	(14)	1 164	(8)
Wheat production	t	1 673	(35)	2 236	(17)	991	(11)
Total labour weeks worked	wks	141	(15)	184	(23)	158	(9)
Cash receipts							
Livestock-							
- sheep	$	26 675	(30)	10 951	(40)	14 127	(45)
- beef cattle	$	86 887	(59)	149 511	(61)	129 874	(42)
Total wool gross receipts	$	32 280	(34)	17 823	(62)	16 306	(60)
Crops-							
- wheat	$	273 588	(33)	269 484	(14)	154 147	(11)
- barley	$	30 738	(42)	17 107	(46)	25 089	(36)
- sorghum	$	64 615	(35)	45 604	(36)	68 511	(30)
- grain legumes	$	7 943	(82)	93 600	(49)	53 107	(29)
- oilseeds	$	26 555	(67)	21 057	(55)	30 376	(36)
- other crops	$	68 234	(83)	17 839	(201)	100 240	(52)
Total crop gross receipts	$	479 711	(20)	480 099	(17)	455 500	(12)
Total cash receipts	$	673 815	(15)	717 748	(14)	699 723	(9)
Cash costs							
Wages for hired labour	$	25 545	(31)	43 263	(40)	35 596	(22)
Fertiliser	$	34 400	(22)	65 538	(18)	51 463	(20)
Crop and pasture chemicals	$	62 616	(25)	85 948	(24)	106 632	(14)
Fuel, oil and grease	$	34 791	(19)	54 186	(24)	60 157	(15)
Repairs and maintenance	$	39 032	(17)	48 901	(17)	68 650	(25)
Other materials	$	28 834	(19)	26 423	(25)	35 789	(23)
Contracts paid	$	48 474	(27)	42 021	(29)	41 697	(19)
Rates	$	10 369	(24)	11 550	(25)	10 260	(11)
Other services	$	98 682	(13)	99 727	(15)	88 003	(10)
Interest paid	$	43 948	(36)	60 991	(19)	70 239	(21)
Total cash costs	$	482 676	(15)	592 047	(13)	651 034	(11)
Farm cash income	$	191 139	(24)	125 701	(41)	48 689	(71)
Farm business profit	$	114 935	(41)	- 575	(5755)	- 95 092	(39)
Rate of return - excl capital app.	%	5.9	(28)	2.6	(31)	-0.5	(237)
Rate of return - incl capital app.	%	10.5	(29)	5.8	(29)	2.3	(38)
Farm business debt June 30	$	701 173	(33)	617 262	(23)	709 790	(24)
Equity ratio at 30 June	%	76	(7)	77	(9)	72	(8)

Source: ABARE surveys. Figures in parentheses are relative standard errors expressed as percentages of estimates. *p* Preliminary estimate

3.2 Subregional Characteristics

There are a number of farming systems of interest within this broad northern cropping region. Some data are available from ABS and ABARE at a sub-regional level. Crop production and livestock data from ABS are based on LGAs, and some but not all NSW Department of Primary Industries agronomy district boundaries are the same as LGA boundaries. Statistical information from the ABS is used to indicate cropping trends in the main LGAs (Table 3.5), and recent ABARE Farm Survey data indicates average farm business returns for the sub-regions (Tables 3.6 and 3.7).

The lack of Agricultural Census data between 1996 and 2001 (the census is now conducted every 5 years) required the use of information from NSW Department of Primary Industries agronomists for district trends (NSW Grains Report series) in crop areas grown post-1997 (Figures 3.1, 3.2 and 3.3). This information is used to describe the whole-farm models developed below for each subregion. Other sources were also available, from project survey information and discussions with local farmer groups. In Figures 3.1 to 3.3, winter cereals are wheat, barley, oats, triticale and rye; pulses are chickpeas, fababeans, lupins and field peas and the only oilseed crop is canola. Summer cereals are sorghum and maize, summer bean crops are mungbeans and soybeans and sunflowers include both early and late sown types. Cotton and safflower figures were not collected.

Estimates (derived from the 2001 Agricultural Census figures) of the proportion of growers who grow particular crops or run livestock are also shown in Table 3.5. There is a great deal of variation across the region. For example, the proportion of growers that grew wheat varied from 19% in the Inverell LGA to 79% in the Walgett LGA, with an average of 57% across the region.

Table 3.5 ABS Agricultural Census data by LGA, 2001

	Walgett	Coonamble	Moree Plains	Narrabri	Yallaroi	Inverell	Gunnedah	Quirindi	Total/Mean
Total area (ha)	1,987,289	854,454	1,601,845	751,892	429,397	602,338	414,870	261,563	6,903,647
Number of growers	314	304	555	555	268	549	515	271	3,330
Mean farm size (ha)	6,332	2,813	2,887	1,355	1,605	1,098	805	964	2,232
Wheat (ha)	294,140	160,353	348,894	147,960	78,759	20,992	72,735	26,093	1,149,926
Oats (ha)	1,531	2,555	3,330	3,534	1,487	2,655	1,254	561	16,907
Barley (ha)	12,298	15,873	51,783	9,321	25,293	16,170	19,232	8,048	158,017
Chickpeas (ha)	45,632	10,669	38,655	1,525	13,092	2,007	345	696	112,621
Lupins (ha)	459	4,569	nc	1,169	113	48	604	nc	6,961
Canola (ha)	1,838	3,618	2,174	889	288	1,115	3,646	1,448	15,016
Sorghum (ha)	24,580	3,129	89,172	13,024	27,095	8,321	28,243	28,851	222,414
Soybean (ha)	2,023	nc	1,339	384	272	521	1,543	1,037	7,119
Sunflower (ha)	nc	nc	4,272	1,271	866	394	3,957	1,743	12,504
Maize (ha)	nc	nc	829	204	663	755	2,450	2,988	7,889
Dryland cotton (ha)	4,363	nc	25,973	8,792	3,402	208	7,506	474	50,719
Mungbean (ha)	80	nc	10,392	1,610	5,937	1,407	3,130	259	22,814
Ewes over 1 year old	392,739	335,679	162,807	124,229	56,526	65,475	37,568	57,452	1,232,473
Total sheep and lambs	732,229	570,941	299,449	217,476	117,759	558,358	75,542	158,083	2,729,837
Beef cows over 1 year	50,298	46,579	65,561	46,441	37,752	61,110	43,974	32,435	384,148
Total meat cattle	107,889	108,133	145,442	96,527	91,923	122,089	92,236	112,204	876,443
Native pasture (ha)	999,260	453,991	523,463	232,123	145,329	297,098	139,923	98,487	2,889,674
Lucerne (ha)	3,173	33,283	5,367	12,022	11,868	12,963	16,488	5,604	100,767
Sown Pasture –total (ha)	18,556	69,621	37,421	45,252	25,624	69,716	44,245	31,739	342,173
Other pasture (ha)	113,038	15,123	38,832	26,431	13,965	39,282	9,923	3,940	260,534
% of growers	**Walgett**	**Coonamble**	**Moree Plains**	**Narrabri**	**Yallaroi**	**Inverell**	**Gunnedah**	**Quirindi**	**Average**
Wheat	79%	68%	75%	60%	59%	19%	58%	42%	57%
Oats	6%	9%	6%	11%	17%	15%	7%	7%	10%
Barley	9%	24%	31%	16%	40%	21%	28%	26%	24%
Chickpeas	29%	13%	26%	3%	20%	2%	1%	5%	12%
Lupins	1%	15%	-	3%	0.4%	0.4%	2%	-	4%
Canola	2%	5%	3%	1%	0.4%	2%	3%	6%	3%
Sorghum	12%	3%	42%	15%	40%	13%	27%	39%	24%
Soybean	0.3%	-	2%	1%	1%	2%	4%	6%	2%
Sunflower	-	-	3%	2%	3%	1%	4%	5%	3%
Maize	-	-	1%	1%	2%	2%	4%	10%	3%
Dryland cotton	2%	-	11%	7%	5%	0.4%	10%	1%	5%
Mungbean	0.4%	-	9%	2%	15%	3%	5%	2%	5%
Sheep	62%	61%	26%	29%	31%	55.3%	17%	24%	38%
Meat cattle	68%	86%	62%	72%	84%	77%	76%	84%	76%

Table 3.6 Physical and financial performance indicators, Inner West, Inner East and Western Clay subregions, average per farm 2000-01

Item	Unit	Inner west		Inner east		Western clay	
Population		135		437		412	
Sample contributing		6		12		10	
Area operated June 30	ha	5 637	(38)	1 660	(16)	5 728	(48)
Wheat sown	ha	861	(27)	510	(23)	1 274	(41)
Sheep June 30	no	326	(88)	239	(109)	3 805	(47)
Beef cattle June 30	no	221	(55)	341	(16)	307	(28)
Areas harvested:							
- wheat	ha	823	(25)	490	(23)	838	(43)
- barley	ha	88	(81)	99	(18)	1	(124)
- sorghum	ha	381	(16)	99	(48)	66	(130)
- grain legumes	ha	125	(131)	88	(53)	242	(82)
- oilseeds	ha	63	(120)	52	(53)	14	(90)
Total cash crop area harvested	ha	1 598	(28)	884	(18)	1 163	(49)
Wheat production	t	1 273	(29)	922	(32)	965	(42)
Total labour weeks worked	wks	186	(41)	177	(12)	158	(20)
Cash receipts							
Livestock-							
- sheep	$	5 103	(87)	8 380	(74)	44 078	(41)
- beef cattle	$	67 183	(43)	233 132	(27)	106 235	(37)
Total wool gross receipts	$	8 533	(111)	3 439	(97)	74 613	(45)
Crops-							
- wheat	$	211 849	(25)	144 954	(30)	146 435	(41)
- barley	$	23 075	(90)	30 391	(18)	322	(124)
- sorghum	$	183 148	(26)	36 570	(91)	15 125	(143)
- grain legumes	$	54 442	(126)	38 125	(42)	55 396	(95)
- oilseeds	$	24 245	(96)	8 911	(65)	3 520	(82)
- other crops	$	398 597	(81)	61 520	(67)	- 7 778	(187)
Total crop gross receipts	$	895 355	(40)	328 923	(36)	213 020	(54)
Total cash receipts	$	1 029 016	(37)	697 484	(14)	492 076	(44)
Cash costs							
Wages for hired labour	$	67 835	(74)	27 947	(34)	34 693	(74)
Fertiliser	$	82 145	(30)	46 935	(32)	15 981	(51)
Crop & pasture chemicals	$	195 465	(59)	80 850	(30)	88 469	(57)
Fuel, oil and grease	$	105 212	(46)	53 343	(57)	45 291	(55)
Repairs and maintenance	$	102 619	(43)	46 347	(23)	75 536	(81)
Other materials	$	36 855	(54)	27 152	(14)	35 143	(62)
Contracts paid	$	61 864	(71)	32 133	(38)	47 883	(58)
Rates	$	17 398	(52)	9 311	(14)	9 272	(24)
Other services	$	151 516	(31)	86 676	(10)	64 829	(36)
Interest paid	$	106 455	(47)	71 298	(32)	42 987	(75)
Total cash costs	$	1 004 954	(41)	637 709	(7)	515 240	(50)
Farm cash income	$	24 062	(229)	59 775	(124)	- 23 164	(246)
Farm business profit	$	- 111 487	(54)	- 64 738	(81)	- 158 314	(72)
Capital July 1	$	3 289 500	(30)	2 496 666	(12)	2 499 909	(31)
Rate of return - excl cap. app.	%	0.1	(1376)	0.4	(316)	-4.7	(53)
Rate of return - incl cap. app.	%	1.7	(107)	3.1	(43)	1.1	(167)
Farm business debt June 30	$	1 194 725	(38)	632 551	(21)	592 417	(71)
Equity ratio at 30 June	%	65	(9)	74	(10)	76	(18)

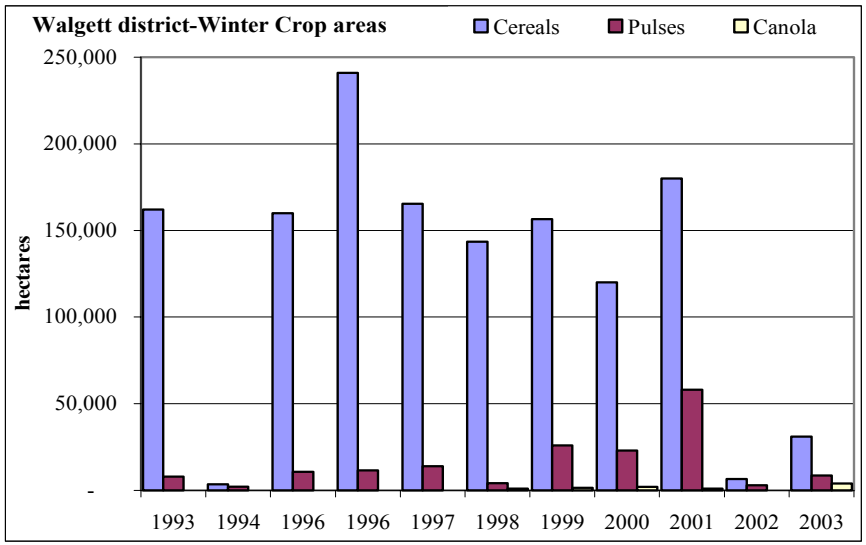
Source: ABARE surveys. Figures in parentheses are relative standard errors expressed as percentages of estimates

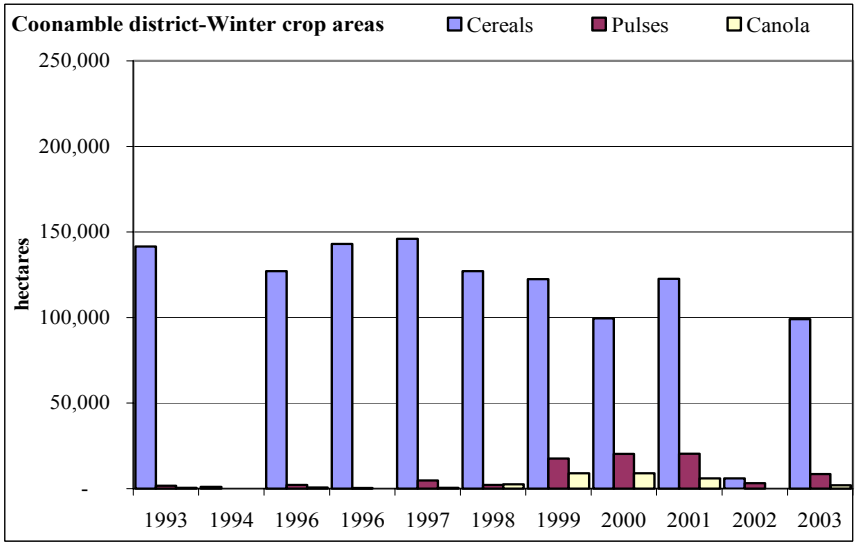
Table 3.7 Physical and financial performance indicators, Liverpool Plains and North-east Slopes subregions, average per farm 2000-01

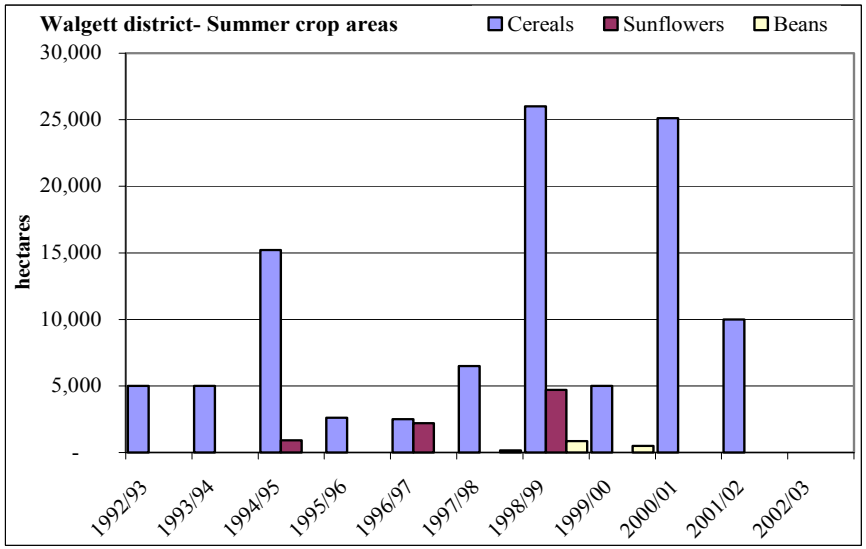
Item	Unit	Liverpool Plains		North east slopes	
Population		559		668	
Sample contributing		8		6	
Area operated June 30	ha	699	(35)	637	(33)
Wheat sown	ha	113	(37)	22	(113)
Sheep June 30	no	73	(89)	871	(63)
Beef cattle June 30	no	153	(45)	156	(33)
Areas harvested:					
- wheat	ha	45	(79)	22	(113)
- barley	ha	80	(64)	0	
- sorghum	ha	31	(119)	0	
- grain legumes	ha	15	(116)	0	
- oilseeds	ha	40	(97)	11	(178)
Total cash crop area harv	ha	246	(63)	41	(112)
Wheat production	t	68	(102)	43	(128)
Total labour weeks worked	wks	108	(12)	90	(16)
Cash receipts					
Livestock-					
- sheep	$	6 642	(80)	6 498	(95)
- beef cattle	$	29 669	(40)	31 476	(54)
Total wool gross receipts	$	304	(99)	13 233	(26)
Crops-					
- wheat	$	15 292	(83)	5 553	(127)
- barley	$	24 181	(55)	0	
- sorghum	$	38 863	(76)	0	
- grain legumes	$	5 020	(116)	0	
- oilseeds	$	31 867	(41)	2 240	(178)
- other crops	$	18 848	(184)	22 115	(174)
Total crop gross receipts	$	152 826	(40)	42 123	(150)
Total cash receipts	$	231 666	(23)	97 489	(80)
Cash costs					
Wages for hired labour	$	9 178	(37)	4 540	(106)
Fertiliser	$	20 725	(49)	1 742	(149)
Crop & pasture chemicals	$	23 717	(34)	7 441	(155)
Fuel, oil and grease	$	22 171	(12)	7 672	(87)
Repairs and maintenance	$	22 350	(28)	6 794	(71)
Other materials	$	19 203	(33)	8 499	(106)
Contracts paid	$	10 198	(82)	4 968	(95)
Rates	$	5 919	(21)	3 597	(45)
Other services	$	34 528	(14)	12 810	(55)
Interest paid	$	21 926	(101)	7 169	(119)
Total cash costs	$	213 787	(26)	77 138	(73)
Farm cash income	$	17 879	(212)	20 351	(118)
Farm business profit	$	- 42 388	(84)	- 49 762	(41)
Capital July 1	$	1 624 390	(30)	1 064 038	(30)
Rate of return - excl cap. app.	%	-0.4	(508)	-3.8	(66)
Rate of return - incl cap. app.	%	1.0	(171)	-0.4	(627)
Farm business debt June 30	$	226 939	(141)	77 004	(84)
Equity ratio at 30 June	%	86	(19)	91	(5)

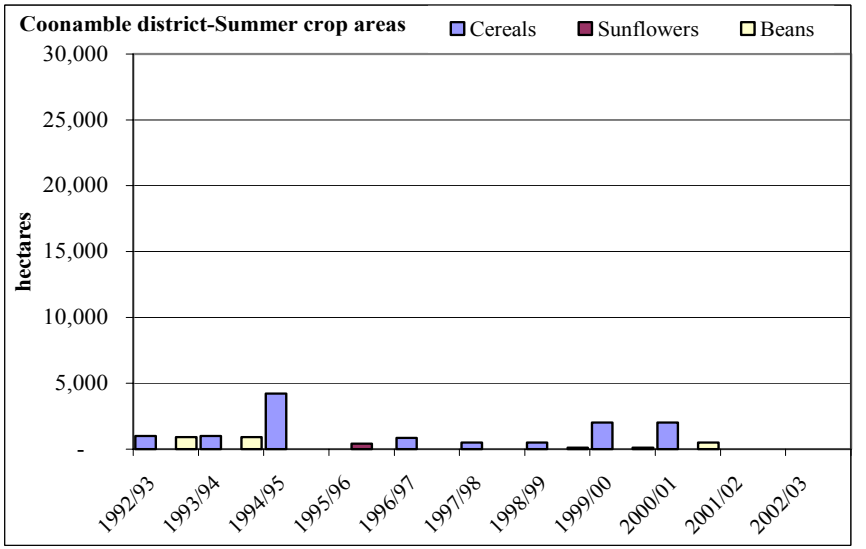
Source: ABARE surveys. Figures in parentheses are relative standard errors expressed as percentages of estimates

Figure 3.1 Walgett and Coonamble agronomy district crop areas, 1993-2003 *



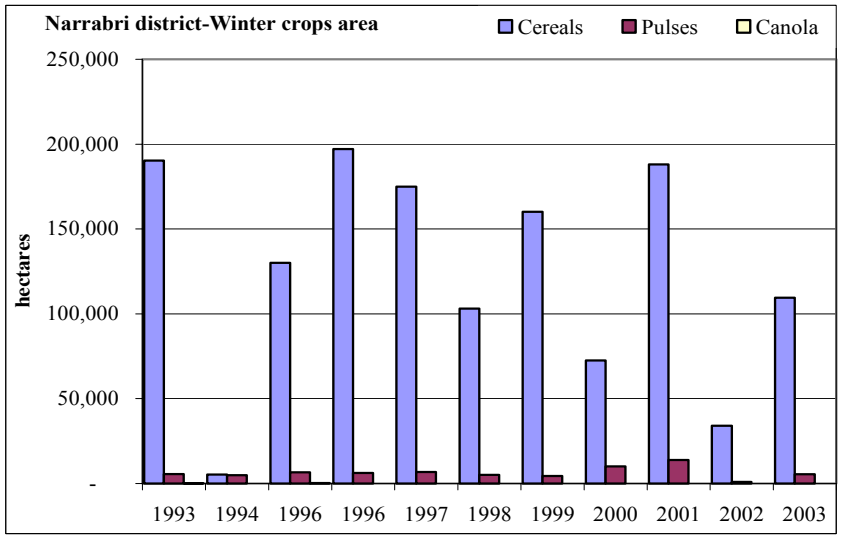


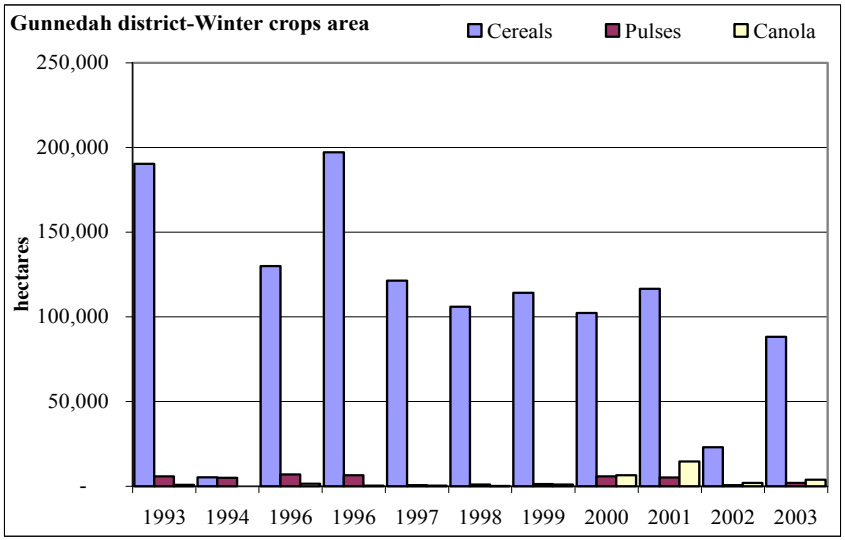


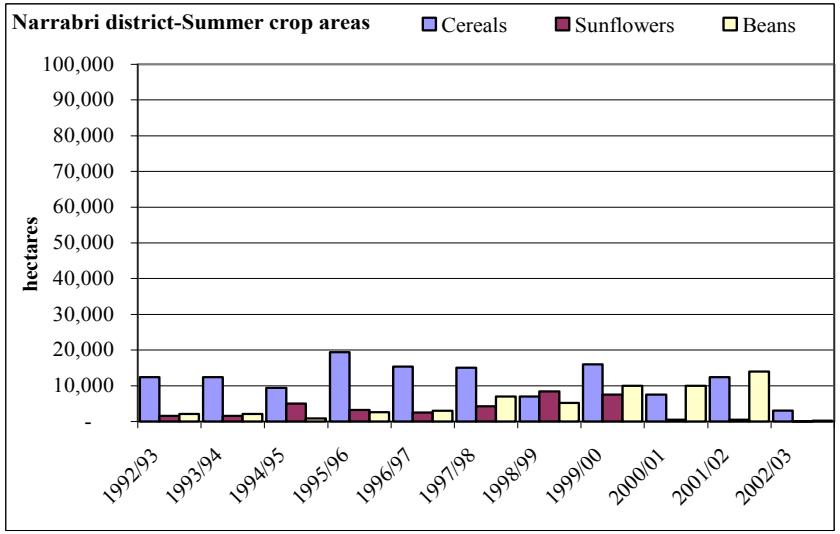


* Winter cereals are wheat, barley, oats, triticale and rye; pulses are chickpeas, fababeans, lupins and field peas and the only oilseed crop is canola. Summer cereals are sorghum and maize, summer bean crops are mungbean and soybeans and sunflowers include both early and late sown types. Cotton and safflower figures were not collected.

Figure 3.2. Narrabri and Gunnedah agronomy district crop areas, 1993-2003







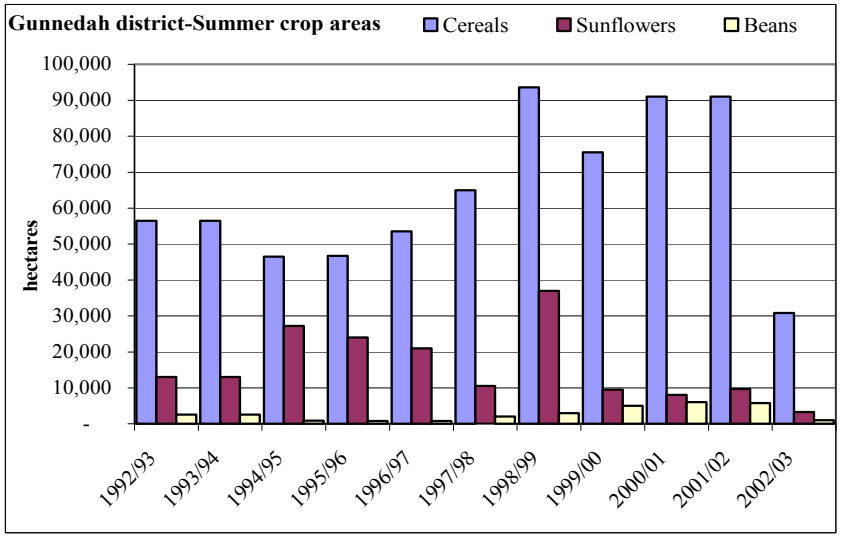
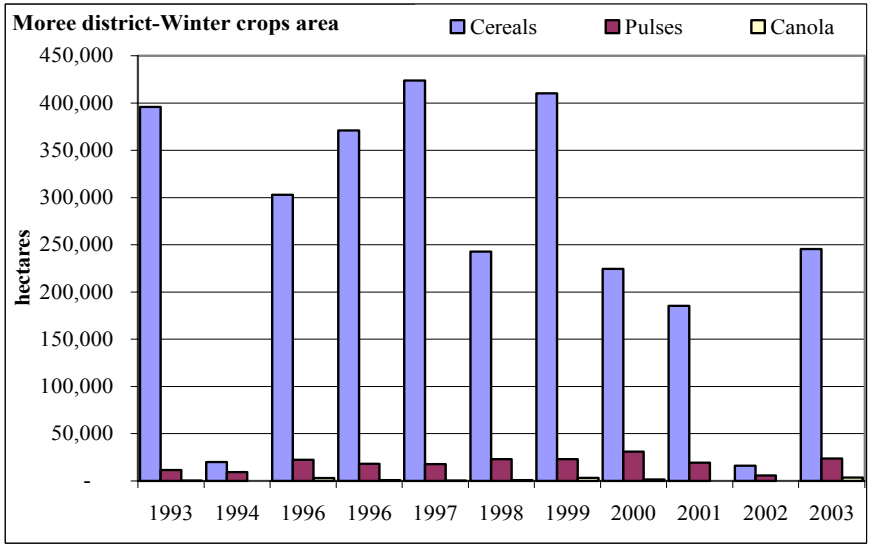
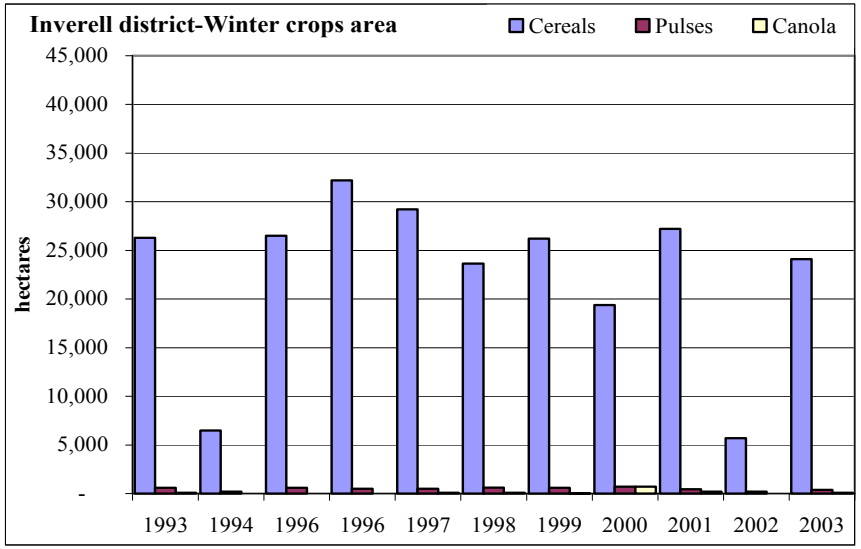
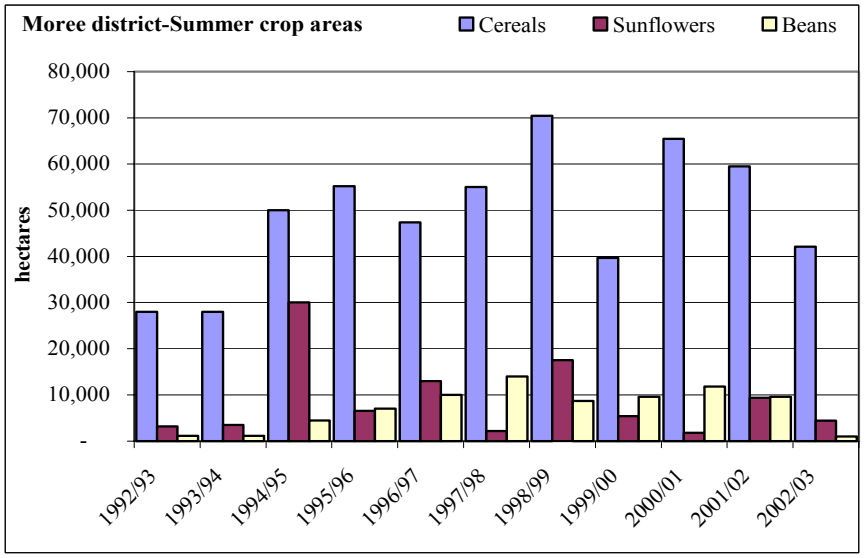
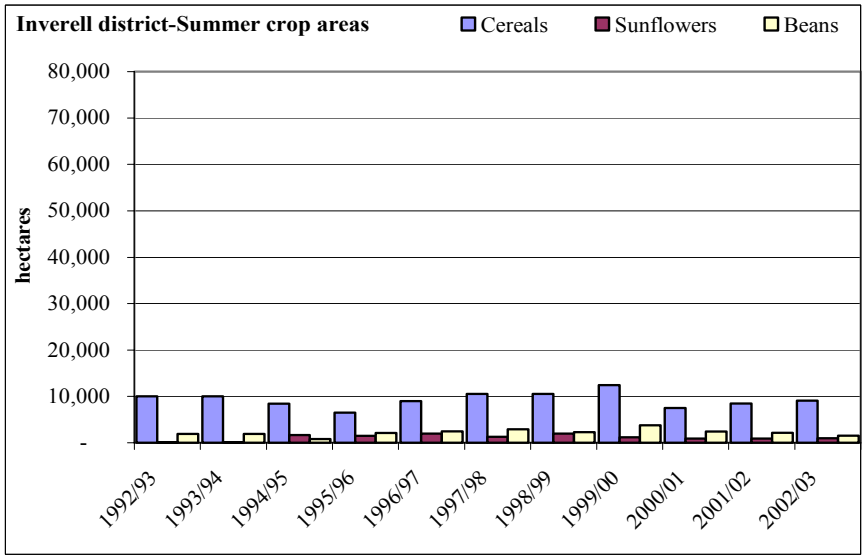


Figure 3.3: Moree and Inverell agronomy district crop areas, 1993-2003









4. Whole-farm Budgets and Examples

4.1 Development and Structure of the Whole Farm Budgets

The aim of this work is to develop models representative of important farming systems in the northern cropping region of NSW. Whole farm budgets have been constructed for each of the six subregions identified in Section 2.

While we have used the ABS and ABARE data described above to 'calibrate' our models, these data give an inadequate description of particular farming systems in terms of crop rotations used and other farm features because they do not relate to particular farming systems but rather are averages across regions or subregions. Useful details for developing a model to measure the impacts of change is often lacking from such statistics, especially at the local level. In addition, there are often substantial differences between neighbouring farms in terms of resources used, farming methods employed and the skills and outlook of the owner/manager.

We obtained additional information for the representative farm models from discussions with research and advisory staff and from meetings with farmers. One method of obtaining data for evaluation at the local level is the Local Consensus Data technique (Jayasuriya *et al*. 1999). This technique is a way of obtaining an accurate picture of the structure of farming for a group of farms in a particular locality. A small group of interested farmers meet with officers of the RD&E agency to discuss all the practices which have a bearing on the costs and returns of a typical farm in the area being studied. As discussion proceeds, a consensus is reached on the size and nature of the 'typical farm' and on all aspects of production such as cultural operations, machinery used and time involved. Consensus is also arrived at about prices or costs of inputs, normal yields and expected returns. The aim is to develop comprehensive sets of data to adequately define the main 'model' farm types in each district, to ensure that farm management analyses are relevant to existing conditions, and to provide suitable examples for extension advice.

The representative farm models are discussed in following sections. For each subregion, a representative farm is described first in terms of a typical size and combination of enterprises and crop rotations. In each case there are two tables presented – an assets and liabilities statement and an annual budget. The assets and liabilities statement shows land, livestock, plant and equipment assets and liabilities according to typical loan type. The annual budget statement shows enterprise and total farm gross margin, overhead costs, farm cash income, operating costs and farm operating surplus, and rate of return on owners equity. Overhead costs were estimated after some discussions with growers and local government and RLPB rates were calculated based on the land value from the assets and liabilities statement. Land values were estimated from published Valuer General information for the relevant regions. Overhead costs will vary considerably between farms since labour requirements, insurance, repairs and maintenance, extra fuel, and administration costs will vary with family requirements, business structure and extra machinery and assets on hand. Similarly income tax varies considerably with business structure and off-farm investments, so income tax estimates have not been included.

The whole budget is used to examine a change in enterprise combination or crop rotation that is likely to be of interest to farmers using a similar farming system. The budgets show financial measures such as farm cash income and rate of return on equity and operator labour for a defined enterprise mix, but are not optimising models in that they do not choose the most

profitable enterprise mix. They are simulation models which can be used for evaluating 'what-if' questions. One drawback of this type of model is that it does not account for cash flows in the transition period from one rotation system to another. The main purpose is to compare different rotations in economic terms, with other techniques being used to answer further questions about the potential change.

The whole farm budget provides a snapshot at a particular point in time of a farm with a particular set of resources. The Farm Operating Surplus indicates whether the business provides enough of a return to cover all variable and overhead costs whilst maintaining assets and covering interest on liabilities. The remaining funds must cover the owners living expenses, debt repayments and off-farm investments and this will also vary widely from farm to farm. Hence while this report may give a broad indication of what is happening on representative farm businesses in the northern cropping region, returns are likely to be different for farms with different soil types or resources to those of the representative farm.

Additionally while the whole farm budget can be manipulated to indicate the change in farm income from a new technology or resource management strategy, again we only get before and after pictures. If the change in technology has an impact on soil fertility, for example, that takes many years to work through the system, then a simple before-and-after comparison of whole farm budgets is an inadequate basis for such an important investment decision. More sophisticated budgeting tools that allow the impact of such changes over many years to be estimated and aggregated are required.

Key characteristics of the whole-farm budgets are shown in Table 4.1. There is substantial variation in farm size and crop rotation typically used. The relative percentages of farm area devoted to crop and pasture was 20:80 for the Western Clay subregion, 45:55 for Western Red, 75:25 for Inner West, 53:47 for Inner East, 6:94 for the North-East Slopes and 35:65 for the Liverpool Plains. This variation relates to the interaction of soil types with comparative returns from livestock and crop enterprises.

Biological parameters (eg yields) are also required, and these were determined from discussion with NSW Department of Primary Industries staff, private agronomists and growers. Research trial results (Western Clays- "GRDC project DAN266NR "Western Farming Systems") and APSIM output (Liverpool Plains-GRDC Project DAN47) were also used to examine the implications for whole farm profitability of particular systems under investigation.

An average debt per ha figure (Table 4.2) was calculated using information from Tables 3.6 and 3.7. Available information on tillage methods from ABS surveys (Table 4.3) shows similar proportions of each district under reduced tillage (one or two cultivations in a fallow period), but a higher proportion of area under zero till in the Walgett LGA. The budgets used in the representative farms assume zero or reduced tillage systems. The crop and livestock prices assumed in the budgets are shown in Table 4.4.

Table 4.1 Key characteristics for each whole-farm budget

Subregion	**Western Clay**	**Western Red**	**Inner West**
Farm area (ha)	6,080	2,917	2,887
Asset value*	$ 4,122,400	$ 1,675,500	$ 3,002,100
Equity	85%	82%	83%
% farm under crop	20%	45%	75%
Crop area (ha)	1,216	1,313	2,165
Pasture area (ha)	4,864	1,604	722
Rotations	lfW-Cp-W-lfS	W-Cp-W-L-L-L-L	W-B-lfS-Cp
	lfW-Cp-W-B-lfS	W-Lp-W-L-L-L-L	W-Cp-W-lfS-lfW
* Asset value rounded to nearest $100			
Subregion	**Inner East**	**North-east slopes**	**Liverpool Plains**
Farm area (ha)	1,660	1,050	1,700
Asset value*	$ 2,485,100	$ 1,711,700	$ 3,055,300
Equity	75%	88%	82%
% farm under crop	53%	6.4%	35%
Crop area (ha)	880	67	595
Pasture area (ha)	780	983	1,105
Rotations	W-B-lfS-Cp	L-L-L-L-W-W-B-B	lfW-lfS
	W-lfS-Cp	L-L-L-L-L-S-S-W	lfSSW

Wheat W, Chickpeas Cp, Sorghum S, Lupins Lp, Lucerne L, Barley B, Soybeans Sb, Long Fallow lf

Table 4.2 Estimated debt per hectare by subregion

Sub-Region	**Debt per hectare**		**Sub-Region**	**Debt per hectare**	
Western Clay	$	103.42	Inner East	$	381.05
Western Red *	$	103.42	North-east slopes	$	120.89
Inner West	$	211.94	Liverpool Plains	$	324.66

Source: ABARE * Figure for Western Red the same as for Western Clay because no small sample area data available for Western Red sub-region

Table 4.3 Adoption of no till and reduced till methods

Local Government Area	**1985**	**1996**	**2000**
Walgett: No-till	1%	7%	26%
Reduced-till	14%	58%	54%
Coonamble: No-till	1%	7%	17%
Reduced-till	14%	53%	55%
Moree Plains: No-till	2%	12%	24%
Reduced-till	16%	41%	44%
Yallaroi: No-till	1%	10%	23%
Reduced-till	9%	45%	58%
Inverell: No-till	0%	3%	17%
Reduced-till	12%	54%	44%
Narrabri: No-till	2%	5%	14%
Reduced-till	17%	35%	44%
Gunnedah + Quirindi: No-till	1%	13%	34%
Reduced-till	9%	18%	33%
Average no-till	**1%**	**8%**	**22%**
Average reduced till	**13%**	**43%**	**47%**

Source: Martin *et al*. 1988, ABS Agricultural Census, 1996 and 2001

Table 4.4 Crop and livestock price assumptions

CROP PRICES	**Grade**	**Price $/t**
Wheat	ASW10	144
	AH (12%)	150
	PH13 (13%)	188
	PH14 (14%)	200
	Feed (<10%)	117
Barley	Feed	106
Sorghum		130
Chickpeas		385
Lupins		250
Wool prices		**$/kg (greasy)**
21 micron Merino flock		
ewe fleece		$5.79
ram fleece		$4.53
ewe hoggets		$5.17
crutchings		$3.45
First cross prime lambs		
ewe fleece		$5.79
ram fleece		$4.53
ewe hoggets		$5.17
crutchings		$3.45
Livestock prices	**21 micron flock $/head**	**1st cross $/head**
wether lambs	$45.00	$61.20
ewe hoggets	$50.00	$70.00
CFA ewes	$48.00	$48.00
CFA rams	$50.40	$50.40
steer yearlings 15-20 months		$622
steer yearlings 20 months		$600
steer yearlings 20 months (NE Slopes-grazed on oats)		$686
heifer yearlings 15-20 mths		$560
heifer yearlings 20 months		$540
CFA bull		$900
CFA cows		$572

Sheep and wool prices from NSW Agriculture Sheep Gross Margin Budgets 2002, cattle prices based on Dubbo saleyard prices averages for late 2000-2003

4.2 Analyses of Returns from Different Crop Rotations

As noted in Pannell *et al.* (2000), survey evidence in Australia indicates the key to achieving the main objectives of farmers (staying in farming and increasing wealth over time), is getting the big decisions right, such as land purchase, machinery investment, resource improvement and major tactical adjustments. Nevertheless it remains important to understand the potential financial consequences of more routine decisions such as varying the rotation , using new technologies, and changing resource management strategies. Farmers are highly unlikely to make on-farm changes unless they are financially attractive.

Important questions being asked by landholders in the northern cropping region relate to how crop rotations can be changed to provide improved financial outcomes. Questions of soil fertility decline and overcoming crop disease, pest and weed problems have been addressed by RD&E programs into both developing new technologies for individual enterprises (breeding new cultivars for existing crops, developing fertilizer recommendations, developing new tillage and stubble treatment machinery) and investigating changes in farming systems such as introducing new crops and investigating new crop rotations. All these initiatives have been considered in a farming systems research approach.

From a financial viewpoint, changes in machinery ownership and input cost tradeoffs (chemical costs versus fuel and machinery depreciation) are important considerations for farmers. Machinery investment decisions have cash flow implications and, while these models are not constructed to consider cash balances over time, they include financial and depreciation costs, as well as changes in variable costs associated with different machinery sizes. They are suitable for investigating these tradeoffs in a whole-farm context.

5. The Western Clay Representative Farm Model

The representative farm for the western clay subregion was constructed from ABS and ABARE data, from information gathered in farm surveys and from discussions with farmer groups and research and advisory staff.

Agricultural Census data from 2001 (Table 3.5) indicate that wheat was the largest dryland crop in both the Walgett and Coonamble LGAs. About 79% of growers in Walgett and 68% in Coonamble grew wheat in that year. The next largest crop by area in the Walgett LGA was chickpeas followed by sorghum with a split between barley, chickpeas and lupins in Coonamble. About 62% of growers in the Walgett district had sheep with 68% running cattle. In Coonamble 61% ran sheep and 86% cattle. There was a higher area (69,621 ha) of sown pasture in Coonamble (compared to 18,556 ha in Walgett).

Discussions about farm production characteristics were conducted with farmer groups by the authors in the Coonamble and Walgett districts. Regarding the integration of crop and livestock activities, while cropping has increased dramatically in recent years, there are still livestock on many properties. At least on the dark cracking clay soils, farmers appear to be unwilling to run livestock on stubble, particularly during wet conditions because of the treading damage to surface soil structure. This question has ramifications for the 'typical' farm, which is already characterised by summer and winter crop options and the need to consider soil fertility and weed, pest and disease control in the context of adverse price movements and soil fertility decline.

A survey of 201 cereal growers in the Warren/Narromine, Coonamble and Walgett areas was undertaken in 1999 as part of the GRDC-funded Western Farming Systems project (Martin and Edwards 2001). The aim of the survey was to ascertain use of rotations, tillage practices and fertiliser use, as well as changes in practices in the preceding 5 years. The average farm size for Coonamble was 2,917 hectares with an average of 45% under cropping. On average in 1999, 75% was under wheat, 4% under chickpeas, 1% under dryland cotton, 4% under canola, and 7% under sown pasture with other crops such as lupins, barley and oats making up the balance.

The 1999 Western Farming Systems project survey (Martin and Edwards, 2001) found that the average farm size in the Walgett area was 6,081 hectares with 20% under crop. On average in 1999, 83.4% of the cropped area was under wheat, 8% under chickpeas, 2% under dryland cotton, 1% under canola, 1% under sown pasture with other crops such as lupins, barley and oats making up the balance. The ABARE survey data from 2000-01 (Tables 3.6 and 3.7) showed a similar proportion under crop.

NSW Grains Report data (Figure 3.1) for the Walgett agronomy district (which is comprised of the Walgett LGA and the northern half of the Brewarrina LGA) and Coonamble agronomy district (same area as the Coonamble LGA) indicate that pulse crops have increased in popularity since the mid 1990s. Crop acreage in the Walgett district has been particularly variable, with the droughts of 1994 and 2002 reducing crop areas to negligible levels.

ABARE performance indicators for the Western Clay subregion for 2000-01 (Table 3.6) indicate slightly negative returns (in terms of net farm cash income and rate of return excluding capital growth). The flood of winter 2000 devastated and downgraded many crops in this region.

5.1 Financial Performance of the Western Clay Representative Farm

The representative farm in the Western Clay subregion comprised 6,080 ha, of which 1,216 ha was crop area and 4,864 ha was pasture. Livestock consisted of 1,086 ewes plus 28 rams and 180 cows plus 4 bulls. Crops grown were wheat, chickpeas and sorghum, with the usual rotation being long fallow wheat-chickpeas-wheat-long fallow sorghum (lfW-Cp-W-lfS).

Based on the information assembled, the statement of assets and liabilities for the representative farm is shown in Table 5.1. Total assets exceed $4 million and the equity percentage is 85%. The corresponding annual operating budget is shown in Table 5.2. The average area under each crop was 243 hectares and the yields used are shown in Table 5.3. Yields are based on the GRDC-funded Western farming Systems (DAN266NR) trial results from Cryon Station, a site 50km east of Walgett. Farm Cash Income (farm gross margin less overhead costs) was $258,622 and after the subtraction of Operating Costs (interest and depreciation), Farm Operating Surplus was $164,456. The business return on owner equity from this was 4.7%.

A positive Farm Operating Surplus means that in this example, the business provided enough funds to meet all overhead and variable costs whilst maintaining assets (depreciation) and meeting interest payments. The remaining Farm Operating Surplus needs to be sufficient to cover owner and family living expenses, debt repayments and off-farm investments. The level required to meet these commitments will vary greatly, depending on loan terms and the requirements of family needs and off-farm investments.

5.2 The Role of Barley

Farmers in the Western Clay subregion are interested in the role of barley in what is predominantly a wheat-chickpea rotation. We compare two rotations under zero tillage, based on the GRDC project trial results from Cryon Station and best estimates of yields by agronomists. Compared to short fallow wheat after cereal, wheat crops following a pulse or oilseed crop, or after a long fallow, have higher yields and lower protein contents. Barley is assumed to yield 3 t/ha.

The two rotations compared are lfW-Cp-W-lfS and long fallow wheat-chickpeas-wheat-barley-long fallow sorghum (lfW-Cp-W-B-lfFS). ‘Long fallow’, in this instance, means a 10-12 month fallow period (over a winter and summer season) to enable fallow moisture build-up between wheat and sorghum crops. The traditional long fallow period used with continuous winter cereal growing in the district is 18 months (i.e. one crop in 2 years). The two rotations used here were considered because of the trend away from continuous winter cereal cropping in the district in the last few years, towards the inclusion of winter pulses (mainly chickpeas) in the rotation.

As already mentioned, the typical rotation for the representative farm was 243 hectares each of long and short fallow wheat, sorghum and chickpeas which earned a farm cash income of $258,622. When barley is introduced these areas are reduced to 203 hectares under each crop and net farm income is similar at $259,519. The return on equity is unchanged at 4.7%, so that there are no immediate financial effects of introducing barley for this example.

Table 5.1 Whole-farm budget, representative farm for Western Clay subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	1,216	ha @	$618	per ha		$751,199
	4,864	ha @	$438	per ha		$2,131,881
	Other improvements (eg sheds)					$250,000
	Total value of land and improvements					**$3,133,080**
Livestock	1,086	ewes @	$50	per ewe	$54,300	
	28	rams @	$750	per ram	$21,000	
	180	Cows @	$750	per cow	$135,000	
	4	bulls @	$4,000	per bull	$16,000	
	Total value of livestock					**$226,300**
Plant and equipment						
	1 Tractor 165-170 KW PTO (260-268 HP)				$184,762	
	Implements (average value)				$128,250	
	Vehicles (car, ute, truck) (estimates)				$100,000	
	Other (auger, motorbike, wool press etc.)				$100,000	
	Total value of plant and equipment					**$513,012**
TOTAL ASSETS						**$4,122,392**
LIABILITIES						
	Overdraft				$76,256	
	Term Loans				$460,000	
	Tractor Loan				$88,246	
TOTAL LIABILITIES						**$624,502**
Equity (Assets – Liabilities)						$3,497,890
Equity percentage (Equity/Total Assets)						85%

Table 5.2 Representative farm for Western Clay subregion, annual operating budget

Annual Operating Budget						
6,080	ha	Total farm area				
1,216	ha	Crop area		20% of farm		
4,864	ha	Pasture area		80% of farm		
Enterprise Gross Margin (lfW-Cp-W-lfS)					GM/ha	
973	ha	Summer Fallow			-$32	-$31,460
486	ha	Winter Fallow			-$19	-$9,180
243	ha	Short Fallow Wheat (ex pulse)			$296	$72,078
243	ha	Long Fallow Wheat			$326	$79,210
243	ha	Long Fallow Sorghum			$163	$39,558
243	ha	Chickpeas			$194	$46,798
4,864	ha	Pasture		1.00 DSE/ha		
1,086	ewes@		2	DSE/ha		$54,735
180	cows@		15	DSE/ha		$74,646
Total Farm Gross Margin						**$326,384**
Overhead Costs						
Casual labour					$0	
Permanent labour (not owner/operator)					$40,000	
Rates					$4,762	
Registration					$3,000	
Insurance (vehicle, building)					$5,000	
Other R&M (fencing, tools, pumps etc.)					$5,000	
Fuel costs (not tractor)					$5,000	
Admin. (elect., phone)					$5,000	
Total Overhead Costs						**$67,762**
Farm cash income						**$258,622**
Operating Costs						
Interest @ 9%		of liabilities			$53,918	
Depreciation on tractor & implements					$20,249	
Depreciation @ 10% of misc, plant & equipment					$20,000	
Operator and family labour					$0	**$94,166**
Farm Operating Surplus						**$164,456**
Business return on owners equity						**4.7%**

Table 5.3 Yield assumptions - Western Clay subregion

	No till	
Crop	**Yield**	**Protein**
SF wheat (after cereal)	2.17	14.1%
SF wheat (after pulse or oilseed)	2.39	13.2%
LF Wheat	2.39	13.8%
SF barley	3.00	
LF sorghum	2.00	
chickpeas	1.13	

6. The Western Red Representative Farm Model

Small sample data from ABARE was not available for this subregion, with Coonamble LGA statistics from 2000-01 indicating an average farm area of 2,813 ha. The farm area figure (2,917 hectares) is from the GRDC Western farming Systems project survey (Martin and Edwards 2001) undertaken in 1999.

Fifty-one percent of the representative farm is assumed to be under unimproved pasture with a carrying capacity of 2.6 DSE per hectare, and 4 percent is assumed to be under improved pasture with a higher carrying capacity (up to five DSE per hectare). The four percent of average farm area in the Coonamble district under improved pasture was found in the GRDC Western Farming Systems project survey (Martin and Edwards, 2001) undertaken in 1999. RLPB figures from the 2001 RLPB Association Annual Report indicate that the majority of livestock in the Coonamble RLPB district are cattle, so sheep are not included in the budget. RLPB figures also indicated the average DSE for the Coonamble area was 2.6 DSE per hectare, and this figure was used in the budget as the carrying capacity for native pasture. Newly established pasture was assumed to be lightly grazed only, so the carrying capacity assumed was 2 DSE/ha.

6.1 Financial Performance of the Western Red Representative Farm

This is a smaller farm than on the adjacent clay soils, with an area of 2,917 hectares and total assets in the order of $1.6 million. A large proportion of the Western Red region is located in the Coonamble LGA, but some is also within the Coonabarabran, Narrabri and Gilgandra LGAs. There is a larger proportion (45%) under crop than in the Western Clay case. Based on the information from ABS and ABARE, the statement of assets and liabilities for the Western Red representative farm is shown in Table 6.1. The equity percentage is 82%.

The two main rotations are wheat- chickpeas-wheat 4 years lucerne (W-Cp-W-L-L-L-L) and wheat-lupins-wheat-4 years lucerne (W-Lp-W-L-L-L-L). There is a substantial area under lucerne in the budget because the budget represents the cropping phase for one year. The area under lucerne, for example, is 50 percent of the cropped area.

Crop rotation with lucerne is more common in this area than in other regions. Agricultural Census figures (ABS, 1997) showed a large area under pure lucerne in 1996-97 (8,443 hectares) with a large increase to 33,283 hectares (Table 4.1) in 2000-01 (ABS, 2001).

The annual operating budget is shown in Table 6.2. The rotation is a combination of wheat, chickpeas and lucerne. According to information from grower meetings at Coonamble, a common rotation in the Western Red subregion is lucerne in rotation with grain crops. Crop yield potential is assumed to be lower than on the western clays due to factors such as lower soil moisture holding capacity. Yields are based on the best estimates of agronomists. The Farm Operating Surplus is $113,356 and business return to owner equity is reasonably good at 8.2%. This provides a reasonable surplus with which to meet other costs such as family living expenses, debt repayments and off-farm investments.

Table 6.1 Whole-farm budget, representative farm for Western Red subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	2,917	ha @	$190	per ha		$554,641
	Other improvements (eg sheds)					$250,000
	Total value of land and improvements					**$804,641**
Livestock	442	Cows @	$750	per cow	$331,500	
	9	bulls @	$4,000	per bull	$36,000	
	Total value of livestock					**$367,500**
Plant and equipment						
	1 Tractor 165-170 KW PTO (260-268 HP)				$196,198	
	Implements (average value)				$107,156	
	Vehicles (car, ute, truck) (estimates)				$100,000	
	Other (augur, motorbike, wool press etc.)				$60,000	
	Total value of plant and equipment					**$463,354**
TOTAL ASSETS						**$1,635,495**
LIABILITIES						
	Overdraft				$58,941	
	Term Loans				$150,000	
	Tractor Loan				$88,246	
TOTAL LIABILITIES						**$297,187**
Equity (Assets – Liabilities)						$1,338,308
Equity percentage (Equity/Total Assets)						82%

Table 6.2 Representative farm for Western Red subregion, annual operating budget

Annual Operating Budget					
2,917	ha	Total farm area			
1,313	ha	Crop area	45% of farm		
1,605	ha	Pasture area	55% of farm		
Enterprise Gross Margin (W-Cp-W-L-L-L-L)				GM/ha	
656	ha	Summer Fallow		-$28	-$18,294
328	ha	Short Fallow Wheat		$303	$99,463
164	ha	Chickpeas		$172	$28,419
164	ha	Lucerne establishment		-$195	-$31,923
574	ha	Lucerne	4.0 DSE/ha		
164	ha	Lucerne removal		-$28	-$4,585
1,488	ha	Native Pasture	2.6 DSE/ha		
58	ha	Established Pasture	5 DSE/ha		
19	ha	Pasture Establishment	2 DSE/ha	-$129	-$2,517
39	ha	Pasture Maintenance	5 DSE/ha	-$40	-$1,575
442	cows	15	DSE/cow		$168,647
Total Farm Gross Margin					**$205,628**
Overhead Costs					
Casual labour				$0	
Permanent labour (not owner/operator)				$40,000	
Rates				$7,839	
Registration				$3,000	
Insurance (vehicle, building)				$5,000	
Other R&M (fencing, tools, pumps etc.)				$5,000	
Fuel costs (not tractor)				$5,000	
Admin. (elect., phone)				$5,000	
Total Overhead Costs					**$70,839**
Farm Cash Income					**$134,789**
Operating Costs					
Interest @ 9% of liabilities				$21,433	
Depreciation on tractor & implements				$21,350	
Depreciation @ 10% of misc plant and equipment				$16,000	
Operator and family labour				$0	**$62,782**
Farm Operating Surplus					**$113,356**
Business return on owners equity					**8.2%**

6.2 The Role of Lupins in the Farming System

Lupins were a more popular pulse crop than chickpeas until recently. The area of lupins in 1997 in the Coonamble LGA was 847 hectares compared to 220 hectares for chickpeas (ABS, 1997). But by 2001 (Table 4.1) , the area under chickpeas was higher (10,669 hectares compared to 4,569 hectares of lupins). Yield assumptions are shown in Table 6.3. The second rotation, which included lupins instead of chickpeas, resulted in slightly lower returns with Farm Operating Surplus at $102,959 and return on equity at 7.7%. The rotation including

chickpeas was slightly better due to chickpeas having a gross margin higher than that of lupins in this example.

Table 6.3 Yield assumptions - Western Red subregion

Crop	Yield	Protein
SF wheat (after cereal)	1.70	13.7%
SF wheat (after pulse or oilseed)	1.90	14.8%
LF Wheat	2.20	13.9%
lupins	1.00	
chickpeas	0.90	

7. The Inner West Representative Farm Model

The Inner West subregion roughly corresponds to the Moree Plains and the western half of the Narrabri LGAs. Agricultural Census data from 2001 (Table 3.5) for the Moree Plains local government area indicate that 75% of growers grew wheat, with substantial areas of sorghum, barley, chickpeas, dryland cotton and mungbeans. Sixty-two percent of growers ran cattle with about 26% running sheep. Trends in crop production over time (Narrabri district in Figure 3.2 and Moree in Figure 3.3) show only a slight increase in winter pulses, sunflowers and bean crops.

The most commonly sown wheat varieties include Sunco, Sunvale and Baxter, with Jimbour and Howzat chickpeas as well as Grimmet and Gardiner barleys also commonly used. The sowing window for wheat is usually early May to early June, depending on the variety. Soil moisture triggers required to sow wheat vary from 40cm to 100cm, with 80 kg/ha of urea and 40 kg/ha of MAP fertiliser commonly applied. Sorghum is the main summer crop, with significant areas of sunflowers and mungbeans also grown (Figure 3.2). Generally 1m of sub-soil moisture is required for planting a summer crop such as sorghum or sunflowers with 60cm the minimum for mungbeans (J. Spenceley; R. Beasley, pers. comm., 2002).

Local area sample data from ABARE are shown in Table 3.6. The sample size is quite small (6 farms) and individual data were not available for confidentiality reasons, so it is possible the results could be skewed by one or two very large or very small farms. The mean farm area for the Moree Plains LGA (Table 3.5) was 2,887 hectares with the ABARE small sample data (Table 3.6) having an average of 5,637 hectares. Rates of return measured by ABARE (Table 3.6) were low but positive for 2000-01, but total farm business profit was negative.

The proportions of crop area under zero till and reduced till for Moree Plains LGA (Table 4.3) are similar to the regional averages, with 24% under zero till and 44% under reduced till. The western half of the Narrabri LGA is included in the Inner West zone, but the ABS Agricultural Census figures cannot be separated into lower levels than LGA.

7.1 Financial Performance of the Inner West Representative Farm

Based on the information from ABS and ABARE, the statement of assets and liabilities for the Inner West representative farm is shown in Table 7.1.Total farm area is 2,887 hectares (using ABS data for 2001 for the Moree Plains LGA) and total capital value over $3.8 million with 75% of the farm under crop. The equity percentage is 81%. According to the district agronomist (J. Spenceley, pers. comm., 2003) the most common proportion of crop to pasture is 75:25. Most keep the cropping and livestock operations separate (about 75-80% of growers). Many growers also own more than one farm; so many businesses may actually be operating on larger land areas than the statistical averages show. However, no data are available on the ownership and operations of properties in the region, so the district average from the 2001 ABS Agricultural survey was used. Some growers in the region have stock only, which may reduce the ABS statistical averages of crop areas per farm downwards (J. Spenceley, pers. comm. 2003).

Table 7.1 Whole-farm budget, representative farm for Inner West subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	2,165	ha @	$964	per ha		$2,086,514
	8722	ha @	$438	per ha		$316,341
	Other improvements (eg sheds)					$300,000
	Total value of land and improvements					$2,702,855
Livestock	120	ewes @	$50	per ewe	$7,250	
	3	rams @	$750	per ram	$3,000	
	79	cows @	$750	per cow	$72,500	
	2	bulls @	$4,000	per bull	$8,000	
	Total value of livestock					$75,500
Plant and equipment						
	1 Tractor 165-170 KW PTO (260-268 HP)				$159,413	
	Implements (average value)				$173,475	
	Vehicles (car, ute, truck) (estimates)				$100,000	
	Other (auger, motorbike, wool press etc.)				$100,000	
	Total value of plant and equipment					$540,094
TOTAL ASSETS						**$3,618,449**
LIABILITIES						
	Overdraft				$251,631	
	Term Loans				$400,000	
	Tractor Loan				$88,246	
TOTAL LIABILITIES						**$616,369**
Equity (Assets – Liabilities)						$3,002,081
Equity percentage (Equity/Total Assets)						83%

The annual operating budget is shown in Table 7.2. The rotation for this farming system is wheat-barley-long fallow sorghum-chickpeas (W-B-lfS-Cp). Farm Operating Surplus is $234,119 and business return to owner equity is 7.8%. The returns are good and generated due to good yields (Table 7.3) and a large proportion of the farm being under crop. The gross margin for short fallow wheat after pulse was also reasonably high at $353 per hectare, due to lower costs (less nitrogen fertiliser) and good returns (2.4 t/ha @ $190/t for PH13 grade). The assumption is that this large crop area is serviced by one main cropping tractor and implement setup. The area sown to winter crop would be 1,624 each year. Assuming sowing takes 0.16 hours (about 10 minutes) per hectare, the sowing time would be 190 hours, or about 24 days (allowing for eight hour days). This is achievable but for the sake of timeliness some growers may choose to operate a second tractor or to employ contractors to assist with peak work periods. The former option will increase the level of capital investment required and annual depreciation and the latter would increase variable costs.

Table 7.2 Representative farm for Inner West subregion, annual operating budget

Annual Operating Budget						
2,887	ha	Total farm area				
2,165	ha	Crop area		75% of farm		
722	ha	Pasture area		25% of farm		
Enterprise Gross Margin (W-B-lfS-Cp)					GM/ha	
1,624	ha	Summer Fallow			-$53	-$85,667
541	ha	Winter Fallow			-$32	-$17,178
541	ha	Short Fallow Wheat (after pulse)			$353	$191,126
541	ha	Barley			$170	$92,179
541	ha	Solid Plant Sorghum			$138	$74,451
541	ha	Chickpeas			$219	$118,385
722	ha	Pasture		2 DSE/ha		
120	ewes@		2	DSE/ewe		$6,200
79	cows@		15	DSE/cow		$33,763
Total Farm Gross Margin						**$413,260**
Overhead Costs						
Casual labour					$0	
Permanent labour (not owner/operator)					$40,000	
Rates					$13,236	
Registration					$3,000	
Insurance (vehicle, building)					$5,000	
Other R&M (fencing, tools, pumps etc.)					$5,000	
Fuel costs (not tractor)					$5,000	
Admin. (elect., phone)					$3,000	
Total Overhead Costs						**$76,236**
Farm Cash Income						**$337,023**
Operating Costs						
Interest @ 9%		of liabilities			$49,230	
Depreciation on tractor & implements					$33,765	
Depreciation @10% of misc, plant @ equipment					$20,000	
Operator and family labour					$0	**$102,905**
Farm Operating Surplus						**$234,119**
Business return on owners equity						**7.8%**

7.2 The Role of Long Fallows

A long fallow is often required to switch from a winter crop to a summer crop, because there is often insufficient time to allow sub-soil moisture to build up to adequate levels if double-cropping is attempted. For example, wheat is typically harvested in November/December but sorghum should be sown by the end of December or early January so there is very little time for sufficient moisture reserves for a sorghum crop to build up. This is assuming the wheat crop has used up most of the sub-soil moisture. There may be more opportunity to sow a winter crop soon after harvesting a summer crop, and this is the assumption in the W-B-lfS-Cp rotation shown in Table 7.2. In this case a sorghum crop is harvested in March and chickpeas sown in May or June.

The second example rotation is a different sequence of wheat-chickpeas-wheat-long fallow sorghum-long fallow wheat (W-Cp-W-lfS-lfW). The Inner West region yield assumptions (Table 7.3) are the best estimates by local agronomists. Long fallow in this instance means a 12 month fallow period (over a winter and summer season) to enable fallow moisture build-up between wheat and sorghum crops. The rates of return are similar for the two rotations (return on equity was 8.0% for the second rotation) and are reasonably high due in part to the high proportion of the farm assumed to be under crop (75%). Chickpeas are the pulse component of the rotations, with winter cereals (wheat and/or barley) dominating the rotations.

Table 7.3 Yield assumptions - Inner West subregion

with added nitrogen	No till	
Crop	Yield	Protein
SF wheat (after cereal)	2.20	12.1%
SF wheat (after pulse or oilseed)	2.40	13.2%
LF Wheat	3.00	13.8%
SF barley	2.70	
LF sorghum	2.00	
canola	2.00	
chickpeas	1.20	

8. The Inner East Representative Farm Model

The Inner East subregion corresponds with the eastern half of the Narrabri LGA and NSW Department of Primary Industries agronomy district, and the Yallaroi LGA and Moree East agronomy district.

Agricultural Census data from 2001 (Table 3.5) for the Narrabri and Yallaroi LGAs show about 60% of growers grew wheat. Areas under barley, chickpeas, sorghum and mungbeans were higher in the Yallaroi LGA. The proportion of growers with sheep was similar (about 30%), with the more growers in the Yallaroi LGA producing cattle (84% compared to 72% in the Narrabri LGA). ABARE figures for area operated (Table 3.6) were 1660 ha with wheat and beef returns being most important.

The most commonly sown wheat varieties include Sunbrook, Sunlin and Sunstate. Jimbour and Howzat chickpeas as well as Skiff and Gardiner barleys are common alternative winter crops to wheat. Commonly used fertiliser rates include 100 to 125 kg/ha of urea and 40 to 60 kg/ha of Starter Z. There is potential for fababeans, canola and mustards in the future (S. Belfield, pers. comm., 2002). The area under zero till according the ABS Agricultural Census figures was 23% (Table 4.6), with 58% under reduced tillage.

8.1 Financial Performance of the Inner East Representative Farm

Based on the information from ABS and ABARE, the statement of assets and liabilities for the Inner East representative farm is shown in Table 8.1. The farm area figures were derived from small sample data from ABARE for the sub-region. Total farm area is 1660 ha and total capital value over $2.4 million. The proportion of the farm under crop is 53%. However, some farms have a high proportion of area (80%) under crop in the Croppa Creek and North Star areas, with considerable variation of the proportion under crop across the region (S. Belfield, pers. comm., 2003). The assumption in this example is that cropping and pastures are kept separate. Also, the stocking rate is assumed to be 1.9 DSE/ha. Yield assumptions shown in Table 8.3 are best estimates for average yields by local agronomists. The equity percentage is 75%, estimated using average debt figures from ABARE.

The annual operating budget is shown in Table 8.2. The Farm Operating Surplus is $144,603 and the rate of return on owners equity is 6.2%. This provides reasonable returns to meet family living expenses, debt repayments and off-farm investments.

Table 8.1 Whole-farm budget, representative farm for Inner East subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	880	ha @	$1,200	per ha		$1,055,760
	780	ha @	$500	per ha		$390,100
	Other improvements (eg sheds)					$200,000
	Total value of land and improvements					$1,645,860
Livestock	99	cows @	$750	per cow	$74,250	
	2	bulls @	$4,000	per bull	$8,000	
	Total value of livestock					$82,250
Plant and equipment						
	1 Tractor 165-170 KW PTO (260-268 HP)				$186,119	
	Implements (average value)				$173,475	
	Vehicles (car, ute, truck) (estimates)				$100,000	
	Other (augur, motorbike, wool press etc.)				$100,000	
	Total value of plant and equipment					$559,594
TOTAL ASSETS						$2,487,704
LIABILITIES						
	Overdraft				$129,880	
	Term Loans				$410,000	
	Tractor Loan				$88,246	
TOTAL LIABILITIES						$628,126
Equity (Assets – Liabilities)						$1,859,578
Equity percentage (Equity/Total Assets)						75%

Table 8.2 Representative farm for Inner East subregion, annual operating budget

Annual Operating Budget					
1,660	ha	Total farm area			
880	ha	Crop area	53% of farm		
780	ha	Pasture area	47% of farm		
Enterprise Gross Margin (W-S-Cp)				GM/ha	
587	ha	Summer Fallow		-$38	-$22,138
293	ha	Winter Fallow		-$32	-$9,435
293	ha	Short Fallow Wheat (+N)		$342	$100,437
293	ha	Long Fallow Sorghum		$347	$101,659
0	ha	Barley		$161	$0
293	ha	Chickpeas		$260	$76,152
780	ha	Pasture	1.9 DSE/ha		
99	cows@		15 DSE/cow		$43,040
Total Farm Gross Margin					**$289,716**
Overhead Costs					
Casual labour				$0	
Permanent labour (not owner/operator)				$40,000	
Rates				$12,553	
Registration				$3,000	
Insurance (vehicle, building)				$5,000	
Other R&M (fencing, tools, pumps etc.)				$5,000	
Fuel costs (not tractor)				$10,000	
Admin. (elect., phone)				$3,000	
Total Overhead Costs					**$78,553**
Farm Cash Income					**$211,163**
Operating Costs					
Interest @ 9% of liabilities				$53,186	
Depreciation on tractor & implements				$25,223	
Depreciation @10% of misc, plant @ equipment				$20,000	
Operator and family labour				$0	**$96,560**
Farm Operating Surplus					**$114,603**
Business return on owners equity					**6.2%**

8.2 Adding Barley to the Rotation

A question of interest is the addition of a crop of barley to the wheat-sorghum-chickpeas rotation. When a barley crop is added to the rotation after the wheat crop, the rate of return on equity drops to 4.3%. This is because the gross margin for barley in this example is lower than the other crops, and the introduction of barley drops the total farm gross margin to $256,126.

Table 8.3 Yield assumptions - Inner East subregion

Crop	Yield t /ha	Protein %
Long fallow sorghum	5.00	
Long fallow wheat	4.00	11.70
Wheat (continuous)	3.90	10.00
70W_90S sorghum	4.70	
70W_90S wheat	3.90	10.33
Barley	2.50	
Chickpeas	1.30	

9. The North-East Slopes Representative Farm Model

The North-East Slopes subregion is comprised primarily of the Inverell LGA. This has large areas under lucerne for grazing which are often rotated with grain crops such as wheat, barley and sorghum. Common rotations include lucerne for 4 or 5 years, followed by 3 to 4 years of cereal crops. There is also a large area sown under forage oats (about 20,000 ha), the only crop grown by many growers (B. McGufficke, pers. comm. 2002). ABS figures for 2001 showed 19,025 hectares of cereal crops were grazed or used for silage in the Inverell LGA. There were no specific ABS figures for oats crops grazed. In a good year, between 20 to 30 percent of the area under forage oats is harvested for grain. Forage oats is used for grazing breeders, prime lambs and steers (B. McGufficke, pers. comm. 2002). Other minor crops include sunflowers and soybeans. About 1,500 to 2000 hectares of the latter are grown each year to the east of Inverell. Few chickpeas are grown, but this crop has potential to expand now that disease control measures and better varieties have been developed. However, chickpeas in rotation with lucerne can be difficult, due to the same strain of phytophthora root rot affecting both lucerne and chickpeas. A small area of canola is grown each year, about 800 to 1,000 hectares (B. McGufficke, pers. comm. 2002).

ABS data for the Inverell LGA (Table 3.5) indicate that 19% of growers grew wheat, with 21% of growers growing barley in 2000. About 55% of growers ran sheep with 77% running cattle. The average farm size indicated by the ABS data was 1,049 hectares, although properties vary in size from 400 to 2,500 hectares towards the Yetman and Ashford areas. The Ashford area is mainly a grazing area (B. McGufficke, pers. comm. 2002). The relatively low proportional areas of crops reflect the predominantly mixed farming and grazing focus of the district. The proportion of farm area under crop varies widely in the district, with many growers only growing forage oats and/or lucerne, whilst many others will grow grain crops in rotation with forage crops (B. McGufficke, pers. comm., 2002). ABARE data for 2000-01 (Table 3.7) indicates a relatively small average farm size and a negative rate of return, but a high equity ratio at 91%. Crop types were mainly cereals (Figure 6). The proportion of crop area under zero till (17%) is slightly lower than other districts (except Coonamble and Narrabri) with reduced till at 44% of crop area (Table 4.6). However, ABS 2001 census figures for crop stubble treatment indicate that this LGA has a high proportion (23% compared to between 3% and 9% in the other northern LGAs discussed here) of crop stubble grazed or baled for hay. This also reflects the higher level of integration of crop and livestock systems in this part of the region.

9.1 Financial Performance of the North-east Slopes Representative Farm

Based on the information from ABS and ABARE, the statement of assets and liabilities for the North-East Slopes representative farm is shown in Table 9.1. For the example evaluated, a farm area of 1,098 hectares with a total capital value is $1.75 million was assumed with 6% of that area under crop. The equity percentage is 90 percent. The average farm area used was that found in the 2001 ABS agricultural census for the Inverell local government area. The two rotations shown here, L-L-L-L-W-W-B-B and L-L-L-L-L-S-S-W, are two of the most common rotations involving cropping in the district. Other variations on these rotations include soybeans in the cropping mix. In addition to the lucerne/grain crop rotation, an improved pasture area of 50 hectares is assumed, with a mixture of sheep and cattle. The proportion of sheep and cattle is based on RLPB estimates for these livestock proportions for the Northern Slopes RLPB district. Native (unimproved) pasture is assumed to have a carrying capacity of 4 DSE per hectare and lucerne and improved pasture is assumed to have a carrying capacity of 8 DSE per hectare.

Table 9.1 Whole-farm budget, representative farm for North-East Slopes subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	1,098	ha @	$731	per ha		$767,742
	Other improvements (eg sheds)					$200,000
	Total value of land and improvements					**$967,742**
Livestock	294	ewes @	$50	per ewe	$14,769	
	5	rams @	$400	per ram	$3,200	
	255	cows @	$750	per cow	$191,099	
	6	bulls @	$4,000	per bull	$24,000	
	Total value of livestock					**$235,550**
Plant and equipment						
	2 Tractor 74 KW PTO (110 HP)				$92,397	
	Implements (average value)				$59,792	
	Vehicles (car, ute, truck) (estimates)				$60,000	
	Other (augur, motorbike, wool press etc.)				$45,000	
	Total value of plant and equipment					**$257,188**
TOTAL ASSETS						**$1,750,193**
LIABILITIES						
	Overdraft				$1,899	
	Term Loans				$90,000	
	Tractor Loan				$77,103	
TOTAL LIABILITIES						**$167,103**
Equity (Assets – Liabilities)						$1,583,091
Equity percentage (Equity/Total Assets)						90%

The annual operating budget is shown in Table 9.2. Farm Operating Surplus ($64,601) and return to owner equity (4.1%) are reasonable, but the adequacy of these returns will depend on family requirements, debt repayments and off-farm investments.

Table 9.2 Representative farm for North-East Slopes, annual operating budget

Annual Operating Budget					
1,098	ha	Total farm area			
70	ha	Crop area	6% of farm		
978	ha	Pasture area	94% of farm		
Enterprise Gross Margin (L-L-L-L-W-W-B-B)				GM/ha	
35	ha	Summer Fallow		-$61	-$2,161
14	ha	Long Fallow Wheat		$382	$5,368
14	ha	Barley - feed		$145	$2,041
7	ha	Lucerne Establishment		-$238	-$1,673
32	ha	Lucerne	8 DSE/ha		
7	ha	Lucerne removal		-$47	-$327
978	ha	Native Pasture	4 DSE/ha		
25	ha	Established pasture	8 DSE/ha		
8	ha	Pasture establishment	0 DSE/ha	-$218	-$1,820
17	ha	Pasture maintenance	8 DSE/ha	-$32	-$525
294	ewes@	2.3	DSE/ewe		$22,388
255	cows@	15	DSE/cow		$101,085
Total Farm Gross Margin					**$124,378**
Overhead Costs					
Casual labour				$434	
Permanent labour (not owner/operator)				$0	
Rates				$6,027	
Registration				$3,000	
Insurance (vehicle, building)				$3,000	
Other R&M (fencing, tools, pumps etc.)				$5,000	
Fuel costs (not tractor)				$5,000	
Admin. (elect., phone)				$3,000	
Total Overhead Costs					**$25,735**
Farm Cash Income					**$98,642**
Operating Costs					
Interest @ 9% of liabilities				$17,850	
Depreciation on tractor & implements				$8,312	
Depreciation @10% of misc, plant @ equipment				$10,500	
Operator and family labour				$0	**$34,041**
Farm Operating Surplus					**$64,601**
Business return on owners equity					**4.1%**

9.2 An Alternative Rotation with Sorghum

The comparison is of barley or sorghum in a lucerne-wheat rotation. A rotation sequence of sorghum-sorghum-wheat-4 years lucerne with the same asset base returned a 4.0% return on owners equity. Yield assumptions are shown in Table 9.3. Crop yields were based on best estimates by agronomists.

Table 9.3 Yield assumptions - North-East Slopes subregion

	Yield t/ha	Protein %
Long fallow sorghum	4.0	
Sorghum (cereal rotation)	3.0	
Long fallow wheat	3.0	12.0
Wheat (cereal rotation)	2.5	11.0
Sorghum (pulse rotation)	3.3	
Wheat (pulse rotation)	2.75	11.5
Barley-feed	2.5	
Chickpeas	1.3	

The rates of return for the two example rotations in the table are relatively low for this region; the low proportion under crop, as well as high costs of lucerne and pasture establishment has an effect. The farm area assumed is also the smallest in the set of six example farms, so there are fewer opportunities to take advantage of economies of scale.

10. The Liverpool Plains Representative Farm Budget

The Liverpool Plains is bounded to the South by the Liverpool Ranges, which form part of the Great Dividing Range, to the east by the Melville Ranges and to the west by the Warrumbungle Range and Pilliga Scrub. The Mooki River and Cox's Creek drain the area northwards into the Namoi River, which is a tributary of the Murray-Darling river system (Ringrose-Voase *et al*. 2003).

The Liverpool Plains region has been the subject of a number of studies and surveys since the early 1990s due to community concerns about various natural resource management issues. The issues include dryland salinity and groundwater recharge, flooding, soil erosion, water quantity and quality, biodiversity and riparian zone health (URS 2001). The total area of the catchment is 1.2 million ha with 1.06 million ha managed for predominantly agricultural production. Of this, approximately 33% of the area (355,000 ha) is devoted to cropping, 13% sown to improved pasture, 10% sown to aerially improved pasture, 35% is native pasture and 7% occurs as dense timber (McLeish and Flavel 1996). The annual rainfall decreases rapidly from over 1200 mm at the top of the Liverpool Ranges (elevation up to 1200 m) in the south-east to 625 mm on the alluvial flats and then more slowly from there to 570 mm to the north of Gunnedah. It falls predominantly in the summer months, often in short duration, high intensity rain events or thunderstorms. Frosts tend to be more frequent in the south of the catchment, and occur later into the spring (Ringrose-Voase *et al*. 2003).

The Liverpool Plains subregion falls within the Gunnedah NSW Department of Primary Industries agronomy district, and includes the Gunnedah (northern Liverpool Plains) and Quirindi (southern Liverpool Plains) LGAs. Agricultural Census data from 2001 (Table 3.5) for the Gunnedah and Quirindi LGAs indicate there are some differences between the two, including the cropping and livestock systems in the north compared to the south of the subregion. ABARE figures for this subregion are shown in Table 3.7. Livestock numbers are higher in the southern Plains, with more growers growing sorghum, maize and sunflowers, but average farm size is smaller than in the western areas (Table 3.7). More growers grow cotton in the northern Plains and there is also more continuous winter cereal (wheat and barley) growing. Major wheat varieties used include Wollaroi (durum), Kennedy, Hybrid Mercury and Sunstate, with usually a minimum of 50cm of sub-soil moisture required before sowing (L. Serafin, pers. comm., 2002). Long fallow wheat-sorghum rotations are widely practiced on the alluvial plains and adjacent volcanic slopes. Short-fallow winter cropping and opportunity cropping systems are also practiced. McLeish and Flavel (1996) found that 55% of respondents used fixed, mostly long fallow, rotations and 35% had adopted opportunity cropping to some extent.

When combined, the Gunnedah and Quirindi LGAs have the highest proportion of crop area under zero till at 34% (Table 4.6) with 33% under reduced till.

A combination of improved and native pastures are common on the Plains (L. Serafin, pers. comm. 2003), so it was assumed that 45% of the farm area would be under native pasture (4 DSE/ha) and 20% under improved pasture (8 DSE/ha), which would be re-sown every eight years. Pasture maintenance assumed was 125 kg/ha of single superphosphate every two years.

10.1 Financial Performance of the Liverpool Plains Representative Farm

Based on the information from ABS and ABARE, the statement of assets and liabilities for the Liverpool Plains representative farm is shown in Table 10.1. Total farm area is 1700

hectares (many growers own more than one farm) and total capital value is $3 million. The assumed proportion of the farm under crop is 35%. The equity percentage is 82%.

The annual operating budget of the long fallow wheat-sorghum strip cropping system is shown in Table 10.2. Return to owners equity was 4.6%. Yield assumptions are shown in Table 10.3. There was a relatively low area under crop with 35 percent of the farm used for cropping, but a large proportion (66%) of this is under fallow in any one season (during winter or summer growing periods). Under this system, any one paddock grows two crops in three years, which is a moderately low cropping frequency.

10.2 Strip Cropping versus Opportunity Cropping

Wheat-sorghum long fallow strip cropping (lfW-lfS) began in the 1970's in an effort to arrest flood flows across the plains. Yields for long fallow wheat and sorghum, continuous wheat and 70W/90S wheat and sorghum sowing rules (sow with 70 cm wet soil for wheat and 90 cm for sorghum) are taken from APSIM modelling results from GRDC project DAN407, using Gunnedah rainfall (635mm annual average). This modelling exercise took the historical rainfall results from 1958 to 1997 and applied different wheat and sorghum cropping systems, including long fallow, continuous wheat and a set of eight opportunity cropping planting rules. In this example we have included median yields from the 70W/90S rule, which is close to actual practice. In this case wheat is planted once the sub-soil moisture reaches 70cm in depth and 90cm for sorghum. Sowing dates for both wheat and sorghum were earlier in the northern part of the plains (Ringrose-Voase *et al*. 2003).

The opportunity cropping sorghum-wheat rotation sequence was sorghum-winter fallow-sorghum-wheat-summer fallow-winter fallow (lfS-S-W). This sequence obtained a business return on owner equity of 5.4% and so outperformed the long fallow strip cropping rotation. Another possibility is a sorghum-winter fallow-sorghum-wheat rotation, but this would occur only if sub-soil moisture was sufficient to allow the crop area to be sown in its entirety to sorghum each year. Part of that area (298ha) would be immediately after a wheat crop, however sufficient subsoil moisture is unlikely to accrue for sorghum planting in every year on this area, since wheat is harvested in November and sorghum can be sown at the latest in early January. Assuming that was achievable, then return on equity would be 9.1% for this particular example.

Table 10.1 Whole-farm budget, representative farm for the Liverpool Plains subregion, statement of assets and liabilities

Statement of Assets and Liabilities						
ASSETS						
Land	595	ha @	$1,490	per ha		$886,684
	1,105	ha @	$790	per ha		$872,481
	Other improvements (eg sheds)					$250,000
	Total value of land and improvements					$2,009,165
Livestock	433	cows @	$750	per cow	$255,000	
	9	bulls @	$4,000	per bull	$28,000	
	Total value of livestock					$283,000
Plant and equipment						
	1 Tractor 165-170 KW PTO (260-268 HP)				$184,908	
	Implements (average value)				$128,250	
	Vehicles (car, ute, truck) (estimates)				$100,000	
	Other (augur, motorbike, wool press etc.)				$100,000	
	Total value of plant and equipment					$513,158
TOTAL ASSETS						**$3,055,323**
LIABILITIES						
	Overdraft				$62,932	
	Term Loans				$400,000	
	Tractor Loan				$88,246	
	Other Loans					
TOTAL LIABILITIES						**$551,178**
Equity (Assets – Liabilities)						$2,504,145
Equity percentage (Equity/Total Assets)						82%

Table 10.2 Representative farm for Liverpool Plains, annual operating budget

Annual Operating Budget					
1700	ha	Total farm area			
595	ha	Crop area	35% of farm		
1015	ha	Pasture area	65% of farm		
Enterprise Gross Margin (lfW-lfS)				GM/ha	
397	ha	Summer Fallow		-$34	-$13,559
397	ha	Winter Fallow		-$36	-$14,212
198	ha	Long Fallow Wheat		$475	$94,248
198	ha	Long Fallow Sorghum		$301	$59,712
765	ha	Native Pasture	4 DSE/ha		
170	ha	Established pasture	8 DSE/ha		
85	ha	Pasture establishment	0 DSE/ha	-$239	-$20,281
85	ha	Pasture maintenance	8 DSE/ha	-$ 38	-$3,255
340	cows@	15	DSE/cow		$139,018
Total Farm Gross Margin					**$241,670**
Overhead Costs					
Casual labour				$2,492	
Permanent labour (not owner/operator)				$0	
Rates				$15,681	
Registration				$3,000	
Insurance (vehicle, building)				$5,000	
Other R&M (fencing, tools, pumps etc.)				$5,000	
Fuel costs (not tractor)				$5,000	
Admin. (elect., phone)				$3,000	
Total Overhead Costs					**$39,173**
Farm Cash Income					**$202,497**
Operating Costs					
Interest @ 9% of liabilities				$47,718	
Depreciation on tractor & implements				$20,176	
Depreciation @10% of misc plant @ equipment				$20,000	
Operator and family labour				$0	**$87,894**
Farm Operating Surplus					**$114,603**
Business return on owners equity					**4.6%**

Table 10.3 Yield assumptions - Liverpool Plains

	Yield t /ha	Protein %
Long fallow sorghum	4.3	
Long fallow wheat	4.7	11.2
Wheat (continuous)	3.7	10.1
70W/90S sorghum	4.5	
70W/90S wheat	3.6	9.9

Note: Median output yield and protein results from APSIM model results at Gunnedah used for long fallow wheat and sorghum, continuous wheat and 70W/90S wheat and sorghum

One issue of note is that whilst APSIM does allow for yield reductions due to drought, it excludes effects of waterlogging, weeds, pests and disease, so there is the possibility that the average yields used here could be overestimated. Nevertheless, there appear to be reasonable advantages of opportunity cropping over the long fallow strip cropping system.

11. Conclusions

This report presents a description of six important crop-based dryland farming systems in the northern cropping region of NSW. The six models are intended to be representative of six subregional areas which differ by characteristics of soil type, rainfall patterns, frost incidence and temperature. Representative farm models were developed for the Western Clay (Walgett and Coonamble grey clays), the Western Red (Coonamble red loams), the Inner West (Moree Plains and west of Narrabri), the Inner East (Yallaroi and east of Narrabri), the North-East slopes (Inverell) and the Liverpool Plains (Gunnedah and Quirindi) subregions. The model farms vary in size from 1050 ha to 6080 ha. The main difference in crop rotations, influenced by soil type and rainfall, was use of lucerne in the rotation in the Western Red and North-East Slopes subregions, compared to continuous cropping in the other four areas. The returns to capital (business return on owner's equity) varied from 2.0 % in the Western Clay subregion to 8.2% for the Western Red subregion. These financial results were based on prices and costs prevalent in the early 2000s. The fact that there is so little difference between common rotations is perhaps not surprising as farmers in the north west use a wide variety of rotations..

The whole farm budget provides a snapshot of the financial performance at a particular point in time of a farm with a particular set of resources. While the representative farm models presented in this Report may give a broad indication of the financial performance of many farms in the northern cropping zone, they may be misleading for farms with markedly different resources or enterprise rotations to those of the representative farms.

As outlined in section 3.2, the agricultural systems in the northern region are diverse, with a wide range of cropping systems. They vary from crop rotations that include pasture or lucerne (usually on lighter soil types) to those that specifically keep livestock separate (usually on the heavier clay soils).

Recent trends have been towards reduced or no tillage systems, with the crop sequence emphasis changing from set rotations to opportunistic or tactical cropping in response to variable seasonal and market conditions. The increased adoption of opportunity cropping has complicated the cropping sequence, requiring careful management to avoid residual herbicide and crop pest and disease problems.

Crop rotations under reduced tillage that include pulse crops are capable of being more profitable than the 'traditional' continuous cereal systems. This also has important implications from a natural resource management and biodiversity perspective, since the diversification of rotations is beneficial in terms of reduced dependence on fertilisers, easier weed control and improved soil health.

These examples of the use of whole-farm models have illustrated that in some cases the comparison of alternative crop rotations makes very little difference for the aggregate return to capital and labour. Assumptions about farm size, arable area and equity levels can be important. While a crop sequence budget might show a potential for profitable change, the change in whole farm profit after accounting for machinery capital costs, labour and finance, might not be so stark. The advantages of farm representations such as these are that, first, they account for different aspects of a farm structure and, second, that the assumptions are transparent, so that models have sufficient flexibility to be adaptable for a range of questions. This report documents and encourages potential users of these RD&E tools.

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