

What should we conserve? Farmer narratives on biodiversity values in the McLaren Vale, South Australia

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ABSTRACT

Major challenges are emerging to integrate private lands into whole-of-landscape conservation policy, especially if definitions of biodiversity and conceptions of conservation alienate farming communities. Insufficient attention has been paid to the way that farmers perceive and value biodiversity. By undertaking ‘walk-and-talk’ in-depth interviews with leading farmers in the South Australian viticultural region of the McLaren Vale, seven important narratives were identified on the way that farmers conceive of and exploit biodiversity on-farm. Farmers’ conceptions of biodiversity challenge traditional policy divisions between ‘natural’ and anthropogenic biodiversity and represent a sophisticated understanding of agricultural and regional ecology. While farmers clearly recognise and prioritise important biodiversity values, the dominant policy frameworks are not effectively defining, quantifying or supporting that biodiversity which is constantly being regenerated through farming practices. A range of opportunities for better conservation emerge from a recognition that productive farming activities and associated agricultural biodiversity form a vital part of the region’s biocultural heritage. Of particular importance is the need for farmer definitions of biodiversity to be included in policy both to guide new connections between private landowners and biodiversity conservation, and to normalise goals of sustainable environmental management across rural landscapes.

1. Introduction

Agricultural development in many Mediterranean climatic regions is increasingly constrained by resource and regulatory limits on intensification. At the same time, biodiversity across the Mediterranean biome provides a wide range of ecological and social services, but is under threat in many places (Underwood et al., 2009; Dearborn and Kark, 2010; Costanza et al., 2017), including the settled landscapes of south-eastern Australia that have experienced some of the highest rates of species loss globally over the last 150 years (Bradshaw, 2012; Woinarski et al., 2015). Agricultural development has been a major cause of that biodiversity decline in South Australia (SA), but that situation is changing, with ecological management on private farmland increasingly providing important conservation outcomes. As a result, there is a growing trend for farmers to imagine, generate and exploit opportunities from multifunctional agricultural ecosystems to increase or diversify their incomes by exploiting biodiversity (Holmes, 2006; Dibden et al., 2009; Roche and Argent, 2015; Bardsley et al., 2018). As farms transition, opportunities are generated to enhance both

biodiversity conservation and agricultural development by integrating management goals in practice and policy. For that reason, we examine farmers’ evaluations of biodiversity within the intensive agricultural/viticultural region of the McLaren Vale on the southern periphery of the state capital Adelaide (Fig. 1), asking the questions: what does biodiversity mean to farmers, and what values does it provide for social-ecosystems and farm businesses.

Global rates of biodiversity loss are indicative of a sixth global mass extinction event (Ceballos et al., 2015). Much of that loss has been generated by intensive industrial activities, including the clearance of native habitat for development in Mediterranean regions that are highly valuable for agriculture (Viers et al., 2013). The challenge to conserve biodiversity in multifunctional landscapes raises important questions about the effectiveness of contemporary conservation practice and policy (Tschamtker et al., 2005; Otte et al., 2007; Bradshaw, 2012; Karp et al., 2012; Bryan et al., 2013). Policy in SA has necessarily focussed on the protection of biodiversity from further clearance, but arguably has struggled to recognise the range of values of biodiversity in agricultural systems on private lands. Since the 1991 Native Vegetation Act,

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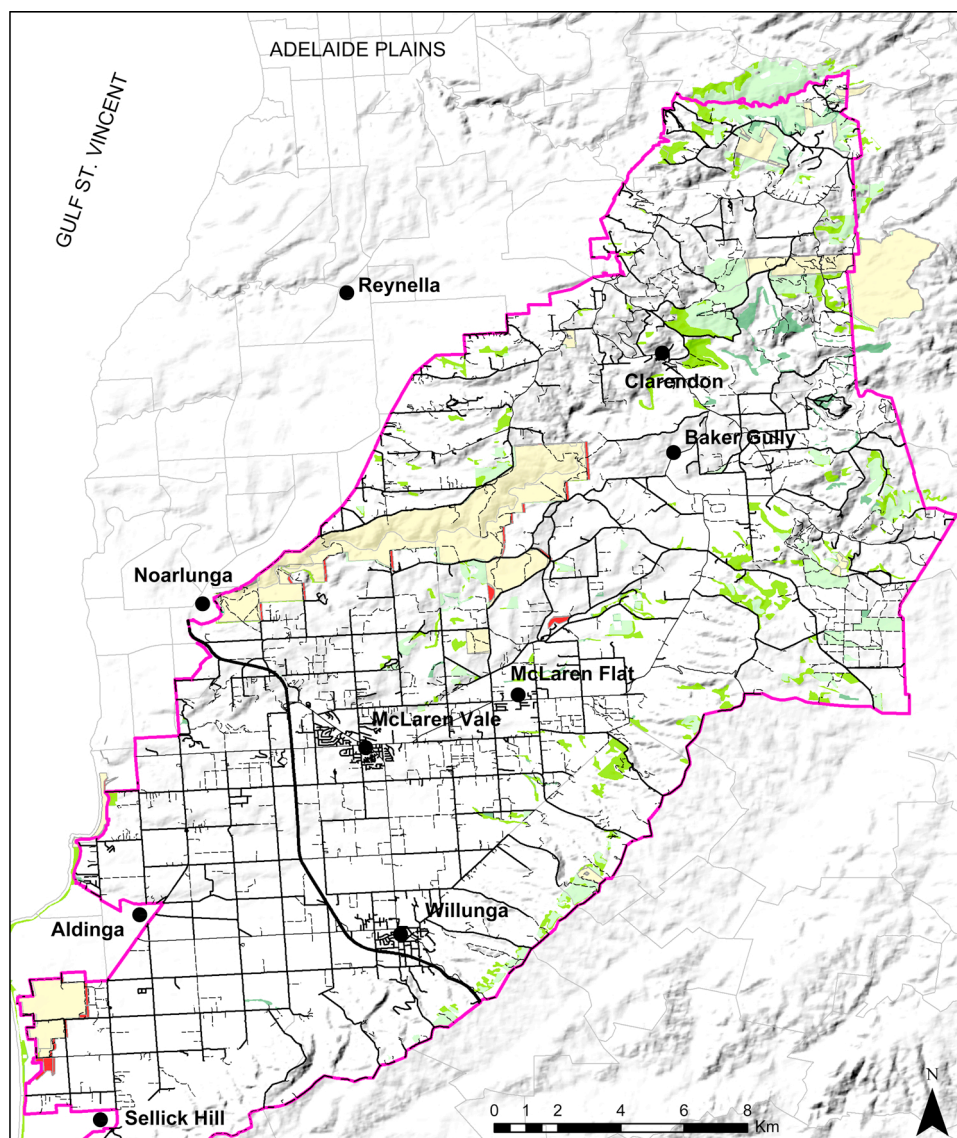


Fig. 1. Changes in the extent of native vegetation from 1993 to 2008 in the McLaren Vale, South Australia. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Yellow = No change from conservation (2563 ha); Red = Loss from conservation (137 ha); Light green = Gain to conservation from grazing modified pastures (1257 ha); Mid green = Gain to conservation from grazing natural pastures (1661 ha); Dark green = Gain to conservation from other land uses (132 ha); White = No change.

conservation policy in SA has relied upon strong command and control regulatory powers to limit further large-scale clearance of vegetation (SA Government, 1991). However, within rural landscapes cleared of most native vegetation prior to that legislation, the government has promoted habitat restoration and invasive species management with heritage agreements where remnants exist, along with morally suasive approaches through voluntary Landcare groups (Argent, 2002; SA Government, 2004; Tennent and Lockie, 2013; Curtis et al., 2014). Now, given the need for greater habitat areas for effective conservation, especially in the context of future climate change (Crossman et al., 2008; Sgro et al., 2011), the model of focusing on conservation outcomes primarily within reserves with little acknowledgement of the importance of that biodiversity within social-ecological or biocultural systems is being questioned within SA (DEWNR, 2017), as they are elsewhere (Ban et al., 2013; Agnoletti and Rotherham, 2015).

What is needed to respond to the scope of the emerging ecological crisis is both more effective conservation within established reserves and a range of biodiversity management approaches on private land –

or in other words, the emerging challenge is not a question of “land sparing versus land sharing” (Phalan et al., 2011; Fischer et al., 2014), but rather an enhanced combination of the two approaches for sustainable development (Heller and Zavaleta, 2009; Ritchie et al., 2013). For that reason, it is increasingly understood that private land-owners need to play more important conservation roles in rural landscapes, and yet developing and applying approaches that encourage farmers to conserve biodiversity remains a key challenge (Robertson et al., 2000; Moon and Cocklin, 2011; Queiroz et al., 2014; Leventon et al., 2017).

Part of the challenge of generating conservation policy for private lands has been associated with definitions of biodiversity that seem to take the local ‘nature’ out of the hands of the people who manage rural landscapes. A technical, exclusive view of biodiversity has dominated in rural Australia, as in many places (Zimmerer, 2006; UNESCO/CBD, 2014), such that it has often been treated as exterior to farmer interests and beyond their positive influence. Partly as a result of the lack of acknowledgement of the vital link between biological and social-ecosystems, the political will is lacking to turn around declining resource

conditions or lobby for funding to generate whole-of-landscape conservation opportunities. Insufficient attention has been placed on bio-cultural elements, such as farmer motivations to conserve biodiversity on-farm (Swift et al., 2004; Kull et al., 2015; Greenland-Smith et al., 2016). For example, biodiversity programs are mostly concerned with conservation, natural resources and heritage values, while agricultural policies tend to focus on industrial production, jobs and economic growth. These program initiatives promote their own specific goals, influencing how landscapes are used and how they evolve, but rarely integrating ambitions.

To overcome the problem of land use policies that are often antagonistic to the other, Kok et al. (2018, p139) are now proposing a “Decentralized Solutions pathway” to conservation gains that “mostly consists of solutions and technologies that can be implemented on a smaller scale and results in multi-functional mosaic landscapes and regional diversity.” Although large areas of intact habitat areas are going to be difficult to re-construct through such a pathway alone, any new opportunities to integrate biodiversity conservation with productive activities for whole-of-landscape conservation will require acceptance amongst private landholders. Attempts at direct funding or tendering for conservation outcomes amongst farmers partly reflect a turn away from a confrontational approach between agricultural and conservation interests to generate complex, multifunctional landscapes (Rolfe et al., 2017). Yet, even when such financial incentives are provided, incorporating the knowledge and experiences of those most closely connected with the landscape will be vital (Nastran, 2015). Genuine engagement with residents and landowners is too often ignored by land use policy-makers for a variety of reasons including a lack of funds, time, engagement capacity, interest or understanding. The result is that in regions such as the McLaren Vale, which contain both high biodiversity and agricultural production values, land, environmental and commodity policies often marginalise farmers from conservation processes, who in turn view them as potentially detrimental to their industrial activities. Understanding how local farmers conceptualise biodiversity is vital for recruiting them into large scale conservation initiatives. The analysis of McLaren Vale farmer narratives aims to identify how alternative evaluations of biodiversity amongst private landholders could be better supported by policy.

2. Defining biodiversity

Biodiversity is a vital element of all natural and anthropogenic ecological systems. While science has predominantly defined biodiversity mathematically and policy has flowed from those metrics, the complex values attributed to the environment by people often do not correlate with those definitions (UNEP, 1992; Whittaker et al., 2001; Morar et al., 2015; Lincoln and Ardoin, 2016). Importantly for this paper, that focus has been a key reason why native or natural biodiversity has dominated conservation research, monitoring, review and policy. Yet with the onset of the Anthropocene, an era defined by human impacts over the Earth, even the most remote ecosystems are influenced, at least indirectly, by human action (Steffen et al., 2011). With that realisation, modern conservation’s focus within “natural” systems is being brought into question, and there is a growing emphasis on the importance of also retaining, regenerating and developing biodiversity in social-ecosystems – the anthropological or biocultural diversity that exists in settled landscapes (UNESCO/CBD, 2014; Agnoletti and Rotherham, 2015; Bürgi et al., 2015; Elands et al., 2015; Rotherham, 2015).

It remains a challenge for conservationists to move away from a strict definition of conserving nature to implement goals of conserving novel, constructed biodiversity assemblages to support a range of societal values (Hobbs et al., 2006; Bartkowski et al., 2015). Agricultural ecosystems remain one of the most important of those altered social-ecosystems and as a result, agricultural biodiversity has, since the Convention on Biological Diversity, become increasingly recognised as

valuable for landscape management (UNEP, 1992; Bardsley and Thomas, 2006). A literature is asking the important question – how can we can reconcile agricultural development and biodiversity conservation practices at the requisite scale and scope to facilitate sustainable development (Wittman et al., 2010; Sayer et al., 2013; Fischer et al., 2014; Rotherham, 2015; Bioversity International, 2017; Glamann et al., 2017). That question is particularly relevant given the importance of biodiversity for generating resilient agricultural ecosystems and the recognition that much of the diversity that remains within those systems is threatened (Bardsley, 2003; Young et al., 2006; Koohafkan and Altieri, 2017).

The Food and Agricultural Organization (FAO) of the United Nations has applied various definitions of agricultural biodiversity, but here we utilise the definition from FAO (1999):

“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.”

That definition of agricultural biodiversity highlights the importance of social processes that lead to the constant renewal and re-generation of the genes, species, systems and landscapes relevant to food and agricultural systems (Thrupp, 1998; Brookfield et al., 2002; Scherr and McNeely, 2008). It is often overlooked as a key systemic component for both conservation and agriculture (Ehrlich and Ehrlich, 1991; Negri, 2005; Love and Spaner, 2007; Zimmerer and Vanek, 2016). The lack of measurement or sustainable management of agricultural biodiversity is being questioned as the need to conceptualise systems holistically and conserve all biodiversity becomes clearer (Berkes et al., 2003; Herzog and Franklin, 2016; Jackson et al., 2007; Ratnadass et al., 2012; Holt-Giménez and Altieri, 2013; de Wit, 2016). Such a recognition offers a pathway of engagement with farmers to conceptualise all of the values of biodiversity in the landscape as important. The complex contributions to society from agriculture need to be better understood. However, in the Australian context the agricultural biodiversity is rarely reflected in planning and policy. In just one local example, the SA Government’s biodiversity conservation policy No Species Loss (2007–2017) focused on native biodiversity but did not cover important productive components of agricultural biodiversity (SA Government, 2007). We aim to develop an understanding of the sophistication of farmer conceptions of biodiversity in the intensive SA wine production region of the McLaren Vale to generate knowledge on how conservation policy could evolve to reflect the new complexity.

3. Method

3.1. Study area

This study focuses on McLaren Vale, an undulating intensively managed rural landscape framed by border hills, populated with townships, farmhouses, wineries, vineyards, olive groves, almond orchards, quarries and beaches (Figs. 1 and 2). The region is an important area for the original custodians, the Indigenous Kaurna people of the Adelaide Plains, and has become increasingly industrialised since European settlement in the 1830s to become a premium wine growing district. McLaren Vale is part of the broader Mount Lofty Ranges and Kangaroo Island Australian National Biodiversity Hotspot and remains an important ecological refuge, but the regional ecosystem is broadly in decline with major problems of fragmentation and invasive species (DEH, 2010; Guerin and Lowe, 2013; MVGWTA, 2017). Part of the ongoing challenge to promote and conserve biodiversity relates back to



Fig. 2. The McLaren Vale landscape.

the juxtaposition between conservation goals and the need to simultaneously generate products from industrialised and heavily settled landscapes.

Native vegetation at the time of European settlement in the McLaren Vale in 1836 was already being moulded by the fires set by Indigenous people (Ellis, 1976; Clarke, 1991; Gammage, 2011). Nevertheless, regional biodiversity changed dramatically from the 1840's, with colonial settlement promoting the widespread destruction of native ecosystems to facilitate agricultural development (Fig. 1). Early colonisers focussed on wheat and sheep production and that focus broadened in the latter part of the Nineteenth century to mixed farms including crops, grazing, dairy, horticulture and the precursors of today's substantial grape industry (Pyke, 1967; Dunstan, 1977; Santich, 1998; Denham et al., 2012). Modern specialisation in the forms of cropping, grazing, dairy, and viticulture, led to a dominance of stone fruits and almonds, and during the last 30 years to the systemic and economic ascendancy of wine grape production (Skinner, 2015). Within this highly anthropogenic landscape we ask farmers: what is biodiversity, how it is valuable and how do they exploit those values to support their businesses.

3.2. Walk and talk interviews

While scientific and economic evaluations of biodiversity dominate policy discussions, an alternative approach to defining biodiversity values can “be traced to what we experience, directly or indirectly” (Morar et al., 2015, 26). The qualitative data on farmer biodiversity values were derived from interviews with 17 leading farmers during a series of “walk and talk” interviews on their properties from March to June 2015 (Table 1). Farmer respondents do not form a representative sample, but were purposefully selected as identified leaders within the McLaren Vale community, who are experimenting and implementing alternative development paths, including organic and biodynamic production. The walk and talk model is a rapid rural appraisal survey device derived from agricultural and landscape planning field practices to generate social-ecological interpretations of systems by integrating a conventional interview process with the physical attribution of value to places in the landscape (Evans and Jones, 2011; Jernejc and Olsson, 2013; Nelson, 2015). Systemic and spatial elements of value are discussed with the use of narratives, maps and physical elements in the landscape. Farmers chose paths to walk down through their properties while we asked questions and, after permission was obtained, the interviews and spatial data were recorded with an audio device and notes were taken. In such a manner, the complexity of farmers' perceptions of their places and systems could be closely associated with the landscape. The interviews with farmers ran for one to three hours, using a set of

open-ended questions to guide discussions on five key themes:

- 1 Details about the property and management
- 2 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 Heritage listing of the regional agrarian landscape
- 5 Agricultural and landscape management governance issues

The interviews were transcribed and examined to determine key themes relevant to how farmers perceive of biodiversity (Thomas, 2006). Small scale, in-depth qualitative analyses are powerful methods for drawing out alternative viewpoints on risk, vulnerability and resilience (Baxter and Eyles, 1999; Wiles et al., 2005; Boholm et al., 2012). While greater rigour can always be generated with further interviews (Mason, 2010), noticeable repetition of narratives suggested that the important messages had been raised, especially when triangulated with secondary academic, government and industry sources. All farmers were asked, “what is biodiversity?” Although not all farmers answered the question directly, their implicit and explicit responses frame the key narratives on the farmer values of biodiversity in the McLaren Vale at two scales: local narratives on the values of biodiversity at the field, farm or business level; and regional agricultural biodiversity at landscape/industry scales (Bardsley, 2015). To maintain respondent anonymity, key interview data is presented in summarized form or as quotes cited according to respondent numbers in Table 1.

Those in-depth deliberations on biodiversity values by McLaren Vale farmers are presented in themes, or narratives. The term narrative here 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). Understanding such narratives will be important for conservation policy within multifunctional agrarian landscapes in SA, but the specific recognition of local biodiversity narratives could facilitate the evolution of multifunctional mosaic rural landscapes in other places. There is a persuasive argument that farmers are not cognisant of the impacts of inappropriate land use on local ecologies – and there are many examples to support that argument – but many other rural communities want policy and action that enables sustainable outcomes. Therefore, this case study is directly relevant to global conservation studies as biocultural influences over natural areas increase everywhere.

4. Results

Seven different narratives on biodiversity emerged from the discussions with farmers. The key conceptions of biodiversity overlap, and in several cases build on each other, yet they remain distinctly clear interpretations on the different values of biodiversity. While there is not space to detail all the responses relevant to each of the values, example quotes from farmers are provided to expand on the key concepts.

4.1. Biodiversity for natural habitat

A prevailing view of biodiversity in the McLaren Vale region is the conventional importance of native species and ecosystems as natural habitat. This viewpoint, which largely aligns with SA Government policy, was often expressed by farmer respondents in association with a range of other narratives. The historical widespread loss of native biodiversity from the region was seen a negative change and most were actively returning native vegetation for animal habitat back into the landscape. Typified this narrative was the views of Farmer 9:

‘I’d like to see revegetation with a lot of diversity and a lot of the original ecology. There are still a lot of remnants of the original

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

No.	Major Agricultural Activities and Place of Interview and Property of Respondent	Biodynamic, Organic, Minimal intervention or Conventional System
1.	Almond producers, Willunga	Minimal Intervention
2.	Vegetable grower, McLaren Flat	Organic
3.	Grape Grower, Willunga	Minimal Intervention
4.	Barley/Wheat Cropper, Willunga	Conventional
5.	Grape grower/Vigneron, McLaren Vale	Minimal Intervention
6.	Grape grower/Vigneron, Willunga	Minimal Intervention/Organic
7.	Vegetable grower, Aldinga	Organic
8.	Mixed Cropping/Grazing/Quarry, McLaren Vale	Conventional
9.	Olives/Almonds/Grape grower, Willunga	Organic
10.	Grape grower/Vigneron, McLaren Flat	Biodynamic Organic
11.	Grape grower/Vigneron, Willunga	Organic
12.	Grazing/Grape grower, Willunga	Minimal Intervention
13.	Grape grower/Vigneron, McLaren Vale	Biodynamic Organic
14.	Mill Owner/Grape/Almond grower, Sellicks Hill	Biodynamic Organic
15.	Grape grower/Vigneron, McLaren Vale	Minimal Intervention/Organic
16.	Olive oil processor/Olive producer, Willunga	Conventional & Organic
17.	Orchardists, McLaren Flat	Minimal Intervention

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. [...] To me it's integrating farming with our native landscape that is the most important thing I have tried to make a point of it, because the old concept of just clearing the land and doing away with all the native landscape is wrong.'

Bequest values were explicitly recognised as important by respondents who highlighted the need to generate native ecosystems that can be sustained across generations. Several farmers mentioned that a particular value of native vegetation was the bird habitat, which also leads to a significant avian diversity and associated birdsong soundscape.

'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).

Those relationships are not always positive however, with several species including Sulphur crested and Black cockatoos, Wattle birds and flocks of Rainbow lorikeets named as species causing the most crop damage. Farmers have sophisticated knowledge of their impacts and are employing that knowledge to live with native species that they broadly appreciate, for example by sacrificing a small part of the crop to protect the rest (Farmers 1 & 6).

4.2. Biodiversity for resource management: erosion control, water management and windbreaks

The management of rainfall, runoff and wind with vegetation was a vital component of farmers' evaluation of biodiversity. SA Government revegetation programs have targeted support for planting that would reduce erosion from the denuded hill slopes of the Willunga Scarp and along creeklines.

'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).

'The government spent a lot of money planting trees for us, we put fences in, and they come along and plant trees in them. They wanted to green the range, so I said fine, but if I green the range then I have no income, so I said 'why don't we just put trees along the creek lines to save the erosion?' (Farmer 12).

4.3. Biodiversity for agricultural pest and weed suppression

There is considerable interest from farmers into organic, biodynamic and low-chemical input agro-ecosystems (Table 1). Tied to those goals is the challenge of management of insect pests that damage crops. Most farmers mentioned the native wasp as a natural predator of caterpillars and moths, and the use of a diversity of crops as complementary or alternative to pesticide use. For example Farmer 10 stated:

'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 moth that control the apple moths. So all of the diversity that we have got is providing habitat for 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.'

Producers are using soursofs (*Oxalis pes-caprae*) for weed suppression. The use of invasive, exotic species as an effective means to reduce herbicide use provides a good example of the challenges that will emerge when aiming to generate consensus on what a sustainable novel ecosystem might involve (Bardsley and Edwards-Jones, 2006), and could even be seen as environmental vandalism from the perspective of retaining a natural landscape.

'One thing that is working well for us is soursof, so the whole of the 15 acre block over there, we just don't have any weed problems any more. We don't spray with herbicide, we plough underneath the vine, and the first hot day in spring they collapse and you virtually get no weeds because all the weed seeds have gone' (Farmer 5).

4.4. Biodiversity to define the regional aesthetic

A large part of the McLaren Vale's appeal is that the landscape aesthetic that is divided between vineyards and native vegetation. Individual large trees, normally River Red Gums (*Eucalyptus camaldulensis*) provide impressive vegetative back-drops. Large trees are particularly important for altering micro-climatic conditions by providing shade, and altering the atmosphere of cellar doors, including creating the aroma of an Australian bush setting.

'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' (Farmer 8).

The mixture of managed landscapes with natural features such as rocks, cliffs or creeks, vegetation remnants or individual trees can be important for differentiating the rural Australian landscape (Lothian, 2007). That aesthetic has value both to attract people to the region, and for individual towns, wineries and restaurants, it provides an identifying characteristic that differentiates places from similar wine regions internationally.

'With a place like this, getting visitors down here and having tourism is actually a big part of it so having and retaining those heritage shrub areas are key to presenting a nice image of a nice place. [...] It complements the vineyard and breaks up the monotony of having vineyards' (Farmer 15).

'There is an incredible view from up here, you get a sort of layered effect because you have the gumtrees and the hills in the distance' (Farmer 17).

4.5. Holistic values of biodiversity

While the more conventional values of native biodiversity regularly emerged as important, farmers expanded on these concepts by emphasising the holistic, existence values of living in a biodiverse landscape. This conception of biodiversity is integrated with people's worldviews and their understanding of where they and their farm are positioned in relation to the environment. Importantly, they did not differentiate between the 'natural' and anthropogenic. Some of that holism relates strongly to the range of practical applications for agriculture.

'It is not just the vineyards, we have 25 acres of wetland and also we lots of beautiful native vegetation on the vineyard [...] Biodiversity is just about having 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' (Farmer 10).

'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).

Another significant component of holistic evaluations of biodiversity are linked to respondents' worldviews and their associated roles and responsibilities as farmers.

'I just feel so blessed to be on this piece of land and have this naturalness around me. Every time I am out working in the vegetables the birds are singing and it is just the most magical place to be, and that means a huge amount to me, but the biodiversity means that you are utilizing everything that you possibly can, trying to work in harmony with everything around' (Farmer 2).

'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' (Farmer 14).

The local recognition of the importance of crop diversification may be linked to some recent history. The McLaren Vale went through a major transition from the 1970s to the 1990s, when many mixed horticultural farms, began to focus almost uniquely on grape production. That loss of agricultural biodiversity increased risks as farms became dependent on one crop, often in association with limited marketing channels. A re-diversification is underway both to generate ecologically resilient production systems and to explore alternative marketing

opportunities, especially: organic and biodynamic production; unique wines linked to different varieties and soils; and direct marketing and tourism.

4.6. Biodiversity for production resilience

There is a focus on the exploitation of crop diversity to generate resilient agroecosystems. That narrative relates to an understanding of the increasing risks to their productive systems, particularly associated with climate change and natural resource constraints. Part of that use of diversity is linked to the native biological heritage, but importantly for the viticultural region, varietal diversity is also expanding. We don't go into detail on this value here (Lereboullet et al., 2013; Bardsley et al., 2018), nevertheless the need to spread the timing of the grape harvest and to manage extreme heat and rainfall conditions is becoming an increasing challenge for grape producers.

'Climate change probably is the biggest risk, [...] and that is one of the reasons we always have new things coming on. [...] We have just released the first PiquePoul in Australia, next year it will be Negroamaro. It matures very late. That will be interesting. Sangiovese is fairly prone to sun damage but Nero d'Avola is not. So some of those varieties might be the opportunity, and might mean we can get through' (Farmer 5).

Farmers are also diversifying into different crops so that they are best able to exploit a range of potential growing conditions and manage the timing of major farm activities.

'We have some really old Shiraz, close to 65, 70 year old Shiraz and the Cabernet are the same age, so they are beautiful old vines there. The apple and pear trees are about 20 years old, so they have been in a while. So, we grow six or 7 types of pears, 6 or 7 types of apples, we have about an acre of cherries, a couple of acres of stonefruit, we've got avocados out the back, mangos, a little patch of loquats at the front, and a little patch of asparagus, so it's a little bit of everything' (Farmer 17).

4.7. Biodiversity to improve marketing opportunities

A final important narrative relates to crop diversification to fit niches in the evolving marketplace. Key to the exploitation of that value has been the development of the successful Willunga Farmers market (Fielke and Bardsley, 2013), which has both generated an outlet for small-scale production and enabled farmers to work together to represent their diversity. The cosmopolitan city of Adelaide is adjacent to the McLaren Vale. So this narrative relates the complexity of the food, wine, tourism, cultural and recreational markets, to the landscape, the roads, rivers, cycling and walking trails, as well as the range of policy and program initiatives, which link the city to the countryside. What urban and tourist visitors buy, experience or value in the landscape increasingly influences what's produced in the McLaren Vale, shaping and reshaping what is developed and conserved.

'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' (Farmer 1).

'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' (Farmer 2).

There has also been a diversification of wines to meet niche demands within an increasingly crowded marketplace. As a priority, the focus is on the production of high quality wines, but a range of

Table 2
Particular farm level values of agricultural biodiversity in the McLaren Vale.

No.	Example values raised during interviews of in-field agricultural heritage
1.	Traditional South Australian almond varieties (Johnston, Somerton) for Farmers market. Windbreak and erosion control.
2.	Mixed plantings of vegetable species, including heritage varieties for Farmers market, to avoid pests and diseases, and to reflect different nutrient requirements. Green manure crops. Native vegetation to attract pest predators, provide shade and suppress runoff.
3.	Mix of surrounding crops and native vegetation reduces pest loads on grape vines.
4.	One of few remaining cereal and legume croppers in the region. Mill and barn built agricultural heritage.
5.	Old vines and high quality varietal mix, including some southern European grapes. In-crop weed suppressant species (<i>Oxalis pes-caprae</i>), mid-row crops (Triticale & Vetch) and native windbreak. Olive production. Cellar door built agricultural heritage.
6.	Unique, old high quality vines. Native windbreak.
7.	20-25 vegetable species in winter, and around 44 in summer, plus varieties within each crop, approximately 100 varieties for local community market.
8.	Pasture Hay-Cropping rotation, ‘Tuscan mix’ olive orchard. House and barns for private functions and built agricultural heritage.
9.	Organic olives, grapes and almonds, native vegetation for pest predators and windbreaks.
10.	High quality, biodynamic viticulture with high varietal diversity, alpacas, sheep, small-scale horticulture and native wetlands.
11.	High quality, organic viticulture systems with a high varietal diversity and use of soursobs. Erosion, biodiversity and aesthetic values of native vegetation. House and barn built heritage.
12.	Prime lamb from clean environment and high quality grape production. Windbreak, erosion, biodiversity and aesthetic values of native vegetation. Barn built heritage.
13.	High quality, biodynamic viticulture. Native windbreaks and pest predator habitat. Redgums around cellar door.
14.	Classic biodynamic organic McLaren Vale shiraz. Windbreak, erosion, biodiversity and aesthetic values of native vegetation. Mill built heritage.
15.	High quality, traditional viticultural system, with unique old vines, new southern European varieties. Windbreak, erosion, biodiversity and aesthetic values of native vegetation. Redgums around cellar door.
16.	Increasing linkages between olive and wine industries. Windbreak and aesthetic values of native vegetation.
17.	Diverse horticulture and viticulture, including old vines, to spread timing of crops and for Farmer markets. Windbreak, erosion, biodiversity and aesthetic values of native vegetation.

marketing approaches were mentioned that linked back to an exploitation of biodiversity.

‘We grow a broad range of varieties - Chardonnay, Pinot, Semignon blanc, Savillon, Viognier, and then the reds Cabernet sauvignon, Petit verdot, Malbec, Grasciano/Grappiano, Touriga nacional, and a little bit of red Frontignac or Muscat petit grand [...] We diversified for grape sales and niche winemaking’ (Farmer 11).

‘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’ (Farmer 15).

Producers are exploiting an expansion of organic and biodynamic production, especially as information technologies provide unique external links and winery cellar doors and cafes provide authentic direct visitor experiences with local producers.

‘Organic labelling attracts people to the brand, it is just a point of difference, and it has actually become our philosophy of the business, because we have the wetlands, and setting up the cellar door we decided to make this a sustainable cellar door’ (Farmer 10).

Diversification also plays out across the geomorphological, edaphic and climatic characteristics of the landscape. The age and complexity of the soils of the region have been well mapped (Fairburn et al., 2010), and that diversity is reflected in the choices of grapes and other crops. More formally, studies of the McLaren Vale terroir are enabling the distinctive influences of the soils to be better understood and reflected in discussions of wine qualities through the Scare Earth project (Skinner, 2015).

‘The terroir project has been fantastic. [...] Grapes are only part of the story, it is how you make it, and how you grow it, and how you store it, and the quality of the wine maker’ (Farmer 5).

‘The soils tell a great story and explain a lot of the characteristics of the wines, soils that are so old and such a great variety of soils from one end of McLaren Vale to the other’ (Farmer 15).

The success of diversifying crops and marketing unique products is not just linked to viticulture, but also some re-emergent horticultural industries, such as table olives, olive oil, almonds and market gardening.

‘As far as olives go, we need biodiversity in groves, just between cultivars as cross-pollinators, so that is the pinnacle of establishing groves. Having the different pollinators, it allows the industry to have these different flavours or styles of oils’ (Farmer 16).

‘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’ (Farmer 7).

As the crops that are marketed in and from the McLaren Vale expand, winery cellar doors are becoming more sophisticated and providing a broader range of goods and services.

‘We sell a regional food platter. We choose the menu to reflect that the Fleurieu isn’t just about wine it is also a really great food bowl, so in the food platter we have organic olives from Willunga, organic almonds from Willunga, island pure Labneh (cheese) from KI, we have the biodynamic Paris Creek cheeses, we have our own olive oil. We have cassundi and dukka that is made by local people here, bread from the local bakery. We have a vegetable patch and we try and put produce from there on the platter, and I also have an orchard’ (Farmer 12)

Through this, and other narratives, farmers are suggesting that their crops and animals, as well as the associated biota and landscape could all be considered part of the regional biological heritage. Much of that biodiversity is not native, not natural and may even be having negative impacts on the local ecology, and yet it is being understood and integrated into their complex, knowledge-led farming systems.

5. A comprehensive biodiversity analysis in a rural landscape

The narratives emerging from the interviews with farmers suggest that agricultural biodiversity is being exploited at different spatial scales (Table 2). At the farm level, a complexity of organisms are being utilised spatially and temporally to generate a range of products and/or support productive systems.

Regional biodiversity values of biodiversity are also being exploited within farming businesses. An increasing range of products are being promoted, in association with a story of retaining native biodiversity or heritage crops from the past.

‘To me it’s integrating farming with our native landscape that is the most important thing’ (Farmer 9).

While traditional crop landraces are rare in Australia, there are almond varieties (Johnston, Somerton) that were developed in SA. The McLaren Vale also contains some vines which predate the Phylloxera crisis that devastated grape production elsewhere, and those grapes are part of a rare global history within the Phylloxera-free zones of SA (MVGWTA, 2017).

‘All of SA is Phylloxera-free: so we have got some vineyards over a hundred years old still; so they are some of the oldest vineyards in the world apparently; so there is a lot of heritage there’ (Farmer 9).

While a number of respondent farmers stated that their agro-eco-systems are what defines how they want to express themselves, the representation of biodiversity is also shaping the regional identity.

‘All of us within the business have a commitment to what is going on in the community and the wine industry. It is a nice place to live and work, put it that way. It is a very progressive wine region because everyone wants to see the region prosper and do well, and people are willing to have a go and try different things’ (Farmer 13).

Some farmers are building their business philosophy around the use of a diversity of local products (see Table 3). As well as exploiting biodiversity in their direct marketing, they are tying those values of sustainability to their wine labels in association with a range of initiatives such as the regional McLaren Vale Geographical Indication, Scarce Earth and Sustainable Australia Winegrowing (Baldwin, 2009; MVGWTA, 2017).

6. Recognising agricultural biodiversity in policy, planning and practice

The farmers interviewed showed considerable enthusiasm for the biodiversity that exists on their farms, whether it be natural or anthropogenic. From those interviews, a range of important farmer narratives on biodiversity in the McLaren Vale were identified:

- Biodiversity for natural habitat
- Biodiversity for resource management
- Biodiversity for agricultural pest and weed suppression
- Biodiversity to define the regional aesthetic
- Holistic values of biodiversity
- Biodiversity for production resilience
- Biodiversity to improve marketing opportunities

While all of these values were important to farmers, they are not being recognised or supported equally in policy. Farmers who wish to replant native vegetation have received considerable external assistance from the SA Government, but even those efforts to conserve native biodiversity are being underestimated. For example, most of the remnant and regenerated native vegetation along creek lines and transport routes has not been mapped comprehensively. A comparison of land use for a McLaren Vale farm is presented in Fig. 3, using the available Government land use data and the corresponding high resolution aerial imagery for the same space. Small-areas of remnant native vegetation are assimilated into the agricultural land use classification, highlighting an under-estimation of farmers’ conservation roles, and highlighting a further discounting of the complexity of biodiversity within the regional landscape mosaic.

Cultural landscapes are partly shaped by both natural and anthropogenic forces working in association through unique co-evolutionary processes (Phillips, 1998). In this case, the gridded rural landscape of the McLaren Vale (Figs. 1–3) is partly representative of an era of systemic colonisation framed by the Wakefield Plan and a period of *Pax Britannica* when the formal rural planning could focus on productivist goals of efficiency and trade (Pike, 1967; Denham et al., 2012; Johnston, 2014). That original colonial agrarian landscape has evolved over time through the constant renewal of knowledge intensive farming practices and the growing influence of metropolitan Adelaide, which is strongly connected through markets, policies and physical infrastructure (Van Oudenhoven et al., 2010). As consumers of regional products understand the activities that farmers are undertaking to establish sustainable landscapes, they are also supporting those actions through their purchases (Ogbeide et al., 2015; Bardsley et al., 2018; Dans et al.,

Table 3
Example farm level species, varietal and biocultural elements mentioned by two McLaren Vale respondents^a.

No.	Species	Varieties/Breeds	Other unique Biocultural elements
10.	Grape - wine	Shiraz, Sangiovese, Tempranillo, Cabernet, Merlot, Chardonnay, Savagnin, Bordello, Petit verdot, Grenache, Mourvèdre	High-quality biodynamic organic wine production. Sustainable cellar door. Use native trees as windbreaks and to add aesthetical value to property.
	Olive	Verdale, Mission, Manzanillo, Kalamata, Frantoio	Diverse ecosystem reduces pests and supports biodynamic production system.
	Sheep	Wiltipoll	Regenerated wetland with recreational ecotrail.
	Alpaca Apple Pears Nectarine Pomegranate		
17.	Grape – wine	70 y.o. Shiraz, 70y.o. Cabernet, Nero d’Avola	Large diversity of horticultural products and old, high quality wines sold through Willunga Farmers’ market. Diversity spreads the workload and the timing of produce throughout the year. Native vegetation frames the property as a windbreak, to manage water flow, generate habitat for pest predators and to provide aesthetic values.
	Grape – table	Crimson seedless, Medindee seedless	
	Apple	Fujis, Sundowners, Royal gala, Pink lady,	
	Pear	Green delicious, Red delicious	
	Cherry	7 varieties, including Corellas	
	Peach	Stella, Sams, Lapins, Empress	
	Plum		
	Nectarine		
	Avocado		
	Mango		
Loquat			
Asparagus			

^a As listed in the order mentioned by farmer respondent.



Fig. 3. Spatial representations of the Willunga creek riparian area within the McLaren Vale, using Australian Bureau of Agricultural and Resource Economics/SA Government data from 2015 and correspondent high resolution imagery analysis. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Map 3a

Blue line = Watercourse; Light blue = Irrigated perennial vines; Turquoise = Rural residence; White = Roads; Yellow = Cropping.

Map 3b

Blue line = Watercourse (center line); Hatched areas = Riparian area and remnant of native vegetation.

2019). In other words, the decisions that have constantly been made by individuals or associations of planners, producers and consumers have generated a distinctive regional landscape pattern linking the agricultural fields, streams and vegetation, and that social-ecosystem continues to be supported locally, regionally, nationally and internationally. Yet, that same rural landscape mosaic is rarely identified as valuable by conservation policy.

What should we conserve? The answers to that question need to be nuanced to represent, at least in part, the local views of farmers and the wider community. There remain vital ecological arguments that more vegetation of minimum viable habitat area must be developed to prevent the collapse of native populations (e.g. Szabo et al., 2011), but developing policy to enable large conservation areas in intensively managed rural landscapes has proven very difficult. There are important natural heritage landscapes in the McLaren Vale, particularly in the Onkaparinga River National Park and Recreation Park, east of Noarlunga, and the Aldinga Scrub Conservation Park, but these cover small portions of relatively low productivity soils and topography, and there is limited adjacent public land for their expansion (Fig. 1). New policy directions must utilise the growing recognition amongst farmers of the complexity of conceptions and values of biodiversity to support the broader acceptance of habitat regeneration. In fact, the articulation, categorisation and highlighting of agricultural biodiversity values based on farmers' sophisticated understandings could support a necessary democratisation of regional conservation planning (Tscharntke et al., 2005; Bardsley and Thomas, 2006; Rotherham, 2015; Zimmerer and Vanek, 2016; Burandt and Mölders, 2017). To achieve that goal of farmer engagement, policy should reflect all of the biodiversity values, not just the "natural", especially in regions where conservation and productivity goals are both important (de Wit's, 2016). Increasingly, a broadening of the scope of conservation will become vital as external ecological drivers such as climate change and industrial intensification make simple boundaries between conservation and productive agrarian spaces in the landscape less relevant.

Farmers recognise biodiversity for natural habitat as one of their key narratives, and policy will need to continue to support heritage agreements with private landholders. Arguably however, for most respondents the more important biodiversity exists as a product of complex biocultural interactions, where both anthropogenic and natural forces are acting to shape novel ecological associations and landscapes. Assistance to diversify agricultural systems is rarely available, however, because the anthropogenic elements of biodiversity that have created the McLaren Vale social-ecosystem are not being effectively recognised, measured or promoted. An alternative, inclusive conservation policy would reinforce the validity of the complex farmer imaginaries of biodiversity, including narratives such as production resilience and improved marketing, which steer away from strict ecological goals (Beilin et al., 2015; Morar et al., 2015; Lincoln and Ardoin, 2016). Such alternatives, which protect and promote systems and brands that conserve biodiversity, could be particularly targeted for regions such as the McLaren Vale where farmers are clearly sympathetic to sustainability goals.

There is an emerging sense from respondents' narratives that they would like to become a greater part of the solution, but they are excluded by the privileging of biodiversity that is not central to their experiences. By formally recognising the right of the local community to define and work towards their own ecological vision, policy could reinforce old, and guide new local regional connections between private landowners and their own biodiversity (de Snoo et al., 2012; Garibaldi et al., 2017; Gordon et al., 2017). That change is beginning to happen, with the Character Preservation (McLaren Vale) Act (SA Government 2012) and the Environmental and Food Production Area in the Adelaide Hills protecting high-quality agricultural lands from urban encroachment (Liu and Robinson, 2016). The SA Natural Resources Management Act (SA Government, 2004) is also helping to transform regional environmental management by prescribing limits on water resource extraction. A more explicit recognition of the management successes of farmer actions would in turn, help to legitimise the range of

farmer conceptions of the environment and enable them to benefit more broadly from those actions (Bryan et al., 2013; Bardsley and Pech, 2012). That could be achieved by engaging regularly with farmers in biodiversity measurement and monitoring; promoting the importance of biocultural actions for conservation through education and funding mechanisms; and through regulatory frameworks that encourage local management to achieve conservation outcomes as well as production goals for sustainable development.

The variety of narratives reflected in McLaren Vale agricultural biodiversity is rarely reflected in conservation policy and practice in Australia. Biocultural heritage is not an odd concept internationally; in fact experiences suggest rather that it is an increasing priority for conservation in many places (Negri, 2005; Altieri and Koohafkan, 2008; Leventon et al., 2017). Although biocultural landscape conservation is most developed in Europe and Asia (Queiroz et al., 2014), modern intensively managed agricultural landscapes are a challenge for conservation outcomes everywhere (Lindenmayer et al., 2012). Vital opportunities for better management emerge from recognition that productive farming activities form a key element of the biological heritage of a place: from farmer monitoring of biodiversity; to understanding the roles of biodiversity in vineyard, orchard, garden, livestock, crop, and pasture management; to bringing the city and the countryside closer together through markets, recreation and a recognition of ecosystem services; to regenerating perceptions of the value of place; through to better control of invasive species; more revegetation and regeneration of important on-farm biodiversity assets; and the renewal of the conception of the roles of local experimentation as agriculture struggles with social-ecological change (Lockie and Carpenter, 2009; Bardsley and Pech, 2012; Viers et al., 2013). Perhaps more questions need to be asked about why agricultural biodiversity is not valued within Australian policy, and why the range of farmers' narratives on the roles of biodiversity within intensive production systems are rarely articulated.

7. Conclusion

There are strong arguments being made that the focus of conservation policy on nature within reserve areas has significant limitations. In particular, while farmers' perspectives on the values of biodiversity within their local social-ecosystem remain secondary in thought, policy and practice to dominant conceptions of natural ecological values, wider goals for nature conservation will not be achieved. Conservation policy could better value the biodiversity developed and regenerated by farmers and support them to reflect their biocultural heritage in the landscape. For a start, there is a data-led under-estimation of farmers' conservation roles, which highlights the need for detailed surveys at local scales. With more holistic analyses of local social-ecosystems, there comes the potential to fully manage all of the biodiversity values within evolving multifunctional rural landscapes. In fact, new biodiversity is constantly being generated through agricultural innovation and change. Farmers' conceptions of biodiversity challenge traditional policy divisions between 'natural' and anthropogenic ecosystems. Just because one singular conception of biodiversity has dominated policy historically, it doesn't mean that it needs to dominate forever. The values of recognising the full range of biodiversity values flow both ways. Clearly, better management of biodiversity on farms in association with remnant native vegetation has a lot to offer whole-of-landscape conservation outcomes, but as farmer responses reflect, agricultural biodiversity can also improve property management. A new perspective on conservation which brings the landowners' values and goals within the envelope of analysis would motivate and support farmers to become a greater part of the ecological solution. Such a change in itself would not be enough to turn around terrestrial biodiversity losses within rural areas, but what we are suggesting here is not an end point - rather a step along an alternative path to overcome the impasse in land use policy between biodiversity

conservation and agricultural development.

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