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Douglas K. Bardsley, Elisa Palazzo, Nathanael D. Wiseman, and Randy Stringer
The roles of agricultural biodiversity in the McLaren Vale landscape

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The roles of agricultural biodiversity in the McLaren Vale landscape

DEWNR Technical report 2017/01



Government of South Australia
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Water and Natural Resources

The roles of agricultural biodiversity in the McLaren Vale landscape

A report prepared for the Department of Environment, Water and Natural Resources, Government of South Australia, October 2016.



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1. Executive Summary

The biodiversity within agricultural systems can be overlooked by research and can also be considered of limited value in conservation policy and natural resource planning. In South Australia, the importance of diverse agricultural ecosystems (agro-ecosystems) are rarely analysed in depth or prioritised for conservation effort. Now, much of the diversity that remains within agro-ecosystems is under pressure due to the fundamental importance of productivity gains, technological change and associated production efficiencies. At the same time, new approaches to working with communities for conservation are being established in Australia and internationally, many of which focus on the importance of a heritage of biodiversity stewardship and sustainable use of resources. This report outlines the values of biodiversity in the viticultural/agricultural region of McLaren Vale, south of Adelaide, with a focus on the processes of erosion and the uses of agricultural biodiversity, or agrobiodiversity, within local production systems.

In this study, example values of agrobiodiversity are analysed at field, farm and regional levels. The crops and animals used, the associated soil biota, native species within and adjacent to productive systems, as well as the landscapes themselves, could all be considered part of the regional agrobiodiversity. The research generated narratives on that biodiversity from the perspectives of landowners working in a range of important McLaren Vale agricultural industries through a series of “walk and talk” meetings. Field survey forms, and farm-scale and sub-regional maps identify diversity within the landscape, and that primary data is linked to existing information on regional landscapes. Together, the approach allows for a discussion of systemic and spatial elements of value, with the use of narratives, maps and physical attributions of value to places in the landscape. The report concludes by outlining the potential implications of landholder values of agrobiodiversity for conservation planning and policy. In addition, this study draws on a range of evidence of land use history and associated bio-cultural landscape values to propose that McLaren Vale has the potential to be recognised as an important heritage landscape.

The key issues are summarised into themes at local and regional scales. At a regional scale, much diversity was lost from agricultural systems during the expansion of the wine grape industry from the 1990s. The loss of agrobiodiversity increased production and marketing risks for many producers as they became dependent on one crop, with limited marketing channels. Nevertheless, there has been an increasing recognition of the important values of diversity within local agriculture for reasons including: habitat conservation; a harmonious existence with nature; aesthetic and spiritual values; pest and soil management; unique production processes and products; tourism; education; marketing; and water resource and climate change risk management. As the range of biodiversity values have been more strongly emphasised, a process of re-diversification is underway as producers aim to generate ecologically resilient production systems and explore alternative production and profitable marketing opportunities, especially: organic and biodynamic

production; unique wines linked to different varieties and soils; the Willunga Farmers Market; and direct marketing and tourism. That re-evaluation of biodiversity is also important because much remaining native vegetation exists in farmers' fields along creek lines or within the Hills Face Zone, which are managed within local agro-ecosystems.

Agrobiodiversity can be measured and valued at different scales within and between socio-ecosystems to understand the bio-cultural heritage of a place and to investigate how that diversity can support the resilience of local systems. The diversity that is being re-developed at systemic, farm, field, species and varietal levels in the McLaren Vale is not only supporting farming, but also recreation and commercial activities, cultural heritage and sophisticated cosmopolitan lifestyles. Some of those values are part of an agrarian heritage of innovation and cooperation that has existed in the region since colonial settlement. That bio-cultural heritage is reflected in the landscape, and includes the colonial grid system of settlement and the built heritage of homes and sheds in proximity to road access and water availability. The values of agrobiodiversity are also related to contemporary responses to the risks of globalization and environmental change, and the opportunity to exploit new production and marketing channels. Together, a new recognition, development and exploitation of agrobiodiversity values is being enabled by landowners from a diversity of cultural and professional backgrounds across the region.

The participation of a diverse group of landowners revealed a complex view of biodiversity, which suggests that a sophisticated values-based approach to conservation exists within the community. The conception of biodiversity presented by respondents challenges traditional policy divisions between 'natural' and productive or anthropogenic landscapes. Artificial divisions between types of biodiversity ignore the complex interactions that exist in socio-ecological systems, where productive activities protect remnant native biodiversity, and in addition, develop new biodiversity through agricultural innovation and change. Indigenous approaches, historical and contemporary vegetation management approaches have strongly shaped the biodiversity that is present in the landscape. Conservation policy could further recognise the importance of people in natural resource management and support them to reflect their bio-cultural heritage in the landscape through the maintenance of novel ecosystems that adapt to changing conditions.

There are already a range of approaches in place to ensure that the local community and their agrobiodiversity are supported through authentic, dynamic practices, such as marketing and tourism, but these could be further supported with research, promotion, infrastructure and other mechanisms linked to the region's proximity to Adelaide.

A regional mechanism to reflect the value of local bio-cultural heritage, such as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage listing, would recognise the local heritage of nature, culture and innovation. It could also help to focus attention on a unique place that is using its agrobiodiversity to generate resilience and exploit opportunities in a period of rapid change. At the same time, the process could more fully acknowledge that agrobiodiversity forms a vital component of the state's heritage.



2. Introduction

An enormous challenge is building for the management of landscapes in late-capitalist societies, such as Australia. Much of the diversity that has developed and remains within agricultural ecosystems (agro-ecosystems) and landscapes is under pressure due to the importance of productivity gains, technological change and the resulting efficiencies of scale and systemic streamlining. Within the peri-urban fringe of Australian cities, those modern rural development pressures are accentuated by the dominant forces of urbanisation, as the city, and the associated needs of employment and returns on capital investment, generate a demand for the ongoing expansion of urban land uses. Such drivers of change have the potential to rapidly erode important heritage, including the bio-cultural heritage within a place. Our work focuses on examining the extant agricultural biodiversity, or agrobiodiversity, and the processes of loss, or erosion, of that diversity, within the high value agricultural/viticultural landscape of the McLaren Vale (MV) on the periphery of Adelaide, the capital city of the state of South Australia (SA) (Figure 3). Opportunities to value, retain, enhance and further exploit agrobiodiversity within the MV landscape are discussed, to inform discussions on conservation and natural resource management policy.

Biodiversity is a vital element of all natural and anthropogenic ecological systems. Biodiversity levels in natural systems are studied, monitored and reviewed regularly and form the focus of government policy for conservation outcomes. The biodiversity within strongly anthropogenic systems, such as agro-ecosystems, have rarely attracted the same attention, particularly in Australia, except where they are considered to have significant value for natural biodiversity conservation outcomes. For those reasons, the agrobiodiversity from individual fields through to regional, national or global scales is generally assessed, valued and managed less explicitly than natural ecosystems, and can often be discounted altogether (Ehrlich and Ehrlich 1991; Negri 2005; Bardsley and Thomas 2006; Love and Spaner 2007).

There are many definitions of agrobiodiversity. In this report we use the broad definition applied by the Food and Agricultural Organization (FAO) of the United Nations (1999), in which they define agrobiodiversity as:

“The variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems.”

The FAO definition attempts to include all organisms directly relevant to food and agricultural systems, but also importantly for this report, those native or indirectly exploited species that deliver ecosystem services within agro-ecosystems. Thus, the crops and animals used, as well as the associated soil biota, native species within and adjacent to productive systems, as well as the landscapes themselves, could all be considered part of the agrobiodiversity of the MV. "Landscape" here means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors (European Landscape Convention 2000). Much of the agrobiodiversity is not native, not 'natural' and may even be having negative impacts on the local ecology or production systems. Just as there is growing evidence from landscape ecology of the intermediate disturbance hypothesis within natural systems, moderate anthropogenic inputs can maintain or increase net biodiversity levels within agrarian landscapes (Huston 2014; Agnoletti and Rotherham 2015; Marull et al. 2016).

Both historical and contemporary human activities are intricately linked to the conservation of the biodiversity within the Mt Lofty Ranges (e.g. Bardsley et al. 2015). Much important biodiversity exists within socio-ecological systems, or socio-ecosystems, where both anthropogenic and natural forces act to shape the important elements and processes of the coupled human–environment systems (Young et al. 2006). Without the evolving cultural relationships with the environment that lead to the constant regeneration of species and renewal of landscapes, important natural and anthropogenic biodiversity can be lost or eroded (Figure 1). Especially relevant for this report is the agrobiodiversity that is intimately anthropogenic and symbiotic with human activities (Brookfield et al. 2002; Scherr and McNeely 2008). That conclusion suggests that the agrobiodiversity in the MV could provide an important example of the broader concept of bio-cultural diversity, which was defined at the UNESCO/CBD (2014) Florence declaration on the links between biological and cultural diversity:

“Bio-cultural diversity results from the combination of historical and ongoing environmental processes, land use processes and cultural heritage. It assimilates economic, social, cultural and environmental processes in time and space and it is often grounded on specific landscape features.”

In other words, a focus on bio-cultural diversity would suggest that our settled landscapes in SA have been significantly altered, initially by indigenous communities and more comprehensively by settler and modern society over the last 200 years. That knowledge could inform SA conservation policy because most ecosystems are not simply natural anymore and require ongoing human interventions to be maintained. Drawing from the agrobiodiversity and broader bio-cultural diversity literature (Agnoletti and Rotherham 2015; Bürgi et al. 2015), we argue for the need for diversity to be measured and valued at different scales to better understand the values that it provides. For that reason, the agrobiodiversity and some other broader elements of bio-cultural diversity are articulated, mapped and analysed for the MV, and the potential

implications for SA conservation policy, including recommendations for the evolution of the state's first biodiversity strategy (No Species Loss - A Nature Conservation Strategy for South Australia 2007-2017), are articulated. This work also informs an opportunity for the agrarian landscapes of the Mt Lofty Ranges to be included in a more specifically defined heritage landscape, such as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage (WH) area.

Figure 1. A typical landscape mosaic in the McLaren Vale: a mix of farms with vineyards, crops and grazing interspersed with native vegetation, especially along water courses



3. Method

Example values of agrobiodiversity and associated bio-cultural heritage have been developed at field, farm and regional levels for the MV. The research aims to generate narratives on biodiversity from the perspectives of local landowners, so even undesirable elements of biodiversity form part of the discussion. To generate and analyse those local stories on agrobiodiversity values, we apply a revised version of the methodology outlined by Bardsley (2015) that draws from the wider biodiversity literature (Whittaker et al. 2001; Gabriel et al. 2006; Karp et al. 2012). There is not space to fully outline the complexity of farmers' stories in this report. Instead, the key issues raised are summarised into themes, or narratives, and supported with example quotes and images obtained during interviews with key respondents. Thus, the term narrative refers to the "stories that are bounded by the narrator's particular experiences, observations, and attachment to place. They include anecdotal information, oral environmental history, and local knowledge" (Robertson et al. 2000, p120).

We argue for the need for agrobiodiversity to be measured and valued at different scales within and between socio-ecosystems to understand the how that diversity can support the resilience of local systems. That goal was achieved in the MV by talking with people from a range of important regional agricultural industries. To target respondents with particular interests in the heritage of the region, support was provided by Mt Lofty Ranges WH bid staff, the MV Grape, Wine and Tourism Association and the Friends of Willunga. Therefore, the farmer respondents (Table 1) are not a representative sample of the rural community in the MV, but rather a selection of people identified as experimenting and applying alternative farming systems to develop their agro-ecosystems along different paths to the dominant regional viticultural system. Interestingly, most respondents have spent time living and working overseas and inter-state, and reference those experiences in their answers to questions. As can be seen in quotes from respondents, some self-identify with a rebellion against uniformity, while others are developing uniquely complex agro-ecosystems in response to external pressures in the market or the changing environment.

In this report, narratives on agrobiodiversity values are supported by the analysis of available secondary data. This results in agrobiodiversity narratives presented at two important scales: local agrobiodiversity is represented by references to the values of agrobiodiversity within individual fields and farms/businesses, while regional diversity is discussed primarily in relation to the wine industry and the MV landscape. The field and farm levels of agrobiodiversity data are derived from interviews with 17 landowners in the MV region during a series of "walk and talk" meetings on their properties from March to June 2015. The walk and talk model is a rapid rural appraisal survey device derived from agricultural and landscape planning field practices to generate socio-ecological interpretations of agricultural systems and landscapes (Nelson 2015). The model allows researchers to discuss systemic and spatial elements of value, with the use of narratives,

maps and physical elements in the landscape. It is an effective tool to get in touch with people within their local context, and record their perceptions of place and change by integrating spatial elements with a conventional interview process.

Table 1. “Walk and Talk” interview respondents from the McLaren Vale

Respondent Number	Major Agricultural Activities and Place of Interview and Property of Respondent
1.	Almond producers, Willunga
2.	Vegetable grower, McLaren Flat
3.	Grape Grower, Willunga
4.	Barley/Wheat Cropper, Willunga
5.	Grape grower/Vigner, McLaren Vale
6.	Grape grower/Vigner, Willunga
7.	Vegetable grower, Aldinga
8.	Mixed Cropping/Grazing/Quarry, McLaren Vale
9.	Olives/Almonds/Grape grower, Willunga
10.	Grape grower/Vigner, McLaren Flat
11.	Grape grower/Vigner, Willunga
12.	Grazing/Grape grower, Willunga
13.	Grape grower/Vigner, McLaren Vale
14.	Mill Owner/Grape/Almond grower, Sellicks Hill
15.	Grape grower/Vigner, McLaren Vale
16.	Olive oil processor/Olive producer, Willunga
17.	Orchardists, McLaren Flat

The open-ended, in-depth interviews involved a series of questions that focus the discussion on the economic, cultural and ecological values of agrobiodiversity in the context of respondents’ properties, businesses and life experiences (Appendix 2). Key themes that have been discussed with landholder respondents include:

1. Details about the property and management
2. The history and heritage of the property and region
3. Relationships with biodiversity, water and other elements of environmental management
4. Risks and opportunities, including those related to the Mt Lofty Ranges UNESCO World Heritage (WH) bid
5. Agricultural and landscape management governance issues

With permission from respondents, the interviews were recorded with an audio device and notes were taken, while at the same time, key spatial data of landscape assets were recorded. The interviews were transcribed and to maintain the anonymity of respondents, the data is either presented in summarized form or respondents are cited according to their respondent number in Table 1. The qualitative data is primarily presented in the form of quotes from the interviews with reference to the respondent's number. Field survey forms were also used during interviews, with the aim of developing a methodological tool to undertake a comprehensive survey of bio-cultural diversity at the regional scale of the Mt Lofty Ranges (Appendix 2). The forms systematically record the main bio-cultural diversity assets on properties in a way that is compatible with Geographical Information System (GIS) applications, allowing for the necessary extension of the investigation to a wider scale and the management of large quantities of data. For example, the informal data on varietal choices collected during the interviews were overlaid upon the existing geological survey for the region (*Geology of the McLaren Vale Wine Region*, GDA 2010) (see for example Figure 25).

The interviews with landowners inform an important discussion of how cultural interpretations of biodiversity values are vital for production across the region. At the same time, farm-scale and sub-regional maps were used to identify and map diversity within the landscape. Data derived from the interviews are utilised to analyse how policy could better recognise and support agrobiodiversity values within local and regional contexts, as well as in relation to the city of Adelaide, national and global scales. Key to those latter discussions are the opportunities for possible heritage listing of the agrarian landscapes of the Mount Lofty Ranges. Thus, the narratives on the values of agrobiodiversity at various scales flow into a brief outline of potential implications for environmental management outcomes and uses of diversity to respond to business risks. Learning from interviews with key stakeholders in UNESCO cultural landscape sites in Italy and Switzerland, as well as a UNESCO workshop in Paris on the challenges of tourism in WH listed agricultural cultural landscape sites, also supports the discussion of SA conservation policy opportunities.

At the regional scale, an integrated approach to bio-cultural landscape analysis was applied based on a multi-criteria assessment using several indicators at different geographical scales. An operational methodology was defined for the evaluation of the bio-cultural diversity according to three guiding principles:

- An interdisciplinary approach, linking historical, cultural, economic and environmental aspects of the landscape;

- A multi-layer comparative analysis, operating simultaneously on different conceptual levels (hydrology, geology, orography, land cover and vegetation, historical cadastre, roads network, heritage listed structures and places, etc.);
- A multi-scalar exploration, tracking phenomena across scales corresponding to three landscape levels: Landscape System (the MV) / Land unit (a water basin) / Landscape patch or unit (Farm and fields).

The regional analysis contains information derived from the collection and systematization of existing knowledge on single landscape components. That information was analysed in association with GIS spatial datasets and thematic surveys, generating important information about changes to landscape and the density of bio-cultural assets. The GIS analysis process led to the identification of some gaps in knowledge and availability of data. In particular, regional-scale agrobiodiversity was assessed by exploring changes in land use over time. Spatial data provided by the SA Department of Environment, Water and Natural Resources (DEWNR), allowed for the mapping of land use change from 1993-2008, with subsequent spatial analysis providing quantitative assessments of types and diversity of land use by area over this period. For vineyards, this data was complemented by the analysis of crush surveys in the MV region from 1990-2014, with a particular focus on the investigation of trends in agrobiodiversity at the grape varietal level (Wine Australia 2015). Remnant vegetation mapping was also combined with land use zoning data to investigate the proportions of native vegetation in different land use zones to understand how the density of remnant vegetation in the landscape differs according to planning/zoning regulations. Two other key methods complemented these approaches, including:

- **High resolution imagery analysis:** Analysis and interpretation of high resolution aerial photography consisting of orthorectified colour images (RGB), radiometrically balanced and mosaicked, covering the greater metropolitan area of Adelaide. The imagery was captured on 8/9 February 2015 and the image pixel size is 0.075m x 0.075m on the ground. The orthophotography has a horizontal accuracy of +/- 0.15metres.
- **On-field sub-regional surveys and analysis:** Verification and assessment of data collected through GIS analysis and remote sensing, coupled with direct experience on the ground and a targeted field survey of a sample MV study area along the Willunga and Maslin creeks.

Finally, a number of terms and acronyms are introduced that are relevant to a discussion about agrobiodiversity, and these are summarised in a glossary in Appendix 1.

4. Biodiversity in the McLaren Vale

4.1 Historical changes to the regional biodiversity of the McLaren Vale

We begin the discussion with a brief summary of changes in the native vegetation and agricultural land use in the MV since the early 1990s. This initial review is important to outline the state of the key drivers of biodiversity within the MV landscape, and thereby provide context to the issues raised by landholders.

4.1.1 Remnant native vegetation in the McLaren Vale

Most of the native vegetation has been cleared or substantially altered in the MV. What remains in the region is vitally important for the aesthetic values of the landscape (Lothian 2007), but as we will show, remnant native vegetation is also considered as a core element of productive MV agro-ecosystems. GIS software was used to analyse the extent of native vegetation remaining, by overlaying the Native Vegetation cover distribution data (2004/2011 NVIS - Biological survey of SA) with land use zoning data (Land Development Zones – DPTI 1996/2016). The vast majority of remnant vegetation is contained within land that is zoned Hills Face (35% of total remnant vegetation area), Watershed Protection (Mount Lofty Ranges, 34%), and Primary Production (27%) (Figure 2). The Primary Production zone also had the highest number of distinct vegetation areas (153) (Figure 2) and the highest overall diversity of remnant native vegetation types (24) compared with other development zones (Figure 3). These results indicate that the native biodiversity present in the MV is strongly represented in agricultural areas.

Figure 2. Area in Hectares of remnant vegetation by land development zone in the McLaren Vale Character Preservation District

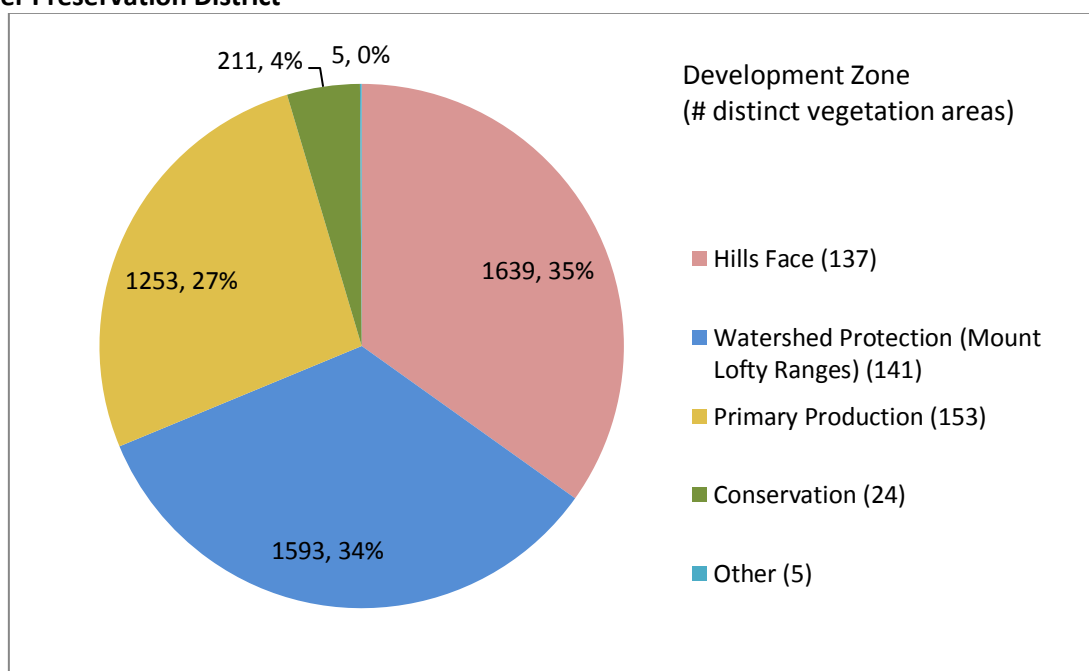
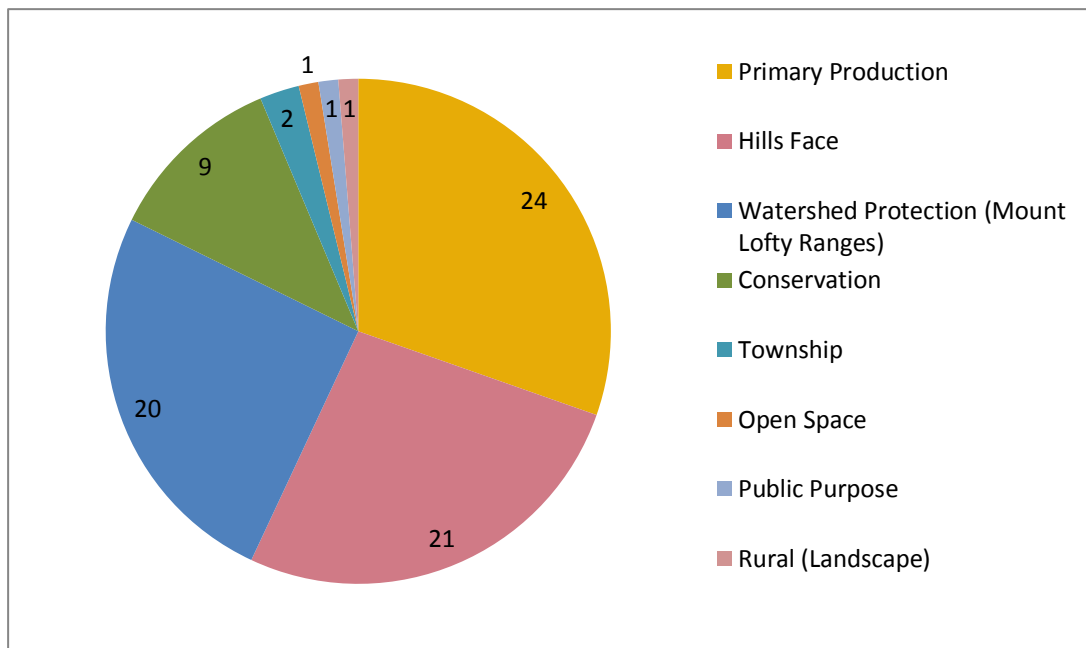


Figure 3. Distinct dominant native vegetation types occurring in each land development zone in the McLaren Vale Character Preservation District

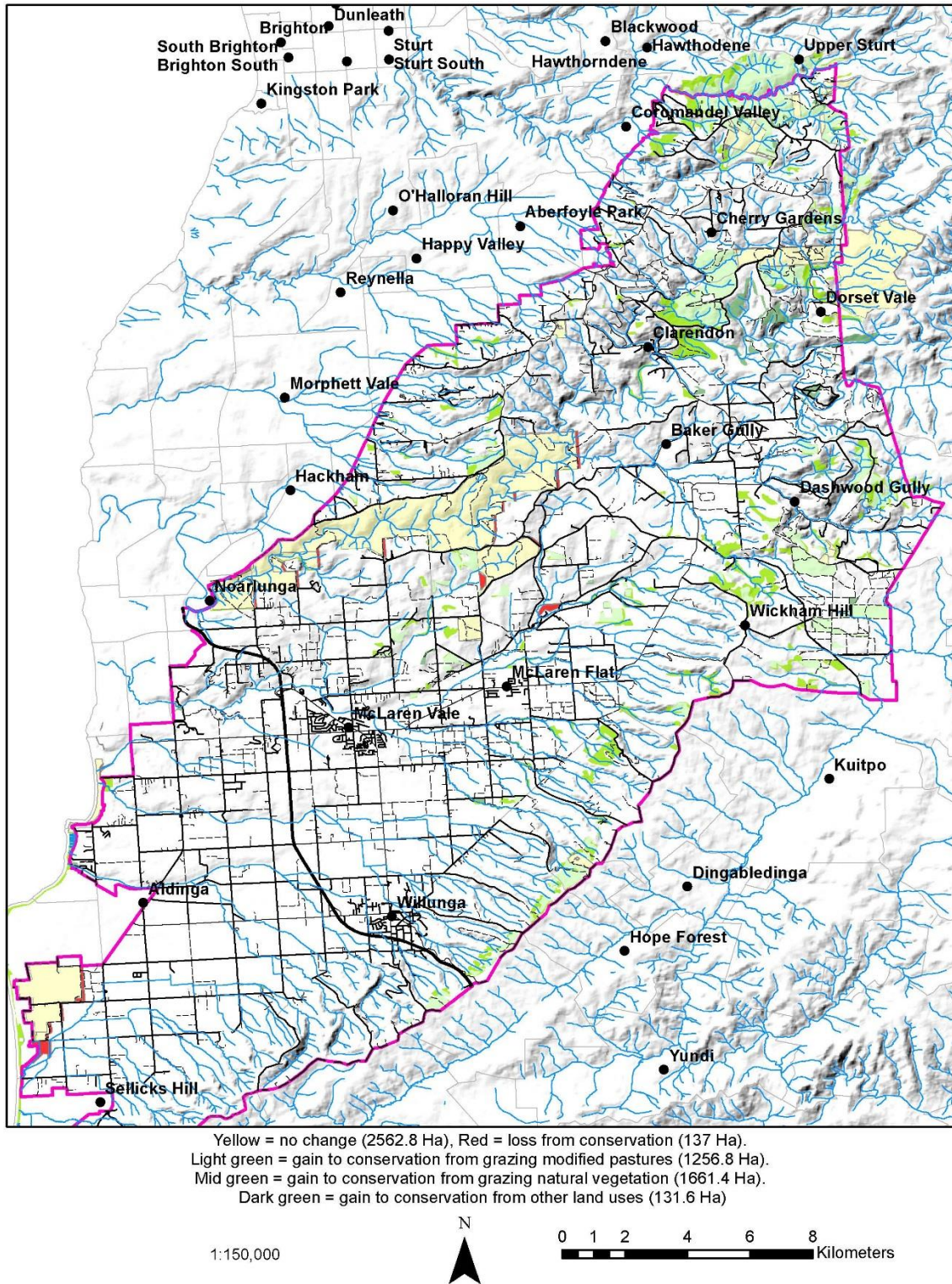


Further analysis using high definition imagery and the field surveys themselves suggest that the SA Government data may actually under-estimate the area of native vegetation in the MV, especially that biodiversity that is being managed by landholders along creek lines and transport routes (Figures 4 & 5). Most of the native vegetation along streams and roads has not been mapped comprehensively, and for that reason cannot be included in the GIS analysis of the distinct dominant native vegetation types occurring in each Land Development Zone (Figure 5). As a result, the native vegetation present in the agrarian landscape may be being neglected in planning and policy discussions.

Figure 4. View of McLaren vale, looking North-West from Willunga Scarp



Figure 5. Changes in native vegetation cover in the McLaren Vale 1993-2008, developed from DEWNR data



A comparison between a map generated from *Australian Bureau of Agricultural and Resource Economics and Sciences* (ABARES) and DEWNR data, and the corresponding high resolution aerial imagery for the same area in the MV are presented in Figure 6. The remnant native vegetation is generally assimilated into the agricultural land use classification in the dataset, highlighting a significant simplification of the landscape

data. This observation suggests a gap in the representation of the complex roles that biodiversity plays within a rural landscape mosaic, and may also lead to the under-estimation of farmers' roles in natural resource management. The gap also highlights a need for detailed surveys of the values of native vegetation in agricultural areas.

Figure 6. Spatial representations of the Willunga creek riparian area within White's valley, utilising ABARES/DEWNR data and correspondent high resolution imagery

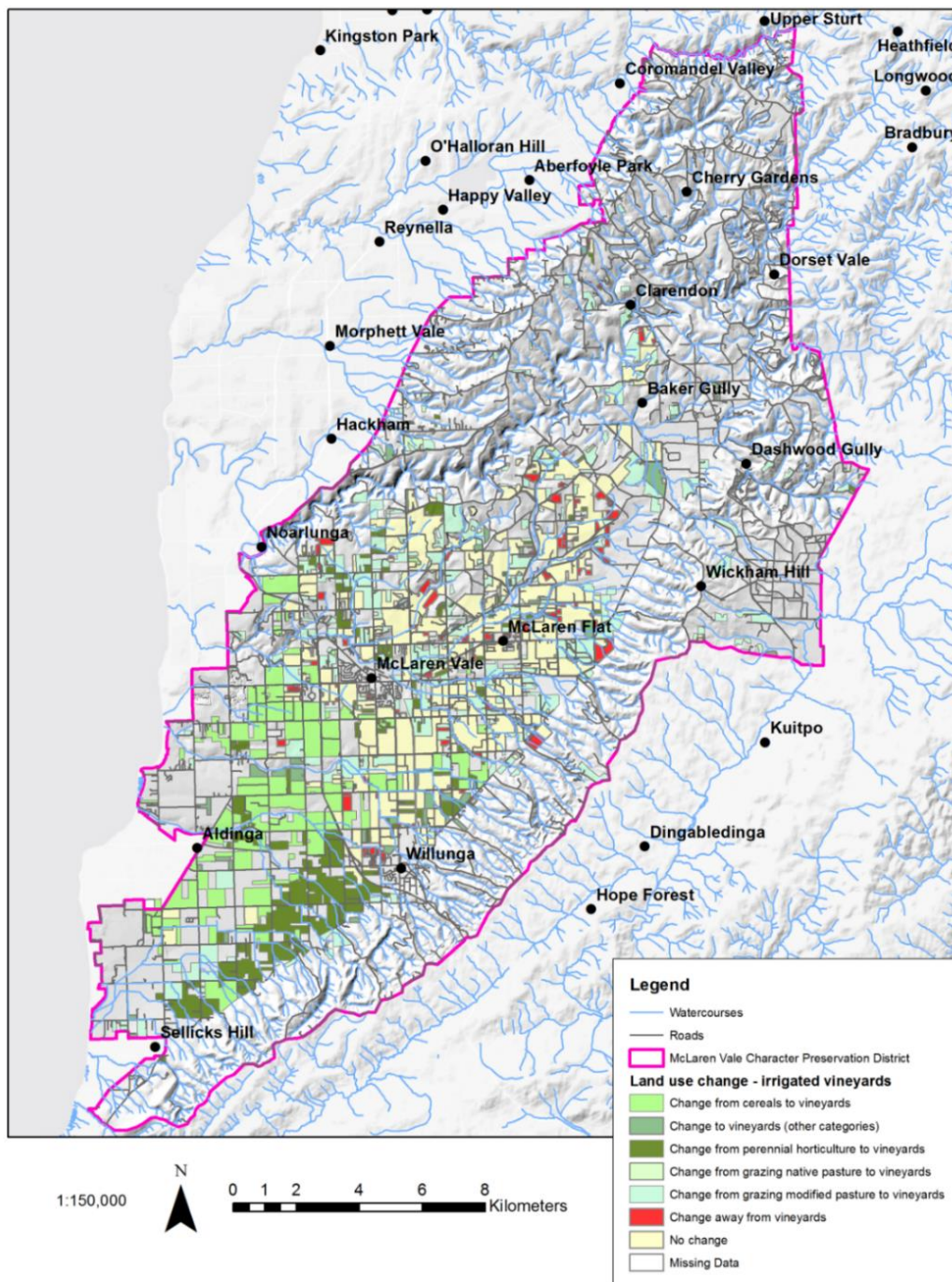


In the following sections, we will discuss all of the biodiversity that is being valued by landholders in the MV. The emphasis remains on the values of biodiversity for agro-ecosystems because a range of other studies have focused on the extent and values of native vegetation within the MV and in fact, across the wider Mount Lofty Ranges.

4.1.2 Agricultural land use change in the McLaren Vale

The MV went through a major agrarian transition from the 1980s through to the early 2000s (Figure 7). During that period, many mixed farms, often with a strong horticultural emphasis on almonds and/or stone fruit, began to focus almost uniquely on wine grape production within irrigated vineyards.

Figure 7. Change in agricultural land use in the McLaren Vale, 1993-2008

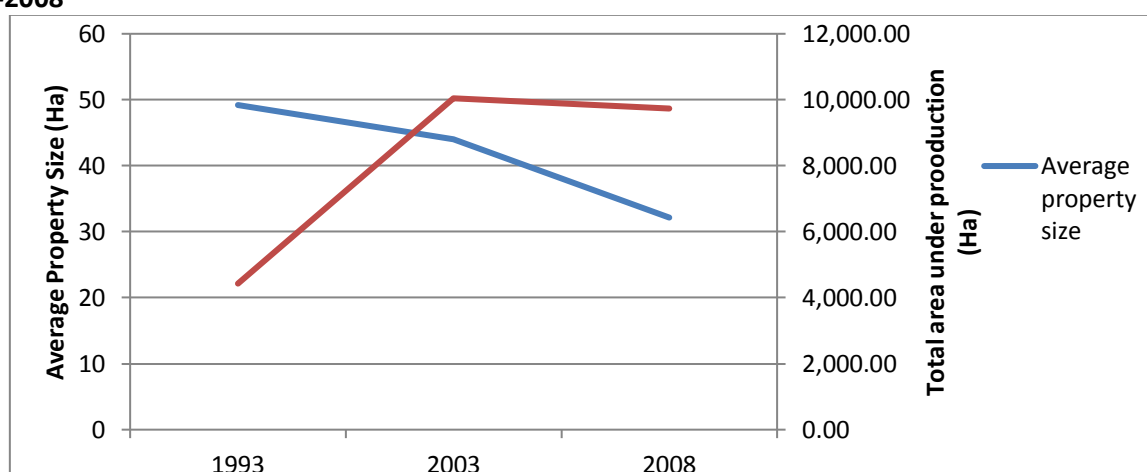


Initially, agricultural settlers in the MV from the 1840s focussed on wheat and sheep production, and that focus broadened in the latter part of the Nineteenth century into mixed farms that involved activities including crops, grazing, dairy, and horticulture, including the precursors of today’s substantial wine grape industry (Dunstan 1977; Santich 1998). From 1993 to 2008, the almond and stone fruit industries significantly declined across the region, which meant a loss in diversity and an increased reliance on one industry alone – viticulture. As indicated in Figure 7, the loss of diversity in agricultural crops was particularly strong in the southern plains around Aldinga and the foothills around Willunga. Along with this increasing trend in total vineyard area over the period 1993-2008, there has been a trend towards smaller block sizes, due to their relative growth in number, as well as a decrease in the number of larger blocks (Table 2). In fact, the area under grape production peaked in 2003, with a decline since that year (Figures 8, 9 and 10).

Table 2. Trends in vineyard block sizes in the McLaren Vale, 1993-2008

Size	# properties	total area	average block size	overall trend
0-2 Ha	more than double	almost doubled	relatively unchanged	growth due to increase in # properties
2-5 Ha	doubled	more than doubled	relatively unchanged	growth due to increase in # properties
5-20 Ha	more than tripled	more than tripled	relatively unchanged	growth due to increase in # properties
20+ Ha	almost quadrupled	slightly declining	decreased by almost half	slight decline due to declining average block size
Overall	more than doubled	declining since 2003	decreased by 32%	Trend towards smaller block sizes, less total area overall (peaked in 2003)

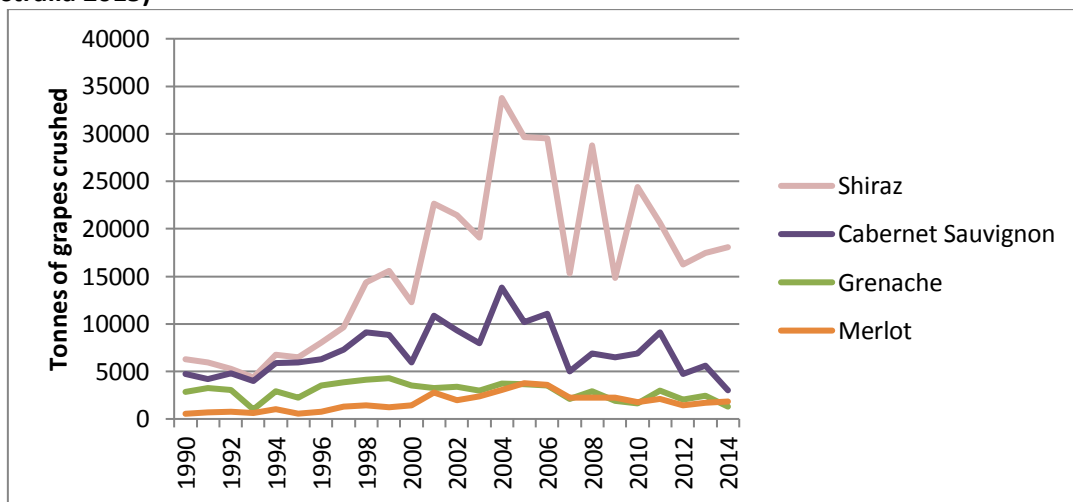
Figure 8. Change in average property size and production area for grape production in the McLaren Vale, 1993-2008



Within the MV viticultural industry, Shiraz has traditionally been and still remains the dominant variety, and most respondents recognized that dominance would be unlikely to change because the variety is well suited to the region, and the MV is recognized for its high-quality Shiraz wines (Figure 9). While Chardonnay

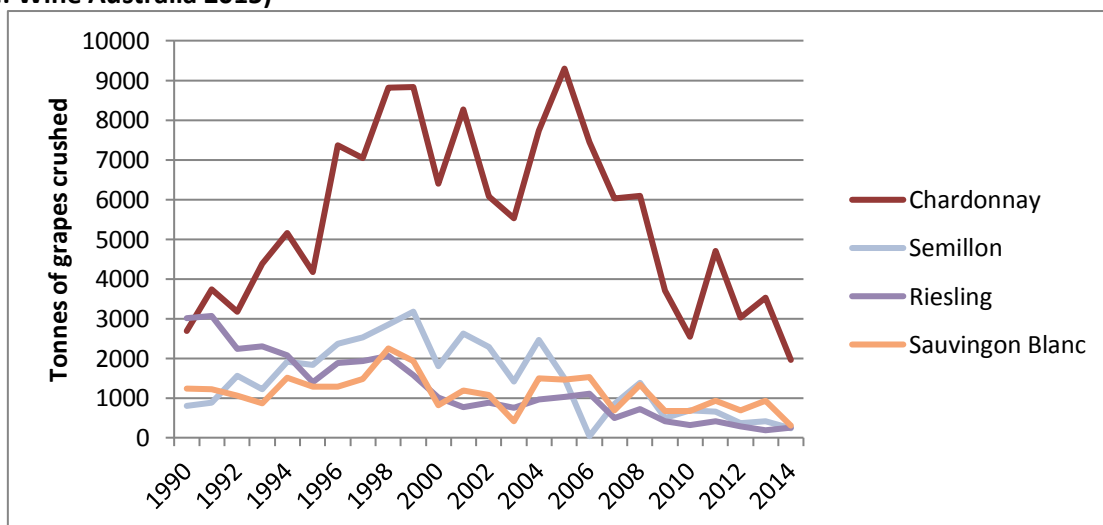
remains the most important white wine grape variety grown in the region, the production of all major white wine grapes has declined in the last decade (Figure 10), along with the red grape Cabernet Sauvignon, also suggesting an increasing dominance of Shiraz. Therefore, not only did the diversity of agricultural species decline considerably during the transitional period over at least the last 25 years, but the wine grape varietal complexity declined as well. The loss of diversity was not comprehensive however, and as the stories from farmer respondents suggest below, agrobiodiversity has been retained or is being reintroduced on farms for many important reasons. Together, the reviews of recent agricultural land use change and the changing expanses of native vegetation suggest that levels of biodiversity are in flux within the MV, driven as much by anthropogenic forces as natural ecological processes.

Figure 9. McLaren Vale Total Vineyard Crush Amounts (tonnes)* 1990-2014, major red varieties (Source: Wine Australia 2015)



* total crush amounts (tonnes) actual usage (measure of demand - i.e. some grapes may not have been crushed due to low demand). Total crush is the sum of purchased and winery grown fruit.

Figure 10. McLaren Vale Total Vineyard Crush Amounts (tonnes)* 1990-2014, major white varieties (Source: Wine Australia 2015)



* total crush amounts (tonnes) actual usage (measure of demand - i.e. some grapes may not have been crushed due to low demand). Total crush is the sum of purchased and winery grown fruit.

4.2 Landholder narratives on the biodiversity of the McLaren Vale

Each respondent was asked what the term biodiversity means for them and for their business. Not all farmers answered the question explicitly, but those who did generate rich stories about biodiversity not necessarily dominated by conceptions of native/natural species and ecosystems, but rather a complexity that includes all of the biodiversity within their productive systems. Those responses support the analyses of available secondary data to suggest that the local biodiversity includes not only very important native species and communities, but also vital agrobiodiversity, or wider bio-cultural diversity. Even though we wish to summarise across all elements of diversity, and have done so in Appendix 3, the quotes in the narrative boxes below (1-6), and the corresponding images (Figures 11-22), highlight the complexity of individual landowner relationships with biodiversity.

Landholder narratives on the values of on-farm biodiversity followed distinct patterns. Some respondents focused on the natural biodiversity, but others were more focused on the values for their productive systems. Together, the key narratives (1-6) on native vegetation reflect a range of values that are summarised in boxes below, including practices such as: habitat conservation; holistic values such as harmony with nature and spiritual values; soil stabilisation and erosion control, drainage and water management; pest animal predator habitat: aesthetic and bequest values. Those values combine to have a range of implications for regional development, including: unique production processes and products; tourism; education; marketing; and, risk management.

Summarised narratives regarding respondents' conceptions of biodiversity in the McLaren Vale

Key narrative 1	Example quotes from respondents
Biodiversity for habitat conservation (Figure 11)	<i>'I'd like to see revegetating with a lot of diversity and a lot of the original ecology. There are still a lot of remnants of the original ecology and that is a golden opportunity not to miss because we have already missed it for 150 years, and we haven't long before the original is all gone.[...] My hedgerows I have planted with the highest diversity I could and some do better than others. They are mostly locally endemic species and it's just in an effort to have the widest habitat appeal to the widest range of species. To me it's integrating farming with our native landscape that is the most important thing I have tried to make a point of, because the old concept of just clearing the land and doing away with all the native landscape is wrong, you don't need to' (Farmer 9)</i>

Figure 11. Regeneration and protection of native habitat to also provide recreation and education opportunities



Key narrative 2	Example quotes from respondents
<p>Biodiversity includes all living things (Figures 12-13)</p>	<p><i>‘Biodiversity is encompassing of everything...biodiversity means that you are utilizing everything that you possibly can, trying to work in harmony with everything around’ (Farmer 2).</i></p> <p><i>‘Biodiversity is exactly what we have now, almonds next door, we used to have an olive grove, gum trees, the native vegetation that is around, the broadacre cropping, there is a lot of it around the place, even to what is grown in the garden, because they attract insects. We live with half a dozen kangaroos on the lawn. Just from a point of view of interest’ (Farmer 3).</i></p> <p><i>‘Biodiversity is an opposite of monoculture, I suppose, and having areas with a range of plants, and some extent animals, that supported natural systems as much as you can when farming’ (Farmer 5).</i></p> <p><i>‘Biodiversity for me is probably a little bit all-encompassing sort of – your whole property side of things – your creek lines, sheds, any scrub, and then the actual farm side of things as well. Obviously vineyards are largely a monoculture but by having it living is important – having either a cover crop or weeds or native grasses or whatever – having it alive I think is important for biodiversity’ (Farmer 11).</i></p> <p><i>‘Biodiversity is everything for me, and it has to be, because if we don’t have the biodiversity then we can’t grow anything and I guess we are all out of a job, it is a complex thing - the sun, the wind, the rain, it is everything we do as farmers’ (Farmer 13).</i></p>

Figure 12. By retaining native vegetation in and around productive crops, such as this mixed market garden, no artificial barrier is perceived between native and agricultural biodiversity



Figure 13. Spiritual values from landscape contemplation



A dominant theme is that native vegetation is consistently used for erosion control in conventional attempts to minimise soil loss from steeper slopes and creek lines, and for windbreaks to protect crops. That emphasis on the value of revegetation activities is reflected in the expansion of native vegetation which is concentrated around creeklines, and particularly on the Hills Face Region of the Willunga Scarp (Figure 5). Respondents noted that the values of native vegetation for erosion control and wind protection have been very well supported in the region, originally by the Onkaparinga Catchment Management Board and subsequently by Natural Resources Adelaide and Mt Lofty Ranges and DEWNR.

Key narrative 3	Example quotes from respondents
Biodiversity for erosion control, drainage management and shelter belts (Figures 14-17)	<p><i>'The best pesticide in the world is the Willunga wind. We are up high here and everything is downwind from us, so we have the prevailing southeasterly and when it blows before Christmas the aphids don't get a chance to establish. [...] The gums here make a great shelter belt which we planted. I really like the hedgerow idea, the southeasterly comes from that way and it is fierce at times, and we use the timber from dead trees for firewood. If it rains on the hills it roars across the paddock, so it protects the house and orchard from the flow' (Farmer 1).</i></p> <p><i>'The Onkaparinga River Catchment Board helped with species selection, and actually did a fair bit of the work on some creeklines which was fantastic. ..It's an aesthetic thing - there might be some erosion control, but aesthetics, wildlife corridors, potentially native species of small birds and hopefully it links up a little bit to other bits and pieces along the creeks' (Farmer 11).</i></p> <p><i>'Diversity works really well for us. The government spent a lot of money planting trees for us, we put fences in, and they come along and plant trees in them. [...] so I said why don't we just put trees along the creek lines to save the erosion, so we have now done that on five or six creeks, and now they have come in with boulders in the creeks where there is erosion, and they have spent \$50,000 on my place alone. We work hand in hand, and I'm about to put another fence in now. [...] We have been doing it for 10 years now, it helps the sheep by providing shelter, stopping the wind and assists the pasture, and also helps us with making some small paddocks. With the fences running up the tree lines we can run fences between them and make some smaller paddocks. That has allowed us to do the fat lambs by keeping the sheep off so the feed can grow well' (Farmer 12).</i></p>

Figure 14. Native vegetation is vital for riparian management in the McLaren Vale



Figure 15. Native vegetation plantings along streamlines to avoid soil erosion



Figures 16 & 17. Cooperation between the local farmers and government has been vital for native habitat restoration/revegetation activities in the McLaren Vale





Key narrative 4	Example quotes from respondents
<p>Native vegetation provides habitat for insects and birds that act as pest predators (Figure 18)</p>	<p><i>'We have fabulous birds, the thrush, magpies, kookaburras, owls at night, mopokes and things, a family of blue wrens, and willy wags are in here obviously getting insects' (Farmer 2).</i></p> <p><i>'You can love wines and love vines, but you can have too much, and so even if the trees didn't have the other values, I wouldn't like to have more vines there. The entomologists talk about 2 predatory wasps that eat a lot of the caterpillars that we might get, but we haven't studied it, but it may be why we don't have a big problem with them. They are hard to spot and I don't get excited about insects, but I am sure that having the trees there helps with the natural balance. The more monoculture you get, the more pests you'll get. Five years agrobiodiversity meant nothing to me, but basically we hadn't thought about it, but now I recognize that a diverse biology is important. The more distance you get from changing the landscape for agriculture, the less it is about survival and the more you develop, I guess it's inevitable that you recognize the values in the diversity' (Farmer 6).</i></p> <p><i>'I planted around the creek as a bit of a wind break. A lot of the Euc's were already there and I planted the other things. [...] The native wasps eat our light brown moth, I've actually seen that process happening, and it's really good. We've planted native vegetation all around our block and because of the size of the vineyard – native wasps don't fly large distances, but I've heard 400m quoted, so it's well within that. (Farmer 9).</i></p> <p><i>'There are plants that provide habitat for pest predators in the vineyard. The light brown apple moth is the main pest, mealy bugs as well but I haven't had them for ages. Lady birds control mealy bugs, we have lace wings and Trichogramma wasps that control the apple moths. So all of the diversity that we have got is providing habitat for</i></p>

	<p><i>the predatory bugs. I used to have spray all the time to control light brown apple moth and now I don't have to spray at all, it is not an issue. So that is it' (Farmer 10).</i></p> <p><i>'We measure predatory wasps, brown and green lacewings, we do earthworm counts and we always keep an eye out for predatory wasps to observe what is going on. [...] Grapegrowers say you don't want birds, but birds are fantastic, they just clean up, they help your pest and disease management program, they are fantastic. We are particularly trying to attract predatory birds, falcons, and if we could get some eagles here that would be great, because they keep out the blackbirds and the silvereyes and things like that, but one thing we do that a lot of other people probably don't do we provide the birds with water, so we have these platforms that we put up every year and we just have 20 litre drums, the birds come down, they know they are at no risk because they are high above the canopy, they have a drink and they fly away, and then they are not coming and pecking your berry, because they are only extracting the water (Farmer 13).</i></p>
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Figure 18. Native vegetation is used to generate pest predator habitat, while reducing wind shear and water erosion, while also generating attractive backdrops to properties



Key narrative 5	Example quotes from respondents
<p>Large eucalypts frame views, helping to define the rural aesthetic (Figures 19-20)</p>	<p><i>'The big gums down by the dam that are probably 150 years old and have their feet in the waters of the dam. It is quite a popular place for weddings, so I would say that they are probably the greatest asset on the place. We have some springs back here and there are big trees in the springs. Most of the buildings here are heritage listed' (Farmer 8).</i></p>

Figure 19. Single large eucalypts, particularly *E. camaldulensis* are fundamental to the aesthetic of the McLaren Vale, and include the bequest values of impressive trees such as “The Mammoth”



Figure 20. Aesthetic values to generate attractive places for cellar doors and functions



Key narrative 6	Example quotes from respondents
Bequest values of retaining diversity in the landscape (Figures 21)	<i>'For one thing, any form of monoculture is just bloody boring and nature isn't like that, and it actually prevents the natural flora and fauna from becoming reestablished, your birds and other animals stay away from the area, and you have economic as well as ecological costs because you have plagues of things as nature falls out of balance. In monocultures of vineyards for example you have plagues of light brown apple moth coming down and destroying the crop because nature is trying to rebalance itself. So if you are able to work with nature you will have a much easier time of it trying to get an economic benefit from the land you live on, as well as passing on the land in a state to the next generation, which is a moral obligation you have as well. So there are moral and economic questions that are both supported by biodiversity over monocultures. As artists we just don't like looking at one thing, there is an aesthetic reasons. It is just so much more beautiful to see things mixed together - vineyards mixed together with native forests mixed together with other forms of agriculture' (Farmer 14).</i>

Figure 21. Native vegetation is used to manage drainage and reduce erosion risk along creek line provides shade and a backdrop to the original Hardy's winery



While we have focused on the values of native vegetation for agro-ecosystems initially, a further important conclusion from the review of landholder conceptions of biodiversity is that most respondents do not recognise the boundary between native and anthropogenic species and systems. For them, the agricultural species, systems and landscapes form just as an important component of the biodiversity for their farms and in the region. The FAO definition of agrobiodiversity becomes important here, because while conventional conservation goals such as the protection of habitat and bequest values are mentioned, landholders in the MV are conceptualizing native species and systems as a vital, living component of their productive agricultural practices, that integrate directly with the crops, livestock and soil biodiversity.

Typifying that important seventh meta-narrative, were quotes from landholders where native and agricultural biodiversity values were seamlessly interwoven to represent the complex values.

'A big thing is for us the diversity of crops we grow (~44 species, 100 varieties), and we grow them in a way that tries to maximise interactions between different crops – we're doing rotations of different crops, not doing massive blocks of the same crop, we've found some amazing insects, like little predatory wasps, all sorts of stuff, this is only a few months after setting up here. For example we had a big outbreak of aphids on the dill but the ladybirds came and cleaned them up. So there's crop diversity, but also we've got a raptor or eagle that provides services to us in terms of catching field mice' (Farmer 7).

'It is not just the vineyards, we have 25 acres of wetland and also we lots of beautiful native vegetation on the vineyard [...] We have beautiful creeklines with lots of native trees and shrubs and we have a native vegetation area that we needed to plant when we removed some trees, and there are a number of dams on the property, so it is a very beautiful vineyard because it is not just a monoculture, a lot of vineyards are just vines, but I think it is a very special vineyard. Because we are biodynamic, I think it all contributes to the holistic approach that we have to farming because we have good biodiversity, it adds to the balance [...] Biodiversity is just about have different species across your land. For me, it includes the livestock we have, you look at it as a farm in a way because it has gone from being just a vineyard to a whole farm, and we have lots of different species, and of the aspects of nature that is happening on this land, it is really quite varied' (Farmer 10).

'Biodiversity is a key area of risk management and dealing with different conditions in vineyards, From a sales or marketing point of view it does help to have something new and different to talk about, so new varieties are handy as well. From the point of view of retaining some of the heritage style bushland it is about maintaining the look of the property and more of a traditional rural outlook than just vineyards, and the positive impact it seems to have as well of having different bugs or animals and having things that are living in different sections of the vineyard that seem to contribute to the whole process' (Farmer 15).

'With the diversity of crops we have total control of what we sell at the markets, we don't have to offload at cheap prices because it is going to go off before we sell it. Biodiversity for us is growing a multitude of things. We haven't worried about planting natives, because it is already a beautiful setting. We pulled some out to put in solar panels. Growing a lot of different things, all the different organisms. For us to have a good little ecosystem where we don't have to use pesticides or things like that it is good for us to have all these different crops because we can have different organisms hiding in different areas - some will prefer to breed in a tree crop and then fly across the vines - lacewings and the like, which are really good at knocking out your damaging insects, and ladybirds grow really well on the tree crop and get rid of the vine scale and the tricola scale and the brown scale. The sap sucking insects are on some of our other tree crops and the mealy bugs can be an issue. We have been able to overcome most of our issues through pruning and the way we do things. We just let the grass grow now rather than have a cover crop because it much better for the beneficial insects to have a variety of grasses, we just sort of let them go. The native grasses grow really well on the sand. Down the bottom we have grown some chicory because we get a bit too much water and so we need to dry it out a bit quicker to get the even ripening and the quality – it works it out itself, where there is water it will grow and where there isn't it dries out – it has really evened out our cropping here' (Farmer 17).

Unique agro-ecosystems have been generated because of the different choices that people have made. As a result, the agrobiodiversity on farms in the MV is reflective, in part, of both historical and contemporary cultural activities. The complexity of species and varietal elements from individual properties that were mentioned by respondents provides an impressive indication of the agrobiodiversity being directly exploited for production (Table 3).

Table 3. A summary of McLaren Vale respondents' important named productive species and varietal diversity

No.	Agricultural species	Named Varieties/Breeds
1.	Almonds	<i>Johnstons, Somertons</i>
2.	Range of garden vegetables, eg. Lettuce, Salad Greens, Zucchini, Kale, Corn, Carrots, Tomatoes, Cucumbers, Broccoli, Baby spinach, Beetroot, Onion	Mostly Hybrids but numerous heirloom varieties egs. <i>Walla Walla</i> and <i>Forens</i> onions <i>Red Ace</i> beetroot <i>Red Russian</i> and <i>Cavelo Nero Kale</i>
3.	Grapes	<i>Shiraz</i>
4.	Grapes Faba beans, Wheat, Barley	<i>Shiraz, Cabernet sauvignon</i>
5.	Grapes Olives Carob, Mulbery	100 y.o. <i>Shiraz, Grenache, Chenin, Fiano, Nero D'avola, San giovese, PicPoul, Negroamaro, Nebbiolo, Barbera, Koroneiki</i>
6.	Grapes	80 y.o. dry grown <i>Grenache, Shiraz, Mouvedre, Graciano</i>
7.	~44 species of garden vegetables, egs. Brussel sprouts, Corn, Broccoli, Cabbages, Chard, Kale, Carrots	About 100 varieties, <i>Corn Max</i> variety to generate super sweet eating corn Heirloom carrots and Beetroot - <i>Choggia</i>
8.	Pastures Sheep Wheat, Barley Olives	Mixed pasture seed <i>Merino, Suffolk</i> crosses Tuscan mix
9.	Olives Grapes Almonds	<i>Kalamata, Frantoio, Koroneiki</i> <i>Shiraz</i> Local <i>Johnstons, Somertons</i> & others
10.	Grapes Olives Sheep Alpacas Apples, Pears, Nectarines, Pomegranates	<i>Shiraz, San giovese, Tempranillo, Cabernet, Merlot, Chardonnay, Savagnin, Bordello, Petit verdot, Grenache, Mourvèdre, Verdale, Mission, Manzanillo, Kalamata, Frantoio</i> <i>Wiltipoll</i>
11.	Grapes	<i>Chardonnay, Pinot blanc, Semignon blanc, Semillon, Viognier, Cabernet sauvignon, Petit verdot, Malbec, Graciano, Touriga nacional, Red frontignac, Muscat petit grand</i>
12.	Sheep	<i>Border Leicester-Merino Ewes and Dorset rams</i>

	Grapes Clovers, rye grass, phalaris	<i>Shiraz, Cabernet sauvignon, Merlot</i>
13.	Grapes Sheep	<i>Shiraz, Pinot, Cabernet sauvignon, Tempranillo, Touriga Nacional, Grenache, Mataró Merino</i>
14.	Grapes Almonds	<i>Shiraz</i>
15.	Grapes Sheep	<i>Shiraz, Grenache, Chardonnay, Sauvignon Blanc, Mouvedre, Aglianico, Sagrantino, Sangiovese, Nero d'avola, Touriga</i>
16.	Olives	Processing a range of olive oil products
17.	Grapes – Wine Grapes – Table Apples Pears Cherries Peaches, Plums , Nectarines, Avocados, Mangos, Loquats, Asparagus	<i>70 y.o. Shiraz, 70 y.o. Cabernet, Nero d'avola Crimson seedless, Medindee seedless Fujis, Sundowners, Royal gala, Pink lady, Green delicious, Red delicious 7 varieties, incl. Corellas Stella, Sams, Lapins, Empress</i>

Respondents represented specific, unique interpretations of biodiversity, reflecting the importance of their ecological, agricultural and other cultural knowledge. By being open to change, landholders are closely observing the agricultural systems and are responding to any issues that arise. Such knowledge-intensive production systems have led to the development of important market and marketing niches, especially through the generation and sale of organic and/or biodynamic produce, direct sales, farmers markets and specialty and regional branding. For example, several landowners have formalised Heritage Agreements on native vegetation protection with the SA Government, and were able to advertise their conservation activities along with their wines.

‘The market stimulates you to grow a variety of crops, because there are so many customers at your market stall that are wanting the veg., so your mind is naturally trying to work out in terms of your rotations, how you can grow different things. The stimulating thing for me is always looking for the niche, to grow something that the other stalls at the market might not have’ (Farmer 2).

There is a focus on soil management through organic and biodynamic practices (Figure 22). Several respondents noted that they were sizing and shaping vineyard blocks according to soil type, instead of larger blocks that span multiple soil types, both for wine quality and for more consistent farm management, including irrigation scheduling, weeding, and ripening times. Product uniqueness is increasingly important, including a trend of moving away from blending wines, to the production of some niche products linked to terroir – unique wines from only particular vineyard blocks on certain soils.

'We would all like to think that our wine is unique. Every wine farmer likes the idea that a block has the ability to express itself in the wine in comparison to next door's block. You can overdo it, there is something to say for it, but you can cheapen it by saying everything is different. We know it because we see the change in soils. At the top of the block is a gravel fan which we have marked with posts with a bell on it. In the past we would plough and we would know it was there because it would tinkle as you went across the top of the block, and then it drops onto a heavy clay. We mark it because it is hard to stop a gang of pickers, so we just say pick to the marker, and we pick them separately and the wines are different. We live with the reality that soil effects vine which effects wine. We use the grapes in different wines' (Farmer 6).

'I think it is important that people understand where wine comes from, it comes from the soils that you grow in, and I wanted to make that connection. I've 26 different soil types ... I've had the soil survey done, so it is very complex, so you need to treat each block according to the soil type that is planted on, the orientation, the topography. Now we organize the plantings according to the soils' (Farmer 10).

Figure 22. A biodynamic preparation



Together, the mechanisms that are supporting the retention and use of biodiversity by farmers extends beyond individual landholder decisions, and are beginning to have such a scale of impact that they are reframing the systemic and landscape diversity of the MV region.

4.3 Regional drivers of agrobiodiversity use

As highlighted above, a major transition occurred in the MV region from mixed farming in the 1980's to an almost exclusive focus on viticulture from the 1990s onwards (see also Santich 1998). Shiraz is the most extensively planted variety, with respondents indicating that would be unlikely to change due to the variety's strengths and the brand associations with the MV region. This specialisation on one crop (grapes), dominated by one variety (Shiraz) represents a significant loss of regional agrobiodiversity from earlier agricultural periods. In addition, relative water scarcity has meant any transition away from grapes to alternative crops that require more water is unlikely due to high water costs, even for recycled water, as well as low and/or constrained water allocation permits. Nevertheless, most respondents recognised the disadvantages of such uniformity, and are retaining or developing diversity for a range of important reasons, a number of which relate to the risks of production and marketing (Table 5).

Table 5. Regional scale reasons for use of diversity within agro-ecosystems in the McLaren Vale

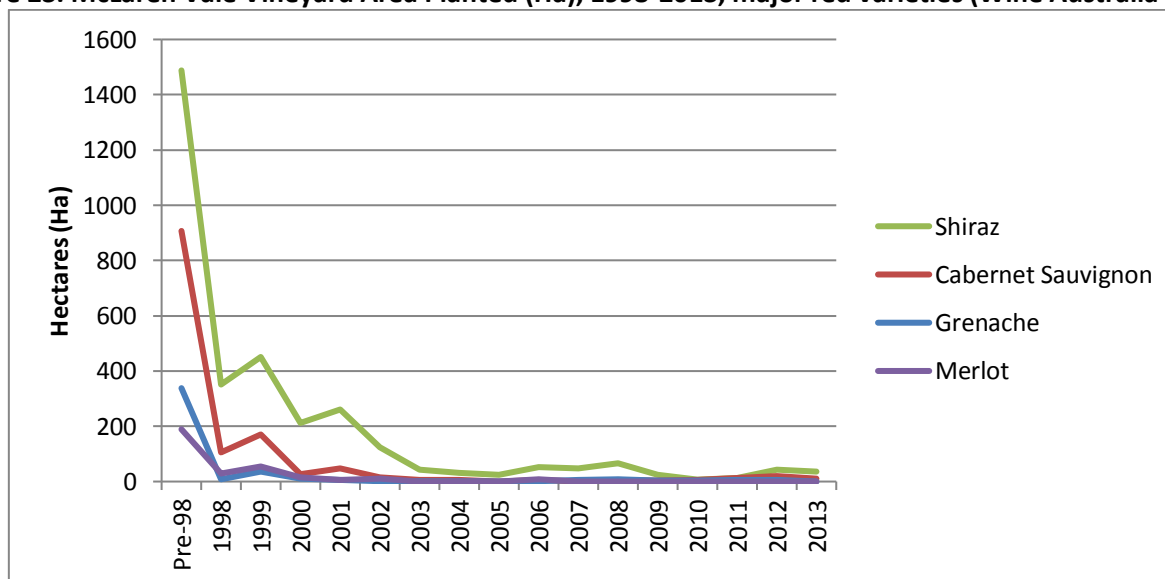
Regional narrative	Example quotes from Respondents
1. Presponding to risks in profitability: vagaries of the market, large multi-national ownership	<p><i>'There is a worrying trend with the big multinationals coming in...we call it modern feudalization, what you end up having is the block sold off to the multinational company, and the worker living in the little house and instead of it being the family home, it is the workers' house and the land is the feudal estate that you work on. Some of the big boys have been dreadful for the district. The last American mob were shocking, just like bandits, they move in for a couple of years, rip the guts out of a place and disappear again' (Farmer 1).</i></p>
2. Tensions exist between rural and urban land use, which has been partly mitigated by the MV Character Preservation bill.	<p><i>'Sometimes they don't know how to relate to rural people. We have tractors and all that on the road. People come into the district and they aren't told about tractors, grape spraying. [...] We used to have sheep but domestic dogs became a problem when more people moved in, and dogs and sheep don't mix' (Farmer 4).</i></p> <p><i>'Then you do get other people who have complained in the past, we were using the recycled water back when there wasn't any crops to get the soil ready to plough, and they were complaining that they could smell the recycled water...it doesn't smell at all, and you could basically drink it it was so clean, but there was this really funny thing about 'oh it's smelling and the breeze is drifting'' (Farmer 7).</i></p> <p><i>'The amount of good agricultural land in SA is limited, it doesn't go too far north of Adelaide, and this is a good place to live as well, so it important to have that discussion. We love it, because we live here of course, but Adelaide people too, can come down and drive down a street covered in trees, if you let that go now it would be forever' (Farmer 6).</i></p>
3. Diversifying and experimenting with winegrape varietal choice	<p><i>'Climate change probably is the biggest risk, particularly if you are growing something, what that is going to mean, and I guess that opportunity in that is the varieties, what alternate varieties will perform, and that is one of the reasons we always have new things coming on' (Farmer 5).</i></p>

<p>to adapt to climate change.</p>	<p><i>'I like to get my kids back to school before I harvest, and it's not happening, and I have a terrible feeling that it is going to continue. The average temperatures in November and December accelerated the flowering process and brought everything forward' (Farmer 10).</i></p> <p><i>'There's a little bit of shift to more southern European varieties – but there's no point growing them if they're not going to sell. You can kid yourself about how willing people are to change their taste and wine style' (Farmer 11).</i></p> <p><i>'Last year was the driest Spring I can ever recall and I'm in my sixteenth year here. It was frightening – we were irrigating vines in September that don't normally get irrigated until the week prior to Christmas, you know there was just no soil moisture whatsoever, it was really scary' (Farmer 13).</i></p>
<p>4. Opportunities for adaptation/growth via alternative marketing channels linked to local biodiversity</p>	<p><i>'The success of the basin comes from its agriculture. The Farmers market has had a huge impact because it has made small enterprises viable, and not just the ones that were here, it has been going for 12 years, and so people have planted land to apples and other things in the expectation that they will have an outlet. I think that has had a hugely positive impact, there are 60 stalls each week, but there are value-adders as well. There are about 100 growers and producers associated with the market, because they aren't there each week, people come and go with the seasons. Even if they are food producers they use products from the districts, like some bakers use our almonds. There is a lot of cross-fertilisation going on which is fantastic' (Farmer 1).</i></p> <p><i>'In the McLaren Vale it is still relatively small and hands-on, not as much as I would like – I think the smaller the better basically – but there is not too much really big industrial type stuff and I think that is all for the better – for the land, for the wine, for families' (Farmer 6).</i></p> <p><i>'Obviously, for a relatively small wine label we've got far too many wines, not an uncommon problem, but yeah like everyone we got carried away! We diversified for grape sales and niche winemaking and that sort of thing. Hopefully being relatively progressive, and also for commercial considerations and also what we thought would do well in the area' (Farmer 11).</i></p>
<p>5. A heritage of cooperation in the region (sharing tools, labour, marketing) and the retention of a range of agricultural enterprises lead to a range of cross-benefits</p>	<p><i>'Friends crack our almonds for us, just as a favour – people are just nice to each other here. This is an area that believes in cooperation more than competition.' (Farmer 14).</i></p> <p><i>'The different types of industry link hand in hand, and the wine industry is a really big one for us, because when the wine industry benefits, we benefit indirectly whether its tourists coming off the beaten track to look at us, or all wineries have their own labels so more sales for them means more sales for us, so it is all intertwined and it works well in this region. The heritage stems back to the almond days, and a lot of those growers had to diversify when almond prices suffered, and that drive from the individual farmers in the area that put up with those tough times and then were willing to continue on in the agricultural industry and diversify helped this business to grow the wine industry to where it is today. So I think the history of farmers who have gone through a tough times and are willing to work through it has been a benefit and provides a wealth to not only this area, but the state' (Farmer 16).</i></p>

6. The diversity of cultural and professional backgrounds of farmers	<p><i>'The Greeks and Italians have been experimenting for generations out here, so we had all the knowledge we needed but people somehow thought the scientific approach was different to that approach, but I was never under that illusion because they are methodical and it goes a long way back in their culture. I met people at the Olive Oil press and they were too pleased to help me, they were so proud of their olive culture. We bought our grafted trees off Greeks mainly - we had them helping us, they got me harvesting wild olives, they taught me how to graft, so about half I bought and about half I grafted myself, and they told me lots of stuff. I got lots of information from the olive renaissance in the 1990s. I've been overseas and checked out a few olive places myself in France, but overall we have some really good knowledge in Greeks, Italians and Yugoslavs, there is a whole plethora of cultures here that traditionally use olives' (Farmer 9).</i></p>
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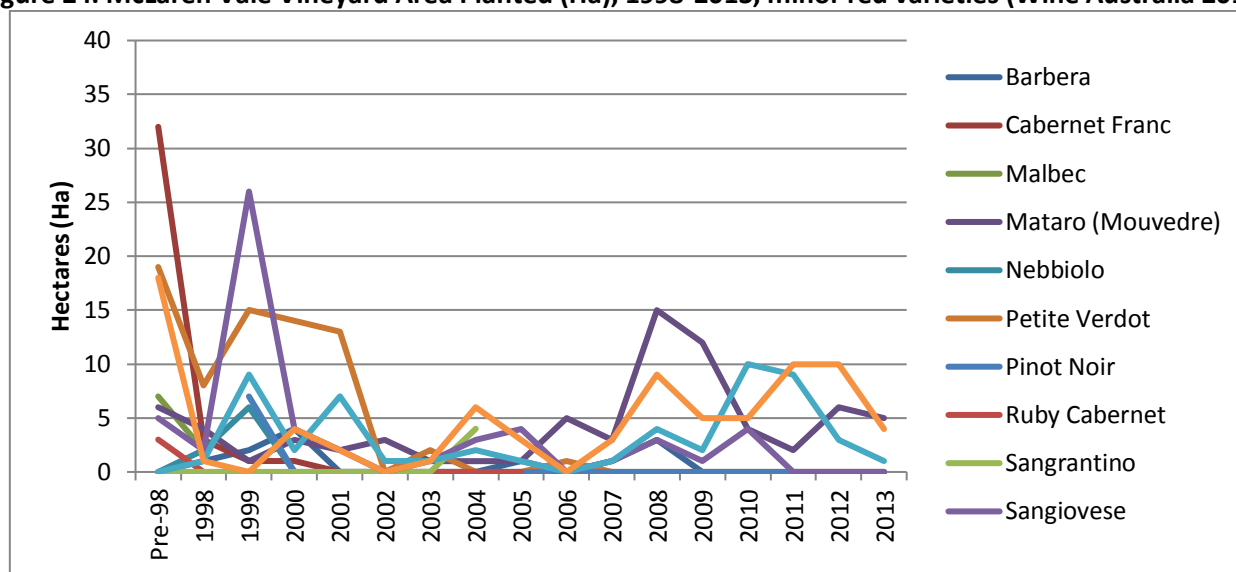
Respondents recognised the risks from the lost complexity of regional agro-ecosystems in the MV (Appendix 3). In response, farmers are using specific diversity elements within their fields, farms, systems and collectively across the region to generate resilience in the face of risk, particularly climate change and the positioning of products within an increasingly competitive global marketplace (Table 5, see also Fielke and Bardsley 2013; Lereboullet et al. 2013). That renewed focus on the importance of the use of diversity is reflected within respondents' stories, and also in the fact that plantings and production of the major red and white varietal choices have declined rapidly since the late 1990s (Figures 6, 7 and 23).

Figure 23. McLaren Vale Vineyard Area Planted (Ha), 1998-2013, major red varieties (Wine Australia 2015)



At the same time as major winegrape varieties are in decline there been an exploration of alternative red varieties, particularly from the drier, southern parts of Europe (Figure 24). As new varieties are exploited more widely there is a returning diversity in the form of varieties of *Vitis vinifera*, which could to some extent offset earlier losses due to the rapid historical advance of wine grapes across the region.

Figure 24. McLaren Vale Vineyard Area Planted (Ha), 1998-2013, minor red varieties (Wine Australia 2015)



The diversity within fields and farms across the region is often a direct product of individual and industry choices, but the ultimate drivers have their roots in the cultural heritage of the MV. This results in the bio-cultural heritage being reflected in the landscape.

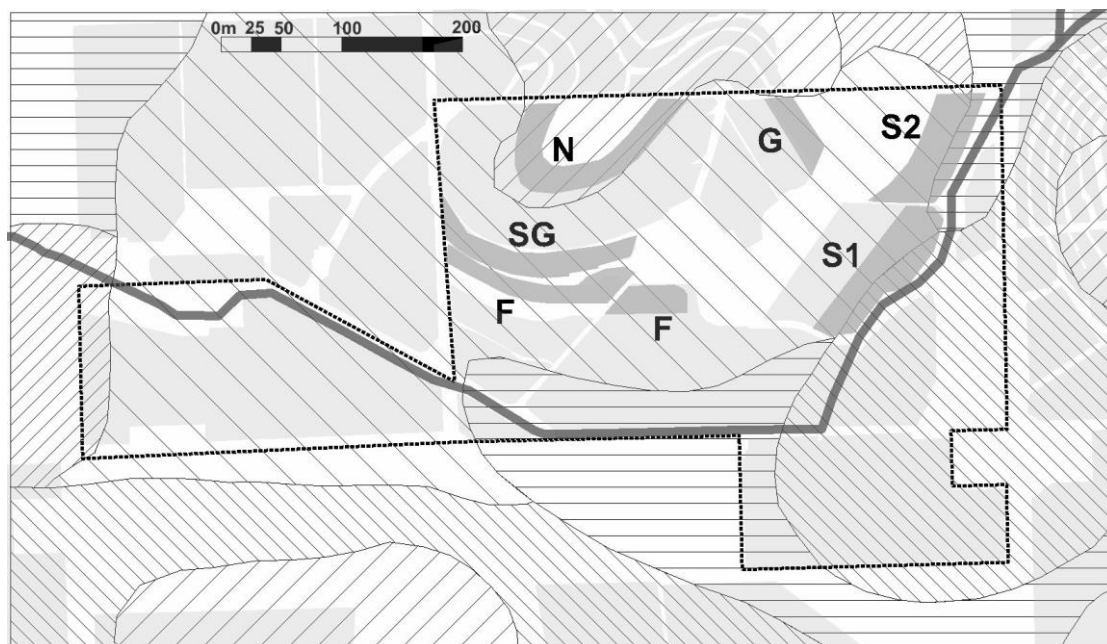
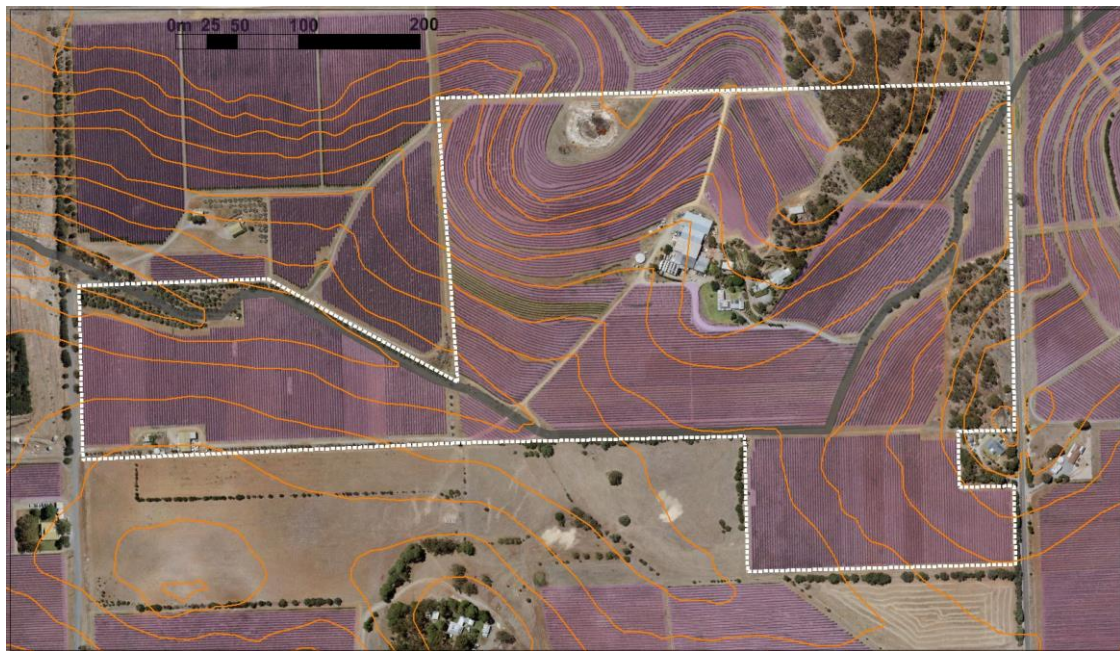
4.4 Heritage in the landscape




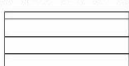

The diversity represented at systemic, farm, field, species and varietal levels add a range of values to farming activities, and also to lifestyle, recreation, heritage and commercial activities, not just at farm scales but across the MV. That evolution is in part associated with the cosmopolitan nature of contemporary rural residents, many of whom have complex international and inter-cultural life experiences, and are open to new ideas. Together, a range of important causal themes are generated for the retention of bio-cultural diversity at farm and regional scales. In other words, the decisions that are being made constantly by individuals and associations of landholders have transformed the local ecology of the entire region.

4.4.1 The example of soil type and wine grape varieties

A particularly important factor highlighted during interviews related to the soil type and the corresponding choices of crops or retention of native vegetation. In the example presented in Figure 25, the data on grape varieties and age collected at one respondent's farm, were compared to the geological survey (Geology of the McLaren Vale wine region, GDA 2010). The choice of wine grape varieties can be seen to be partly an adaptation to soil type and water availability. The oldest vineyards are planted on deeper, alluvial soils adjacent to the creek. On the other hand, new experiments with drought and heat-tolerant Mediterranean varieties (egs. *Fiano*, *Nero*, *San giovese*) have been carried out on the comparatively skeletal soils on the hill slope, with encouraging results in terms of both production and quality.

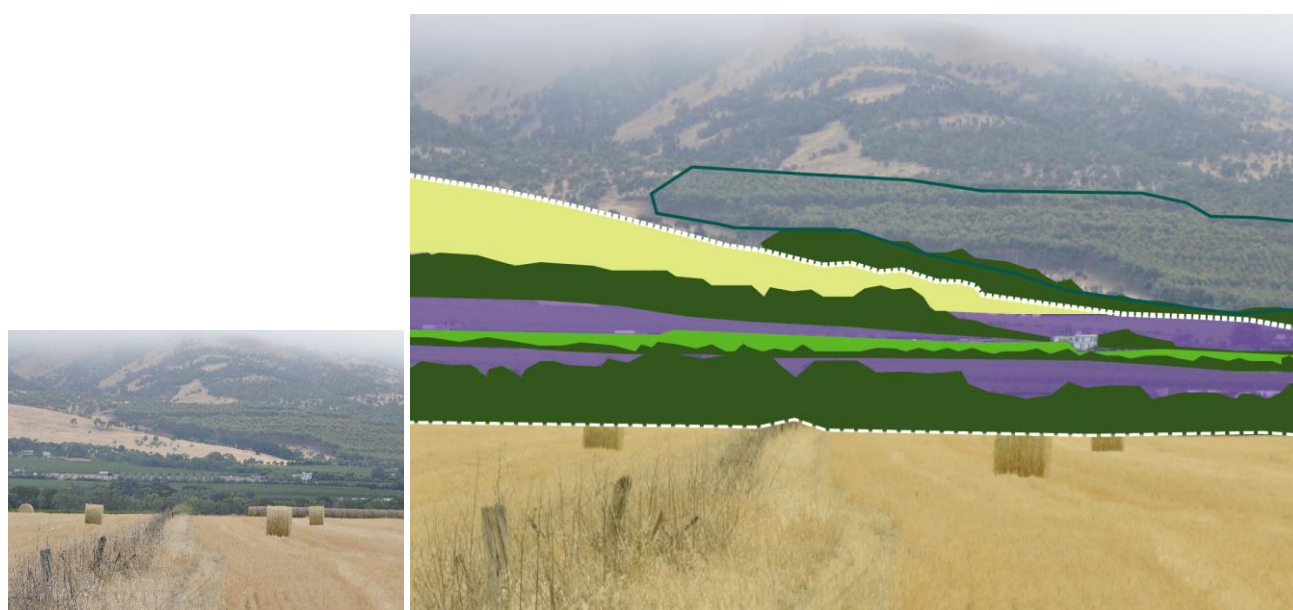
Figure 25. Soils type, water availability and major vines varieties on an example property



	<p>Non arable hills and rises with shallow stony soil and variable rock outcrop</p>	<p>S - Shiraz (S1 1919, S2 1977)</p>
	<p>Low hills and rises with mainly acid to neutral, loam to clay loam texture contrast soil</p>	<p>G - Grenache</p>
	<p>Low hills and rises with mainly sandy to loamy, texture contrast soil with calcareous subsoil</p>	<p>SG - San Giovese</p>
	<p>Plains and gentle slopes with mainly deep texture contrast soil with calcareous subsoil</p>	<p>N - Nero d'Avola</p>
	<p>Low hills and rises with mainly neutral to alkaline gradational soil, calcareous soil and / or shallow stony soil. Soils formed on deeply weathered material with ironstone.</p>	<p>F - Fiano d'Avellino</p>

The local agrobiodiversity is constantly evolving with crop experimentation. The evidence of regular renewal of socio-ecosystems also suggests that there has been progressive adaptation to new conditions in a series of historical steps, which could to be seen to represent a cultural of ongoing struggle by farmers to learn and adjust their knowledge to meet the needs of changing environmental and social conditions. Arguably, such a liberal, autonomous process of adaptation has been passed on from generation to generation since the first establishment of the rural colony in MV and in a way that could be seen as important component of the cultural heritage in itself. In other words, diversity is temporal as well as systemic and spatial, suggesting that there is an important “heritage of innovation” within regional agro-ecosystems (see also Pike 1957).

Figure 26. The bio-cultural diversity of the landscape mosaic



LEGEND

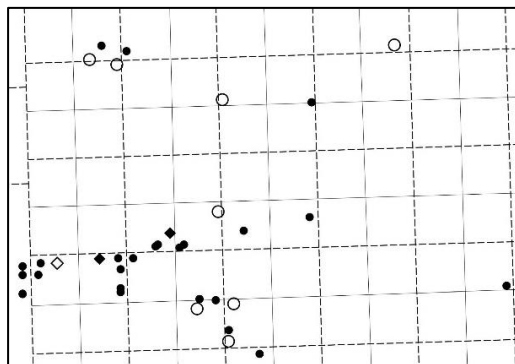
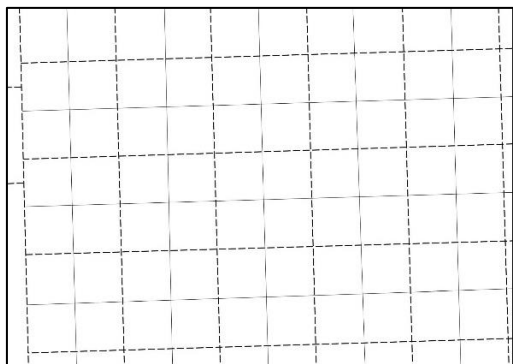
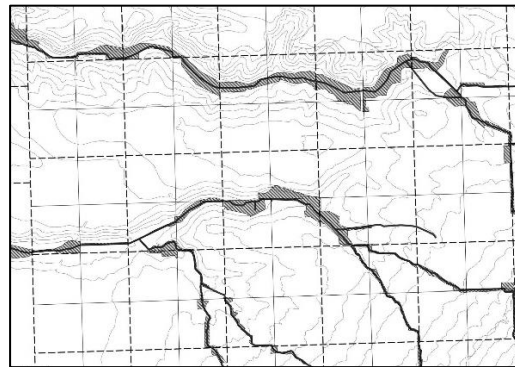
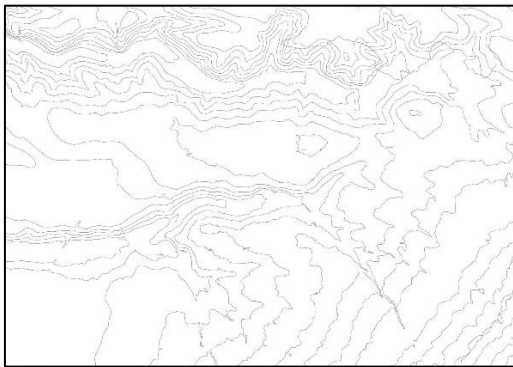
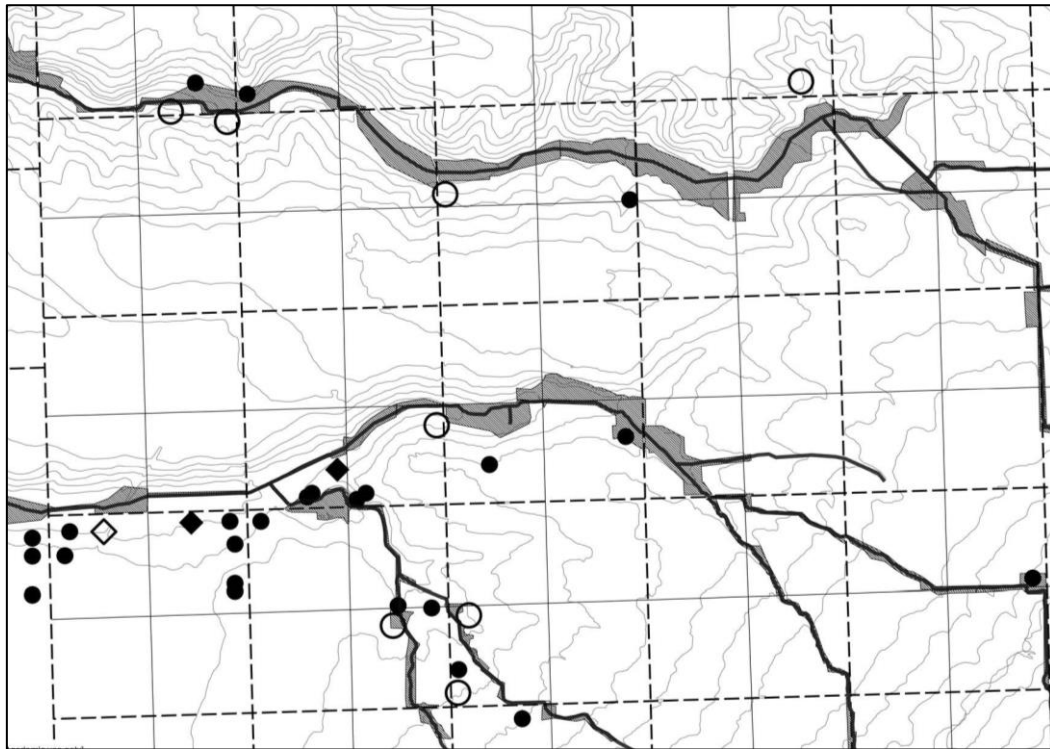
Image code	ANTHROPOGENIC processes: Farmed and pasture land	NATURAL processes: interspersed native and spontaneous vegetation	Function	Level of disturbance
Crop photo	Cereals cropping, extensive broad acre (or vineyards)	Edges, backdrops, trees alignments along roads	Shade, enclosure, windbreaks. Provide corridors for wildlife.	High
Purple	Irrigated vineyards	Edges, backdrops, trees alignments along roads	Soil erosion and water management, enclosure, windbreaks. Provide corridors for wildlife.	High/medium
Light green	Irrigated perennial and orchards	Edges and backdrops and Riparian vegetation	Shade, enclosure, windbreaks, soil erosion and water management. Provide nich habitats and corridors for wildlife.	medium
Yellow	Pasture Land	Remnants of native vegetation	Shade, Grazing	Medium/low
Hatched surface	Riforested areas		Provide areas for wildlife and native vegetation.	low
Hills-face photo	Hill top Native woodland	Remnants of native vegetation	Provide areas for wildlife and native vegetation. Recreation activities.	None/low

4.4.2 Knowledge intensive farming and the bio-cultural heritage in the agrarian landscape

Along with the returning contemporary systemic diversity within the MV, there is a clear historical landscape pattern at a regional scale linking the first settlements, fields, water-courses and roads, which continues to be exploited by producers (Figure 27). Therefore, the landscape is the unique result of historical co-evolutionary processes and knowledge intensive farming practices (van Oudenhoven 2010), evolved over time in a close relationship between the specific local landscape features and social development. Details of the dominant pattern of agricultural lands and cultural heritage remnants interspersed with native vegetation emerged during the mapping exercises in field surveys. The intentional use of the native vegetation, interspersed with the cropping varieties, has determined the peculiar landscape mosaic of the region that has significant aesthetic values, which helps to generate development opportunities through tourism. In terms of complexity, diversity and multifunctionality, the landscape of the MV has become comparable to the “bocage” system, which are large areas of small fields hedged by trees constructed and maintained in parts of Europe (Figure 26).

A grid pattern was laid down from colonial planners has been applied strongly but with variations to account for natural landscape features, including the water basins, large areas like the Onkaparinga River National Park and the revegetated Hills Face Zone (Figure 28). Now, approximately 30% of the built heritage in the same areas has been abandoned. These farming structures were related to pre-existing broad acre cropping and pasture land related activities, such as cereals mills and dairy production buildings. A more detailed analysis of the landscape mosaic of a case study sample along Maslin and Willunga creeks in McLaren vale, shows the interdependence relationship between the natural features (orography, hydrogeology and riparian vegetation) and the anthropogenic components of the landscape, including the layout of the colonial roads and property boundaries system and the location of built structures. In particular the analysis of the map reveals a recurrence of clusters of heritage-listed farms in proximity to road access, water availability, shade, riparian vegetation and fertile soils.

Figure 27. Bio-cultural heritage patterns in the agrarian landscape of the McLaren Vale, along Maslin and Willunga creeks: The map reveals the orography, hydrogeology and riparian vegetation, as well as the colonial grid system and built heritage patterns that reoccur in proximity to road and water access.



5. Key findings and policy implications

Several key findings emerge from the research that could have policy implications for the South Australian Government and others. These include:

1. The artificial division between 'natural' and 'human' landscapes ignores the complex interactions within agro-ecosystems in the MV. Production systems are protecting remnant native biodiversity in addition to developing new forms of biodiversity through agricultural innovation and change.
2. According to many respondents, the lack of policy acknowledgement of local agrobiodiversity, or bio-cultural diversity in general, discounts some of the most important biodiversity, including the heritage of productive systems in the landscape.
3. Geographical/ecological limits to productive agricultural land (suitable soils, groundwater availability, climates types etc.), as well as risks such as urban expansion, globalisation and climate change, suggest regions such as the MV need to be carefully managed for resilience. Assumptions of sustainable levels of resource use and production may not hold in such a rapidly changing situation, and a focus on resilient systems will become more important.
4. A monoculture of grapes and the over-dependence on one industry can lead to low resilience, and particular risks are generated if climate or market conditions change rapidly.
5. Cultural heritage and links with biodiversity need to be understood and reflected in management goals or key values will be lost with the disappearance of diverse agro-ecosystems and the decline of heritage landscapes and built structures.
6. More could be made of the agrobiodiversity that exists in agricultural landscapes simply by monitoring its use, with necessary provisions for data privacy. For example, existing surveys that were used here included: crop-level agrobiodiversity data from ABARES and the varietal-level data from Wine Australia (2015), which is commercially protected.
7. The expansion of knowledge intensive farming practices, that include native habitat management, demonstrates that novel/experimental forms of landscape management are being employed and becoming more important. More policy could recognise and support this heritage of innovation and might include support for novel forms of agri-tourism, agricultural parks, or Heritage Listing.
8. A history of adaptation to change, and in particular, climate change, could be a key element in the development of greater policy support for agrobiodiversity in the peri-urban agrarian region. Examples of adaptation include varietal selection for hotter, drier climates, land use planning, native vegetation management within farms, the recycled water scheme and regulation of groundwater resources, and more broadly the social processes of learning, cooperation and innovation within the MV.
9. The effective adaptation responses to climate change could potentially have wider importance, such that the MV could be viewed as an exemplar region that has generated resilient agro-ecosystems.

We expand on two of these major themes below, namely the role of agrobiodiversity in South Australian conservation policy and the role of agrobiodiversity in UNESCO WH listing, because these two topics have been the major drivers of the research.

5.1 Agrobiodiversity in South Australian Conservation Policy

The valuation of agrobiodiversity is a challenge to historical conceptions of biodiversity analysis and conservation in Australia. For example, conservation policy, such as the SA Government's No Species Loss (2007-2017), has justifiably focused on native biodiversity, but with only limited acknowledgement of the importance of agrobiodiversity for resilient socio-ecosystems (Bardsley 2003; Government of SA 2007; Ratnadass et al. 2012). While just one conception of biodiversity has dominated policy until now, it does not mean that the concept of conservation cannot evolve to incorporate that diversity which is vital for maintaining human foods, fibres and beverages. Simultaneously arguments are being made that the current system of conserving biodiversity in SA is not without significant limitations (Bradshaw 2012), and that a new perspective on landscape management which brings the landowners and their productive systems fully within the envelope of analysis and practice would allow for a maturing of policy. Such a recognition of the importance of agrobiodiversity in policy could lead to a timely re-assessment for South Australian conservation, especially given that the core policy of 'No Species Loss' is in the process of renewal.

With holistic analyses that allow for the full complexity of socio-ecosystems to be understood, there is the potential to comprehensively manage systems that are more or less natural to develop better ways to work with communities to protect biodiversity values. In fact, there is a sense coming from the respondents' narratives that they would like to become a greater part of a solution to the ecological challenges of managing SA. By recognising that farmers' productive activities form a vital part of the biological heritage of the place, a range of opportunities for better management emerge, including:

- farmer monitoring of biodiversity
- understanding of the roles of biodiversity to assist vineyard, orchard, garden, livestock, crop, and pasture management
- better control of pests and invasive species
- more revegetation and regeneration of important on-farm biodiversity assets
- increasing perceived values of local ecosystems and landscapes
- bringing the city and the countryside closer together; and,
- the renewal of the conception of the role of experimentation in Australian landscapes as agriculture struggles to manage the external drivers of environmental and socio-economic change.

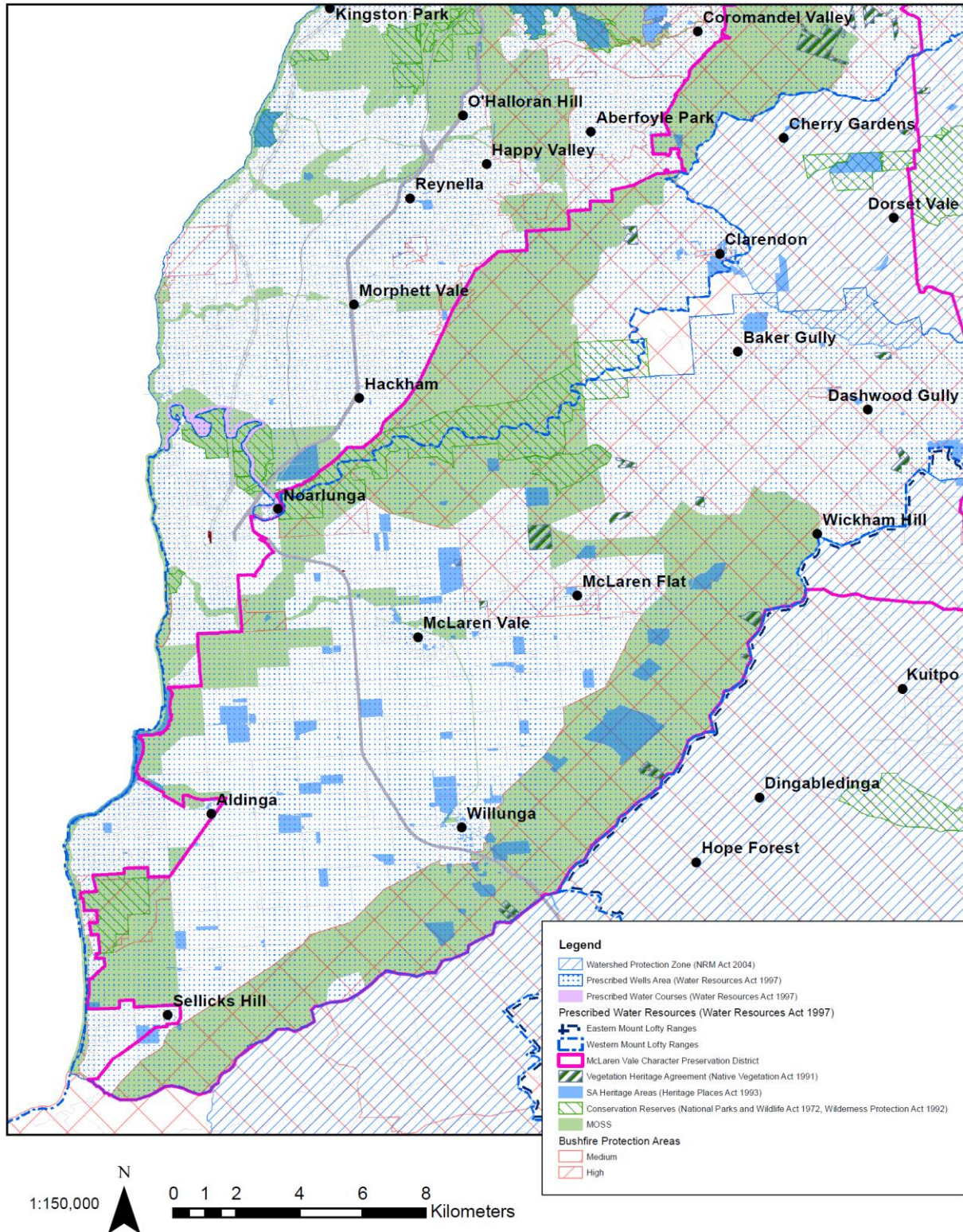
The values flow both ways – clearly the better management of biodiversity on farms has a lot to offer conservation outcomes in the region, but also the biodiversity that exists in and around properties also provides significant ecological and commercial services for local producers. By recognising the bio-cultural diversity that landholders are managing as important components of the state’s heritage, broader opportunities arise to include landholders in conservation programs, especially where there are important links to the marketing of products from sustainable systems. There is significant interest internationally in land use classifications for guiding and supporting sustainable management of biodiversity and the conservation of associated cultural activities and landscapes, such as bio-districts and agricultural parks. Those ideas are further discussed in relation to the potential for WH listing of the Mt Lofty Ranges below, but raise important questions about why agrobiodiversity has not been similarly valued in Australia.

5.2 World Heritage listing and agrobiodiversity in the McLaren Vale

The authentic bio-cultural diversity that exists in the agrarian MV region could be better linked to methods of supporting farmers, their activities and the community. One way that this could be achieved is if the diversity that exists could form an important element of a bid that is developing for Heritage listing of the Mt Lofty Ranges. Interviews with managers and researchers from the Langhe-Roero and Monferrato (Italy) and Lavaux, Jungfrau-Aletsch and Entlebuch (Switzerland) UNESCO reserve sites in late 2015, all suggest that UNESCO will not impose new regulations on listed regions, but the core attributes of the cultural landscape that led to the successful bid must remain valid and be supported. Thus, constraints on inappropriate development may occasionally exceed current levels of State or Local Government planning and regulation, but if strong management systems are already in place, there are unlikely to be significant changes required. The region already has high levels of regulatory control at Federal, State and Local Government levels, as well as industry-led initiatives associated with Geographical Indication branding (Figure 28), so it would be unlikely that any significant additional regulatory burdens will need to be carried by landholders.

There would be benefits for the MV producers from being within a UNESCO WH site for tourism and branding. At the moment, some UNESCO sites are experiencing a particular risk – that tourism might increase with a listing, but that the mechanisms to link financial benefits back to local communities and their agricultural production systems are lacking or weak. In effect, the landscape is free to be experienced by tourists without necessarily compensating local farmers for their heritage management activities (Rotherham 2015). To respond to that risk, it would be important for the benefits of increased heritage recognition and tourism visitor numbers to directly support the values of productive agricultural activities within the landscape. In such a manner, producers who have already accepted considerable constraints on production based on regulatory controls to guide sustainable management of the region (Figure 27), would benefit directly from regulatory controls (Bardsley and Pech 2012).

Figure 28. Summary of regulatory constraints on land use within the McLaren Vale*



* one of the largest constraints on land use is associated with the MOSS, or Metropolitan Open Space Scheme, commonly referred to as the Hills Face Zone, in the McLaren Vale.

Our MV research suggests that there is already a strong relationship between the cultural heritage of the area and tourists that enjoy the place, with many examples highlighted: from single family wine producers and cellar doors; to small-scale food producers and farmers' markets; to restaurants and production systems

with authentic opportunities to experience and understand the agricultural systems in the place. Those authentic relationships between agricultural producers and consumers are generating forms of marketing that value relationships between people very highly. In other words, there is already a range of approaches to ensure that tourism supports local farming activities and the associated bio-cultural heritage through authentic, dynamic practices, and these could be further supported with targeted policy. Beyond those authentic established links, assistance for landholders to experiment with agrobiodiversity within the unique rural space might provide an important mechanism for continuing to support sustainable landscape management. Learning about the processes of adaptation to emerging risks from a region that is part of the way along that journey needs to be more widely acknowledged elsewhere. So initiatives such as a Heritage listing could help to focus national and global attention on the adaptation underway in the region to generate resilience to environmental and social change.

6. Conclusion

There is important biodiversity in the MV, but much of it is neither native nor natural. What native vegetation there is in the region is highly valued by farmers for a range of important reasons. Landholders recognise that it is important to understand the values of diversity within agro-ecosystems to develop a complete picture of the important heritage within the region. Beyond that important general finding, there are some key specific outcomes of the research including:

- there is important agrobiodiversity that is not fully understood or included in policy
- the bio-cultural heritage that has strongly shaped the agrobiodiversity in the MV is reflected in the landscapes and in the heritage of innovation
- the complexity of agro-ecosystems in the MV assists adaptation and generates resilience.

Those findings are important for conservation in SA, because they suggest an important gap in policy. That gap may be tolerable within a stable environment, but SA is projected to experience significantly more climate change throughout this Century. A holistic approach to valuing biodiversity would also provide a means for integrating landholders into conservation practices, because they would be more able to own the approach being taken, when for a long time the biodiversity that is of most importance to their productive systems has not been emphasised in policy. The report has outlined an approach for developing such understanding through an inter-disciplinary review of the agrobiodiversity within an important rural area.

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9. Appendices

9.1 Appendix 1. Glossary of unusual terminology and acronyms used

ABARES - Australian Bureau of Agricultural and Resource Economics and Sciences

Adaptation - refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with change

Agrobiodiversity - The variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems (FAO 1999).

Agro-ecosystem - A spatially and functionally coherent unit of agricultural activity, and includes the living and nonliving components involved in that unit as well as their interactions.

Anthropogenic - Caused directly or indirectly by humans.

Bio-cultural diversity - comprises the diversity of life in all its manifestations – biological, cultural and linguistic – which are interrelated (and likely co-evolved) within a complex socio-ecological adaptive system (Maffi 2010).

Cultural Landscape - Are cultural properties and represent the combined works of nature and humanity (UNESCO)

DEWNR – Department of Environment, Water and Natural Resources

GIS - Geographical Information System

Landscape - An area whose character is the result of the action and interaction of natural and/or human factors. (European Landscape Convention 2000)

Landscape mosaic - A landscape constructed of perceptibly different types, generally involving natural and anthropogenic components.

MV – McLaren Vale

Narrative - Stories that are bounded by the narrator's particular experiences, observations, and attachment to place. They include anecdotal information, oral environmental history, and local knowledge" (Robertson et al. 2000, p120).

Resilience – the ability to recover quickly from set-backs and difficulties

SA – South Australia

Socio-ecosystem - A coupled human–environment systems, where anthropogenic and natural forces are both important to shape their important elements and processes (Young et al. 2006).



APPENDIX 2: FIELD SURVEY FILE FORM

FIELD SURVEY FILE FORM

WALK & TALK FIELD SURVEY

Date of survey: / / 2015 Surveyor name:

INFORMATION ABOUT PROPERTY *(in office)*

Cadastral sheet number Cadastral parcel number Field survey number

GPS coordinates Property extension Ha

Farm name Number

Contact Name Position

Contacts Web site

Address Number

Photos #

Historical photos Yes No Years

PROPERTY AND USE

Ownership:

- Public *(specify board/authority)*
- Religious *(specify institution)*
- Company *(specify firm)*
- Private *(specify family)*
- Other

Partnerships and business model:

- Cooperative of farmers
- Neighborhood collaboration / mutual support
- Foreign investor / partnership
- Buy from other farmers
- Farmers markets *(specify)*
- Other *(specify)*

LANDSCAPE CHARACTER

Landscape type

- Low valley
- Hills foot
- Hills slope
- Hills ridge
- Water basin
-
-
- Other *(specify)*

Landscape patterns

- Patch
- Ecotone
- Ecocline
- Corridor
-
-
- Other *(specify)*

Land use (ABARES 2008)

- Cereals
- Grazing
- Perennial tree nuts
- Irrigated perennial vine fruits
- Rural residential
- Intensive horticulture
- Other conserved area
- Other *(specify)*

Geology and soil type:

- Alluvial soil
-
- Sandstone
- Clay
- Black clay
-
- Other *(specify)*

FARMING

Type of farming:

- Traditional farming
- Organic
- Organic certified since _____
- Biodynamic
- Biodynamic certified since _____

- GM free
- Hybrid plants
- Heirloom varieties
- GMO
- Other *(specify)*

Crop types:

- Vineyards *(specify varieties)*
- Vegetable orchards *(specify varieties)*
- Olive orchards *(specify varieties)*
- Almond groves *(specify varieties)*
- Fruit orchards *(specify varieties)*
- Grazing / pastures *(specify varieties)*
- Breeding *(specify)*
- Other *(specify)*

Shiraz / Grenache / _____

Kalamata / Frantoio / Coronaki / _____

Johnston / Summerstone / Papershell / _____

Apricots / Peaches / Pears / Apples _____

Wheat / Barley / Flax / Legumes / _____

Sheep / Cattle / Pigs / Alpaca / _____

Farming techniques:

- Crops rotation *(specify varieties)*
- Mixed/multiple cropping *(specify varieties)*
- Mechanical harvesting *(specify varieties)*
- Hand harvesting *(specify varieties)*
- Other *(specify)*

Quantities of production:

- Tons/year
- Trees #
- \$/year
-
- Other *(specify)*

Other notes:

BUILDINGS

Residential Units

- Stone Cottage
- Wood cottage
- Brick cottage
- Courtyard house
- Mansion, villa
- Other *(specify)*

Rural Units

- Barn / Granary
- Warehouse / Shed
- Greenhouse
- Nethouse
- Water tank
- Other *(specify)*

Other buildings

- Mill
- Factory
- Church / chapel
- Shrine
-
- Other *(specify)*

State of preservation

- Good
- Fair
- Poor
-
- Abandoned
- Ruins

OTHER VALUABLE STRUCTURES

Architectural structure

- Loggia/balcony
- Portal / gate
- Veranda
- Stone/brick Vault
-
-
-
- Other *(specify)*

Rural structures

- Stone Wall
- Brick wall
- Retaining stone walls
- Terraced landscape
- Cellar
-
-
-
- Other *(specify)*

Water structures

- Fountain
- Well
- Cistern
- Pond
- Creek
-
-
-
- Other *(specify)*

Landscape

- Formal garden
- Swale
- Lookout
- Windbreak
- Native plants edge
- Significant trees
- Aboriginal remnants
- Other *(specify)*

CONSTRUCTION AGE

- Before 18--
- Between 18-- and 18--
- Between 19-- and 19--
- After 20--

RESIDENTS / WORKERS

Permanent inhabitants number Families number Workers *(specify seasonal / permanent)*

9.3 Appendix 3. Elements of on-farm agrobiodiversity mentioned by respondents from the McLaren Vale

Number, agricultural activity & place	Form of Produce	Agricultural species	Varieties/ Breeds	Unique Bio-cultural elements	Field level values of agrobiodiversity	Farm level values of agrobiodiversity	Natural species/systems highlights	Important risks	Values and opportunities to adapt to risk
1 Almond producers, Willunga	Minimal Intervention	Almonds	Johnstons, Somertons	Traditional almonds varieties for local farmers market. Native birds clean crop remnants from trees. Trees as windbreaks.	Cross pollination of different almond varieties.	Paper shell to Local varietal almonds, allowed respondent to manage water constraints, control their supply chain and generate a unique market position associated with the high quality, local product.	Eucalypt Shelter Belt Casuarina soak up extra water Lorikeets, galahs, white corellas, black cockatoos do damage, but also clean up left over crop	Age of farmers. Climate change. Unprofitability of viticulture. Urbanisation. Influence of multinationals.	Almond history. Willunga Farmers market; urban proximity; community strength; improved environmental management & recycled water scheme.
2 Vegetable grower, McLaren Flat	Organic	Large range of garden vegetables	Mostly Hybrids but numerous heirloom varieties	Large diversity of organic vegetables sold to local farmers market. Use native trees as windbreak and backdrop to property.	Mixed plantings and rotations of vegetable species/varieties to avoid pests and diseases, and to reflect nutrients. Green manure crops. Flowering plants attract good insects.	'I do think the new generation of gardeners will be different from market gardeners – it is small scale, intensive, sustainable operations. [...] They are working together, and it just going from strength to strength.'	The big redgums provide a sanctuary, beauty, shade and buffer from non-organic neighbouring properties	Pests and diseases. Climate change	New small scale intensive market gardening. Alternative marketing linked to Willunga Farmers market and direct links to buyers.
3 Grape Grower, Willunga	Minimal Intervention	Grapes	Shiraz	Friends of Willunga standing up for local heritage values, including working on native plantings along roadsides.	Mix of surrounding crops reduces pest loads on the grape vines.	Small scale vineyards in two regions.	Corellas damage crops, but parrots, magpies, pee wees, willy wagtails, koalas, echidnas and kangaroos are fantastic.	Unprofitability of viticulture. Dependence on multinationals. Urbanisation. Climate change	McLaren Vale Shiraz. Recycled water scheme. Strength of the community.
4 Barley/ Wheat Cropper, Willunga	Conventional	Grapes Fava beans Wheat Barley	Shiraz Cabernet sauvignon	One of the few grain producers remaining in the region. High quality products for local and export markets.	One of few remaining cereal and legume crops in the region. Built agricultural heritage.	Export high quality faba bean to Japan, barley supply for local brewer.		Markets & labour costs. Climate change. Rights to farm, urbanisation & multinationals.	Diversification of cropping systems and markets.
5 Grape grower/ Vigneron, McLaren Vale	Minimal Intervention	Grapes Olives Carob Mulberry	1919 Shiraz Grenache Chenin Fiano Nero D'avola San Giovese Pic Poul Negroamaro Nebbiolo Barbera Koroneiki Significant tree Significant tree	High quality wine production. Old grapes and innovation based on grape varietal choices and use of olives. Use native shrub as windbreak and backdrop to property.	Old vines with deep roots into clay soils and high quality varietal mix, including southern European grapes. In-crop weed suppressant species (Oxalis) and mid-row crops (Triticale & vetch). Built agricultural heritage.	Different winegrape varieties provide to manage environmental variation and change, as well as consumer tastes and market demand. Olives and attractive cellar door add to diversification. Aesthetic and sense of place values of mixed viticultural native shrubs landscapes. Grapes from several regions.	The aesthetic and sense of place provided by the native species. Kangaroos and birds are having a bigger impact on the crop.	Climate Change. Lack of consumer acceptance of new varieties. Regulatory limitations on innovation. Urbanisation	Traditional and diversification of varieties and cropping systems, especially varietal selection and developing organic production system. Alternative income sources through restaurant and tourism. Strength of community. McLaren Vale Shiraz.

ber, agricultural activity & place	Form of Produce	Agricultural species	Varieties/ Breeds	Unique Bio-cultural elements	Field level values of agrobiodiversity	Farm level values of agrobiodiversity	Natural species/systems highlights	Important risks	Values and opportunities to adapt to risk
6 Grape grower/ Vigneron, Willunga	Minimal Inter-vention/ Organic	Grapes	1934 Dry grown Grenache Shiraz Mouvedre Graciano	High quality wine production. Old, dry grown bush vine Grenache. Cellar door. Native windbreak & aesthetics.	Unique, high quality old vines with deep roots into clay soils.	Dry grown old Grenache with minimal intervention. Unique marketing and distribution system with attractive cellar door bordered by big redgums. Grapes from two regions.	The aesthetic & sense of place provided by big gums, birds, koalas & kangaroos. Trees provide wind break & habitat for pest predators. Wattle birds & Rainbow lorikeets damage crop.	Urbanisation. Climate change.	Traditional grape varieties and production methods.
7 Vegetable grower, Aldinga	Organic	Range of garden vegetables, (~44 species)	About 100 varieties Mix of hybrids and hierloom varieties	Large diversity of organic vegetables sold through local community market	20-25 varieties of vegetables in winter, and ~44 in summer, plus varieties within each crop, so ~100 varieties across the whole year.	Small scale gardening vegetable producers in loosely defined cooperative arrangement.	Eucalyptus provide a windbreak. Native insect and bird pest predators.	Urbanisation, Climate change. Vagaries of the Market.	New small scale producers with micro-businesses often on small holdings.
8 Cropping/ Grazing/ Quarry, McLaren Vale	Conventional	Pastures Sheep Wheat, Barley Olives	Mixed pasture seed Merino, Suffolk crosses Tuscan mix	Weddings, functions, Bed and Breakfast. Quarry.	Pasture Hay-Cropping rotation, 'Tuscan mix' olive orchard. Built agricultural heritage.	Quarry and agrotourism. A farming system different to other people.	Big gums for functions. 'I have never seen so many kangaroos, they are a danger on the roads. In the past they were always spotlighting, but now the neighbours are too close.'	Business planning. Vagaries of the Market.	Cultural built heritage for agrotourism and catering, mixed use landscapes.
9 Olives/ Almonds/ Grape grower, Willunga	Organic	Olives Grapes Almonds	Kalamata Frantoio Koroneiki Shiraz Local Johnstons, Somertons & others	Organic high quality table olive, grape and almond production, including own Shiraz vinegar production. Use of native species in organic and wind protection border.	Organic production systems working with native pest predators and co-plantings	Organic olive producer who have concentrated on high quality.	Eucalyptus as windbreak, barrier to non-organic spraydrift and to support pest predators.	Climate change. Urbanisation.	Organic production of high quality products with knowledgeable consumers able to understand the values of those products.

Number, agricultural activity & place	Form of Produce	Agricultural species	Varieties/ Breeds	Unique Bio-cultural elements	Field level values of agrobiodiversity	Farm level values of agrobiodiversity	Natural species/systems highlights	Important risks	Values and opportunities to adapt to risk
13 Grape grower/ Vigneron, McLaren Vale	Bio-dynamic Organic	Grapes Sheep	Shiraz Pinot Cabernet sauvignon Tempranillo Touriga Nacional Grenache Mataró Merino	High quality biodynamic organic wine.	Biodynamic viticulture, built agricultural heritage	High quality, biodynamic organic wine producer with attractive cellar door	Pest control, fertility and other viticultural values of native biodiversity. Big redgums add to aesthetic values of the vineyard.	Climate change. Urbanisation. Pests and diseases.	Biodynamic organic production of high quality wine.
14 Mill Owner/ Grape/ Almonds, Sellicks Hill	Bio-dynamic Organic	Grapes Almonds	Shiraz	Old mill. High quality biodynamic organic grapes.	Classic biodynamic organic McLaren Vale shiraz. Built agricultural heritage.	Renovating original mill. High value biodynamic shiraz.	Important and attractive biodiversity for aesthetic and bequest values.	Urbanisation. Lack of interest in cultural heritage.	Cultural built heritage. Biodynamic organic grapes.
15 Grape grower/ Vigneron, McLaren Vale	Minimal Inter- vention/ Organic	Grapes Sheep	Shiraz Grenache Chardonnay Sauvignon Blanc Mouvedre Aglianico Sagrantino Sangiovese Nero d'avola Touriga	Traditional grape and wine production techniques to produce high quality wines.	High quality, traditional viticultural system, with unique old vines, new southern European varieties and use of terroir. Built agricultural heritage.	Traditional wine production linked to natural and built heritage.	Heritage vegetation provides attractive cellar door and vineyard, while also providing habitat for pest predators.	Climate change. Vagaries of the market.	Traditional production systems, terroir and wines. Tourism.
16 Olive oil processor/ Olive producer, Willunga	Conven- tional & Organic	Olives	Processing	Enabling a diverse, high quality olive oil industry with strong cultural knowledge.	Opportunities to expand the size, marketing and tourism opportunities of the olive industry.	Diversity of olive varieties and growers allows for a large range of high-quality products in the marketplace	Olives interact with native vegetation where they are picked for table olives.	Vagaries of the market. Climate change. Business planning.	Facilitating diversity in the olive industry through mechanical flexibility and social cooperation.

Number, agricultural activity & place	Form of Produce	Agricultural species	Varieties/ Breeds	Unique Bio-cultural elements	Field level values of agrobiodiversity	Farm level values of agrobiodiversity	Natural species/systems highlights	Important risks	Values and opportunities to adapt to risk
17 Orchardists, McLaren Flat	Minimal Inter-vention	Grapes – Wine Grapes – Table Apples Pears Cherries Peaches Plums Nectarines Avocados Mangos Loquats Asparagus	70 y.o. Shiraz 70y.o. Cabernet Nero d'avola Crimson seedless Medindee seedless Fujis Sundowners Royal gala Pink lady Green delicious Red delicious 7 varieties, incl. Corellas Stella Sams Lapins Empress	Large diversity of horticultural products and high quality old wines sold through Farmers' markets.	Highly diverse horticultural and viticultural production to meet volumes and timings of crops and to meet local market demand.	Targeting production to meet local demand for horticultural and viticultural products, particularly for the Farmers Markets.	Native vegetation frames the property and adds to the beauty of the sights and sounds. Cockatoos damage crops.	Climate change. Water availability. Urbanisation.	Tourism - providing local diversity and opportunity for people to reconnect with the land.

