2016

Healthy, Productive and Resilient Landscapes

NORTH CENTRAL VICTORIA

REGIONAL **SUSTAINABLE AGRICULTURE** STRATEGY

Purpose: ***Productive farming while protecting the natural resource base.***

Environmental improvement

Profitable and productive agriculture

Enhanced social capacity

Climate change resilience

Version October 2016

Acknowledgement of Country

The North Central Catchment Management Authority acknowledges Aboriginal Traditional Owners within the region, their rich culture and spiritual connection to Country. We also recognise and acknowledge the contribution and interest of Aboriginal people and organisations in the management of land and natural resources.

Document name: North Central Victoria Regional Sustainable Agriculture Strategy

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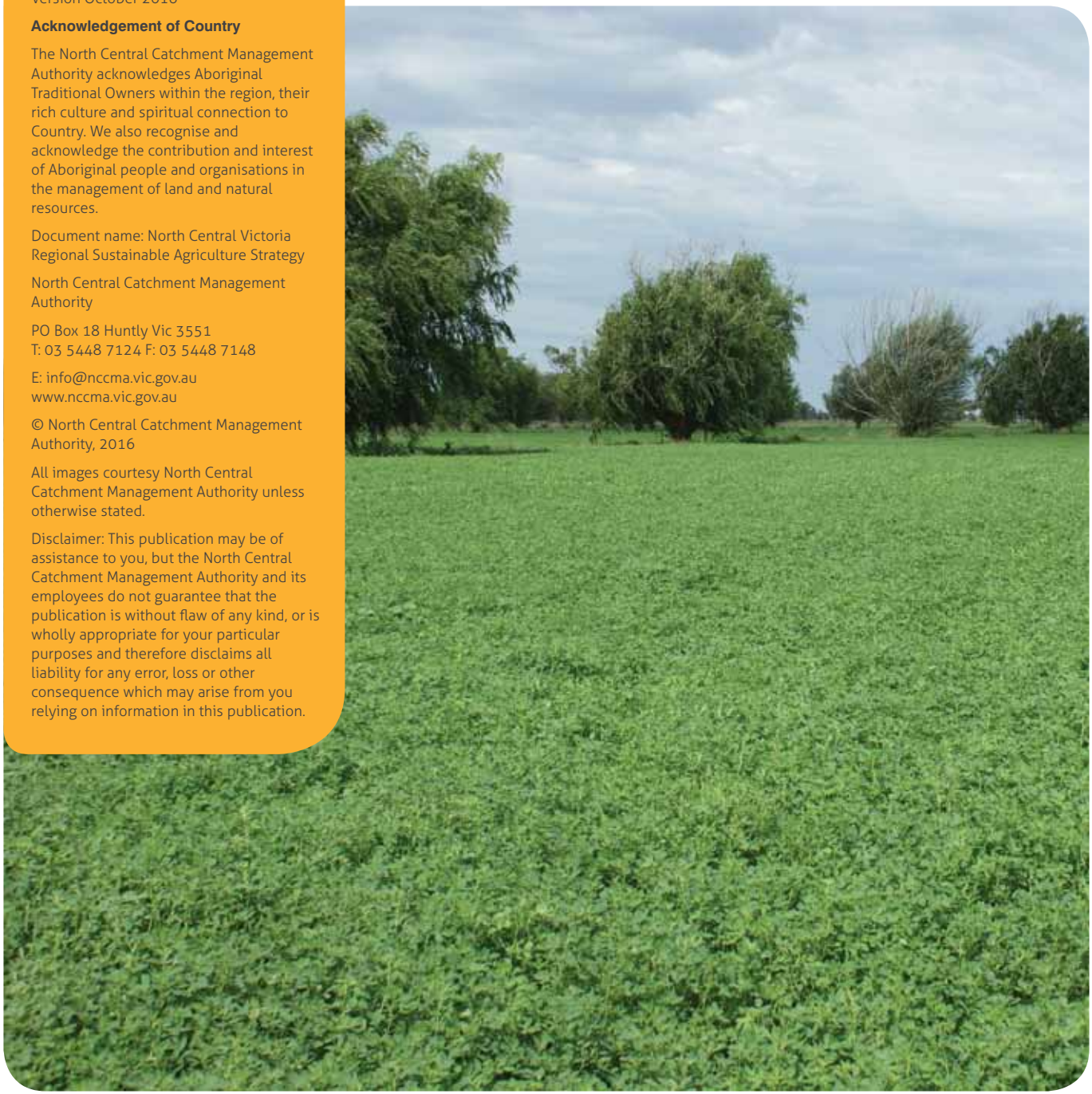
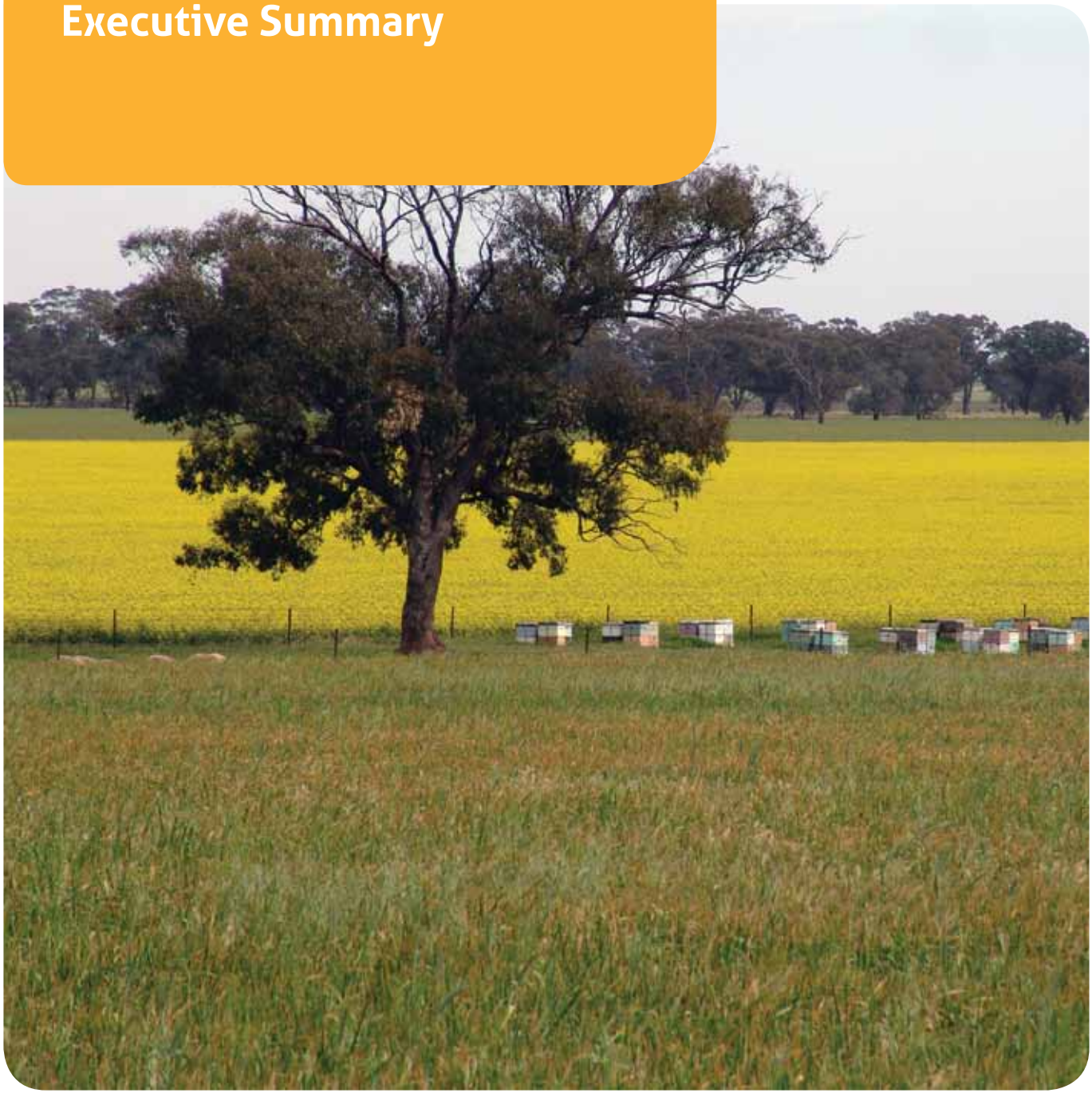


Contents

Executive Summary



Agriculture in north central Victoria continues to undergo rapid change and to achieve greater agricultural sustainability, there will need to be the balance between achieving greater farming productivity whilst protecting the natural resource base and investing in the capacity of our agricultural community.

The change drivers affecting agriculture currently include:

- Increasing climate variability
- Declining soil health
- Water reform and irrigation modernisation
- Technological advances
- Consumer demand for quality food and organic products
- High animal welfare standards and expectations.

Agriculture in north central Victoria has significant economic growth opportunities available but will need to rethink itself in order to be contemporary and profitable. The north central Victoria Regional Sustainable Agriculture Strategy (the Strategy) sets the strategic direction to seize growth opportunities by increasing the adoption of sustainable agricultural practices, addressing the change factors outlined above and protecting the natural resource base on which agriculture depends.

The release of this Strategy comes at a time of high commodity prices, increasing demand for product, an unprecedented level of interest in investing in Australian agriculture, and a buoyant Victorian agricultural community that is positive about its future. At the same time the Strategy recognises the dry conditions that have prevailed across the region, both through the Millennium drought and also over the past two years.

The Strategy draws on the experiences and feedback of hundreds of land managers who have participated in sustainable agriculture programs in north central Victoria over the past ten years. Experienced practitioners, both from private industry and government programs, have also contributed in providing well-rounded perspectives.

The Strategy will:

- Strengthen the improvement of sustainable agriculture in the region over the next 15 years through strategic and practical measures
- Provide a regionally coordinated approach to sustainable agriculture that enhances and builds relationships between the region's service providers, producers, manufacturers and consumers
- Function as a prospectus for attracting future investment and additional resources to achieve sustainable agriculture.

A regionally endorsed Sustainable Agriculture Strategy is a powerful document. Investment in this Strategy is justified as it can:

- Leverage against and optimise existing resources (public and private investment) in regional strategic activities
- Generate and share knowledge, current best practice, learnings and experiences amongst partners
- Generate project ideas and collaborations with other stakeholders.

Improved understanding of soils is a foundation of sustainable agriculture.

Agriculture is experiencing improved on-farm water use efficiency coupled with irrigation modernisation in the north of the region.

Eight well defined world-wide regions of importance are emerging. Australia is located in the Asia Pacific region; and this region leads the world with a GDP of 31% (Northern America is next at 23% and then Western-Central Europe at 19%). The powerful countries within the Asia Pacific region are, in order, China 45%, India 16% and Japan 14% - Australia is 3%. The opportunity exists to generate more wealth by Australia into this region. Australian agriculture export is 'locked into' China due to trade agreements – so the basis for increased wealth is there. In the agribusiness chain, agriculture alone is worth 2.3% to GDP, but the whole value-add chain is worth 10%.

720,000 hectares were cropped in 2012 yielding a GVAP of $368 million.

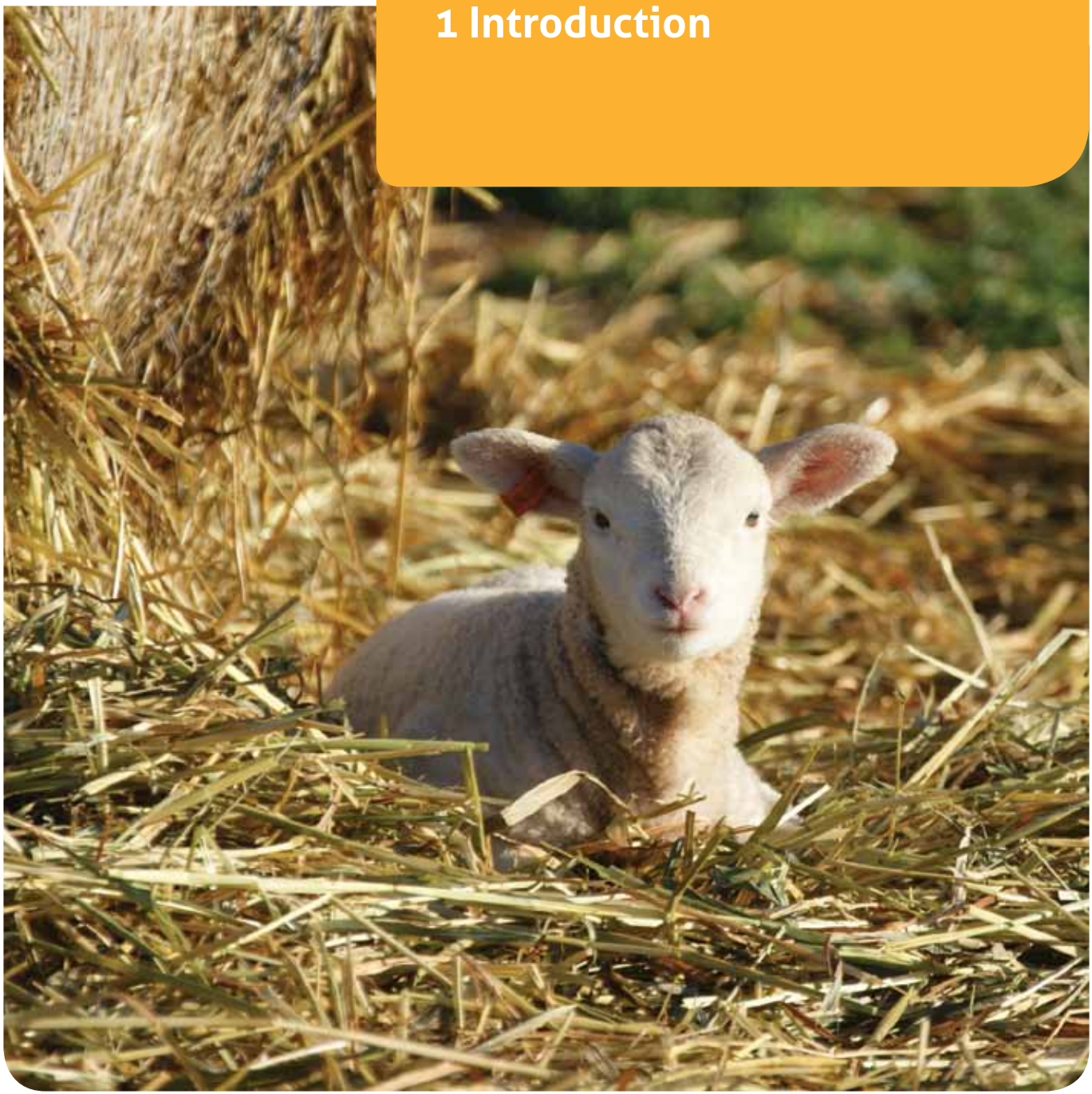
To progress big changes for agriculture we must:

- Acknowledge and keep adapting to a changing climate
- Continually develop agricultural systems and technologies that match local conditions and natural resources
- Explore new commodities, and develop new products and markets
- Determine how to be relevant to external food chains and needs if we want to export successfully
- Invest in infrastructure (i.e. telecommunication, farming, road and rail networks)
- Consider and implement new or alternative land ownership/ management, succession planning and corporate farming structures
- Improve soil health and function
- Improve water use efficiency
- Maintain and enhance social capital by investing in people and communities
- Foster stronger relationships with key players (i.e. communities, politicians and government agencies).

Technological advances in machinery allow liquids to be applied at the time of sowing which is increasing yields and improving soil health.

Perennial horticulture generates a GVAP of around $100M (2012), or 7 % of the total GVAP in the region.

1 Introduction



1.1 Farming productively whilst protecting the natural resource base

Agriculture in the North Central Catchment Management Authority (CMA) region (referred to in this document as north central Victoria) continues to undergo rapid change. This is due to factors that include:

- Increasing climate variability
- Declining soil health
- Water reform and irrigation
- Modernisation
- Technological advances
- Consumer demand for quality food, organic product, and high animal welfare standards.

The timing of the release of the Strategy coincides with variable commodity prices across agricultural industries, increasing demand for product, an unprecedented level of interest in investing in Australian agriculture, and a Victorian agricultural community that is positive about its future. At the same time the Strategy recognises the fluctuating weather conditions that have prevailed across the region, both through the Millennium drought and recent floods.

The Strategy draws on the experiences and feedback of hundreds of land managers who have participated in sustainable agriculture programs in north central Victoria over the past ten years. Experienced practitioners, both from private industry and government programs, have also contributed in providing well-rounded perspectives. The Strategy complements a number of partner initiatives, including local government agribusiness plans, and is strongly aligned to all levels across the agricultural value chain.

The Strategy is an initiative of the North Central CMA in partnership with the region's agricultural community and is supported by government departments and other organisations that work in agriculture.

The *Victorian Catchment and Land Protection Act 1994* (CaLP Act) provides the legislative framework for the North Central CMA's involvement in land protection and sustainable agriculture (see Section 1.2).

Revegetation efforts by land managers, Landcare and community groups over recent decades have created new habitat and protected important land and water assets.

In the CaLP Act land is defined as the 'soil, water, vegetation and fauna that occur on the land'. The stated purpose of the Act is to address land management issues that reduce the quality and productive capacity of the land. Any activity that has an adverse effect on the above elements falls within the definition of causing 'land degradation'.

Providing a broad spectrum of agricultural perspectives and considerations, a Project Steering Committee with community, agency and agriculture industry representatives, has guided the development of this Strategy and has adopted the following **vision**:

'The Strategy provides a framework for achieving a fully functioning regional agricultural sector driven by a healthy, knowledgeable and capable farming community. It will help secure the future of agricultural lands and protection of the natural resource base on which agriculture depends. It will result in healthy soils, increasing food security, improved agricultural enterprise viability, and grow the region's contribution to the economic output of Australia's agriculture.'

Strategy Rationale

To achieve progress towards improved agricultural sustainability in north central Victoria, there needs to be a balance between achieving greater farming productivity while ensuring that the environmental assets and values of the region are enhanced. The region's land managers fully understand that agricultural productivity and environmental well-being are intrinsically linked. The Strategy provides the agricultural community of north central Victoria with opportunities to coordinate efforts, optimise resources and share knowledge through one planning framework. In the face of rapid change it is timely to develop a strategy that improves partnerships and provides the strategic direction to progress agricultural sustainability.

The Strategy aims to strengthen the future of agriculture by being able to 'achieve land protection and secure the natural resource base by increasing the adoption of sustainable agricultural practices'.

The role of the Strategy is to:

- Strengthen the improvement of sustainable agriculture in the region over the next 15 years through strategic and practical measures
- Provide a regionally coordinated approach towards sustainable agriculture that enhances and builds relationships between the region's service providers, producers, manufacturers and consumers
- Function as a prospectus for attracting future investment and additional resources to achieve sustainable agriculture.

The Strategy takes an overarching perspective to guide sustainable agriculture and does not provide paddock level detail to land managers. This Strategy does not tell land managers how to farm but rather provides a regional decision support framework to guide sustainable agricultural practices appropriate to north central Victoria.

The Strategy identifies practices and farming systems that will lead to sustainable agriculture outcomes; and over time as information improves and experiences point towards alternative thinking, agricultural practices and farming systems will be adapted. The Strategy takes the position that practices and systems applied on an individual farm will depend on local factors that include the family's goals, enterprise types, soil types, climate, access to a reliable water supply, access to technology and the internet, level of debt, and attitude for risk.

A regionally endorsed Sustainable Agriculture Strategy is a powerful document. Investment in this Strategy is justified as it can:

- Leverage against and optimise existing resources (public and private investment) in regional strategic activities
- Generate and share knowledge, current best practice, learnings and experiences amongst partners
- Generate project ideas and collaborations amongst stakeholders.

In order to evaluate the impact of this Strategy the North Central CMA and its partners will develop a monitoring, evaluation, reporting and improvement sub-strategy that will look to a number of indicators, including:

- The value of any increased funding; or funding retained in the area of sustainable agriculture
- Partnerships developed and relationships fostered
- Knowledge transfer and the increase in community capacity
- The number of adopters of practice change reflecting progress towards improved sustainable agriculture
- The improvement in the condition of the region's natural resource base.

This Strategy is founded on the principle that given appropriate support the regional community will have the capacity and be prepared to make the hard decisions necessary to achieve a more sustainable future.

1.2 Sustainable agriculture

Agriculture is a very recent experience for the ancient Australian landscape. However, the ability of the agricultural industry to adapt, innovate and form successful collaborations will continue to support a strong and prosperous Australia with sustainable food security, provided we recognise and act on the need to protect the natural resource base on which agriculture depends.

Regardless of the future economic and social drivers for agriculture, the skillful combination of scientific and practical knowledge will remain the essential vehicle on this journey towards sustainability (Keating and Harle, CSIRO, 2004).

Moving towards greater adoption of sustainable agriculture requires our region's land managers to collectively reconsider current practices. Rethinking our agricultural practices requires us to consider the constraints that could prohibit us from a long-term sustainable future. It is vital to talk with land managers in order to understand what is important to them for the long-term health of the environment and for the benefit of current and future generations.

Practices that degrade the natural resource base and cause off-site impacts need to be mitigated against so that we enhance our local environment and regenerate our agriculture.

'Sustainable agriculture' means different things to different people. The Strategy describes, but does not define, sustainable agriculture. Four different perspectives of sustainable agriculture are provided here:

- In its simplest form 'sustainable agriculture' is any of a number of environmentally friendly farming methods that preserve an ecological balance by avoiding depletion of natural resources. (dictionary.com)
- According to the Project Steering Committee 'sustainable agriculture' is achieved when a farming system is able to proceed over the longer-term (a number of generations), without degrading the quality of the land or causing negative off-site impacts to the environment, whilst supporting ecosystem services, community wellbeing and financial viability (Project Steering Committee, 2015)
- The Sustainable Agriculture Initiative (SAI) Platform is a global food industry initiative based in Europe. According to the SAI Platform 'sustainable agriculture' is *the efficient production of safe, high quality agricultural products, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of all farmed species." (http://www.saiplatform.org/)*
- Sustainable agriculture refers to an agricultural system that is ecologically sound, economically viable, and socially just—a system capable of maintaining productivity indefinitely. (Eicher, University of California, 2003).

The Strategy advocates farming for Australian conditions in order to move towards greater sustainability. The quote from Charlie Massy 'many of us still have not mentally or ecologically arrived on this continent' is a real thought provoker (Massy, 2013).

The natural resource base includes major assets such as vegetation, soil, and water. A sustainable agricultural system requires 'healthy' ecological systems. A good indicator of ecological health is assessing the presence and condition of the autotrophic (self-nurturing) species such as plants, fungi, bacteria and the lower heterotrophic level species such as micro and macro invertebrates in the soil and water.

Achieving improved agricultural productivity is a balancing act. Productivity is often driven by price, and if circumstances prevail for greater production, then the ability of our natural systems to hold up under sustained pressure will depend on farming practices that match land use to land capability. The Sustainable Agriculture Framework (see Section 2) provides land managers with the opportunity to consider their current land and water management practices and whether these are sustainable or not.

The framework espouses the productivity indicator in combination with environmental improvements which can be measured through gauges such as the level of groundcover (measured through Landscape Function Analysis - Sydney University methodology), soil carbon (measured through soil organic carbon), and off-site impacts (nutrient and sediment loads into receiving waterways).

1.3 North central Victoria

Covering 13 per cent of Victoria the region is bordered by the Murray River to the north, the Great Dividing Range and Wombat State Forest to the south, Mt Camel Range to the east, and the western boundary of the Avon-Richardson catchment to the west. The region's main rivers are the Campaspe, Loddon, Avoca and Avon-Richardson rivers, which form part of the southern Murray-Darling Basin. The region also has a diversity of natural environments, including rivers and floodplains, Box-Ironbark forest and woodlands, iconic River Red Gum forests and Riverine Plain grasslands. These habitats contain significant biodiversity, including many endangered flora and fauna species. From mountain forests to floodplains north central Victoria contains some of the most diverse landscapes and land-uses of all ten catchment management authority (CMA) regions in Victoria. (see Figure 1.1).

The region has a population of over 240,000 people, concentrated in the growing regional hub of Bendigo, and towns of Kyneton, Woodend, Castlemaine, Echuca and Swan Hill. The southern part of the region is a popular lifestyle choice for "tree-changers" with the annual population growth projected to continue at almost 50 per cent greater than the average for regional Victoria (Loddon Mallee Strategic Regional Plan Southern Region, 2013).

The annual rainfall varies across the region from 300 millimetres (mm) in the north-west to over 1200 mm in the south-east. Temperatures to the south often fall below one degree celsius (°C) during the winter months while to the north regularly reaches above 40°C in summer.

Gunbower Creek

The Cascades on Coliban River. Courtesy Imagine Photography

Figure 1.1 North central Victoria is agriculturally diverse.

1.4 Agriculture in north central Victoria

North central Victoria is agriculturally diverse. Eighty seven per cent of land in the region is privately owned and much of it is used for agriculture. The region comprises a rich variety of land and soil types that sustain a diverse range of agricultural enterprises. There are extensive areas of irrigation in the north, productive cropping and mixed farming (largely in the west) and cropping and mixed farming country in the mid and upper catchments. Intensive animal and horticultural enterprises are also found throughout the region. Rural living is an emerging and expanding land use across the region.

In 2012 the total area of agricultural production was 1.7 million ha. Broadacre cropping and mixed farming takes place on 87% of land used for agriculture (around 1.48 million ha). The gross value of agricultural production (GVAP) in north central Victoria was around $1.4 billion in 2012 up from $1.1 billion in 2001 (see Figures 1.2 and 1.3).

Based on GVAP grain is the region's largest sector, followed by dairy, livestock and the intensive animal industries. Wheat generated $166 million in 2012 or 15% of the value of the Victorian crop. In 2012 the dairy industry generated $316 million in gross value of milk, representing around 13% of the state's gross value. Horticulture accounted for around 10% of the region's GVAP in 2012.

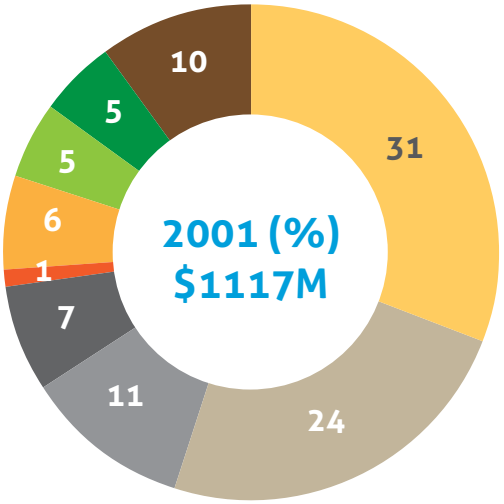


Figure 1.2 Percentage of gross value of agricultural production in north central Victoria: 2001.

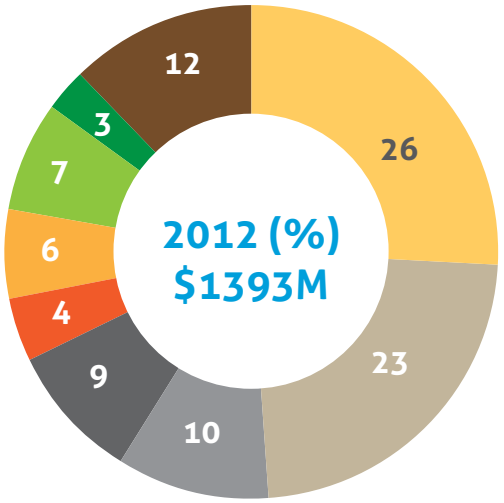


Figure 1.3 Percentage of gross value of agricultural production in north central Victoria: 2012.

The industries where there has been the highest growth in GVAP over the past decade are meat sheep, intensive animals and perennial horticulture. The relative proportions of the other sectors have remained relatively steady. There has been substantial consolidation of dairy and intensive animal farms, and some consolidation of grain farms over the past decade. On the other hand, there has been little consolidation of sheep and beef farms whereby the range of farms by business size and area of holding changed little between 2001 and 2012. The relative proportions of the other sectors have remained steady.

Most of the region's production is generated in the northern areas from broadacre cropping, mixed farming, horticulture and dairy. north central Victoria does, however, include a significant high value fresh stonefruit industry located in Woorinen and Tresco. There has been substantial consolidation of dairy and intensive animal farms, and some consolidation of grains farms over the past decade. On the other hand, there has been little consolidation of livestock farms whereby the range of farms by business size and area of holding has changed little between 2001 and 2012.

In the north of the region the efficient use of irrigation water continues to drive population and economic growth. In the southern area, particularly near major population centres, traditional agricultural pursuits are giving way to smaller enterprises and rural living zones. While many profitable farms remain south of Bendigo, this transition is being driven by increased land amenity values, which in most cases exceed the primary production capacity of the land.

Figure 1.3 also illustrates the uniqueness of agriculture in north central Victoria where there is a diverse range of industries each contributing strongly to the Victorian economy.

1.5 Agriculture zones of north central Victoria

For the purpose of this Strategy, north central Victoria has been divided into four broad agricultural zones (see Figure 1.4). The zoning recognises the main agricultural land uses so that information provided to land managers in these zones is factual and relevant. The actions undertaken in these zones can also be tailored to meet the land and water management challenges and provide opportunities relevant to each zone. The four broad agricultural zones featured in Figure 1.4 will allow us to analyse data from a variety of sources to provide both a quantitative (e.g. ABARE Census) and a qualitative (e.g. 2014 Charles Sturt University social survey) perspective of agricultural practices and production in north central Victoria (see Section 5.2).

Large machinery makes it possible to sow more than 200 hectares in a day.

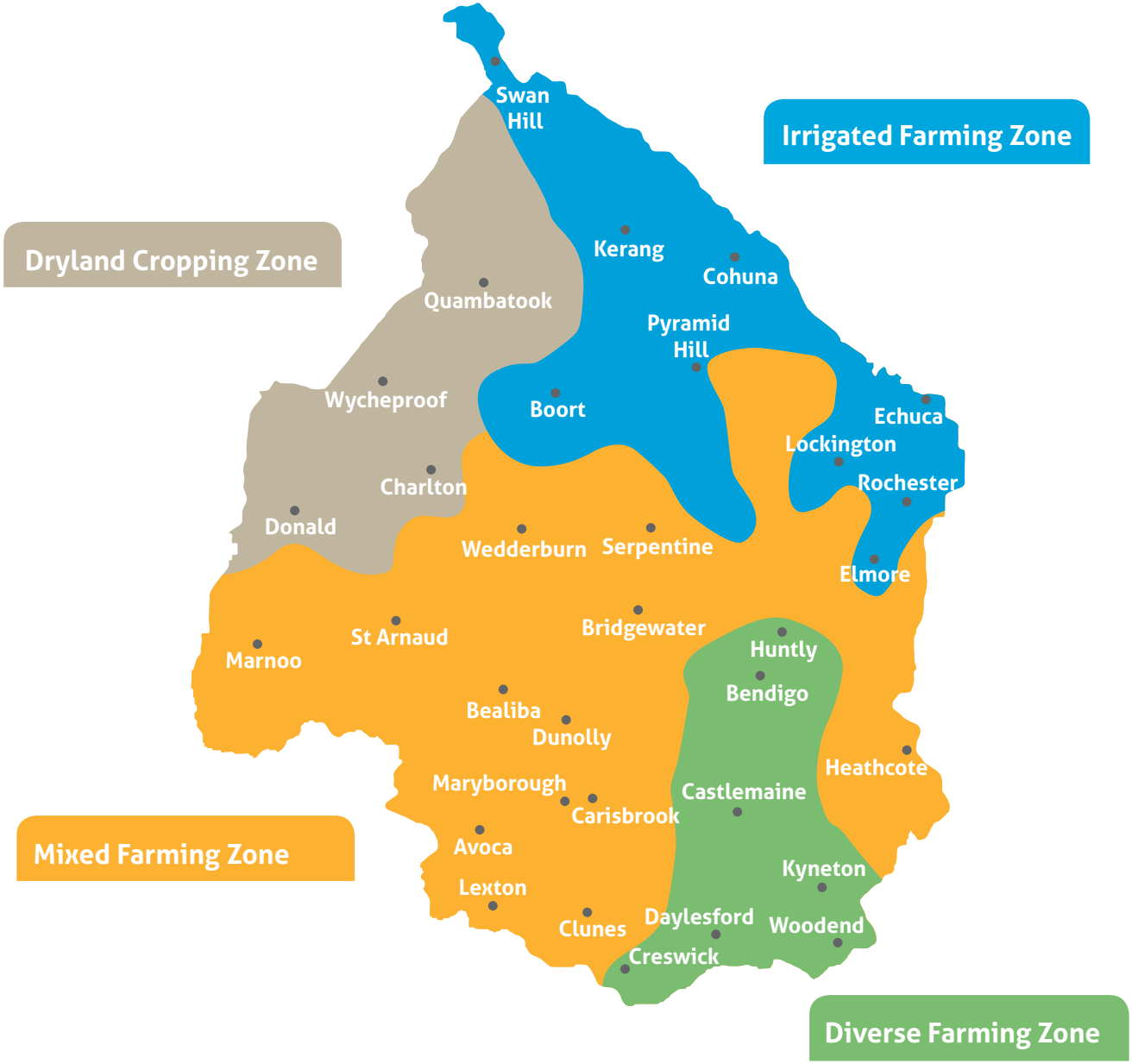


Figure 1.4 The four broad agricultural zones based on the geomorphology of north central Victoria.

Land use data for the four north central Victoria Agricultural Zones

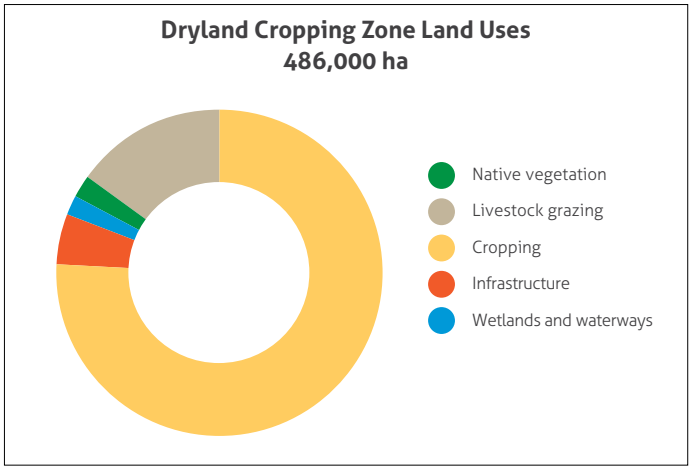
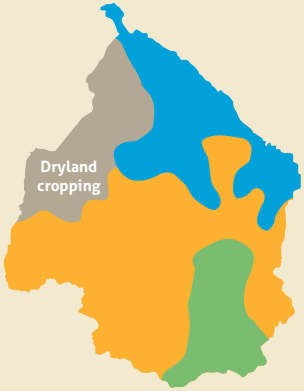


Figure 1.5 Land use in the Dryland Cropping Zone of north central Victoria.

Dryland Cropping Zone key points:

- 76% of land used for dryland cropping (2012)
- Production levels and crop area remained steady
- Farm businesses increasing in size of holding and GVAP
- Cereals (wheat, barley, and oats) are the main crops
- Advances in wheat yield have slowed over past 15 years
- No-till and reduced tillage widely adopted reducing the risk of wind and water erosion.

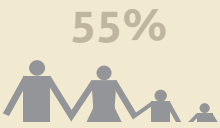
Main regional agricultural zone: Dryland Cropping



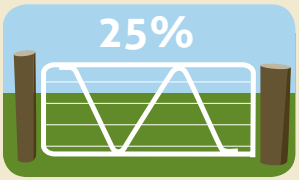
Average property size

Cropping farmers average age

GVAP (2012)



Stage of Succession plan (not started or early stages)



Property Management Plan (Yes)

Undertaken a soil test survey in past 5 years

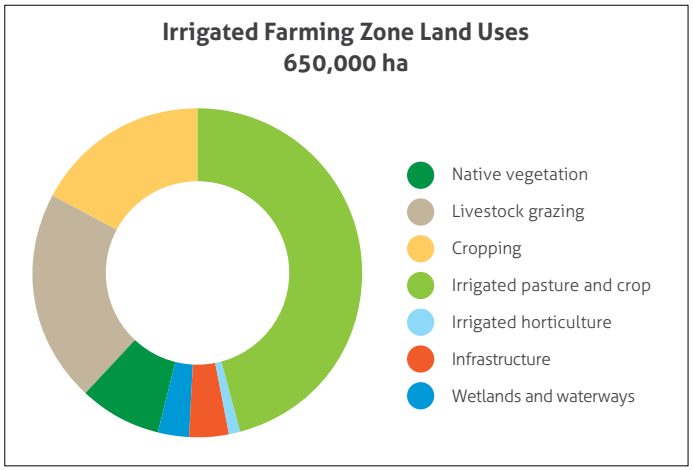
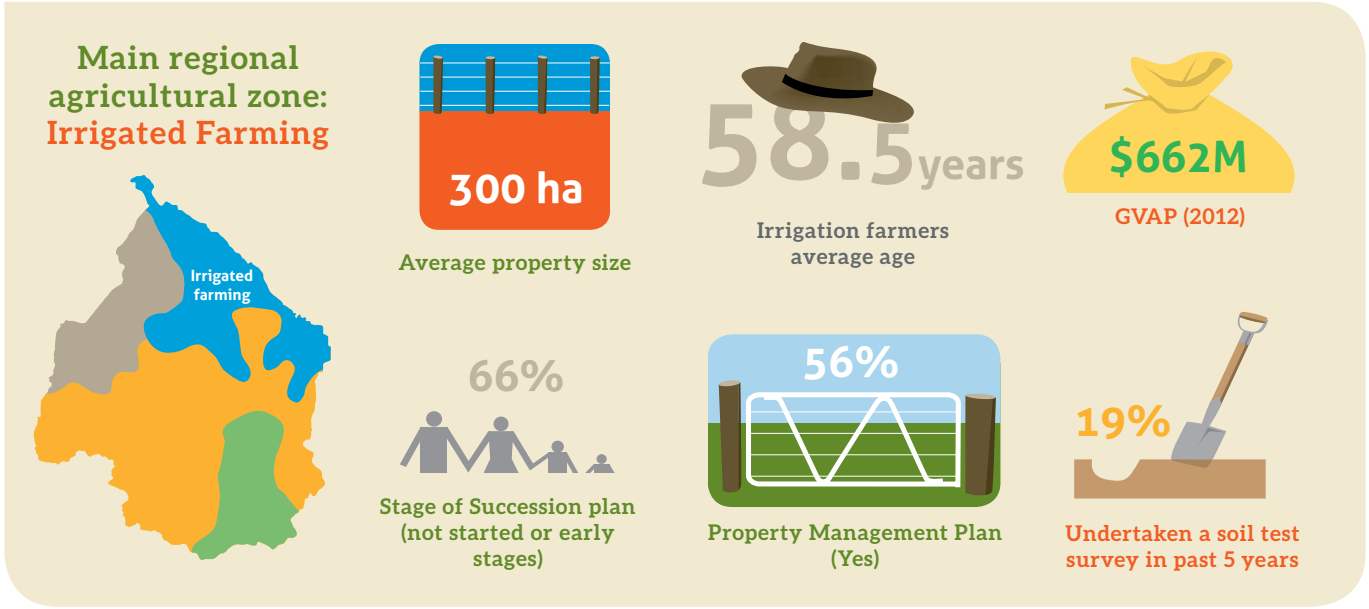


Figure 1.6 Land use in the Irrigated Farming Zone of north central Victoria.

Irrigated Farming Zone key points:

- 46% of land is irrigated pasture and cropping. A further 38% mixed is irrigated farms (2012)
- Land managers deal with risk by opportunistic irrigation (availability, commodity price) and property amalgamation
- Dairying generates over 20% of the total GVAP in north central Victoria from 5% of the land area; and uses 55% of the irrigation water in the region
- Irrigated mixed farms (crops, fodder and pastures for grazing beef cattle and sheep) use 40% of the region's irrigation water. These farms have contracted due to water trade. Significant areas of land are now dryland or are only opportunistically irrigated
- Perennial horticulture generates around 7% of the total GVAP in the region from 1% of the land area and approximately 5% of the irrigation water use.



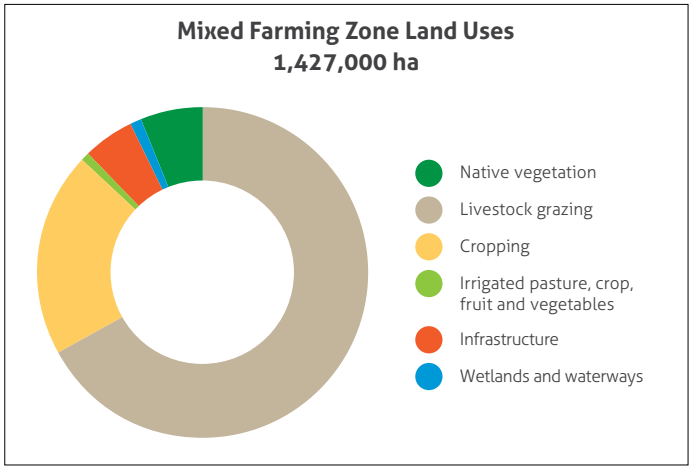
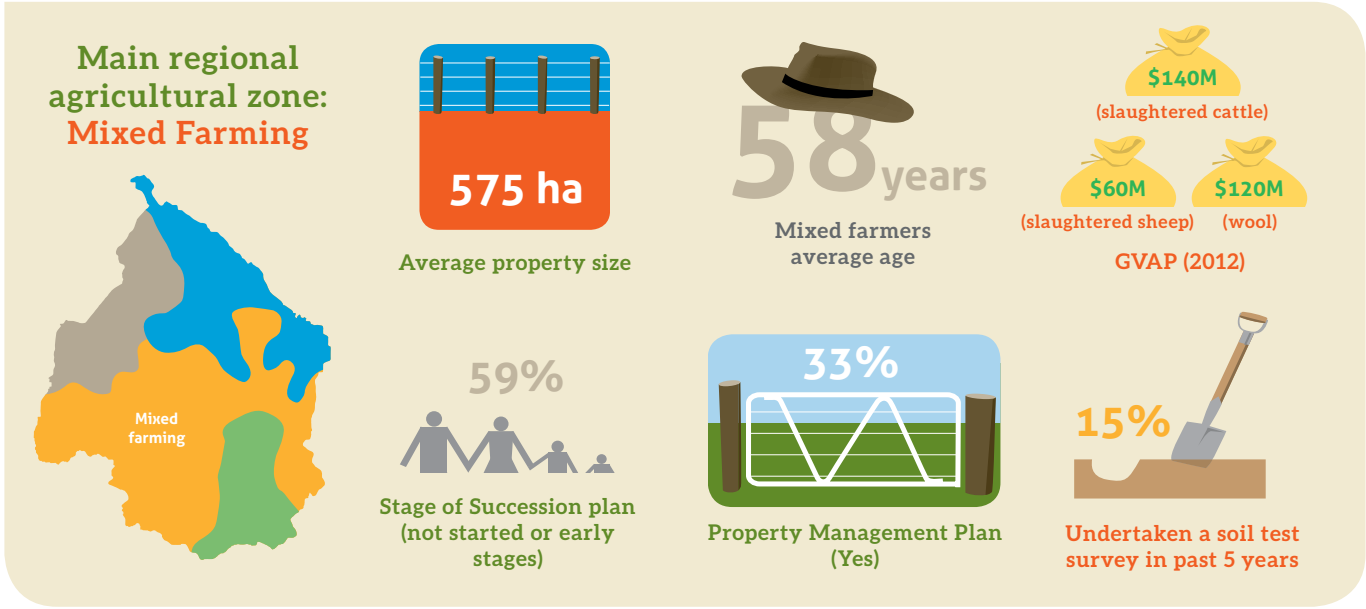


Figure 1.7 Land use in the Mixed Farming Zone of north central Victoria.

Mixed Farming Zone key points:

- 67% of land used for livestock grazing and 20% used for cropping (2012)
- Sheep numbers have decreased, but gross value of sheep meat has increased over last ten years
- Cattle numbers fell continuously during the extended dry period, but have since recovered
- Little consolidation of livestock farms. Range of farms by business size and area has changed little since 2001
- A marked increase in smaller beef farms (< 50 ha) in the highlands, including Daylesford and Kyneton areas.



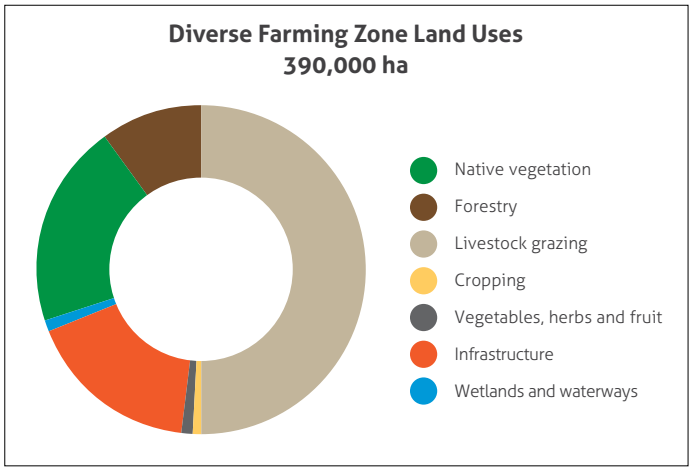
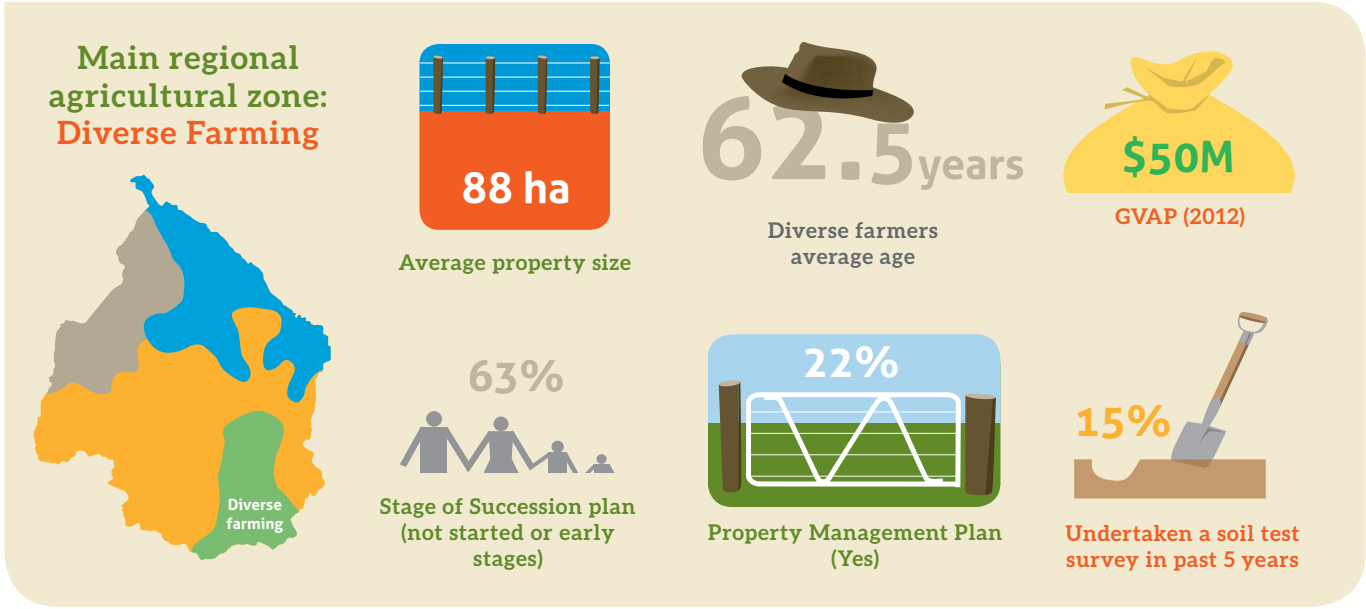


Figure 1.8 Land use in the Diverse Farming Zone of north central Victoria.

Diverse Farming Zone key points:

- 50% of land use is livestock grazing. Many farms are categorized as lifestyle grazing
- 10% of the zone is commercial forestry
- Native vegetation comprises 20% of the land area and is predominantly on public land
- 17% of land is classified as Infrastructure (roads, railways, buildings and urban areas).



1.6 Environmental stewards of north central Victoria

The region's land managers are recognised as some of the most successful and innovative growers of food and fibre. They are also passionate about improving the condition of the natural resources on which they rely. Landcare was founded in the region in 1986 and there are now approximately 160 Landcare groups across north central Victoria. The 2014 Charles Sturt University (CSU) social benchmarking survey revealed that 40% of the region's land managers are members of a Landcare group. Landcare will remain an important vehicle for communicating with the region's land managers.

The region's land managers are at the frontline of protecting and enhancing the region's high priority natural assets by undertaking conservation activities such as minimum-till cropping, fencing out livestock from waterways and wetlands, planting cover crops, and integrating crop and pasture rotations. They are also leaving priority areas such as riparian zones and native grasslands to naturally regenerate. This protects biodiversity and makes these areas available for future generations to enjoy.

Many land managers are also moderating their use of nutrients, fertilisers, pesticides and insecticides. They are increasingly using soil tests and monitoring farming practices to inform how much, when and where to apply inputs. Not only does this reduce the impact of agriculture on the environment but is also a smarter use of resources that helps improvement profitability.

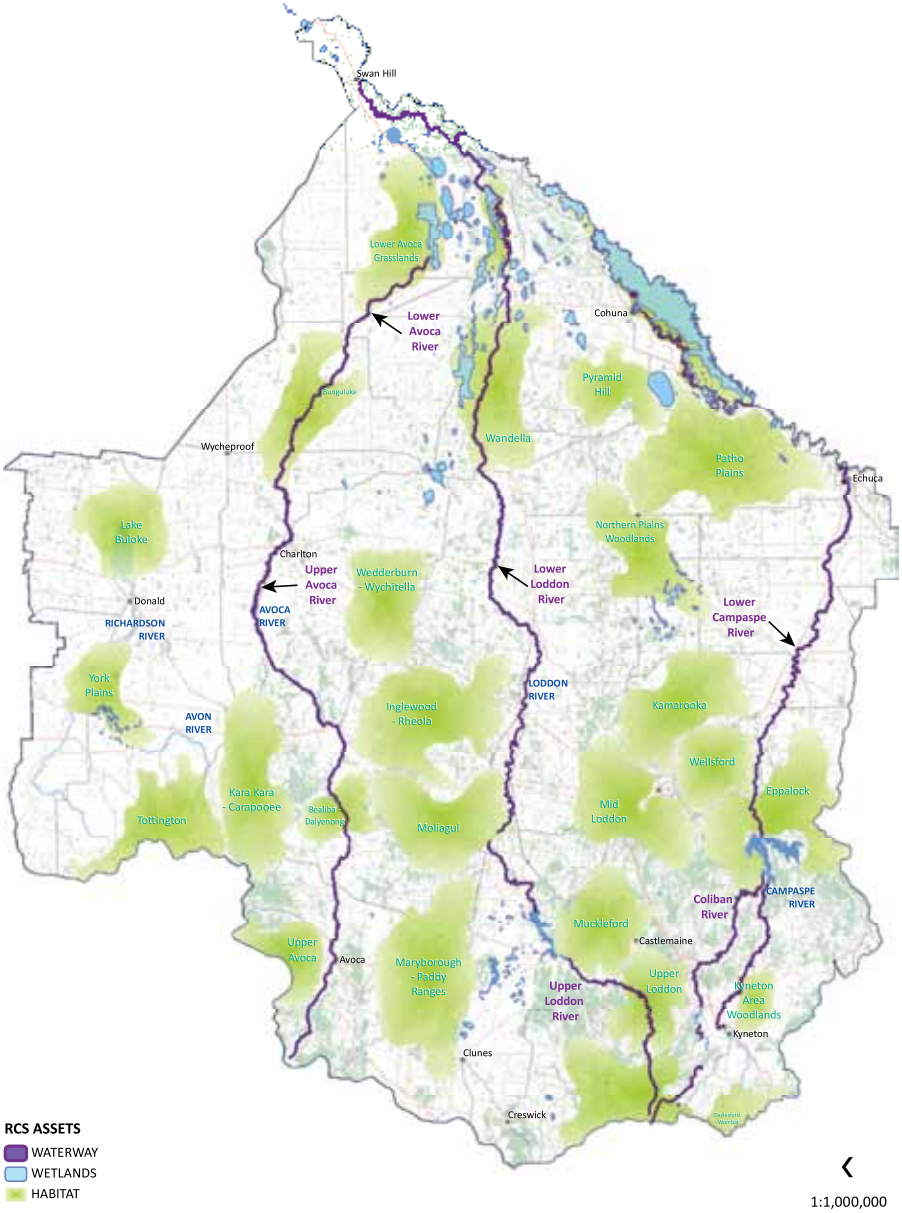
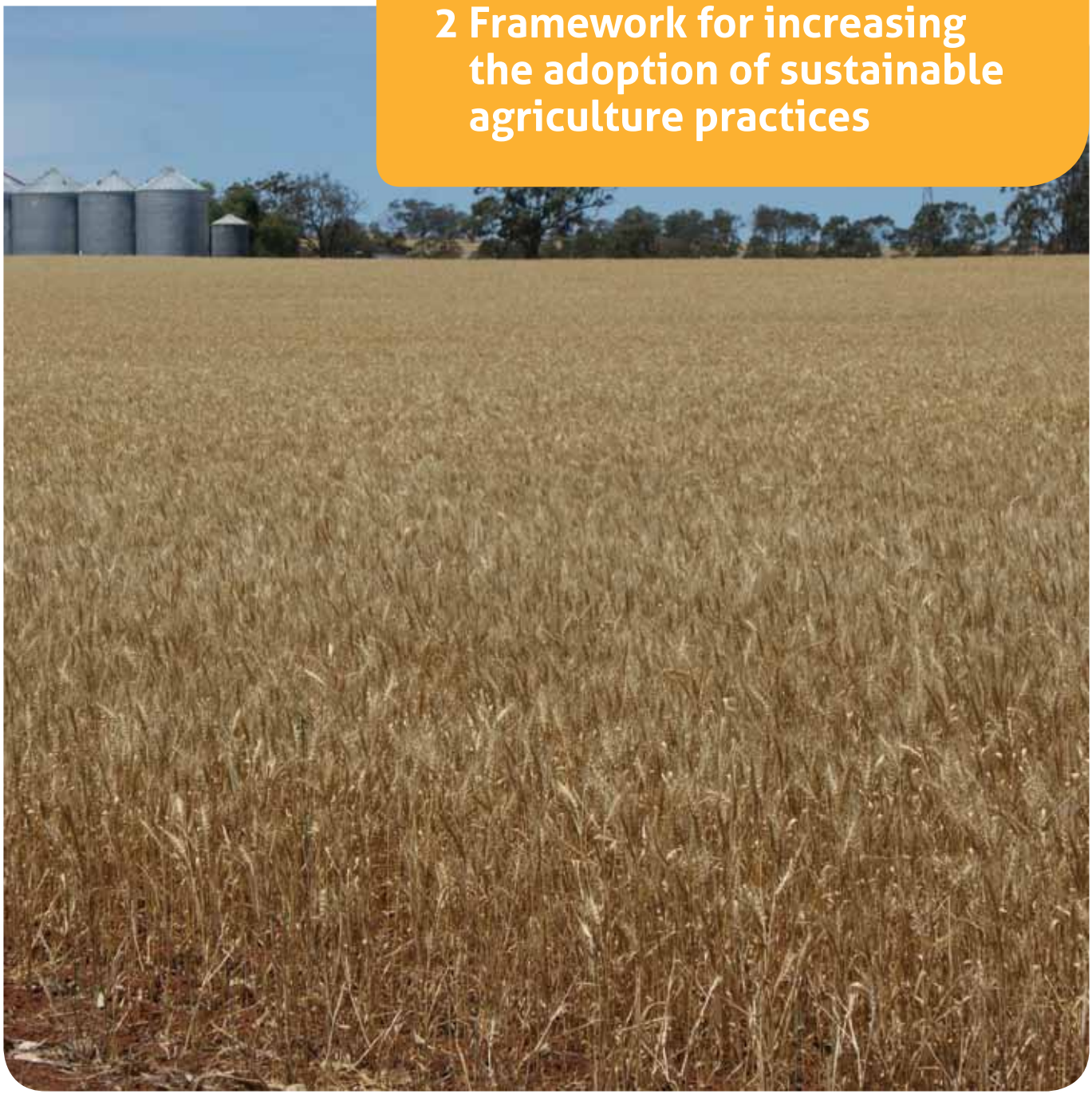


Figure 1.9 Key environmental features of north central Victoria.

2 Framework for increasing the adoption of sustainable agriculture practices



This Strategy provides a framework for increasing the adoption of sustainable agricultural practices across the region. Subsequently, the Strategy takes the position that as a region and as individuals we have not achieved sustainable agriculture. The Strategy also takes the position that there is no single definition of sustainable agriculture that is applicable and meaningful to each individual landholder or organisation.

Depending whether you are a landholder, working for a government agency, or providing industry support, what shapes your thinking will be different (i.e. key questions, timeframes, deliverables and outcomes). Each person's journey to sustainable agriculture is different. The path can best be determined by asking:

'Where am I currently in terms of sustainable agriculture and can I do better?'

The efficient application of irrigation water is vital to a sustainable agricultural future.

Farming is a complex business. There are four key considerations which guide the answers to this question:

1. Will the farm be suitably productive over the long-term to generate wealth and be economically viable?
2. Are the farming practices environmentally sound by enhancing the natural resource base and minimising off-site impacts?
3. Are the farming practices socially acceptable and do we have adequate social capacity and knowledge?
4. Will the farm be resilient to variable climatic conditions and change whilst maintaining productive capacity?

This Strategy adopts a framework that any land manager, service provider or government agency member can use to help determine their progress along the continuum to sustainable agriculture (see Figure 2.1).

2.1 Key sustainable agriculture indicators

Regional spatial landscape information is available at a scale that when layered together provides the 'story' of where the region is now and provides us with the opportunity to measure progress along pathways towards sustainable agriculture. When soil types, land use, industry zones, bioregions, social analysis etc., are collated and analysed into a catchment-level model we can scope sustainability pathways and identify change drivers, separating out whether we can influence these or not.

This regional analysis is useful to provide an overall understanding about the progress towards sustainable agriculture, but there is still the need for paddock scale analysis by land managers and experts. The Strategy will support avenues for paddock-scale analysis and point to the opportunity but will not actively undertake such action.

This Strategy's sustainable agriculture framework utilises the four key farming considerations to provide the sustainability indicators; that any individual land managers can use in order to help determine points to progress along the continuum to sustainable agriculture. Collectively the aggregated data of all or many of the region's land managers will provide a metric that indicates the overall region's progress and the success of this Strategy (also see proposed approach to regularly surveying land managers in Section 5).

The Strategy's four sustainable agriculture indicators are:

1. Profitable agricultural production
2. Environmental improvement
3. Enhanced social capacity
4. Climate change resilience.

Each individual landholder's journey along the path to sustainability will constantly evolve and be modified depending on the likes of current weather conditions, commodity prices and available resourcing. It will be useful for land managers and agricultural stakeholders to regularly reflect and answer against the sustainable agriculture framework and key indicators.

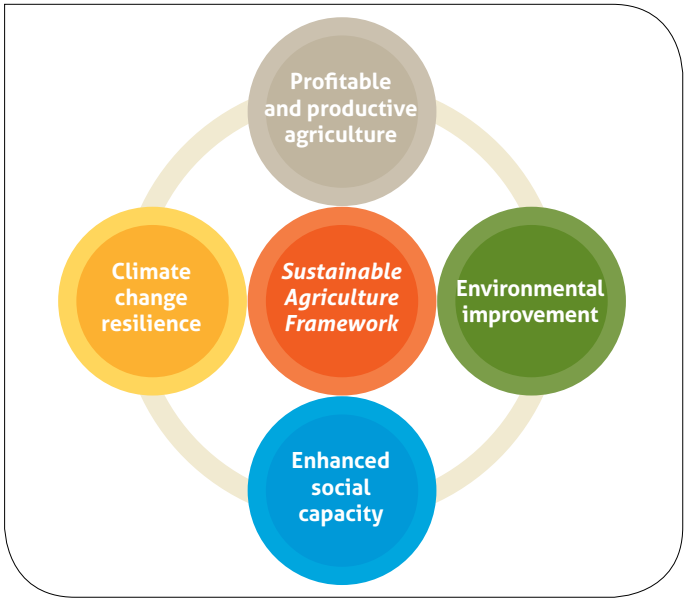


Figure 2.1: The Regional Sustainable Agriculture Strategy's framework.

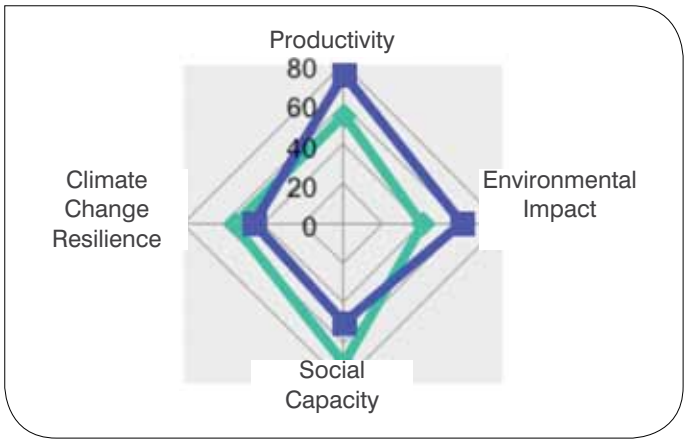
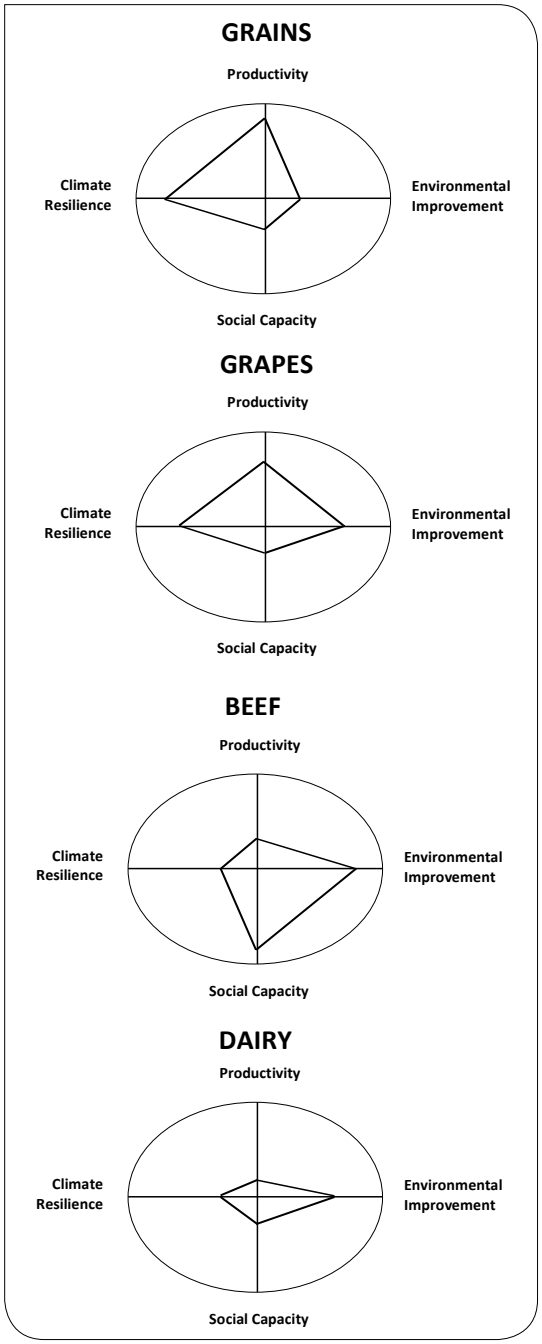


Figure 2.2: A hypothetical example of two different land management practices and how these might apply to each of the four key sustainability indicators.

As an example of the framework being utilised, converting to continuous cropping may increase agricultural productivity but it could also cause greater soil compaction; therefore an increased environmental impact. The landholder may then assess whether they have enough knowledge to mitigate the threat of soil compaction. Finally, if the soil compaction threat does eventuate and wind erosion is a risk, they probably aren't more resilient to climate variability by adopting continuous cropping; therefore they are not more sustainable. Another option can then be considered to determine if it provides greater sustainability according to the four indicators identified in Figure 2.1.

The Strategy is using "spider diagrams" to provide an example about how a changed agricultural practice could be assessed in terms of generating greater sustainability (see Figure 2.2).

In implementing this Strategy the North Central CMA will work with its partners to build a baseline of agricultural information that can demonstrate the sustainability of different agricultural systems in the region as measured by the four key indicators. Maps and other visual products will be produced to communicate the current state and trends under management and policy levers to improve the sustainability of agricultural systems across the region under different combinations of change drivers. An example of the visual products is shown in Figure 2.3.



There are around 430 perennial horticulture farms in the region, down from over 700 in 2001. GVAP has increased by around 100% during this time.

There has been a marked increase in smaller beef farms (< 50 ha) in districts such as the Daylesford and Kyneton areas.

Figure 2.3: Hypothetical current state of major agricultural systems (spider diagram) measured by the key sustainability indicators (axes), and trend under sustainability pathways. (Source: CSIRO, 2014).

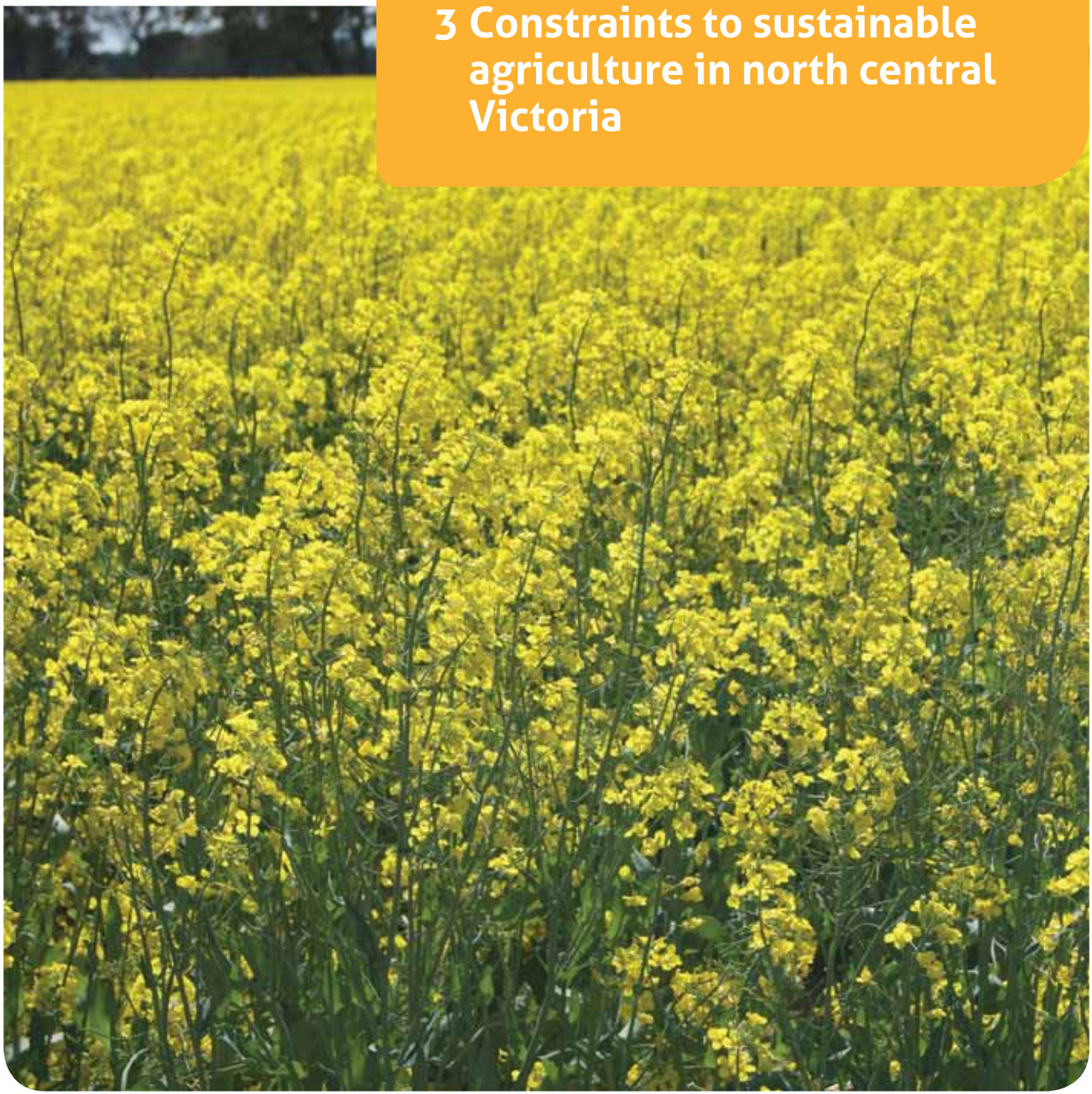
2.2 Sustainable agriculture scenarios

An individual's journey towards achieving their definition of sustainable agriculture will differ in both the approach taken and the timeframe. The ongoing change required to achieve sustainable agriculture comprises three levels of magnitude.

1. **Paradigm shift:** farming for Australian conditions
   - This involves significant change to traditional farming practices (i.e. a move away from high input cropping and grazing system to a low input grazing system based on native grasses).
2. **A mid-level change:** farming towards sustainability
   - This involves moderate changes and a targeted approach to address priority issues (i.e. increasing soil carbon through sub-soil manuring).
3. **Incremental change:** adapting farming systems
   - This involves making small changes and allows for adaptation to uncontrollable influences (i.e. climate change, commodity price) but the risk to sustainable agriculture can still occur (i.e. soil loss).

The Strategy recognises each land manager will decide on their own journey.

3 Constraints to sustainable agriculture in north central Victoria



The pursuit of sustainable agriculture requires an understanding of the constraints or threats confronting land managers identified in Table 3.1. How land managers are affected by these constraints depends largely on their enterprise mix, their approach to managing risk, their debt level, and access to information about mitigation options to lessen the potential impact.

Some of the constraints are out of the control of land managers (e.g. climate change, ready access to technology), but recognising them, and planning how to deal with them, is important to the viability of the region's agriculture in the future.

3.1 Main constraints

Of the factors listed in Table 3.1 this Strategy focuses on eight constraints that are likely to have the most influence on the region's agriculture over the next 15 years. A brief discussion of each is included here.

(a) Soil health

Soil health is one constraint over which land managers have some control. The pursuit of sustainable agriculture can only help to improve the region's soil condition. Australia is an ancient continent with ancient soils. Seventy-five per cent of soils in north central Victoria are sodosols (soils with a clear or abrupt transition to the B horizon, that is sodic and not strongly acid, formerly known as duplex soils or sodic duplex soils) and after almost 150 years of traditional European style farming severe structure issues, particularly in the subsoil, are commonplace. If we are to have any hope of meeting both domestic and global markets we have to continue to explore ways of regenerating these soils and increasing soil carbon to improve surface and subsoil structure and soil health.

Table 3.1: Key change drivers, some of which are constraints affecting agriculture and land managers.

Constraints affecting agriculture and land managers
Soil health, particularly soil carbon
Land use
Water use efficiency
Water and land scarcity
Environmental impacts
Climate change
Floods and droughts
Increasing costs
Agricultural production
Farm business planning and debt, access to finance
Markets
Planning and Knowledge
Animal welfare standards
Science and technology
Ready access to technology and the internet
Investment in agricultural research
Policy and governance reform
Ageing population of the region
Income growth, particularly in Asia
Urbanisation
Energy and fertiliser deficits

Soil organic carbon (SOC) levels dropped when natural areas were cleared and used for agricultural production. For example; 'In the Australian wheatbelt, it has been estimated that >60% of SOC in 0-10 cm layer has been lost.' (KY Chan, et al). [1] This represents an opportunity to increase levels of sequestered carbon back in to our soils. While carbon can be measured, and plays an important role, there is a need for a holistic approach to soil health.

(b) Climate change

The present erratic climate is predicted to extend for the life of the Strategy and beyond. A more variable rainfall trend is predicted with the potential for a more arid climate, increased intensity and frequency of rainfall events along with increased temperatures and days of extreme heat will all require farmers to adapt their practices. Such adaptation has already and will continue to happen by land manages and communities in response to droughts, floods and fires. Farm practices that are part of a holistic approach to soil health will be a key factor in achieving resilience in the face of a changing climate. It is most likely

[1] K. Y. Chan, A. Oates, D. L. Liu, G. D. Li, R. Pragnell, G. Polie and M. K. Conyers (2010). *A farmer's guide to increasing soil organic carbon under pastures, Industry & Investment NSW, Wagga Wagga NSW.*

that this will mean a substantial contraction of cereal cropping in accordance with changing growing season rainfall and soil moisture regimes. Mixed farmers may consider rotational grazing to increase soil carbon and water retention. Irrigation farmers will invest in practices to increase water security and lifestyle farmers will progress fuel reduction activities.

(c) Ageing landholder population

By 2030 Australia will most likely have a population of about 36 million people, while the global population is projected to reach 9 billion at that time. It is uncertain what this will mean for agriculture and agricultural markets given at present we export about 60 per cent of what we produce. Population increase will also increase the demand for a share of the finite available water resource and increase the demand for energy. However the ageing population of land managers in the region will reduce the community's capacity to support a range of volunteer services (e.g CFA) and deal with many of the threats to the natural resource base, e.g. pest plant and animal control.

(d) Markets

It is likely that China and India will be the focus of food production and consumption over the coming decades. In Asia the demand for protein will continue to be high. The difficulty, however, is that Australia is only capable of supplying about 2% of Asia's needs. This may be an opportunity for Australia's land managers to achieve a premium price for Australian produce.

There is evidence that we may well become exporters of knowledge and technologies around building sustainable agriculture industries. For example, in 2015 Canberra Institute of Technology (CIT) signed a memorandum of understanding with India as part of a push by the ACT government to promote vocational education on the sub-continent. Hydroponic technologies become more important for production systems and some of these currently under-utilised approaches may offset deficits in traditional broad acre production.

(e) Energy and fertiliser deficits

Many of the newer technologies require farm machinery that has a high energy demand, so that large areas can be covered with large equipment. Biofuel will ultimately replace our finite fossil fuel resources. The shift to biofuel may have an impact on food production. Fertiliser use is likely to change especially when we reach peak global phosphorous levels, probably in the early 2030s.

The rising costs of electricity, fuel and other inputs have a significant impact on agricultural profitability. They particularly impact the dairy industry. Renewable energies will become more prominent for farming enterprises and farming systems will change to improved energy and fertiliser efficiency.

It is important to understand energy cycles in agriculture as there are many sources of energy losses from farming systems. These losses enter the atmosphere and become green house gases (GHGs) that have contributed to

Dryland lucerne makes good use of any summer rainfall.

Biodynamic farming is becoming increasingly popular throughout the region.

the global warming that affects the climate (Eckard et al). [2] Methane mostly comes from the digestive systems of sheep and cattle. Methane is the largest inefficiency in animal production systems - 6% to 10% of gross energy intake is lost as methane. That's three to four times the gross energy intake for liveweight gain or wool production. It clearly makes sense to search for ways to capture that energy and convert it into increased animal productivity.

Nitrous oxide mostly comes from soil – as a result of fertilisers, nitrogen excretion on pastures, soil microbes capturing nitrogen from the air and changing it to nitrous oxide, and nitrogen leaching out of soil to waterways and wetlands. DPI and Melbourne University scientists estimate that *60% of nitrogen inputs are lost from grazing systems*. The Nitrogen cycle explains the process of nitrification and denitrification that takes place in the soils by soil microbial activity. Nitrogen is not usually available to a plant unless it undergoes this transformation. If the transformation takes place in an anaerobic (without oxygen) environment it forms nitrous oxide (N_2O) and lost to the atmosphere. If N fertiliser is applied at the wrong time (i.e before a heavy downpour) it may be lost into the waterway and may cause algal blooms downstream.

Carbon dioxide emissions are not the major focus of concern for the Australian agricultural sector. However the carbon cycle explains how carbon is sequestered into the soil and used by soil microbes, plants and then by animals. It is eventually released back into the atmosphere at various times.

(f) Water

In the future more water will be needed for a growing urban population, and industrialisation and together with rainfall deficits associated with climate change less water may be available for agriculture. It is already government policy to reduce the volume of water available for consumptive use by agriculture.

(g) Farm business planning and debt

Land managers who are in the midst of making important decisions about their future farming plans are in need of good information and support in order to make good decisions. The decisions range from financial (e.g. debt management), agronomic (e.g. crop type), land use (e.g. matching agriculture to land capability) to people management (e.g. succession planning).

The decisions that land managers make over the next few years will have enduring implications for the future of agriculture and land managers in our region. There is a real need to provide 'whole of enterprise' decision making support in order to move towards sustainable agriculture.

(h) Ready access to technology

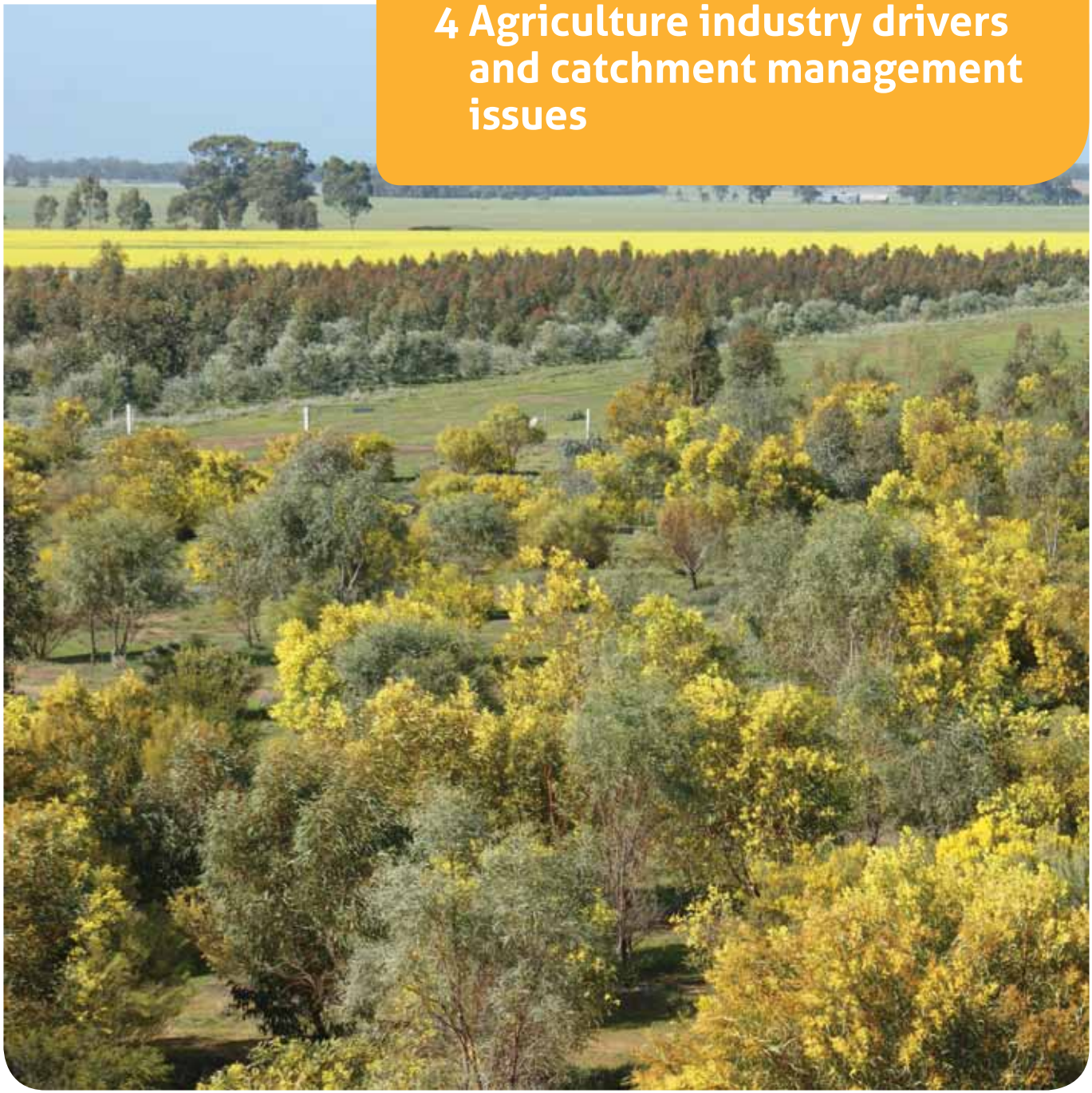
Living in a modern age of technology we expect to be able to be 'digitally connected' at all times, but for some of the region's land managers the lack of internet connection and mobile phone reception is limiting the adoption of current available best practices, access to the latest information and connectivity to people external to the farm and local area. Digital connectivity is considered an essential element to agriculture in Australia keeping pace with the rest of the world and connecting with them to optimise available opportunities (e.g. export markets, communication).

In addition to communication and access to information technology will play an important role in:

- Improving efficiency
- Reducing the negative impact of production on the landscape
- Providing quality of life in regional areas
- Access to services.

[2] R. J. Eckard, C. Grainger & C. A. M. de Klein. *Options of abatement of methane and nitrous oxide from ruminant production-a review (unpublished).*

4 Agriculture industry drivers and catchment management issues



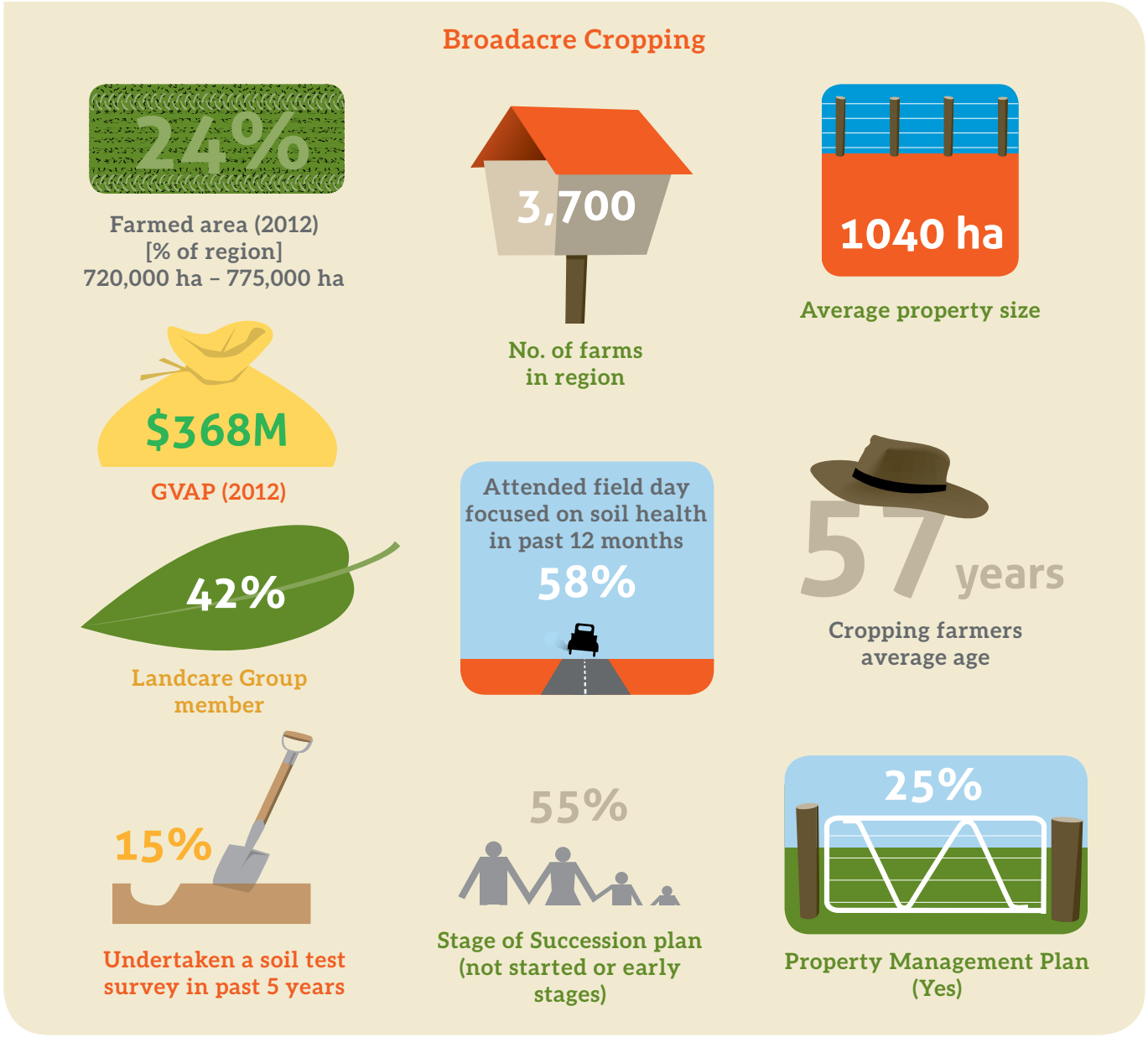


Figure 4.1: Snapshot of the broadacre cropping farms and farmers in the region.

Agriculture in north central Victoria is readily described according to the main agricultural industries within the region. In developing the Strategy, statistical analysis of available data (sourced from the Australian Bureau of Statistics) and an examination of the most important issues facing land managers and their industries was undertaken. The current status and trends, the key drivers of change and the probable impacts on agricultural practices and any implications for the natural resource base was documented through the statistical analysis and through consultation with representatives from the main agricultural industries.

4.1 North central Victoria main agricultural industries, the key drivers and catchment management issues

Figures 4.1 to 4.6, together with Tables 4.1 to 4.6 summarise the data for the region's main agricultural industries, the key drivers and catchment management issues.

Pine Vale farmer Grant Sims applies liquids at sowing time which increases crop yields and improves soil structure.

Table 4.1: ***Broadacre Cropping*** *in north central Victoria.*

Cropping in the region	Most grain is grown in the northern and western parts of the region.
	1,000 farms are located in the northern and western parts of the region. 3,700 across whole region.
	Most broadacre farms in the north are between 500 and 2,500 hectares, with around 55% less than 1000 ha.
	Cropped area ~720,000 hectares (2012).
	GVAP of cereals $295M (2012) [wheat (57%), barley (37%), and oats (6%)].
	Canola is increasingly being grown, generating GVAP $63M (2012) up from $29M (2001).
Important trends in cropping	GVAP was $348M in 2001 and $368M in 2012.
	The number of broadacre mixed farms has decreased by around 30% from 5,300 farms in 2001 to 3,700 farms in 2012. (Includes cropping only and mixed cropping and livestock enterprises).
	The area of cropland has been stable over the past decade at just over 720,000 hectares (2012), with the majority under wheat.
	Farm businesses are increasing in both size of holding and GVAP. Farm size tends to increase moving west.
	Since the mid-1990s there has also been a reduction of around 20% in the long-term average growing season rainfall (Birchip weather station).
	The area of land prepared for crops and pastures using no cultivation increased by around 70,000 ha between 2007 and 2009.
	The area of land receiving one or two cultivations reduced by around 100,000 ha between 2007 and 2012.
	Widespread continuous cropping to meet productivity and viability (cereals, legumes).

Strengths of cropping land managers	No-till and reduced tillage has been widely adopted in the region subsequently reducing the risk of wind and water erosion of cropland.
	Cropping land managers have shown remarkable ability to adapt to climate variability and other challenges.
	Cropping land managers are requiring enhanced knowledge and are strong participants in R&D, trials, farm walks, field days.
	Land managers adapt their cropping rotations to mitigate risk, while adapting to seasonal conditions and implementing best practice. There are still plenty of other crops, i.e. canola sown, and growers adapt to reduce risks of pest and disease, as well as nutrients etc. Legumes including lentils, peas, chickpeas, faba beans, vetch have all been grown within the last decade and will continue to persist into the future.
	Flexibility to adapt crop rotation in opportunistic years.
	Sowing at the right time.
Challenges facing cropping	Advances in wheat yield have slowed over the past 15 years however the reasons for this are uncertain and could include reduced growing season rainfall and farm survey bias.
	Projected increases in average temperatures and reduced annual and seasonal rainfall will impact on crop yields over the medium to long term.
	Frost or hot days (above 30 ° C) during September-October damages crop yield.
	Herbicide resistance.
	Pests and disease.
	Summer weeds.
	Poor soil structure
	Continues cropping and the costs associated with annual fertilizers, chemicals and long-term viability of the soils structure and productivity.
	Yield potential.
	Closure of the yield gap.
	Water use efficiency.
	Climate change.
	Cost of production.
Land management issues for cropping	Below average growing season rainfall between 1997 and 2009 resulted in poor crop yields and poor stubble cover over summer months.
	Soil loss is reducing due to improved land management practices, including less cultivation and more no-till seeding, and reduced sheep numbers across the region.
	Under cropping systems soils can be degraded by compaction and surface sealing/hardsetting, particularly on the duplex soils, where frequently cultivated. Managing subsoil sodicity is a high priority for some land managers.
	Cropping soils are prone to wind erosion when left unprotected by low crop residues or stubbles, or have insufficient ground cover in grazed paddocks. However, the rapid move to no-till cropping systems and a marked reduction in sheep numbers across the region has substantially reduced the erosion risk.

Adoption and adaptation of technology	Knowledge exchange. Participate in research, development and extension.
	Collaboration in this Strategy.
	Department of Economic Development research, development and extension programs with grower groups and on behalf of GRDC.
	DEDJTR Land Health Program.
	Large Farming Groups field days and research trials/demonstration sites on local farms.
	GRDC and Climate Change Champions.
	EverCrop (incorporating perennial forages into existing annual cropping systems).
	Network of Farming for Sustainable Soils groups.
Change drivers and implications for the Strategy	Rapid adoption of new machinery, notably precision agriculture technologies including GPS assisted navigation.
	Farm consolidation.
	Use of consultant advisors for agronomic and business management.
	The younger generation of land managers has a preference away from sheep.
	The adoption of no-till cropping systems and reduced sheep numbers has the potential to reduce soil erosion risk in many parts of the region.
	A reduction in the price of glyphosate made it cheaper to chemical fallow rather than mechanically fallow. As a result chemical resistance is an issue of concern and poses risk to production systems.
	Projected increases in average temperatures and reduced annual and seasonal rainfall may result in some shift in the cropping zone further south, however, there are limitations on crop production in large parts of the upper catchment areas due to terrain and poorer soils.
	Land managers will keep increasing their productivity by increasing their enterprise scale and adopting new technologies. This is a challenge given the area of cropped arable land has remained relatively static over past decade indicating that land inputs are finite.
	Some grains enterprises are partnering directly with intensive animals operations to supply grain as a way to diversify and expand their businesses.
	The use of private extension or advisory services dramatically increased over the past decade, especially in the cropping and intensive livestock sectors.

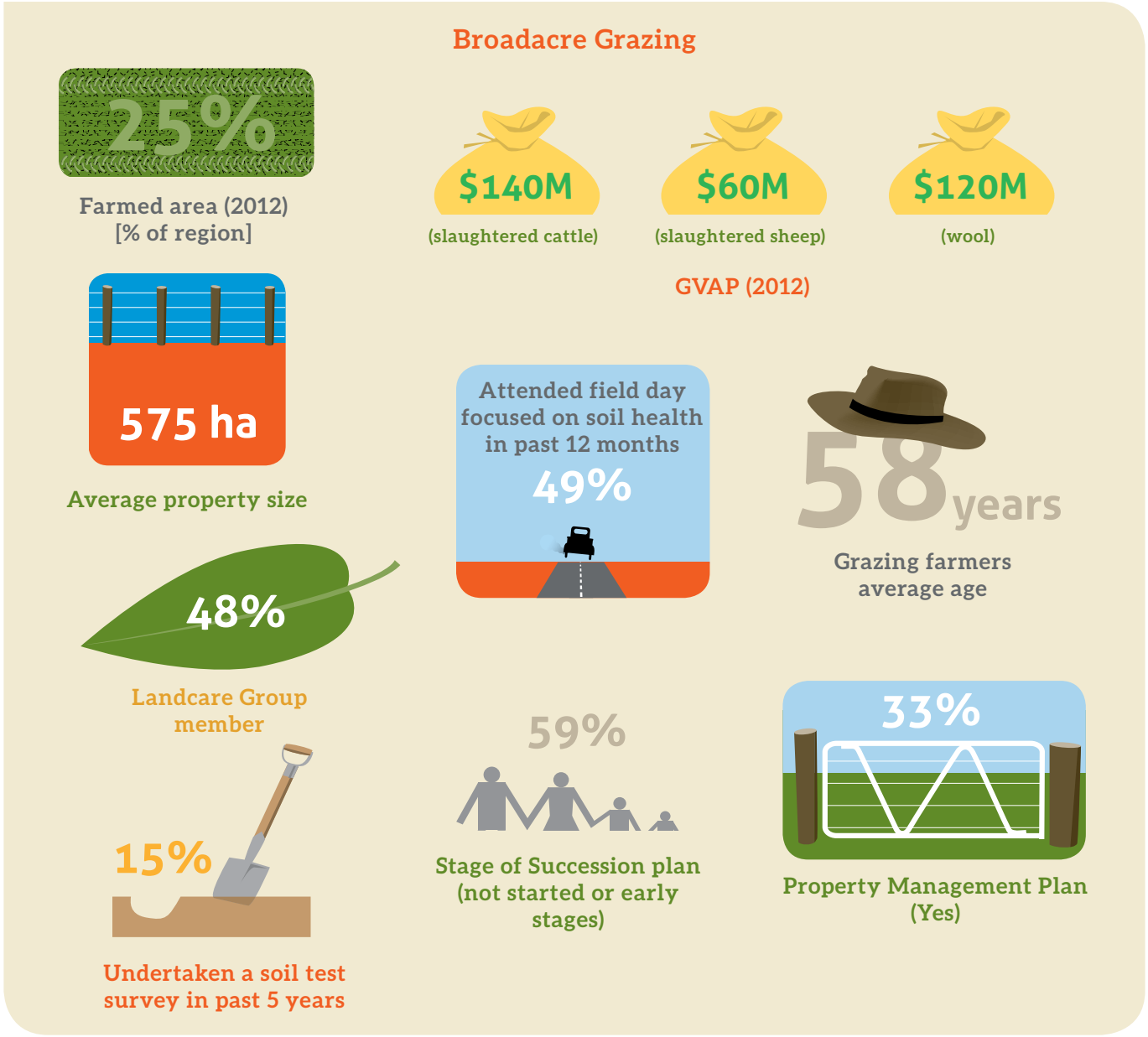


Figure 4.2: Snapshot of the broadacre grazing farms and farmers in the region.

Table 4.2: ***Broadacre Grazing*** *in north central Victoria*

Grazing in the region	Commercial scale grazing is undertaken primarily in the northern areas of the region, with many sub-commercial or lifestyle grazing farms in the southern areas of the region.
	Around 750,000 hectares or 45% of the farmed areas within the region is used for livestock grazing.
Important trends in grazing	There has been little consolidation of livestock farms. The range of farms by business size and area of holding has changed little between 2001 and 2012.
	Sheep numbers have decreased by almost 30% over the past decade, reducing from around 3.8 million to 2.8 million head.
	The gross value of livestock slaughtered in 2012 was around $200 million and $120 million from wool; up from $133 million and $83 million in 2001 respectively.
	The gross value of sheep meat has dramatically increased over the past decade, now up to $64M.
	Cattle numbers fell continuously during the extended dry period getting down to around 100,000 and have since recovered to just over 200,000 head in 2012.
	There has been a marked increase in smaller beef farms (< 50 ha) in some districts in the highlands, including the Daylesford and Kyneton areas.
	Increasing numbers of small or hobby properties are not being captured in the ABS survey data where their gross value of agricultural production is less than $5,000 per year.
Strengths of land managers	Land managers with grazing are thirsty for knowledge and strong participants in R&D, trials, farm walks, field days.
	Adapting to change and risk, implementing innovative techniques.
	Conservative practices that reduce risk.
Challenges facing grazing	Livestock grazing producers need to manage a feedbase that is highly seasonal by increasing utilisation. Over time, additional dry matter production may tend to shift towards provision of different fodder types for the dairy industry as it expands.
	Limitations due to poorer soils, terrain and pressure on land prices from sub division and growth in and around the main towns are all working to constrain this industry in the central and southern parts of the region.
	These types of land use and biophysical constraints will continue to make it difficult for grazing enterprises to restructure, scale up their operations and stay competitive.
	Increasing temperatures.
	Water availability and security in drier seasons.
	Lower rainfall.
	Shorter growing season.
	Private advisors linked with specific products providing advice (at times recommending products that may not be entirely relevant or required).
	Animal welfare issues.
	Pest and diseases.
	Market volatility.

Land management issues for grazing	Grazing of native vegetation including grazing of understorey in forests and woodlands and native grasses.
	Grazing of riparian areas and accessing waterways and wetlands.
	Replacement of native grasslands with exotic species.
	Construction of dams in catchments of waterways.
	Application of fertilisers where runoff rates are high.
	Overgrazing – intensive grazing of pasture for extended periods or inadequate recovery time resulting in insufficient ground cover to prevent soil erosion.
	The above practices can result in: – Fragmentation of native vegetation and habitat – Decline in diversity and abundance of native species – Introduction and competition with native species by invasive plants – Introduction of exotic plants that compete with native species – Water quality decline – Reduced or altered water flows – Bed and bank instability – Soil erosion – Access to water
Meeting the challenges	Knowledge exchange.
	Collaboration in this Strategy.
	Network of Farming for Sustainable Soils groups.
	Participate in research, development and extension.
	EverGraze.
	EDGEnetwork courses.
	Target 100.
	BetterBeef.
	BestWool/BestLamb.
	DEDJTR Land Health Program
	Possible Changes to management practices: – Change lambing times to suit best pasture growth / feed availability – Investigating pasture species suited to lower rainfall / altered or shorter growing period – Implementing rotational grazing regimes
Change drivers and implications for the Strategy	Unlike the grains sector, livestock grazing in terms of farm business and production management systems has remained relatively static for a long time (especially in the central and southern parts of the region).
	If NRM messages are to be conveyed to land managers private providers may need to be contracted to provide this service alongside their primarily production focused advice.

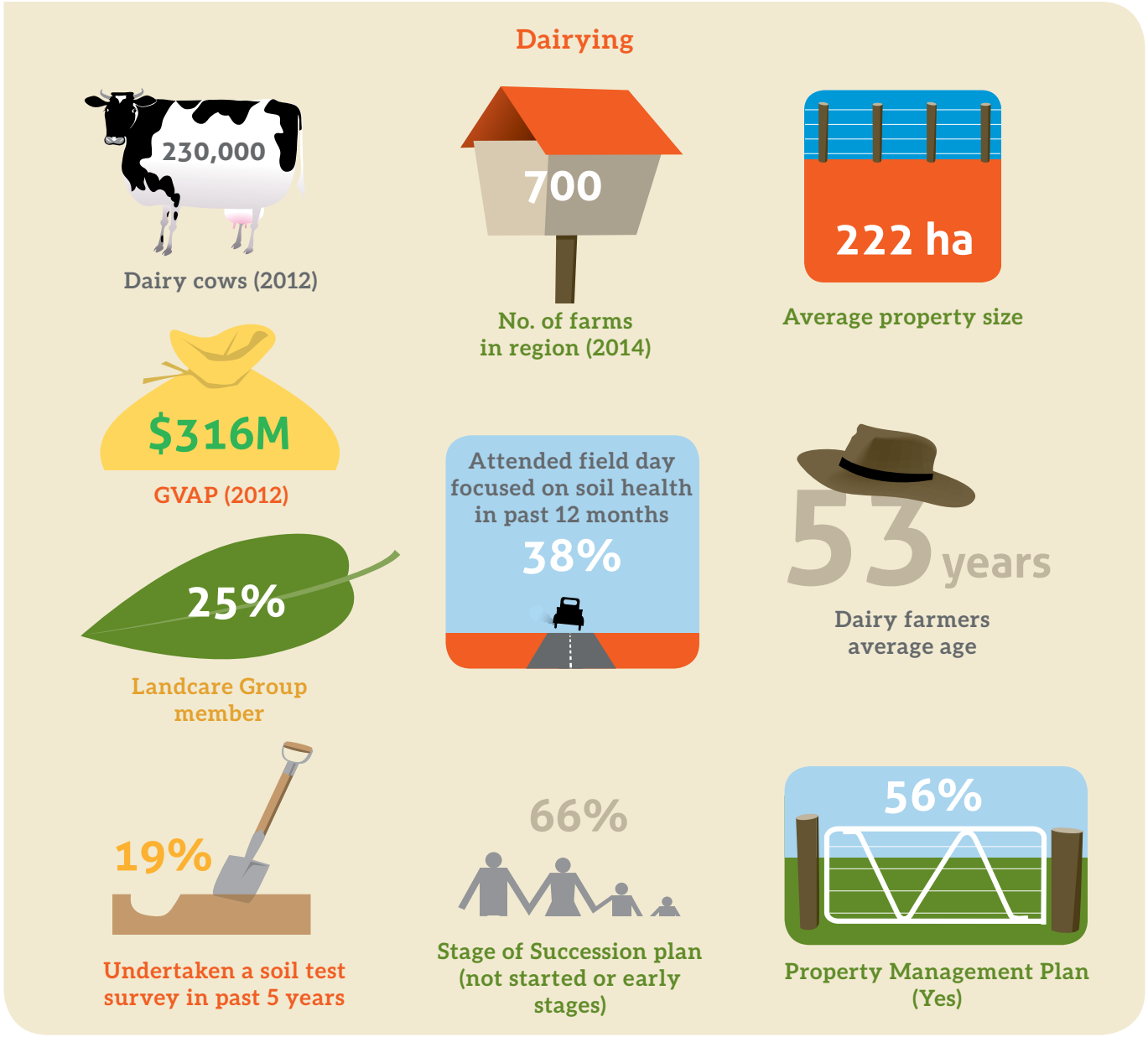


Figure 4.3: Snapshot of dairy farms and farmers in the region. Sources: Dairy Farm Monitor; Victorian Water Entitlements and Use 2014-15 Annual Report

Table 4.3: ***Dairying*** *in north central Victoria.*

Dairying in the region	In 2012 there were just over 700 dairy farms in the region concentrated in the northern irrigation areas and along the Murray River.
	The area of dairy farms is around 93,000 ha (5% of the region).
	Dairy farms use around 440,000 ML of water (55% of irrigation water use in the region).
	Dairy industry GVAP of $316 million in 2012 (20% of the total GVAP in the region).
	The average dairy farm is between 100 and 500 ha in size and generates between $350 and $500k.
Important trends in dairying	The number of dairy farms has decreased by around 30% since 2001 from over 1,000 dairy farms.
	During the Millennium Drought there was a reduction of approximately 47% in land primarily devoted to dairying from 2006 to 2010, and a 57% reduction in the number of properties primarily devoted to dairying (HMC Property Group, 2010).
	Dairy cow numbers fell to 170,000 at the end of the drought in 2009 and are now back up to around 230,000 (2012).
	There has been a trend towards larger farms – more than 500 ha in physical size and $500k-1million in business size.
Strengths of dairying	The dairy industry has strong research, development and extension programs supported by grower levies through Dairy Australia as well as DEDJTR programs and also a network of private consultants.
	Dairy land managers are thirsty for knowledge and strong participants in R&D, trials, farm walks, field days.
	Dairying is well supported by milk companies (who are continuing to invest in infrastructure development) with strong competition for milk volume across the region.
	While the core of the feed base is pasture produced from irrigated agriculture, the region has strong access to concentrate (grains) and fibre sources (hay, straw, silages) which further boosts the region's competitive advantage.
	A range of farm business models operate within the region. There are low cost entry options as well as the ability for large scale operations.
Challenges facing dairying	As the temperatures and rainfall patterns change, there will be some effect on dairy farms in the region.
	Water pricing and water availability.
	It is likely there will be less rainfall and less run-off. This will reduce water security for stock and irrigation, as well as for plant and shed cleaning.
	Warmer and drier conditions will increase the likelihood of heat stress in cattle.
	Animal welfare issues.
	Profitability.

Land management issues for dairying	Livestock grazing in riparian zones – grazing by livestock of riparian areas and direct access to waterways and wetlands.
	Intensification "Mega Dairies" – access to water, application of nutrients to land, odour, drainage and watertables.
	Irrigation practices – inefficient application and drainage of irrigation water may impact on receiving waterways, neighbouring wetlands and watertables.
	Nutrient budgeting – over application of fertiliser relative to crop/pasture may result in high nutrient loads in runoff that can impact on waterways and wetlands.
	Overgrazing – intensive grazing of pasture for extended periods or insufficient recovery time resulting in insufficient ground cover.
	Inappropriate effluent management – poor capture, containment and disposal of animal effluent resulting in effluent entering waterways.
Meeting the challenges	Knowledge exchange. Participation in research and extension.
	Dairying for Tomorrow.
	DairySAT (Self-assessment Tool).
	Effluent and Manure Management Database for the Australian Dairy Industry 2008.
	Management of Dairy Effluent 2008 DairyGains Victorian Guidelines.
	Accounting 4 Nutrients.
	Irrigation system selection and design guidelines.
	Whole farm planning and irrigation efficiency.
	Network of Farming for Sustainable Soils groups.
	Modernisation of the Irrigation supply network.
	Possible changes to management practices: – Shifting calving times to make better use of changing pasture growth patterns. Spring calving could be earlier and autumn calving may become an option, depending on milk supply opportunities – Cutting silage and hay 2-3 weeks earlier to better match changing pasture growth curve – Increasing the amount of forage cropping during winter – Using 'hot day' timetables or cross breeds to manage heat stress – Continuing to expand the use of dairy shed effluent and wash down water – Planting trees near dams to reduce evaporation – Maintaining or re-establishing shade and shelter belts to protect cattle in extreme temperatures – Improving the efficiency of irrigation systems and practices.

Change drivers and implications for the Strategy	Accelerating Change.
	Regional Extension and Education Committee (REEC).
	Regional Network Groups, Discussion Groups and Dairy Business Network Groups.
	Irrigation modernisation to improve water use efficiency and increasing farm scale are key drivers of change in the Region.
	The $2 billion GMW Connections Project.
	The North Central CMA's Innovative Farming Program.
	The On-Farm Irrigation Efficiency Program as part of the Australian Government's Water for the Future initiative.
	There is an opportunity for dairying to expand in the area.
	Rural residential in areas that were once traditional dairy, for example, in Tyntynder Flats near Swan Hill. This land use change is likely to continue near urban areas and is unlikely to return to dairying.
	Cohuna and Gunbower are very strong dairy areas that are also in transition to larger units.

The dairy industry is experiencing tough times currently.

Dairy farmers are adopting new technologies and modernising infrastructure to increase production and profits.

Dairy herds are increasing in cow numbers.

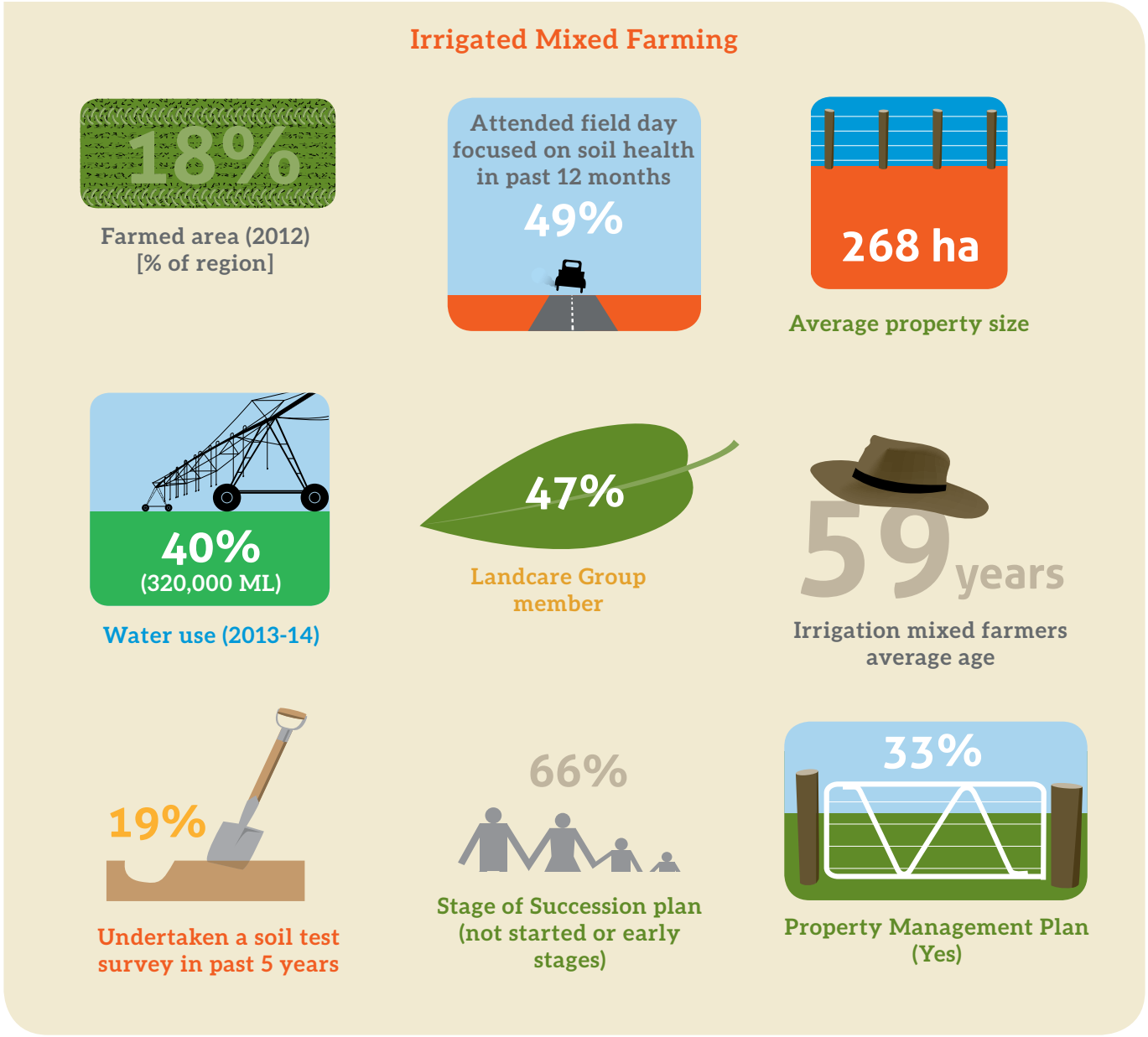


Figure 4.4: Snapshot of irrigated mixed farms and farmers in the region.

*Table 4.4: **Irrigated mixed farming** in north central Victoria (Note: similar challenges and drivers for mixed **dryland** farming).*

Irrigated mixed farming in the region	Irrigated mixed farms produce crops for grains and fodder and pastures for livestock grazing (mostly beef cattle and sheep).
	Much of the irrigated mixed farming industry is associated with supplying feed to neighbouring dairy farms.
	It is estimated that the area of mixed farms is around 550,000 ha and represents almost 18% of farmed areas in the region.
	Mixed irrigation farms use around 320,000 ML of water and represent approximately 40% of the irrigation water use in the CMA region.
Important trends in irrigated mixed farming	Mixed farming has contracted the most as a result of water trade and significant areas of land around Kerang and Pyramid Hill have now become dryland or are only opportunistically irrigated.
	Increasing competition for water resources, and increasing costs, put pressure on the viability of mixed farming operations even before the onset of reduced water availability. Mixed farming operations have been more opportunistic in their use of water and have been net sellers of water during low allocations years. There are always exceptions, with some mixed farmers actually growing, but the overall trend has been a decline in water use by the mixed farming operations.
Strengths of irrigated mixed farming	Land managers are moving to a more opportunistic use of irrigation water, using more water when it is affordable and expected irrigation commodity prices warrant its use and using less when it is scarce. The ability to move in and out of irrigation according to water availability and returns means the area is well suited to adaptation to a variable climate.
	The large scale of holdings and relatively low cost of entry, compared to other areas with the same security of water, means that there is a relatively high return on investment for those land managers with the skills to manage these systems. At the same time there are opportunities available to diversify the agricultural base and develop more high value irrigation enterprises and intensive animal industries alongside the opportunistic irrigators and dryland enterprises.
Challenges facing irrigated mixed farming	A key challenge for mixed farms in a future with less water will be the affordability of remaining connected to an irrigation supply whilst being only an opportunistic user. With reduced access to irrigation water, the income-generating capacity of their land will decline, which will generate pressure to increase in scale in order to remain viable.
	Opportunistic irrigation may be substantially smaller in the future. During the transition some land may continue to be farmed productively; some will be retained but not farmed; and some will be sold.
	Due to land capability and the reduction in total available water for irrigation, many holdings will need to increase in size substantially to support a farming family who transition to a dryland enterprise (to between 2,000 ha and 5,000 ha for a cropping enterprise for example. But this is difficult to achieve with the current block size). There will also be significant cost and effort in removing irrigation infrastructure and configuring the land for dryland farming.
	The overriding issue for mixed irrigation is the affordability of water. Water charges represent a high proportion of income per ML and unless infrastructure is rationalised to more affordable levels this industry will come under increasing pressure.

Land management issues for irrigated mixed farming	Livestock grazing in riparian zones – grazing by livestock of riparian areas and direct access to waterways and wetlands.
	Irrigation practices – inefficient application and drainage of irrigation water may impact on receiving waterways, neighbouring wetlands and watertables.
	Overgrazing – intensive grazing of pasture for extended periods or insufficient recovery time resulting in insufficient ground cover.
Meeting the challenges	The experience of drought was that much of the area reverted to dryland farming or remained idle. With the return of conditions closer to the long-term average and an increase in water allocation in the current years, land managers are making commercial decisions on their land use between intensively irrigated (nearly all years), opportunistic irrigation (occasionally irrigated) and dryland agriculture (not irrigated).
Change drivers and implications for the Strategy	Water reform, extreme climate variability, water trade and fluctuating commodity prices are expected to reduce the area of irrigated agricultural land (the irrigation footprint). Significant structural change is happening. The subsequent increase in the area of dryland farming in traditional irrigation districts will be keenly felt in mixed farming districts such as Kerang, Pyramid Hill and Boort.
	Under climate change, sustainable diversion limits under the Basin Plan and ongoing water trade (where there has been a tendency to trade water out of north central Victoria) future water use could drop from around 800 GL/y to 400 to 600 GL/y.
	Potential evapotranspiration demand will increase irrigation water requirements, and this combined with lower water availability means that there will be a continuing imperative to increase water use efficiency t/ML and adopt more efficient irrigation systems.
	Land managers in Northern Victoria's gravity irrigation districts are gaining access to a $2 billion modernised irrigation supply system that will deliver higher service levels for increasing the productivity from irrigation. It is important that the maximum benefit is achieved from this investment. The modernisation of the GMW system is well underway and due to be completed in 2018. Land managers need to make important decisions and it is understood that currently there is delay because of the difficulties in making these decisions in a compressed timeframe.

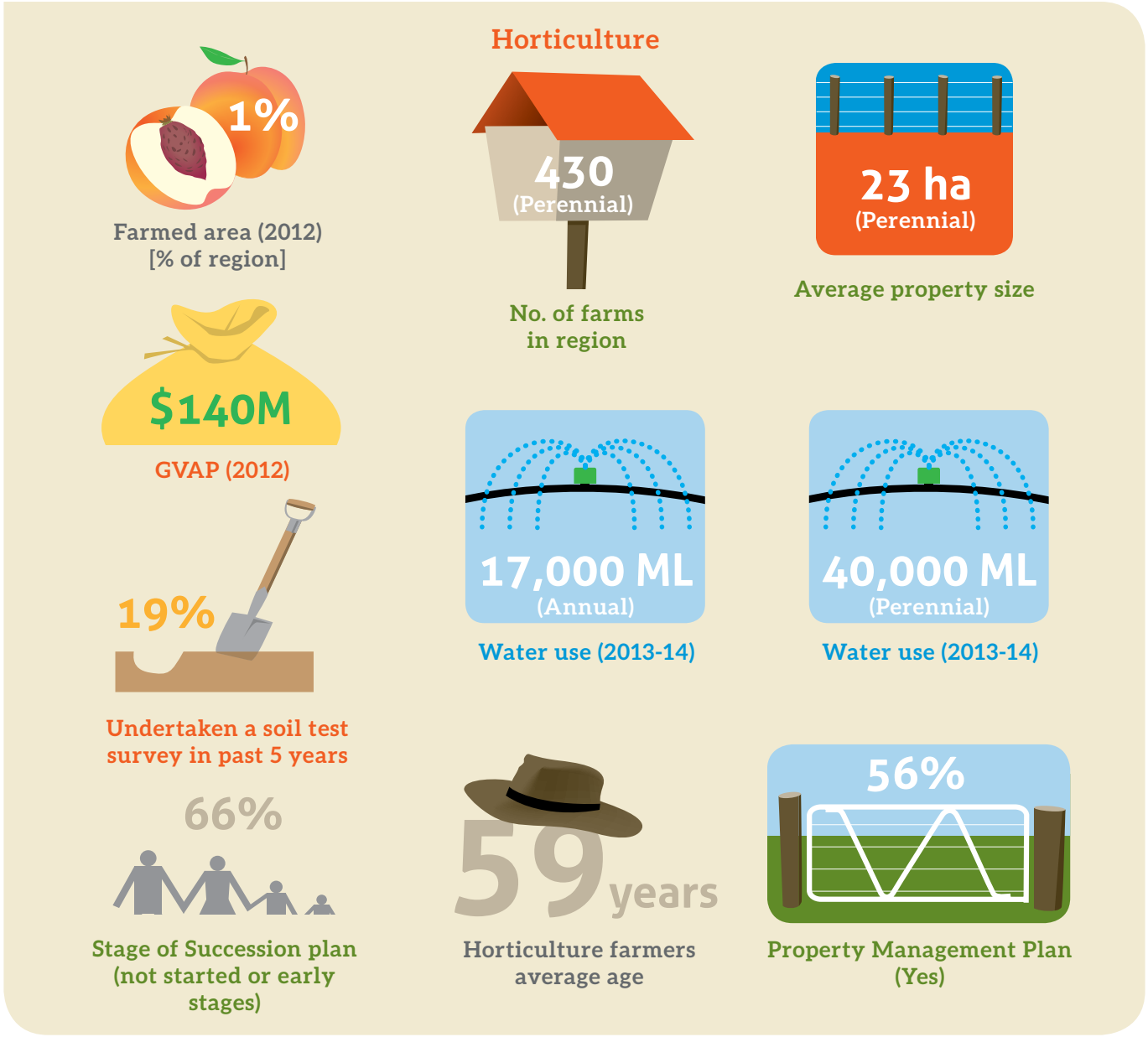


Figure 4.5: Snapshot of horticulture farms and farmers in the region.

Table 4.5: ***Horticulture*** *in north central Victoria*

Horticulture in the region	The perennial horticultural industry had a GVAP in 2012 of around $140M, which is 7% of the total GVAP in the region (up from around $50M in 2001).
	Perennial horticulture farms cover a very small proportion of the land area occupying around 10,000 ha in 2011.
	Perennial horticulture uses around 40,000 ML of water (5% of the irrigation water use in the region).
	The industry is concentrated in the Swan Hill statistical area and to a much lesser extent, the Castlemaine statistical area.
	The main crops are stone fruit, olives and pome fruit. There is a small citrus area located at Koondrook and wine regions around Kerang, Heathcote and Bendigo.
	The area of annual horticulture is estimated to be in the order of 3,400 hectares, using around 17,000 ML of water producing commodities with a gross value of almost $40M in 2012.
	Annual horticulture includes potatoes and some other vegetables in the upper Loddon and Campaspe catchment areas.
	Processing tomatoes are grown on the lower Loddon floodplain and in the Campaspe catchment with major processing at Echuca.
Important trends in horticulture	There are around 430 perennial horticulture farms in the region, down from over 700 in 2001, however the GVAP has increased by around 100% during this time.
Strengths of horticulture	Horticulturalists are often sophisticated managers, early adopters and innovators, thirsty for knowledge and strong participants in R&D, trials, farm walks, field days.
Challenges facing horticulture	Climate change. The potential impacts of climate change on the horticulture industry include: – Government water policy decreasing the pool of available water for productive agriculture – Decreased water availability due to reduced rainfall – Increased water demand arising from greater evapotranspiration (ET) – Increased incidence of damage from sunburn and other breakdown disorders due to increase in the number of hot summer days (over 35°C) – A reduction in the number of frost days reducing winter chilling (which is important for some fruit trees for setting fruit, meaning that it may become necessary to consider low chill varieties and alternative management options) – Increased intensity of frosts during spring may damage developing fruit and production – Increase in intense weather events (extremely heavy rainfall events) impacting on fruit quality – The risk of crop failures due to more variable/volatile growing conditions is also predicted to increase, affecting the industry's ability to meet increasingly specific and targeted quality assurance/market requirements – The horticulture industry may also be affected by policies to mitigate climate change, which are likely to result in higher energy, input and transport costs. For example cooling – Pests and disease.

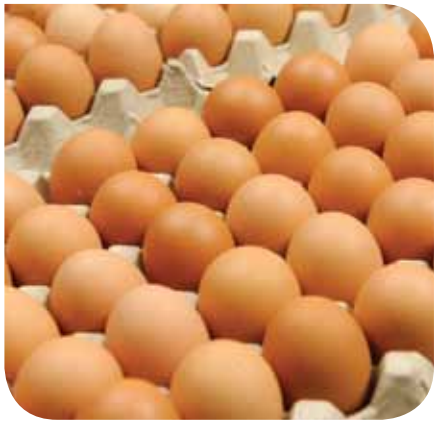
Land management issues for horticulture	The environmental issues associated with this industry include potential spray drift, noise (scare guns), and subsurface drainage disposal, which may impact on the aquatic ecology of drainage basins.
	Soil and water salinity.
Meeting the challenges	Horticulture (overall) would respond to a drying climate and uncertainty about water availability by buying more water to hold the same volume it initially held. In systems where water trade is well developed (northern Victoria) this water would largely come from mixed farming and to a lesser extent from dairy.
	Grape and Wine Research and Development Corporation (GWRDC).
	Horticulture Australia Limited (HAL).
	AUSVEG
	Apple and Pear Australia Ltd. (APAL) - Productivity, Irrigation, Pests and Soils (PIPS) program.
	Fruit Growers Victoria.
	Summer Fruit Australia.
	Freshcare Environmental.
	EnviroVeg.
	EnviroVeg Platinum.
	EntWine Australia.
	Wine Industry National Environment Committee (WINEC).
	Root demand irrigation (see www.rootdemandirrigation.com).
	Improved irrigation management – e.g. soil moisture monitoring, automation, water application technology.
Change drivers and implications for the Strategy	Like all forms of agriculture economies of scale are increasing. Mechanisation is important to offset internationally high labour costs.
	Over the long term climate change (extreme temperatures) may encourage some of the Mildura based industries to relocate further south to north central Victoria, for example wine grapes, citrus and table grapes, to reduce the impacts of prolonged periods of extreme temperatures during the growing season.
	The demand for fresh fruit from Asia could result in higher demand and further plantings such as stone fruit based on the skills and distribution networks around Swan Hill. Gaining new market access is an ongoing issue and accelerating productivity to stay competitive is also challenging given the high price of labour in Australia. With food processing in Australia becoming increasingly non-competitive, new fresh fruit markets will become even more important.
	Land area impacts of any horticultural expansion should be negligible but only if they are implemented and managed appropriately – otherwise they could be significant. That is why we have New Irrigation Development Guidelines across the catchment.
	The industry could take a large percentage of available water in dry years. New development may require drainage services in the long term. This needs to be considered in any planning and approvals process for new developments.

Figure 4.6: Snapshot of intensive animal industries and farmers in the region.

Table 4.6: ***Intensive animal industries*** *in north central Victoria.*

Intensive animal industries in the region	There are 195 intensive animal producers in the region, remaining stable since 2001.
	Pig production is the most significant industry by GVP followed by eggs and broilers.
	Bendigo, Loddon and St Arnaud statistical areas generate the most in terms of GVAP from intensive animal production.
	The industry has a larger proportion of farm businesses generating more than $500k per annum gross income compared to those generating less than $500k.
Important trends in intensive animal industries	The GVAP for intensive animal industries was $166M in 2012, increasing from $114M in 2001.
	There has been a trend over time towards more businesses generating more than $500k per annum.
Strengths of intensive animal industries	Industry Codes and guidelines, administered through the Victoria Planning Provisions, provide a strong regulatory framework for effluent management and disposal.
Challenges facing intensive animal industries	Poor effluent management practices pose a significant threat to environmental values.
	Climate change. The potential impacts of climate change on the intensive animal industries include: – Decreased water availability due to higher temperatures – Increased water demand.
	The industry may also be affected by policies to mitigate climate change, which are likely to result in higher energy, input and transport costs. For example cooling.
	Increasing pressure from lobby groups and communities who don't want such industries in their back yard.

Land management issues for intensive animal industries	Intensive animal farms pose a number of potential threats to environmental values including:
	Inappropriate effluent management – poor capture, containment and disposal of animal effluent, resulting in effluent entering waterways.
	Odour issues are also sometimes a concern, especially when farms are in close proximity to urban areas.
Meeting the challenges	Threatening processes are addressed through Various Codes of Practice for intensive animal husbandry including: – Free Range Chicken Farm – Victorian Code for Broiler Farms – Victorian Code of Practice – Piggeries.
	The Codes deal with management of waste, a potentially threatening process to environmental values.
	A number of national guidelines have been developed to provide operators of intensive livestock facilities with guidance on environmental best practice in relation to siting, design, construction and management. Although the guidelines are not incorporated into the Victorian Planning provisions (VPPs) they are included here because they cover the industries for which no Victorian codes have been developed and because they provide more up-to-date information for some of the industries that do have codes (piggeries and cattle feedlots).
Change drivers and implications for the Strategy	Climate change.
	Urbanisation.
	Animal welfare issues.



Productivity is increasing significantly for the industry.

There are high animal welfare standards and expectations.

Pig production is the most significant intensive animal industry in the region.

4.2 North Central Regional Sustainable Agriculture Strategy actions

The Strategy provides a framework for progressing agricultural sustainability throughout the region. It proposes changes to regional agricultural practices that increase productivity, achieve environmental improvement, enhance social capacity and make farming systems more resilient to climate change.

Table 4.7 outlines the region's natural resource assets, the pressures that agricultural practices put on the condition of these assets, and a range of strategic responses that may reduce the pressures. Importantly, the Strategy does not provide paddock level detail for land managers or tell them how to farm. Rather the Strategy provides a decision support framework to guide sustainable agricultural practices appropriate to north central Victoria.

The Strategy does not provide detailed information about the programs and projects to be implemented throughout the region. The Strategy provides guidance towards the key elements for inclusion into implementation actions by the regional stakeholders. The aim is for programs and projects to be developed as required and relevant by the regional stakeholders, as the Strategy will have improved and fostered the relationships and partnerships between them.

The regionally-endorsed Strategy provides agreement and collaboration amongst stakeholders and is evidence that the region is a sound place for investment for sustainable agricultural outcomes. The Strategy is a sub-strategy to the North Central Regional Catchment Strategy (RCS) and previous and current collaborative implementation arrangements will be utilised for efficient and effective delivery of outputs and outcomes. Specific aspects to progress implementation will include:

- Implementation targets and milestones
- Action planning to be updated annually
- Targeted investment proposals
- Integrated delivery arrangements
- Coordinated monitoring and evaluation of implementation, including integrated reporting
- Adaptive management.

Table 4.8 includes the key government agencies or industry bodies that would take a lead role in facilitating appropriate actions to improve the uptake of sustainable agricultural practices, and a suggested timeframe for each.

Wycheproof farmer Gary Pollard checks seed distribution after sowing the 2015 crop.

Projected increases in average temperatures and reduced annual and seasonal rainfall will impact on future crop yields.

Table 4.7: Regional assets, pressures, state of NRM assets and possible strategic responses.

Regional Assets	Pressure	Impact	Responses
Land and Soils	Market forces, global competitiveness	Reduced GVAP and productivity from agriculture	Market adjustment by individual businesses with regard to scale, labour efficiency and succession based on a farm business plan. Increase productivity per ha, yields/quality/returns
	Overgrazing	Reduced soil quality and increased erosion risk	Manage stocking levels to land capability and seasonal conditions, altering grazing regimes (shift towards more rotational / managed grazing)
	Land use conflict – agriculture and residential / industry	Loss of 'right to farm'	Ensure valuable agricultural land is protected and developed to its maximum agricultural potential
	Dryland salinity and sodicity.	Reduced soil quality	Perennials on recharge areas and discharge area treatment (apply gysum, maintain groundcover)
	Wind & water erosion of soils	Soil loss and declining fertility	Maintain ground cover, reduce tillage
	Weeds - herbicide resistance in dryland cropping	Increased prevalence of weeds	Integrated weed management approach (multiple approaches to weed control) Change cropping rotations if appropriate
	Soil health including structure & acidity	Reduced soil quality	Retain crop residues to improve soil carbon condition, apply appropriate ameliorants such as lime where economic. Carbon retained to hold water
	Irrigation salinity & sodicity	Reduced soil quality within irrigation districts	Irrigate low salinity class soils, revegetate discharge areas, Improve water use efficiency & drainage, Irrigation application methods matched to crop and soil type.
Waterways, Floodplains and Wetlands	Rainfall runoff contains high sediments, nutrients or pollutants	Reduced water quality of rivers and wetlands	Implement current recommended practices to reduce water quality risks – buffers, reduce fertiliser, control soil erosion
	Irrigation runoff contains high sediments, nutrients or pollutants	Reduced water quality of rivers and wetlands	Implement current recommended practice - tail water reuse, fencing off, appropriate fertiliser & dairy effluent management. Ensure drains are managed for rainfall runoff only and not irrigation runoff discharge
	Runoff - intensive animal industry	Reduced water quality of rivers and wetlands	Implement current recommended practice - surface water runoff capture & reuse etc
	Inappropriate structures/ earth moving on floodplain/drains	Altered flooding and drainage patterns	Ensure compliance with floodplain management strategies

Regional Assets	Pressure	Impact	Responses
Consumptive water available for irrigation	Market forces, water trade removing water from less profitable industries	Reduced GVAP, profitability and productivity from irrigated agriculture	Market adjustment by individual businesses with regard to scale, water and labour efficiency, succession Lift productivity per megalitre use (water use efficiency) Upgrade irrigation services – public supply system & on-farm
Agricultural livestock and crop health	Agricultural: pest and diseases	Reduced biosecurity status; Reduced animal and crop health; loss of export markets	Biosecurity controls; Surveillance; Control programs, Biosecurity education on farm.
Natural biodiversity	Natural environment: pest plants and animals	Decline of bioregions due to pest plants or pest animals from agriculture	Monitoring and control of pest plants and animals, listed species
	Fragmentation of biodiversity	Decline in biodiversity resilience	Re-establish landscape vegetation connections between significant habitat
	Inappropriate clearing	Decline in the area and extent of native vegetation	Awareness of landholder obligations. Compliance.
Atmosphere	High greenhouse gas emissions	Climate change - lower winter rainfall / irrigation allocations, higher temperatures, higher fire risk & more extreme weather events	Reduce emissions Mitigate impacts through improving water use efficiency for both dryland and irrigated agriculture, shade & shelter for livestock. Capture CO^2 in carbon farming; Adaptation to new climate, improve nitrogen use efficiency
	Odour from intensive animal industries	Increase in land use conflicts due to odour	Current recommended practices to reduce odour. Ensure appropriate siting of intensive animal industries and rural residential areas
People in agriculture	Profitability, wages, skills, labour efficiency, succession, young farmers	Change in the profile of people in agriculture	Skills and training programs. Farmer health & safety programs, support services, infrastructure. Low interest rate loans to encourage young farmers

Table 4.8: Strategic actions for the responses outlined in Table 4-1, Stakeholders responsible and timeframe for action.

Regional Assets	Responses	Possible actions for Strategy – must be tailored to industry / target audience and also consider rural residential land managers where significant	Stakeholders							Time-frame
			CMA	DEDJTR	DELWP	Industry	Local Government	Community	Water Authorities	
Land and Soils	Market adjustment by individual businesses with regard to scale, labour efficiency and succession. Increase productivity per ha, yields/quality/returns	Ensure extension and other RSAS programs are aware of market forces in framing policy responses. Extension and R&D in land use efficiency (e.g. yield per ha or per mm rainfall)				✓		✓		Ongoing
	Manage stocking levels to land capability and seasonal conditions	Extension, grants Education/information on pastures, promote stock containment, incentives/ grants for stock containment, rotational/cell grazing regimes, demo sites, native grass management. Compliance	✓	✓	✓	✓		✓		Ongoing
	Ensure valuable agricultural land is protected and developed to its maximum agricultural potential	Ensure Local Government Planning Scheme Reviews are informed on importance of agricultural soils, and other agricultural assets. Ensure high value soils are identified and developed for maximum agricultural potential (e.g. Whole Farm Planning)		✓	✓		✓			Ongoing
	Perennials on recharge areas and discharge area treatment	Extension, grants	✓	✓		✓		✓		Priority sites in 5 years
	Maintain ground cover, reduce tillage	Extension, grants		✓		✓		✓		Priority sites in 5 years

Regional Assets	Responses	Possible actions for Strategy – must be tailored to industry / target audience and also consider rural residential land managers where significant	Stakeholders							Time-frame
			CMA	DEDJTR	DELWP	Industry	Local Government	Community	Water Authorities	
Land and Soils (cont)	Integrated weed management approach (multiple approaches to weed control) Change cropping rotations if appropriate	Extension - Improving farmer knowledge and skills, integrating with local community groups; R&D - new herbicides and new cropping rotations		✓		✓		✓		Priority sites in 5 years
	Retain crop residues to improve soil carbon apply ameliorants such as lime where economic	Extension - Improving farmer knowledge and skills, integrating with local community groups; R&D - new practices	✓	✓		✓		✓		Priority sites in 5 years
	Move water to low salinity class soils and revegetate discharge areas, Improve irrigation efficiency, Improve surface drainage	Soil salinity mapping, upgrade irrigation systems, ensure drainage systems including tailwater reuse is appropriately managed. Maintain regional drains.	✓	✓		✓		✓	✓	Priority sites in 5 years
Waterways, Floodplains and Wetlands	Implement current recommended practice to reduce water quality risks such as fencing off stream sides, stream buffers, appropriate fertiliser management and controlling soil erosion	Extension, grants	✓	✓	✓	✓		✓	✓	Priority sites in 5 years
	Implement current recommended practice to reduce water quality risks such as irrigation tail water reuse, fencing off stream sides, stream buffers, appropriate fertiliser applications and dairy effluent Ensure drains are managed for rainfall runoff only and not irrigation runoff discharge management.	Extension, grants	✓	✓	✓	✓		✓		Priority sites in 5 years

Regional Assets	Responses	Possible actions for Strategy – must be tailored to industry / target audience and also consider rural residential land managers where significant	Stakeholders							Time-frame
			CMA	DEDJTR	DELWP	Industry	Local Government	Community	Water Authorities	
Waterways, Floodplains and Wetlands (cont)	Implement current recommended practice to reduce water quality risks such as surface water runoff capture and reuse, fencing off stream sides, stream buffers and effluent management.	EPA compliance						✓		Ongoing
	Ensure compliance with floodplain management strategies	Extension and monitoring and compliance. Prevent inappropriate development on the floodplain	✓		✓		✓		✓	Ongoing
Consumptive Water available for irrigation	Market adjustment by individual businesses with regard to scale, water and labour efficiency, succession Lift productivity per ML use (water use efficiency) Upgrade GMW services and Farm systems	Ensure extension and other programs are aware of market forces in framing policy responses. Grants, extension and R&D in water use efficiency Upgrade GMW supply (Connections)	✓	✓	✓	✓			✓	Ongoing
Agricultural livestock and crop health	Biosecurity controls, Surveillance, Control programs.	Extension, Monitoring and Compliance		✓		✓				Ongoing
Natural Biodiversity	Monitoring and control of PPA, listed species	Extension, grants and monitoring, Where needed compliance and enforcement	✓	✓	✓					Ongoing
	Re-establish landscape vegetation connections between significant habitat	Extension, grants and monitoring, Where needed compliance and enforcement	✓	✓	✓					Priority sites in 5 years
	Awareness of landholder obligations	Where needed compliance and enforcement	✓				✓			Ongoing

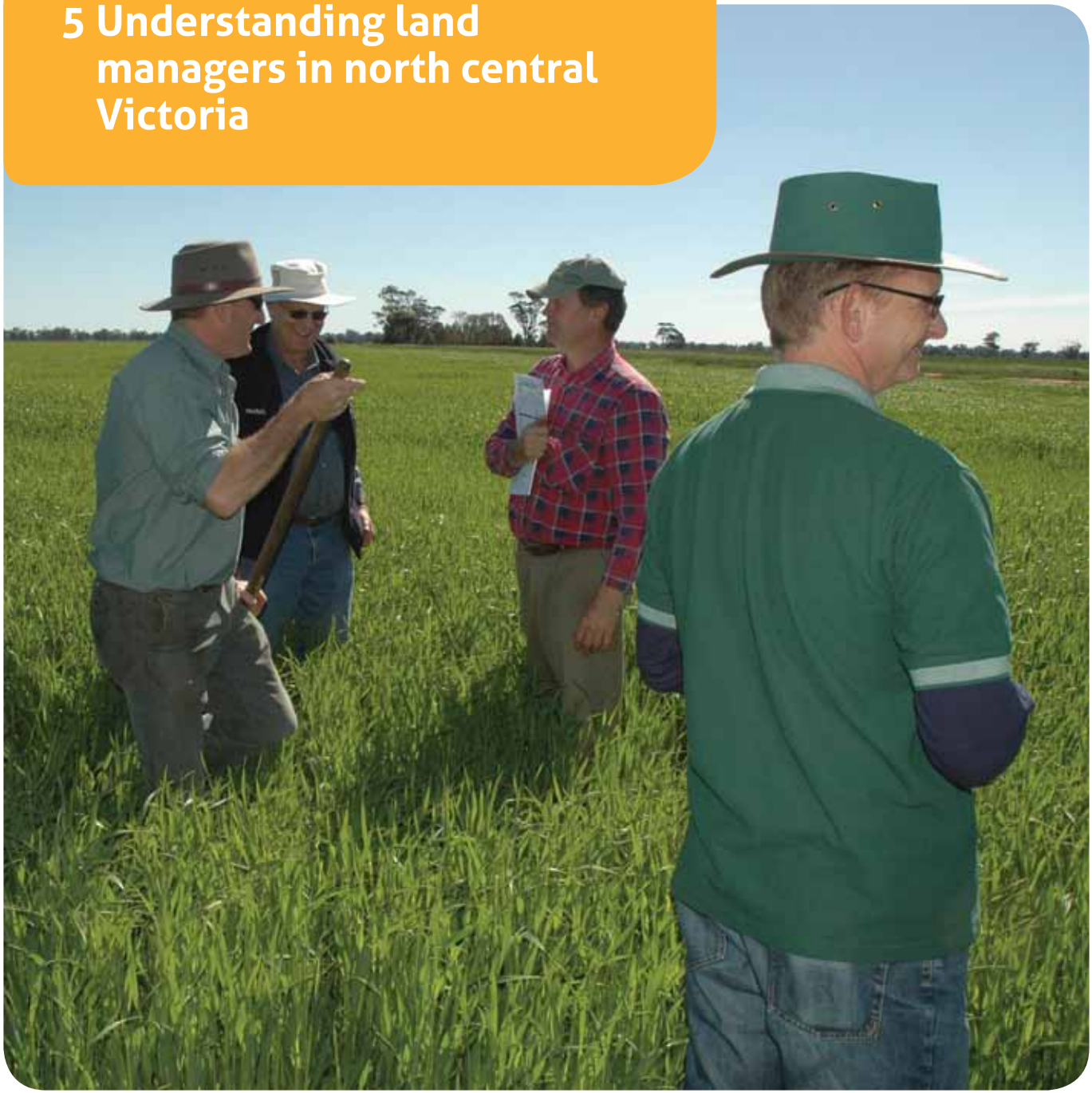
Regional Assets	Responses	Possible actions for Strategy – must be tailored to industry / target audience and also consider rural residential land managers where significant	Stakeholders							Time-frame
			CMA	DEDJTR	DELWP	Industry	Local Government	Community	Water Authorities	
Atmosphere	Reduce emissions, N_2O and methane Mitigate impacts through improving water use efficiency for both dryland and irrigated agriculture. Capture CO_2 in carbon farming. Adaptation to new climate	Extension/ awareness of emissions, energy audits, fertiliser use, animal emissions etc. Carbon Farming Initiative, soil carbon etc. R&D - new varieties, new crops moving south	✓	✓		✓				Ongoing
	Current recommended practices to reduce odour. Ensure appropriate siting of intensive animal industries and rural residential areas	Monitoring and compliance. Local Government Planning Schemes.								Ongoing
People in agriculture	Skills and training programs	Ensure Regional industry skills and training opportunities are available		✓		✓		✓		Ongoing

Wheat, barley and oats are the most common cereals grown in the region.

The region's perennial horticulture industry is concentrated in the Swan Hill statistical area.

On-farm revegetation provides shade and shelter for stock.

5 Understanding land managers in north central Victoria



Eighty seven per cent of the region is privately owned, so improving the health of land, water and biodiversity in north central Victoria requires the cooperation of land managers.

Achieving greater adoption of sustainable agricultural practices requires an understanding of the issues facing land managers, knowing the opportunities and challenges, and targeting the actions that will lead to practice change.

Undertaking a regular, repeatable and longitudinal survey will provide important qualitative and quantitative data on practice change. 2015 will be the benchmark survey year for the Strategy. Once a benchmark is established for the region against which improvement can be measured the results of future surveys will help guide the development of targeted actions for programs and projects that come under the Strategy.

To be truly representative of the region, the strategy must embody the directions and strategic intent of the key agricultural stakeholders:

- Land managers
- Industry and service providers (private and public)
- Agencies and departments
- Government: federal, state and local.

The survey will provide information on what land managers across 13% of the state are thinking and doing, providing unique opportunities for both the community and government.

Rural land managers are key stakeholders in regional natural resource management (NRM) because they own most rural land in Victoria; their management actions directly influence the condition of soil, water and biodiversity assets; and in turn, the condition of those assets influences their livelihoods and well-being. Engaging rural land managers in practice change is complex and difficult, not least because the private benefits of action by rural land managers to address environmental degradation are often uncertain. There is also a potentially large set of factors (personal, societal) influencing their decisions and these vary according to each technology, each landholder, each farming context and over time (Curtis & Mendham, 2011).

To address this challenge, researchers have drawn upon established theory (e.g. the Theory of Planned Behaviour) and considerable empirical research to identify key variables expected to influence rural landholder decisions. A key lesson is that there are important personal factors such as values, beliefs and personal norms that NRM practitioners cannot readily influence but that they need to understand if they are to effectively engage rural land managers. At the same time, we also know that interventions that focus on engaging and building human capital (e.g. knowledge or skills) and social capital (e.g. build trust, establish networks, create social norms), including through participation in field days and trials, involvement in short courses and group discussions, can lead to changes in land use and management.

Whilst we explore opportunities for how we drive, encourage, motivate change, or define what we might mean by change, it is important to understand where the region's land managers are currently and to monitor what changes are being made over time. As such this Strategy seeks to implement a series of replicable surveys that provide the qualitative and quantitative data that will help tell the story of change.

By properly understanding how people are thinking and practicing agriculture, the Strategy will be able to define the key targets and deliverables to achieve greater agricultural sustainability in the region. The Strategy will be able to drive, encourage and motivate change; then regularly measure progress to identify areas of success or areas for adaptation.

5.1 Landholder survey format

A two-step format for interviewing landholders is proposed:

- First cycle – quantitative: build on the Census timing and data collection; understand the *why* and *how* of decision making towards sustainable agriculture.
- Mid-point cycle – qualitative: one-on-one interviews with key stakeholders; providing greater insights into the *what, where* and *when*.

Each step in the cycle is proposed to be undertaken every five years.

5.2 Social benchmarking

Over time, social benchmarking provides data on three indicators related to understanding insights into sustainable agriculture. These are:

- A better understanding of community expectations, attitudes and behaviours towards sustainable agriculture.
- Information that allows us to identify communication, knowledge and action gaps, and to guide development of implementation priorities.
- Data that allows us to assess and evaluate the short and long-term (2–15 years) effectiveness of sustainable agriculture activities, knowledge exchange and partnerships against defined targets.

Social benchmark questions are:

1) Repeatable over time via a cost effective process (region-wide action)
2) Provide the required level of detail for assessment
3) Can be posed across the various stakeholders in order for them to benchmark where they are at in terms of:

    'Where am I currently in terms of sustainable agriculture and can I do better?'

For the Strategy to be truly representative of the region, it must embody the directions and strategic intent of the key agricultural stakeholders:

- Land managers
- Industry and service providers (private and public)
- Agencies and departments
- Government: federal, state and local.

Over a 15-year timeframe, these will change and adapt and therefore the Strategy needs to be contemporary, adaptable and resilient. It must include actions that clearly focus on developing, maintaining and enhancing relationships.

Change is inevitable for agriculture and occurs for a wide range of reasons that involve both internal and external factors. Stressful situations arise and land managers do what they know at these times. This Strategy needs to ensure that we continue to provide information and therefore knowledge to land managers so that when change occurs, they have enough confidence to change what they can manage for the good and understand how they can cope for the changes they can't manage (in this case sustainable agriculture).

Evidence suggests that paradigm shifts take place incrementally and continue to evolve. Whilst this initially may seem to be a contradictory statement, in terms of agriculture, it is very risky to entirely change practices/enterprises without 'practicing through change'. The pace of this shift, or evolution towards and beyond the paradigm shift, is generally driven by two factors - significant stress (be it financial, environmental, emotional etc) and a willingness to change and motivation to change (increased knowledge - learning that there is a new/better way, increased external pressure - social as in a practice such as cultivation is no longer socially acceptable, family as in chemical usage is causing disagreement and concern for child/family health and safety).

Minimising the impacts of stressful events such as drought, flood, financial challenges, etc., is important for the support services that exist within agriculture. In Australia, it is a given that these events will happen. To facilitate and support the move towards a sustainable agriculture future it is imperative that information (knowledge) continues to be provided to land managers so that when these events occur (motivation as a result of stress) the knowledge, skills and awareness are there to guide them in the right direction.

In 2014 CSU undertook a social benchmarking survey of the region's rural land managers to support the development of the *North Central Regional Sustainable Agriculture Strategy*. Profiles have been produced for land managers in each of four agricultural zones (see Figure 1-4). Profiles will assist in tailoring actions within the Strategy towards achieving outcomes in line with the region's agricultural communities and industries. A sample of the profiles are presented in Table 5.1. The survey will be repeated every five years.

Discussions with farmers are important to understand their expectations, attitudes and behaviour towards sustainable agriculture.

Table 5.1: Sample land manager profile data for north central Victoria's four agriculture zones.

	Dryland cropping zone n=71	Irrigated farming zone n=160	Diverse farming zone n=83	Mixed farming zone n=276
Average age	57 years	59 years	62.5 years	58 years
Average property size	1040 ha	300 ha	88 ha	575 ha
Member of a Landcare Group	42%	25%	41%	48%
Attended soil health field day in past 12 months	58%	38%	35%	49%
Undertaken a soil health survey in past 5 years	15%	19%	15%	15%
Prepared a property management plan	25%	56%	22%	33%
Stage of Succession plan (not started or early stages)	55%	66%	63%	59%

5.3 Community capacity

Monitoring the improved community capacity to deal with the issues outlined in this Strategy will be an important measure of the success of the Strategy. We are fortunate that the regional community is coming off a strong base. The regional community has demonstrated strong leadership in responding to agricultural challenges and, with appropriate support, has tackled difficult issues successfully. For example, in the 1980s, the communities within north central Victoria led the development and implementation of salinity management plans across Victoria. The threat posed by salinity is now managed through actions such as soil salinity mapping, community surface drainage, salinity interception schemes, improved irrigation layout and concentrating irrigation on the most productive soils.

This demonstrates that the region's land managers are well versed in making strategic land management decisions. This Strategy is founded on the principle that given appropriate support the regional community has the capacity and is prepared to make the hard decisions necessary to achieve a more sustainable future.

Many more of the region's farmers are now doing soil tests to better understand their soils.

Mixed irrigation farms use around 320,000 ML of water and represent approximately 40% of the region's irrigation water use.

6 Measuring the region's progress towards sustainable agriculture

In order to evaluate the impact of this Strategy the North Central CMA and its partners will develop a monitoring, evaluation, reporting and improvement sub-strategy that will look to a number of indicators, including:

- The value of any increased funding or funding retained in the area of sustainable agriculture;
- Partnerships developed and relationships fostered;
- Knowledge transfer and the increase in community capacity;
- The number of adopters of practice change reflecting progress towards improved sustainable agriculture; and
- The improvement in the condition of the region's natural resource base.

The Monitoring Evaluation and Reporting (MER) component will describe how implementation will be monitored and the effectiveness of actions towards sustainable agriculture. The MER process will provide a consistent basis for communicating implementation results to stakeholders and funding investors.

Integrated outcomes will be achieved for sustainable agriculture and healthy waterways through joint projects and activities.

Partnerships help provide a formal framework from which to deliver mutual outcomes.

The transfer of knowledge and increasing community capacity is vital to achieve practice change leading to increased agricultural sustainability.

6.1 Monitoring

Implementation progress of the Strategy will be monitored by collecting and collating quantitative measures from regional stakeholders.

Monitoring will contribute to the ability to apply adaptive management and be undertaken in an integrated manner to reflect the nature of the region's delivery of actions (multiple delivery partners, multiple investment sources).

The North Central CMA will coordinate with partner agencies to collect and collate the data needed for effective monitoring, evaluating and reporting.

6.2 Evaluation

Program evaluation will be used to test the validity of assumptions that underpin the program logic about how and why particular management activities will contribute to the Strategy objectives.

Data from our monitoring activities will be used to consider evaluation questions, designed to affirm or adapt the assumptions upon which the program logic relies.

Examples of evaluation questions are:

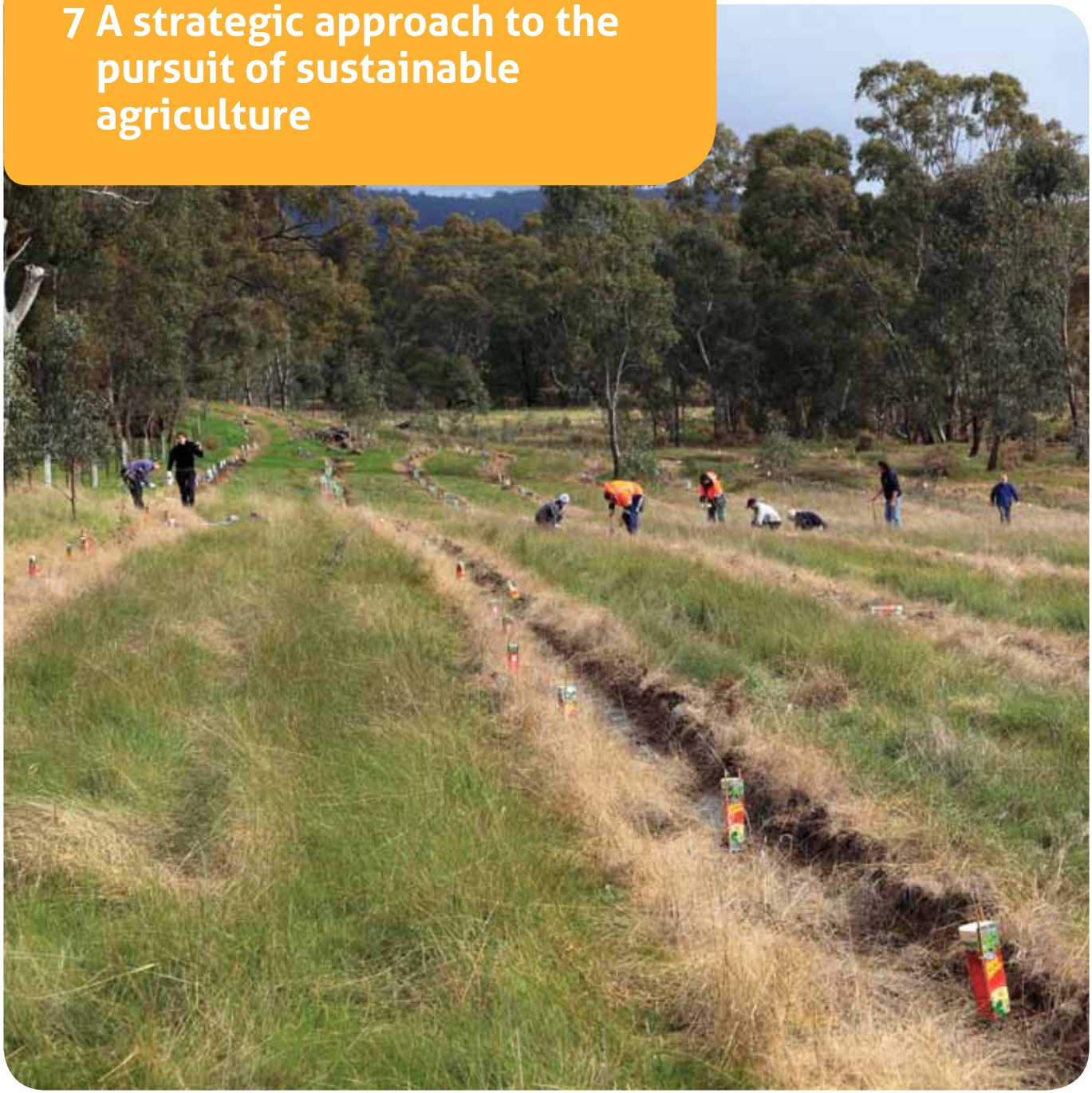
- To what extent were the Strategy implementation actions completed (during the life of the Strategy)?
- How effective were the implemented measures (actions)?
- How have completed actions contributed towards the agreed Strategy targets and objectives?

Program evaluation will make a significant contribution to the Strategy reviews.

6.3 Reporting

It is recognised that all delivery partners have internal reporting obligations for activities they undertake and have various arrangements to meet these obligations. A role of the North Central CMA is to ensure that reporting obligations are met for funding that is directed to the region and relevant to the Strategy.

7 A strategic approach to the pursuit of sustainable agriculture



7.1 The North Central CMA and sustainable agriculture

Established in 1997 under Victoria's *Catchment and Land Protection Act 1994* (CaLP Act) the North Central CMA also has powers and functions under the *Water Act 1989*. It is accountable to the Minister for Environment, Climate Change and Water, the Hon. Lisa Neville MP.

The aim of this Strategy is to therefore achieve land protection by increasing the adoption of appropriate and sustainable agricultural practices.

The *CaLP Act* highlights the importance of community involvement in the management and protection of land and water resources and supports the efforts of land managers throughout the state to 'improve the long-term productivity of their land'.

On behalf of the regional agriculture community of north central Victoria, the North Central CMA has led the development of this Strategy. The Strategy can provide surety to the regional community in guiding the region towards a future founded in more sustainable agriculture; the Strategy also provides surety to those external to the region that we understand our catchments, the issues constraining progress and the opportunities being taken to achieve a carefully considered vision with strategic actions for achieving sustainable agriculture.

Input to this Strategy has been sought from the regional agricultural community, agricultural industry bodies and grower groups (e.g. Horticulture Australia Limited, Murray Dairy, the Irrigated Cropping Council), the Department of Environment Land Water and Planning (DELWP), the Department of Economic Development, Jobs, Transport and Resources (DEDJTR), local governments, and agribusinesses . Regional groups and individuals can use this Strategy with confidence, knowing that there is both evidence and strong support for the region's goals and actions towards a future grounded in sustainable agriculture.

Actions identified within this Strategy are designed to lead to improved agricultural sustainability that will benefit land managers, agricultural industries, rural communities, consumers, and the natural environment.

The Strategy helps guide the regional community towards a future founded in more sustainable agriculture.

Regional Catchment Strategy

Catchment management authorities are required in accordance with the *CaLP Act* to develop a RCS. Currently the North Central CMA's six-year strategy is known as the 2013-19 North Central Regional Catchment Strategy. The role of the strategy is to serve as a basis for providing ongoing advice to government on how catchments are to be managed in the region. [3] A requirement of the *CaLP Act* is that a regional catchment strategy must contain an assessment of the region's land and water resources, including:

- How they are being used within the catchment
- The nature, cause, extent and severity of any land degradation that maybe occurring
- Identifying priority areas for attention in terms of implementing the necessary actions designed to improve the quality of catchment land and water resources. [4]

[3] Coleman, *op.cit*, p1621.
[4] See Part 4 – Catchment Planning, Division 1, Section 24 of the *CaLP Act 1994*, pp50-51.

Statement of Obligations

The guiding principles set out in the Statement of Obligations created under the *CaLP Act 1994* and the *Water Act 1989* are designed to impose obligations on catchment management authorities to ensure their planning and the decisions that are made occur within the context of integrated catchment management. [5]

In this context, achieving a sustainable approach to catchment management requires catchment management authorities to balance social, economic and environmental outcomes to deliver improvements in the land, water and biodiversity of the catchment.

This Strategy is therefore a call to action by the North Central CMA and its partners for all land managers to ensure the management of their land is contributing positively to the health of the catchment in which they live.

Figure 7.1: The interrelationships between the key North Central CMA strategies and programs that contribute to integrated catchment management and the health of the region's land and soil.

[5] See Part 2 – General, Guiding Principles, 7.1 (c), Catchment and Land Protection Act 1994. Statement of Obligations – North Central Catchment Management Authority, p7 [Issued 20 June 2007] and Part 2 – General, Guiding Principles, 7.1 (c), *Water Act 1989*. Statement of Obligations – North Central Catchment Management Authority, p6 [Issued October 2006].

Appendix 1: Key terminology in the sustainable agriculture space

Source: http://regenag.com/web/

Applied Watershed Restoration involves practical, natural materials and good design to repair and restore the most degraded gullies, creeks and floodplains back to their natural capacity as moisture-rich landscapes.

BioFertile Farming involves making the fertilisers needed on your farm in order to restore fertility to their landscape and yields.

Holistic Management involves animal and land management practice that mimics nature to benefit grazing stock and biodiversity at the same time.

Polyface Farming involves local farms and the benefits of local food systems in creating resilience, stability and abundance for both local farmers and the wider community.

Pasture Cropping is a technique of sowing crops into living perennial (usually native) pastures.

Regenerative agriculture is a sub-sector practice of organic farming designed to build soil health or to regenerate unhealthy soils. The practices associated with regenerative agriculture are those identified with other approaches to organic farming, including maintaining a high percentage of organic matter in soils, minimum tillage, biodiversity, composting, mulching, crop rotation, cover crops, and green manures.

In **permaculture**, a regenerative farm is one where biological production and ecological structure are growing increasingly more complex over time, but yields continue to increase while external inputs decrease.

The source of the following definitions is: Organic Farming Program Coordinator, University of California

Agroecology: the study of the interrelationships of living organisms with each other and with their environment in an agricultural system.

Biodiversity: a measure of the variety of species comprising a community.

Biodynamic: a type of organic farming system developed by Austrian scientist and philosopher Rudolf Steiner in the early 1900's. Biodynamic farming takes into consideration both biological cycles and also "dynamic"—metaphysical or spiritual—aspects of the farm, with the intention of achieving balance between physical and non-physical realms.

Bio-Intensive: a combination of biodynamics and the French-intensive method of farming, which involves the use of raised beds, with crops planted very close together and in combination with other crops.

Biological control: the practice of using beneficial organisms—such as insect predators or parasites of pest insects, pest disease agents, insect-eating birds and bats—to keep pest populations at a tolerable level.

Biotechnology: the science of gene modification, in which DNA is transferred from one organism to another, altering the molecular makeup of the recipient and resulting in the expression of new characteristics.

Certified Farmers' Market: a marketplace in which farmers sell their produce directly to consumers. In a certified farmers' market, farmers are exempt from packing, sizing, and labelling requirements, however, they can only sell products that they have produced.

Certified Organic: referring to a product that has been produced in accordance with specific regulations and that has been inspected and approved by an accredited certifying agent. The USDA Federal Rule governing organic certification requires that an organic production system is managed "to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity."

Companion Crops: crops that are planted close to one another to achieve some mutual benefit such as repelling insect pests or attracting beneficial insects, shade, wind protection, support, or nutrient enrichment.

Conservation Tillage (CT): a production system in which at least 30% of the soil surface is covered by residues from previous crops. Conservation tillage is practiced to reduce erosion and to conserve soil carbon. Surface organic mulches are heavily used in CT systems.

Conventional (Agriculture): an industrialized agricultural system characterized by mechanization, monocultures, and the use of synthetic inputs such as chemical fertilisers and pesticides, with an emphasis on maximizing productivity and profitability. Industrialized agriculture has become "conventional" only within the last 60 or so years (since World War II).

Cover Crop: a crop grown to prevent soil erosion by covering the soil with living vegetation and roots that hold on to the soil. Cover crops are also grown to help maintain soil organic matter and increase nitrogen availability (green manure crop), and to "hold on" to excess nutrients (a catch crop) still in the soil following an economic crop. Other benefits of cover crops include weed suppression and attraction of beneficial insects.

Crop Rotation: the practice of planting a sequence of different crops and cover crops on a specific field. Crop rotations can be used to help build soil fertility, reduce insect pest pressure, and suppress weeds.

Farmscaping: the practice of designing and maintaining habitats that attract and support beneficial organisms, used to improve crop pollination and to control pest species.

Flame-Weeding: the practice of using heat to kill weeds. Typically a flame torch is used to sear weed species in a manner that does not affect the crop species or at a time when the crop species is not present.

Genetically Modified Organism (GMO): an organism that has been genetically altered through the transfer of DNA from another organism, resulting in the expression of new characteristics in the recipient.

Green Manure: a cover crop grown to help maintain soil organic matter and increase nitrogen availability. Legumes are often used because they have rhizobial bacteria living in their root nodules that are able to fix nitrogen from the air and add it to the soil. Grasses grow quickly, providing biomass good for increasing organic matter.

Humus: well-decomposed organic matter which is resistant to further decomposition and which may persist for hundreds of years. Humus holds on to some nutrients, storing them for slow release to plants.

Integrated Pest Management (IPM): a strategy of pest management that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

Intercropping: the practice of planting two or more mutually beneficial crops in close proximity, typically as alternating rows or numbers of rows. (On a small scale, this is often called companion planting). Benefits can include insect or weed suppression, structural support, or shade.

Mulching: the practice of spreading organic materials—such as straw, compost, or wood chips—over otherwise bare soil between and among crop plants. Mulching helps to conserve moisture, suppress weeds, and build soil organic matter.

Organic (Agriculture): referring to a type of agriculture that promotes the use of renewable resources and management of biological cycles to enhance biological diversity, without the use of genetically modified organisms, or synthetic pesticides, herbicides, or fertilisers. Organic livestock production promotes concern for animal welfare, without the use of synthetic foodstuffs, growth hormones, or antibiotics.

Permaculture: a term coined in 1978 by Bill Mollison, Australian ecologist, and one of his students, David Holmgren. "Permaculture" stands for "permanent agriculture" and it is a land use concept that refers to the design of ecological human habitats and food production systems, with goal of harmonious integration of human dwellings, annual and perennial plants, animals, soil, and water, into stable, productive communities.

Soil Organic Matter (SOM): soil organic matter has three parts: living organisms, fresh residues, and well-decomposed residues (the living, the dead, and the very dead). Fresh residues are a primary source of food for living organisms. Decomposition of fresh residues releases nutrients needed by plants. Well-decomposed matter, also called "humus," holds on to some nutrients, storing them for slow release to plants.

Tilth: the physical structure of soil as it influences plant growth. A soil with good tilth is porous, allowing water to infiltrate easily, and permitting roots to grow without obstruction.

Transitional: referring to a production system which follows organic management practices, but has not yet fulfilled time requirements to be certified organic (land must be free from prohibited materials for a minimum of three years to be certified).

Understanding soils is a foundation of sustainable agriculture.

Cropping land managers have the flexibility to adapt crop rotation in opportunistic years.

The gross value of sheep meat has dramatically increased over the past decade, now up to $64M.

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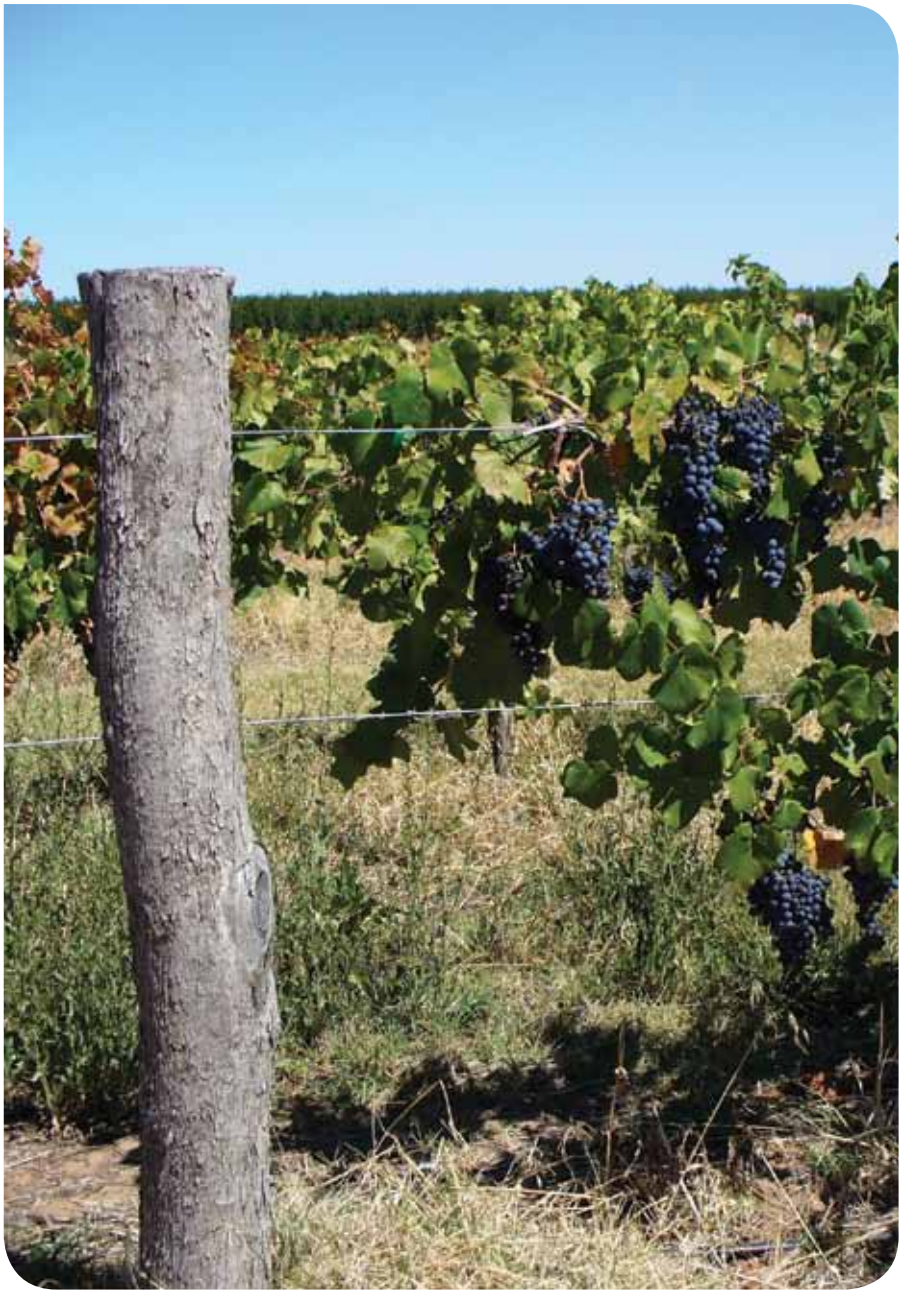

This North Central Victoria Regional Sustainable Agriculture Strategy is an initiative of the North Central Catchment Management Authority (CMA) in partnership with the region's agricultural community and is supported by the Victorian Department of Economic Development, Jobs, Transport and Resources.

The Strategy is available electronically at www.nccma.vic.gov.au

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