

Farm Practices Survey Report 2012



Title: **GRDC Farm Practices Survey Report 2012**

This report outlines the adoption of key management practices used in Australian grain-growing regions. Specific practices include:

- matching land use to land capabilities;
- reduced or no-tillage;
- stubble retention;
- crop rotation with pastures, oilseeds and pulses;
- controlled traffic and precision agriculture;
- nutrient budgeting and soil testing;
- use of soil conditioners;
- sowing dates;
- managing water use efficiency; and
- water budgeting.

Authors: **Jan Edwards, Alan Umbers and Stephen Wentworth**

Jan Edwards
Grains Research and Development Corporation
PO Box 5367
KINGSTON ACT 2604
P: 02 6166 4500
E: jan.edwards@grdc.com.au

Stephen Wentworth
Kaliber Research Pty Ltd
PO Box 1624
NEUTRAL BAY NSW 2089
P: 02 8458 5700
E: stephen.wentworth@kalibergroup.com.au

ISBN 978-1-921779-42-8
November 2012

© 2012 Grains Research and Development Corporation. To the extent permitted by law, all rights are reserved and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of the GRDC.

Design and production:
Coretext, www.coretext.com.au

coretext

GRDC
**Grains
Research &
Development
Corporation**

Your GRDC working with you

Disclaimer

This publication has been prepared in good faith on the basis of information available at the date of publication without any independent verification. The Grains Research and Development Corporation does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication. The Grains Research and Development Corporation will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

Products may be identified by proprietary or trade names to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to. Other products may perform as well or better than those specifically referred to.

FOREWORD

Australian grain growers continually demonstrate their resourcefulness and success in managing challenging seasonal, industry and market conditions to deliver profitable and sustainable farm businesses. In turn, farming practices are constantly changing to match these challenges.

The adoption of sustainable practices in tillage, fertiliser application, crop residue management, integrated pest, disease and weed management, rotations, precision agriculture, and other farming practice improvements has contributed to the resilience and success of grain businesses.

The Grains Research and Development Corporation (GRDC) invests around \$150 million of grain levies and government funds each year in research, development and extension (RD&E). Of this, about \$37 million is invested in farming practices RD&E to provide grain growers with better tools and information to enhance farm profit and sustainability.

In this, the second GRDC Farm Practices Survey Report, the GRDC and Kaliber Research conducted a national survey of growers to capture information about farming practices in use on grain and mixed farms across Australia.

The report provides baseline data to monitor and evaluate which farming systems and practices are working well and where 'gaps' are evident. The report is a key source of information for identifying future investment opportunities to drive productivity, profitability and sustainability improvements on grain farms.

The GRDC will continue to work with growers, advisers and research partners to improve adoption and make our industry more sustainable and profitable.



Steve Thomas
Executive Manager, Research Programs
Grains Research and Development Corporation

CONTENTS

INTRODUCTION	10
SURVEY METHODOLOGY	10
Who was surveyed	10
The survey questions	11
The data analysis process	11
How the data is presented	11
EXECUTIVE SUMMARY	12
Measurement of farming practices	12
What is new in this survey?	12
Summary of main trends	12
2012 SURVEY RESULTS	14
GRAIN FARM STATISTICS	14
Number of grain farms and total area of farmland	14
Farm size	14
Area of crop per farm	15
Use of farm area	15
Average percentage of crop per farm	15
Average percentage of pasture per farm	16
Farmland with native vegetation	18
INCOME	22
Farm income from grain	23
Percentage of farm income from winter cereal production	23
Percentage of farm income from winter pulse production	23
Percentage of farm income from winter oilseed production	23
Farm income from livestock	23
Percentage of farm income from sheep, wool, lambs	23
Percentage of farm income from beef cattle production	23
National trends in farm income source	24
CROP MIX ON GRAIN FARMS	28
Wheat	28
Barley	29
Other winter cereals	30
Summer cereals	30
Oilseeds	31
Pulses	32
Total crop mix	33
National trends	34
TILLAGE	37
Zero-tillage	38
No-tillage	41
Zero-tillage or no-tillage combined	42
Direct drill	43
Zero-tillage, no-tillage and direct drill combined	43
Minimum-tillage	44
Reduced tillage	44
Multiple-tillage (conventional cultivation)	45
PRECISION AGRICULTURE	46
Controlled traffic/tramlines	46
Autosteer	47
Variable rate technology	49
Yield mapping	50
FALLOW	51
Percentage of crop planted following a previous crop	52

FALLOW MANAGEMENT	53
Fallow weed control.....	53
Fallows maintained weed-free.....	53
Fallows where some weed growth was present.....	53
Fallow management techniques.....	53
Use of herbicide only.....	53
Combination of cultivation and herbicide.....	54
Summer fallow maintained weed-free without cultivation.....	55
Summer fallow: stubble present but burnt within one month of planting.....	56
LIVESTOCK GRAZING OF THE FALLOW	60
Fallows that are grazed.....	60
Fallows grazed for more than one month.....	60
Number of weeks summer fallow grazed by livestock.....	60
STUBBLE MANAGEMENT	64
Stubble retained through to planting.....	64
Stubble retained intact (standing) through to planting.....	64
Stubble retained (not necessarily standing).....	65
Stubble burnt.....	66
Stubble burnt early (hot burn).....	66
Stubble burnt late prior to planting (cool burn).....	67
Windrow management.....	68
Windrow raking.....	68
Burning of windrows for weed management.....	68
Stubble baling.....	69
PADDOCK HISTORY	72
Previous crop.....	72
Previous canola crop.....	72
Previous pulse crop.....	72
Previous legume-dominant pasture.....	73
Planted to have full access to the soil profile.....	73
Planted risking root disease.....	74
Planted with subsoil constraints.....	74
Crop planted for disease or weed control.....	75
SOWING TIME	80
Crops sown on time.....	80
Percentage of cereal crops sown before 15 May.....	80
Percentage of cereal crops sown before 30 June.....	81
NUTRIENT MANAGEMENT	84
Amount of soil testing.....	84
Frequency of soil testing.....	84
Use of soil testing to develop a fertiliser program.....	85
SOIL CONDITIONERS	88
Lime.....	88
Percentage of crop area where lime was applied.....	88
Use rate of lime.....	89
Gypsum.....	89
Dolomite.....	89
Use of dolomite.....	89
Summary.....	90
SOIL MOISTURE ASSESSMENT	92
Assessment of soil moisture at planting to assist in crop decisions.....	92
Average percentage of crop where plant-available water was assessed through the crop period.....	93
APPENDIX 1: QUESTIONS USED IN THE GRDC SURVEY 2011	95
Basic statistics.....	95
Crop mix.....	95
Fallow management.....	95
Weed control in the fallow.....	95
Stubble management between crops.....	95

Tillage.....	95
Stubble retention.....	96
Sowing time.....	96
Assessment of soil moisture at planting to assist in crop decisions.....	96
Amount of soil testing being carried out on grain farms in 2011.....	96
Soil conditioners.....	96
Precision agriculture.....	96
Paddock history.....	96

INDEX OF TABLES

Table 1	Estimate of the number of farms, sample size and margin of error for each of the agro-ecological zones.....	10
Table 2	Sample size and total farmland represented in the survey data by agro-ecological zone in 2008 and 2011.....	14
Table 3	Total crop area (ha) in 2008 and 2011 GRDC surveys.....	15
Table 4	Average farm size (ha) within agro-ecological zones in 2008 and 2011.....	15
Table 5	Average area (ha) of crop per farm.....	16
Table 6	Average percentage of farm area cropped.....	19
Table 7	Average percentage of farm area maintained as pasture.....	19
Table 8	Average percentage of farm area reported as native vegetation.....	21
Table 9	Average percentage of farm income derived from winter cereal production.....	22
Table 10	Average percentage of farm income derived from winter pulse production.....	22
Table 11	Average percentage of farm income derived from winter oilseed production.....	23
Table 12	Average percentage of farm income derived from sheep, wool and lamb production.....	26
Table 13	Average percentage of farm income derived from beef cattle production.....	26
Table 14	Average national percentage of farm income derived from different enterprises.....	27
Table 15	Average percentage of crop area planted to wheat.....	28
Table 16	Average percentage of crop area planted to barley.....	28
Table 17	Average percentage crop area planted to other winter cereals.....	29
Table 18	Average percentage of crop area planted to summer cereals.....	29
Table 19	Average percentage of crop area planted to winter oilseeds.....	31
Table 20	Average percentage of crop area planted to pulses.....	31
Table 21	Average percentage of cropped area planted with the major crops in 2008.....	33
Table 22	Average percentage of cropped area planted with the major crop in 2011.....	33
Table 23	Average national percentage of cropped area planted with the major crops in 2008 and 2011.....	33
Table 24	Average percentage of cropped area planted with zero-tillage (less than 10% soil disturbance).....	37
Table 25	Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance)....	37
Table 26	Average percentage of cropped area planted with zero-tillage or no-tillage (less than 30% soil disturbance).....	38
Table 27	Average percentage of cropped area planted with direct drill.....	39
Table 28	Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill.....	42
Table 29	Average percentage of cropped area planted with minimum-tillage techniques.....	42
Table 30	Average percentage of cropped area planted with reduced tillage techniques.....	43
Table 31	Average percentage of cropped area planted with multiple tillage techniques.....	45
Table 32	Average percentage of cropped area where controlled traffic/tramlines were used.....	46
Table 33	Average percentage of cropped area where autosteer was used.....	46
Table 34	Average percentage of cropped area where variable rate technology was used.....	47
Table 35	Average percentage of cropped area where yield mapping was used.....	49
Table 36	Average percentage of cropped area planted with a crop in 2011 following a preceding crop in 2010.....	52
Table 37	Average percentage of cropped area planted with a crop in 2011 where the fallow period was maintained weed-free.....	53
Table 38	Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth.....	54
Table 39	Average percentage of crop area in 2011 where the fallow period was managed by herbicides only.....	55
Table 40	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed with herbicides and cultivation.....	56
Table 41	Average percentage of cropped area planted with a crop in 2011 where preceding summer fallow period was maintained weed-free without cultivation.....	57
Table 42	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting.....	58
Table 43	Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period.....	60
Table 44	Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period.....	61
Table 45	Average number of weeks in 2011 where grazing occurred in the previous fallow period.....	62
Table 46	Average percentage of cropped area in 2011 where stubble was retained through to planting.....	64

Table 47	Average percentage of cropped area where stubble was retained intact through to planting	65
Table 48	Average percentage of cropped area where stubble was retained (not standing) through to planting	66
Table 49	Average percentage of cropped area where stubble was burnt early (hot burn)	67
Table 50	Average percentage of cropped area where stubble was burnt late (cool burn)	68
Table 51	Average percentage of cropped area where stubble was raked (windrow raking).....	69
Table 52	Average percentage of cropped area where stubble was windrow burnt in 2011	71
Table 53	Average percentage of cereal crop area planted in 2011 following canola, pulses or legume-based pasture....	72
Table 54	Average percentage of cereal crop area planted in 2011 following canola in 2010.....	73
Table 55	Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010	74
Table 56	Average percentage of cereal crop area planted in 2011 following a legume-dominant pasture.....	75
Table 57	Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile.....	76
Table 58	Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease	77
Table 59	Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present	78
Table 60	Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011	79
Table 61	Average percentage of crop area planted at the grower-assessed optimum time in 2011	80
Table 62	Average percentage cereal crop area planted prior to 15 May 2011	81
Table 63	Average percentage of cereal crop area planted prior to 30 June 2011	83
Table 64	Average percentage of crop area where soil was tested for nutrient status.....	84
Table 65	Average percentage of farms that use soil testing annually, two yearly and three yearly.....	87
Table 66	Average percentage of crop area where the fertiliser program was informed by soil testing.....	87
Table 67	Average percentage of crop area where lime was applied.....	88
Table 68	Average use rate of lime (t/ha) on area where applied	89
Table 69	Average percentage of crop area where gypsum was applied	90
Table 70	Average use rate of gypsum (t/ha) on area where applied	90
Table 71	Average percentage of farms applying soil conditioners prior to sowing	91
Table 72	Average percentage of crop area where plant available water was assessed at planting.....	92
Table 73	Average percentage of crop area where plant available water was assessed through the crop period.....	93

INDEX OF FIGURES

Figure 1	Number of grain farms in 2011 (map)	15
Figure 2	Farm size (ha) in 2011 within agro-ecological zones	16
Figure 3	Average area (ha) per grain farm in 2011 (map).....	16
Figure 4	Average area of crop (ha) per farm in 2011	17
Figure 5	Average area of crop (ha) per farm in 2011 (map)	17
Figure 6	Average percentage of farm area cropped in 2011	18
Figure 7	Average percentage of farm area cropped in 2011 (map)	18
Figure 8	Average percentage of farm area maintained as pasture in 2011	19
Figure 9	Average percentage of farm area maintained as pasture in 2011 (map).....	20
Figure 10	Average percentage of farm area reported as native vegetation in 2011.....	20
Figure 11	Average percentage of farm area reported as native vegetation in 2011 (map).....	20
Figure 12	Average percentage of farm income derived from grain production in 2011 (map).....	23
Figure 13	Average percentage of farm income derived from winter cereal production in 2011	24
Figure 14	Average percentage of farm income derived from winter pulse production in 2011	24
Figure 15	Average percentage of farm income derived from winter oilseed production in 2011.....	25
Figure 16	Average percentage of farm income derived from sheep, wool and lamb production in 2011	25
Figure 17	Average percentage of farm income derived from beef cattle production in 2011	26
Figure 18	Average national percentage of farm income derived from different enterprises in 2008 and 2011	27
Figure 19	Average percentage of crop area planted to wheat in 2011.....	29
Figure 20	Average percentage of crop area planted to wheat in 2011 (map)	30
Figure 21	Average percentage of crop area planted to barley in 2011	30
Figure 22	Average percentage of crop area planted to other winter cereals in 2011	31
Figure 23	Average percentage of crop area planted to summer cereals in 2011.....	32
Figure 24	Average percentage of crop area planted to summer cereals in 2011 (map).....	32
Figure 25	Average percentage of cropped area planted to winter oilseeds in 2011.....	34
Figure 26	Average percentage of crop area planted to oilseeds in 2011 (map).....	32
Figure 27	Average percentage of cropped area planted to pulses in 2011.....	34
Figure 28	Average percentage of cropped area planted with the major crops in 2008 and 2011 – first seven agro-ecological zones.....	35
Figure 29	Average percentage of cropped area planted with the major crops in 2008 and 2011 – second seven agro-ecological zones.....	35

Figure 30	Average national percentage of cropped area planted with the major crops in 2008 and 2011	36
Figure 31	Average percentage of cropped area planted with zero-tillage (less than 10% soil disturbance) in 2011 ...	38
Figure 32	Average percentage of cropped area planted using zero-tillage (less than 10% soil disturbance) in 2011 (map).....	38
Figure 33	Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance) in 2011	39
Figure 34	Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance) in 2011 (map).....	39
Figure 35	Average percentage of cropped area planted with no-tillage or zero-tillage (less than 30% soil disturbance) in 2011	40
Figure 36	Average percentage of cropped area planted with direct drill in 2011	40
Figure 37	Average percentage of cropped area planted with direct drill in 2011 (map).....	41
Figure 38	Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill in 2011	41
Figure 39	Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill in 2011 (map)	41
Figure 40	Average percentage of cropped area planted with minimum-tillage techniques in 2011	42
Figure 41	Average percentage of cropped area planted with minimum-tillage techniques (map)	43
Figure 42	Average percentage of cropped area planted with reduced tillage techniques in 2011	44
Figure 43	Average percentage of cropped area planted with reduced tillage techniques in 2011 (map).....	44
Figure 44	Average percentage of cropped area planted with minimum-tillage or reduced tillage techniques in 2011 (map).....	44
Figure 45	Average percentage of cropped area planted with multiple tillage techniques in 2011.....	45
Figure 46	Average percentage of cropped area planted with multiple tillage techniques in 2011 (map).....	45
Figure 47	Average percentage of cropped area where controlled traffic/tramlines were used in 2011	47
Figure 48	Average percentage of cropped area where controlled traffic/tramlines was used in 2011 (map)	47
Figure 49	Average percentage of cropped area where autosteer was used in 2011	48
Figure 50	Average percentage of cropped area where variable rate technology was used in 2011	48
Figure 51	Average percentage of cropped area where yield mapping was used in 2011	49
Figure 52	Average percentage of farms where yield mapping was used in 2011 (map).....	49
Figure 53	Average percentage of cropped area planted with a crop in 2011 following a preceding crop in 2010	51
Figure 54	Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop was maintained weed-free	54
Figure 55	Average percentage of fallows that were kept weed-free in 2011 (map)	54
Figure 56	Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth.....	55
Figure 57	Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth (map)	55
Figure 58	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides only.....	56
Figure 59	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides only (map)	56
Figure 60	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides and cultivation.....	57
Figure 61	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides and cultivation (map).....	57
Figure 62	Average percentage of cropped area planted with a crop in 2011 where preceding summer fallow period was maintained weed-free without cultivation	58
Figure 63	Average percentage of cropped area planted with a crop in 2011 where the preceding summer fallow period was managed without cultivation (map)	58
Figure 64	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting	59
Figure 65	Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting (map).....	59
Figure 66	Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period.....	61
Figure 67	Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period (map)	61
Figure 68	Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period	62
Figure 69	Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period (map).....	62
Figure 70	Average number of weeks in 2011 where grazing occurred in the preceding fallow period	63
Figure 71	Average number of weeks in 2011 where grazing occurred in the preceding fallow period (map)	63
Figure 72	Average percentage of cropped area in 2011 where stubble was retained through to planting	65
Figure 73	Average percentage of cropped area in 2011 where stubble was retained through to planting (map)	65

Figure 74	Average percentage of cropped area where stubble was retained intact through to planting in 2011	66
Figure 75	Average percentage of cropped area where stubble was retained intact through to planting in 2011 (map).....	66
Figure 76	Average percentage of cropped area where stubble was retained (not standing) through to planting in 2011.....	67
Figure 77	Average percentage of cropped area where stubble was retained (not standing) through to planting in 2011 (map).....	67
Figure 78	Average percentage of cropped area where stubble was burnt early (hot burn) in 2011	68
Figure 79	Average percentage of cropped area where stubble was burnt early (hot burn) in 2011 (map).....	68
Figure 80	Average percentage of cropped area where stubble was burnt later (cool burn) in 2011	69
Figure 81	Average percentage of cropped area where stubble was burnt late (cool burn) in 2011 (map)	69
Figure 82	Average percentage of cropped area where stubble was raked (windrow raking) in 2011.....	70
Figure 83	Average percentage of cropped area where stubble was windrow burnt in 2011	70
Figure 84	Average percentage of cereal crop area planted in 2011 following canola in 2010.....	73
Figure 85	Average percentage of cereal crop area planted in 2011 following canola in 2010 (map).....	73
Figure 86	Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010	74
Figure 87	Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010 (map).....	74
Figure 88	Average percentage of cereal crop area planted in 2011 following a legume dominant pasture	75
Figure 89	Average percentage of cereal crop area planted in 2011 following a legume dominant pasture (map).....	75
Figure 90	Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile. 76	
Figure 91	Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile (map).....	76
Figure 92	Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease	77
Figure 93	Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease (map).....	77
Figure 94	Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present	78
Figure 95	Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present (map)	78
Figure 96	Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011	79
Figure 97	Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011 (map).....	79
Figure 98	Average percentage of crop area planted at the grower-assessed optimum time in 2011	81
Figure 99	Average percentage of crop area planted at the grower-assessed optimum time in 2011 (map)	81
Figure 100	Average percentage of cereal crop area planted prior to 15 May 2011.....	82
Figure 101	Average percentage of cereal crop area planted prior to 15 May 2011 (map).....	82
Figure 102	Average percentage of cereal crop area planted prior to 30 June 2011	83
Figure 103	Average percentage of cereal crop area planted prior to 30 June 2011 (map).....	83
Figure 104	Average percentage of crop area where soil was tested for nutrient status in 2011	85
Figure 105	Average percentage of farms in 2011 using soil testing (map).....	85
Figure 106	Average percentage of farms in 2011 conducting soil testing every year (map).....	85
Figure 107	Average percentage of farms in 2011 conducting soil testing every second year (map).....	86
Figure 108	Average percentage of farms in 2011 conducting soil testing every third year (map)	86
Figure 109	Average percentage of crop area where fertiliser program was informed by soil testing in 2011	86
Figure 110	Average percentage of crop area where lime was applied in 2011.....	89
Figure 111	Average percentage of farms where lime was applied prior to sowing in 2011 (map).....	89
Figure 112	Average percentage of crop area where gypsum was applied in 2011	90
Figure 113	Average percentage of crop area where plant-available water was assessed at planting in 2011	93
Figure 114	Average percentage of crop area where plant-available water was assessed at planting in 2011 (map)	93
Figure 115	Average percentage of crop area where plant-available water was assessed through the crop period in 2011.....	94
Figure 116	Average percentage of crop area where plant-available water was assessed through the crop period in 2011 (map)	94

INTRODUCTION

This is the second GRDC Farm Practices Survey Report.

The GRDC commissioned Kaliber Research Pty Ltd to survey a national subset of grain producers and gather data about their farming operations and practices. The survey was based on their farming operations for the 2011 (winter) cropping year and where possible was tracked against the 2008 baseline assessment conducted by Solutions Marketing and Research Pty Ltd.

SURVEY METHODOLOGY

Who was surveyed

To qualify for the 2011 Farm Practices Survey respondents needed to be either a:

- grains specialist with a farm size of 500 hectares; or
- mixed grain/livestock producer with a farm size of 1000ha.

The definitions used were from the Australian and New Zealand Standard Industry Classification (ANZSIC). A grains specialist is defined as deriving at least 75 per cent of their farm income from grain production. A mixed grain/livestock producer is defined as deriving at least 25 per cent of their farm income from grain production.

Kaliber contacted 9820 grain producers randomly selected from its rural database. The response rate was 26 per cent. The response rate was low as the survey was conducted at the beginning of the winter crop harvest. A total of 1312 grain producers agreed to be interviewed. This gave an overall margin of error of ± 2.65 per cent.

The sample size and margins of error in each agro-ecological are presented in Table 1. This sample size represents approximately 4.3 per cent of the estimated number of grain producers in Australia. However, in both surveys the amount of crop area represented by the survey respondents represented 2.35 and 2.8 million ha, or approaching 10 per cent of the estimated total crop area in Australia.

Because the respondents were chosen randomly for each survey, and were independent of each other, the sample is different in 2008 and 2011.

TABLE 1 Estimate of the number of farms, sample size and margin of error for each of the agro-ecological zones

Agro-ecological zone	Estimate of number of farms*	Interview sample size	Margin of error
NSW Central	2260	95	$\pm 9.8\%$
NSW North-East / QLD South-East	2497	86	$\pm 10.4\%$
NSW North-West / QLD South-West	1315	94	$\pm 9.7\%$
NSW / VIC Slopes	5156	160	$\pm 7.6\%$
QLD Central	388	35	$\pm 15.8\%$
SA Mid North / Lower Eyre Peninsula	3047	118	$\pm 8.9\%$
SA / VIC Bordertown, Wimmera	4304	106	$\pm 9.4\%$
SA / VIC Mallee	2790	160	$\pm 7.5\%$
TAS	110	7	$\pm 36.0\%$
VIC High Rainfall	1519	65	$\pm 11.9\%$
WA Central	2997	185	$\pm 7.0\%$
WA Eastern	477	62	$\pm 11.6\%$
WA Mallee/Sandplain	588	57	$\pm 12.4\%$
WA Northern	798	82	$\pm 10.3\%$
Totals	30,316	1312	$\pm 2.65\%$

* Neil Clark and Associates (NCA) estimate of the number of farms in the grain industry in 2010.

The survey questions

The final questionnaire consisted of 48 individual questions. The survey questions were designed to provide data on the following sustainable farm practices:

- land use (land use to land class) – the actual use of land on the farm and how well this relates to land capability as described by land class;
- reduced or no-tillage – the use of minimum, zero-tillage or no-tillage systems for crop and pasture establishment;
- stubble retention – the level of retention of crop and pasture residues following harvest or grazing;
- crop rotation with pastures, oilseeds and pulses;
- controlled traffic/precision agriculture;
- nutrient budgeting and soil testing in crop and pasture;
- use of soil conditioners;
- sowing dates;
- managing water use efficiency; and
- water budgeting.

Quantitative answers were sought wherever possible.

The survey was restricted to 15 minutes and was carried out from 23 September to 16 October 2011.

Interviewing was conducted using computer-aided telephone interviews (CATI). A team of specialised interviewers, with empathy for rural Australia and farmers' availability, made telephone contact.

Calls were conducted during the day and at night to maximise response rates and minimise non-response bias.

The data analysis process

Following interviews, the data was imported into Plenari Investigator (Kaliber's analytical tool). Each record was checked for validity, errors and simple keying mistakes.

Data has been amalgamated to agro-ecological zone level so it could be compared with the 2008 study.

In all questions where the answer was quantitative (i.e. area), both acres and hectares were accepted, and the data was presented in uncorrected form.

How the data is presented

It is important to note that this was a survey, not a census. The data represents the averages of the survey respondents in each agro-ecological zone.

As the methodology for both surveys was the same (sample size, agro-ecological zone quotas and screening criteria), the 2008 and 2011 results can be compared in all agro-ecological zones except Tasmania.

The data from both the 2008 and 2011 surveys is presented in this report as:

- tables comparing 2008 and 2011 winter crop year data;
- figures comparing the 2011 data in each agro-ecological zone; and
- maps showing the 2011 data.

Where shown on figures and tables, 'LSD' denotes the least significant difference between means as determined by analysis of variance (ANOVA) techniques.

In tables and figures, where shown, means that share the same letters are not significantly different at the 5% level, using ANOVA analysis techniques.

Differences between means are signified by:

- ns = not significant at the 5 per cent level;
- ** = means are significantly different at the 5 per cent level; and
- *** = means are significantly different at the 1 per cent level.

Error bars on figures are the standard error of the mean. On figures and tables showing data for agro-ecological zones, the means that share the same letter are not significantly different at the 5 per cent level.

Where tables show both 2008 and 2011 data (i.e. means for each agro-ecological zone), the significance as indicated is between years within each zone with LSD shown for the 5 per cent level of probability.

All data in this report was sourced from the surveys carried out for the GRDC in 2008 and 2011.

The first survey was conducted in 2009 and reported on grower's on-farm activities for the 2008 (winter) cropping year. For the northern region this also included data from the 2007-08 summer cropping activities. The second survey was conducted late in 2011 and records grower's on-farm activity for that year. In this report these two surveys will be referred to as '2008' and '2011'.

This document, Farm Practices Survey Report, is referred to as '2012', since this is the publication year of the data. The previous survey report, which presented data on 2008 grower practices was published in 2010 and that document may be referred to as the 'GRDC Survey Report 2010'.

EXECUTIVE SUMMARY

Measurement of farming practices

The GRDC commissioned Kaliber Research Pty Ltd to contact a national subset of grain producers and gather data about their farming operations and practices. The survey was based on the farming operations for the 2011 (winter) cropping year and where possible was tracked against the 2008 baseline assessment conducted by Solutions Marketing and Research Pty Ltd.

What is new in this survey?

This survey asked questions that were not asked in the previous survey and thus includes data that was not presented in the comparative document of 2011, based on the data for the 2008 crop year.

Additional information presented in this report includes data about some aspects of management of the fallow or period between successive crops, including how weeds were managed and grazing activities. Data was also gathered about crop sequencing and how much crop was planted where risks were known about root disease and subsoil constraints.

Summary of main trends

The survey covered 1312 grain farming businesses and 2.355 million hectares of crop area in 2011, representing approximately 8 per cent of the estimated area of crop planted in Australia (ABS data).

Farm size has remained similar to that noted in 2008, with the largest farms being in Western Australia, Central Queensland and Central and North-West New South Wales/South-West Queensland.

The largest cropping properties, as a percentage of farm size, remain in WA, with little change in the percentage of the farm that is cropped.

The percentage of farm income flowing from winter cereals has decreased in Central Queensland and parts of WA while showing an increase in other areas, although it remains at 66 to 67 per cent of farm income nationally. Winter pulses and oilseeds remain a minor contributor to farm income, at less than 3 per cent (each) of income nationally, although oilseeds are more popular in some areas of the southern grain-producing regions of Australia. Income from livestock remains at almost 26 to 27 per cent on the farms surveyed nationally, with the percentage from sheep increasing at the expense of cattle.

The percentage of wheat in the cropping mix has increased in many regions of Australia, notably in the eastern states and the central and eastern areas of WA. The percentage of barley has fallen significantly in most regions, while winter oilseeds have shown an increase in many areas. Winter pulses have increased in the northern and western parts of NSW and Queensland, much of Victoria and SA, and the northern and southern areas of WA.

Tillage practices have shown some changes since the previous survey, with the percentage of the crop planted

using zero or no-tillage, taken together, remaining high, at more than 60 per cent of the hectares nationally, although the percentage has fallen in parts of SA, Victoria and NSW. This decrease has been matched by an increase in (full cut) direct drilling and some increase in minimum-tillage. Weed-management strategies may lie behind these changes.

The use of controlled traffic continues to grow nationally and now represents more than 20 per cent of the cropped area, although this is higher in the heavier soils of Northern NSW and Central Queensland. The use of autosteer is also reported as being very high, at more than 60 per cent of the cropped area in some regions, although this figure may require verification. Variable rate technology remains at below 10 per cent of the cropped area, while yield mapping has increased to now represent more than 20 per cent of the cropped area.

The use of fallow was investigated in the 2011 survey and showed that almost 75 per cent of the crop in the eastern and northern states is planted following some kind of fallow, although more than 75 per cent of the cropped area was planted where a crop was present in the preceding year. These 'fallows' are often short, summer periods where stubble is retained and weed control is carried out. The majority of these fallows are maintained weed-free, with more than 60 per cent (and often more than 75 per cent) of the fallow kept weed-free. Herbicides are the method of choice for weed control in fallow, with more than two-thirds – and in the northern regions more than three-quarters – of fallows maintained by herbicide only, with the balance using a mixture of approaches, including some grazing and cultivation through the fallow period.

Nationally, almost half of all fallows had some grazing, with the number being higher in the southern areas.

Sixty per cent of the cropped area had stubble retained right through to planting in 2011, with this being slightly higher in the northern areas. There has been a slight increase in stubble being burnt; nationally, more than 5 per cent was burnt early and almost 8 per cent burnt later as a 'cool' burn. Both these are increases compared with the 2008 crop year.

Almost 30 per cent of cereal crops planted in Southern WA, the NSW/Victorian Slopes and the Victorian High Rainfall regions were planted following a canola crop in 2011, while more than 25 per cent of cereal crops in North-West NSW/South-West Queensland, Central Queensland and the SA Mid North/Lower Eyre Peninsula were planted following a pulse crop in 2010. More than 10 per cent of cereal crops in SA, the Victorian Mallee and Central, Eastern and Southern WA were planted following a legume-dominant pasture phase.

More than 60 per cent, and in many agro-ecological zones more than 80 per cent, of the crop area was planted into a full soil moisture profile, with only Southern WA having less than 60 per cent planted into good moisture in 2011.

Across much of NSW, Victoria, SA and WA about 25

per cent or more of the crop was sown after growers had assessed the amount of plant available water at planting, with similar levels of assessment being made throughout the season, especially in NSW, Southern Queensland and SA.

Nationally, approximately 25 per cent of the crop was planted where some risk of root disease was estimated to be present; this figure was more than 30 per cent in parts of SA and WA.

Similarly, growers estimated the presence of some subsoil constraints in more than 25 per cent of their crop in much of SA, and more than 30 per cent in almost all of WA. Subsoil constraints were less prevalent in NSW and Queensland.

In 2011, most growers estimated that more than 80 per cent of their crops were planted at the optimum time, except in parts of WA, where more than 70 per cent was planted at the optimum time.

Soil testing remains a popular practice, with most regions soil testing more than 30 per cent of their cropped area.

The use of lime has markedly increased in the NSW/Victorian Slopes in 2011 compared with 2008; increased use was also noted in the Victorian High Rainfall zones and Northern WA.

Gypsum use also increased in the NSW/Victorian Slopes, as well as across Victoria and SA.

2012 survey results

GRAIN FARM STATISTICS

A number of questions were asked about the farm:

- What is the total area of your property, including all leased land and any unused land?
- In 2011, excluding any share farming arrangements, what percentage of your property was used for cropping, pasture (improved and unimproved), native and/or remnant vegetation, and roadways, buildings etc.

Number of grain farms and total area of farmland

In both 2008 and 2011 approximately 1300 farms were accessed, representing 4.3 per cent of the estimated number

of grain producers in Australia (Table 2 and Figure 1).

However, in both surveys the amount of crop area represented by survey respondents represented between 2.4 and 2.8 million hectares, or approaching 10 per cent, of the estimated 30 million ha of crop grown in Australia (Table 3).

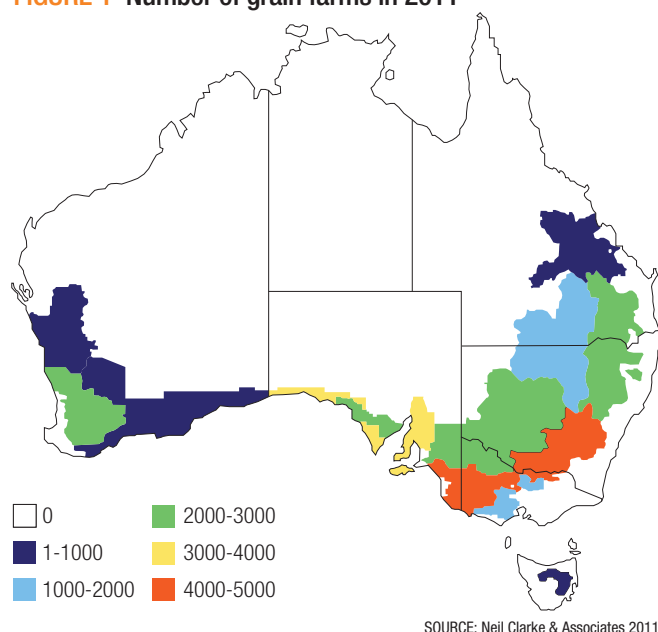
The Australian Bureau of Statistics estimates the total Australian grain crop area in 2010-11 (major crops only) was close to 30 million ha, (Source: ABS, www.abs.gov.au/ausstats/abs@.nsf/Lookup/7106.0Main+Features52011).

Farm size

All grain-only farms included in the survey were a minimum

TABLE 2 Sample size and total farmland represented in the survey data by agro-ecological zone in 2008 and 2011

Agro-ecological zone	Sample size		Total farm area (ha) surveyed	
	2008	2011	2008	2011
NSW Central	75	95	361,822	588,559
NSW NE / QLD SE	158	86	424,831	250,633
NSW NW / QLD SW	60	94	270,496	443,651
NSW / VIC Slopes	124	160	319,586	375,633
QLD Central	23	35	137,003	177,243
SA Mid North / Lower EP	97	118	231,131	257,819
SA / VIC Bordertown Wimmera	126	106	242,981	188,513
SA / VIC Mallee	180	160	613,059	627,427
TAS	4	7	12,435	15,185
VIC High Rainfall	37	65	86,636	111,685
WA Central	200	185	728,108	663,131
WA Eastern	62	62	347,584	382,235
WA Mallee / Sandplain	68	57	325,016	279,801
WA Northern	86	82	492,904	464,709
Total	1300	1312	4,593,592	4,826,224

FIGURE 1 Number of grain farms in 2011

of 500ha (total farm size) and mixed grain/livestock farms were 1000ha or larger. Smaller farms were excluded from the survey.

The data from this survey for the cropping year of 2011 shows a slight decrease in average farm size from that of the 2008 survey, average 3768ha, down from 3810ha (Table 4, Figures 2 and 3).

The largest grain farms are located across Western Australia and in the agro-ecological zones of Central NSW, Central Queensland and North-West NSW/South-West Queensland.

In some agro-ecological zones farm size appears to have increased since the last survey, while in others to have

decreased. Some of this change may be due to survey error, although in some areas it may be due to other factors, including farm consolidation.

Area of crop per farm

The largest crop areas per farm are in Western Australia, Western NSW, the Mallee region of SA and Victoria, and Northern NSW/Southern Queensland (Table 5, Figures 4 and 5). There is a significant variation between years in some agro-ecological zones.

Use of farm area

Three components generally comprise total farm area: areas of crop, pasture and native or remnant vegetation. Together, these components should add to the total farm area, although this does not always occur. Reasons for this may include: farms having essentially no native vegetation present and thus the farm comprises only crop and pasture; in some cases areas of 'fallow' may be described as either a pasture (if grazing of the fallow occurs) or crop area not yet planted; and growers identifying areas of native or remnant vegetation as 'available' for some grazing and often listing these areas also as 'pasture'.

There has been very little change in the average total area of farms that have been allocated to either cropping or pasture in the past three years. While there was an increase in use of the farm for cropping in Eastern WA, there was a decrease in Central Queensland, Tasmania and Northern WA (Table 4).

Average percentage of crop per farm

The percentage of the farm area that is under crop ranges between 50 and 70 per cent (Table 6, Figures 6 and 7). Tasmania is an exception, with only 39 per cent of the farm area cropped.

There have been some increases in the percentage of farm that is cropped since the last survey, notably in

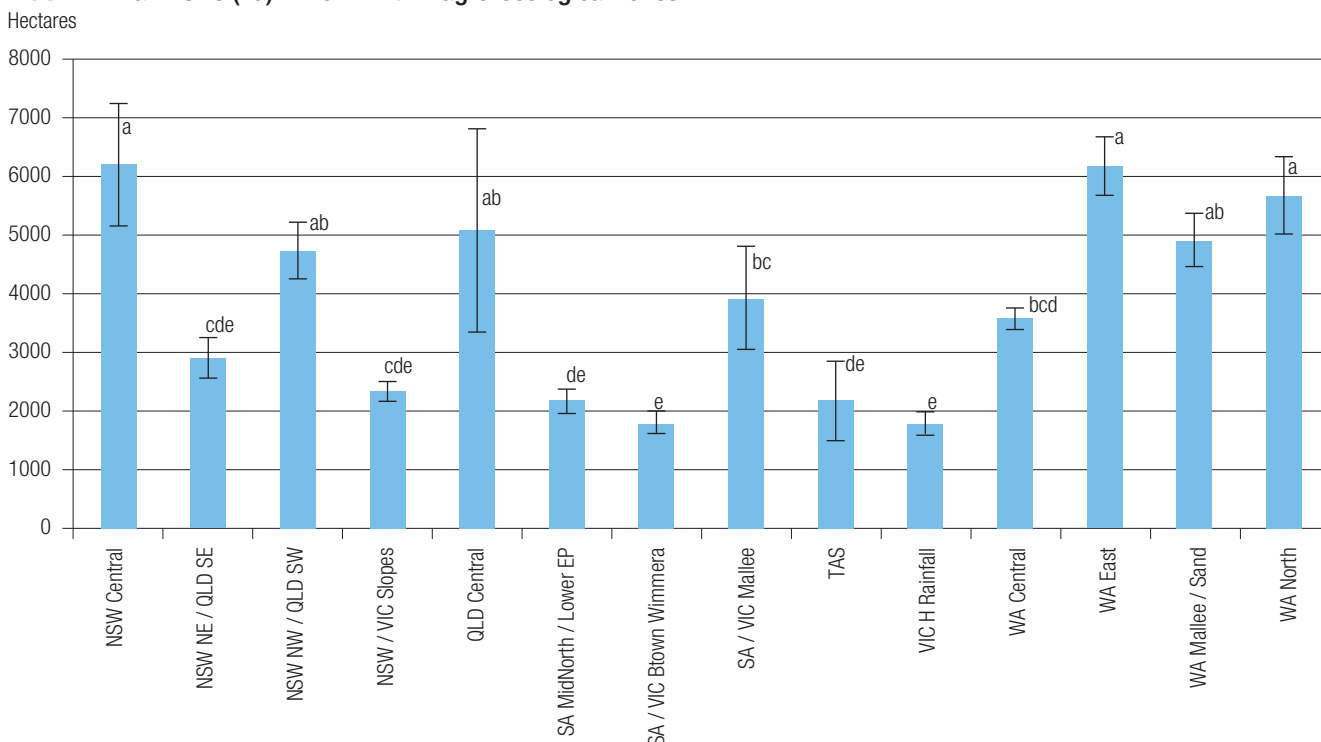
TABLE 3 Total crop area (ha) in 2008 and 2011 GRDC surveys

Agro-ecological zone	2008 (ha)	2011 (ha)
NSW Central	129,205	171,572
NSW NE / QLD SE	189,031	88,814
NSW NW / QLD SW	112,443	161,461
NSW / VIC Slopes	237,149	180,828
QLD Central	51,793	44,020
SA Mid North / Lower EP	152,396	156,052
SA / VIC Bordertown Wimmera	174,060	92,102
SA / VIC Mallee	399,534	287,024
TAS	4453	1767
VIC High Rainfall	59,308	67,777
WA Central	502,201	380,849
WA Eastern	265,492	233,744
WA Mallee / Sandplain	222,949	178,059
WA Northern	313,473	311,067
Total in survey	2,813,487	2,355,135

TABLE 4 Average farm size (ha) within agro-ecological zones in 2008 and 2011

Agro-ecological zone	Average area per farm (ha)		LSD (5%) between years	Significance between years
	2008	2011		
NSW Central	4824	6195	1839	ns
NSW NE / QLD SE	2689	2914	697	**
NSW NW / QLD SW	4508	4720	1080	ns
NSW / VIC Slopes	2577	2348	335	ns
QLD Central	5957	5064	3134	ns
SA Mid North / Lower EP	2383	2185	538	ns
SA / VIC Bordertown Wimmera	1928	1778	320	ns
SA / VIC Mallee	3406	3921	1259	ns
TAS	3109	2169	2215	ns
VIC High Rainfall	2342	1718	802	ns
WA Central	3641	3584	361	ns
WA Eastern	5606	6165	942	ns
WA Mallee / Sandplain	4780	4909	871	ns
WA Northern	5731	5667	1238	ns
National Averages	3768	3810		

FIGURE 2 Farm size (ha) in 2011 within agro-ecological zones



Error bars represent the mean standard error. The means sharing the same letter are not significantly different at the 5% level. See page 11 for more information.

Southern and Northern WA, the Wimmera and the Mallee areas of Victoria and SA. There has been a decrease in the percentage of the farm cropped in North-East NSW/South-East Queensland and SA Mid North/Lower Eyre Peninsula. The percentage does fluctuate over time, likely due to a combination of seasonal conditions and grain pricing.

Average percentage of pasture per farm

Grain-only farms are relatively few and the presence of some pasture is a general feature of most grain-producing areas.

Data on pastures is often complicated by the definition of a 'pasture'. Pastures can be:

- perennial;
- annual;
- 'improved' (i.e. planted and managed as a dedicated pasture);

FIGURE 3 Average area (ha) per grain farm in 2011

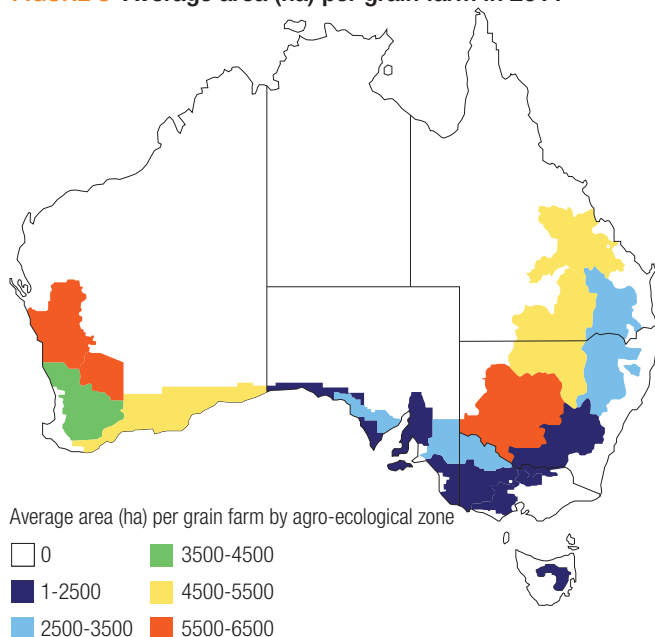
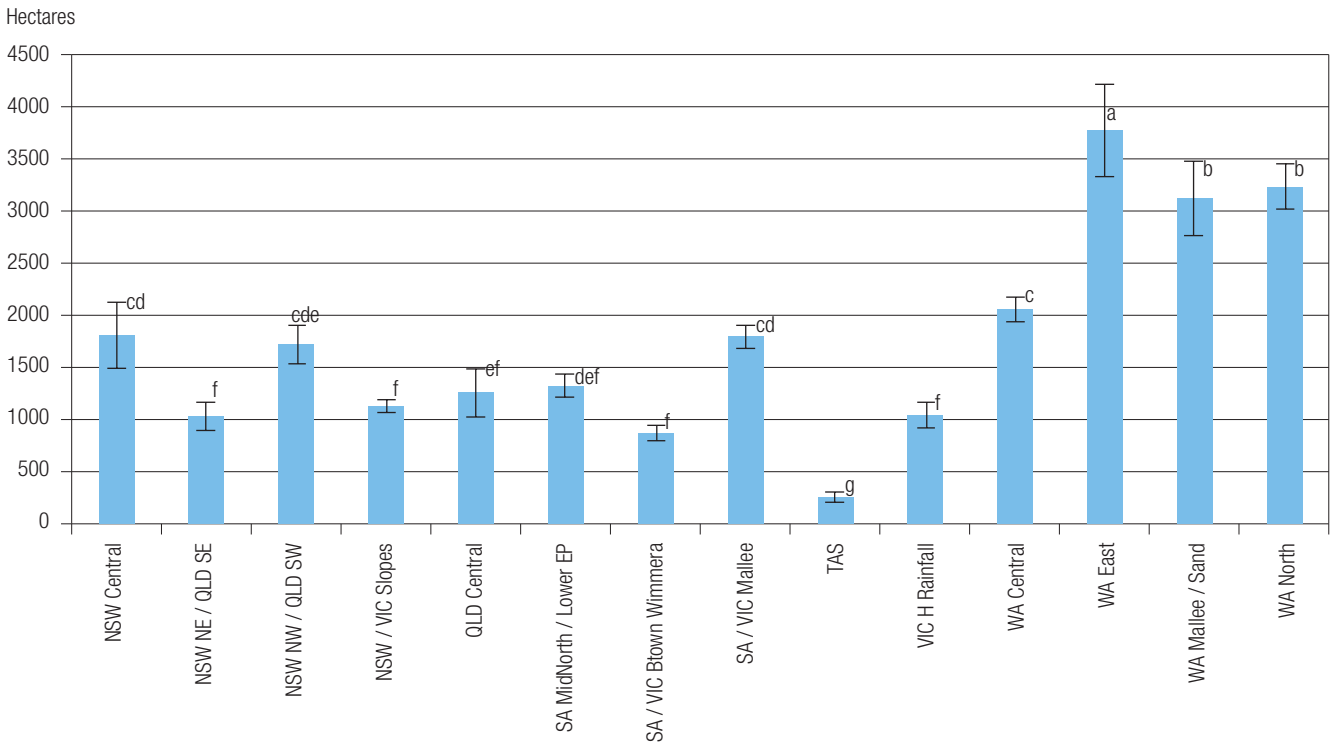


TABLE 5 Average area (ha) of crop per farm

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	2115	1806	572	ns
NSW NE / QLD SE	1954	1036	355	***
NSW NW / QLD SW	1977	1718	533	ns
NSW / VIC Slopes	1480	1130	165	***
QLD Central	2242	1258	584	***
SA Mid North / Lower EP	1263	1322	190	ns
SA / VIC Bordertown Wimmera	1168	869	153	**
SA / VIC Mallee	2096	1794	335	ns
TAS	1068	252	522	***
VIC High Rainfall	1282	1043	534	ns
WA Central	2247	2059	243	ns
WA Eastern	3537	3770	744	ns
WA Mallee / Sandplain	2995	3124	650	ns
WA Northern	3489	3231	450	ns
National Averages	2065	1744		

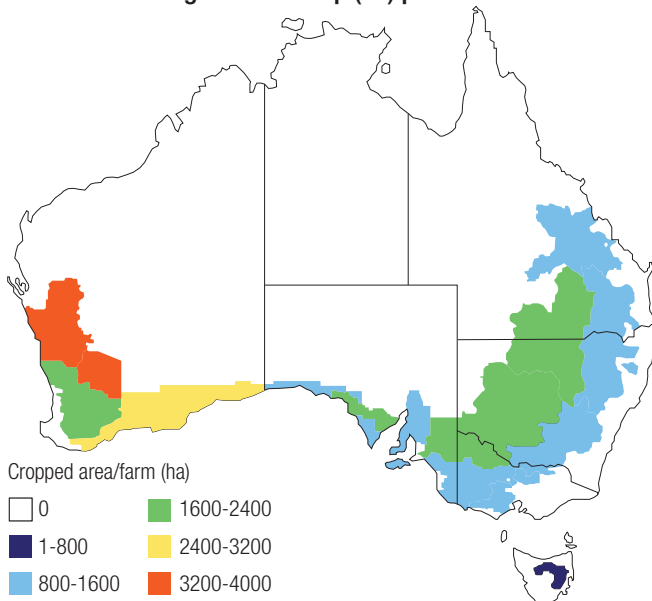
FIGURE 4 Average area of crop (ha) per farm in 2011



- 'unimproved' (i.e. volunteer plants or native species that simply emerge on land otherwise not managed); or
- several combinations of the above.

Further, in some areas there is uncertainty about the difference between 'native vegetation' and unimproved, extensive 'pastures'. Livestock can make use of areas of native vegetation as 'pasture' and therefore these areas can be reported as 'unimproved pasture' or 'remnant/native vegetation' or sometimes both.

FIGURE 5 Average area of crop (ha) per farm in 2011



For these reasons data about pastures often fluctuates widely between surveys and therefore it can be difficult to make solid interpretations about changes presented by survey results. However, as a general rule where area of crop is high, pasture is expected to be low and vice versa.

Estimates by growers of the percentage of their holding under 'pasture' can also be somewhat unreliable. In examining the data from the 2008 crop year, it was found that in some cases the percentages of the various land uses on many farms added to more than 100 per cent. Summing the areas of the actual crops grown tended to arrive at a more accurate figure for 'area of crop' and 'area of pasture'. As such, data here is presented as the percentage of the farm that is said to be pasture, expressed as a percentage of the farm.

There appear to have been some minor changes to the amount and percentage of the farmed area that is denoted pasture since the last survey, although in most cases these are not significant.

The increases in pasture areas were on those farms where mixed farming is more common, for example, in North-East NSW/South-East Queensland. There was a decrease in pasture area in North-West NSW/South-West Queensland and in the SA/Victorian Mallee (Table 7, Figures 8 and 9).

FIGURE 6 Average percentage of farm area cropped in 2011

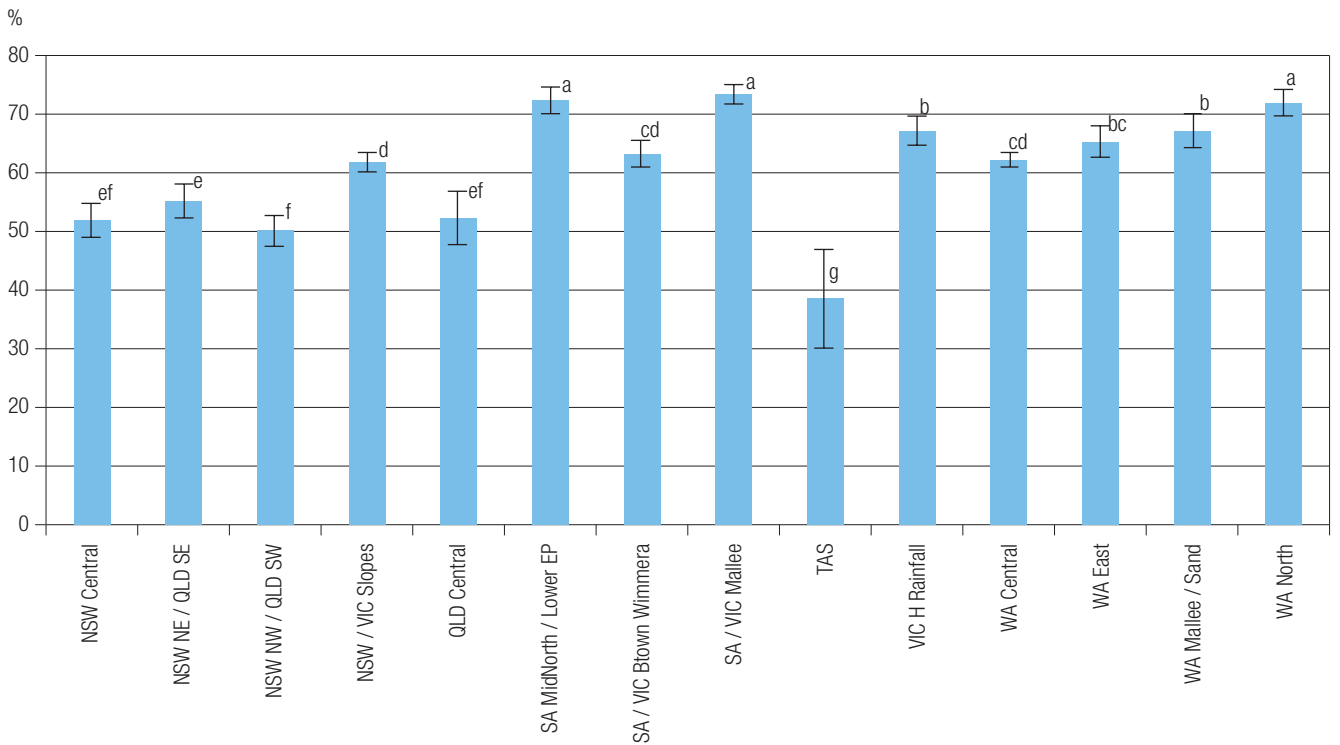
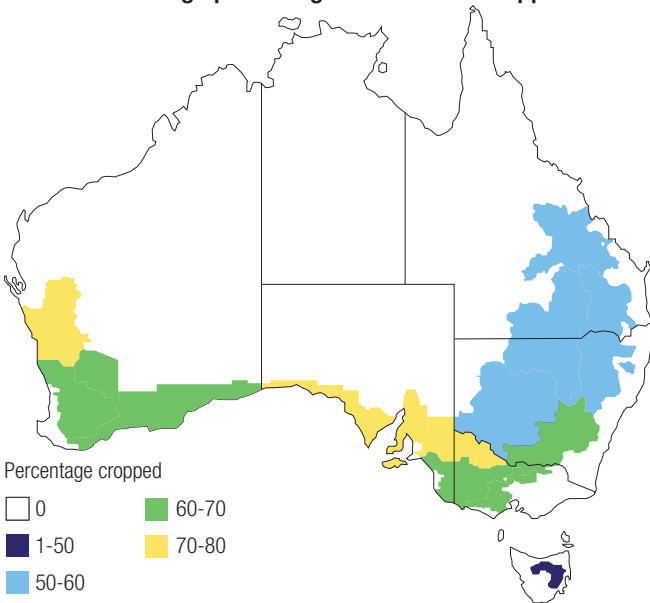


FIGURE 7 Average percentage of farm area cropped in 2011

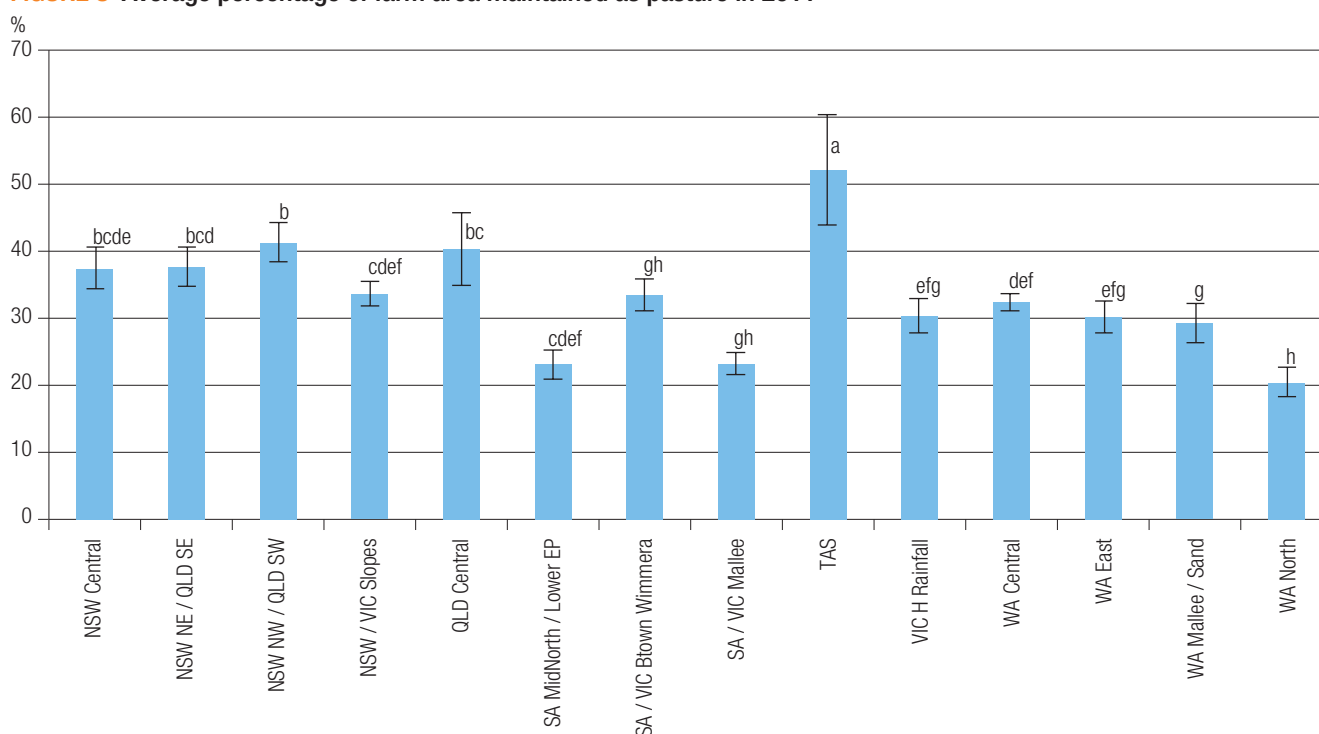


Farmland with native vegetation

The definition of native and remnant vegetation on farms is often contentious and can vary with individual farm/manager. On some farms regrowth vegetation is considered to be native vegetation, while on other farms areas that have never been cleared and yet are used for some grazing activities are still considered native or remnant vegetation. Thus, how native and remnant vegetation is identified on farms in a survey is likely to be somewhat unreliable.

Nonetheless, the two GRDC surveys for the years 2008 and 2011 show all agro-ecological zones to have less than 10 per cent of the farmed area identified as native or remnant vegetation, with the percentages not having changed appreciably between surveys (Table 8, Figures 10 and 11). However, farmers in Central Queensland reported an increase in native and remnant vegetation, while those in Eastern WA reported a decrease.

Not all grain-producing properties in the 2008 and 2011 studies reported the presence of native vegetation. Only between about 15 and 40 per cent of the grain-producing properties reported the presence of any native vegetation.

FIGURE 8 Average percentage of farm area maintained as pasture in 2011**TABLE 6** Average percentage of farm area cropped

Agro-ecological zone	2008	2011	Significance between years	LSD (5%) values for each AEZ comparison
NSW Central	49.8	51.9	ns	5.7
NSW NE / QLD SE	61.5	55.2	**	5.0
NSW NW / QLD SW	44.7	50.1	ns	5.9
NSW / VIC Slopes	61.4	61.7	ns	3.6
QLD Central	52.2	52.2	ns	10.3
SA Mid North / Lower EP	70.0	63.1	**	4.9
SA / VIC Bordertown Wimmera	63.3	73.3	***	3.7
SA / VIC Mallee	65.5	72.2	***	3.9
TAS	45.0	38.6	ns	22.5
VIC High Rainfall	63.2	66.9	ns	6.3
WA Central	61.3	62.1	ns	2.7
WA Eastern	63.9	65.2	ns	4.7
WA Mallee / Sandplain	61.4	67.1	**	5.5
WA Northern	66.8	71.8	**	4.4
National Averages	59.3	60.8		

TABLE 7 Average percentage of farm area maintained as pasture

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	38.7	37.4	6.1	ns
NSW NE / QLD SE	32.4	37.6	5.0	**
NSW NW / QLD SW	48.8	41.3	6.2	**
NSW / VIC Slopes	35.1	33.5	3.7	ns
QLD Central	45.7	40.3	11.4	ns
SA Mid North / Lower EP	26.3	23.1	4.7	ns
SA / VIC Bordertown Wimmera	33.7	33.5	4.3	ns
SA / VIC Mallee	30.7	23.1	3.4	***
TAS	52.5	52.1	23.9	ns
VIC High Rainfall	34.0	30.3	6.6	ns
WA Central	34.4	32.4	2.7	ns
WA Eastern	28.0	30.2	4.8	ns
WA Mallee / Sandplain	34.8	29.2	5.8	ns
WA Northern	28.1	20.3	4.5	ns
National Averages	35.9	33.2		

FIGURE 9 Average percentage of farm area maintained as pasture in 2011

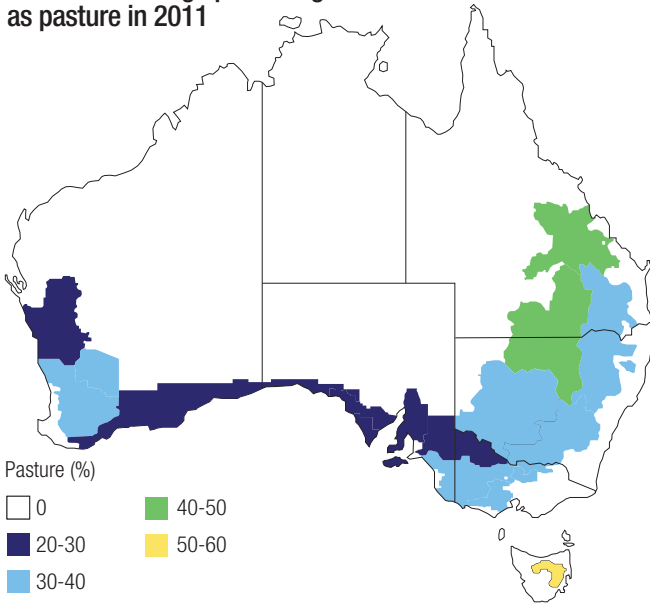


FIGURE 11 Average percentage of farm area reported as native vegetation in 2011

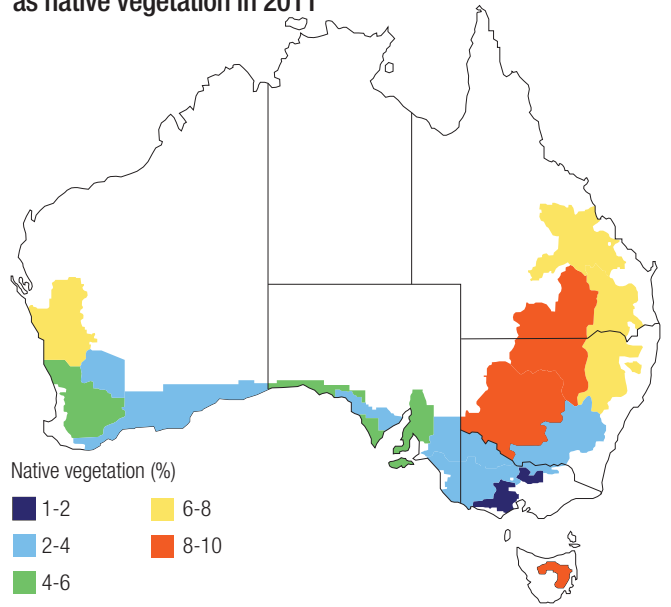


FIGURE 10 Average percentage of farm area reported as native vegetation in 2011

% of farm area

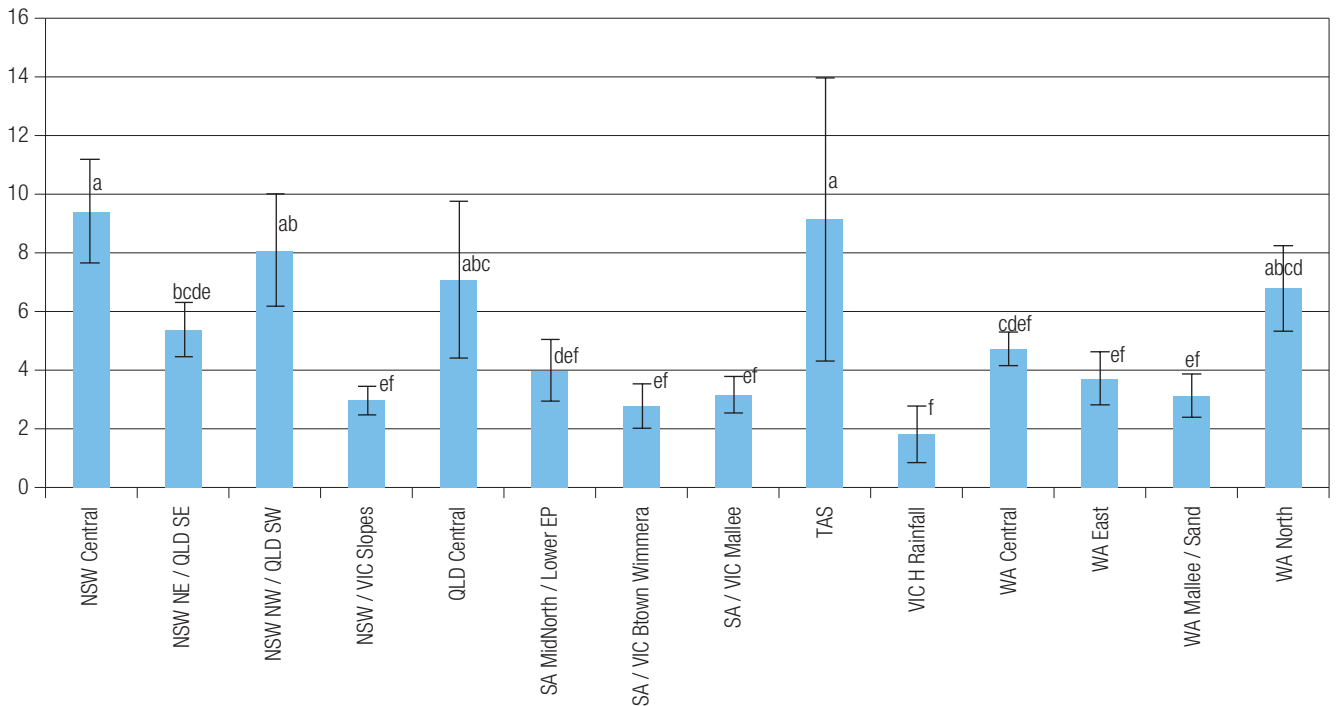


TABLE 8 Average percentage of farm area reported as native vegetation

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	9.44	9.39	3.88	ns
NSW NE / Qld SE	5.07	5.38	1.86	ns
NSW NW / Qld SW	6.06	8.07	3.84	ns
NSW / VIC Slopes	2.50	2.98	1.02	ns
QLD Central	1.73	7.09	4.64	***
SA Mid North / Lower EP	3.37	3.98	2.04	ns
SA / VIC Bordertown Wimmera	2.43	2.77	1.33	ns
SA / VIC Mallee	3.36	3.15	1.38	ns
TAS	1.25	9.14	9.24	***
VIC High Rainfall	2.33	1.82	1.96	ns
WA Central	3.88	4.73	1.06	ns
WA Eastern	7.42	3.71	2.83	***
WA Mallee / Sandplain	3.46	3.13	1.46	ns
WA Northern	4.76	6.79	2.58	ns
National Averages	4.1	5.1		

INCOME



The percentage of farm income from various enterprises was included in the surveys of both 2008 and 2011. Enterprises included beef cattle, sheep and lambs, dairy, sugar, cotton, rice and grain crops.

The category of grain crops was further divided into winter cereals, winter pulses, winter oilseeds, summer cereals, summer pulses and summer oilseeds.

While data is available for all these categories, some were reported at very minor levels in the survey. This is likely due to the survey mainly involving producers whose dominant activity is grain, although additional enterprises are often present on their properties.

Most data is available for the percentage of income from grain crops, beef cattle and sheep. Other data is not

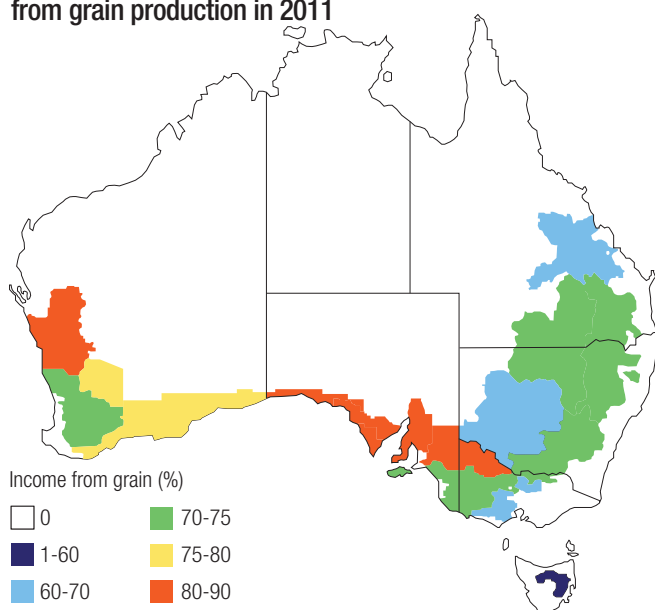
TABLE 9 Average percentage of farm income derived from winter cereal production

Agro-ecological zone	2008	2011	LSD (5%)	Significance
NSW Central	64.8	63.3	5.9	ns
NSW NE / Qld SE	56.7	53.5	4.4	ns
NSW NW / Qld SW	57.5	57.8	4.6	ns
NSW / VIC Slopes	60.9	62.0	3.4	ns
QLD Central	50.7	40.4	10.2	**
SA Mid North / Lower EP	73.4	74.3	3.5	ns
SA / VIC Bordertown Wimmera	62.9	63.5	3.9	ns
SA / VIC Mallee	72.0	77.7	2.9	**
TAS	32.5	30.0	11.6	ns
VIC High Rainfall	66.5	63.8	5.4	ns
WA Central	69.5	66.3	2.9	**
WA Eastern	84.2	74.7	4.1	***
WA Mallee / Sandplain	63.3	69.0	5.3	ns
WA Northern	83.0	80.1	3.4	ns
National Averages	64.1	62.6		

TABLE 10 Average percentage of farm income derived from winter pulse production

Agro-ecological zone	2008	2011	LSD (5%)	Significance
NSW Central	0.2	0.7	0.7	ns
NSW NE / Qld SE	2.7	0.4	1.3	***
NSW NW / Qld SW	4.6	3.5	2.7	ns
NSW / VIC Slopes	0.5	0.4	0.4	ns
QLD Central	1.5	9.3	5.5	***
SA Mid North / Lower EP	4.3	4.5	2.0	ns
SA / VIC Bordertown Wimmera	4.7	3.2	1.8	ns
SA / VIC Mallee	2.6	1.6	1.3	ns
TAS	6.3	8.1	8.1	ns
VIC High Rainfall	0.7	1.2	1.2	ns
WA Central	2.1	1.2	1.0	ns
WA Eastern	0.7	0.6	0.8	ns
WA Mallee / Sandplain	2.6	1.4	1.9	ns
WA Northern	1.6	3.7	1.6	**
National Averages	2.5	2.8		

FIGURE 12 Average percentage of farm income derived from grain production in 2011



considered suitable for analysis due to very low numbers of respondents reporting these enterprises.

Data presented here is for the major grain crop categories of winter cereals, pulses and oilseeds, and summer cereals; sheep (including wool and lambs); and beef cattle, and are presented as a percentage of total farm income as described by the survey participants.

TABLE 11 Average percentage of farm income derived from winter oilseed production

Agro-ecological zone	2008	2011	LSD (5%)	Significance
NSW Central	0.0	1.2	0.9	**
NSW NE / Qld SE	0.4	0.3	0.5	ns
NSW NW / Qld SW	0.4	1.8	0.9	ns
NSW / VIC Slopes	3.9	3.7	1.5	ns
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	1.2	1.5	0.9	ns
SA / VIC Bordertown Wimmera	1.8	2.3	1.2	ns
SA / VIC Mallee	0.2	1.2	0.6	**
TAS	5.3	0.0	5.0	**
VIC High Rainfall	5.3	6.3	2.9	ns
WA Central	3.2	2.4	1.2	ns
WA Eastern	0.4	0.1	0.5	ns
WA Mallee / Sandplain	8.1	5.4	3.6	ns
WA Northern	1.5	2.7	1.2	ns
National Averages	2.3	2.1		

Farm income from grain

The grain-producing properties across SA and Northern WA were more likely to derive a higher percentage of their income from grain production (Figure 12).

Percentage of farm income from winter cereal production

It is apparent from the survey that the majority of respondents derive the majority of their income from winter cereals. This is particularly the case in WA and the lower-rainfall areas of the eastern and southern states.

There have been some changes between 2008 and 2011, notably a decrease in the percentage of income from winter cereals in Central Queensland and Central and Eastern WA in 2011 (a dry year in WA), and an increase in the percentage of income from cereals in the SA/Victorian Mallee (Table 9 and Figure 13).

Percentage of farm income from winter pulse production

Winter pulses remain a relatively minor crop and contributor to farm income on grain farms. They have grown slightly in importance, notably in Central Queensland and Northern WA, with a (non-significant) slight decrease in importance in parts of NSW, Victoria, SA and Southern WA (Table 10 and Figure 14).

Percentage of farm income from winter oilseed production

Winter oilseeds (notably canola) have grown in importance – although not always at a significant level – as a contributor to farm income in much of NSW, SA and Victoria since the previous survey, while remaining relatively static nationally. This is most likely driven by seasonal conditions and the relative pricing of oilseeds compared with other crops (Table 11 and Figure 15).

Farm income from livestock

Percentage of farm income from sheep, wool, lambs

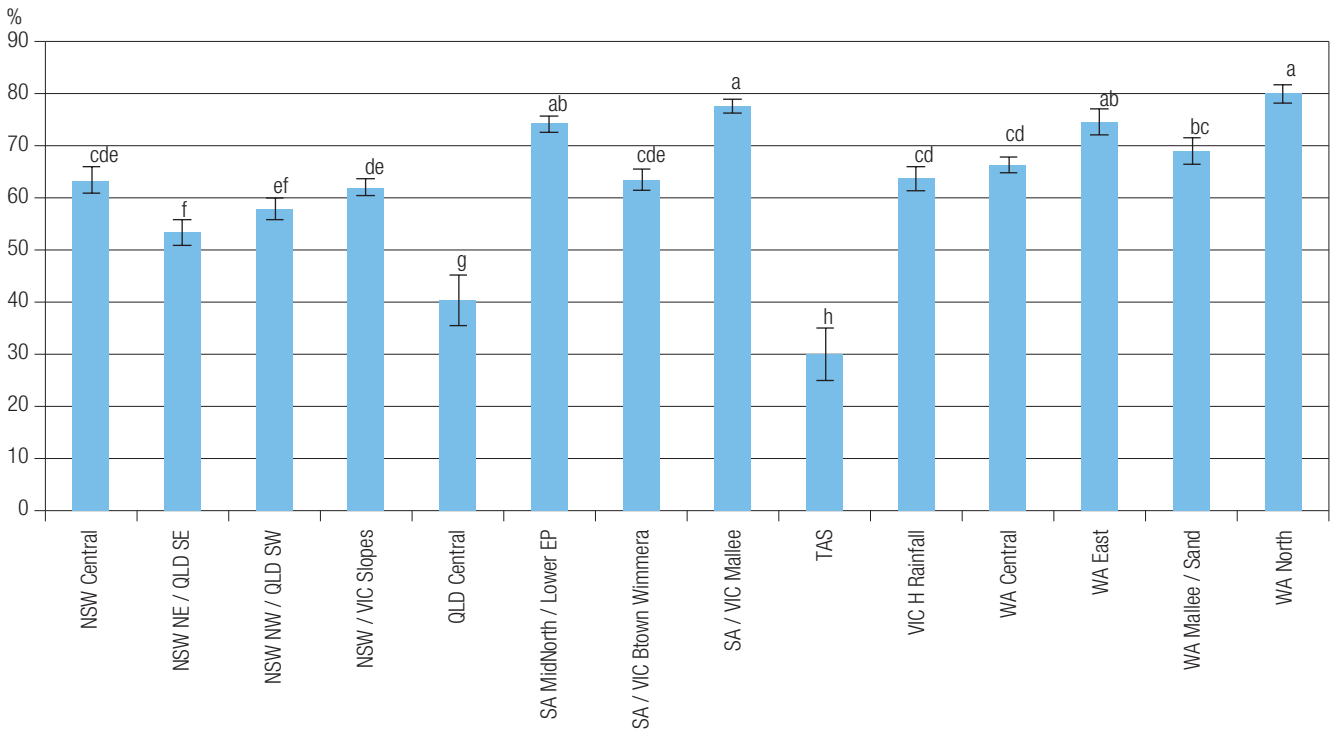
Income from sheep enterprises remains important in the traditional 'wheat/sheep' areas of Australia. The percentage of farm income from sheep is lower where grain dominates, and vice versa. Some changes in recent years are apparent, with an increase in the percentage of income coming from sheep in some parts of NSW and Central and Eastern WA, and a decrease in the SA/Victorian Bordertown Wimmera (Table 12 and Figure 16).

Percentage of farm income from beef cattle production

As with sheep, income from beef cattle tended to remain important in the traditional areas where beef cattle are prevalent, for example, Northern NSW and Queensland.

The changes in percentage of income from beef cattle since the previous survey are generally minor, with some decrease evident in Central NSW and the Victorian High Rainfall zone (Table 13 and Figure 17).

FIGURE 13 Average percentage of farm income derived from winter cereal production in 2011



National trends in farm income source

National trends in the percentage of farm income show a slight increase in income from sheep.

The percentage of farm income from oilseeds and pulses is generally low, indicating that there may be reasons other than income in the year of production for growing these crops (Table 14 and Figure 18).

FIGURE 14 Average percentage of farm income derived from winter pulse production in 2011

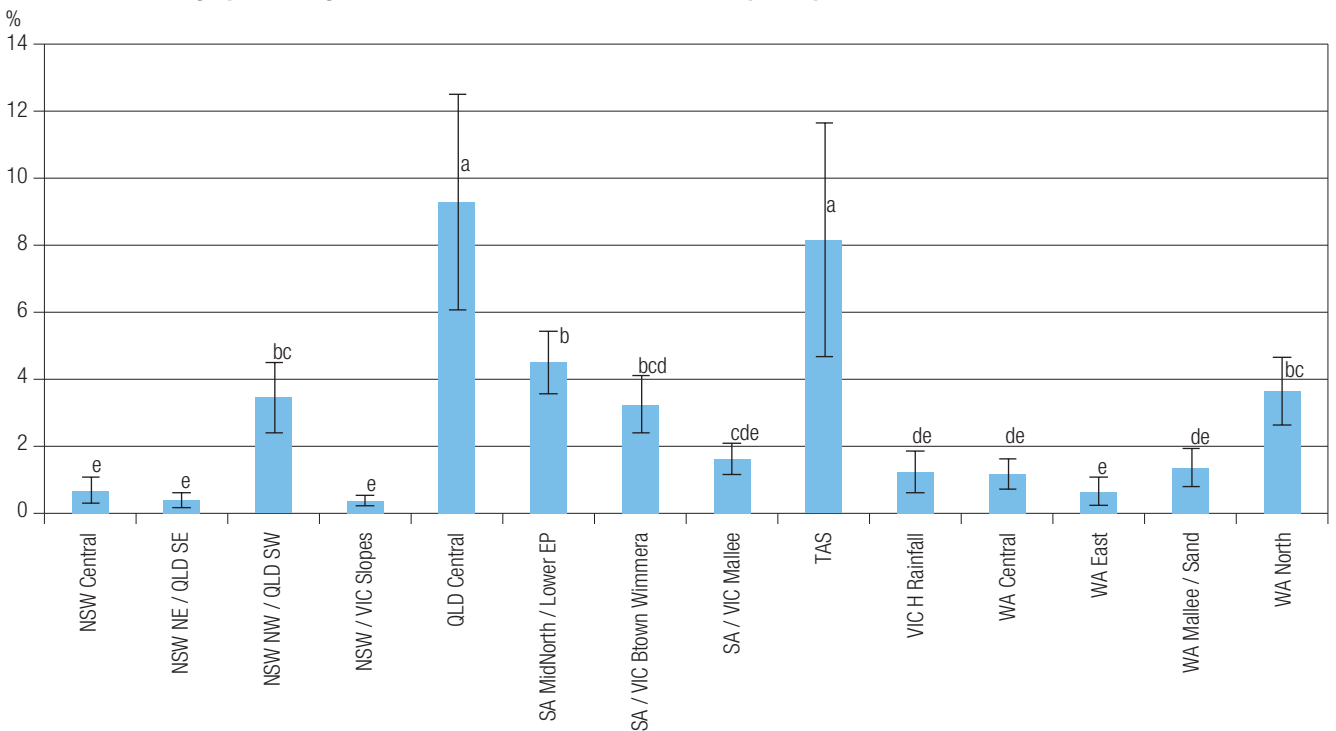


FIGURE 15 Average percentage of farm income derived from winter oilseed production in 2011

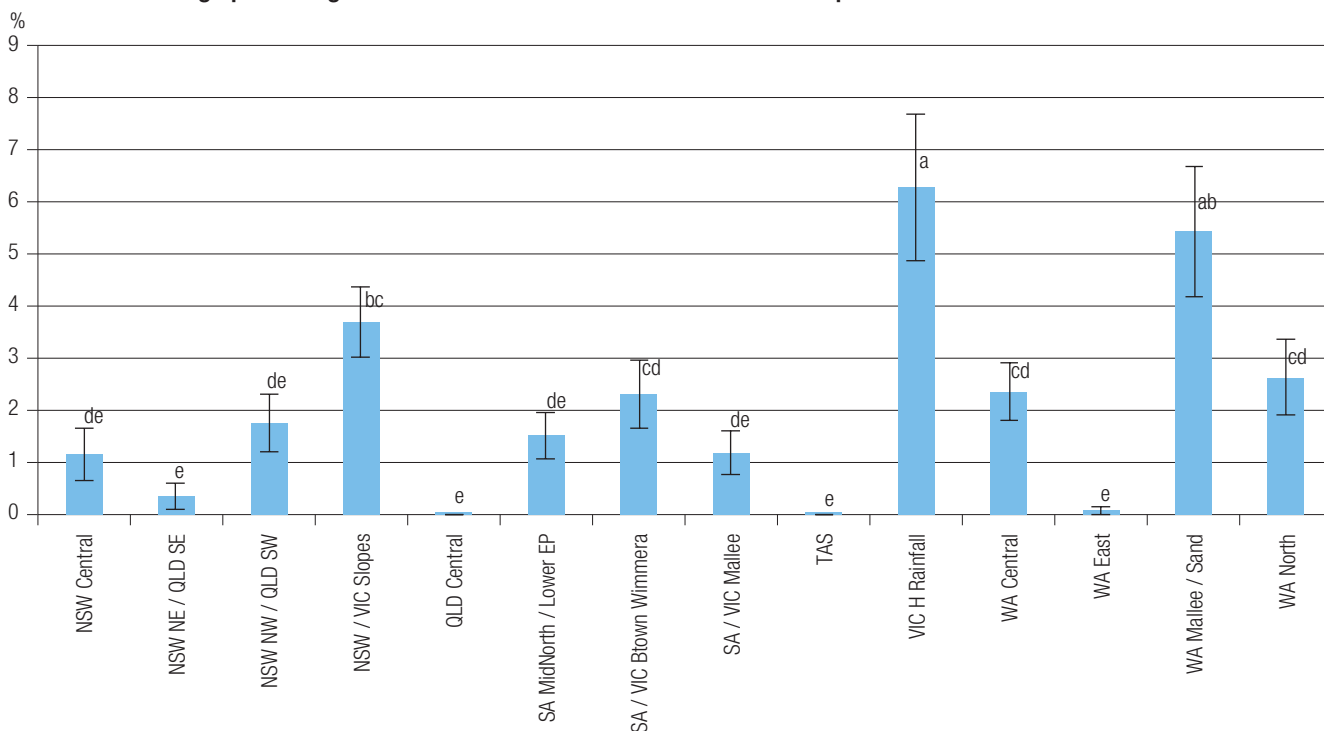


FIGURE 16 Average percentage of farm income derived from sheep, wool and lamb production in 2011

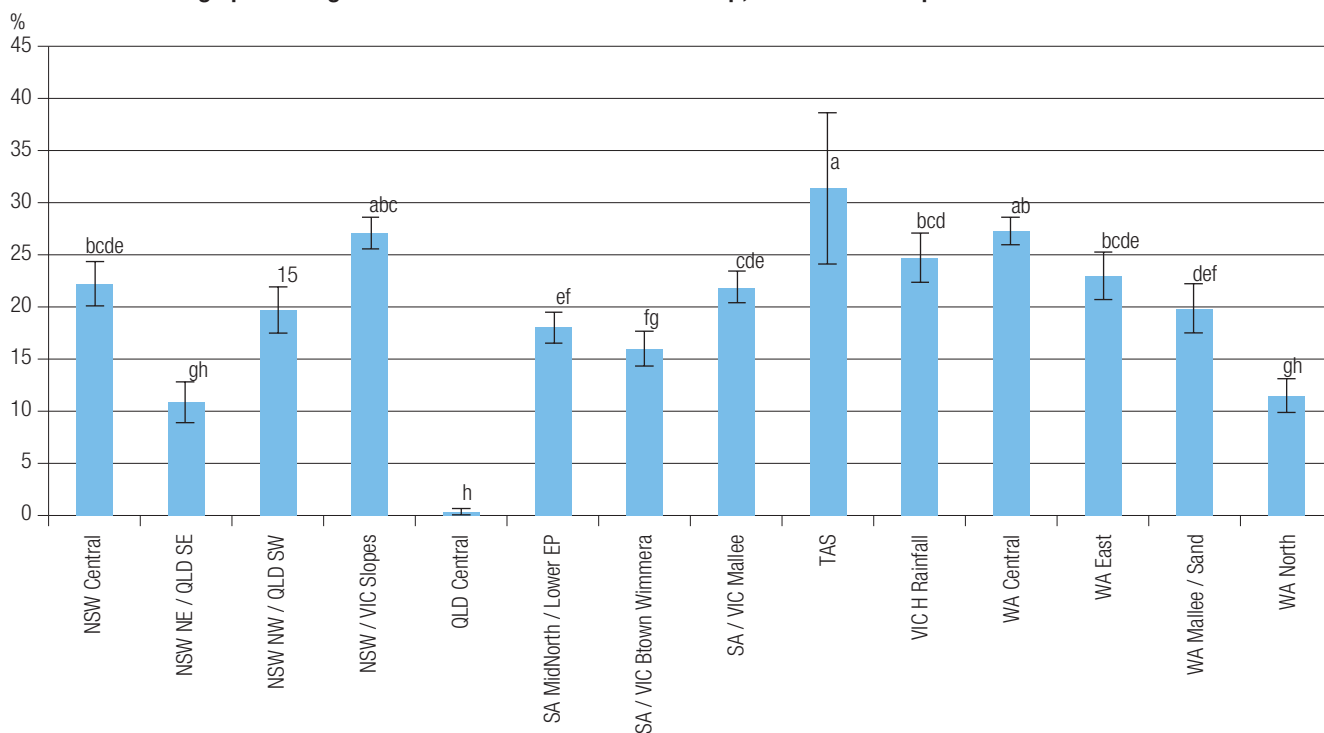


FIGURE 17 Average percentage of farm income derived from beef cattle production in 2011

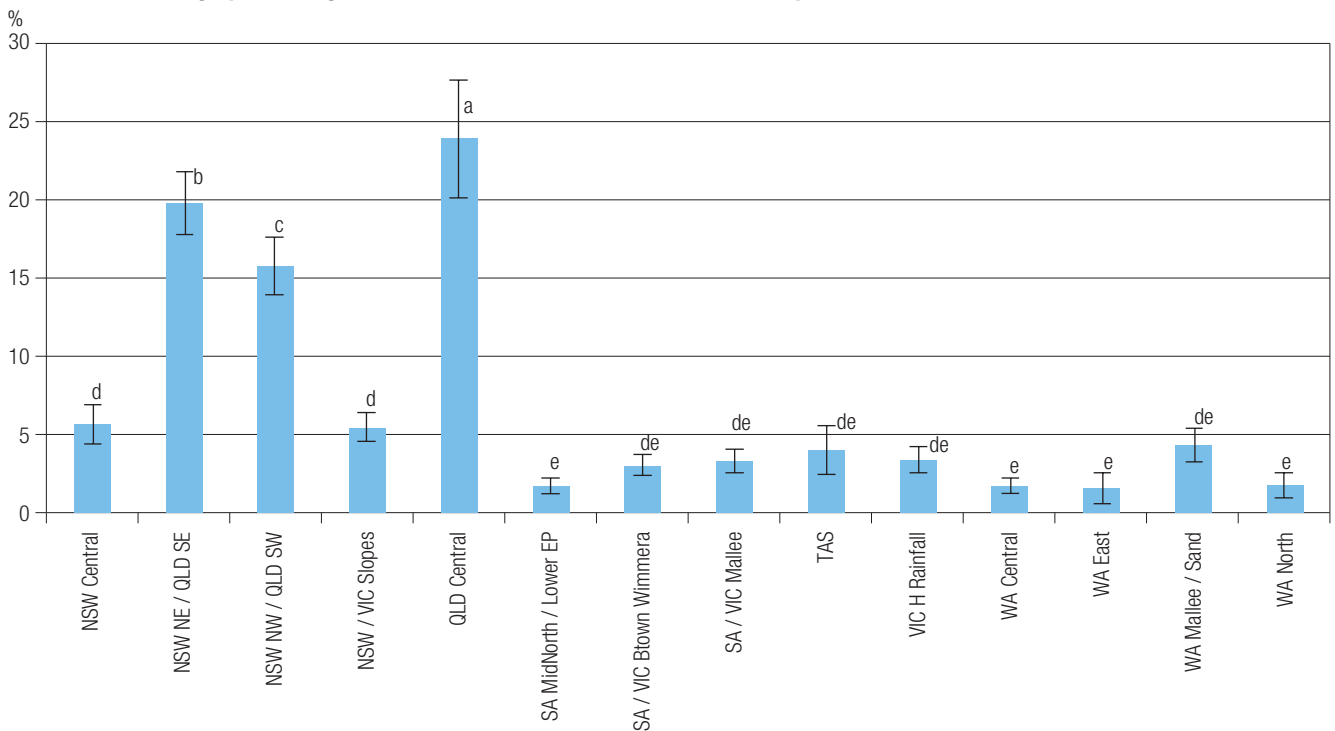


TABLE 12 Average percentage of farm income derived from sheep, wool and lamb production

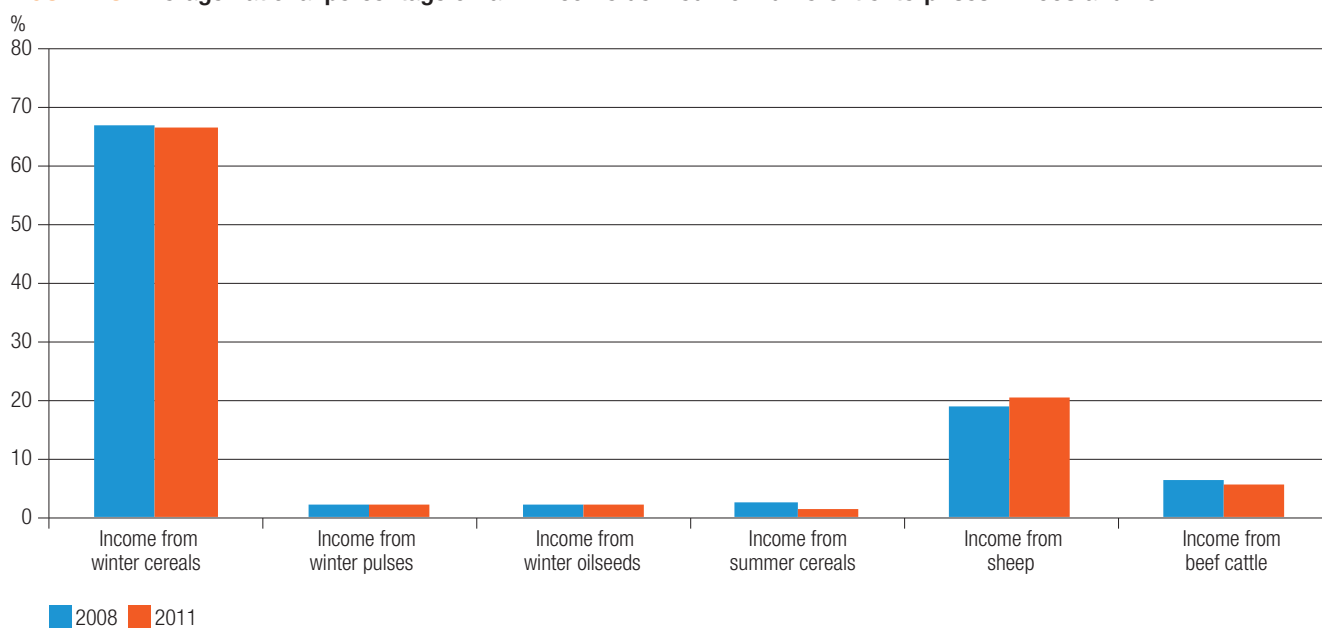
Agro-ecological zone	2008	2011	LSD (5%)	Significance
NSW Central	19.6	22.2	4.5	ns
NSW NE / Qld SE	5.2	10.9	2.6	***
NSW NW / Qld SW	17.5	19.7	4.7	ns
NSW / VIC Slopes	27.1	27.1	3.3	ns
QLD Central	0.0	0.3	0.5	ns
SA Mid North / Lower EP	18.9	18.1	3.3	ns
SA / VIC Bortown Wimmera	24.4	15.9	3.4	***
SA / VIC Mallee	22.5	21.9	3.0	ns
TAS	37.5	31.4	19.1	ns
VIC High Rainfall	19.4	24.7	5.1	**
WA Central	22.9	27.3	2.5	***
WA Eastern	14.0	23.0	3.9	***
WA Mallee / Sandplain	20.3	19.8	4.1	ns
WA Northern	12.0	11.6	2.9	ns
National Averages	18.7	19.8		

TABLE 13 Average percentage of farm income derived from beef cattle production

Agro-ecological zone	2008	2011	LSD (5%)	Significance
NSW Central	9.2	5.6	3.0	**
NSW NE / Qld SE	18.1	19.7	3.6	ns
NSW NW / Qld SW	14.5	15.8	3.9	ns
NSW / VIC Slopes	6.7	5.4	2.0	ns
QLD Central	18.7	23.9	8.0	ns
SA Mid North / Lower EP	1.9	1.7	1.2	ns
SA / VIC Bortown Wimmera	3.8	3.0	1.7	ns
SA / VIC Mallee	3.0	3.3	1.4	ns
TAS	7.8	4.0	8.1	ns
VIC High Rainfall	6.3	3.4	2.5	**
WA Central	1.2	1.7	0.8	ns
WA Eastern	0.2	1.6	1.4	ns
WA Mallee / Sandplain	5.7	4.3	2.4	ns
WA Northern	1.9	1.8	1.7	ns
National Averages	7.1	6.8		

TABLE 14 Average national percentage of farm income derived from different enterprises

	2008	2011	LSD 5%	Significance
% income from winter cereals	66.9	66.4	1.2	ns
% income from winter pulses	2.2	2.1	0.4	ns
% income from winter oilseeds	2.0	2.2	0.4	ns
% income from summer cereals	2.7	1.5	0.5	**
% income from sheep	18.7	20.6	1.0	**
% income from beef cattle	6.2	5.7	0.7	ns

FIGURE 18 Average national percentage of farm income derived from different enterprises in 2008 and 2011

CROP MIX ON GRAIN FARMS

Wheat

The highest percentage of wheat is grown in Eastern and Northern WA, Central NSW and North-West NSW/South-West Queensland (Table 15, Figures 19 and 20).

An increase in the percentage of wheat grown between 2008 and 2011 was recorded in the following zones:

- Central NSW;
- SA Mid North/Eyre Peninsula;
- SA/Victorian Mallee;
- SA/Victoria Bordertown Wimmera;
- Victorian High Rainfall; and
- Central and Eastern WA.

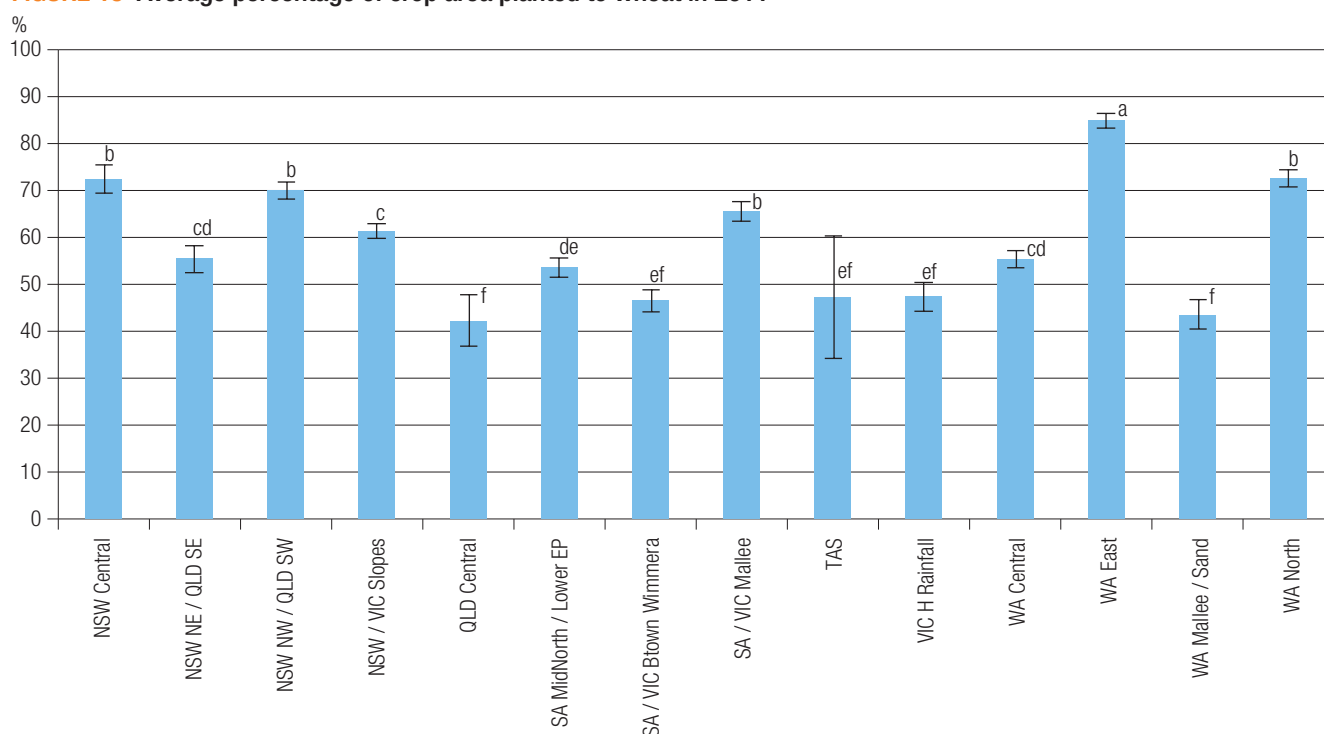
The change is likely driven by seasonal conditions,

TABLE 15 Average percentage of crop area planted to wheat

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	60.2	72.2	6.9	**
NSW NE / QLD SE	51.2	55.3	5.6	ns
NSW NW / QLD SW	74.1	70.0	4.8	ns
NSW / VIC Slopes	65.5	61.2	3.7	**
QLD Central	38.5	42.0	10.8	ns
SA Mid North / Lower EP	47.4	53.5	4.4	**
SA / VIC Bordertown Wimmera	36.3	46.4	4.3	***
SA / VIC Mallee	58.9	65.4	4.2	***
TAS	24.0	47.2	26.5	ns
VIC High Rainfall	37.5	47.3	6.9	***
WA Central	51.9	55.2	4.1	**
WA Eastern	80.3	84.8	4.0	**
WA Mallee / Sandplain	37.6	43.4	5.8	ns
WA Northern	77.8	73.2	4.4	**
National Averages	52.9	58.4		

TABLE 16 Average percentage of crop area planted to barley

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	22.2	10.2	4.8	***
NSW NE / QLD SE	11.8	9.7	3.5	ns
NSW NW / QLD SW	11.2	7.4	3.3	**
NSW / VIC Slopes	15.0	9.0	2.7	***
QLD Central	0.0	0.9	1.3	ns
SA Mid North / Lower EP	31.8	21.6	3.8	***
SA / VIC Bordertown Wimmera	32.0	17.7	4.1	***
SA / VIC Mallee	29.3	16.5	3.2	***
TAS	13.8	39.4	24.3	ns
VIC High Rainfall	30.7	14.8	5.6	***
WA Central	19.1	19.3	2.5	ns
WA Eastern	13.7	8.3	3.6	***
WA Mallee / Sandplain	34.2	26.3	5.6	***
WA Northern	7.3	2.7	2.4	***
National Averages	19.4	14.5		

FIGURE 19 Average percentage of crop area planted to wheat in 2011

notably at planting.

Where wheat is traditionally the dominant crop, better soil moisture at the ideal planting dates for wheat would likely result in more wheat areas.

Barley

The highest percentages of barley were grown in the SA/ Victorian Mallee and WA Mallee/Sandplain regions, where it exceeded 20 per cent of the cropped area in 2011 (Table 16 and Figure 21).

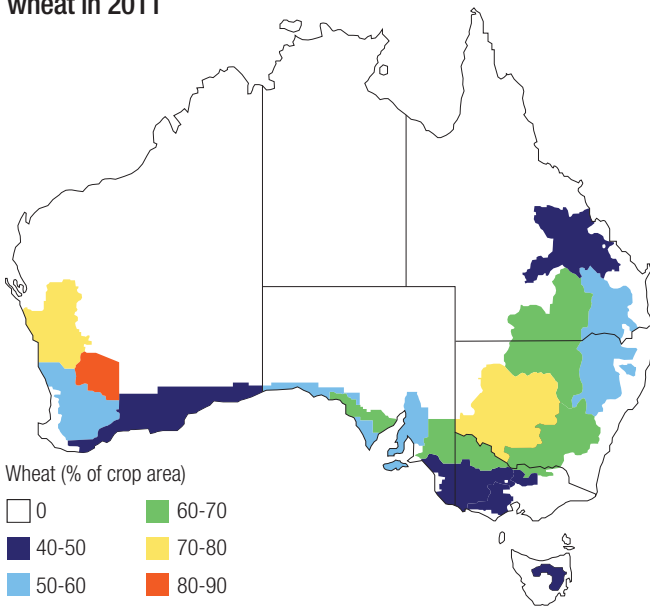
TABLE 17 Average percentage of crop area planted to other winter cereals

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	8.6	4.6	3.3	**
NSW NE / QLD SE	2.3	7.5	2.6	***
NSW NW / QLD SW	3.5	3.8	2.4	ns
NSW / VIC Slopes	3.5	3.3	1.4	ns
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	3.0	2.2	1.7	ns
SA / VIC Bordertown Wimmera	7.9	5.7	2.7	ns
SA / VIC Mallee	4.9	1.0	1.2	***
TAS	3.3	7.1	13.9	ns
VIC High Rainfall	15.2	7.9	6.0	***
WA Central	6.1	9.7	2.3	**
WA Eastern	2.1	3.7	1.2	**
WA Mallee / Sandplain	0.6	2.9	1.2	**
WA Northern	1.3	1.4	0.9	ns
National Averages	4.4	4.3		

TABLE 18 Average percentage of crop area planted to summer cereals

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	0.4	1.2	1.4	ns
NSW NE / QLD SE	25.6	18.2	5.1	**
NSW NW / QLD SW	3.4	2.4	2.1	ns
NSW / VIC Slopes	0.0	0.1	0.1	ns
QLD Central	49.1	28.0	10.6	***
SA Mid North / Lower EP	0.0	0.0	0.0	ns
SA / VIC Bordertown Wimmera	0.0	0.0	0.0	ns
SA / VIC Mallee	0.0	0.0	0.0	ns
TAS	2.8	0.0	2.8	ns
VIC High Rainfall	0.5	0.2	0.6	ns
WA Central	0.0	0.0	0.0	ns
WA Eastern	0.0	0.0	0.0	ns
WA Mallee / Sandplain	0.0	0.0	0.0	ns
WA Northern	0.0	0.0	0.0	ns
National Averages	5.8	3.6		

FIGURE 20 Average percentage of crop area planted to wheat in 2011



Overall, there has been a decline in the area of barley planted by grain producers in 2011 compared with 2008. Changes in the percentage of barley are potentially driven by:

- seasonal conditions in the year, especially at the time planting decisions are made;
- the relative price prospects for barley (both for malt and feed); and

- the price of feedgrains (influenced by the supply of feed wheat from the 2010 wet harvest, especially in the eastern states).

Other winter cereals

The percentage of other winter cereals in the cropping program is quite minor, with all agro-ecological zones showing averages of below 10 per cent of cropped area in 2011. There appears to have been a slight increase in these crops in North-East NSW/South-East Queensland and in much of WA between 2008 and 2011 and a decrease in Central NSW and the SA/Victorian Mallee (Table 17 and Figure 22).

The 'other winter cereal' category includes oats, triticale and cereal rye, which are mainly used either for grazing or for providing grain for livestock. For this reason the highest percentage of these is in mixed-farming areas and higher-rainfall zones.

Summer cereals

Summer cereals, principally grain sorghum and maize, comprise 18 per cent of the cropping area of North-East NSW/South-East Queensland and 28 per cent of the cropping area of Central Queensland (Table 18, Figures 23 and 24).

Small areas are grown in North-West NSW/South-West Queensland and Central NSW.

There appears to have been a reduction in the percentage of these summer crops grown in the 2010-11 season compared with 2007-08. The decrease could be attributed to a wetter-than-normal summer in 2010-11, which may have prevented some of the crops being planted.

FIGURE 21 Average percentage of crop area planted to barley in 2011

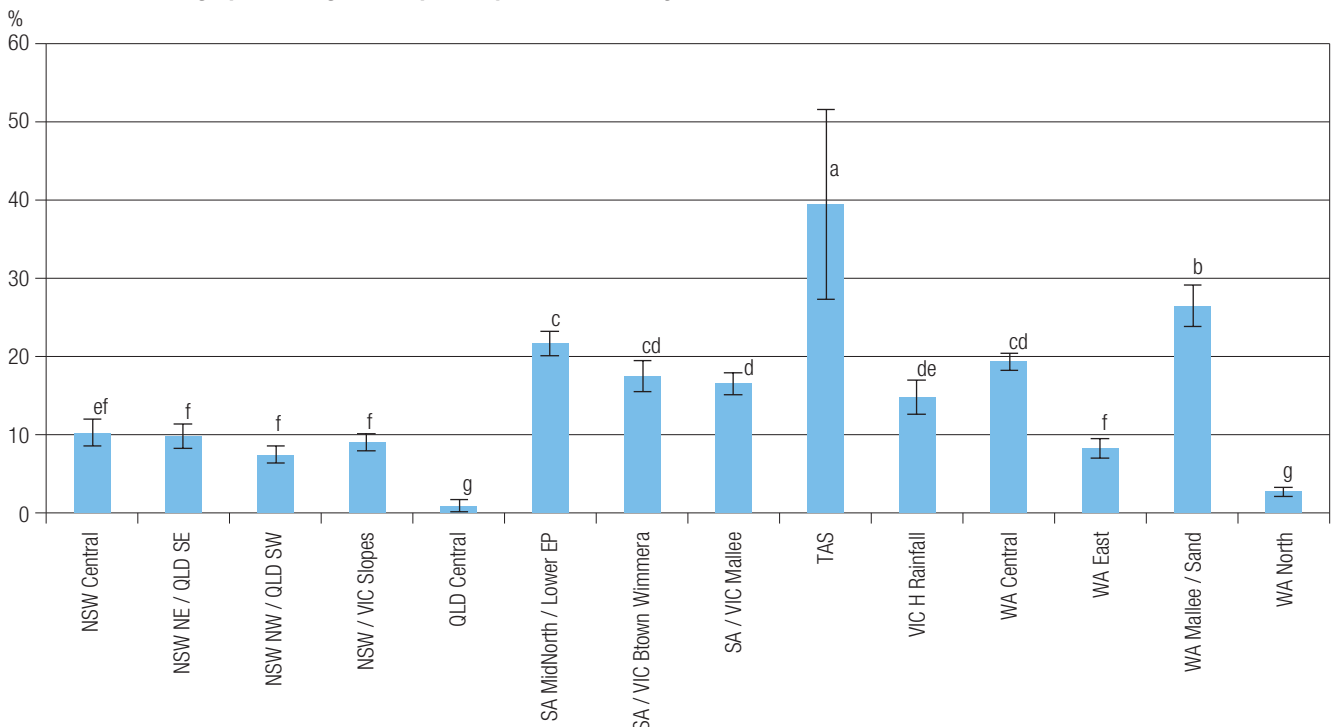
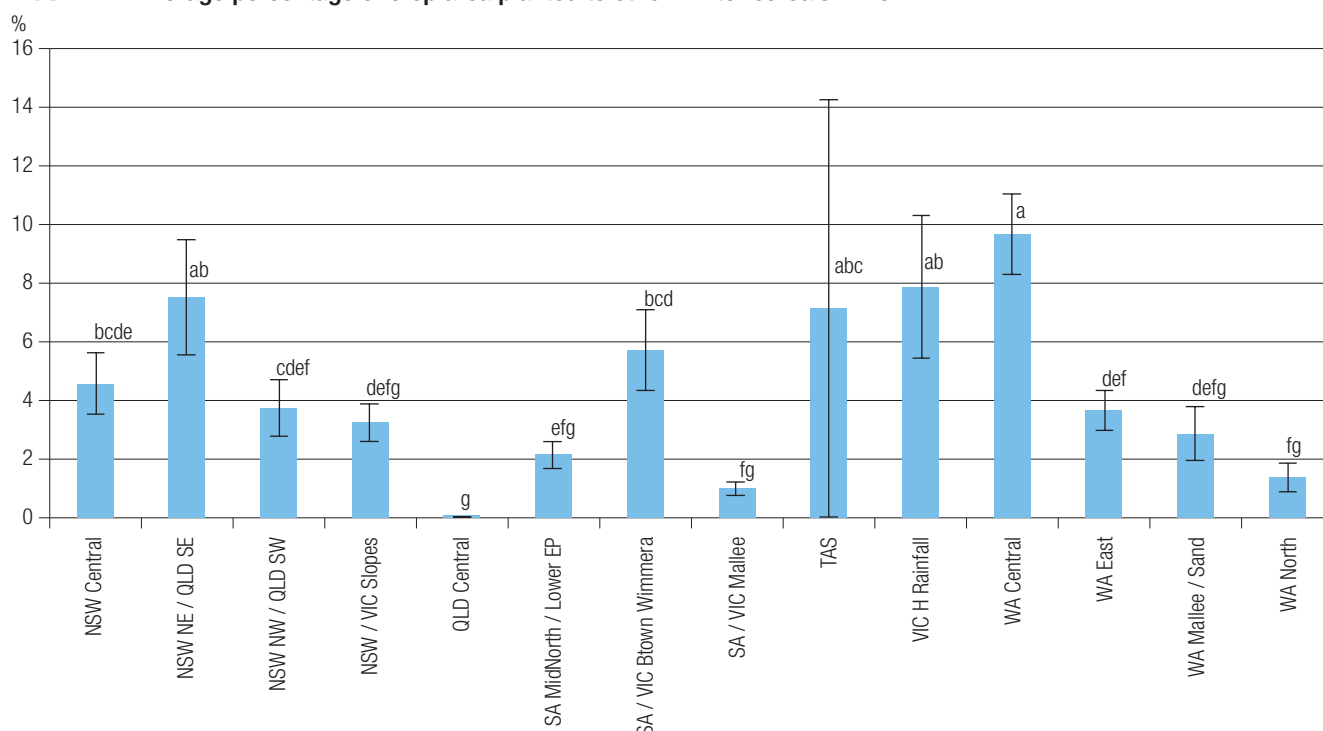


FIGURE 22 Average percentage of crop area planted to other winter cereals in 2011

Oilseeds

Oilseeds (predominantly canola) tend to be more commonly grown in Southern NSW, the Victorian High-Rainfall zone, the Bordertown/Wimmera areas of Victoria and SA, and the southern cropping areas of WA (Table 19, Figures 25 and 26).

There was an increase in the percentage of oilseeds (expected to be mainly canola) recorded between 2008 and 2011, mostly in the following zones:

- NSW/Victorian Slopes;
- NSW Central;

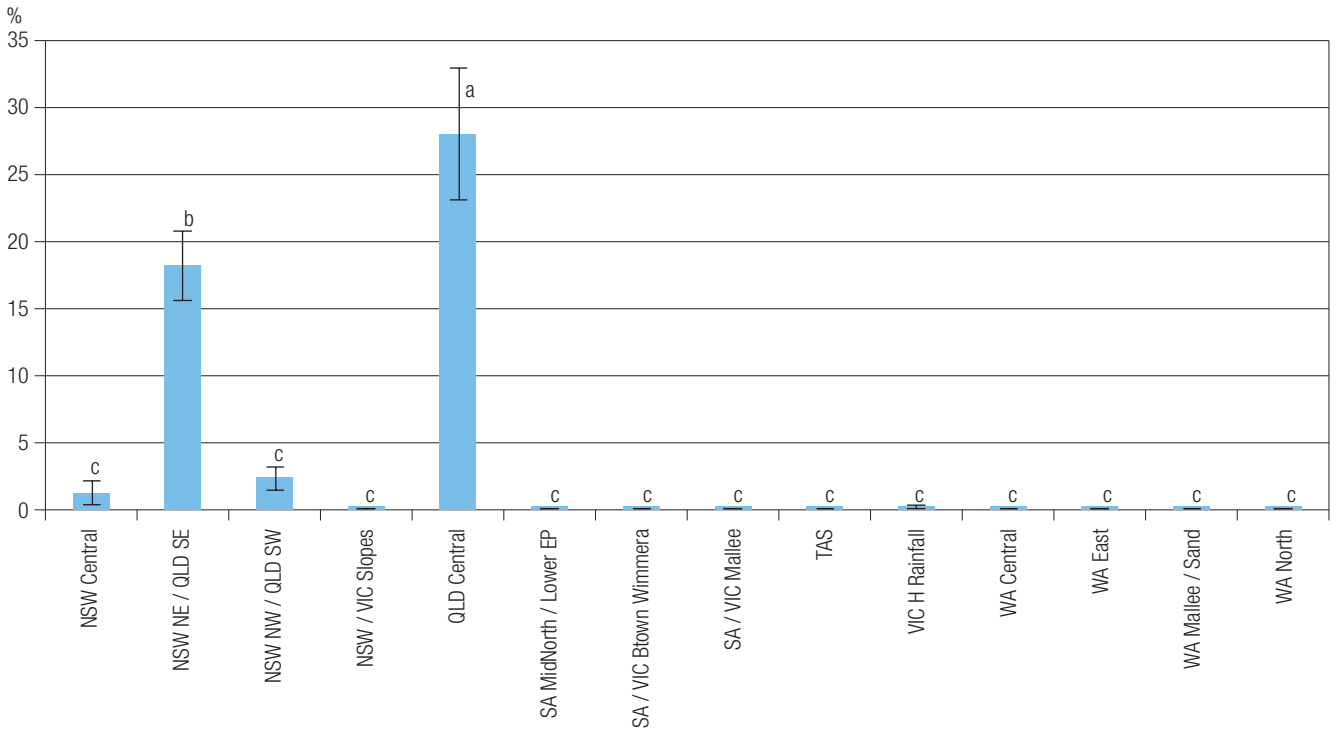
TABLE 19 Average percentage of crop area planted to winter oilseeds

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	1.6	6.7	2.6	***
NSW NE / QLD SE	0.8	1.8	1.0	ns
NSW NW / QLD SW	1.0	3.8	1.5	***
NSW / VIC Slopes	11.3	22.7	2.9	***
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	6.0	8.3	2.4	ns
SA / VIC Bordertown Wimmera	15.0	18.2	3.8	ns
SA / VIC Mallee	1.4	8.6	1.8	***
TAS	23.9	2.6	16.7	***
VIC High Rainfall	16.1	22.3	4.8	***
WA Central	15.0	10.0	2.6	***
WA Eastern	1.4	1.7	1.2	ns
WA Mallee / Sandplain	23.4	19.8	5.1	ns
WA Northern	6.4	7.7	2.9	ns
National Averages	8.8	9.6		

TABLE 20 Average percentage of crop area planted to pulses

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	0.3	1.0	0.7	ns
NSW NE / QLD SE	5.2	3.0	2.0	**
NSW NW / QLD SW	5.2	11.4	2.8	***
NSW / VIC Slopes	3.1	2.1	1.0	ns
QLD Central	12.4	8.1	6.7	ns
SA Mid North / Lower EP	6.7	12.8	2.4	***
SA / VIC Bordertown Wimmera	7.1	10.4	2.6	**
SA / VIC Mallee	2.8	8.6	1.9	***
TAS	7.1	3.7	10.0	ns
VIC High Rainfall	0.0	4.2	2.2	***
WA Central	5.9	5.8	1.5	ns
WA Eastern	2.6	1.6	1.1	ns
WA Mallee / Sandplain	2.8	7.7	1.9	***
WA Northern	6.1	14.7	2.9	***
National Averages	4.8	6.8		

FIGURE 23 Average percentage of crop area planted to summer cereals in 2011



- North East NSW/South East Queensland;
- SA/Victorian Mallee; and
- Victorian High Rainfall.

The percentage of oilseeds in the crop mix decreased in Central WA, likely due to the seasonal conditions experienced in 2011 in that zone.

Pulses

Pulses are a relatively minor crop for most agro-ecological zones (Table 20 and Figure 27), with the exception of:

- North-West NSW/South-West Queensland (likely to be chickpeas);

- Central Queensland (likely to be mungbeans and chickpeas);
- SA Mid North/Lower Eyre Peninsula (lentils, chickpeas, field peas, faba beans and vetch);
- SA/Victoria Wimmera (lentils, faba beans, chickpeas and vetch); and
- Northern WA (lupins).

It is difficult to make comments about changes in the percentage of pulses in the cropping mix, since pulse crops vary between areas in both crop type and in what influences their growth.

For example, pulses decreased in percentage between

FIGURE 24 Average percentage of crop area planted to summer cereals in 2011

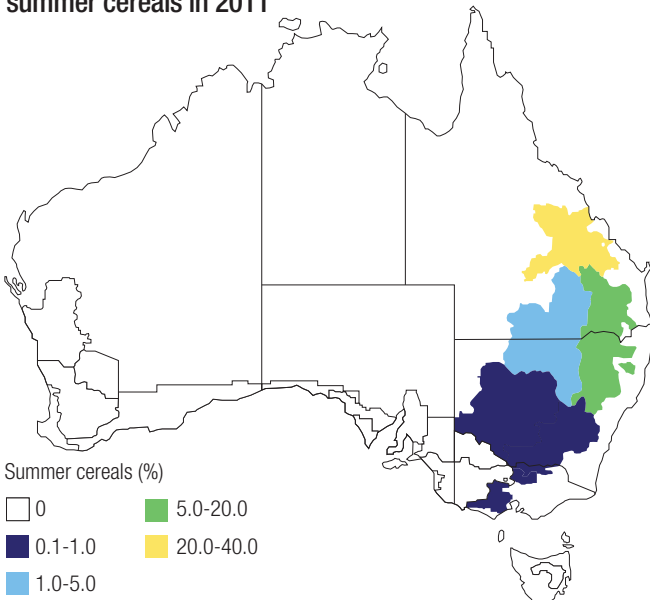


FIGURE 26 Average percentage of crop area planted to oilseeds in 2011

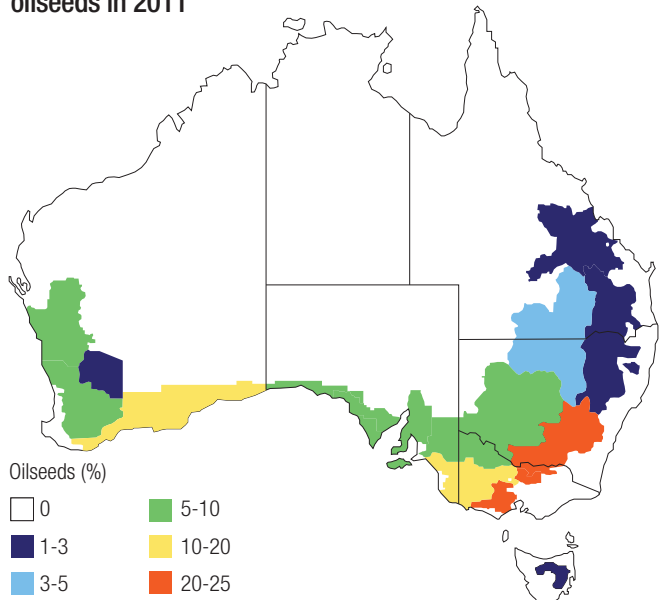


TABLE 21 Average percentage of cropped area planted with the major crops in 2008

Agro-ecological zone	% wheat	% barley	% other cereals	% summer cereals	% oilseeds	% pulses
NSW Central	60.2	22.2	8.6	0.4	1.6	0.3
NSW NE / QLD SE	51.2	11.8	2.3	25.6	0.8	5.2
NSW NW / QLD SW	74.1	11.2	3.5	3.4	1.0	5.2
NSW / VIC Slopes	65.5	15.0	3.5	0.0	11.3	3.1
QLD Central	38.5	0.0	0.0	49.1	0.0	12.4
SA Mid North / Lower EP	47.4	31.8	3.0	0.0	6.0	6.7
SA / VIC Bordertown Wimmera	36.3	32.0	7.9	0.0	15.0	7.1
SA / VIC Mallee	58.9	29.3	4.9	0.0	1.4	2.8
TAS	24.0	13.8	3.3	2.8	23.9	7.1
VIC High Rainfall	37.5	30.7	15.2	0.5	16.1	0.0
WA Central	51.9	19.1	6.1	0.0	15.0	5.9
WA Eastern	80.3	13.7	2.1	0.0	1.4	2.6
WA Mallee / Sandplain	37.6	34.2	0.6	0.0	23.4	2.8
WA Northern	77.8	7.3	1.3	0.0	6.4	6.1

TABLE 22 Average percentage of cropped area planted with the major crops in 2011

Agro-ecological zone	% wheat	% barley	% other cereals	% summer cereals	% oilseeds	% pulses
NSW Central	72.2	10.2	4.6	1.2	6.7	1.0
NSW NE / QLD SE	55.3	9.7	7.5	18.2	1.8	3.0
NSW NW / QLD SW	70.0	7.4	3.8	2.4	3.8	11.4
NSW / VIC Slopes	61.2	9.0	3.3	0.1	22.7	2.1
QLD Central	42.0	0.9	0.0	28.0	0.0	8.1
SA Mid North / Lower EP	53.5	21.6	2.2	0.0	8.3	12.8
SA/VIC Bordertown Wimmera	46.4	17.4	5.7	0.0	18.2	10.4
SA / VIC Mallee	65.4	16.5	1.0	0.0	8.6	8.6
TAS	47.2	39.4	7.1	0.0	2.6	3.7
VIC High Rainfall	47.3	14.8	7.9	0.2	22.3	4.2
WA Central	55.2	19.3	9.7	0.0	10.0	5.8
WA Eastern	84.8	8.3	3.7	0.0	1.7	1.6
WA Mallee / Sandplain	43.4	26.3	2.9	0.0	19.8	7.7
WA Northern	73.2	2.7	1.4	0.0	7.7	14.7

TABLE 23 Average national percentage of cropped area planted with the major crops in 2008 and 2011

	2008	2011	LSD 5%	Significance between years
Wheat	55.3	59.8	1.5	***
Barley	21.0	13.8	1.1	***
Other cereals	4.5	4.5	0.7	ns
Oilseeds	8.0	10.9	0.9	***
Pulses	4.6	6.8	0.6	***
Summer cereals	4.2	2.2	0.7	***

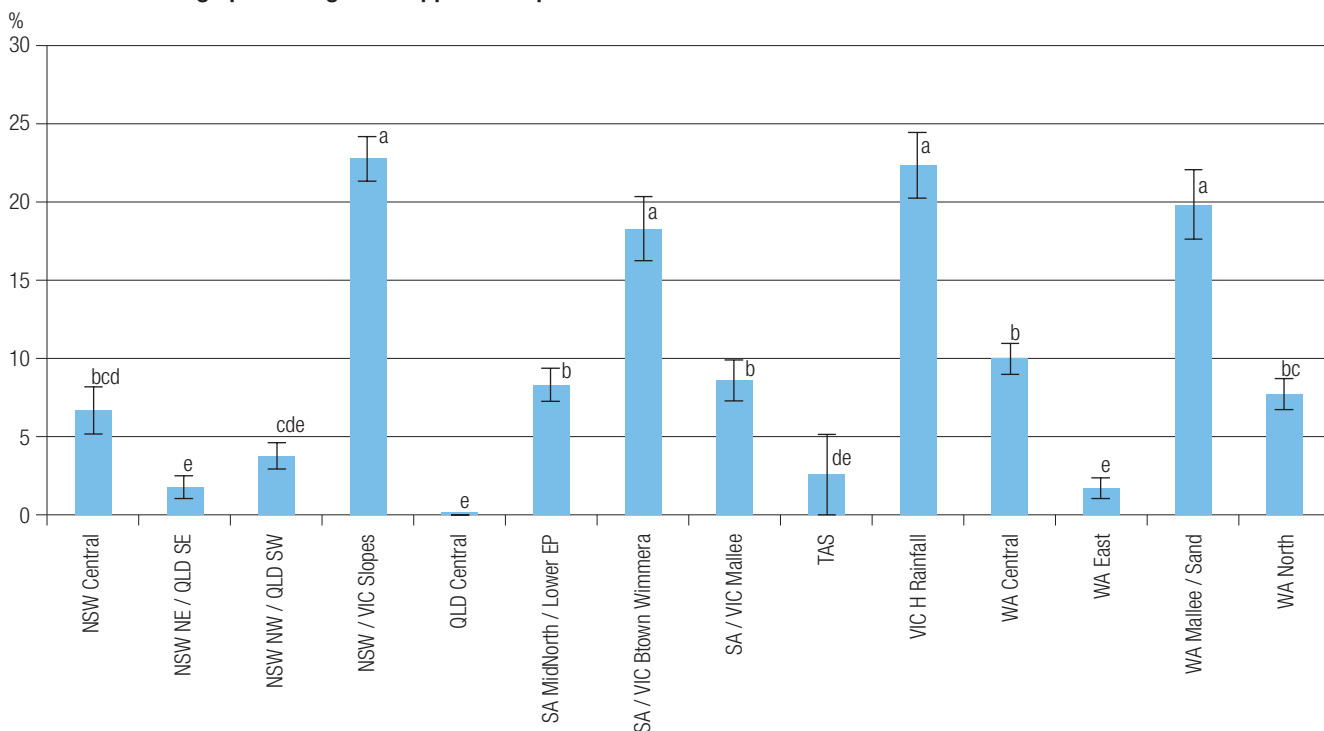
2008 and 2011 in North-East NSW/South-East Queensland, yet increased in North-West NSW/South-West Queensland. Pulses increased in much of Victoria, SA and WA.

Reasons for these changes vary between different agro-ecological zones, but are likely to be due to seasonal conditions coupled with grower perceptions of risk and price prospects.

Total crop mix

Tables 21 and 22 and Figures 28, 29 and 30 show in summary the percentage of the major crops, as a percentage of the cropped area on farms, as recorded in the 2008 and 2011 GRDC surveys. Data is presented from both the 2008 and 2011 crop years.

FIGURE 25 Average percentage of cropped area planted to winter oilseeds in 2011



National trends

When the data is considered on a national basis (see Table 23 and Figure 30), some trends can be noted. The percentages of wheat, oilseeds and pulses grown have increased since the 2008 crop year, while summer cereals and barley have shown decreases.

FIGURE 27 Average percentage of cropped area planted to pulses in 2011

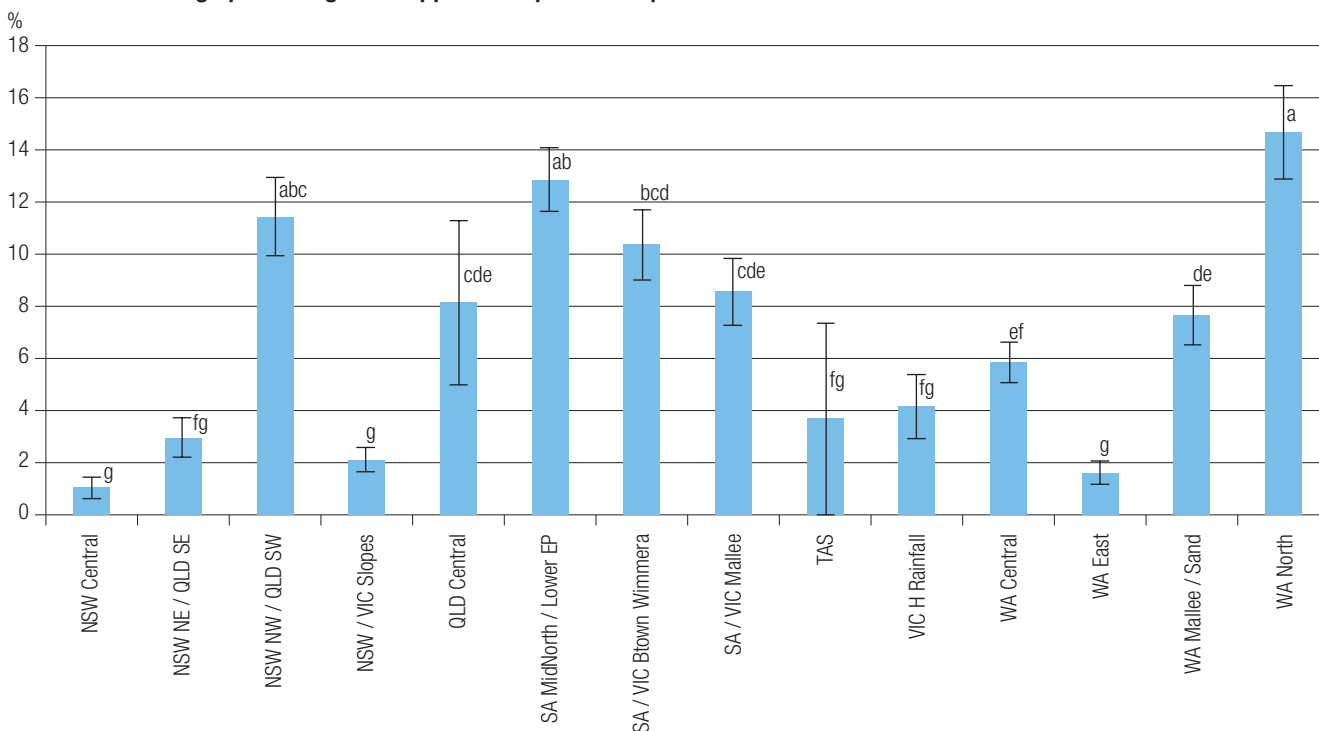


FIGURE 28 Average percentage of cropped area planted with the major crops in 2008 and 2011 – first seven agro-ecological zones

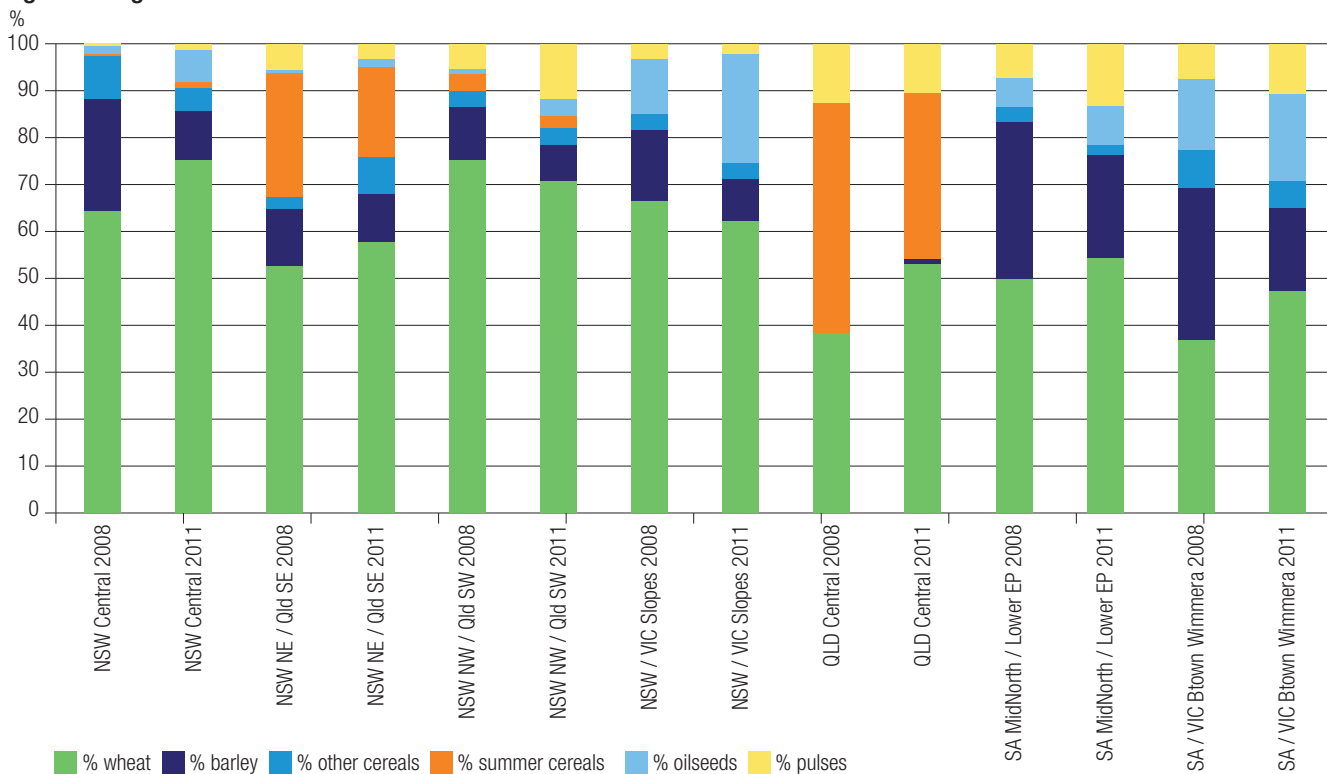


FIGURE 29 Average percentage of cropped area planted with the major crops in 2008 and 2011 – second seven agro-ecological zones

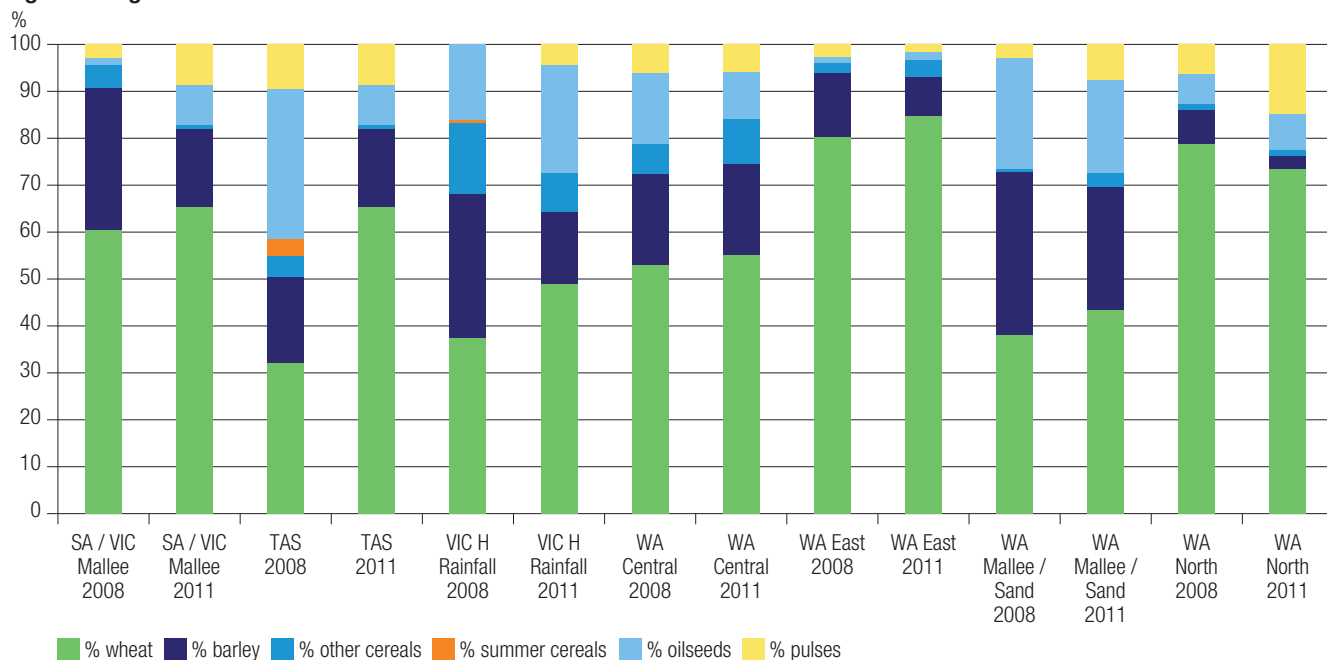
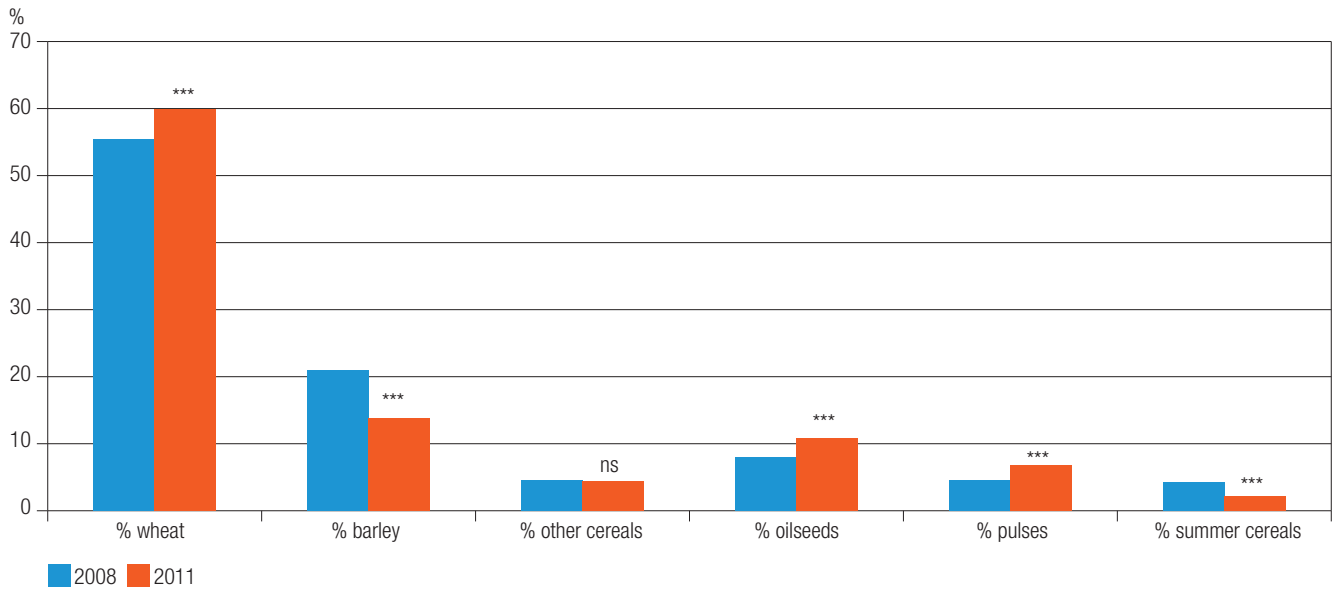


FIGURE 30 Average national percentage of cropped area planted with the major crops in 2008 and 2011



TILLAGE

The following question was asked about the use of tillage systems for crop and pasture establishment: In the sowing of your crops in 2011, what percentage were sown using:

- zero-tillage – less than 10 per cent soil disturbance, e.g. disc planters;
- no-tillage – less than 30 per cent soil disturbance, e.g. knife points;

- direct drill – one pass at sowing, with full cut planting;
- minimum-tillage – one cultivation prior to planting;
- reduced-tillage – one or two cultivations before sowing but less soil disturbance than conventional at sowing; and
- multiple-tillage – more than two cultivations prior to sowing.

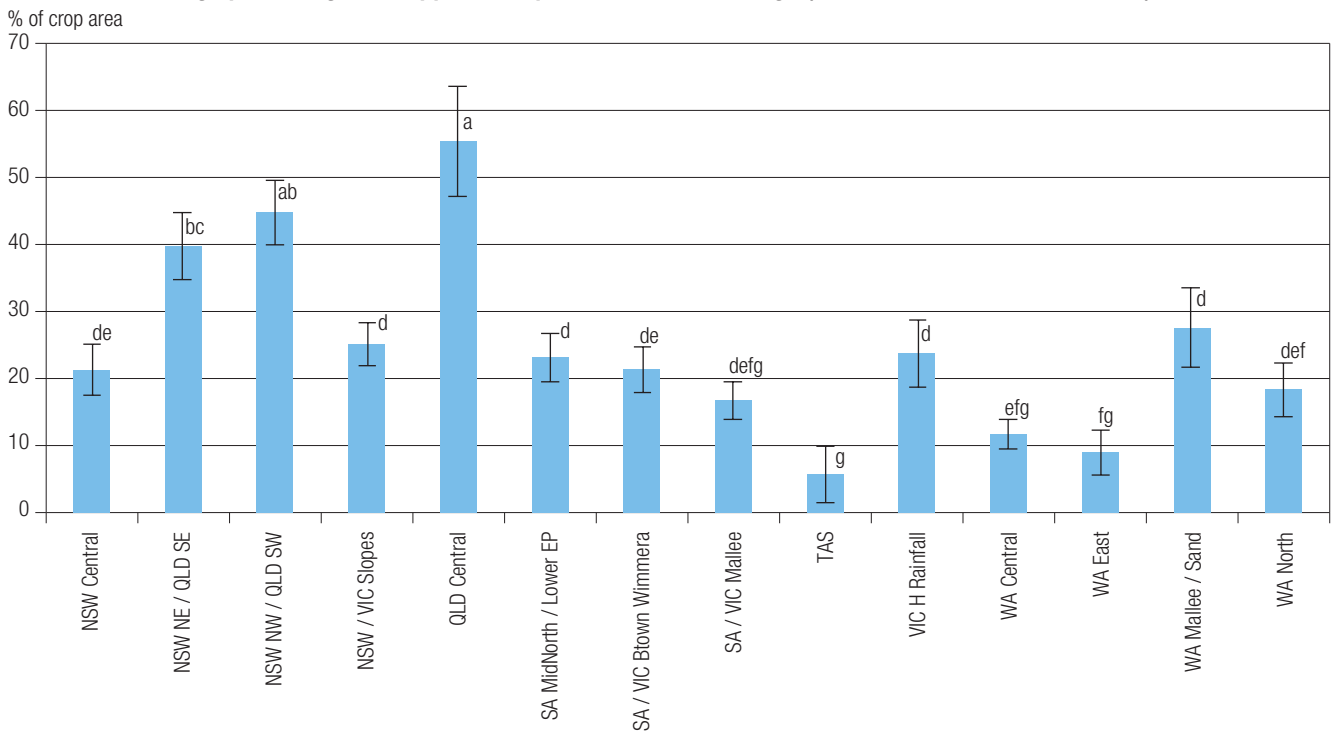
TABLE 24 Average percentage of cropped area planted with zero-tillage (less than 10% soil disturbance)

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	30.5	21.3	8.6	**
NSW NE / QLD SE	42.9	39.7	8.1	ns
NSW NW / QLD SW	48.8	44.8	10.6	ns
NSW / VIC Slopes	40.9	25.1	7.2	***
QLD Central	54.3	55.4	18.0	ns
SA Mid North / Lower EP	39.9	23.2	8.4	***
SA / VIC Bordertown Wimmera	25.2	21.4	7.1	ns
SA / VIC Mallee	22.2	16.7	5.7	ns
TAS	50.0	5.7	30.3	**
VIC High Rainfall	36.2	23.8	12.0	**
WA Central	36.8	11.7	5.8	***
WA Eastern	26.2	9.0	8.9	***
WA Mallee / Sandplain	35.7	27.6	11.6	ns
WA Northern	28.0	18.4	8.7	**
National Averages	37.0	24.6		

TABLE 25 Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance)

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	26.3	21.1	8.1	ns
NSW NE / QLD SE	23.4	19.3	6.8	ns
NSW NW / QLD SW	20.2	25.8	8.9	ns
NSW / VIC Slopes	27.3	33.5	7.3	ns
QLD Central	30.4	14.6	14.2	**
SA Mid North / Lower EP	32.3	37.2	8.8	ns
SA / VIC Bordertown Wimmera	37.5	31.9	8.1	ns
SA / VIC Mallee	33.9	38.2	6.9	ns
TAS	25.0	11.4	29.2	ns
VIC High Rainfall	18.1	33.8	11.8	**
WA Central	46.8	70.1	6.7	***
WA Eastern	51.1	59.2	12.0	ns
WA Mallee / Sandplain	45.3	47.2	12.2	ns
WA Northern	45.3	52.1	10.4	ns
National Averages	33.1	35.4		

FIGURE 31 Average percentage of cropped area planted with zero-tillage (less than 10% soil disturbance) in 2011



Zero-tillage

Zero-tillage is where no prior cultivation of the soil occurs, and less than 10 per cent of the soil is disturbed in the planting operation.

Typically, machinery used would be a disc-based implement, where vertical or near-vertical discs (several combinations are available, often with leading coulter discs) effectively 'slice' through the soil, placing seed and fertiliser at the desired depth and leaving very little soil actually disturbed. Presswheels are also often used.

The data from the 2011 survey suggests that the percentage of the crop reported by survey participants

TABLE 26 Average percentage of cropped area planted with zero-tillage or no-tillage (less than 30% soil disturbance)

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	56.8	42.4	9.7	***
NSW NE / QLD SE	66.3	59.0	7.9	ns
NSW NW / QLD SW	69.0	70.6	9.6	ns
NSW / VIC Slopes	68.2	58.7	7.6	**
QLD Central	84.8	70.0	14.6	**
SA Mid North / Lower EP	72.3	60.4	8.6	**
SA / VIC Bordertown Wimmera	62.7	53.3	8.3	**
SA / VIC Mallee	56.0	54.9	7.2	ns
TAS	75.0	17.1	31.5	**
VIC High Rainfall	54.3	57.5	13.0	ns
WA Central	83.6	81.8	5.3	ns
WA Eastern	77.3	68.2	10.6	ns
WA Mallee / Sandplain	81.0	74.8	10.1	ns
WA Northern	73.3	70.5	9.4	ns
National Averages	70.0	59.9		

FIGURE 32 Average percentage of cropped area planted using zero-tillage (less than 10% soil disturbance) in 2011

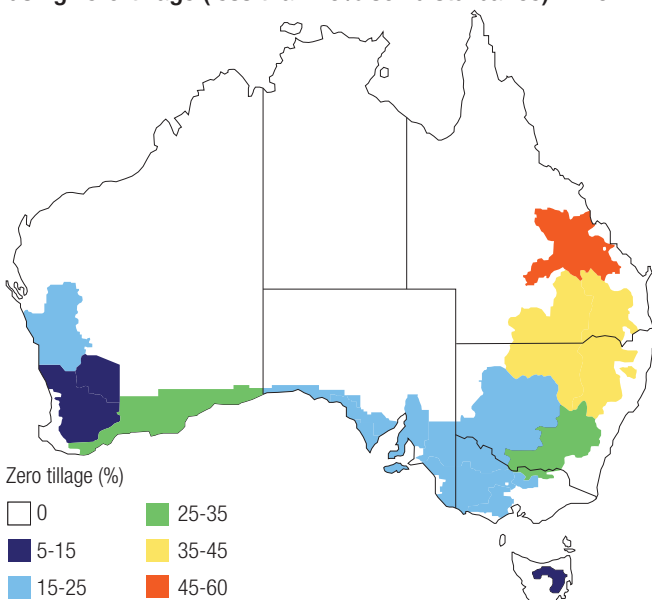
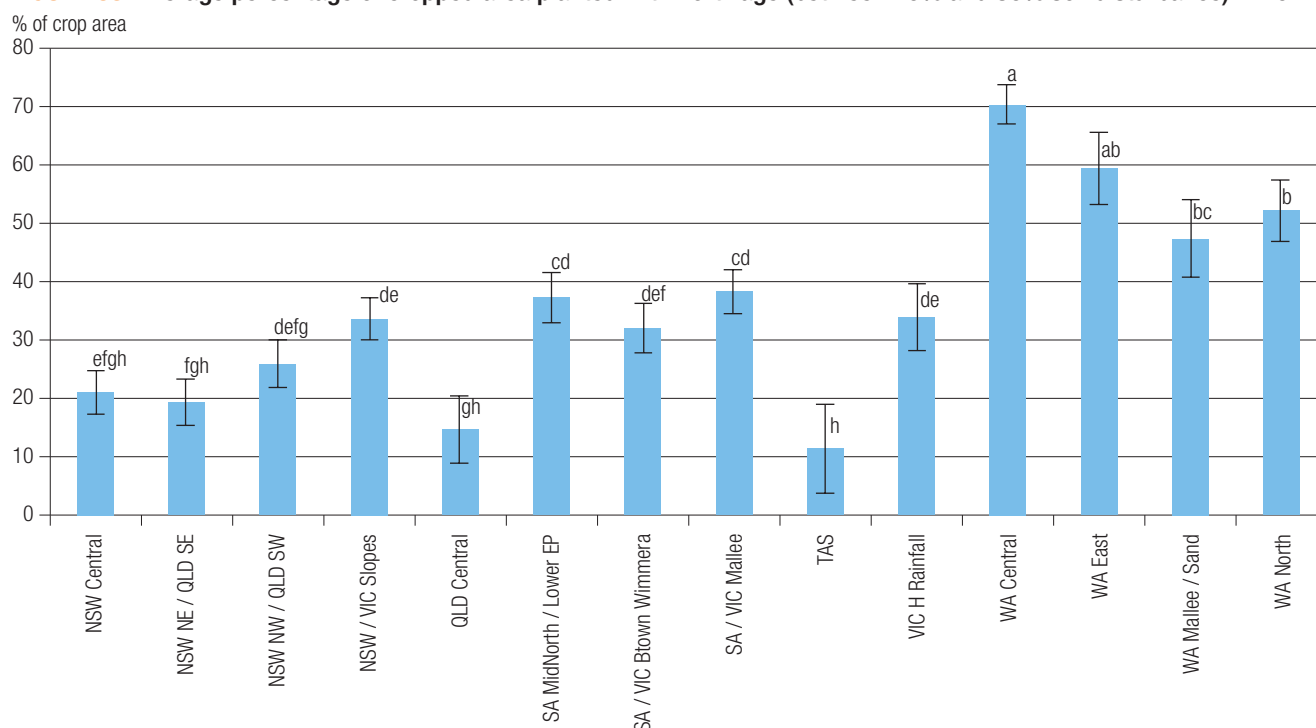


FIGURE 33 Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance) in 2011



planted using zero-tillage in 2011 has decreased compared with what was reported in 2009 for the 2008 year (Table 24, Figures 31 and 32).

Zero-tillage in 2011 was reported by participants to be used on approximately 20 to 30 per cent of the cropped area in many agro-ecological zones, with Central Queensland showing the highest percentage of cropping using this practice in 2011.

However, the data from the 2011 survey also suggests that the percentage of no-tillage has increased in many agro-ecological zones, although not always at a statistically significant level (Table 25, Figures 33 and 34).

FIGURE 34 Average percentage of cropped area planted with no-tillage (between 10% and 30% soil disturbance) in 2011

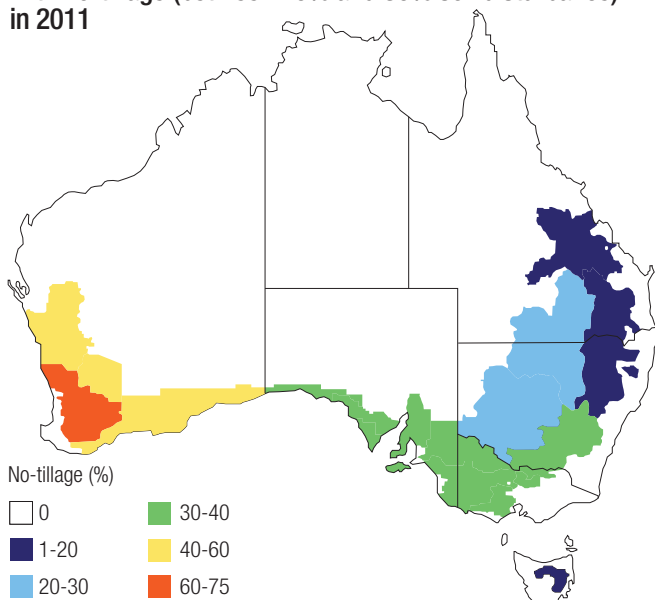
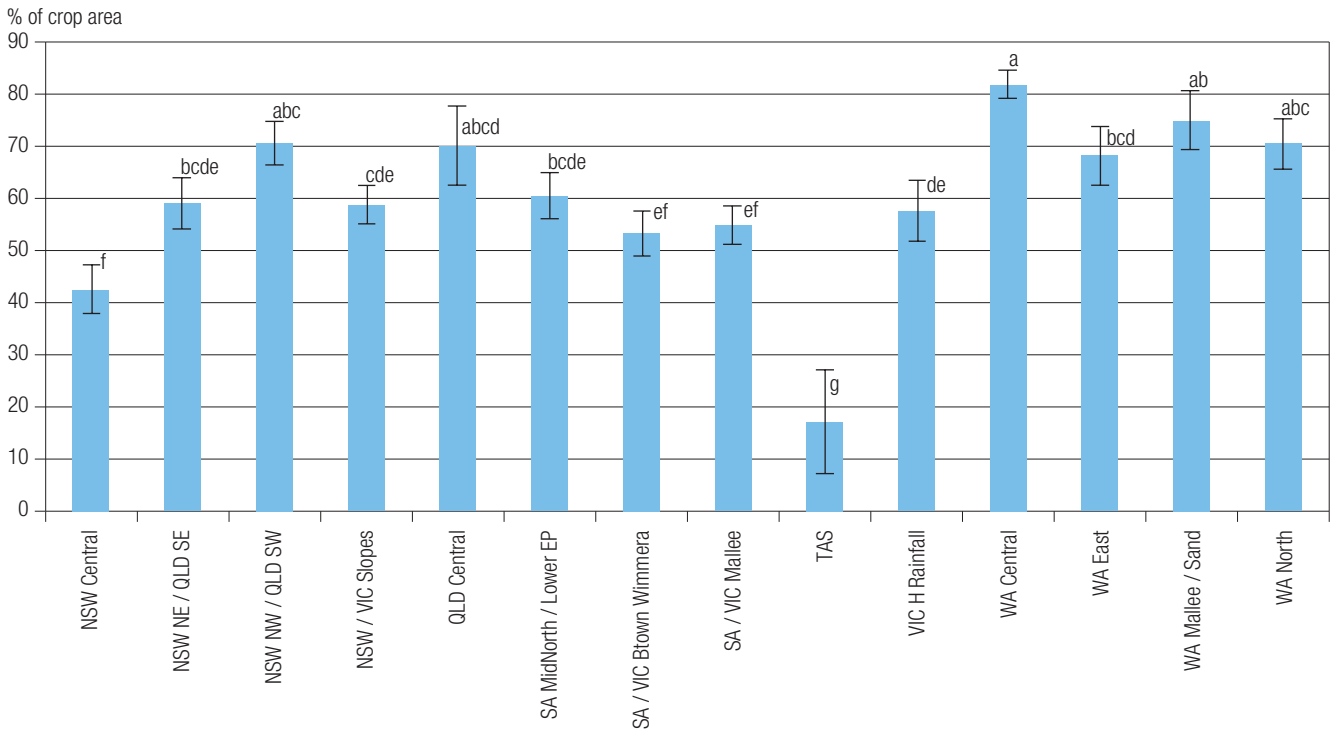


TABLE 27 Average percentage of cropped area planted with direct drill

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	18.2	23.3	7.8	ns
NSW NE / QLD SE	19.0	24.5	6.8	ns
NSW NW / QLD SW	18.2	13.7	7.5	ns
NSW / VIC Slopes	25.2	31.5	7.2	ns
QLD Central	6.5	9.1	8.5	ns
SA Mid North / Lower EP	17.9	29.7	7.9	***
SA / VIC Bordertown Wimmera	25.7	31.8	7.7	ns
SA / VIC Mallee	23.3	22.9	5.9	ns
TAS	20.0	54.3	34.3	ns
VIC High Rainfall	44.7	33.5	12.8	ns
WA Central	13.7	14.8	4.9	ns
WA Eastern	14.7	24.7	9.5	**
WA Mallee / Sandplain	15.4	18.2	9.2	ns
WA Northern	18.1	22.0	8.1	ns
National Averages	20.0	25.3		

FIGURE 35 Average percentage of cropped area planted with no-tillage or zero-tillage (less than 30% soil disturbance) in 2011



These trends, as reported by growers, may be an artifact of the survey questions. In the agro-ecological zones where zero-tillage has declined, no-tillage has generally increased. This effect in the data may also be influenced by the definitions and how well known and understood these were among grain growers in 2008 compared with in 2011. It is possible that growers who reported using zero-tillage in the 2008 survey may have actually been using knife points and reported this as 'zero-tillage', when such a planting system

is now defined as 'no-tillage'.

This appears to require further investigation since anecdotally the use of disc machinery among grain growers is increasing, and the expectation would be for the percentage of this practice to be maintained or have increased since 2008.

Once a grower invests in a disc (zero-tillage) machine, it would be expected that the machine be in use for some years, and that few of these growers would revert to using no-tillage planters in the short term.

FIGURE 36 Average percentage of cropped area planted with direct drill in 2011

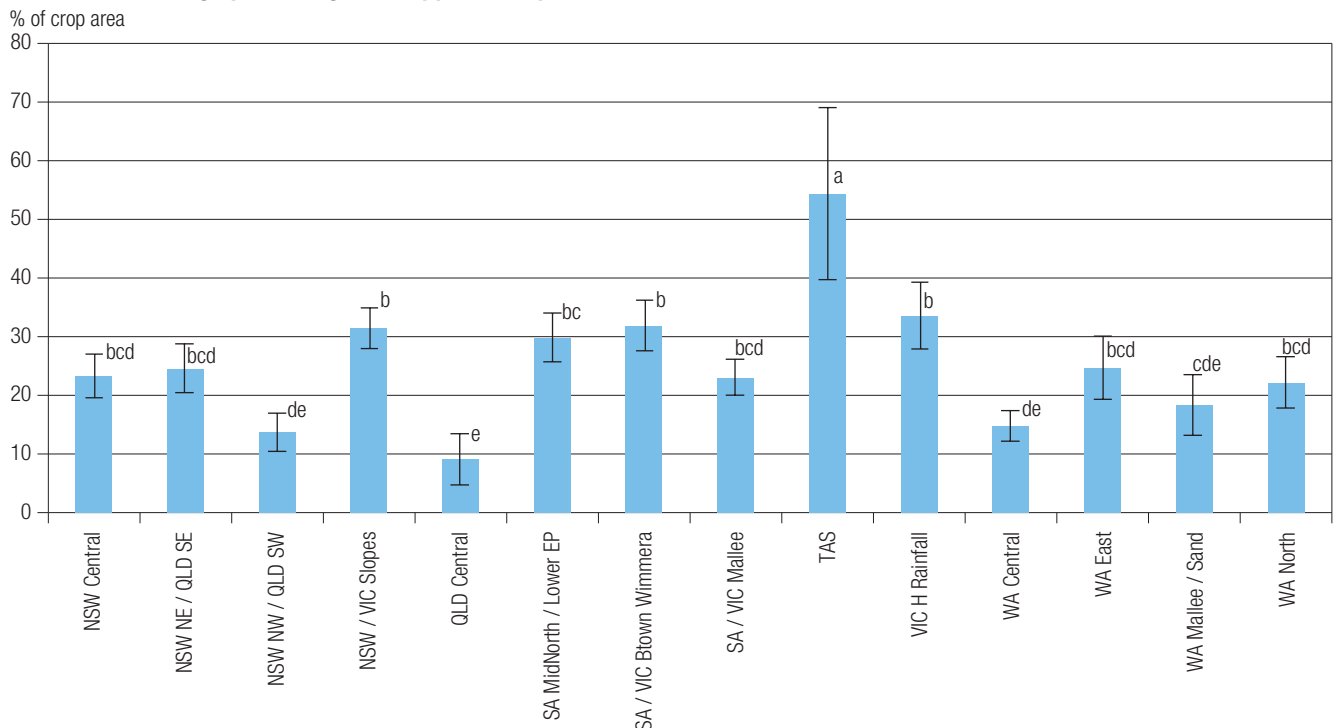


FIGURE 37 Average percentage of cropped area planted with direct drill in 2011

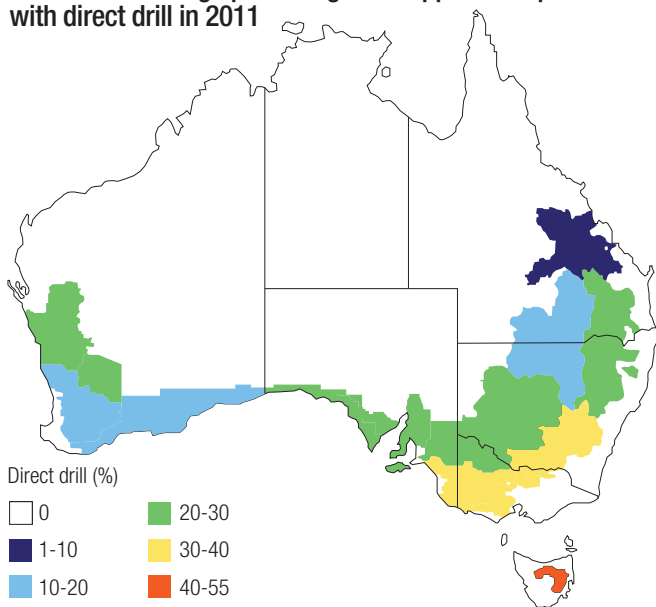
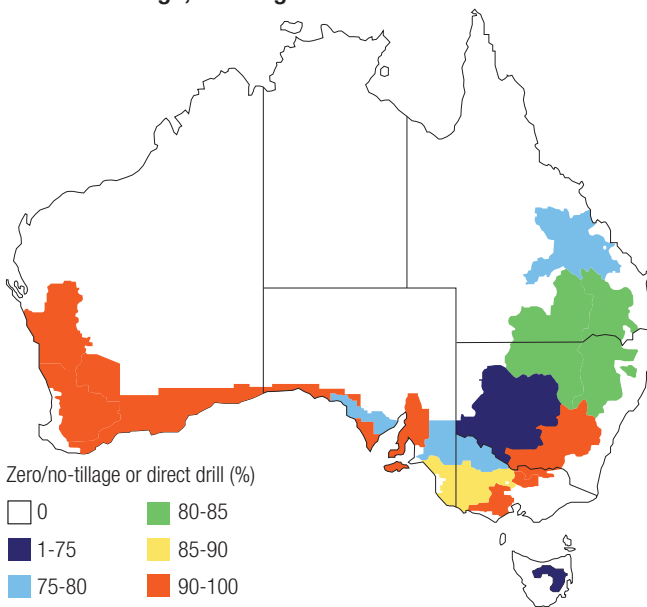


FIGURE 39 Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill in 2011



No-tillage

No-tillage is defined as where machinery disturbs more than 10 per cent but less than 30 per cent of the soil surface across the planting width. Typically such machinery consists of vary narrow, or ‘knife’, soil-engaging tools, where a relatively narrow area of soil is moved aside, allowing seed and fertiliser to be placed in the ‘trench’. Loosened soil then falls or is pushed back in to cover the seed and presswheels are commonly used to firm the soil over the seed. Row spacing is often set to allow for ease of crop residue flow.

In WA the use of knife-type planting systems (i.e. no-tillage) remains high, although disc-based implements are also now in significant use. More than half of the WA crop

is planted using no-tillage, with the exception of the Mallee/Sandplain region, which had higher use of zero-tillage (Table 25, Figures 33 and 34).

As mentioned in the section concerning zero-tillage above, the data for many agro-ecological zones shows a decrease in zero-tillage and an increase in no-tillage between the survey years, with these changes in several cases showing similar absolute levels of change. It is possible that the reasons mentioned earlier concerning definitions may lie behind these movements in the data, with the actual levels of adoption of such practices somewhat different in the field. These suggestions cannot be verified by the data, although perhaps warrant some further qualitative investigations.

FIGURE 38 Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill in 2011

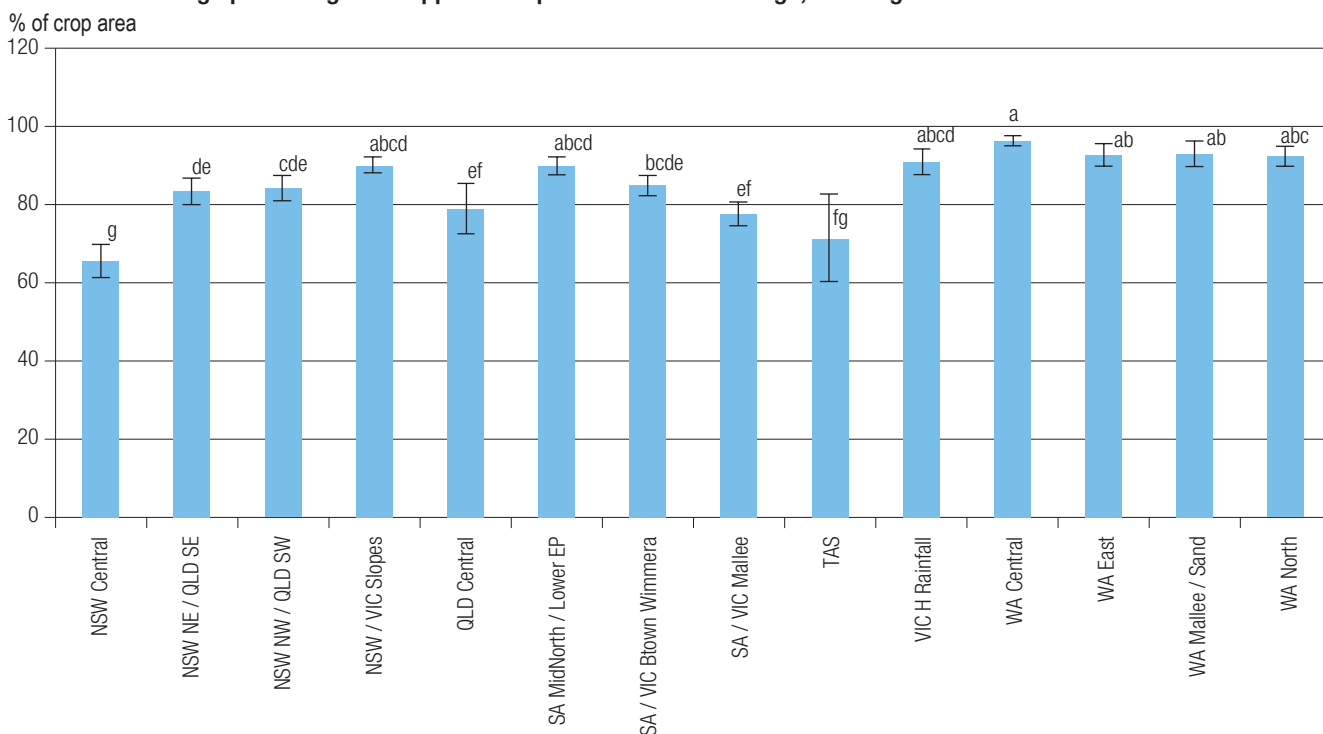


TABLE 28 Average percentage of cropped area planted with zero-tillage, no-tillage or direct drill

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	75.0	65.7	8.4	**
NSW NE / QLD SE	85.3	83.6	5.9	ns
NSW NW / QLD SW	87.2	84.3	6.9	ns
NSW / VIC Slopes	93.5	90.2	3.9	ns
QLD Central	91.3	79.1	13.0	ns
SA Mid North / Lower EP	90.2	90.2	5.0	ns
SA / VIC Bordertown Wimmera	88.4	85.1	5.2	ns
SA / VIC Mallee	79.4	77.8	5.7	ns
TAS	95.0	71.4	21.8	**
VIC High Rainfall	99.0	91.0	5.6	**
WA Central	97.3	96.5	2.2	ns
WA Eastern	92.0	92.9	5.9	ns
WA Mallee / Sandplain	96.4	93.1	5.0	ns
WA Northern	91.4	92.5	5.1	ns
National Averages	90.1	85.2		

TABLE 29 Average percentage of cropped area planted with minimum-tillage techniques

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	16.1	22.6	7.4	**
NSW NE / QLD SE	6.8	7.9	4.1	ns
NSW NW / QLD SW	9.2	10.1	5.7	ns
NSW / VIC Slopes	4.1	6.4	3.2	ns
QLD Central	4.3	12.3	10.0	ns
SA Mid North / Lower EP	4.4	6.6	3.6	ns
SA / VIC Bordertown Wimmera	9.3	9.8	4.5	ns
SA / VIC Mallee	14.4	14.2	4.9	ns
TAS	5.0	22.1	21.9	ns
VIC High Rainfall	0.4	5.2	4.2	**
WA Central	2.0	2.3	1.8	ns
WA Eastern	5.9	3.9	4.6	ns
WA Mallee / Sandplain	1.1	3.9	3.5	ns
WA Northern	7.1	3.0	4.0	**
National Averages	6.4	9.3		

Zero-tillage or no-tillage combined

One way of considering the adoption of the conservation farming techniques *in toto* is to consider the combination of zero- and no-tillage taken together, and consider changes in

levels of adoption of these combined practices.

Given the potential for definitional confusion among grain producers and the potential impact of how they reported the usage of different tillage practices, the data for the combination of these practices is presented in amalgamated

FIGURE 40 Average percentage of cropped area planted with minimum-tillage techniques in 2011

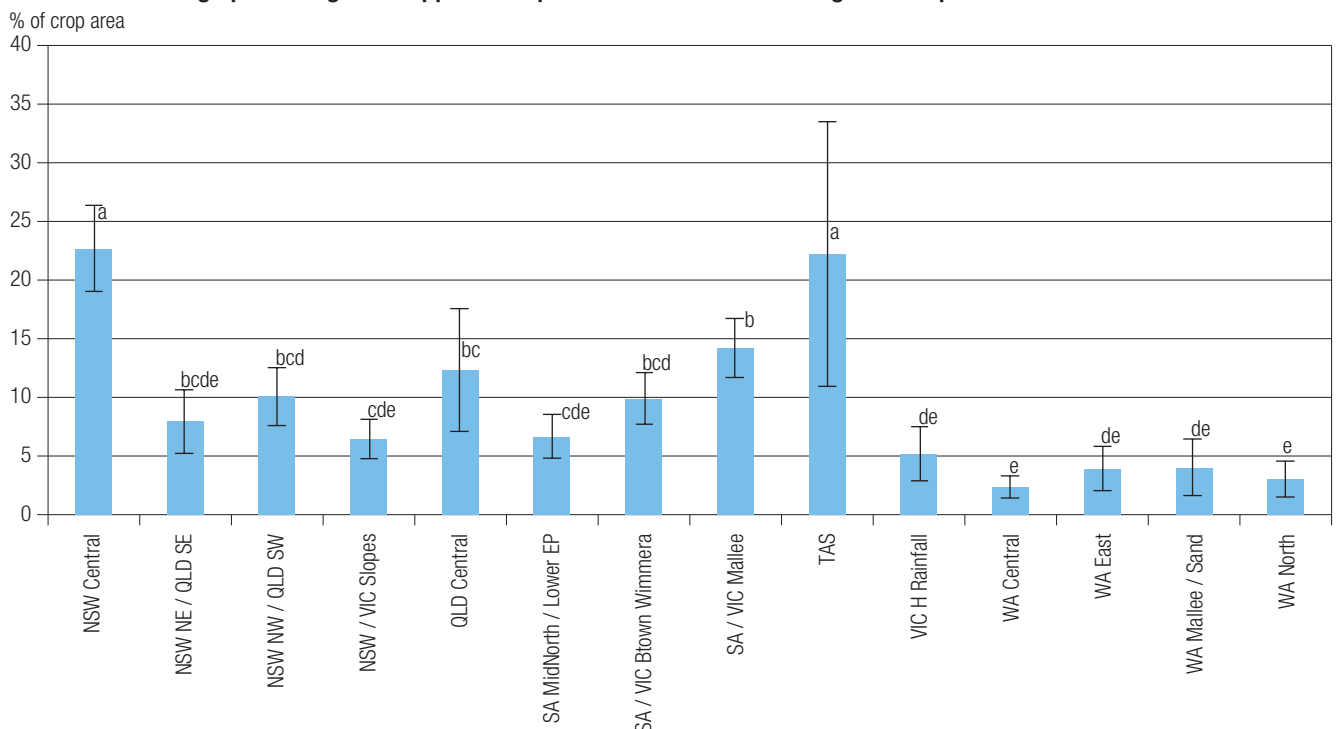
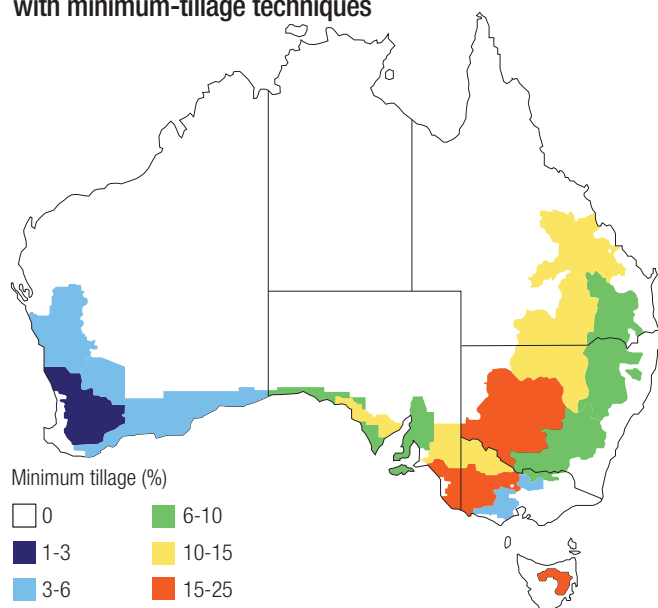


FIGURE 41 Average percentage of cropped area planted with minimum-tillage techniques



form. This allows some consideration to be made between the levels of adoption of the combined zero-tillage and no-tillage (that is, any practice that disturbs less than 30 per cent of soil when planting) and how these may have changed in the absence of any effect of the way the two practices are understood to be defined by growers.

The adoption of zero-tillage or no-tillage combined remains quite high, with close to 60 per cent of cropped area planted using these techniques nationally, and 70 per cent or higher planted using these techniques in five agro-ecological zones (Table 26 and Figure 35).

It appears that the levels of use of either zero-tillage or no-tillage have declined over much of Australia since 2008, notably in the Mid North, Lower Yorke and Eyre Peninsula areas of SA, the NSW/Victorian Slopes and Central NSW, as well as Central Queensland in 2011.

When added to the data for direct drill (see below), the percentage of the national crop that is planted with a single machinery pass remains at greater than 80 per cent of the cropped area, exceeding 90 per cent for much of the eastern state agro-ecological zones, although with some decline in previously similar levels in WA.

Direct drill

In a direct-drilling system there are no cultivations prior to planting. However, the crop is planted in a single pass with full soil disturbance across the full width of the machine. While, as with zero-tillage and no-tillage, this is a 'one-pass' planting operation, frequently more 'conventional' or modified conventional machines are used.

When direct drilling, soil-engaging points are wide enough to loosen the soil across the whole planting width, providing a 'full cut' of the soil surface. Covering devices may consist of a range of options, from presswheels to more conventional harrows in various forms.

The percentage of direct drill in 2011 was higher in WA

TABLE 30 Average percentage of cropped area planted with reduced tillage techniques

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	4.2	5.4	4.0	ns
NSW NE / QLD SE	6.1	6.8	4.2	ns
NSW NW / QLD SW	1.5	5.2	3.8	ns
NSW / VIC Slopes	2.4	2.2	2.1	ns
QLD Central	4.3	8.6	9.4	ns
SA Mid North / Lower EP	5.4	2.9	3.6	ns
SA / VIC Bordertown Wimmera	1.4	2.5	1.8	ns
SA / VIC Mallee	3.6	6.2	3.0	ns
TAS	0.0	2.9	5.4	ns
VIC High Rainfall	0.3	3.8	4.0	ns
WA Central	0.7	1.2	1.3	ns
WA Eastern	2.1	1.6	3.2	ns
WA Mallee / Sandplain	1.0	3.0	2.9	ns
WA Northern	1.5	3.3	2.9	ns
National Averages	2.5	4.0		

and the Mid North/Lower Yorke and Eyre Peninsula areas of SA than in the eastern states (Table 27, Figures 36 and 37). It is possible that there are reasons for wanting some increased soil disturbance in the planting operation in these zones, potentially to do with weed management, for example, the management of herbicide-resistant weeds.

The increase in percentage of direct drilling in WA and parts of SA may be correlated to the decline in the use of no-tillage practices in those areas since the last survey.

Zero-tillage, no-tillage and direct drill combined

Given the potential for some confusion about conservation tillage system terminology among grain producers and the potential impact of this on how they may have reported the usage of different tillage practices, the data for the combination of these three practices is also presented in amalgamated form. This allows some consideration to be made between the levels of adoption of the combined zero-tillage, no-tillage and direct drilling (that is, any practice where only one pass through the soil occurs at planting) and how these one-pass practices may have changed in relation to the use of minimum-tillage, reduced-tillage and multiple-tillage practices that are described below.

These data are shown in Table 28 and Figures 38 and 39.

The three one-pass practices (zero-tillage, no-tillage and direct drill) represent the majority of cropped area in most agro-ecological zones, with typically 80 per cent or more of the crop area planted using these techniques. However, there seems to be some decline in their use in a general sense since the last survey.

FIGURE 43 Average percentage of cropped area planted with reduced tillage techniques in 2011

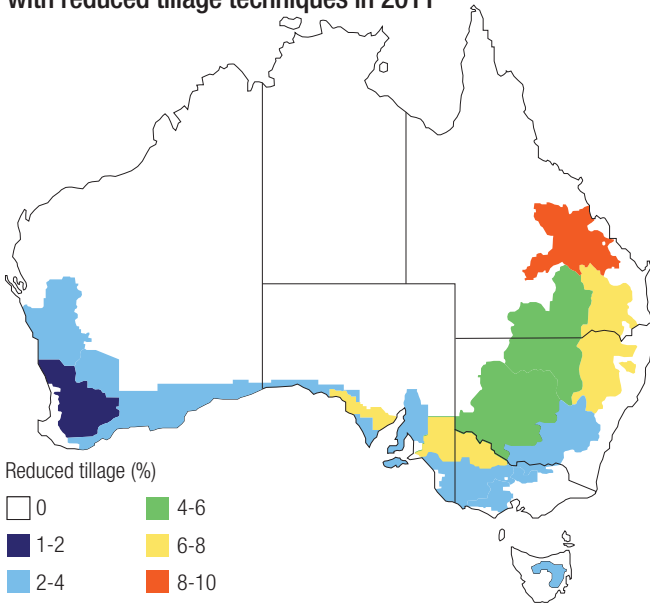


FIGURE 44 Average percentage of cropped area planted with minimum-tillage or reduced tillage techniques in 2011

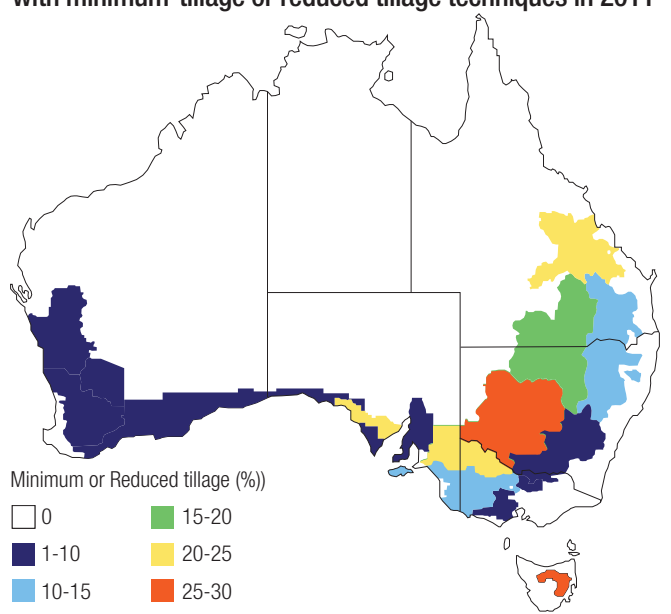
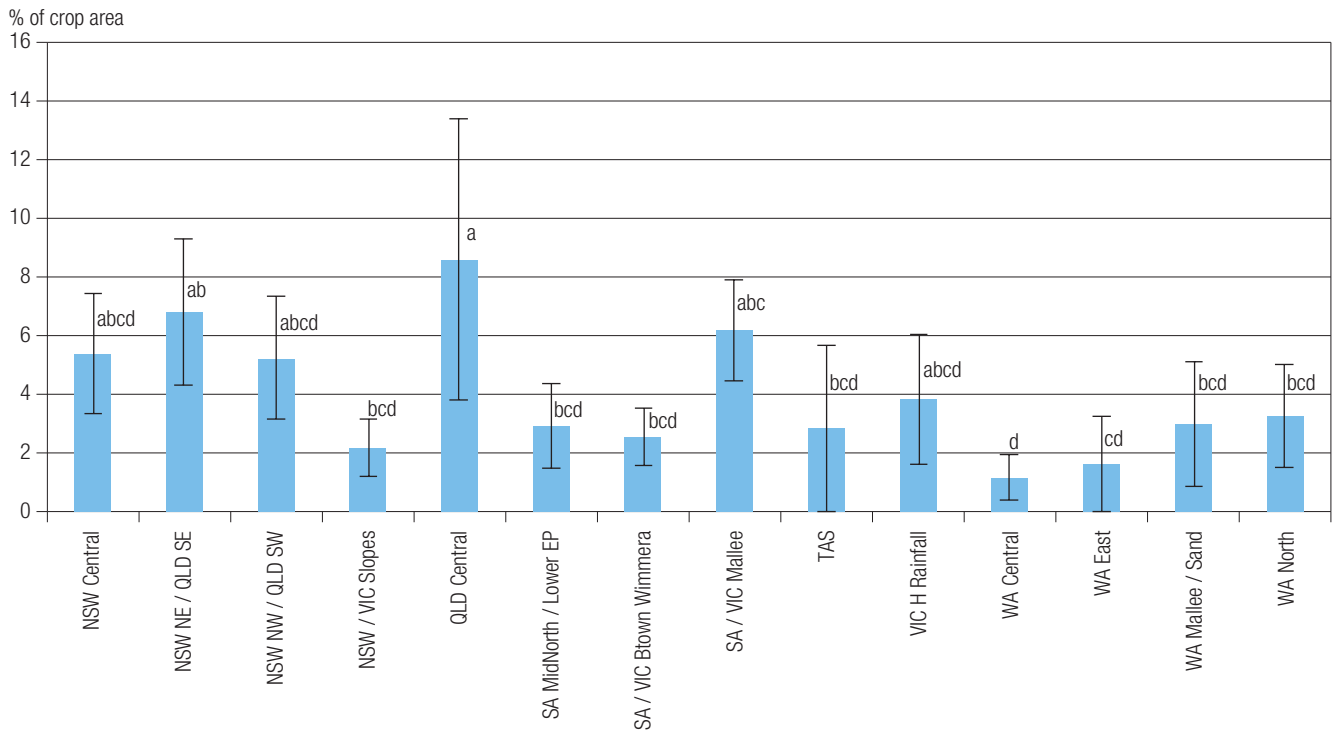


FIGURE 42 Average percentage of cropped area planted with reduced tillage techniques in 2011



Minimum-tillage

Minimum-tillage involves generally only one or two cultivations, with full soil disturbance, prior to the planting operation. This is less than the often numerous cultivations of a 'multiple-tillage' system. Such cultivations are often used for weed control or to place previous crop residues into the soil so that planting operations, often with conventional machinery, are not impeded by such residue.

Minimum-tillage techniques tend to be more frequently used in some of the lower-rainfall areas, for example, Central NSW (Table 29, Figures 40 and 41).

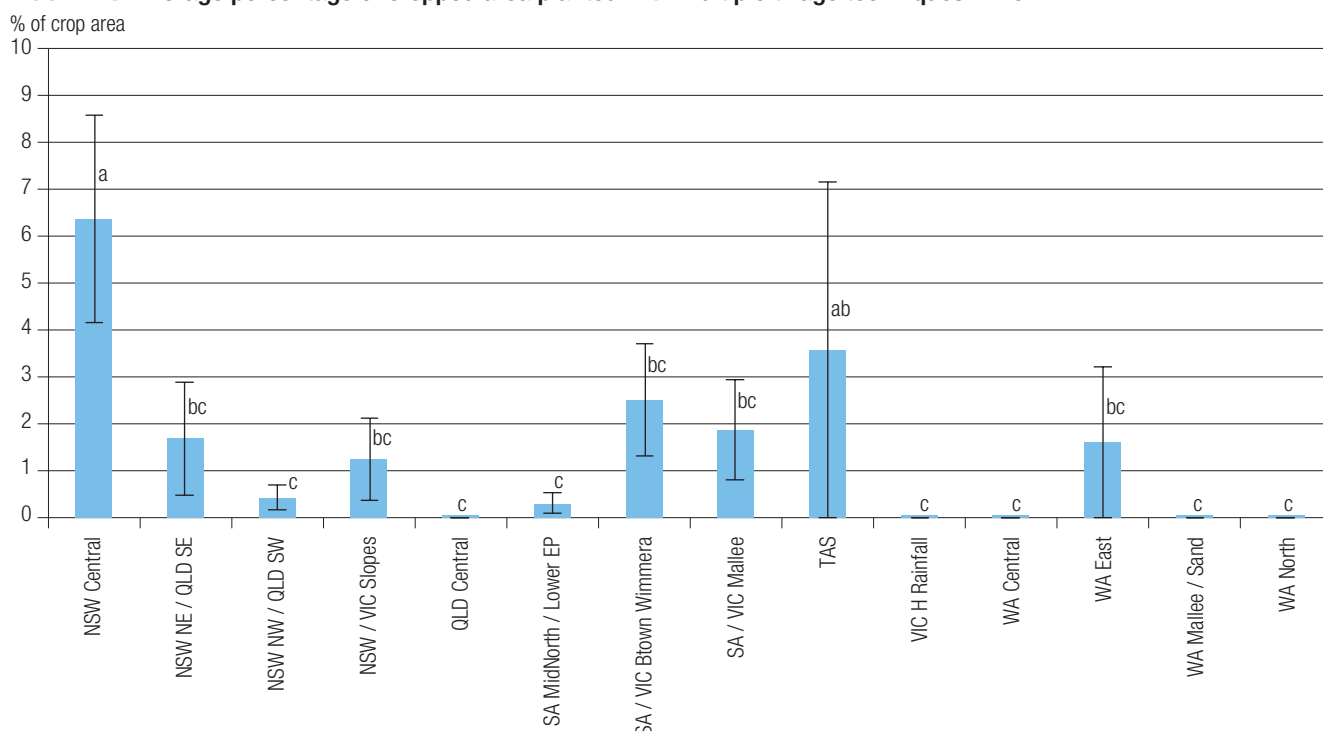
Reduced tillage

Under a reduced tillage system more than two tillage operations – still fewer than in the multiple or conventional-tillage system – occur before planting.

This is a difficult category to describe since there are no 'set' numbers of cultivations in the 'multiple-tillage' category.

The combined percentage of the cropped area under minimum-tillage or reduced tillage is between 10 and 20 per cent in most agro-ecological zones (Table 30, Figures 42, 43 and 44).

FIGURE 45 Average percentage of cropped area planted with multiple tillage techniques in 2011



Multiple-tillage (conventional cultivation)

This system often includes a long, cultivation-based fallow where tillage is the dominant method of soil preparation prior to planting.

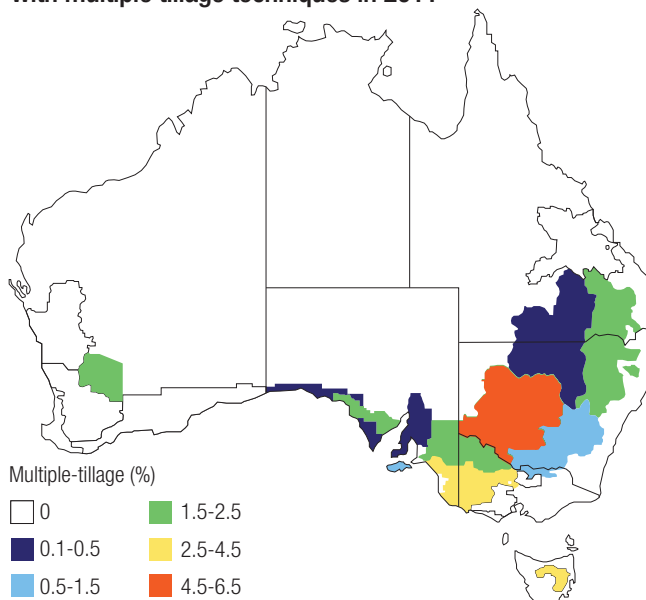
This category, previously known as ‘conventional cultivation’, is used to ensure weed and residue-free, fine and loose soil at planting.

The use of a multiple-tillage-based system has remained at very low levels. This system has almost disappeared in some agro-ecological zones, for example, much of Queensland, NSW, Victoria and SA, although is still present and has increased in NSW Central and SA/Victorian Bordertown Wimmera (although at non-significant levels). (Table 31, Figures 45 and 46).

TABLE 31 Average percentage of cropped area planted with multiple tillage techniques

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	3.4	6.4	4.1	ns
NSW NE / QLD SE	1.7	1.7	2.1	ns
NSW NW / QLD SW	0.4	0.4	0.5	ns
NSW / VIC Slopes	0.0	1.3	1.4	ns
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	0.0	0.3	0.3	ns
SA / VIC Bordertown Wimmera	0.8	2.5	1.9	ns
SA / VIC Mallee	2.1	1.9	2.0	ns
TAS	0.0	3.6	6.8	ns
VIC High Rainfall	0.3	0.0	0.3	ns
WA Central	0.0	0.0	0.0	ns
WA Eastern	0.0	1.6	2.2	ns
WA Mallee / Sandplain	0.0	0.0	0.0	ns
WA Northern	0.0	0.0	0.0	ns
National Averages	0.6	1.4		

FIGURE 46 Average percentage of cropped area planted with multiple tillage techniques in 2011



PRECISION AGRICULTURE



Precision agriculture practices include the use of controlled traffic, autosteer, yield-mapping and variable rate fertiliser application.

Controlled traffic/tramlines

In a controlled traffic (CT) system, the drive and other wheels on all implements and tractors, headers, sprayers, etc. follow

the same path with each pass over the paddock. This means that wheels always travel on defined paths, leaving the soil area between wheels un-trafficked. It appears that in general CT is widely used on larger farms with larger crop areas in NSW Central, North-West NSW/South-West Queensland and Central Queensland agro-ecological zones (Table 32, Figures 47 and 48).

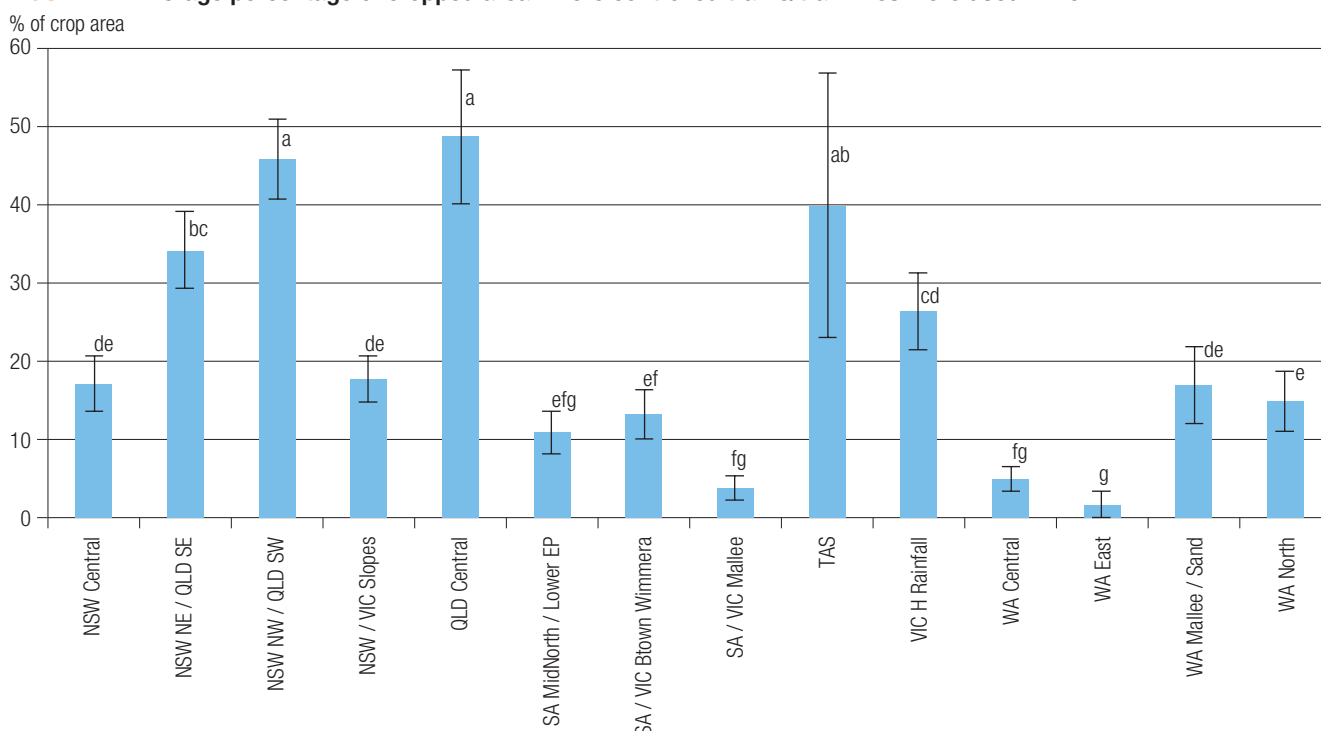
TABLE 32 Average percentage of cropped area where controlled traffic/tramlines were used

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	8.4	17.1	6.8	**
NSW NE / QLD SE	35.4	34.0	8.2	ns
NSW NW / QLD SW	30.5	45.6	10.8	***
NSW / VIC Slopes	15.8	17.6	6.0	ns
QLD Central	39.1	48.6	18.5	ns
SA Mid North / Lower EP	5.7	10.8	5.0	**
SA / VIC Bordertown Wimmera	9.0	13.2	5.6	ns
SA / VIC Mallee	4.4	3.7	3.0	ns
TAS	12.5	39.7	34.3	ns
VIC High Rainfall	24.5	26.3	11.2	ns
WA Central	3.7	4.9	2.8	ns
WA Eastern	1.3	1.6	2.9	ns
WA Mallee / Sandplain	14.2	16.8	8.8	ns
WA Northern	6.6	14.9	6.4	**
National Averages	15.1	21.1		

TABLE 33 Average percentage of cropped area where autosteer was used

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	46.9	67.5	10.1	***
NSW NE / QLD SE	53.5	57.1	8.6	ns
NSW NW / QLD SW	53.3	75.9	10.2	***
NSW / VIC Slopes	48.3	69.4	7.8	***
QLD Central	69.6	76.1	16.2	ns
SA Mid North / Lower EP	46.7	69.0	9.0	***
SA / VIC Bordertown Wimmera	43.1	62.6	9.0	***
SA / VIC Mallee	44.5	71.2	7.1	***
TAS	25.0	39.3	41.1	ns
VIC High Rainfall	47.8	74.3	12.3	***
WA Central	38.1	65.7	6.7	***
WA Eastern	40.8	60.0	12.1	***
WA Mallee / Sandplain	58.1	73.0	11.5	***
WA Northern	38.5	72.0	10.0	***
National Averages	46.7	66.7		

FIGURE 47 Average percentage of cropped area where controlled traffic/tramlines were used in 2011



CT is known to have benefits for soil compaction, which can be a problem in heavier clay soils, for example, the vertisols of Northern NSW and Southern and Central Queensland. This could explain the relatively high adoption in these zones.

Autosteer

Autosteer uses GPS-based guidance to assist with guiding the tractor, header and/or sprayer across the cropped or pasture area. Autosteer is a more sophisticated than manual GPS guidance, as the technology steers the machine for the driver, who only has to make turns where necessary.

Autosteer can now be used to guide machinery to within two centimetres (or less) of the desired location and can be a form of controlled traffic, although this is not always the case. Autosteer can be used with any implement to provide accurate steering and to avoid overlapping or missing areas.

There has been a significant uptake in the adoption of autosteer in the past two years, with usage as reported in

FIGURE 48 Average percentage of cropped area where controlled traffic/tramlines was used in 2011

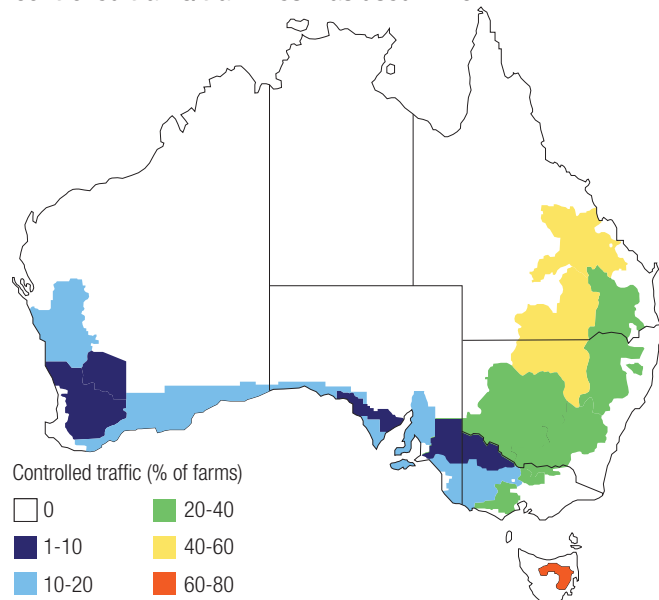
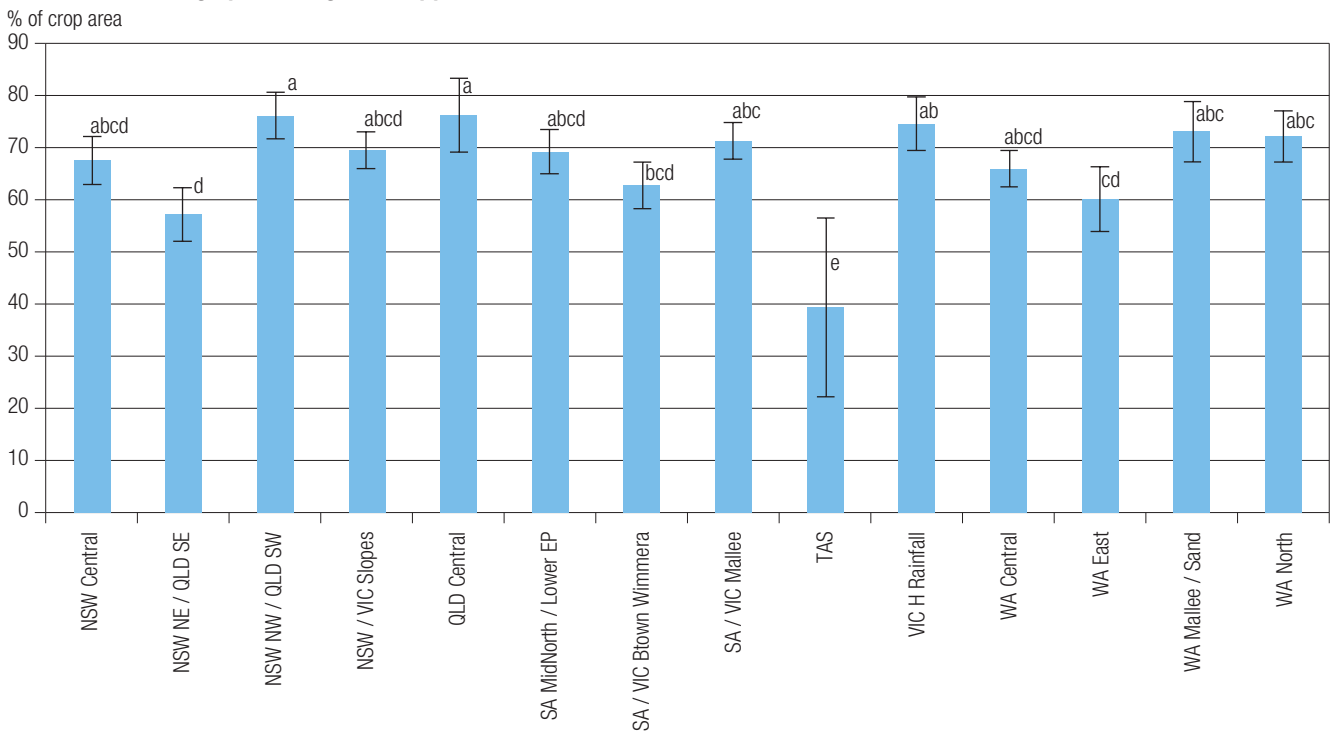


TABLE 34 Average percentage of cropped area where variable rate technology was used

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	13.3	10.1	6.3	ns
NSW NE / QLD SE	12.7	10.6	5.5	ns
NSW NW / QLD SW	11.7	6.8	6.0	ns
NSW / VIC Slopes	9.6	5.3	3.9	**
QLD Central	0.0	2.9	4.8	ns
SA Mid North / Lower EP	9.3	9.3	5.0	ns
SA / VIC Bordertown Wimmera	5.2	6.1	3.7	ns
SA / VIC Mallee	19.1	29.4	6.2	**
TAS	0.0	0.0	0.0	ns
VIC High Rainfall	12.7	2.2	6.0	***
WA Central	6.2	4.9	3.0	ns
WA Eastern	10.2	8.0	6.8	ns
WA Mallee / Sandplain	5.6	12.5	6.3	***
WA Northern	6.4	5.5	4.8	ns
National Averages	8.7	8.1		

FIGURE 49 Average percentage of cropped area where autosteer was used in 2011



the 2011 survey now at quite high levels – two-thirds of the cropping area, up from just under half in 2008 (Table 33 and Figure 49).

The survey data indicates a relatively rapid uptake considering this technology has only been available in relatively recent years.

Anecdotally, it is suggested that larger grain farms are

embracing this technology and that where it is used it is employed on nearly all of the cropping area.

The higher uptake of autosteer over the past three years compared with controlled traffic could suggest that grain growers are going directly for the benefits of controlled traffic that are offered through autosteer, without implementing controlled traffic on its own as a first step.

FIGURE 50 Average percentage of cropped area where variable rate technology was used in 2011

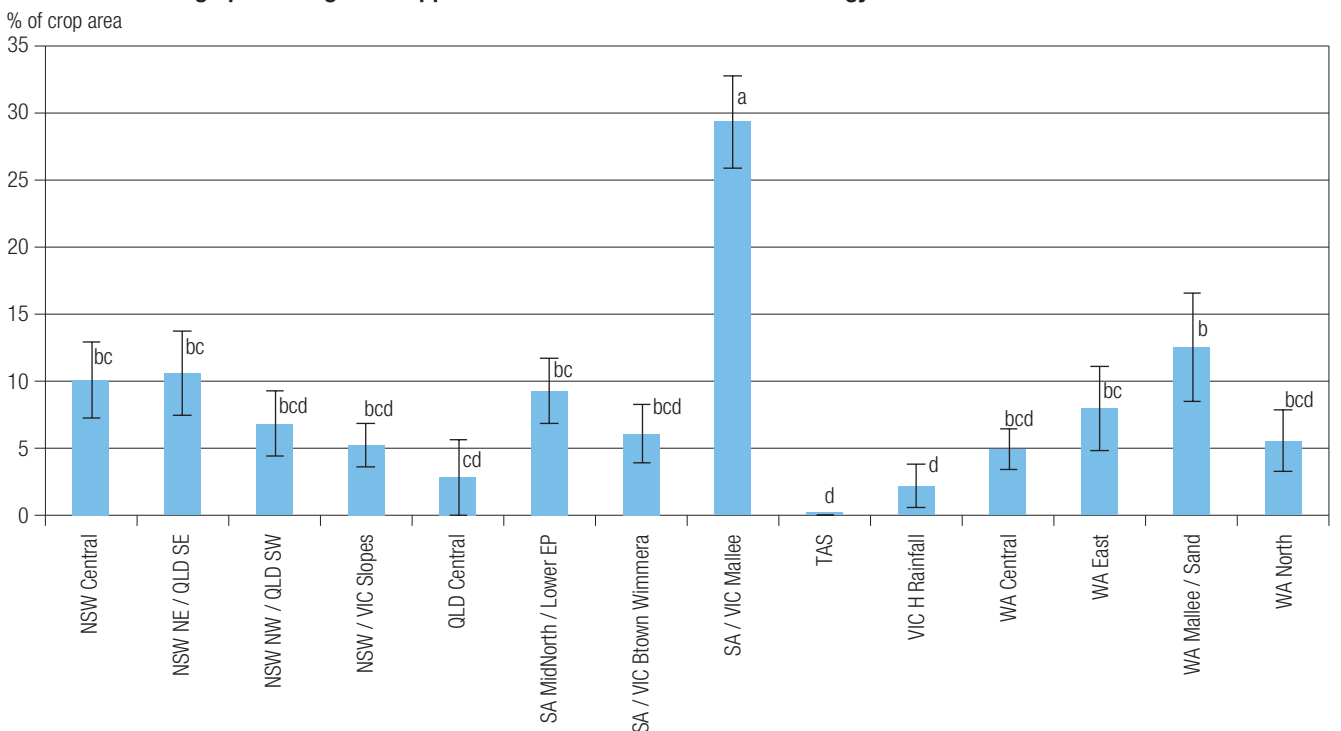
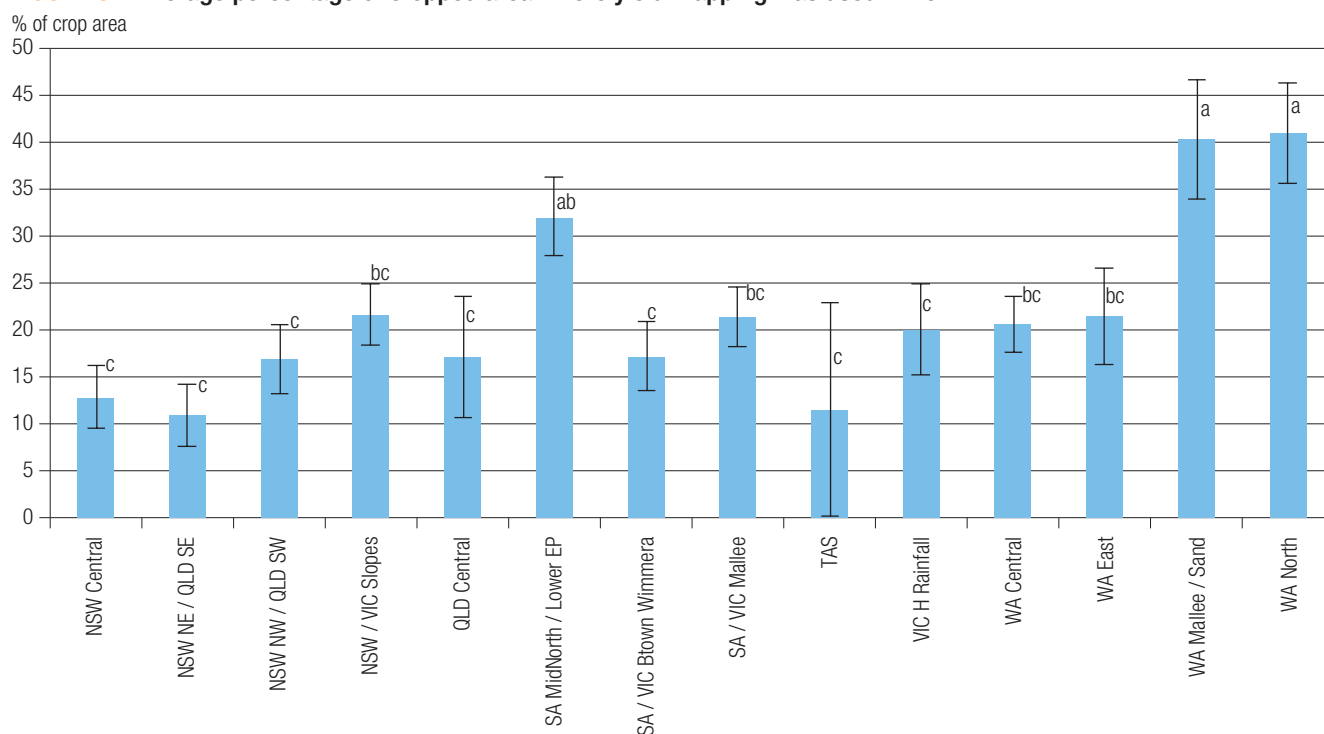


FIGURE 51 Average percentage of cropped area where yield mapping was used in 2011



Variable rate technology

One aspect of precision agriculture is to use data about crop performance, soil tests and paddock history, along with other remote sensing data, to determine the characteristics of various areas within a paddock. One application of this integrated approach is to use these data to apply variable rates of fertiliser (or other inputs) to different areas of a paddock using satellite-guided positioning. This technology is relatively sophisticated and complex and requires expert technical input.

The uptake of variable rate technology (VRT) is lower than for all other forms of precision agriculture technologies studied in the 2011 survey, although it is reported by growers in the SA/Victorian Mallee to be used on almost 30 per cent of the grain-growing area (Table 34 and Figure 50).

FIGURE 52 Average percentage of farms where yield mapping was used in 2011

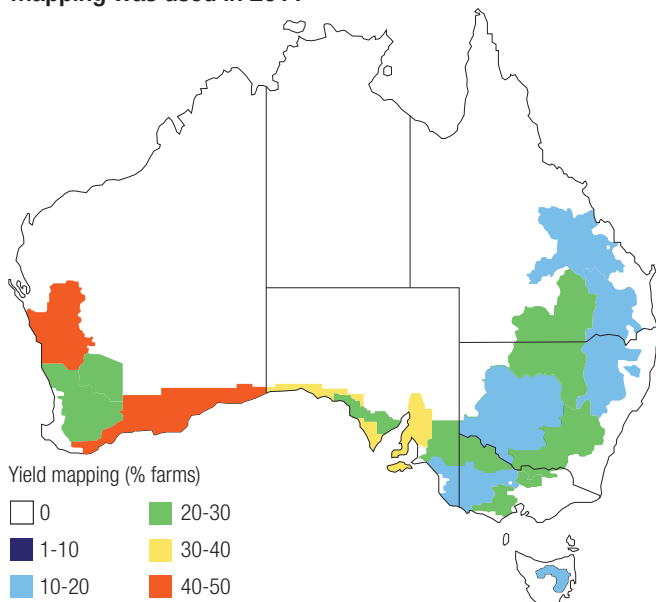


TABLE 35 Average percentage of cropped area where yield mapping was used

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	15.5	12.7	7.3	ns
NSW NE / QLD SE	11.5	10.9	5.5	ns
NSW NW / QLD SW	10.0	16.9	7.5	ns
NSW / VIC Slopes	15.0	21.6	6.3	**
QLD Central	13.0	17.1	13.5	ns
SA Mid North / Lower EP	17.3	32.0	8.0	***
SA / VIC Bordertown Wimmera	10.5	17.2	6.1	**
SA / VIC Mallee	8.3	21.4	5.1	***
TAS	0.0	11.4	21.6	ns
VIC High Rainfall	8.8	20.0	9.6	**
WA Central	16.5	20.6	5.4	ns
WA Eastern	18.1	21.5	9.9	ns
WA Mallee / Sandplain	22.4	40.4	11.1	***
WA Northern	22.7	41.0	9.6	***
National Averages	13.5	21.8		

This result may require some validation, although it may be due to the development of applying different fertiliser regimes to Mallee dunes and swale areas in a paddock, which are quite prevalent across much of the Mallee. This would be an example of a valuable use for this technology and may explain its adoption in the Mallee. In some other zones the use of variable rate technology seems static or has decreased slightly.

Yield mapping

Yield mapping can be used for general monitoring of crop performance, to make decisions about inputs, or even to choose the type of crop for various paddocks. It can provide guidance on further investigations that should be undertaken, for example, zoned soil tests, and for evidence of impediments in soil or the presence of diseases or other factors across a paddock.

There has been an increase in the number of grain properties using yield mapping over the past two years (Table 35, Figures 51 and 52). This is possibly due to grain producers trading in their combine headers/harvesters for newer models with the software that enables them to map the yields of their paddocks. It is also possible that where contract harvesters are used, many will have yield-mapping capability.

FALLOW

A period of fallow can mark:

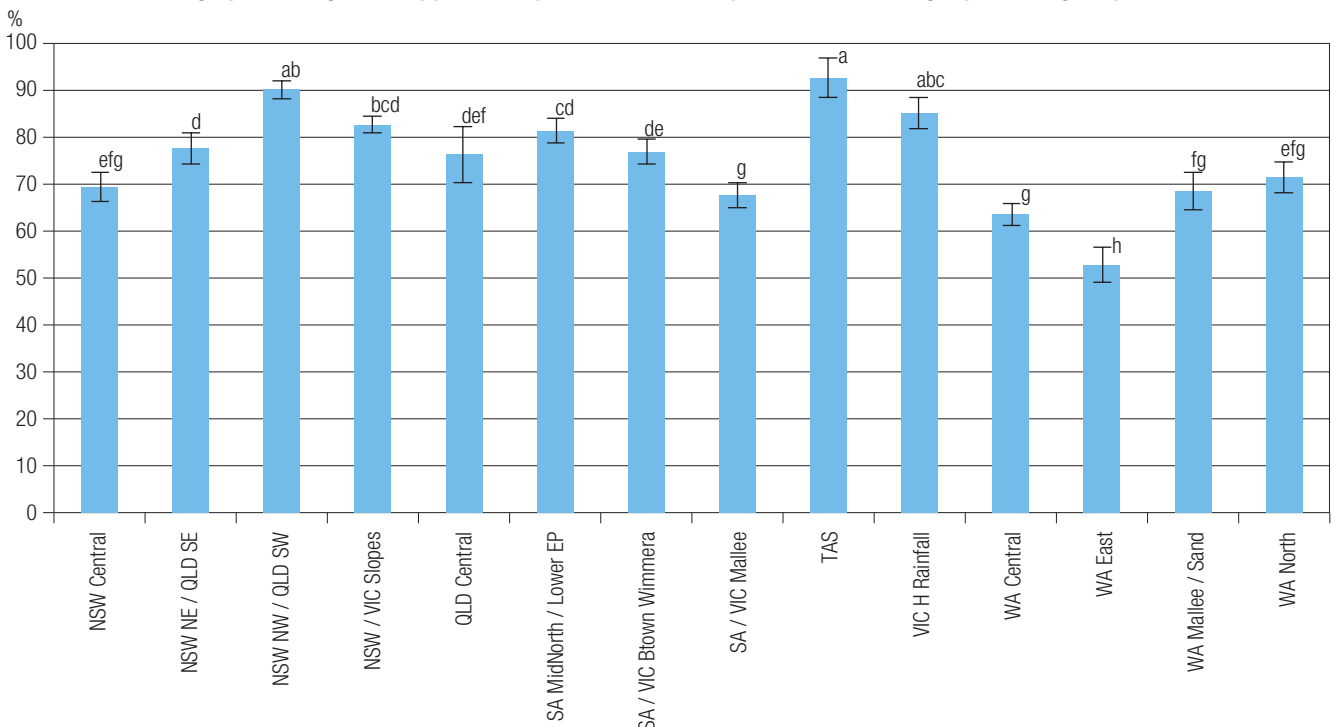
- the period of time from the harvest of one winter crop in early summer until the planting of the next crop in the paddock in the following autumn/early winter;
- the transition from a pasture phase to a crop phase; or
- the transition from one summer crop harvest to the next summer crop sowing.

Fallows vary in length. A short fallow can be very short – as short as weeks for a summer crop following a winter

crop harvest in the more northern regions, to some months (between three and seven months in the southern and western cropping areas from a November/December harvest to a April/May/June plant). Long fallows can last up to 18 months.

Fallow periods have traditionally been seen as useful for storing soil moisture, weed control, mineralisation of nitrogen and providing a disease break. The length of the fallow period and how it is managed can have an influence on the

FIGURE 53 Average percentage of cropped area planted with a crop in 2011 following a preceding crop in 2010



available soil moisture and ultimate water use efficiency of the crop.

The following question was asked in the 2011 survey:

- In the sowing of your crops in 2011 (this year), what percentage was sown where a crop was grown in the paddock in 2010?

Percentage of crop planted following a previous crop

The question about how much of the crop was planted where a crop was grown in the paddock immediately before was only asked in the 2011 survey (Table 36 and Figure 53).

In all agro-ecological zones the majority of crop area is planted in paddocks where a previous crop was grown.

However, the data indicates that about 20 to 30 per cent (or more) of crop area is planted where no crop was in the paddock previously. This suggests that this percentage of the crop is either coming in from a pasture phase or is still subject to a long fallow.

TABLE 36 Average percentage of cropped area planted with a crop in 2011 following a preceding crop in 2010

Agro-ecological zone		Significance between agro-ecological zones
NSW Central	69.4	efg
NSW NE / QLD SE	77.8	d
NSW NW / QLD SW	90.4	ab
NSW / VIC Slopes	82.8	bcd
QLD Central	76.5	def
SA Mid North / Lower EP	81.5	cd
SA / VIC Bordertown Wimmera	77.0	de
SA / VIC Mallee	67.7	g
TAS	92.9	a
VIC High Rainfall	85.3	abc
WA Central	63.7	g
WA Eastern	52.8	h
WA Mallee / Sandplain	68.6	fg
WA Northern	71.6	efg
National Averages	75.8	
LSD (5%)	8.4	

FALLOW MANAGEMENT

Maintaining a weed-free fallow is important for the following crop for three main reasons:

- to store water for subsequent use by the crop;
- to ensure an easy and timely seeding program; and
- to prevent carryover disease by controlling volunteer crop plants (removing the 'green bridge').

Weed-control options for the fallow period include herbicides, grazing and cultivation.

Questions asked in the survey were:

- What percentage of your crops this year have been planted where this intercrop period has been maintained weed-free since the last crop?
- What percentage has been planted when some weed growth has been present through this intercrop period?
- What percentage has been planted where weed control in this fallow period has been by herbicide only?
- What percentage has been planted where weed control has been by cultivation and herbicide?
- What percentage of the summer fallow was maintained by herbicide?
- What percentage of your fallow was maintained without any cultivation through the fallow period yet weed control was maintained?

Fallow weed control

Fallows maintained weed-free

The majority of the cropped area was reported by survey respondents to be maintained weed-free through the fallow period (Table 37, Figures 54 and 55) .

Fallows where some weed growth was present

The survey data for the amount of fallow that showed some weed growth corresponded to the balance of the fallow area that was kept weed-free in most agro-ecological zones (Table 38, Figures 56 and 57).

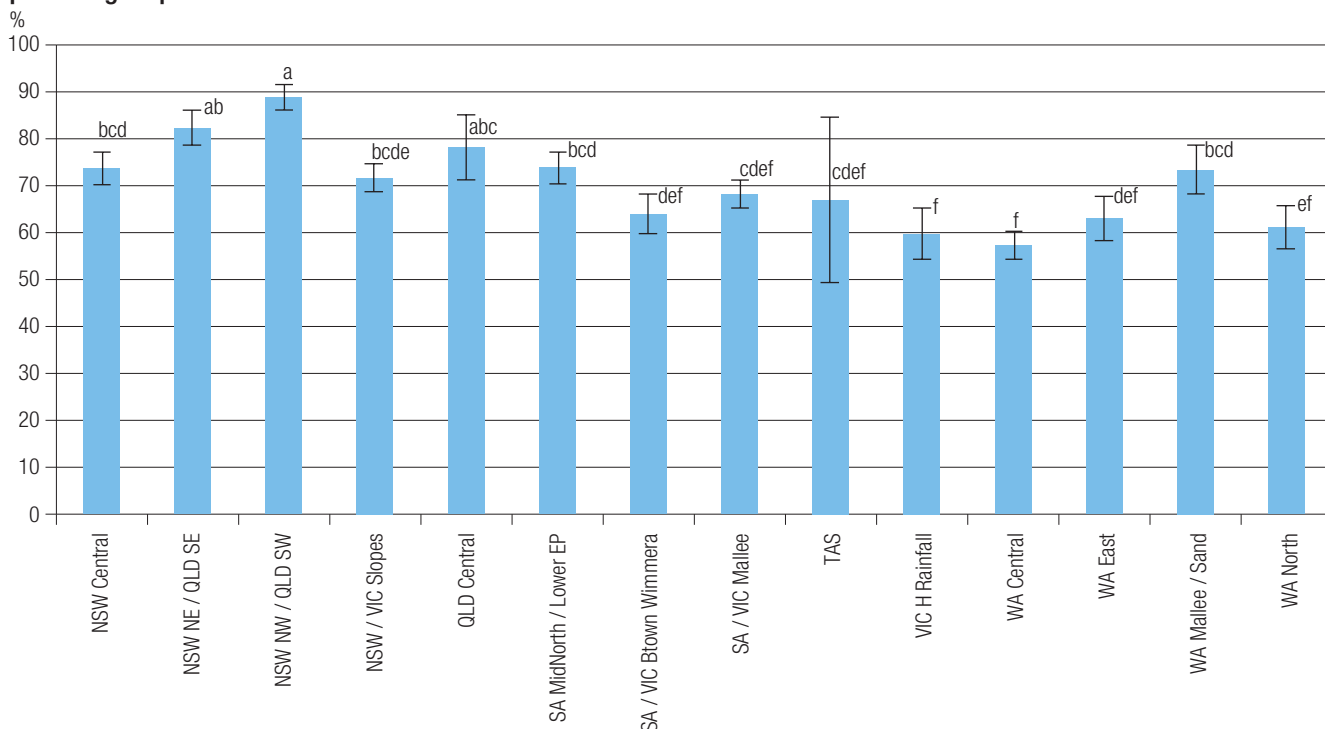
Fallow management techniques

One of the main activities in managing the fallow period is controlling plant growth (weeds and volunteer crop plants) to try to maintain the area free of plant growth. There are several options and combinations available to growers, including the use of herbicides, cultivation or grazing.

TABLE 37 Average percentage of cropped area planted with a crop in 2011 where the fallow period was maintained weed-free

Agro-ecological zone	% of crop area maintained weed-free	Significance between agro-ecological zones
NSW Central	73.9	bcd
NSW NE / QLD SE	82.4	ab
NSW NW / QLD SW	89.0	a
NSW / VIC Slopes	71.8	bcde
QLD Central	78.3	abc
SA Mid North / Lower EP	74.0	bcd
SA / VIC Bordertown Wimmera	64.0	def
SA / VIC Mallee	68.4	cdef
TAS	67.1	cdef
VIC High Rainfall	59.9	f
WA Central	57.4	f
WA Eastern	63.1	def
WA Mallee / Sandplain	73.6	bcd
WA Northern	61.2	ef
National Averages	70.3	
LSD (5%)	11.3	

FIGURE 54 Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop was maintained weed-free



Use of herbicide only

The data for 2011 suggests that herbicides are responsible for the majority (although not all) of the weed management on fallow areas. Some weed control is carried out by a variety of approaches including grazing and strategic cultivation (Table 39, Figures 58 and 59).

Combination of cultivation and herbicide

It is possible that decisions about whether to use herbicide or to cultivate for weed control through the period between crops would have depended on several factors, including:

- paddock history;
- history of weed-control tactics used;
- amount and type of weeds present;

FIGURE 55 Average percentage of fallows that were kept weed-free in 2011

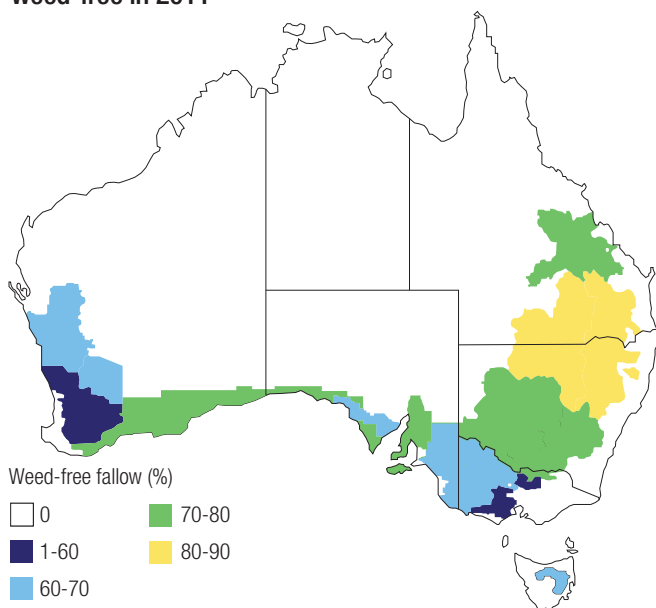
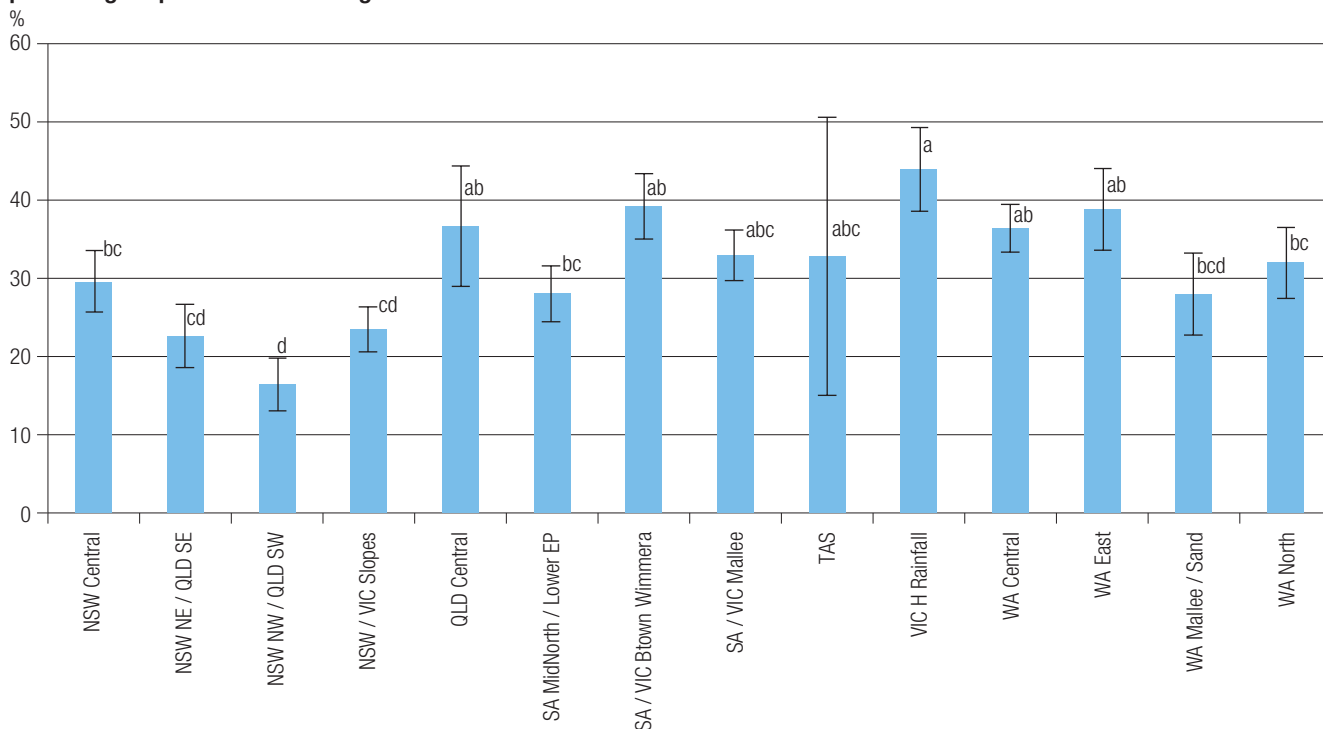


TABLE 38 Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	29.5	bc
NSW NE / QLD SE	22.6	cd
NSW NW / QLD SW	16.5	d
NSW / VIC Slopes	23.5	cd
QLD Central	36.7	ab
SA Mid North / Lower EP	28.1	bc
SA / VIC Bordertown Wimmera	39.2	ab
SA / VIC Mallee	32.9	abc
TAS	32.9	abc
VIC High Rainfall	44.0	a
WA Central	36.3	ab
WA Eastern	38.8	ab
WA Mallee / Sandplain	27.9	bcd
WA Northern	32.0	bc
National Averages	31.5	
LSD (5%)	11.5	

FIGURE 56 Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth



- seasonal conditions; and
- plans for the coming year.

In many of the eastern agro-ecological zones the summer period of 2010-11 was wetter than average and may have led some growers to opt to use some cultivation as well as herbicide for weed management through the period between crops. The management of herbicide-resistant weeds may be another factor in choosing to use some cultivation on many farms (Table 40, Figures 60 and 61).

Summer fallow maintained weed-free without cultivation

Achieving a summer fallow period free of weeds is an important aspect of fallow management. The 2011 survey included questions that allowed this aspect to be evaluated and ascertain what practices were used for this weed control.

The percentage of crop where the intercrop (or summer or short fallow) period has been kept weed-free without the use of cultivation represents approximately 50 to 65 per cent of the

FIGURE 57 Average percentage of cropped area planted with a crop in 2011 where the fallow period following the preceding crop had some weed growth

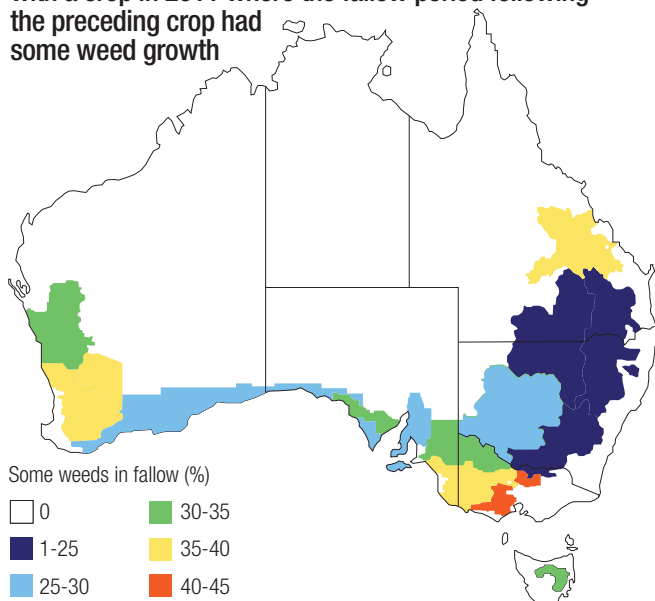
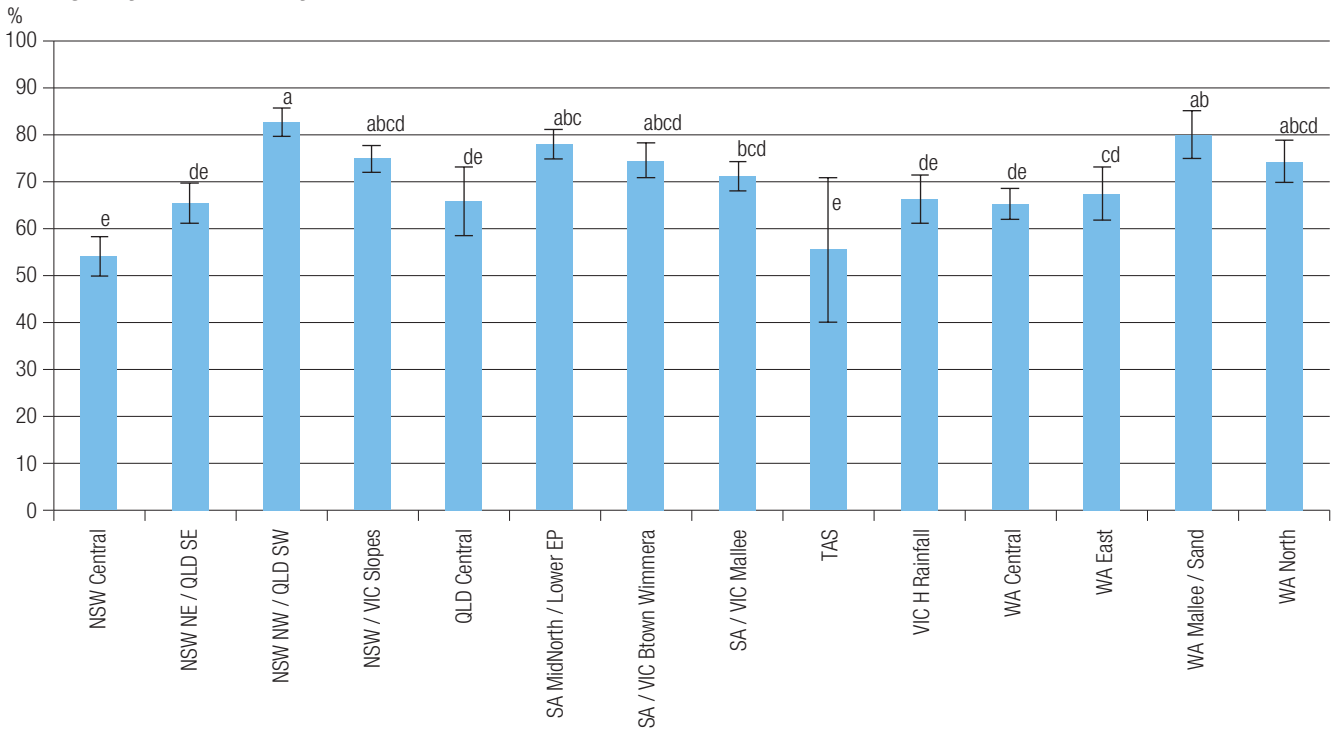


TABLE 39 Average percentage of crop area in 2011 where the fallow period was managed by herbicides only

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	54.2	e
NSW NE / QLD SE	65.6	de
NSW NW / QLD SW	82.9	a
NSW / VIC Slopes	75.1	abcd
QLD Central	66.0	de
SA Mid North / Lower EP	78.1	abc
SA / VIC Bordertown Wimmera	74.6	abcd
SA / VIC Mallee	71.4	bcd
TAS	55.7	e
VIC High Rainfall	66.5	de
WA Central	65.3	de
WA Eastern	67.5	cd
WA Mallee / Sandplain	80.1	ab
WA Northern	74.4	abcd
National Averages	69.8	
LSD (5%)	11.4	

FIGURE 58 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides only



cropped area in a general sense (Table 41, Figures 62 and 63).

It is likely that the balance receives either some cultivation or grazing. These areas would likely also correspond to:

- the use of both cultivation and herbicides, as described in the above section; and
- one of the minimum-tillage crop-establishment practices, as described in the Tillage section.

Summer fallow: stubble present but burnt within one month of planting

The intercrop (or summer or short fallow) period is usually characterised by the presence of the previous crop's stubble. Respondents were asked about how such stubble was managed, including what percentage of this stubble was burnt relatively close to the planting of the next crop (within one month of planting). This burning may be for

FIGURE 59 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides only

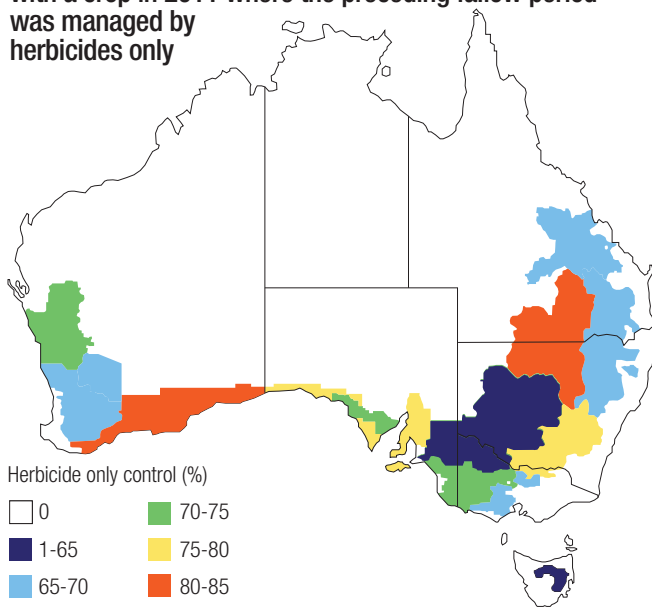
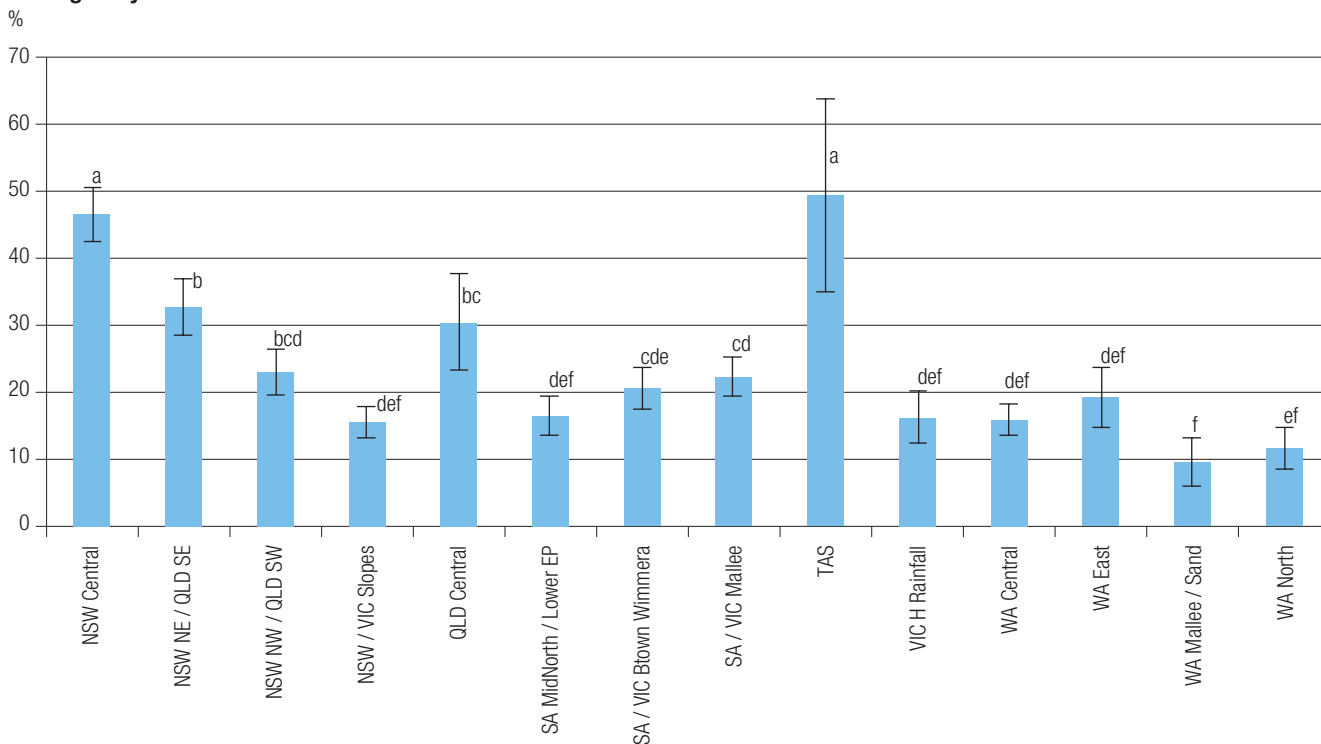


TABLE 40 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides and cultivation

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	46.5	a
NSW NE / QLD SE	32.7	b
NSW NW / QLD SW	23.0	bcd
NSW / VIC Slopes	15.6	def
QLD Central	30.3	bc
SA Mid North / Lower EP	16.5	def
SA / VIC Bordertown Wimmera	20.6	cde
SA / VIC Mallee	22.2	cd
TAS	49.3	a
VIC High Rainfall	16.2	def
WA Central	15.9	def
WA Eastern	19.2	def
WA Mallee / Sandplain	9.5	f
WA Northern	11.6	ef
National Averages	23.5	
LSD (5%)	9.9	

FIGURE 60 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides and cultivation



a combination of reasons, including weed-management factors, and to allow planting machinery to operate without being blocked by the stubble.

Management of previous crop stubble *per se* as part of the farming system is dealt with in the Stubble Management section of this report. The data presented here relates to the management of the fallow/intercrop period where stubble

is present. Any burning of the remaining stubble present through the intercrop or short fallow period may not be a weed-management practice, although is presented here to distinguish these data from that of the Stubble Management section of this report.

The data presented here shows that where the previous crop stubble is present in the fallow period it is burnt at

FIGURE 61 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow period was managed by herbicides and cultivation

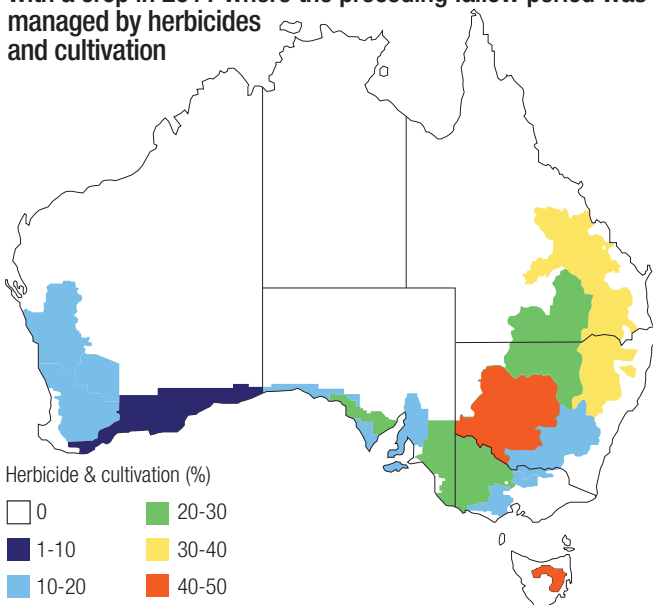
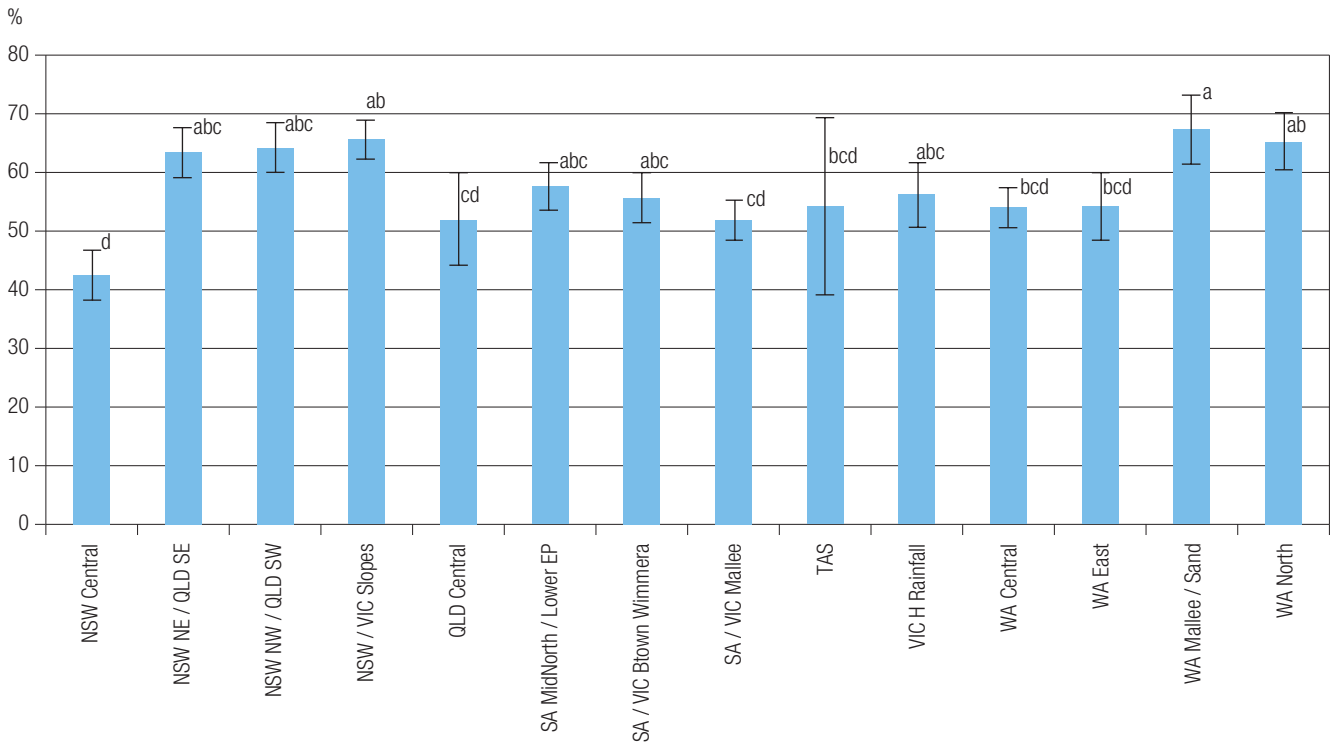


TABLE 41 Average percentage of cropped area planted with a crop in 2011 where the preceding summer fallow period was maintained weed-free without cultivation

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	42.5	d
NSW NE / QLD SE	63.5	abc
NSW NW / QLD SW	64.3	abc
NSW / VIC Slopes	65.7	ab
QLD Central	52.0	cd
SA Mid North / Lower EP	57.7	abc
SA / VIC Bordertown Wimmera	55.8	abc
SA / VIC Mallee	51.9	cd
TAS	54.3	bcd
VIC High Rainfall	56.3	abc
WA Central	54.1	bcd
WA Eastern	54.3	bcd
WA Mallee / Sandplain	67.4	a
WA Northern	65.3	ab
National Averages	57.5	
LSD (5%)	12.8	

FIGURE 62 Average percentage of cropped area planted with a crop in 2011 where the preceding summer fallow period was maintained weed-free without cultivation



relatively low percentages, generally less than 20 per cent of the area, and tends to be more prevalent in those agro-ecological zones where high stubble loads are more likely, for example, the Victorian High Rainfall and NSW/Victorian Slopes zones and Tasmania (Table 42, Figures 64 and 65).

FIGURE 63 Average percentage of cropped area planted with a crop in 2011 where the preceding summer fallow period was managed without cultivation

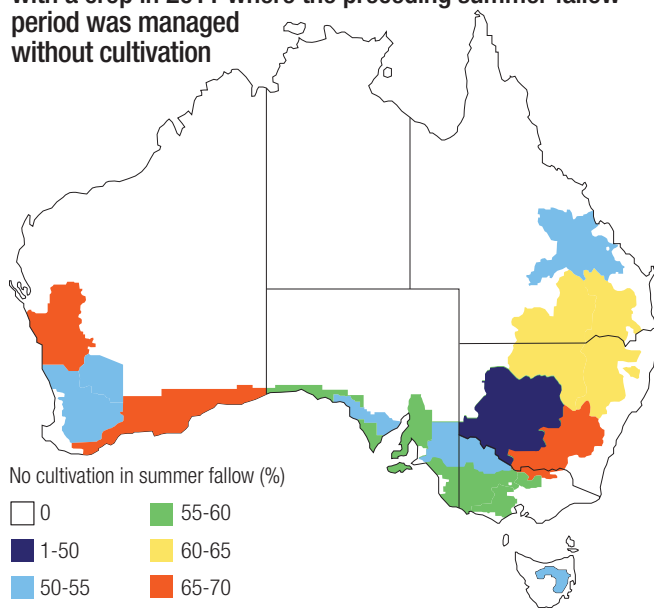


TABLE 42 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	19.7	bc
NSW NE / QLD SE	7.5	def
NSW NW / QLD SW	11.5	de
NSW / VIC Slopes	40.5	a
QLD Central	5.1	ef
SA Mid North / Lower EP	13.3	cd
SA / VIC Bordertown Wimmera	25.1	b
SA / VIC Mallee	13.0	cd
TAS	35.7	a
VIC High Rainfall	42.5	a
WA Central	8.2	def
WA Eastern	2.0	f
WA Mallee / Sandplain	1.5	f
WA Northern	11.1	de
National Averages	16.9	
LSD (5%)	7.1	

FIGURE 64 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting

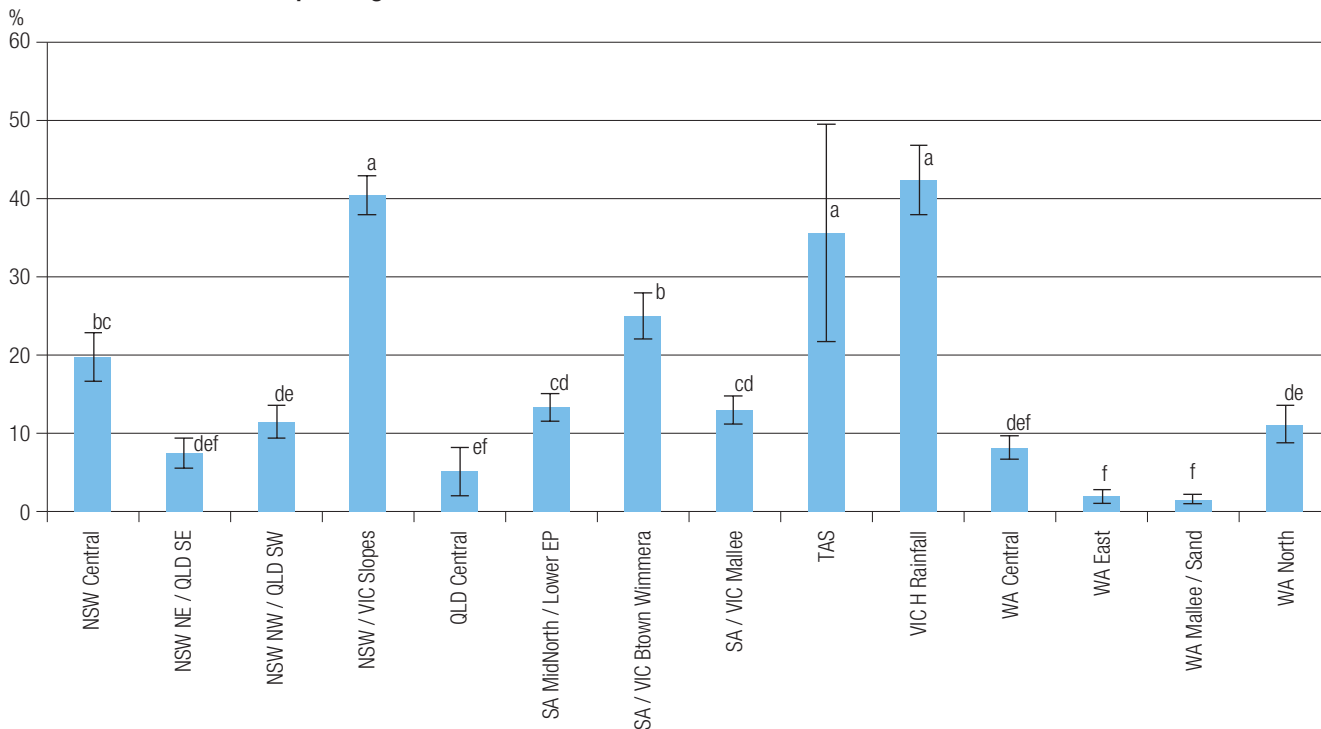
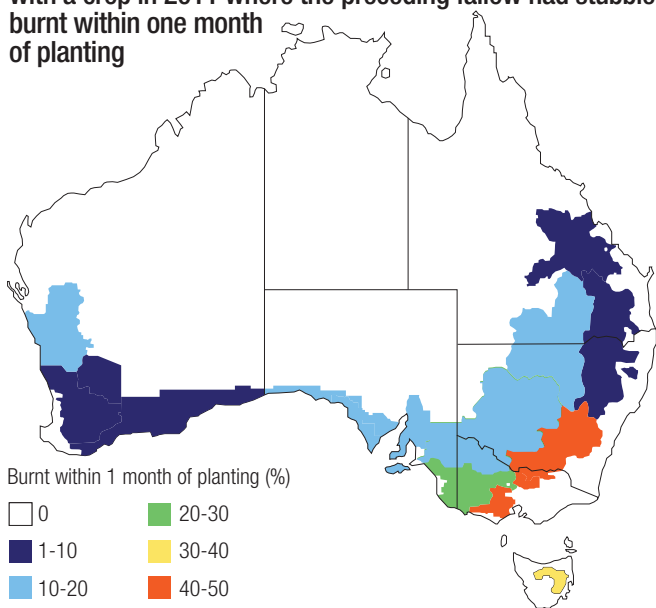


FIGURE 65 Average percentage of cropped area planted with a crop in 2011 where the preceding fallow had stubble burnt within one month of planting



LIVESTOCK GRAZING OF THE FALLOW



Questions that were asked of survey respondents were:

- What percentage of your fallow had livestock grazing through the fallow period?
- What percentage of your fallow had livestock grazing on it for more than one month through the summer fallow period?
- On this percentage of the fallow, estimate the number of weeks that livestock were grazing.

Fallows that are grazed

The data shows that a significant percentage of the fallow and intercrop period has some grazing through the intercrop or summer/short fallow period.

This may be a standard practice, as perhaps suggested by the level being between 25 and 65 per cent of the intercrop areas in general.

Grazing is sometimes seen as a cheap alternative to the use of herbicides for the control of weeds in stubbles or fallow periods, although grazing for weed control can vary in effectiveness and livestock can have negative effects on soil structure.

The 2011 data suggests the grazing of livestock on fallows is more prevalent in the southern and western agro-ecological zones (Table 43, Figures 66 and 67).

Fallows grazed for more than one month

This data reinforces the data below and shows that, in general, where livestock is grazed on fallows it is for more than one month.

This may be a standard practice, as possibly suggested by the level being between 25 and 65 per cent of the intercrop areas in general (Table 44, Figures 68 and 69).

Number of weeks summer fallow grazed by livestock

The data shows that where livestock was used on the intercrop areas, it was grazed for between four and nine weeks (between one and two months), with most agro-ecological zones at a similar statistical level (Table 45, Figures 70 and 71).

It is not clear what drives this length of grazing, and no data about stocking rates exist, although the amount of feed on offer and seasonal conditions are likely to be important.

TABLE 43 Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	40.5	d
NSW NE / QLD SE	26.6	e
NSW NW / QLD SW	26.6	e
NSW / VIC Slopes	50.8	bcd
QLD Central	9.9	f
SA Mid North / Lower EP	45.9	cd
SA / VIC Bordertown Wimmera	51.7	bcd
SA / VIC Mallee	51.7	bcd
TAS	54.3	bc
VIC High Rainfall	49.4	cd
WA Central	58.2	ab
WA Eastern	69.2	a
WA Mallee / Sandplain	50.8	bcd
WA Northern	46.9	cd
National Averages	45.2	
LSD (5%)	12.5	

FIGURE 66 Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period

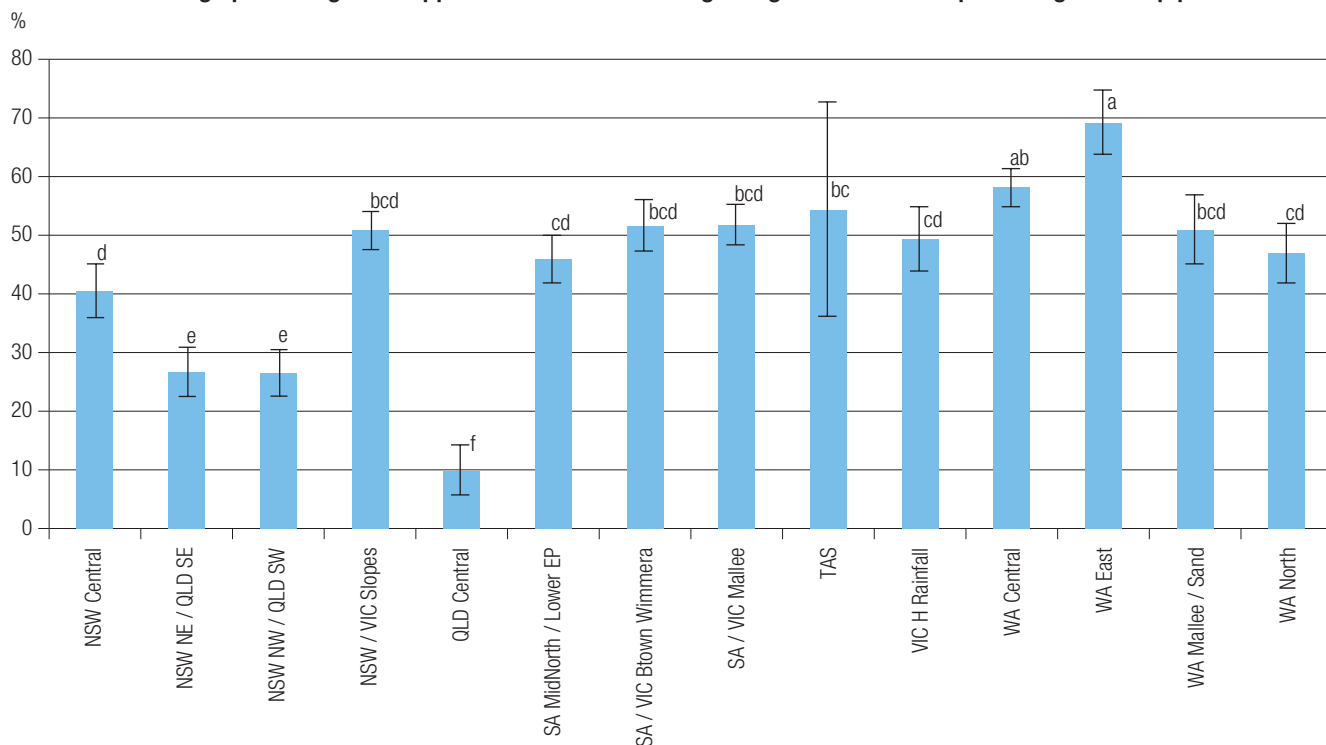


FIGURE 67 Average percentage of cropped area in 2011 where grazing occurred in the preceding intercrop period

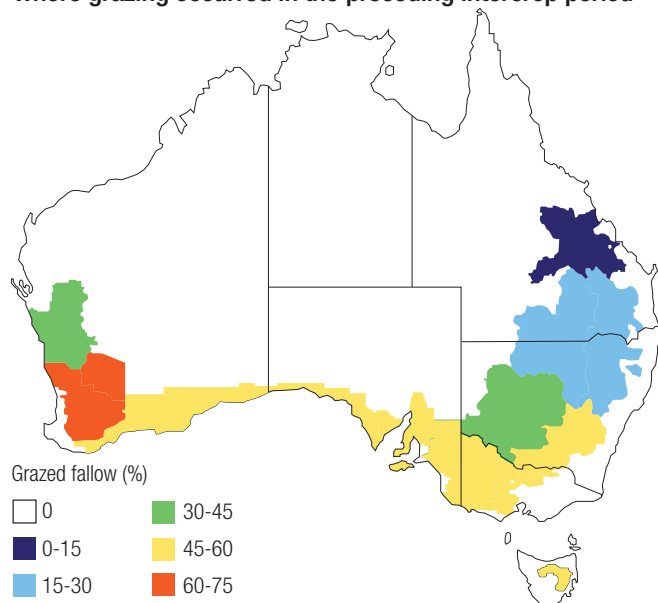


TABLE 44 Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	42.5	c
NSW NE / QLD SE	24.9	d
NSW NW / QLD SW	24.8	d
NSW / VIC Slopes	53.5	abc
QLD Central	10.0	0
SA Mid North / Lower EP	49.1	bc
SA / VIC Bordertown Wimmera	49.8	bc
SA / VIC Mallee	51.4	bc
TAS	58.6	ab
VIC High Rainfall	51.6	bc
WA Central	60.0	ab
WA Eastern	64.6	a
WA Mallee / Sandplain	54.5	abc
WA Northern	43.8	c
National Averages	45.7	
LSD (5%)	12.2	

FIGURE 68 Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period

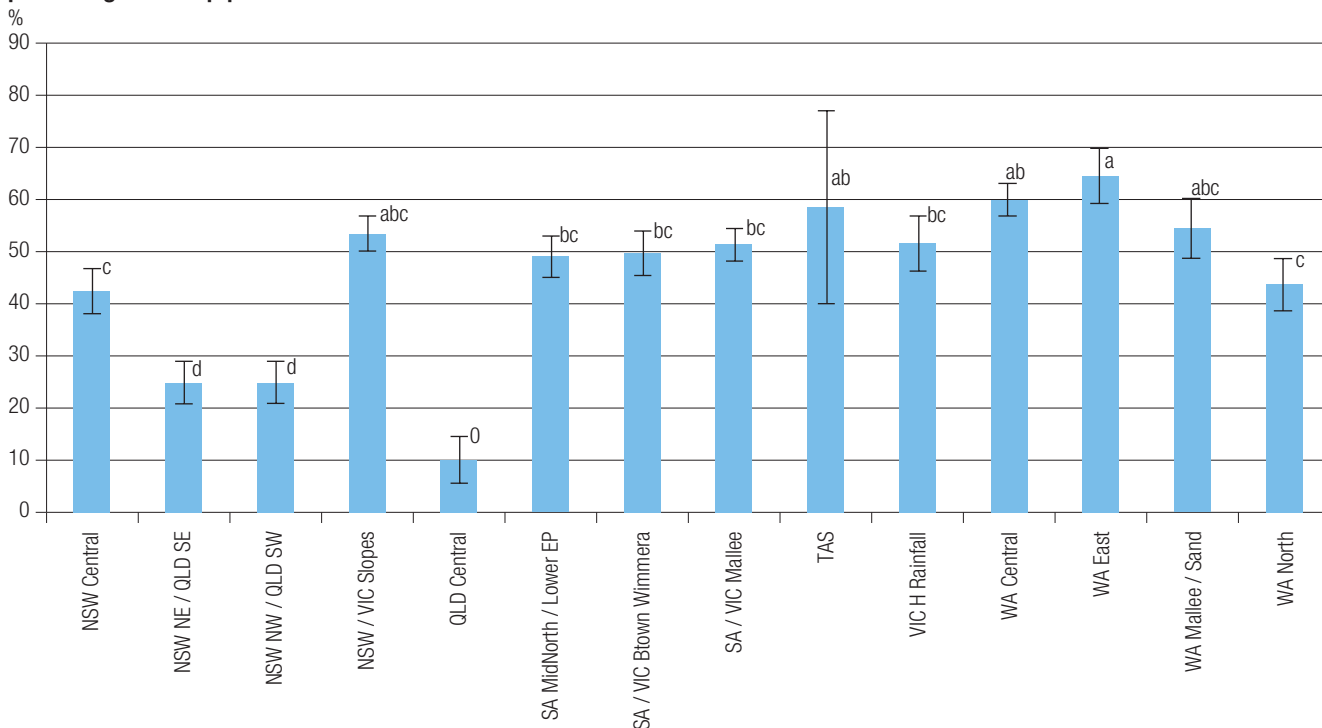


FIGURE 69 Average percentage of cropped area in 2011 where grazing occurred for more than one month in the preceding intercrop period

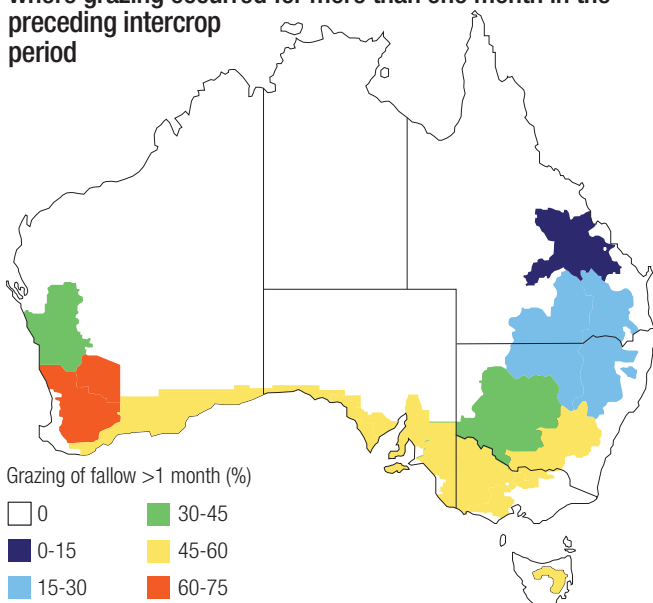


TABLE 45 Average number of weeks in 2011 where grazing occurred in the preceding fallow period

Agro-ecological zone	Number of weeks of grazing	Significance between agro-ecological zones
NSW Central	6.8	bcd
NSW NE / QLD SE	4.5	de
NSW NW / QLD SW	4.9	cde
NSW / VIC Slopes	6.8	bcd
QLD Central	2.3	e
SA Mid North / Lower EP	7.2	bcd
SA / VIC Bordertown Wimmera	7.8	bcd
SA / VIC Mallee	9.0	ab
TAS	11.6	a
VIC High Rainfall	7.6	bcd
WA Central	10.2	ab
WA Eastern	9.7	ab
WA Mallee / Sandplain	7.9	bcd
WA Northern	8.0	bc
National Averages	7.5	
LSD (5%)	3.5	

FIGURE 70 Average number of weeks in 2011 where grazing occurred in the preceding fallow period

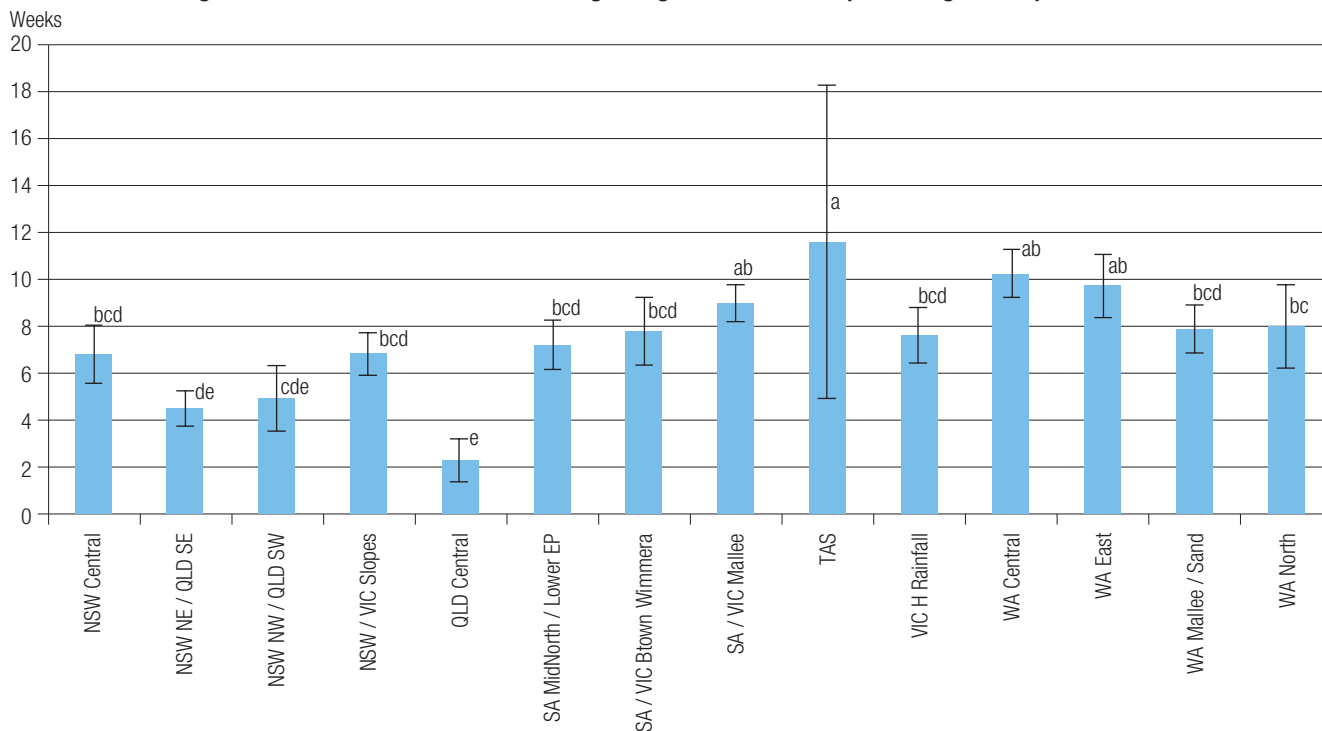
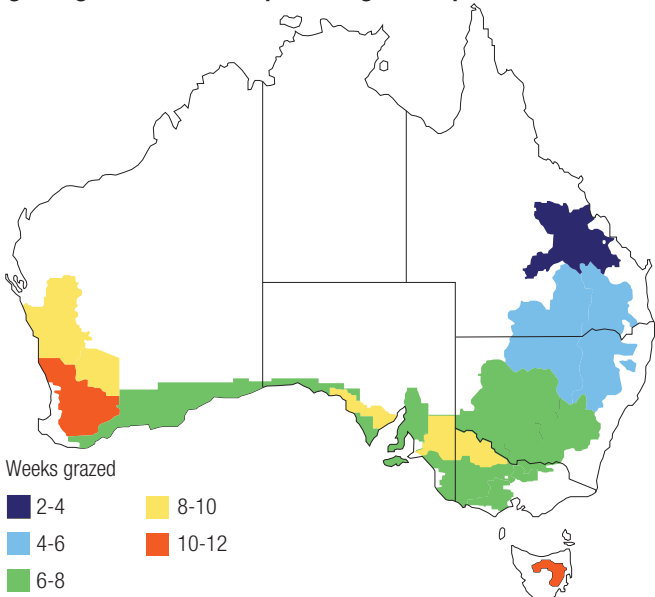


FIGURE 71 Average number of weeks in 2011 where grazing occurred in the preceding fallow period



STUBBLE MANAGEMENT



There are several options for management of crop residues (stubbles). The following questions were asked:

- What percentage of your (summer) fallow paddocks had stubble retained right through until planting?
- Thinking about stubble practices, for your crops sown in 2010, what percentage of your stubble was:
 - intact at planting – standing, not grazed or slashed;
 - not standing – for example, grazed, slashed, mulched, incorporated;
 - burnt within one month of planting – i.e. a ‘cool’ burn;
 - burnt relatively soon after harvest – i.e. a ‘hot’ burn;
 - windrow-burnt for weed management;
 - stubble-raked/windrow-burnt – whole paddock; and/or
 - stubble-baled.

Stubble retained through to planting

This data suggests that, where possible, most growers choose to retain stubble cover on paddocks intended for a following crop right through until planting.

This practice is slightly higher in eastern and northern regions than in southern and western regions, although it is carried out on more than 50 per cent of the crop area in general (Table 46, Figures 72 and 73).

While more than 50 per cent of grain growers maintained stubble in their fallows right through until planting, there was some grazing in these paddocks (see Fallow and Grazing section).

The vast majority of stubble continues to be either left intact, or left not-standing, with very small percentages burnt or otherwise managed. The small increases in the amount of stubble that was burnt or otherwise managed may be attributed to seasonal conditions in 2011.

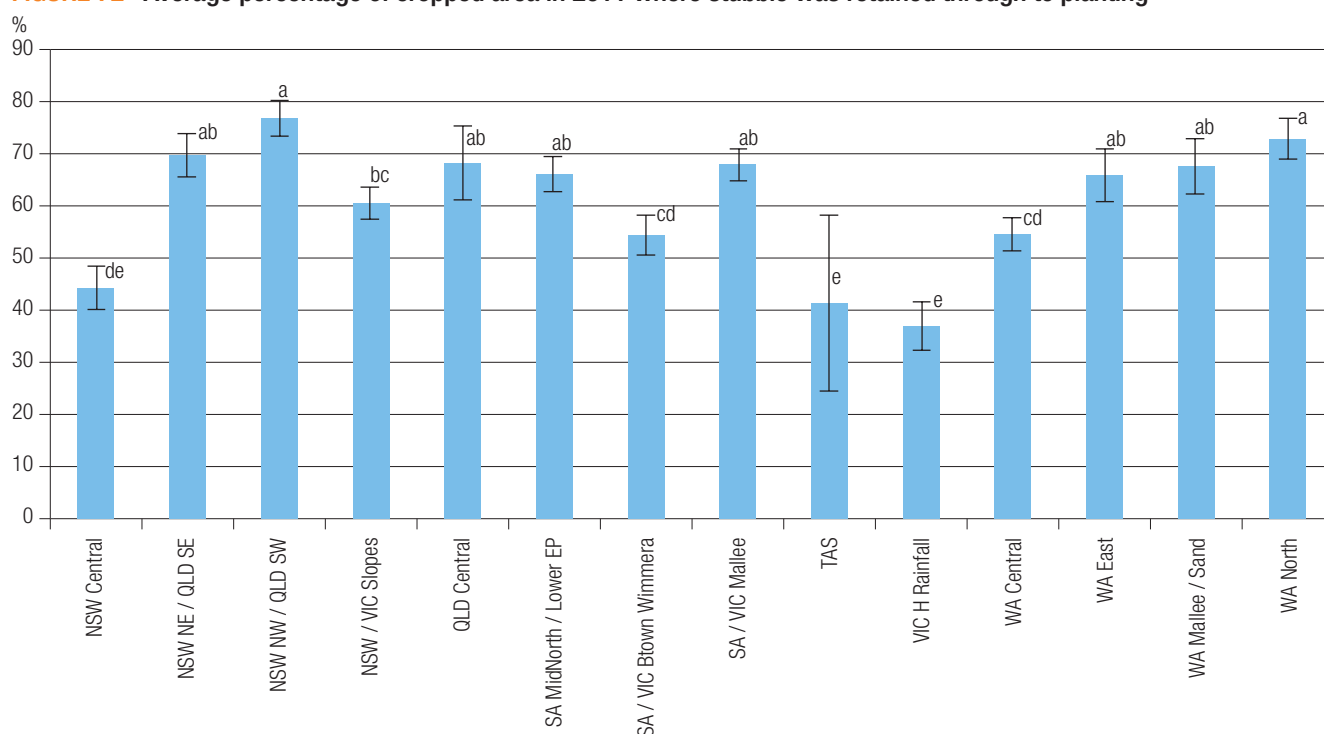
Stubble retained intact (standing) through to planting

Stubble retained intact is defined as stubble that has not been grazed, slashed or otherwise managed.

There appears to have been an increase in stubble retained in North-West NSW/South-West Queensland, and a decrease in North-East NSW/South-East Queensland and

TABLE 46 Average percentage of cropped area in 2011 where stubble was retained through to planting

Agro-ecological zone	% of crop area (2011)	Significance between agro-ecological zones
NSW Central	44.2	de
NSW NE / QLD SE	69.7	ab
NSW NW / QLD SW	76.9	a
NSW / VIC Slopes	60.6	bc
QLD Central	68.3	ab
SA Mid North / Lower EP	66.1	ab
SA / VIC Bordertown Wimmera	54.3	cd
SA / VIC Mallee	67.9	ab
TAS	41.4	e
VIC High Rainfall	37.0	e
WA Central	54.5	cd
WA Eastern	66.0	ab
WA Mallee / Sandplain	67.6	ab
WA Northern	72.8	a
LSD (5%)	11.3	
National Averages	44.2	

FIGURE 72 Average percentage of cropped area in 2011 where stubble was retained through to planting

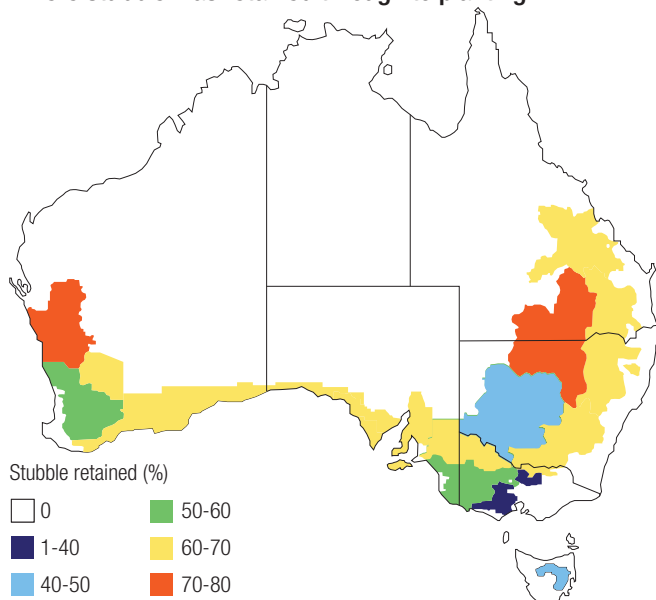
the Victorian High Rainfall zones, with some slight changes elsewhere (Table 47, Figures 74 and 75).

Stubble retained (not necessarily standing)

Stubble retained (not standing) can include stubble grazed, slashed or otherwise managed such that it remains present on the soil surface. Where livestock is used on stubbles it is likely to knock stubble down, such that what was 'standing' becomes 'not standing' by virtue of grazing.

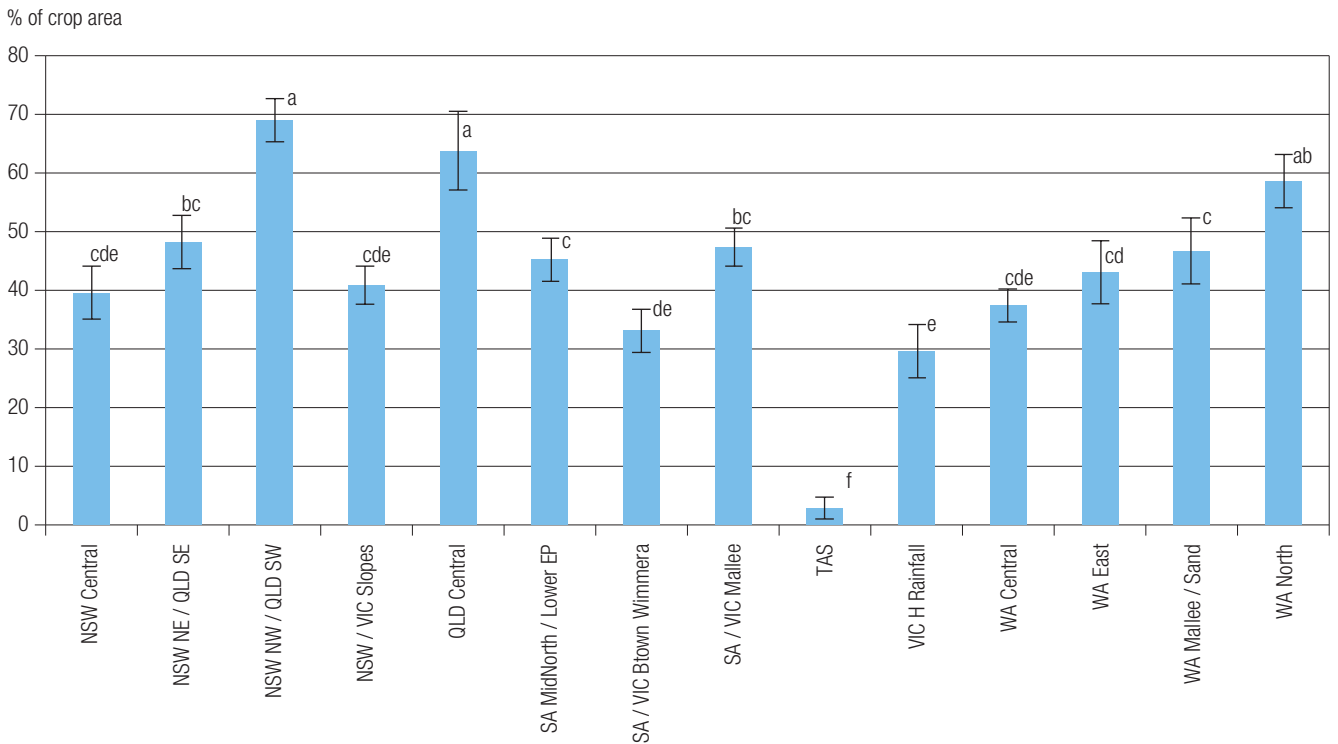
There appears to be a potential interaction between the two categories of stubble retained, i.e. standing or not standing. The percentage of stubble retained (standing)

has decreased in some agro-ecological zones while the corresponding percentage of stubble retained (not standing) has increased (Table 48, Figures 76 and 77). When the percentages of retained stubble standing and not standing are added, it is apparent that the great majority of stubble is retained, totalling more than 90 per cent of crop area in many agro-ecological zones.

FIGURE 73 Average percentage of cropped area in 2011 where stubble was retained through to planting**TABLE 47** Average percentage of cropped area where stubble was retained intact through to planting

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	38.1	39.5	9.3	ns
NSW NE / QLD SE	60.0	48.1	7.2	**
NSW NW / QLD SW	48.9	68.9	8.6	***
NSW / VIC Slopes	45.2	40.8	7.0	ns
QLD Central	59.0	63.7	14.3	ns
SA Mid North / Lower EP	43.7	45.3	8.1	ns
SA / VIC Bordertown Wimmera	41.7	33.1	7.4	**
SA / VIC Mallee	41.5	47.4	6.5	ns
TAS	38.6	2.9	13.5	***
VIC High Rainfall	47.3	29.6	11.0	***
WA Central	37.1	37.4	5.8	ns
WA Eastern	54.1	43.1	10.6	ns
WA Mallee / Sandplain	47.5	46.6	10.6	ns
WA Northern	50.6	58.6	9.2	ns
National Averages	46.7	43.2		

FIGURE 74 Average percentage of cropped area where stubble was retained intact through to planting in 2011



Stubble burnt

Stubble burning represents a minority of the crop area. Burning can be carried out anytime following harvest of the previous crop, although often stubble is left in place to assist with protecting soil from erosion and to assist with capturing rainfall and holding soil moisture.

The stubble load from the previous crop, coupled with a consideration of the stubble-handling ability of the planting machinery, generally determines whether stubble is burnt and it is likely some high loads were present in the eastern states from the 2010 crop.

Stubble burnt early (hot burn)

A 'hot' burn occurs when stubble is burnt relatively soon after harvest, for example, in summer following harvest of the winter crop.

The percentage of stubble burnt soon after the previous harvest is generally quite low – less than five per cent of the

TABLE 48 Average percentage of cropped area where stubble was retained (not standing) through to planting

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	51.5	36.7	9.2	***
NSW NE / QLD SE	36.6	42.3	7.2	ns
NSW NW / QLD SW	44.6	22.1	8.3	***
NSW / VIC Slopes	45.5	29.0	6.8	***
QLD Central	28.8	28.7	13.9	ns
SA Mid North / Lower EP	50.1	38.3	8.1	***
SA / VIC Bordertown Wimmera	48.4	41.7	8.1	ns
SA / VIC Mallee	50.9	39.9	6.5	***
TAS	37.5	42.1	38.7	ns
VIC High Rainfall	45.2	34.0	11.8	ns
WA Central	50.2	53.9	6.2	ns
WA Eastern	31.3	53.1	10.7	***
WA Mallee / Sandplain	45.0	51.0	10.7	ns
WA Northern	40.1	31.8	9.0	ns
National Averages	43.3	38.9		

FIGURE 75 Average percentage of cropped area where stubble was retained intact through to planting in 2011

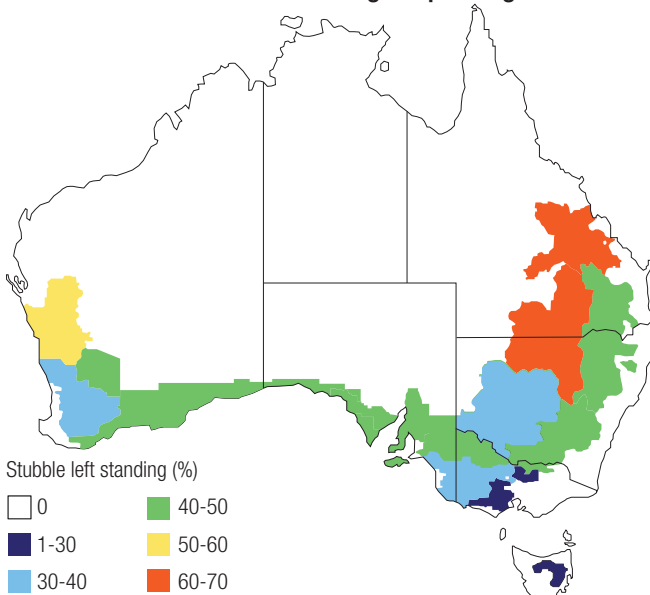
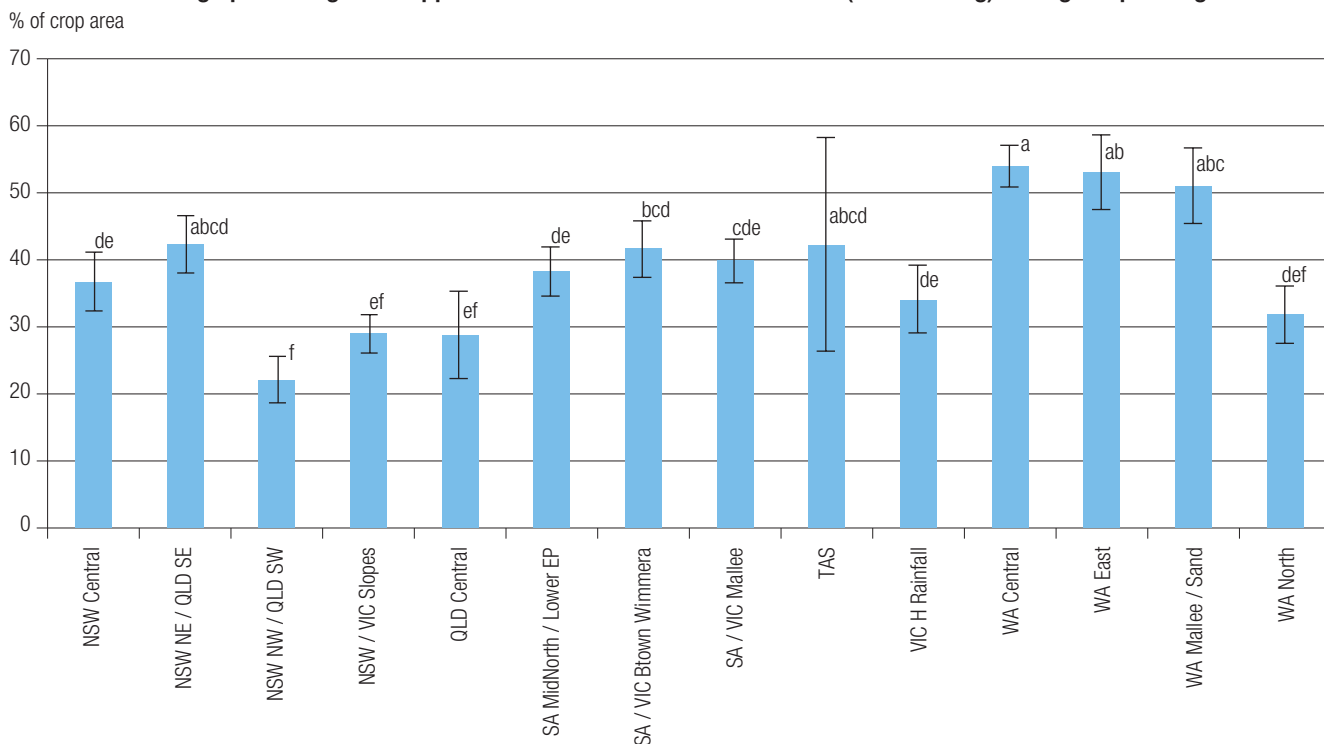


FIGURE 76 Average percentage of cropped area where stubble was retained (not standing) through to planting in 2011



cropped area in many agro-ecological zones and exceeding 10 per cent in only one (Table 49, Figures 78 and 79). However, the percentage of the cropped area where early burning occurred was higher in 2011 than in 2008, notably in NSW and Southern Queensland, the Mid North/Lower Eyre Peninsula and Mallee areas of SA and Victoria, leading to a national increase in this practice, although a decrease was evident in WA.

point of planting. Such burns are often incomplete, leaving a percentage of the stubble remaining on or attached to the soil, but remove enough stubble to allow most planting machinery, including conventional, to get through.

It is evident that more burning was done in 2011 than in 2008 (Table 50, Figures 80 and 81), except in WA.

Stubble burnt late prior to planting (cool burn)

A 'cool burn' is defined as burning stubble late in the season (late summer or early autumn), often just before or at the

TABLE 49 Average percentage of cropped area where stubble was burnt early (hot burn)

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	3.6	9.9	5.1	**
NSW NE / QLD SE	1.0	1.7	1.7	ns
NSW NW / QLD SW	0.0	3.6	2.4	**
NSW / VIC Slopes	0.2	10.2	3.3	***
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	1.6	6.3	3.0	***
SA / VIC Bordertown Wimmera	2.0	8.5	3.1	**
SA / VIC Mallee	0.0	4.9	1.9	***
TAS	0.0	0.0	0.0	ns
VIC High Rainfall	0.8	12.5	6.3	***
WA Central	5.0	1.7	2.1	***
WA Eastern	6.3	1.3	4.0	**
WA Mallee / Sandplain	0.0	0.0	0.0	ns
WA Northern	3.7	3.0	3.2	ns
National Averages	1.7	4.5		

FIGURE 77 Average percentage of cropped area where stubble was retained (not standing) through to planting in 2011

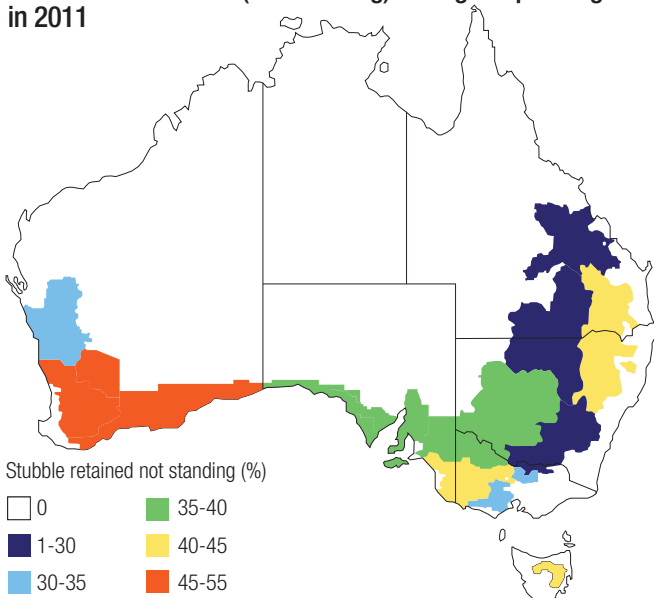
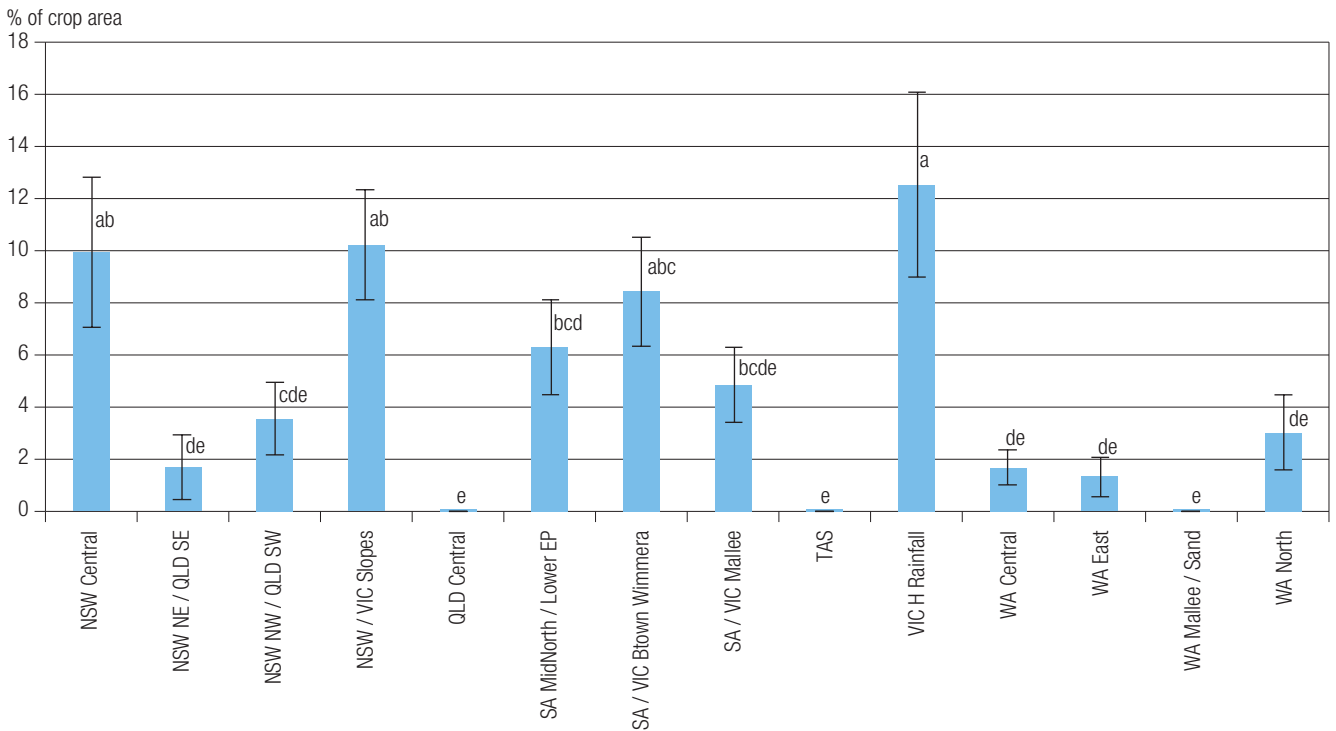


FIGURE 78 Average percentage of cropped area where stubble was burnt early (hot burn) in 2011



Windrow management

Windrow raking

Windrow raking of stubbles is a minor practice, used on only two per cent or less of stubbles in general (Table 51 and Figure 82).

Burning of windrows for weed management

In this practice, stubble is either cut and placed or raked into windrows. The windrows are then burnt, with the objective that the weed seeds in the windrows are burnt. This is one practice that can be used as part of a program for the

FIGURE 79 Average percentage of cropped area where stubble was burnt early (hot burn) in 2011

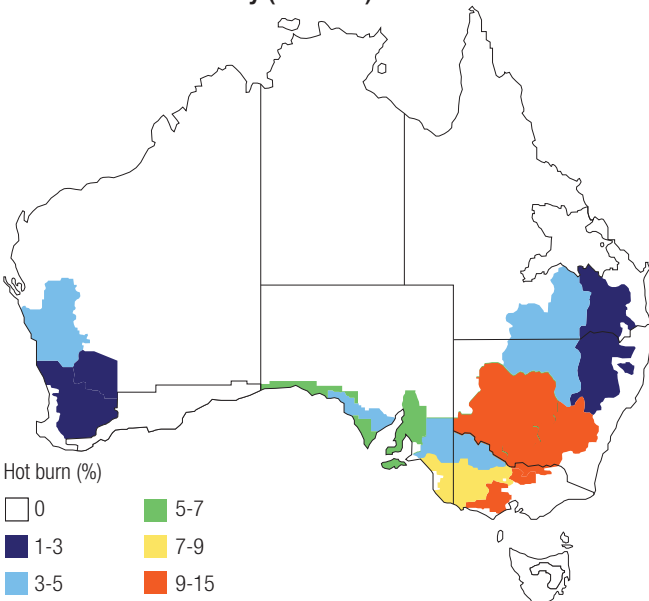
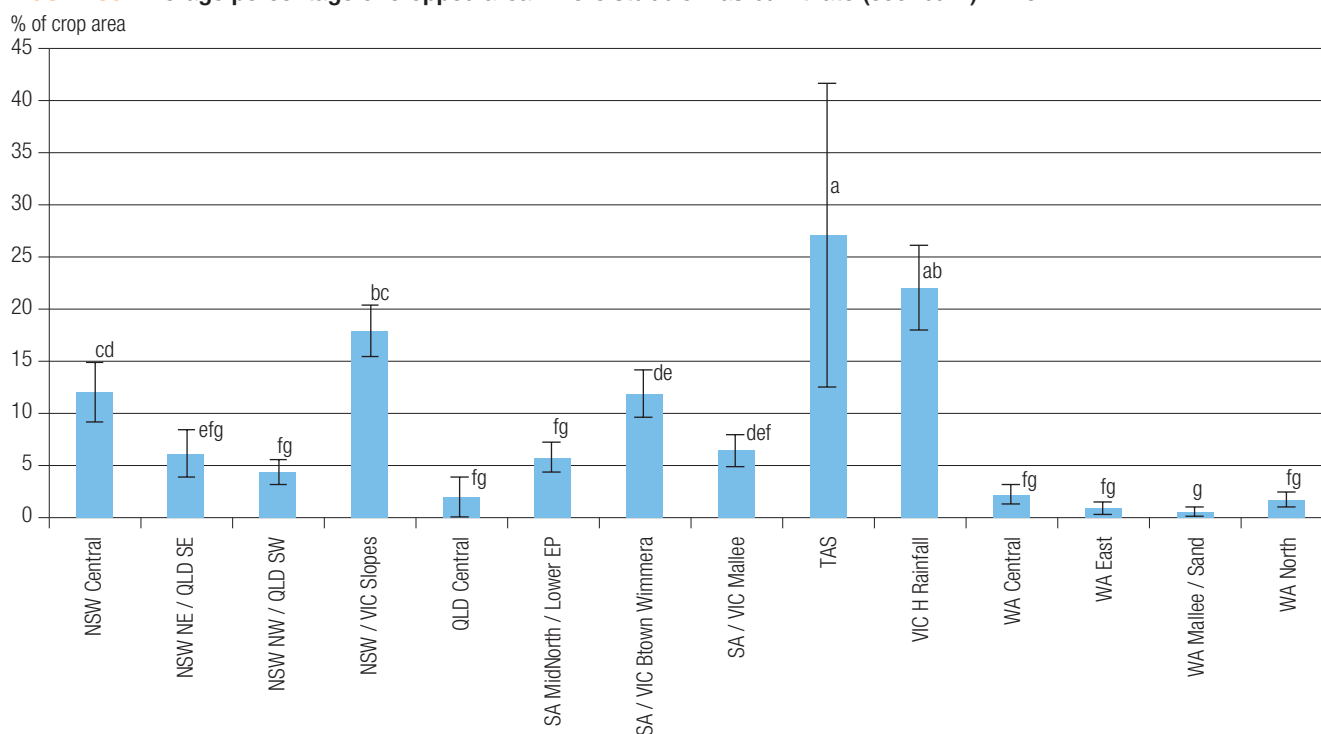


TABLE 50 Average percentage of cropped area where stubble was burnt late (cool burn)

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	0.0	12.1	4.4	***
NSW NE / QLD SE	1.7	6.1	2.9	***
NSW NW / QLD SW	0.4	4.3	2.2	***
NSW / VIC Slopes	2.1	17.9	4.0	***
QLD Central	0.0	2.0	3.4	ns
SA Mid North / Lower EP	0.3	5.7	2.3	***
SA / VIC Bordertown Wimmera	4.7	11.9	3.9	***
SA / VIC Mallee	0.0	6.5	2.1	***
TAS	12.5	27.1	30.4	ns
VIC High Rainfall	2.8	22.0	7.4	***
WA Central	4.5	2.2	2.1	**
WA Eastern	4.8	0.9	3.3	***
WA Mallee / Sandplain	0.6	0.5	1.0	ns
WA Northern	1.8	1.7	2.0	ns
National Averages	2.6	8.6		

FIGURE 80 Average percentage of cropped area where stubble was burnt late (cool burn) in 2011

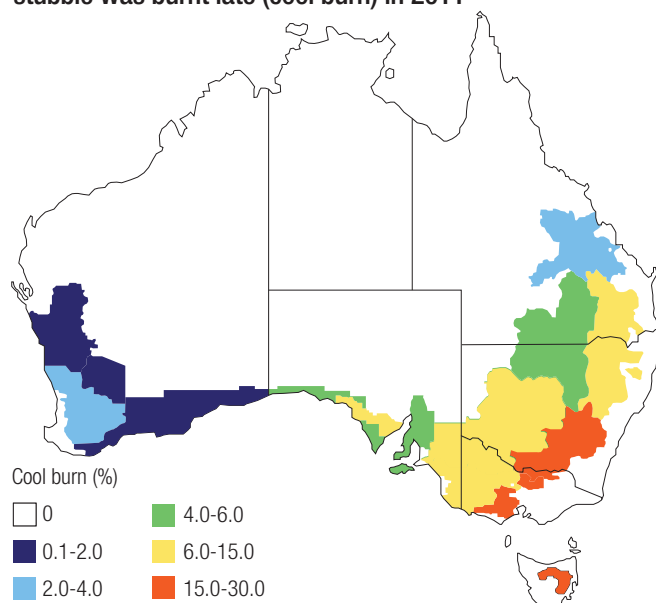
management of herbicide-resistant weeds. Data for this practice is available only for the 2011 survey (Table 52 and Figure 83).

Windrow burning is a practice used only on a very small percentage of the cropped area, and may often be linked with windrow raking.

Stubble baling

This includes methods where stubble is baled and removed from the paddock. Often it can take place directly at the back of the harvester and is used in the management of herbicide-resistant weeds to remove the seeds from the seedbank.

From the 2011 dataset, only 32 farms, representing 1.2 per cent of the crop area in the survey, reported baling any stubble. The average crop area baled on these farms was 49.5 per cent.

FIGURE 81 Average percentage of cropped area where stubble was burnt late (cool burn) in 2011**TABLE 51** Average percentage of cropped area where stubble was raked (windrow raking)

Agro-ecological zone	2009	2011
NSW Central	0.0	0.2
NSW NE / QLD SE	0.7	0.9
NSW NW / QLD SW	1.3	0.1
NSW / VIC Slopes	0.8	1.0
QLD Central	0.0	2.1
SA Mid North / Lower EP	0.1	1.4
SA / VIC Bordertown Wimmera	0.8	2.8
SA / VIC Mallee	0.6	0.7
TAS	0.0	0.0
VIC High Rainfall	2.6	0.6
WA Central	1.1	0.7
WA Eastern	0.0	0.0
WA Mallee / Sandplain	0.0	0.0
WA Northern	1.2	0.9
National Averages	0.65	0.81

FIGURE 82 Average percentage of cropped area where stubble was raked (windrow raking) in 2011

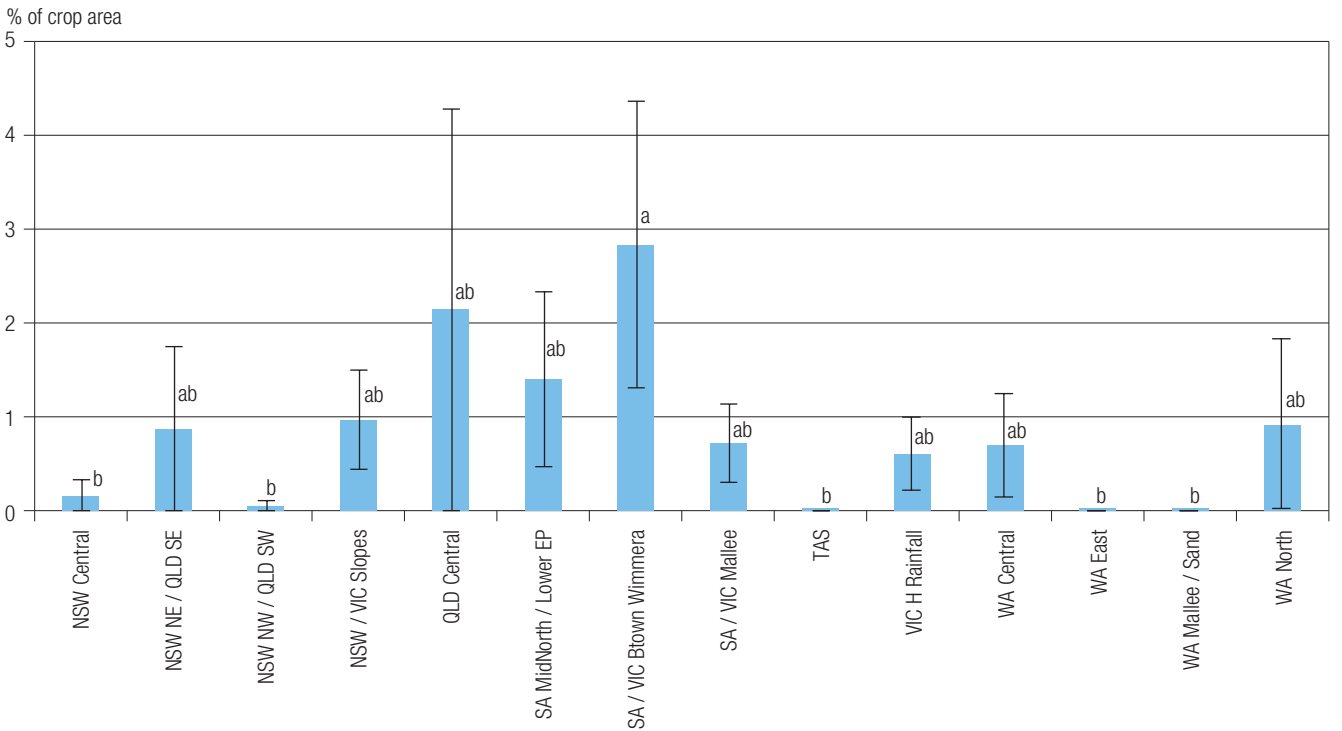


FIGURE 83 Average percentage of cropped area where stubble was windrow burnt in 2011

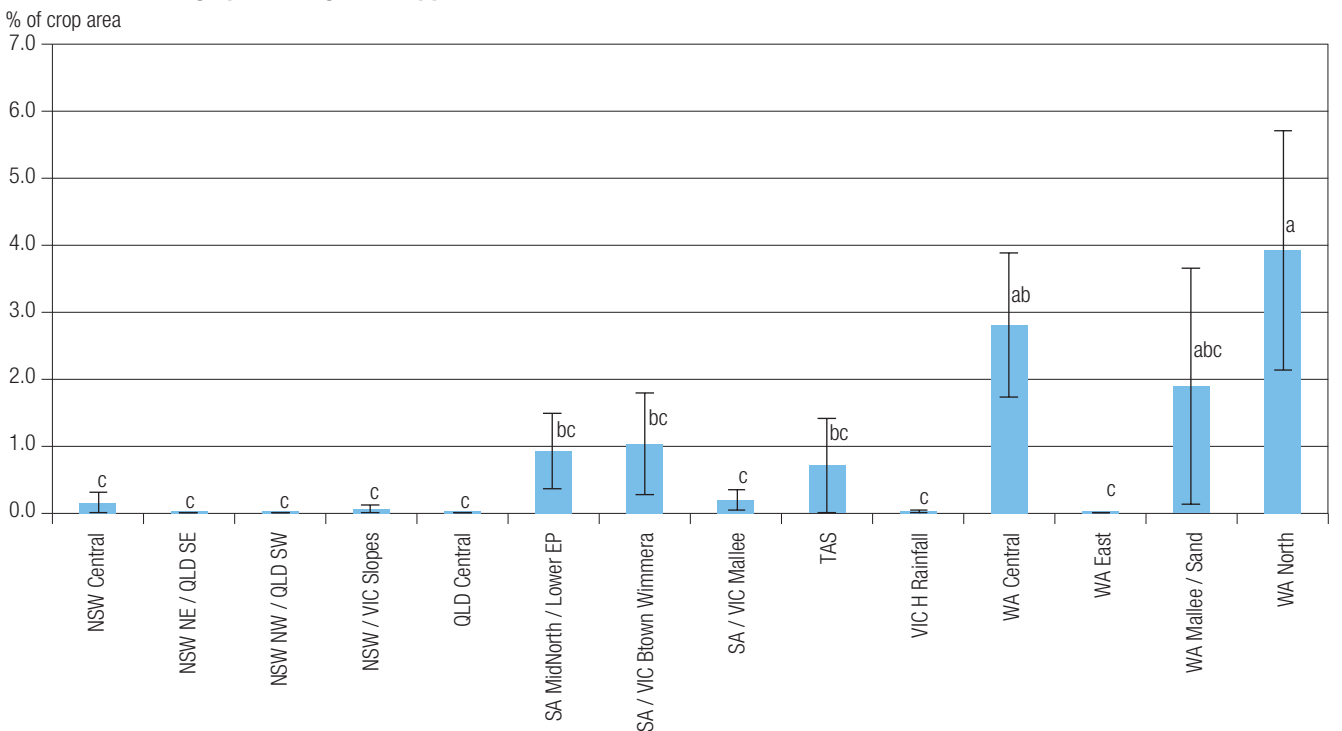


TABLE 52 Average percentage of cropped area where stubble was windrow burnt in 2011

Agro-ecological zone	% of crop area	Significance between agro-ecological zones
NSW Central	0.2	c
NSW NE / QLD SE	0.0	c
NSW NW / QLD SW	0.0	c
NSW / VIC Slopes	0.1	c
QLD Central	0.0	c
SA Mid North / Lower EP	0.9	bc
SA / VIC Bordertown Wimmera	1.0	bc
SA / VIC Mallee	0.2	c
TAS	0.7	bc
VIC High Rainfall	0.0	c
WA Central	2.8	ab
WA Eastern	0.0	c
WA Mallee / Sandplain	1.9	abc
WA Northern	3.9	a
National Averages	0.84	
LSD (5%)	2.31	

PADDOCK HISTORY

Respondents were asked:

- What percentage of your cereal crop was planted following:
 - a pulse crop in 2010?
 - a canola crop in 2010?
 - a pasture phase, where the pasture was legume-dominant?
- What percentage of your 2011 crop was planted specifically for weed, disease or other control purposes (for example, green or brown manure crop, short-term forage legumes, hay crop cut for optimum weed control)?
- What percentage of your crop do you estimate has access to the full soil profile?
- What percentage of your crop had any risk of root disease?
- What percentage of your crop was grown in areas where some soil constraints are present in the subsoil (such as acidity, sodicity, hard pans or toxicity (for example, boron))?

Previous crop

Previous canola crop

Cereal crops were more likely to have been planted in 2011 following a canola crop in 2010 in the NSW/Victorian Slopes, Victorian High Rainfall, Central WA and WA Mallee/Sandplain agro-ecological zones (Tables 53 and 54, Figures 84 and 85).

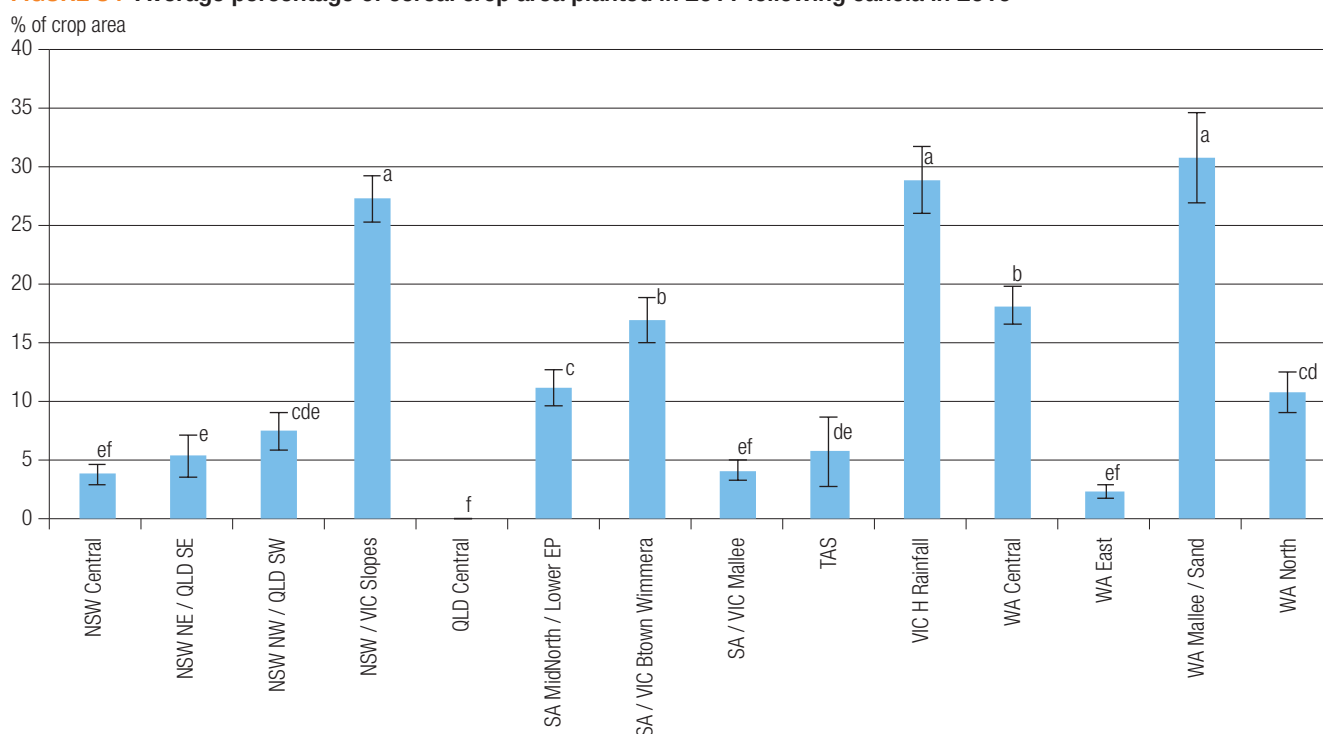
Previous pulse crop

Cereal crops planted in 2011 were more likely to have followed a pulse crop in the agro-ecological zones of North-West NSW/South-West Queensland, Central Queensland (possibly following chickpeas) and SA's Mid North/Lower Eyre Peninsula (possibly following lentils or field peas).

Pulse crops were less likely to have been used in rotation in the Central NSW, NSW/Victorian Slopes, Victorian High Rainfall and Eastern WA agro-ecological zones (Tables 53 and 55, Figures 86 and 87).

TABLE 53 Average percentage of cereal crop area planted in 2011 following canola, pulses or legume-based pasture

Agro-ecological zone	Following canola crop	Following pulse crop	Following legume pasture
NSW Central	3.8	3.5	9.8
NSW NE / Qld SE	5.3	15.7	4.1
NSW NW / Qld SW	7.5	27.2	5.0
NSW / VIC Slopes	27.2	7.5	6.3
QLD Central	0.0	27.6	0.0
SA Mid North / Lower EP	11.1	26.8	12.5
SA / VIC Bordertown Wimmera	16.9	18.0	10.6
SA / VIC Mallee	4.1	12.4	16.4
TAS	5.7	6.4	5.7
VIC High Rainfall	28.8	5.1	6.0
WA Central	18.1	11.2	22.2
WA Eastern	2.3	4.0	15.5
WA Mallee / Sand	30.7	9.5	23.1
WA Northern	10.7	18.0	4.2

FIGURE 84 Average percentage of cereal crop area planted in 2011 following canola in 2010

Previous legume-dominant pasture

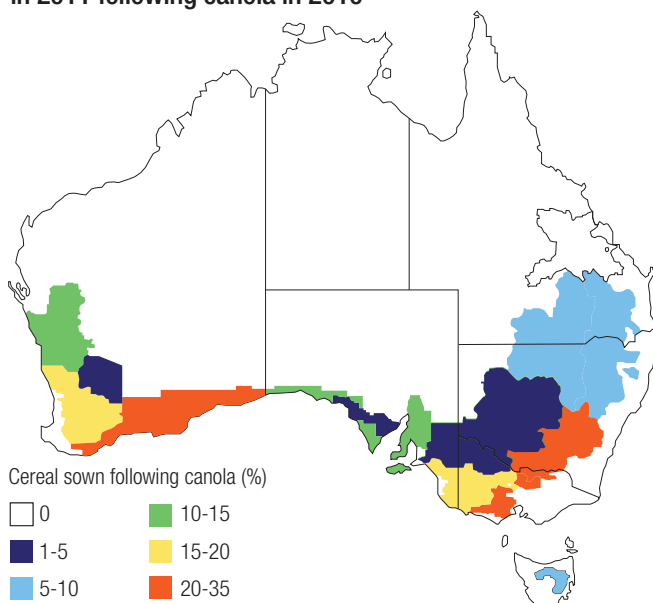
Legume pastures were more likely to be grown in the agro-ecological zones with higher levels of mixed cropping/livestock enterprise. They are used for many purposes including as a break crop and for nitrogen fixation, weed management and feed for stock. Such agro-ecological zones include the SA/Victorian Mallee, Central WA, Eastern WA and WA Mallee/Sandplain (Tables 53 and 56, Figures 88 and 89).

Conversely, pasture legumes were less likely to be used in the crop rotation on the grain-intensive properties of NSW/

Queensland and the Central Queensland, NSW/Victorian Slopes or Northern WA agro-ecological zones.

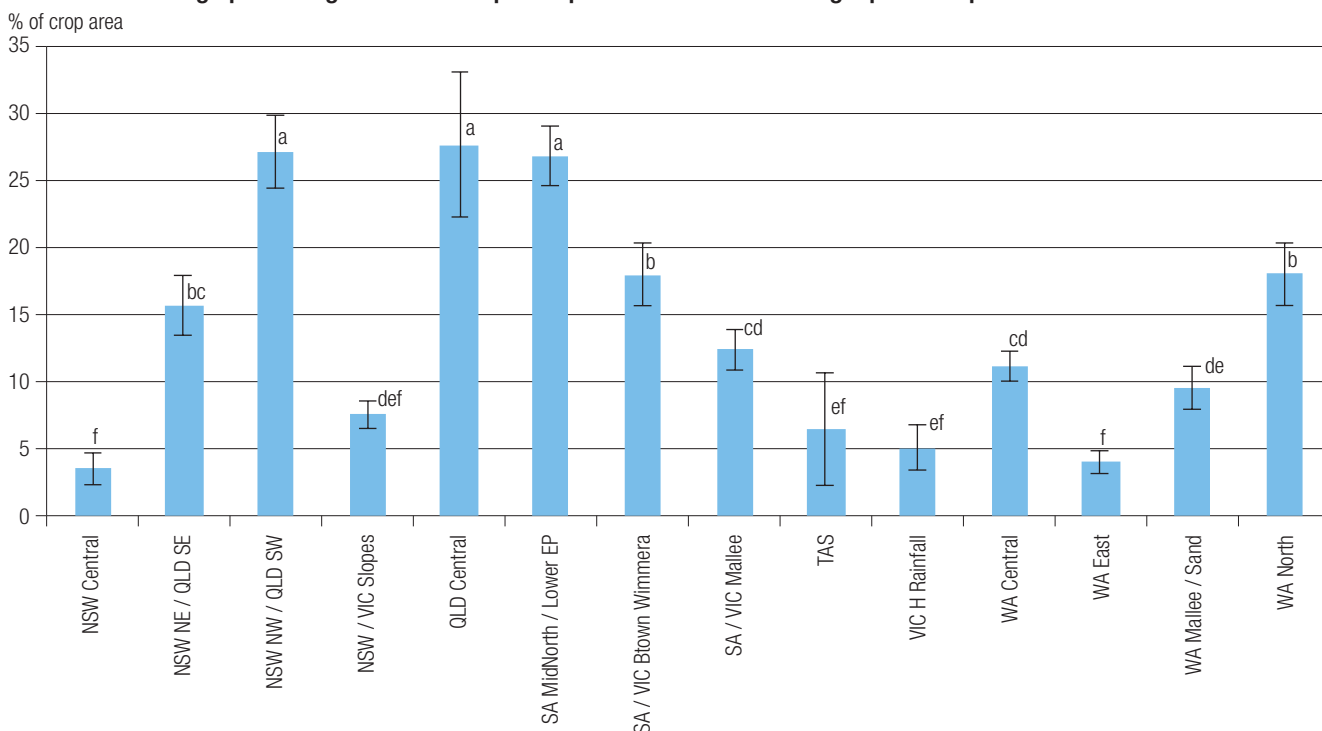
Planted to have full access to the soil profile

Grain producers were asked to estimate how much of their 2011 crop was planted where it would have access to a full profile of soil moisture. This would be dependent on seasonal conditions leading up to the planting period, coupled with growers' management of soil moisture and

FIGURE 85 Average percentage of cereal crop area planted in 2011 following canola in 2010**TABLE 54** Average percentage of cereal crop area planted in 2011 following canola in 2010

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	3.8	ef
NSW NE / Qld SE	5.3	e
NSW NW / Qld SW	7.5	cde
NSW / VIC Slopes	27.2	a
QLD Central	0.0	f
SA Mid North / Lower EP	11.1	c
SA / VIC Bordertown Wimmera	16.9	b
SA / VIC Mallee	4.1	ef
TAS	5.7	de
VIC High Rainfall	28.8	a
WA Central	18.1	b
WA Eastern	2.3	ef
WA Mallee / Sand	30.7	a
WA Northern	10.7	cd
National Averages	12.3	
LSD (5%)	5.3	

FIGURE 86 Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010



weeds, and the effects of potential limiting factors such as root disease levels or subsoil constraints.

Nationally, approximately 80 per cent of cropped areas were considered to have full access to the soil profile (Table 57, Figures 90 and 91).

Planted risking root disease

Growers were asked to estimate the percentage of their 2011 crop that was at risk from root disease. Root diseases, such as take-all, pythium, rhizoctonia, cereal cyst nematode and others,

can significantly impede the ability of infected plants to access soil moisture and nutrients, resulting in sub-optimal yields.

Nationally, approximately 25 to 30 per cent of the crop was felt to have some risk from root diseases, with this risk seen as slightly higher in the west (Table 58, Figures 92 and 93).

Planted with subsoil constraints

Subsoil constraints can include soils affected by acidity, sodicity, hard pans or toxicity (for example, boron). Such constraints restrict crop growth and result in poor uptake

FIGURE 87 Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010

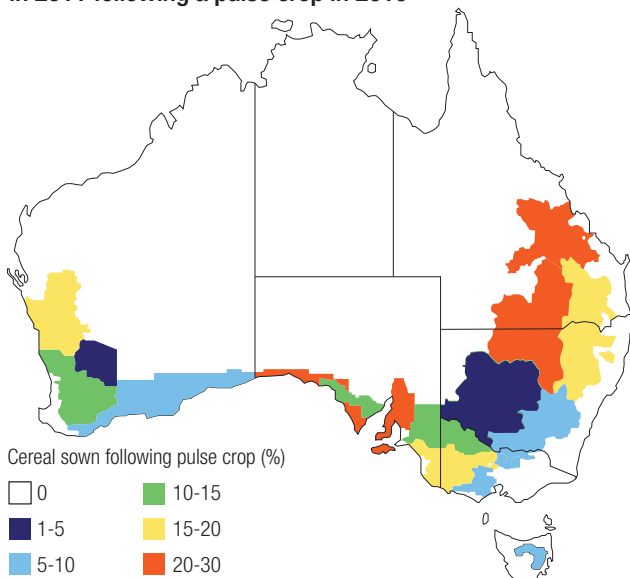
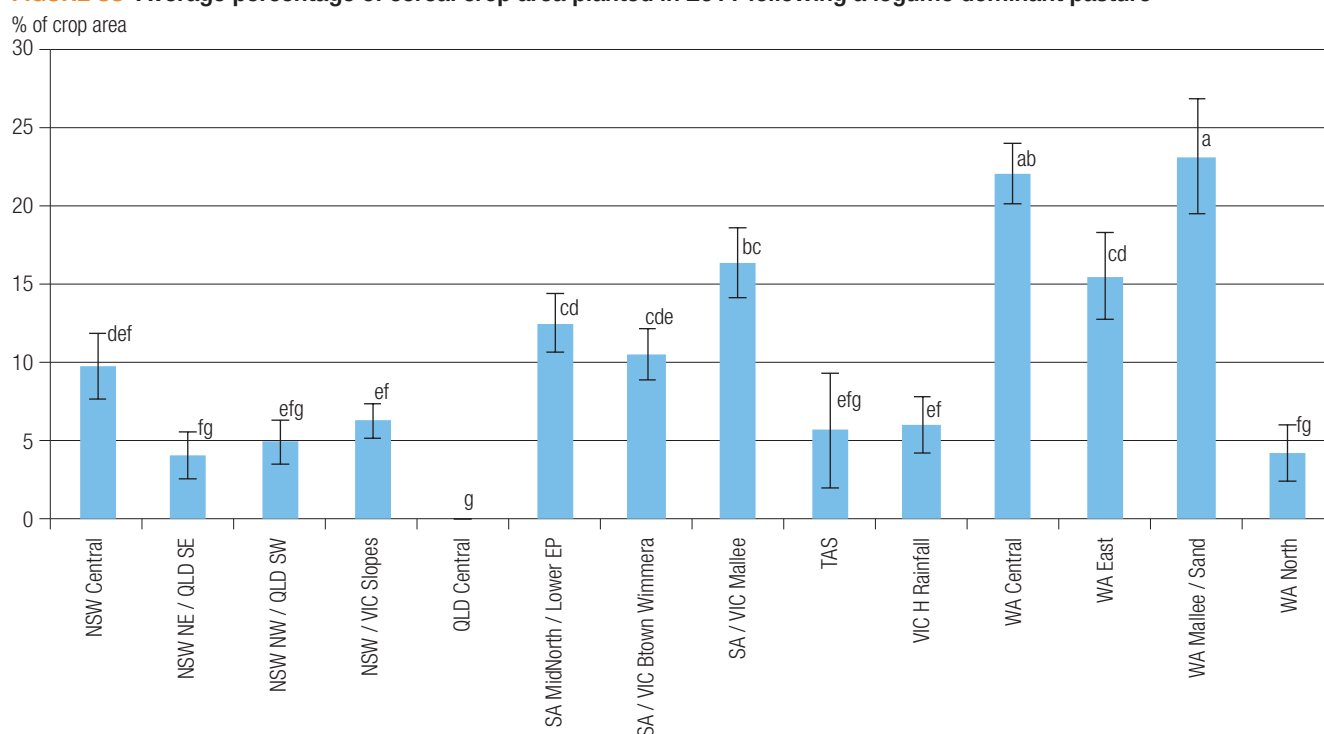


TABLE 55 Average percentage of cereal crop area planted in 2011 following a pulse crop in 2010

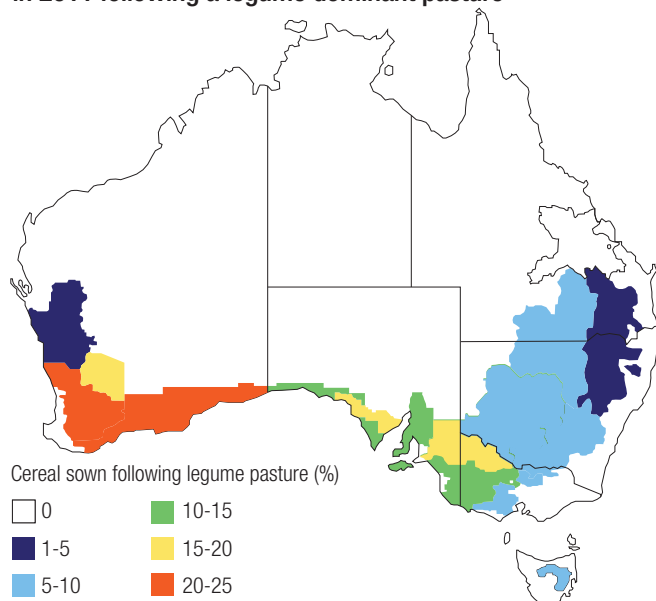
Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	3.5	f
NSW NE / Qld SE	15.7	bc
NSW NW / Qld SW	27.2	a
NSW / VIC Slopes	7.5	def
QLD Central	27.6	a
SA Mid North / Lower EP	26.8	a
SA / VIC Bordertown Wimmera	18.0	b
SA / VIC Mallee	12.4	cd
TAS	6.4	ef
VIC High Rainfall	5.1	ef
WA Central	11.2	cd
WA Eastern	4.0	f
WA Mallee / Sand	9.5	de
WA Northern	18.0	b
National Averages	13.8	
LSD (5%)	5.5	

FIGURE 88 Average percentage of cereal crop area planted in 2011 following a legume dominant pasture

of moisture and nutrients. Growers were asked to estimate what percentage of their 2011 crop was planted where such constraints were present (Table 59, Figures 94 and 95).

Crop planted for disease or weed control

This category refers to the percentage of crop planted specifically for weed, disease or other control purposes (for example, green or brown manure crop, short-term forage legumes, hay crop when cut for optimum weed control) (Table 60, Figures 96 and 97).

FIGURE 89 Average percentage of cereal crop area planted in 2011 following a legume dominant pasture**TABLE 56** Average percentage of cereal crop area planted in 2011 following a legume-dominant pasture

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	9.8	def
NSW NE / Qld SE	4.1	fg
NSW NW / Qld SW	5.0	efg
NSW / VIC Slopes	6.3	ef
QLD Central	0.0	g
SA Mid North / Lower EP	12.5	cd
SA / VIC Bordertown Wimmera	10.6	cde
SA / VIC Mallee	16.4	bc
TAS	5.7	efg
VIC High Rainfall	6.0	ef
WA Central	22.0	ab
WA Eastern	15.5	cd
WA Mallee / Sand	23.1	a
WA Northern	4.2	fg
National Averages	10.1	
LSD (5%)	5.9	

FIGURE 90 Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile

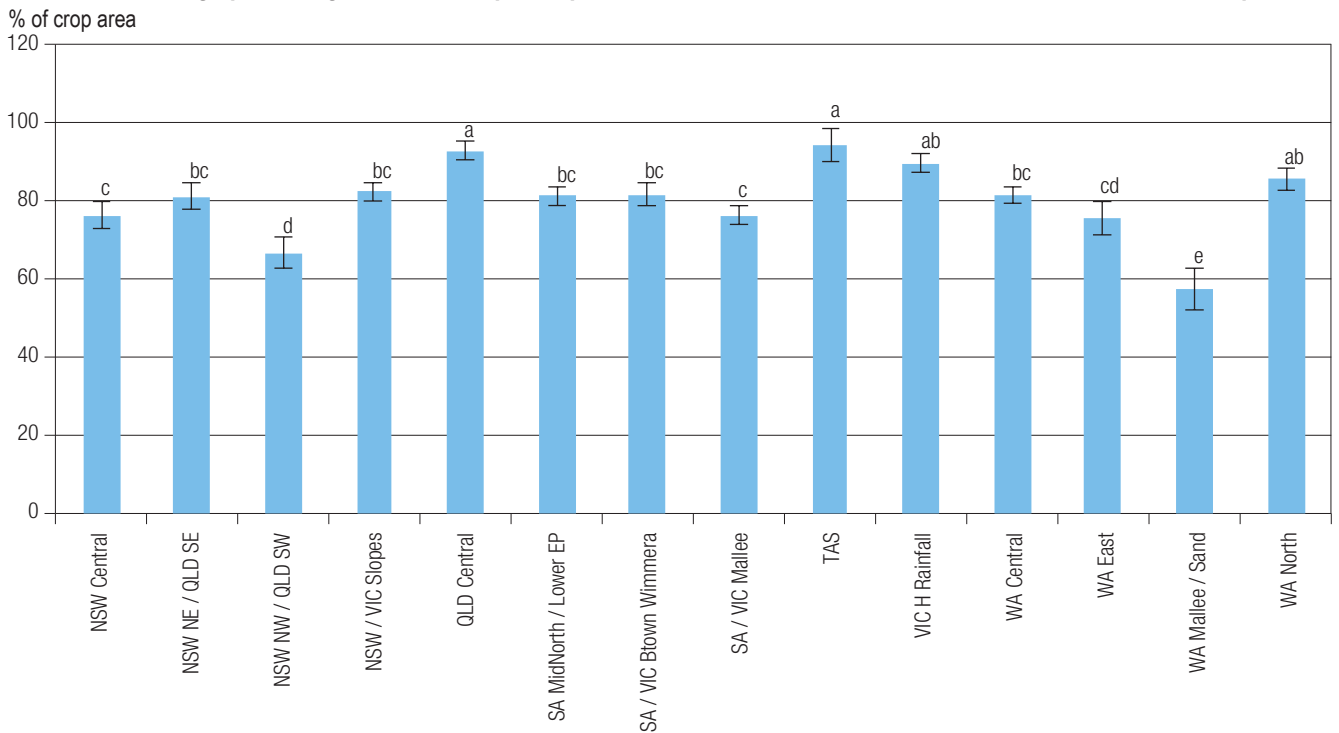


FIGURE 91 Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile

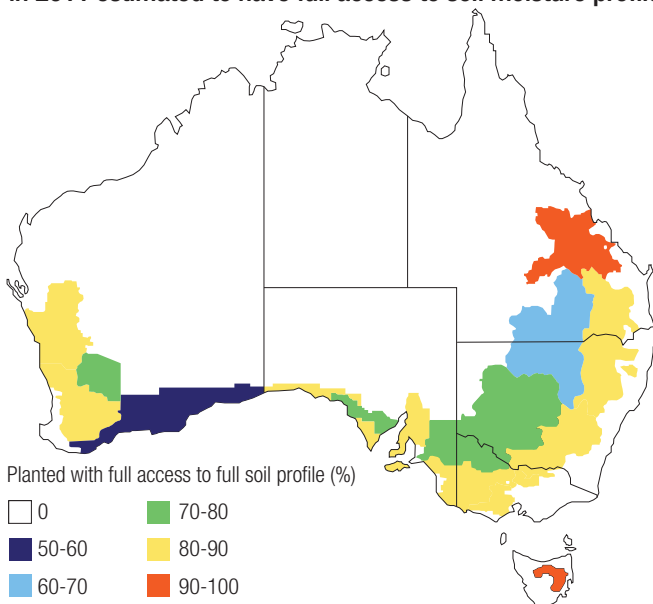


TABLE 57 Average percentage of cereal crop area planted in 2011 estimated to have full access to soil moisture profile

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	76.3	c
NSW NE / Qld SE	81.1	bc
NSW NW / Qld SW	66.7	d
NSW / VIC Slopes	82.3	bc
QLD Central	92.7	a
SA Mid North / Lower EP	81.2	bc
SA / VIC Bordertown Wimmera	81.4	bc
SA / VIC Mallee	76.3	c
TAS	94.3	a
VIC High Rainfall	89.6	ab
WA Central	81.5	bc
WA Eastern	75.5	cd
WA Mallee / Sand	57.4	e
WA Northern	85.5	ab
National Averages	80.1	
LSD (5%)	8.8	

FIGURE 92 Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease

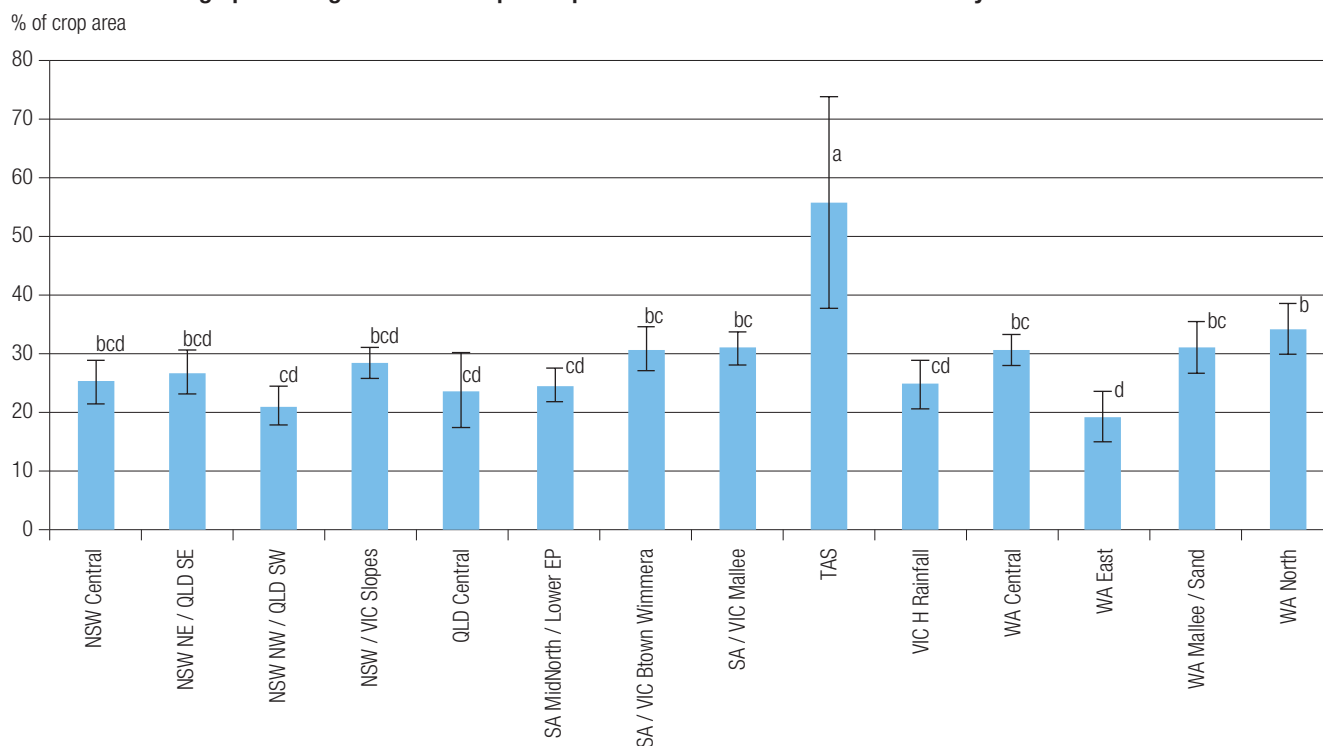


FIGURE 93 Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease

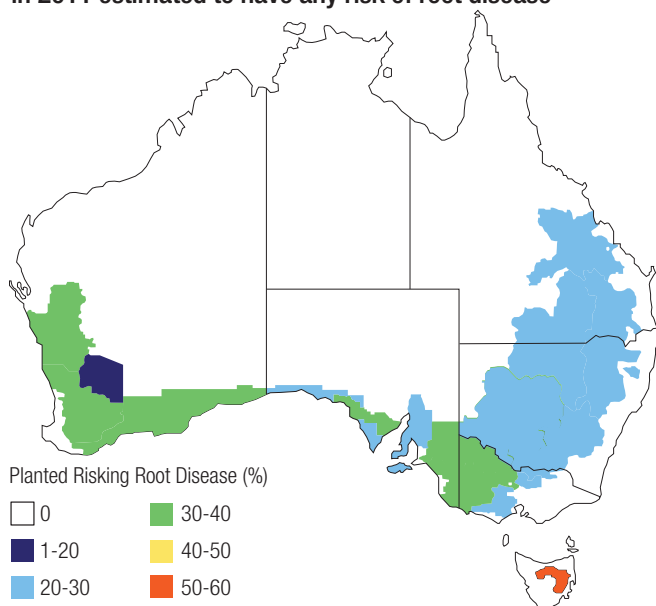


TABLE 58 Average percentage of cereal crop area planted in 2011 estimated to have any risk of root disease

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	25.2	bcd
NSW NE / Qld SE	26.9	bcd
NSW NW / Qld SW	21.0	cd
NSW / VIC Slopes	28.3	bcd
QLD Central	23.7	cd
SA Mid North / Lower EP	24.7	cd
SA / VIC Bordertown Wimmera	30.7	bc
SA / VIC Mallee	31.0	bc
TAS	55.7	a
VIC High Rainfall	24.7	cd
WA Central	30.5	bc
WA Eastern	19.2	d
WA Mallee / Sand	30.9	bc
WA Northern	34.3	b
National Averages	29.1	
LSD (5%)	10.2	

FIGURE 94 Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present

% of crop area

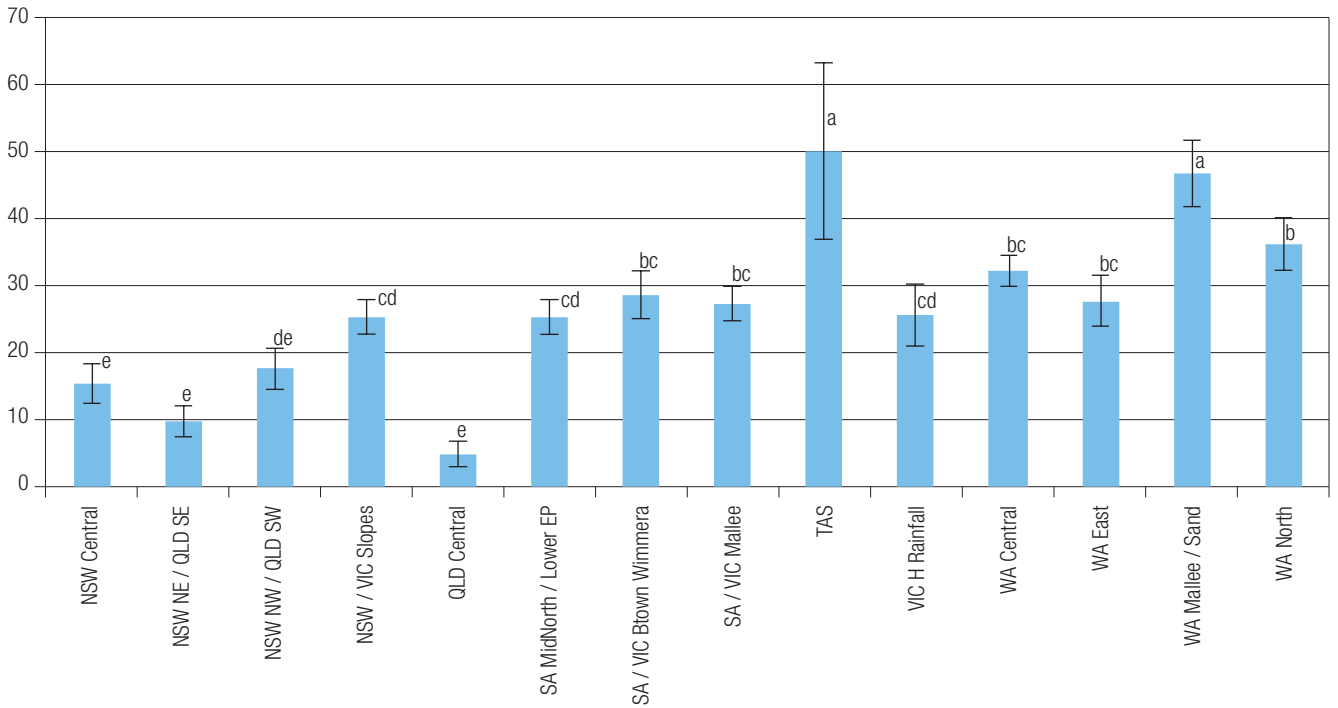


FIGURE 95 Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present

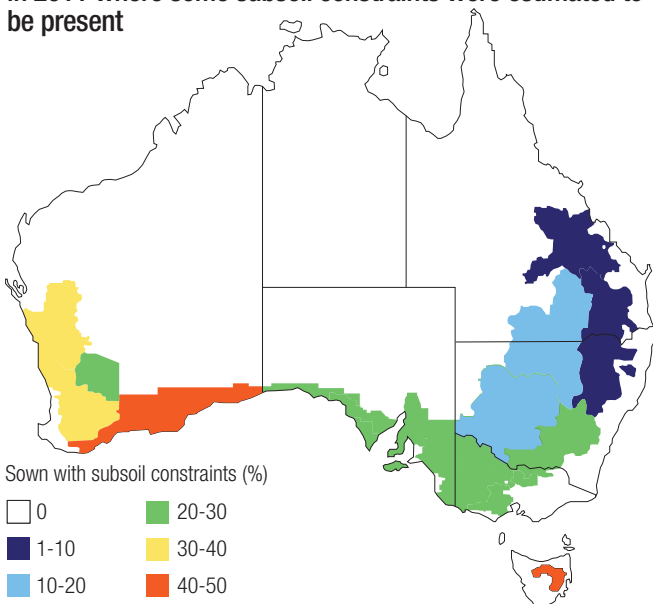
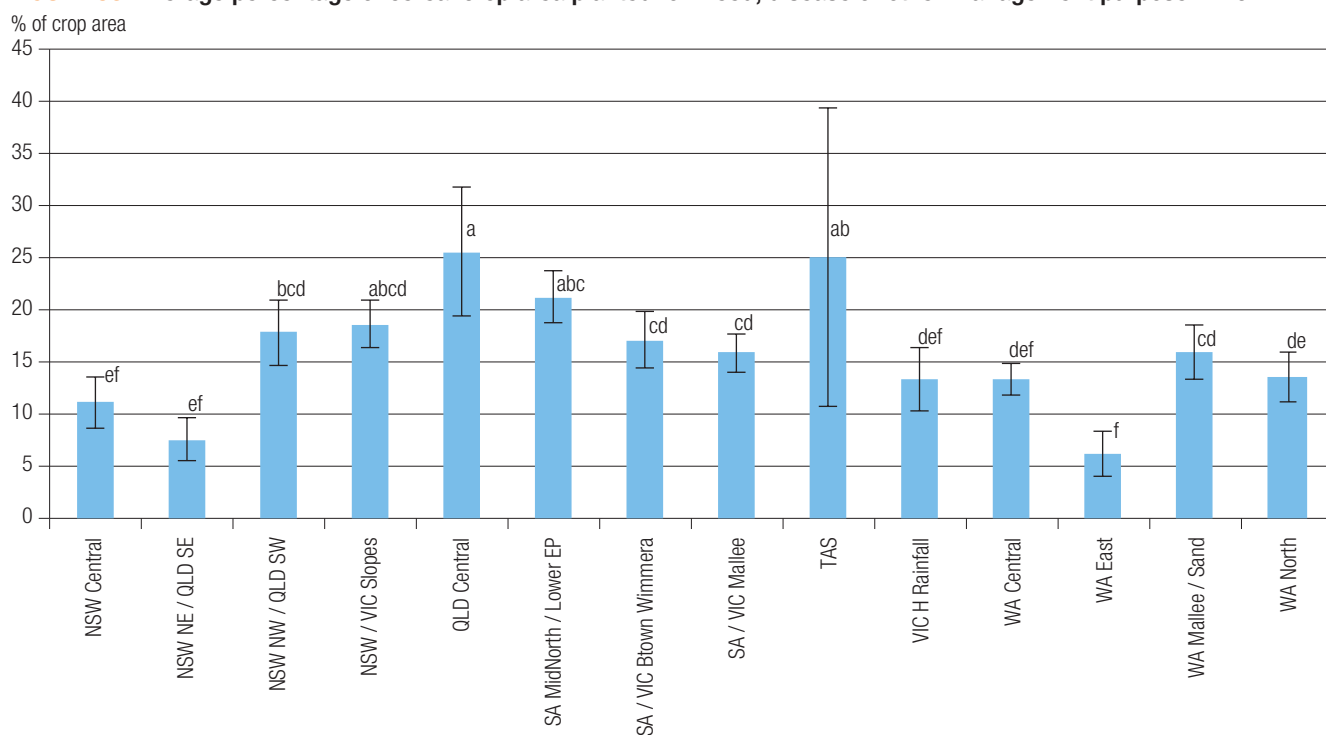
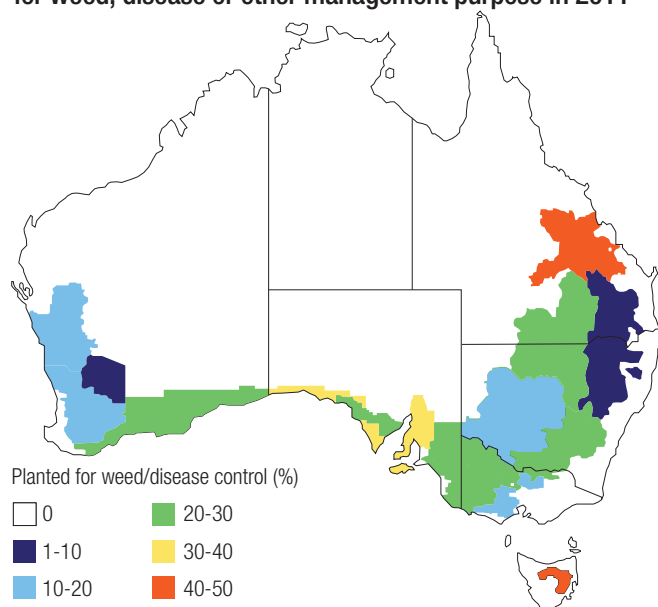


TABLE 59 Average percentage of cereal crop area planted in 2011 where some subsoil constraints were estimated to be present

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	15.4	e
NSW NE / Qld SE	9.8	e
NSW NW / Qld SW	17.6	de
NSW / VIC Slopes	25.4	cd
QLD Central	4.9	e
SA Mid North / Lower EP	25.4	cd
SA / VIC Bordertown Wimmera	28.7	bc
SA / VIC Mallee	27.3	bc
TAS	50.0	a
VIC High Rainfall	25.6	cd
WA Central	32.3	bc
WA Eastern	27.7	bc
WA Mallee / Sand	46.8	a
WA Northern	36.3	b
National Averages	26.6	
LSD (5%)	9.2	

FIGURE 96 Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011**FIGURE 97** Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011**TABLE 60** Average percentage of cereal crop area planted for weed, disease or other management purpose in 2011

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	11.1	ef
NSW NE / Qld SE	7.5	ef
NSW NW / Qld SW	17.8	bcd
NSW / VIC Slopes	18.6	abcd
QLD Central	25.6	a
SA Mid North / Lower EP	21.2	abc
SA / VIC Bordertown Wimmera	17.1	cd
SA / VIC Mallee	15.8	cd
TAS	25.0	ab
VIC High Rainfall	13.3	def
WA Central	13.4	def
WA Eastern	6.2	f
WA Mallee / Sand	15.9	cd
WA Northern	13.5	de
National Averages	15.9	
LSD (5%)	7.3	

SOWING TIME



Survey respondents were asked the following questions:

- What percentage of your crop do you estimate was planted at the optimum time for that crop and variety?
- What percentage of your cereal crop was planted prior to 15 May?
- What percentage of your cereal crop was planted prior to 30 June?

These questions were not included in the earlier survey of 2009 for the crop year of 2008.

Crops sown on time

Planting crops at the optimum time can be an important factor in achieving high yields and is one area where growers can have some influence, given suitable soil moisture and other seasonal factors.

Varieties differ in their length of growing season, for example, days until flowering. Planting winter crops before the optimum time risks frost during the flowering window, which reduces yield; conversely, late planting risks heat and moisture stress during flowering and grain filling.

The optimum sowing or planting date is generally crop and variety-specific, and there is no general date when all crops would ideally be planted. However, for many cereals the mid-May to mid-June period is generally considered a good time for planting most winter grain crops, at least in the southern and western areas.

More than three-quarters of the 2011 winter crop was planted at what growers assessed was the optimum time for their varieties (Table 61, Figures 98 and 99).

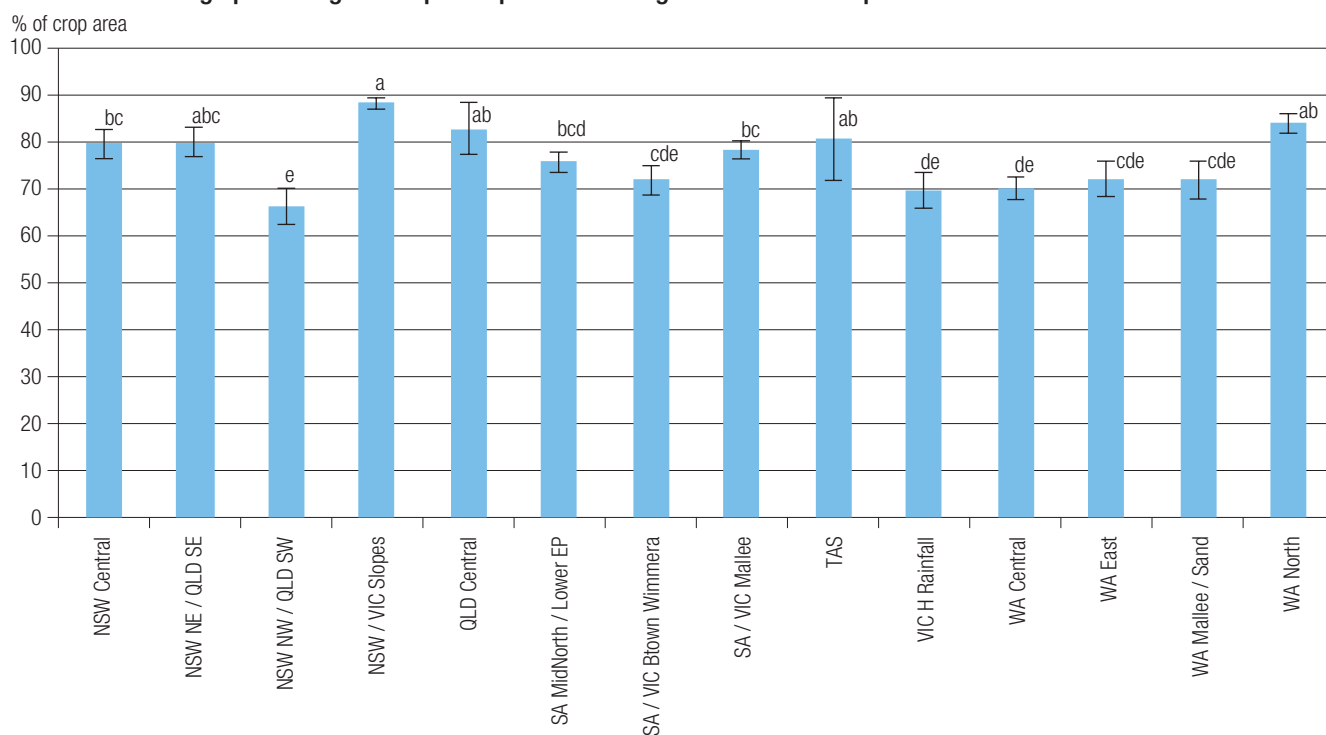
Percentage of cereal crops sown before 15 May

Results from the 2011 survey reflect the early-season rainfall in the eastern states in that year, which provided conditions conducive to planting at the optimum time, for example, by mid-May. Some agro-ecological zones had sown in excess of 50 per cent of their cereals by 15 May. The late start to the season in WA in 2011 was illustrated by the low area of cereals planted by 15 May. The majority of cereals had been planted in all agro-ecological zones by 30 June in 2011.

In general, about 30 per cent or more of the crop was

TABLE 61 Average percentage of crop area planted at the grower-assessed optimum time in 2011

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	79.6	bc
NSW NE / Qld SE	80.0	abc
NSW NW / Qld SW	66.2	e
NSW / VIC Slopes	88.2	a
QLD Central	82.7	ab
SA Mid North / Lower EP	75.7	bcd
SA / VIC Bordertown Wimmera	71.9	cde
SA / VIC Mallee	78.4	bc
TAS	80.7	ab
VIC High Rainfall	69.7	de
WA Central	70.1	de
WA Eastern	72.1	cde
WA Mallee / Sand	71.8	cde
WA Northern	84.0	ab
National Averages	76.5	
LSD (5%)	8.3	

FIGURE 98 Average percentage of crop area planted at the grower-assessed optimum time in 2011

planted by 15 May in the 2011 crop year (Table 62, Figures 100 and 101).

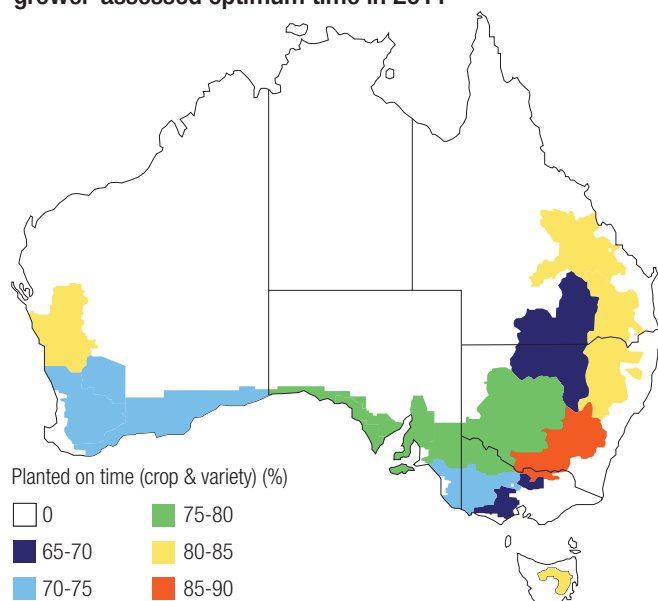
There appears to be a slight trend for crops to be planted slightly earlier in the more northern grain-growing areas and slightly later in the southern and higher-rainfall areas.

There are few statistical differences between agro-ecological zones.

Percentage of cereal crops sown before 30 June

In 2011, in almost all agro-ecological zones, approximately 90 per cent of the crop was planted by 30 June (Table 63, Figures 102 and 103).

Only the Tasmanian and WA agro-ecological zones (apart from WA Central) were lower. These variances are potentially due to seasonal condition differences between these zones; it would be expected that cereal crops would be sown later in Tasmania due to the cooler, later finish to the season there.

FIGURE 99 Average percentage of crop area planted at the grower-assessed optimum time in 2011**TABLE 62** Average percentage of cereal crop area planted prior to 15 May 2011

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	54.1	a
NSW NE / QLD SE	20.8	gh
NSW NW / QLD SW	29.9	ef
NSW / VIC Slopes	49.5	ab
QLD Central	44.7	bc
SA Mid North / Lower EP	32.3	de
SA / VIC Bordertown Wimmera	29.2	efg
SA / VIC Mallee	50.7	ab
TAS	38.6	cd
VIC High Rainfall	34.9	de
WA Central	16.3	h
WA Eastern	16.6	h
WA Mallee / Sandplain	18.3	h
WA Northern	23.0	fgh
National Averages	32.8	
LSD (5%)	8.5	

FIGURE 100 Average percentage of cereal crop area planted at the prior to 15 May 2011

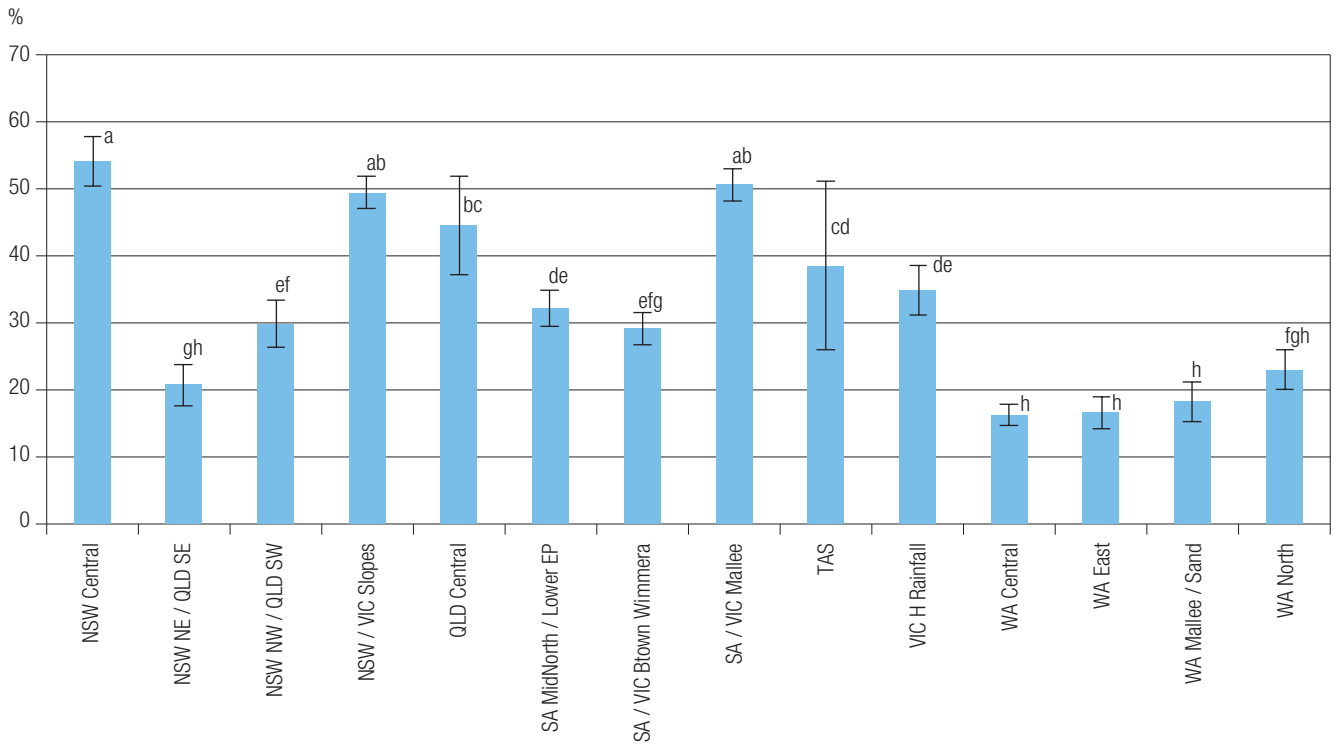


FIGURE 101 Average percentage of cereal crop area planted at the prior to 15 May 2011

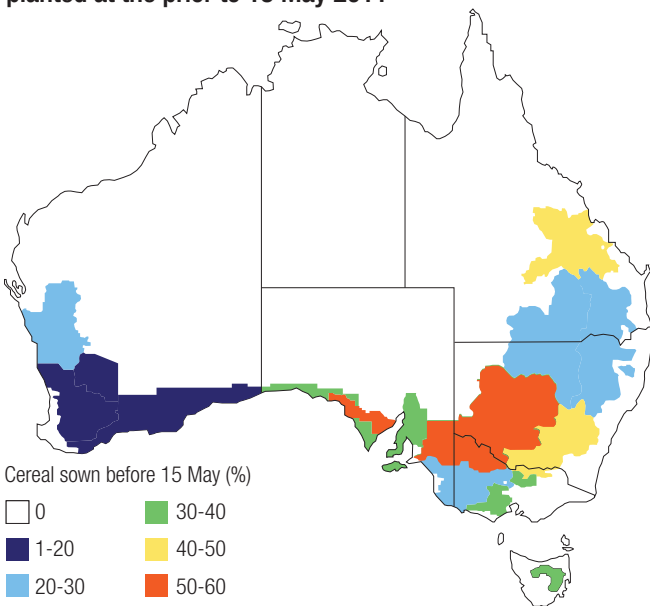
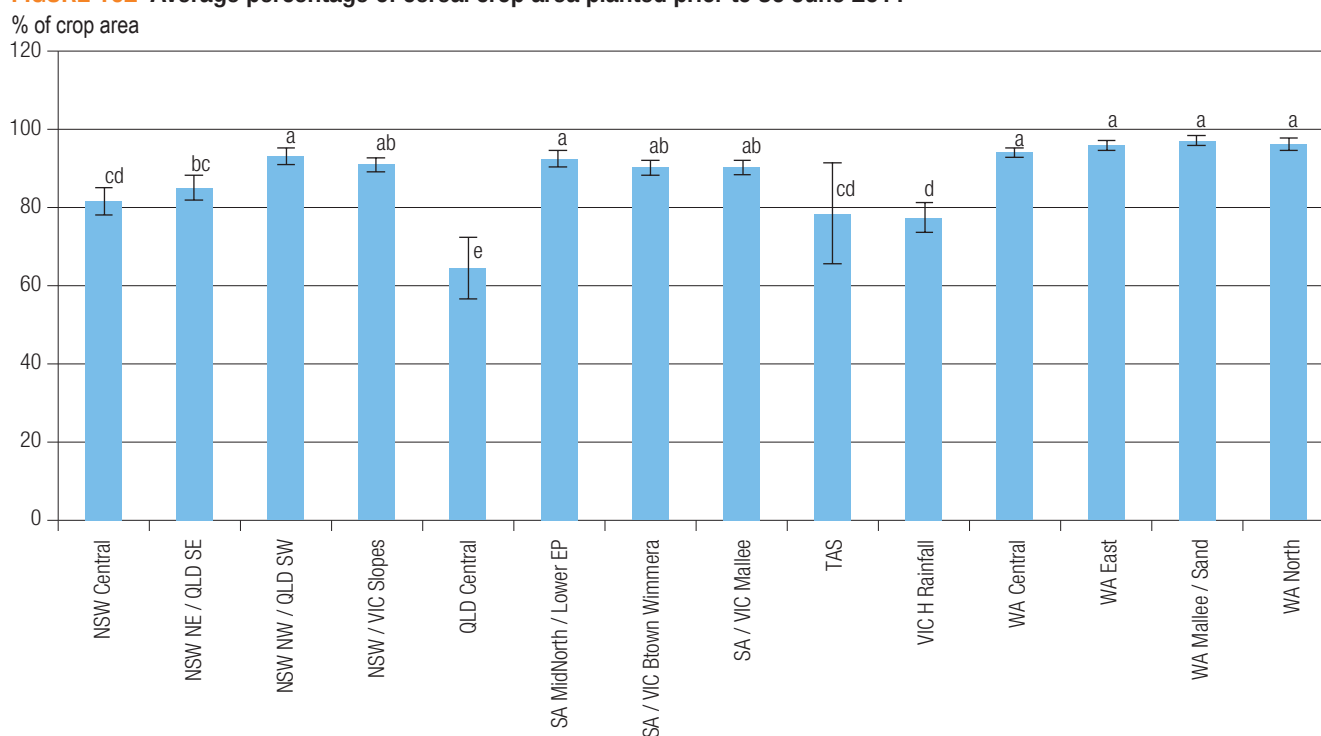
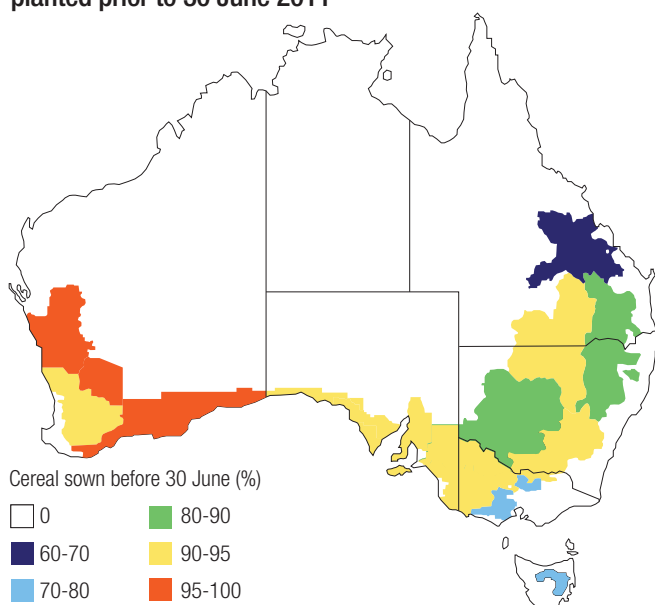


FIGURE 102 Average percentage of cereal crop area planted prior to 30 June 2011**FIGURE 103** Average percentage of cereal crop area planted prior to 30 June 2011**TABLE 63** Average percentage of cereal crop area planted prior to 30 June 2011

Agro-ecological zone	2011 data	Significance between agro-ecological zones
NSW Central	81.8	cd
NSW NE / QLD SE	85.2	bc
NSW NW / QLD SW	93.2	a
NSW / VIC Slopes	91.2	ab
QLD Central	64.6	e
SA Mid North / Lower EP	92.6	a
SA / VIC Bordertown Wimmera	90.4	ab
SA / VIC Mallee	90.5	ab
TAS	78.6	cd
VIC High Rainfall	77.6	d
WA Central	94.3	a
WA Eastern	96.0	a
WA Mallee / Sandplain	97.2	a
WA Northern	96.3	a
National Averages	87.8	
LSD (5%)	6.9	

NUTRIENT MANAGEMENT



In the survey, questions asked relating to the use of soil testing and fertiliser use based on soil testing on grain farms were:

- Do you routinely undertake nutrient soil tests?
- On what percentage of your farm (crop area, total area) do you conduct soil testing?
 - On average, how often do you soil test in any given paddock? (Yearly, every two years, every three years?)
- On how much of your crop area do you use the results of soil tests to choose the fertiliser program for your crop?

Amount of soil testing

It is apparent that soil testing is a relatively common practice in Australia, both in terms of number of farms and cropping area.

Approximately two-thirds of grain growers routinely use soil tests (68 per cent in 2011, up from 66 per cent in 2008), with this representing just over 60 per cent of the total crop area (unchanged) (Table 65).

Percentages of crop area that were soil tested in 2011 were lower than in 2008 in Central NSW, North-East NSW/South-East Queensland, the SA/Victorian Mallee and Central WA (Table 64 and Figure 104).

Frequency of soil testing

Questions were included in the survey to identify if the regularity of soil testing was annually, every two years or every three years or longer.

There was a preference for annual soil tests in any given paddock (29 per cent), followed by every three years (23 per cent) and every two years (16 per cent, down from 20 per cent). The remainder of growers (33 per cent) undertook soil tests less frequently (Table 65 and Figures 105, 106, 107 and 108).

The period between soil tests varied between grain

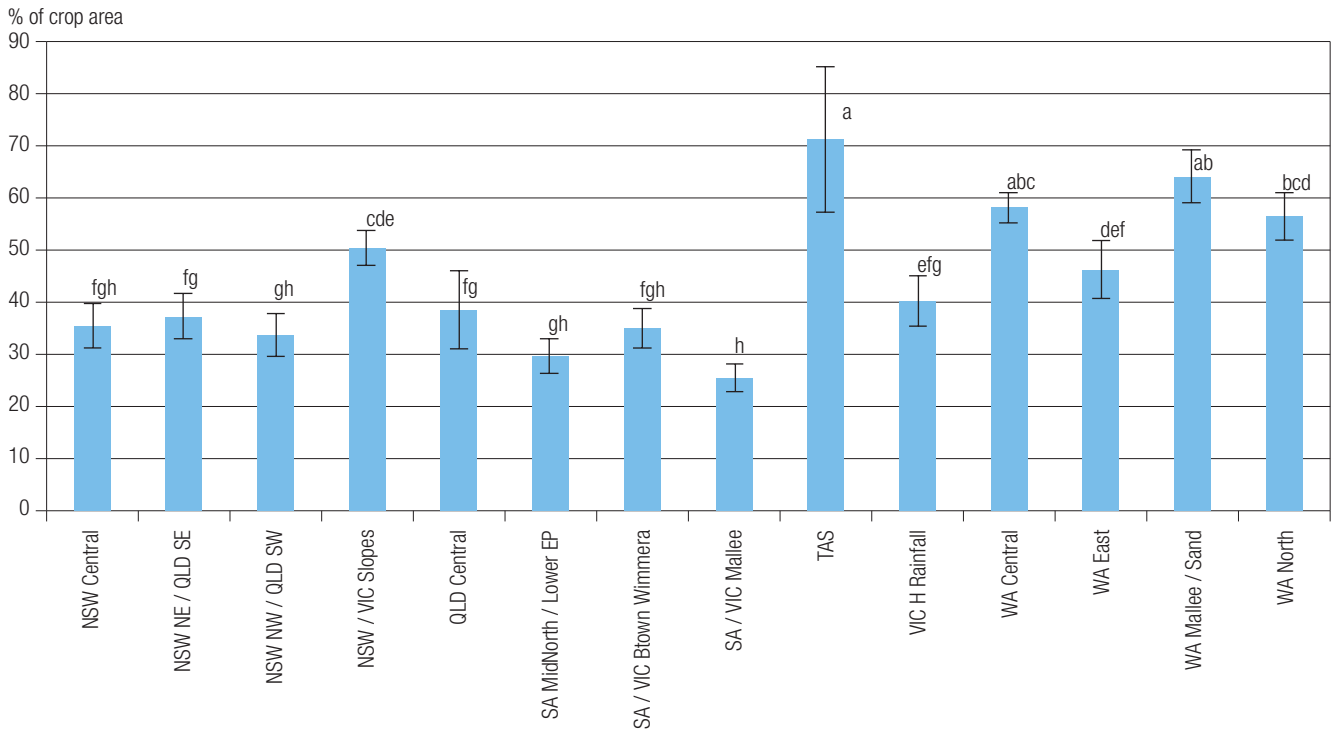
properties. The factors that may determine the frequency of soils tests include crop rotation and history and the price of fertiliser.

The difference between agro-ecological zones was minor.

TABLE 64 Average percentage of crop area where soil was tested for nutrient status

Agro-ecological zone	2009	2011	LSD (5%)	Significance between years
NSW Central	53.6	35.5	9.2	***
NSW NE / Qld SE	51.9	37.2	7.9	***
NSW NW / Qld SW	41.7	33.8	9.7	ns
NSW / VIC Slopes	56.2	50.4	6.9	ns
QLD Central	33.3	38.6	17.0	ns
SA Mid North / Lower EP	30.8	29.7	7.2	ns
SA / VIC Bordertown Wimmera	38.7	35.1	7.3	ns
SA / VIC Mallee	39.4	25.5	6.1	***
TAS	75.0	71.4	36.8	ns
VIC High Rainfall	56.2	40.3	11.5	ns
WA Central	64.8	58.2	5.8	**
WA Eastern	47.7	46.2	11.0	ns
WA Mallee / Sand	54.4	64.1	10.2	**
WA Northern	55.4	56.5	9.1	ns
National Averages	49.9	44.5		

FIGURE 104 Average percentage of crop area where soil was tested for nutrient status in 2011



Use of soil testing to develop a fertiliser program

The data shows the extent to which soil tests are used as a basis for fertiliser application; that is, how much of the crop has a fertiliser program designed based on soil test results.

For the 2011 cropping season, three-quarters of grain growers used soil tests as a basis for their fertiliser program (77 per cent, up from 74 per cent) (Table 66 and Figure 109).

There also appeared to be an increase (generally non-significant) in the percentage of the crop area where fertiliser usage was informed by soil testing.

FIGURE 105 Average percentage of farms in 2011 using soil testing

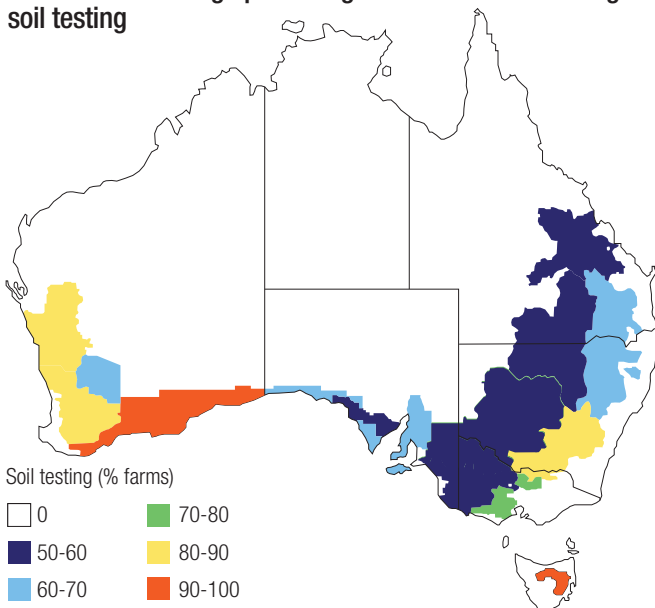


FIGURE 106 Average percentage of farms in 2011 conducting soil testing every year

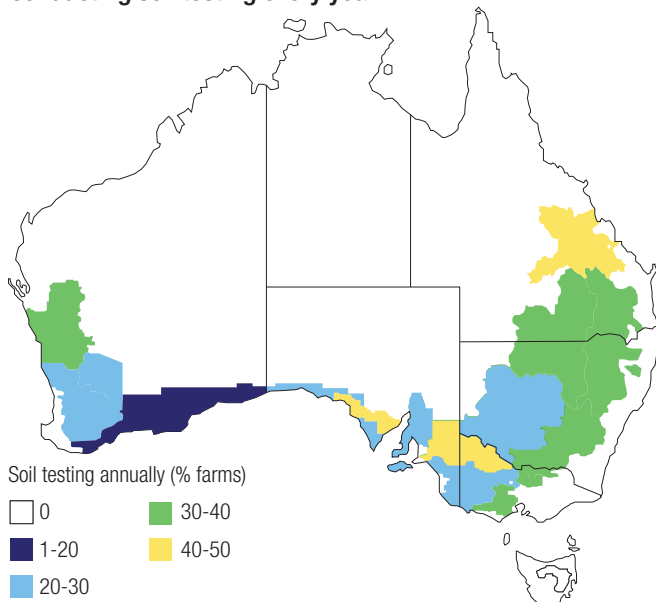


FIGURE 107 Average percentage of farms in 2011 conducting soil testing every second year

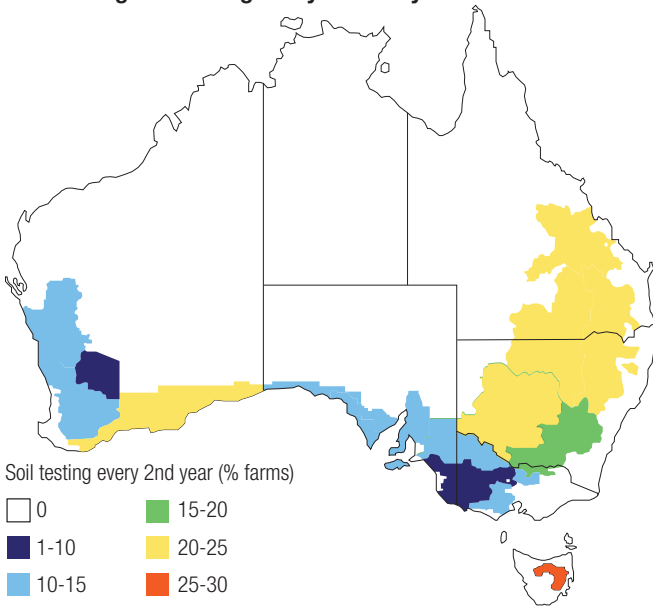


FIGURE 108 Average percentage of farms in 2011 conducting soil testing every third year

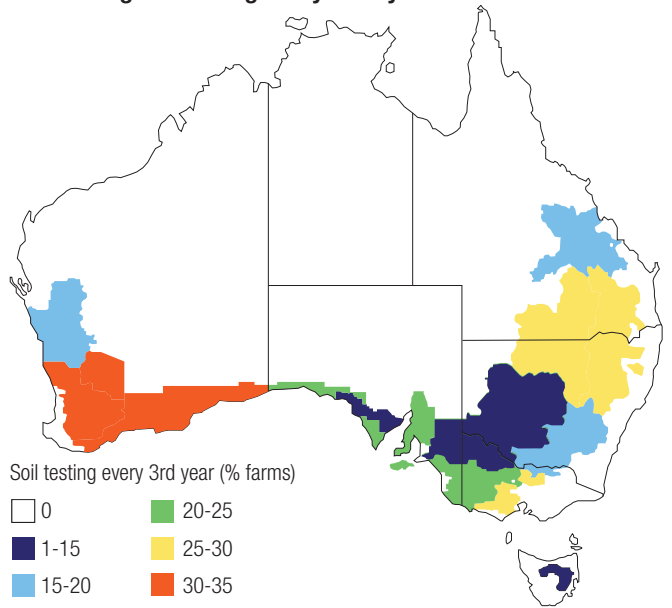


FIGURE 109 Average percentage of crop area where fertiliser program was informed by soil testing in 2011

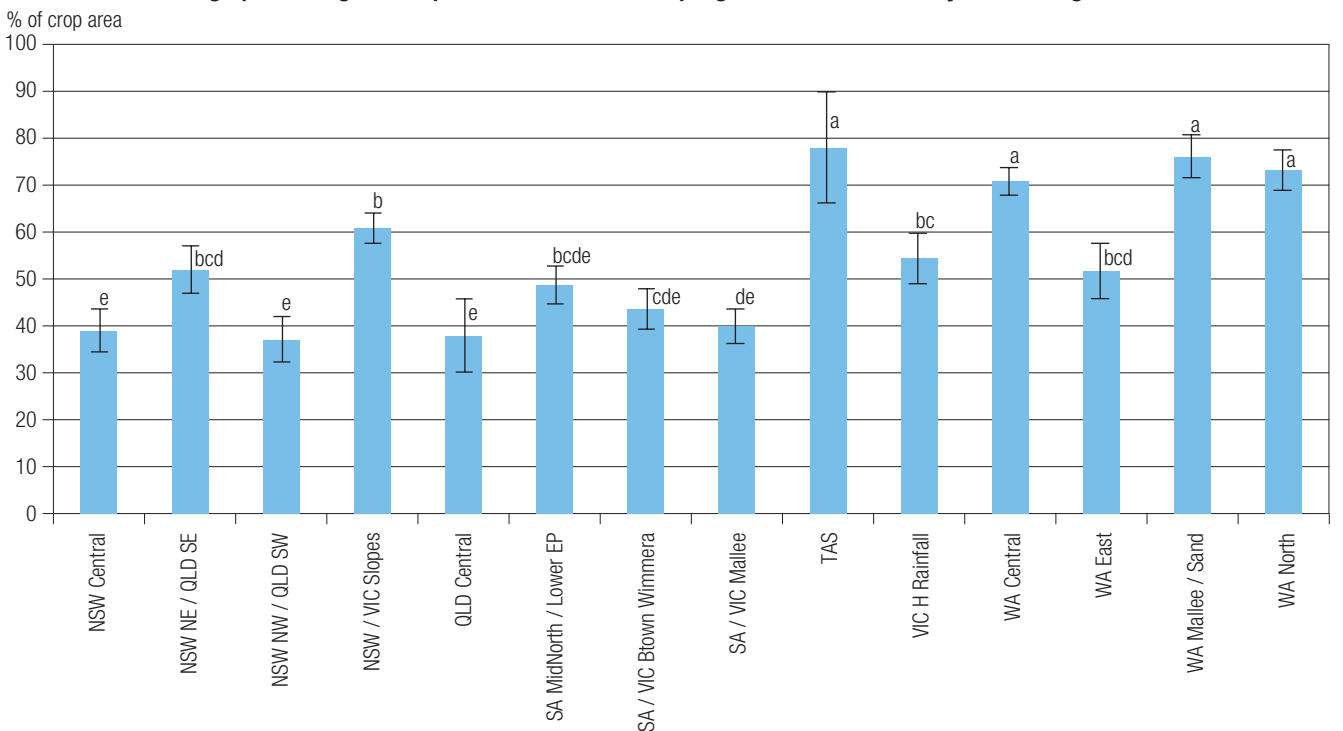


TABLE 65 Average percentage of farms that use soil testing annually, two yearly and three yearly

Agro-ecological zone	Yearly		Every 2 years		Every 3 years	
	2008	2011	2008	2011	2008	2011
NSW Central	23%	29%	20%	23%	34%	12%
NSW NE / QLD SE	33%	39%	25%	21%	25%	29%
NSW NW / QLD SW	33%	31%	15%	20%	23%	29%
NSW / VIC Slopes	33%	30%	18%	16%	20%	18%
QLD Central	38%	47%	38%	21%	12%	16%
SA Mid North / Lower EP	35%	22%	5%	10%	16%	22%
SA / VIC Bordertown Wimmera	33%	27%	19%	6%	18%	22%
SA / VIC Mallee	32%	49%	22%	13%	23%	14%
TAS	0%	0%	33%	29%	33%	14%
VIC High Rainfall	31%	35%	22%	10%	31%	27%
WA Central	31%	22%	14%	12%	30%	32%
WA Eastern	28%	20%	10%	8%	20%	30%
WA Mallee / Sandplain	35%	19%	22%	21%	25%	31%
WA Northern	34%	30%	19%	11%	22%	19%
National Averages	30%	29%	20%	16%	24%	23%

TABLE 66 Average percentage of crop area where the fertiliser program was informed by soil testing

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	41.7	38.9	9.6	ns
NSW NE / Qld SE	50.9	51.9	8.3	ns
NSW NW / Qld SW	34.2	37.0	10.4	ns
NSW / VIC Slopes	58.8	60.8	7.1	ns
QLD Central	23.9	37.9	16.6	ns
SA Mid North / Lower EP	36.3	48.6	8.6	**
SA / VIC Bordertown Wimmera	40.4	43.5	8.3	ns
SA / VIC Mallee	40.1	39.9	6.8	ns
TAS	75.0	77.9	33.8	ns
VIC High Rainfall	53.6	54.4	12.7	ns
WA Central	67.2	70.9	5.9	ns
WA Eastern	44.8	51.8	11.6	ns
WA Mallee / Sand	59.3	76.1	10.2	***
WA Northern	66.3	73.1	9.2	ns
National Averages	49.5	54.5		

SOIL CONDITIONERS



Soil conditioners include lime, gypsum and dolomite.

Soil conditioners are applied to the soil to change its chemical properties. The type of conditioner applied depends on the current soil composition, climate and the type of crop to be sown (Table 71). The most commonly applied products are: lime (calcium carbonate) to raise soil pH; and gypsum (calcium sulfate) to alter the soil calcium:magnesium ratio, assist with sodic soil structure and water relations in the soil, and as a means of providing additional sulfur where desirable. Conditioners can be incorporated into the soil or applied to the surface.

Questions asked in the survey were:

- Now, thinking about soil conditioners, prior to sowing your crops in 2011, did you apply any
 - lime;
 - gypsum; or
 - dolomite?
- In 2010 how many tonnes of lime/gypsum/dolomite did you apply?
- In 2010, to how many hectares did you apply lime/gypsum/dolomite?

Lime

Lime is applied to increase the pH of the soil – the higher the pH the less acidic the soil. Lime also provides a source of calcium for plants, permits improved water penetration for acidic soils and improves the uptake of major plant nutrients such as nitrogen, phosphorus and potassium by plants growing in acidic soils. The percentage of farms where lime was applied prior to planting in 2011 is shown in Figure 111.

Percentage of crop area where lime was applied

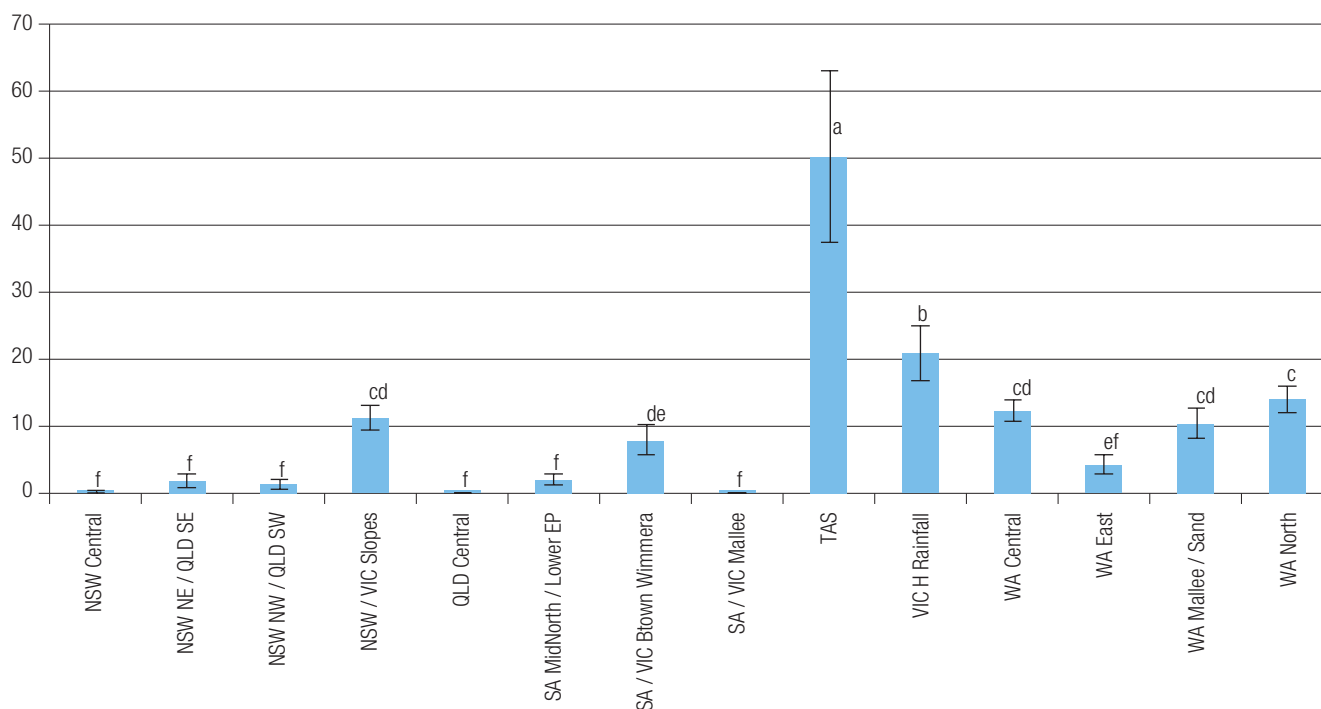
Some Australian grain-producing soils are naturally more acidic than others and the use of annual legume-based pastures (for example, clover and medic-dominant) can also increase soil acidity. There has been an increase in lime use in the NSW Slopes, Victorian High Rainfall zone and parts of SA and Northern WA since 2008 (Table 67 and Figure 110).

TABLE 67 Average percentage of crop area where lime was applied

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	0.1	0.2	0.3	ns
NSW NE / QLD SE	0.9	1.8	1.5	ns
NSW NW / QLD SW	1.2	1.4	1.7	ns
NSW / VIC Slopes	4.1	11.1	3.2	***
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	0.4	2.0	1.3	**
SA / VIC Bordertown Wimmera	4.8	7.8	3.3	ns
SA / VIC Mallee	0.2	0.1	0.2	ns
TAS	8.1	50.2	24.8	***
VIC High Rainfall	12.2	20.9	8.0	**
WA Central	13.2	12.2	2.7	ns
WA Eastern	5.1	4.2	3.1	ns
WA Mallee / Sandplain	9.2	10.3	4.3	ns
WA Northern	6.0	14.1	3.3	***
National Averages	4.7	9.7		

FIGURE 110 Average percentage of crop area where lime was applied in 2011

% of crop area



Use rate of lime

Where lime was used the rate of lime that was applied to the hectares treated was calculated (Table 68).

Gypsum

Gypsum is applied to release nutrients and improve soil structure; in particular it is used for ameliorating sodic soils. Gypsum can also be applied in advance of planting crops with increased sulfur requirements, for example, canola.

There appears to have been an increase in the percentage of the crop where gypsum was used in 2011 as compared with 2008, notably in the NSW/Victorian Slopes

and much of SA and Victoria (Table 69 and Figure 112). Average use rate of gypsum applied is shown in Table 70.

Dolomite

Dolomite is applied, like lime, prior to the sowing of crops such as canola and pulses to increase the pH of the soil, but it is used where magnesium levels are low.

Use of dolomite

The data for the use of dolomite from both the 2008 and 2011 crop seasons is very sparse. In 2008 only 19 farms

TABLE 68 Average use rate of lime (t/ha) on area where applied

Agro-ecological zone	Average use rate (t/ha) 2008	Average use rate (t/ha) 2011
NSW Central	2.00	1.60
NSW NE / QLD SE	1.13	1.81
NSW NW / QLD SW	1.22	1.59
NSW / VIC Slopes	1.51	1.47
QLD Central	0	0
SA Mid North / Lower EP	1.57	1.57
SA / VIC Bordertown Wimmera	1.75	1.00
SA / VIC Mallee	1.66	0.50
TAS	3.96	2.59
VIC High Rainfall	1.90	1.36
WA Central	1.07	1.10
WA Eastern	1.12	1.23
WA Mallee / Sandplain	1.36	1.23
WA Northern	1.18	1.48
National Averages	1.53	1.32

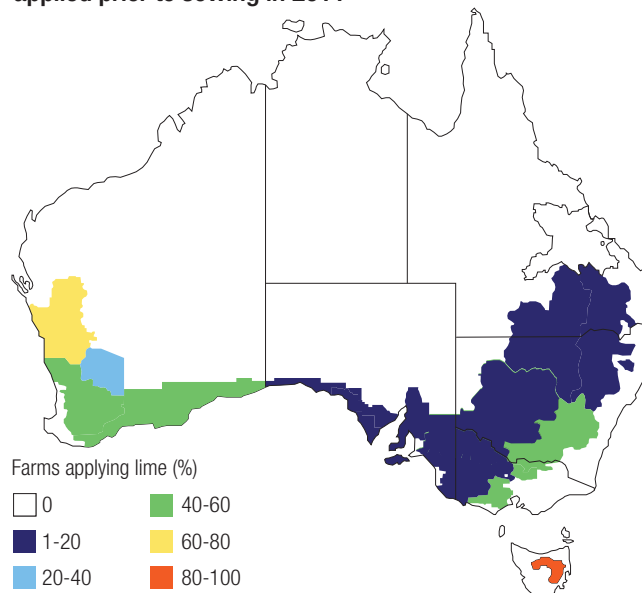
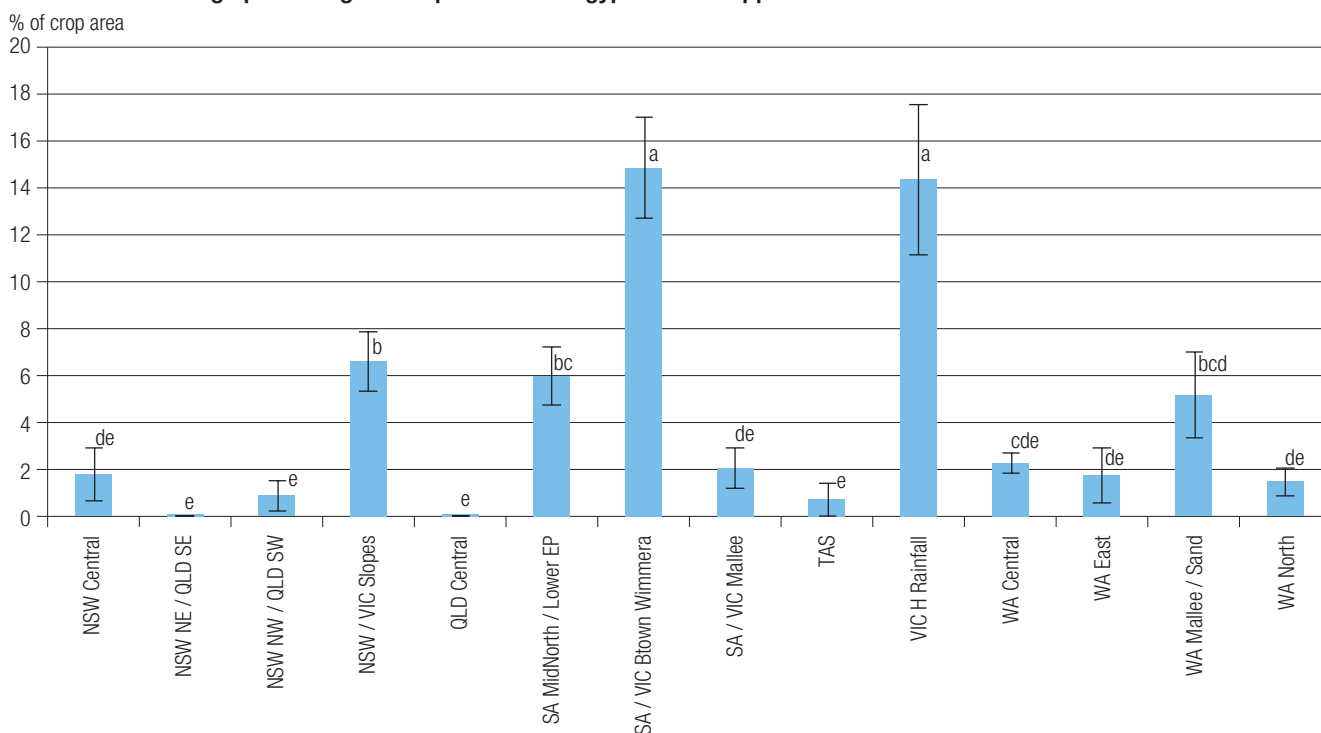
FIGURE 111 Average percentage of farms where lime was applied prior to sowing in 2011

FIGURE 112 Average percentage of crop area where gypsum was applied in 2011



used any dolomite, on a total of 8764ha. In 2011, 21 farms in the survey used dolomite on a total of 4509ha.

Neither dataset could be analysed for any trends of statistical significance.

Summary

Lime continues to be the main soil conditioner applied.

The main agro-ecological zones where lime was applied in 2011 were NSW/Victorian Slopes, Victorian High Rainfall Zone, SA/Victorian Bordertown Wimmera and much of WA (Table 71).

TABLE 69 Average percentage of crop area where gypsum was applied

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	0.7	1.8	1.9	ns
NSW NE / QLD SE	0.9	0.0	1.1	ns
NSW NW / QLD SW	1.5	0.9	1.5	ns
NSW / VIC Slopes	4.0	6.6	2.4	**
QLD Central	0.0	0.0	0.0	ns
SA Mid North / Lower EP	1.4	6.0	2.0	***
SA / VIC Bordertown Wimmera	7.2	14.8	3.3	***
SA / VIC Mallee	1.4	2.0	1.5	ns
TAS	0.0	0.7	1.4	ns
VIC High Rainfall	2.9	14.4	5.8	***
WA Central	2.3	2.3	1.1	ns
WA Eastern	0.7	1.8	1.7	ns
WA Mallee / Sandplain	4.1	5.1	3.0	ns
WA Northern	1.2	1.5	1.1	ns
National Averages	2.0	4.1		

TABLE 70 Average use rate of gypsum (t/ha) on area where applied

Agro-ecological zone	Average use rate (t/ha) 2008	Average use rate (t/ha) 2011
NSW Central	0.87	0.70
NSW NE / QLD SE	1.46	0.00
NSW NW / QLD SW	1.01	0.80
NSW / VIC Slopes	1.02	0.91
QLD Central	0.00	0.00
SA Mid North / Lower EP	1.70	1.30
SA / VIC Bordertown Wimmera	1.46	1.10
SA / VIC Mallee	1.01	0.76
TAS	0.00	0.00
VIC High Rainfall	1.02	0.70
WA Central	0.71	0.92
WA Eastern	1.50	1.32
WA Mallee / Sandplain	1.19	1.72
WA Northern	1.09	0.96
National Averages	1.0	0.8v

TABLE 71 Average percentage of farms applying soil conditioners prior to sowing

Agro-ecological zone	Lime		Gypsum		Dolomite	
	2008	2011	2008	2011	2008	2011
NSW Central	0%	2%	3%	5%	0%	0%
NSW NE / QLD SE	4%	5%	4%	0%	0%	0%
NSW NW / QLD SW	6%	5%	10%	3%	0%	0%
NSW / VIC Slopes	32%	41%	24%	26%	0%	1%
QLD Central	0%	0%	0%	0%	0%	0%
SA Mid North / Lower EP	5%	12%	16%	25%	0%	0%
SA / VIC Bordertown Wimmera	21%	16%	37%	43%	1%	3%
SA / VIC Mallee	2%	1%	6%	7%	0%	0%
TAS	75%	86%	0%	14%	0%	29%
VIC High Rainfall	43%	45%	30%	34%	0%	0%
WA Central	59%	48%	15%	14%	5%	4%
WA Eastern	34%	31%	13%	10%	2%	0%
WA Mallee / Sandplain	33%	40%	28%	33%	1%	0%
WA Northern	30%	60%	10%	11%	7%	10%

SOIL MOISTURE ASSESSMENT



Soil moisture is often the greatest limiting resource for crop production in Australia. Soil moisture levels are an obvious determinant of how well crops can germinate, establish and grow, and – from a management viewpoint – how well crops can respond to additional inputs or management, for example, fertiliser and weed and disease-control measures.

Two questions were included regarding the assessment of soil moisture both at planting and through the crop's life:

- In what percentage of your crop did you measure the plant available soil moisture at planting?
- For what percentage of your crop did you monitor the plant available soil moisture through the crop period?

Assessment of soil moisture at planting to assist in crop decisions

Knowing the level of soil moisture when planning or carrying out management decisions is seen as an important element in a cropping program, both at planting and through the period of the crop.

It appears that assessing soil moisture at planting is a more common practice in NSW and Southern Queensland than elsewhere. The practice is not used in SA and WA to the same extent (Table 72, Figures 113 and 114).

This is likely due to the nature of soils and the climate. In NSW and Queensland, many soils are known to have the capacity to store moisture from rainfall received prior to the crop being planted. An assessment of pre-planting soil moisture is a more standard practice with these soils.

By comparison, in SA and WA soils are generally lighter in texture and do not store as much moisture. Additionally, in the southern and western areas rainfall tends to be more winter-dominant, ideally received through the winter growing season. Hence the need to assess soil moisture at planting of winter crops in the south and west is often considered less. In the southern and western cropping areas the 'break

of season' can determine planting activities more than the amount of soil moisture available at the desired time.

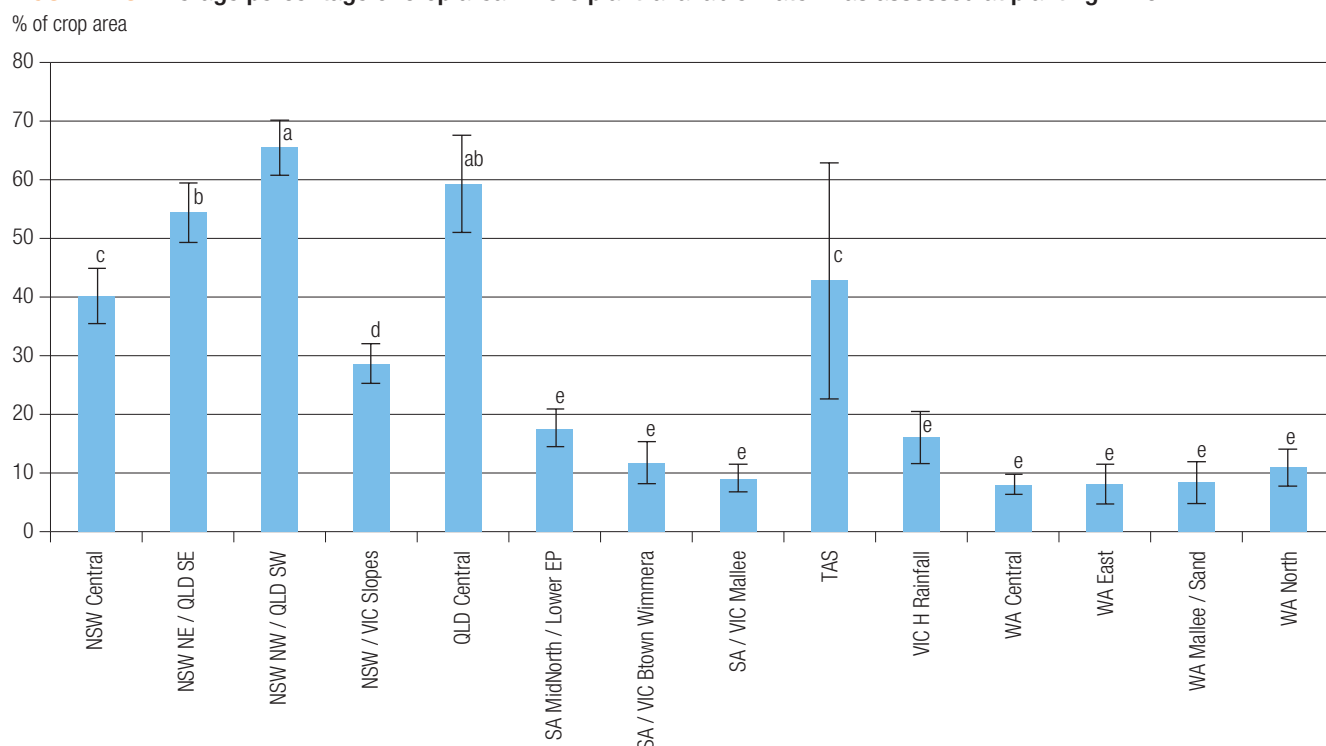
Nonetheless, the percentage of the crop where soil moisture was assessed at planting has grown significantly in 2011 over that in 2008 in all agro-ecological zones.

It is noticeable that a significant increase in the amount of cropland where plant available water is measured at planting

TABLE 72 Average percentage of crop area where plant-available water was assessed at planting

Agro-ecological zone	2008	2011	LSD (5%)	Significance between years
NSW Central	16.8	40.3	9.1	***
NSW NE / Qld SE	27.4	54.5	7.9	***
NSW NW / Qld SW	29.2	65.6	10.3	***
NSW / VIC Slopes	20.1	28.7	6.6	**
QLD Central	8.7	59.3	15.4	***
SA Mid North / Lower EP	3.6	16.6	5.4	***
SA / VIC Bordertown Wimmera	5.2	17.7	5.1	***
SA / VIC Mallee	7.0	12.1	3.9	**
TAS	0.0	42.9	38.3	***
VIC High Rainfall	3.3	16.2	8.5	**
WA Central	3.1	8.0	2.9	***
WA Eastern	2.0	8.1	5.2	***
WA Mallee / Sandplain	0.0	8.4	4.6	***
WA Northern	5.3	11.0	5.3	**
National Averages	9.4	27.8		

FIGURE 113 Average percentage of crop area where plant-available water was assessed at planting in 2011



has occurred since 2008. This is the case across much of SA and Victoria, and all of WA.

Average percentage of crop where plant-available water was assessed through the crop period

Assessing soil moisture through the crop season can assist with strategic decisions, including the application of in-crop fertilisers (for example, nitrogen) and some pesticide or herbicide applications. In partnership with knowledge of soil moisture at planting, this can assist with these and other crop-management practices and gives producers confidence in making some strategic marketing decisions.

The percentage of the crop where soil moisture is being assessed through the crop period has increased substantially since the previous survey. In-crop soil-moisture monitoring is now common in most agro-ecological zones and has grown strongly in all cropping areas (Table 73, Figures 115 and 116).

FIGURE 114 Average percentage of crop area where plant-available water was assessed at planting in 2011

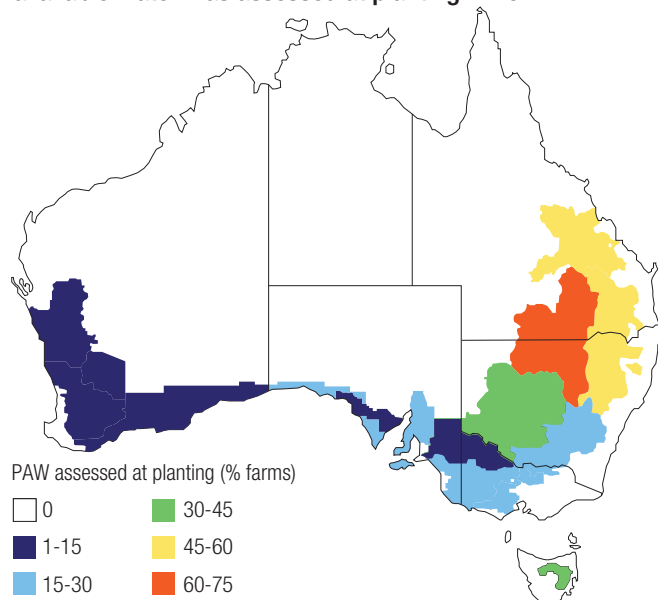


TABLE 73 Average percentage of crop area where plant-available water was assessed through the crop period

Agro-ecological zone	2009	2011	LSD (5%)	Significance between years
NSW Central	11.5	32.2	8.3	***
NSW NE / Qld SE	18.0	33.8	7.1	***
NSW NW / Qld SW	18.5	46.9	10.1	***
NSW / VIC Slopes	19.2	29.4	6.5	***
QLD Central	0.0	37.4	14.0	***
SA Mid North / Lower EP	2.4	17.9	5.5	***
SA / VIC Bordertown Wimmera	4.0	18.3	5.1	***
SA / VIC Mallee	2.8	12.4	3.4	***
TAS	0.0	40.0	36.0	**
VIC High Rainfall	6.0	13.3	8.2	ns
WA Central	3.0	17.5	4.0	***
WA Eastern	0.9	10.2	5.4	***
WA Mallee / Sand	1.5	20.7	7.2	***
WA Northern	5.5	21.1	6.8	***
National Averages	6.7	25.1		

FIGURE 115 Average percentage of crop area where plant-available water was assessed through the crop period in 2011

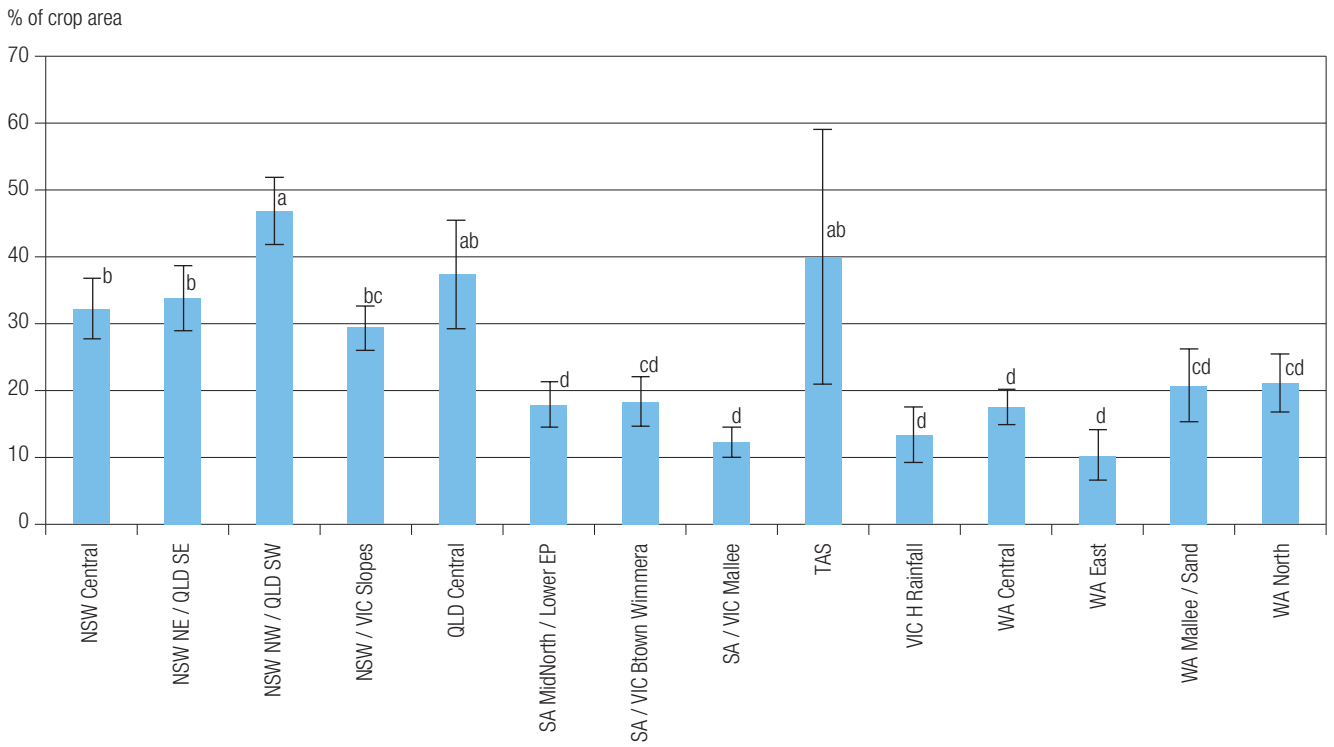
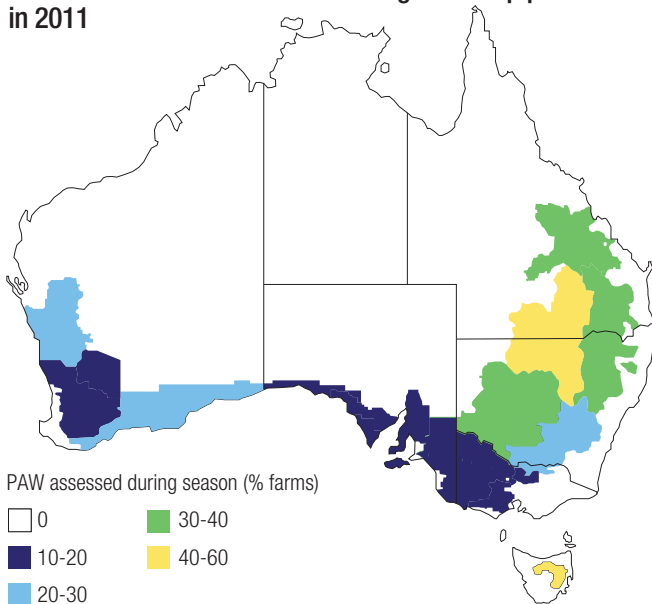


FIGURE 116 Average percentage of crop area where plant-available water was assessed through the crop period in 2011



APPENDIX: QUESTIONS USED IN THE GRDC SURVEY 2011

Basic statistics

- What is the total area of your property, including all leased land and any unused land?
- In 2011, excluding any share farming arrangements, what percentage of your property was used for:
 - cropping;
 - pasture (improved and unimproved);
 - native and/or remnant vegetation; and
 - roadways, buildings etc?

Crop mix

- What crops did you or do you intend to plant in 2011?

Choices were:

- wheat – bread;
 - wheat – durum;
 - barley – feed;
 - barley – malt;
 - oats;
 - triticale;
 - cereal rye;
 - canola;
 - mustard;
 - linola;
 - sorghum;
 - maize/corn;
 - sunflowers;
 - chickpeas;
 - field peas;
 - lentils;
 - lupins;
 - faba beans;
 - broad beans;
 - vetch;
 - soybeans;
 - mungbeans;
 - cotton;
 - cowpeas;
 - azuki beans;
 - navy beans;
 - lima beans;
 - rice; and
 - did not grow crops.
- How many hectares of each of the above crop choices did you or will you plant this year?
 - And what was the main month that you planted or intend to plant your crop this year?
 - How many hectares/acres of crop will you harvest that you sowed this year?
 - And in what month(s) will you harvest your crop that you sowed this year?

Fallow management

- In the sowing of your crops in 2011 (this year), what percentage was sown where a crop was grown in the paddock in 2010?
- What percentage of your crops this year have been planted where this intercrop period has been maintained weed-free since the last crop?
- What percentage has been planted where some weed growth has been present through this intercrop period?
- What percentage has been planted where weed control on this fallow period has been by herbicide only?

Weed control in the fallow

- What percentage has been planted where weed control has been by cultivation and herbicide?
- What percentage of your fallow had livestock on it for greater than one month through the summer fallow period?
- What percentage of your crop had stubble burnt within one month of planting (i.e. a 'cool' burn)?
- What percentage of the summer fallow was maintained by herbicide?
- What percentage of your fallow had livestock grazing through the fallow period?
- On this percentage of the fallow, estimate the number of weeks that livestock grazing occurred?
- What percentage of your fallow was maintained without any cultivation through the fallow period, yet weed control was maintained?

Stubble management between crops

- What percentage of your (summer) fallow paddocks had stubble retained right through until planting?

Tillage

- In the sowing of your crops in 2011, what percentage, was sown using:
 - zero-tillage (<10% soil disturbance, e.g. disc planters);
 - no-tillage (<30% soil disturbance, e.g. knife points);
 - direct drill (one pass at sowing, with full cut planting);
 - one or two cultivations prior to planting operation;
 - reduced-tillage (one cultivation before sowing but less soil disturbance than conventional at sowing); and/or
 - more than two cultivations prior to sowing?

Stubble retention

- Thinking about stubble practices, for your crops sown in 2010, what percentage of your stubble was:
 - intact at planting – standing, no grazing;
 - not standing (e.g. grazed, slashed, mulched, incorporated);
 - cool burn;
 - hot burn;
 - burning of windrows for weed management;
 - stubble raking/windrow burning – whole paddock; and/or
 - stubble-baled?

Sowing time

- What percentage of your crop do you estimate was planted at the optimum time for that crop and variety?
- What percentage of your cereal crops were planted prior to 15 May?
- What percentage of your cereal crops were planted prior to 30 June?

Assessment of soil moisture at planting to assist in crop decisions

- What percentage of your crop did you measure the plant available soil moisture at planting?
- What percentage of your crop did you monitor the plant available soil moisture through the crop period?

Amount of soil testing being carried out on grain farms in 2011

- Do you routinely undertake nutrient soil tests? (Yes/No)
- And what percentage of your arable land has soil testing?
- And on average, how often do you soil test any given paddock? (Yearly, 2 years, 3 years)
- And of your arable land, what percentage of it has its fertiliser use based on soil tests or other predictive tools?

Soil conditioners

- Now, thinking about soil conditioners, prior to sowing your crops in 2011, did you apply any
 - lime;
 - gypsum; or
 - dolomite?
- In 2010 how many tonnes of lime/gypsum/dolomite did you apply?
- In 2010, to how many hectares did you apply lime/gypsum/dolomite?

Precision agriculture

- In 2010, on what percentage of your crop did you use controlled traffic/tramlines?
- In 2010, on what percentage of your crop did you use autosteer GPS systems?
- In 2010, on what percentage of your crop did you use yield mapping or similar technology?
- What percentage of your arable land has fertiliser applied using variable rate technology?

Paddock history

- What percentage of your crop do you estimate has full access to the full soil profile?
- What percentage of your crop had any risk of root disease?
- What percentage of your crop was grown in areas where some soil constraints are present (acidity, sodicity, hard pans, toxicity (e.g. boron)) in the subsoil?
- What percentage of your cereal crops planted this year were planted following a canola crop in 2010?
- What percentage of your cereal crops were planted following a pulse crop last year?
- What percentage of your cereal crops were planted following a pasture phase where the pasture was legume-dominant?
- What percentage of your 2011 crop was planted specifically for weed, disease or other control purposes (e.g. green or brown manure crop, short-term forage legumes, hay crop cut for optimum weed control)?



GRDC
**Grains
Research &
Development
Corporation**

Your GRDC working with you

GRDC, PO Box 5367, Kingston ACT 2604 T 02 6166 4500 F 02 6166 4599