ORIGINAL ARTICLE

Using the three horizons approach to explore pathways towards positive futures for agricultural landscapes with rich biodiversity

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Abstract

In light of the global challenges of the Anthropocene, including biodiversity loss, there are increasing calls for positive, inspirational futures to motivate action and help steer away from current, largely unsustainable trajectories. The three horizons framework is an approach in future studies that engages with normative futures and helps develop pathways towards them. However, this approach has not been applied to explore opportunities for biodiversity conservation with farming communities. We developed a template to apply the three horizons framework in combination with storytelling to explore positive futures for agricultural landscapes with rich biodiversity. We then applied this method over two workshops with a rural community in a farming landscape of south-eastern Australia facing typical contemporary challenges of an ageing population, climate change, biodiversity loss and global market uncertainty. In the workshops, six pathways for change were developed. We unpack these narratives of change to contrast problem framings, future aspirations and mechanisms of change and discuss implications for conservation. We discuss our approach to integrating diverse perspectives and values, creating actionable knowledge and highlight the role of governance and policy to support individual and collective agency. We conclude that the three horizons approach has the potential to create actionable knowledge through locally meaningful narratives of change, and thus influence priorities and empower local action. For lasting on-ground change, leadership and effective cross-scale governance is required.

Keywords Biodiversity conservation · Futures methods · Narratives · Storytelling · Systems thinking · Transformation

Introduction

The notion of the Anthropocene as a new geological era highlights the extent of human impact on the world's ecosystems (Crutzen 2002), which is irreversibly threatening

the basis upon which humanity relies (Steffen et al. 2015). Recent global projections of the impacts of human-induced climate change (IPCC 2021) and loss of biodiversity and ecosystem services (IPBES 2019) highlight the need for urgent action. However, despite increased knowledge of these unsustainable trajectories, existing approaches to protect biodiversity have largely failed to achieve global objectives such as the Aichi targets (Díaz et al. 2019). As a result, it is increasingly recognised that business-as-usual is not an option, and fundamental, system-wide changes are needed (IPBES 2019; Díaz et al. 2019). A key challenge for research on biodiversity conservation is that it involves tackling a wicked problem characterised by uncertainty and unclear and often ambivalent solutions (c.f. Rose 2018). Much debate in conservation has narrowly focused on agricultural production and disregarded societal issues such as justice and governance (Loos et al. 2014) and has not considered the issue through a systems lens. Subsequently, there are calls to make conservation

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research more transformative to address biodiversity loss (Colloff et al. 2017; Wyborn et al. 2020b). This means including different perspectives and values (Colloff et al. 2017), moving away from research that is focused exclusively on scientific knowledge and instead recognising different types of knowledge (e.g. Sterling et al. 2017) such as indigenous and local knowledge (e.g. IPBES 2019) and drawing on interdisciplinary and participatory research approaches (Rose 2018).

To counteract the often negative projections of future ecological and social decline, there have been calls to develop novel, inspirational scenarios (Bennett et al. 2016) and positive visions that inspire people to act (Raudsepp-Hearne et al. 2020; Pereira et al. 2019a, 2018). By providing directions for change, desirable futures and visions play a key role for sustainability transformations (Wiek and Iwaniec 2014). Developing such normative or positive futures requires more than the progression of change from existing drivers or trends. An ability to imagine is vital. Imagination refers to ideas about the future that cannot be captured by the senses (Moore and Milkoreit 2020). Processes that foster imagination can help to improve system understanding, co-create new solutions, fill participants with a greater sense of hope for the future, and foster a commitment to action (Pereira et al. 2019b, 2018). Imaginative futures can also help to explore and engage with different worldviews and values, as outlined by Wyborn et al. (2020a) in the context of biodiversity loss. However, future pathways developed thus far have predominantly had a global or regional focus and quantitative methods dominate (Mangnus et al. 2019). More participatory and imaginative approaches are needed to complement these efforts in ways that can enable more effective and practical local-level human agency (Pereira et al. 2019b), especially those approaches that start from bottom-up interventions (Pereira et al. 2021).

In this paper, we focus on the three horizons framework, a participatory future studies approach that helps grapple with future uncertainty and divergent perspectives and focuses attention on the role of humans to bring about positive futures (c.f. Sharpe et al. 2016). This makes it a potential tool to explore options for improving biodiversity outcomes at a local level. Three horizons structures discussions about desirable futures and ways to get to those futures along three horizons (Sharpe et al. 2016). Horizon 1 is the current system or business-as-usual, Horizon 3 is the imagined future system, and Horizon 2 represents the transition or transformation zone from Horizon 1 to Horizon 3 (Curry and Hodgson 2008; Sharpe et al. 2016). Three horizons is an approach to systems analysis where each of the three horizons represents a different condition of the system (Curry 2015) or different system patterns (Leicester 2020). These three horizons can be understood as an 'orientating heuristic', bringing focus and awareness to different patterns of change and the disconnect between the current situation and desired futures.

The three horizons framework has been applied to a broad range of topics, often in combination with scenario planning. Initially developed as a practitioners' tool, the approach has been increasingly used in research since 2006 (Curry and Hodgson 2008). It has been used to create scenarios based on existing initiatives of positive futures or 'seeds' (Pereira et al. 2019a, 2018; Raudsepp-Hearne et al. 2020) and to explore the role of human agency in achieving positive futures (Falardeau et al. 2019). It has also been applied to structure discussions about strategies that will lead to preferred scenarios for human–wildlife coexistence (Jiren et al. 2021). Three horizons has frequently been applied to develop bottom-up or local pathways of change, including to develop value-based local scenarios (Harmáčková et al. 2021) and to understand how regional pathways contribute to achieving the Sustainable Development Goals (Aguiar et al. 2020). To our knowledge, the utility of the three horizons framework to address biodiversity loss has not been assessed to date. We created a template that combines the three horizons framework with a storytelling approach to elicit pathways towards positive futures. We applied this method in a case study on biodiversity conservation in an agricultural landscape in south-eastern Australia.

The aim of this paper is twofold. First, we provide a step-by-step guide for how three horizons, in combination with a storytelling approach, can be applied to explore systems change towards desirable futures. Second, we assess how useful this approach is to developing locally meaningful narratives about positive futures that help identify opportunities for protecting biodiversity. To this end, we engaged a place-based community to collaborate with us to: (1) explore different perspectives on systems change towards positive futures, and (2) assess the utility of the three horizons framework for navigating towards those futures. The place was the Muttama Creek Catchment, a farming area in south-eastern Australia which faces challenges representative of the broader region in Australia and the globe, including climate change, biodiversity loss and an ageing rural population. We collaborated with the Muttama Creek Landcare Group, who was keen to develop community activities and broaden engagement with other people in the community. For our first research aim, we conducted two full day workshops over the course of two weeks. For aim two, we used questionnaires to document workshop participants' evaluation of the utility of the three horizons framework to support futures thinking, creativity, empowerment and dealing with diverse viewpoints and complexity. We describe the workshop process and the resultant six pathway narratives that emerged from discussions. We then reflect on the approach with specific reference to how our application helped with mutual understanding across different perspectives among

the Muttama community, the social impact of this research approach, and the utility of this futures studies tool for biodiversity conservation in farming landscapes.

Materials and methods

Situating the three horizons framework

Futures studies offers a range of methods to enable communities to explore possible, plausible and normative futures that improve decision-making and help navigate pathways towards those futures (Bai et al. 2016; Bengston 2019). Such methods can help make people's assumptions about the future explicit and explore novel futures. For example, Jarva (2014) argues that even though the future has not materialised in the real word, "it does exist in peoples' minds as passive and active (motivational) futures" (p. 21). Scenarios, visioning and backcasting are well-known participatory methods in transformation research (Wittmayer et al. 2018) and share common characteristics with the three horizons framework.

Scenarios can be applied in a range of different ways to make predictions, for exploring a topic, or engaging with normative questions (Börjeson et al. 2006). In recent years, there has been a growing interest in normative scenarios (e.g. Aguiar et al. 2020) and application of scenario planning to explore positive futures (e.g. Falardeau et al. 2019; Iwaniec et al. 2020). Scenario planning has become a prominent tool in social–ecological systems research to study, inter alia, biodiversity questions (Oteros-Rozas et al. 2015). Despite the plethora of ways in which scenarios have been applied to date, their role to enhance human agency and create positive scenarios remain under-researched (Falardeau et al. 2019). While scenarios have been used to help build common visions, their use as a standalone exercise has limited their utility in bringing about collaborative action—both for rural communities (Nieto-Romero et al. 2016) and for biodiversity conservation (Pert et al. 2010).

Visioning is another approach in futures studies that aims to develop a normative, desirable future (Wiek and Iwaniec, 2014) and is often combined with other future studies tools that build on these visions (e.g. Hamann et al. 2020). Visions of the future can be valuable in providing motivation for change but this may not be enough to help translate the visions into human action nor enable transformative change (Iwaniec et al. 2020). In contrast to these forward-looking approaches, backcasting connects the future with the present by starting from an endpoint and working back towards the present (e.g. Inayatullah 2008; Vervoort et al. 2014), thus enabling a systemic and long-term oriented perspective to be taken (Quist 2016). In backcasting, alternative futures or visions are developed and their feasibility and

consequences for actions and planning in the present are considered (Dreborg, 1996; Quist and Vergragt, 2006).

A key challenge that remains for any futures method engaging with normativity is the inherent subjectivity related to positive or preferable futures. Achieving a 'good future' is difficult because of the normative nature of these futures and the divergent perspectives that exist (Pereira et al. 2019a). Therefore, it is increasingly recognised that there exists not just one single ideal future and one single path, but multiple desirable futures and pathways (Bai et al. 2016; Bennett et al. 2016; Scoones et al. 2020), with pathways defined as being "courses of events and actions towards the desired targets" (Aguiar et al. 2020, p. 2). The three horizons framework offers an approach to developing pathways that simultaneously considers the present and the future systems and connects the present with desirable end points in the future. In addition to being highly participatory, it takes a systems perspective and focuses on identifying how humans can bring about change.

Case study context

The catchment area of the 100 km long Muttama Creek (1138 km^2) lies in the so-called sheep–wheat belt of south-eastern Australia, i.e. where land use is a mix of cropping and livestock grazing with sheep and cattle. The study area is located in the temperate climate zone, which, due to stable weather conditions, contributes to farms having relatively high commercial property values (Olsauskas et al. 2018). The agriculture, forestry and fishery industries together are the largest employer in the Cootamundra-Gundagai Regional Council (CGRC), the local government area encompassing our study area (ABS 2022). Agriculture thus plays a vital role in the regional economy and it is largely export-oriented. The majority of land in the region is privately owned. Most of the Council's approximately 11,000 population reside in the two major towns, with the rest of the area being sparsely populated. On average, the population in the area is older than the population of the state of New South Wales and migration trends show an increase of older residents (Cootamundra-Gundagai Regional Council 2018).

Since European colonisation in the early nineteenth century, and more specifically, since the onset of industrialised agriculture, much of the original grassy woodland ecosystems has been removed through land clearing with only remnant areas of natural vegetation remaining. While the study region has experienced a decline in rainfall since 1990 (Bureau of Meteorology and CSIRO 2020), since 2020, there has been above average rainfall leading to record canola harvests and cattle prices. However, according to climate projections for the broader region, average temperatures are expected to increase and rainfall patterns are projected to change with increased rainfall in summer,

and declining rainfall for other seasons (Local Land Services 2015). These climate changes scenarios are projected to result in decreased pasture production and profitability by 2030 (Local Land Services 2015). Based on global emission scenarios and projected changes in rainfall and temperature, the broader Riverina region, which our study area is part of, could experience a decrease in farm profits by 2050 of up to 31.5% compared to the 1950–2000 period (Hughes et al. 2020).

There have been several community-led initiatives in the area addressing climate change and environmental issues. The Muttama Creek Regeneration Group was founded in 2003 to focus community effort to improve riparian health of the section of the Muttama Creek that runs through the urban areas of one of the towns in the area.[1] Then, in late 2018, members of the local farming community formed the Muttama Creek Landcare Group, which aims "to protect and rehabilitate the natural vegetation of the Muttama Creek and surrounds, to reduce adverse impacts of climate volatility in the area and increase biodiversity".[2] Key actions of the local Council's Rural Lands Strategy include increasing tree canopy and encouraging regenerative farming (Cootamundra-Gundagai Regional Council 2019).

Research approach

In this section, we first outline how we selected and recruited participants for the workshops before detailing how participants were guided through the three horizons. We then highlight how we analysed the six pathways through thematic clustering and used narratives to uncover the multiple ways in which people view the future before describing how we evaluated participants' assessment of our workshop approach.

Participant selection and recruitment

To address our two research aims, we conducted two full-day workshops two weeks apart in April and May 2021. Through earlier research involving case study participants, we identified contrasting perspectives on the biodiversity–production intersection reflecting different perceptions of biodiversity and land use priorities (Schaal et al. 2022b). Workshop participants were thus selected to reflect the diverse viewpoints held among farming stakeholders in our study area so that desirable futures could be created to encompass this diverse

range of values and perceptions. Due to the systemic nature of the three horizons approach, we also sought to invite participants with different roles in the agricultural system. This included land managers in the area, staff from local and state government and non-government agencies (Cootamundra Gundagai Regional Council, Local Land Services, Biodiversity Conservation Trust), members of local community groups (a regional Landcare coordinator, members of the Muttama Creek Landcare Group), a teacher from the local high school, and other key organisations and individuals working in that space. We sent email invitations to over 130 people who we had either interviewed in the project previously, identified as key stakeholders, or who had been suggested to us by other interviewees. We also advertised the workshops via Facebook as well as through articles in two local newspapers (*Cootamundra Herald*, *Gundagai Independent*) and a newspaper focused on agriculture and rural topics in Australia (*The Land*). There were 28 participants at each of the workshops. 16 participants who participated in the first workshop also participated in the second one.

Workshop process

Previous research in the study area highlighted that peoples' perspectives on the role and importance of biodiversity conservation in farming varied substantially, from a more ecological perspective that sees biodiversity as the prerequisite for profitable farming to a pro-production perspective that questions biodiversity benefits to farming (Schaal et al. 2022b). Building on these insights, we defined the following overarching question to frame the discussions: *How will we create a future where our landscape sustains viable communities, profitable farming and a rich biodiversity?* Based on this framing, we developed key questions to guide participants through the three horizons (Fig. 1).

The workshops alternated between group discussions with changing compositions and plenary discussions. During the first workshop participants were asked to:

1. Identify signs that the current system is not viable in the long run (Horizon 1; Fig. 1, W1.1).
2. Identify the drivers behind these unsustainable trajectories (Fig. 1, W1.2).
3. Discuss what aspects they would like to retain from the current system (Fig. 1, W1.3).
4. Identify characteristics of a desirable future (without specifying a particular time frame) (Horizon 3; Fig. 1, W1.4).
5. Identify examples of a desirable future that exist already today (Fig. 1, W1.5).

The examples identified by participants of aspects of desired futures already existing today thus become the seeds
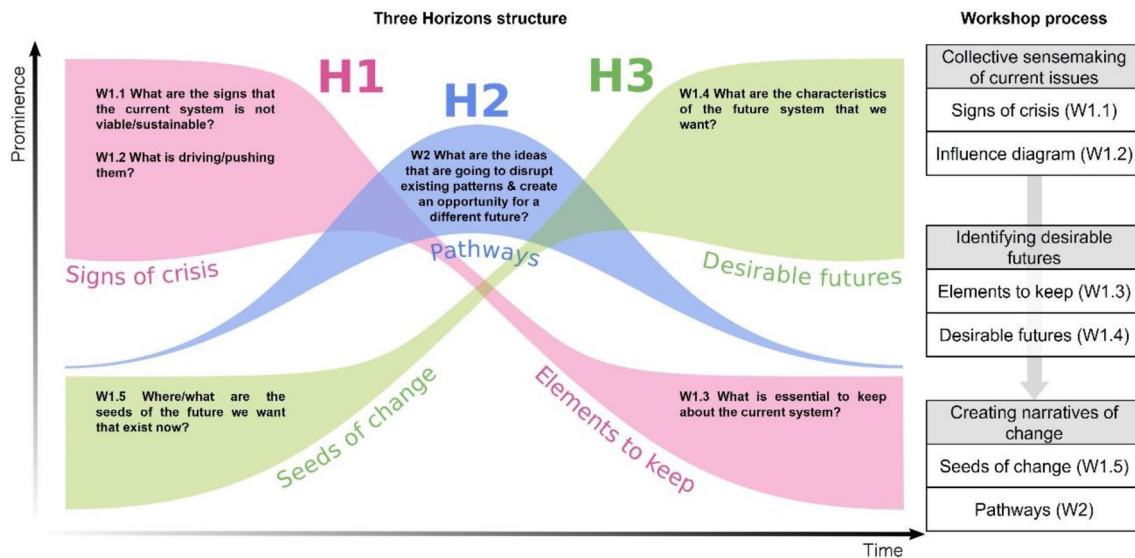

Fig. 1 The three horizons (H1–H3) and the questions guiding the discussions for each of the horizons during the two workshops. The letters and numbers indicate which aspects were covered during the first (W1) and second (W2) workshop and in which order (1–5)

that will help create the positive futures of tomorrow. Seeds are understood to be "initiatives (social, technological, economic, or social–ecological ways of thinking or doing) that exist, at least in prototype form […] but are not currently dominant or prominent in the world" (Bennett et al. 2016, p. 442).

The focus of the second workshop was to develop future pathways where key issues in the current system (Horizon 1) were bridged with desirable characteristics of the future (Horizon 3) through project ideas (Horizon 2). Participants split into groups and were asked to come up with project ideas that would help move away from current issues (Horizon 1) and towards desirable system characteristics (Horizon 3). Some groups chose to stick to broad themes, e.g. addressing the issue of declining community health and capacity, whereas others focused on more narrowly defined issues, e.g. set stocking and its impacts. After this initial brainstorming, the result of which were ten different project ideas, participants grouped themselves around a particular project idea they preferred to work on more (Fig. 1, W2) by writing their name against that project idea. The total number of groups was not pre-determined, but during the selection, six groups emerged with group sizes ranging from 2 to 5 participants. A storytelling approach was then used to develop pathways using so-called storyboards. Storyboards were initially developed in the film industry and are sequences of drawings to map out the film narrative (Hart 2008). The groups were encouraged to draw on people from other groups with expertise that they needed for their pathway. Each group was asked to discuss and draw four steps of a storyboard: (1) the context or setting of their projects; (2) which enablers would help advance the project; (3) what potential barriers

the project might face; and (4) how the successful project would look and feel like (Supplementary Material I). We decided to draw on a storytelling approach as it helps foster imagination, i.e. ideas which do not form part of "sensory and lived experience" (Moore and Milkoreit 2020, p. 9). Stories are also important to create shared understandings of dynamics in social–ecological systems (Galafassi et al. 2018).

To broaden the ways in which people in the area can engage with the workshop outcomes, we invited an interpretive artist to join the workshops and to create artworks inspired by the discussions. Arts represent an alternative mode of engagement with a topic, which can help communicate and illustrate research findings, and complement them through critical, creative or engaging outputs (Saratsi et al. 2019).

Thematic clustering

After obtaining oral consent from participants, we recorded all sessions where participants presented outcomes from small group work to the large group and subsequent discussions involving all participants. We also kept all written workshop outcomes produced by the individual groups. All recorded workshop discussions were transcribed verbatim. We took an inductive approach to clustering the written workshop outcomes into key themes. The Horizon 1 themes (W1.1) were clustered around aspects from the group presentations that were delivered during the workshop. Themes derived for other workshop outcomes (W1.3–1.5) were grouped together by the authors after the first workshop by drawing on the workshop transcripts to inform our

Fig. 2 Participants' demographics regarding gender, age and stakeholder group ($n=39$)
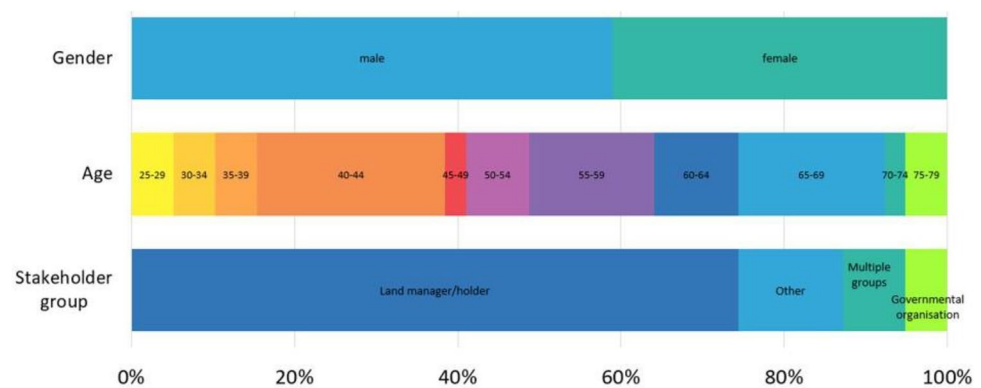
understanding of their meanings. In the two weeks between the two workshops, we summarised outcomes and key insights from the first workshop into a report that was sent to all participants of both workshops. At the beginning of the second workshop, we briefly presented the outcomes from the first workshop and asked participants to add themes or drivers that they felt were missing. After the second workshop, we wrote up storylines the groups had presented using workshop recordings, and gave each a name based on the descriptions and expressions used by participants during their presentations. We then sent summaries of workshop outcomes to all participants for feedback. We also presented them at several meetings of the Muttama Creek Landcare Group to report back on the workshop and obtain feedback on the outcomes. These steps were vital to understand whether our interpretations of the storylines and labels were reflective of the groups' understandings.

Narratives of change

Our first research aim was to articulate how the three horizons framework, in combination with a storytelling approach, can be applied to explore different perspectives on systems change towards positive futures. For this, we were interested in understanding the narratives of change produced through the storytelling approach as a reflection of different perspectives on systems change. Narratives provide both a useful way to communicate imaginary futures (Beckert 2016) and to engage with multiple imaginations of the future (Wyborn et al. 2020b). From a constructivist perspective, Leach et al. (2010) argue that for the same issue there are multiple co-existing narratives framing the system and its dynamics differently, each reflecting different values and goals through which problem and solutions are variously identified. In a narrative, different events are put into a sequence, starting with a beginning, e.g. a particular problem; the middle, in which certain events subsequently unfold; leading to the end, where certain outcomes are identified (Roe 1994). Narratives thus not only frame a problem

in a certain way, but also who is responsible to address the problem and how. They give structure to future imaginaries (Pigott 2018) by, for example, considering three key elements: a rationale, relevant actors, and a plot (Wittmayer et al. 2019). We understand narratives here as storylines that start with a perceived problem which is addressed through a set of activities and developments leading to a desired future.

Participant evaluation

Our second research aim was to assess the utility of the three horizons approach for navigating towards those futures. For this, we were interested in understanding participants' assessment of the workshops regarding five recurring topics in the current literature on futures studies: (1) dealing with complexity (e.g. Bengston 2019); (2) providing space for creativity and imagination (e.g. Wyborn et al. 2020b); (3) dealing with a diversity of goals and perspectives (e.g. Pereira et al. 2019a); (4) empowering participants and agency (e.g. Sharpe et al. 2016); and (5) fostering future thinking or literacy (e.g. Pereira et al. 2018, 2019b). At the end of each workshop, we asked participants to complete a questionnaire where they were asked to rank a question regarding each of these five key futures studies aspects on a five-point Likert scale from 'strongly disagree' to 'strongly agree'. We received 39 questionnaires; 18 from participants at the first workshop and 21 from the second. The questionnaire also served to obtain participant demographic details: 59% of the respondents were male, they were predominantly land managers or landholders (74%), and they covered a range of different age groups, with over half of the respondents 55 years or older (Fig. 2).

Results

During the workshops, participants discussed a range of interconnected issues with the current system and expressed diverse aspirations for the future. Based on these
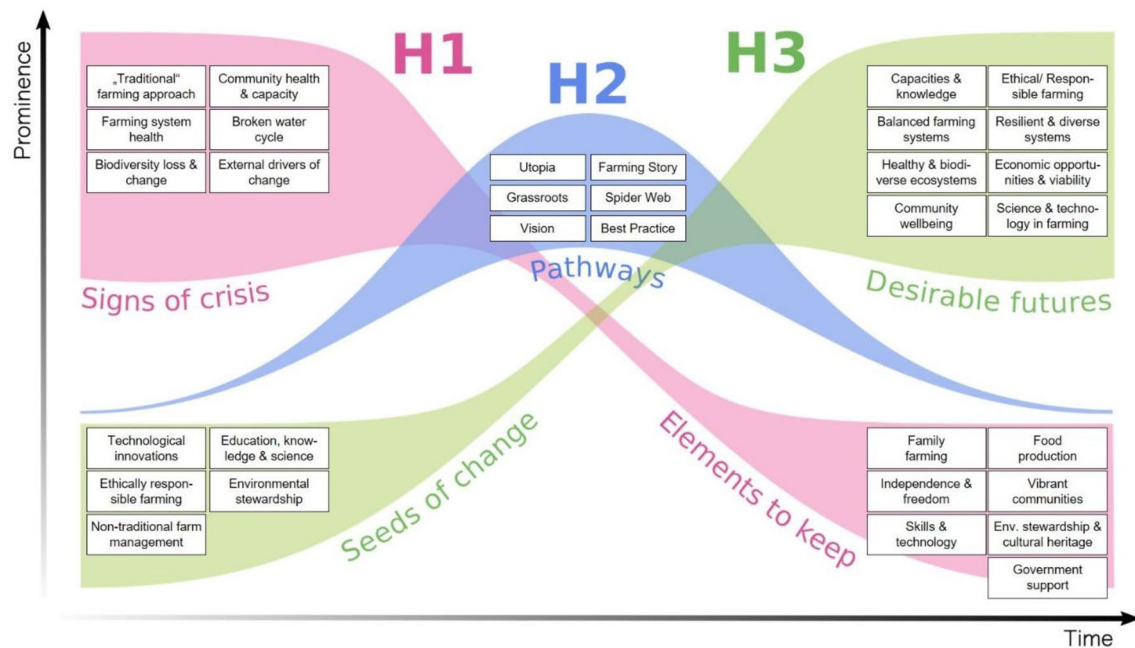
Fig. 3 The three horizons (H1–H3) and the main themes that emerged from the discussions about each of the horizons

discussions, participants in groups then developed six storyboards in which innovations, technologies or new ways of thinking and doing provided the impetus for moving away from a non-viable system towards positive futures. The resultant pathways combine six cross-cutting themes that emerged during the workshops: technology, knowledge, community, responsibility, environment, and farming systems. Each pathway represents a unique combination of these themes, highlighting the diversity of future aspirations and perspectives.

In the following, we present our findings in the order in which the three horizons were discussed during the workshops.

Horizon 1

Participants in small group discussions identified different aspects that they felt were indicative of how the current system will not remain viable in the future (Fig. 3, 'Signs of crisis'). The most prominent theme across the groups were issues related to "traditional" or more conventional farming approaches that were seen as lacking agility or having an over-reliance on chemical inputs. Biodiversity loss was also perceived to be a key issue, examples being the loss of birds or big old trees from the landscape. Another biophysical concern related to the water cycle, in particular poor water quality in the catchment area and increased run-off after heavy rainfall. Several groups mentioned issues related to farming system health, specifying a decline in soil quality, loss of crop diversity and invasive weeds. Similarly, participants

perceived a decline of individual and community health and capacity, including an ageing population in rural areas and mental health issues driven by burn out. Finally, examples of external system drivers beyond the immediate control of participants included climate change, increasing natural disasters and increasing consumer awareness about impacts of farming practices.

The discussion on drivers of change identified by participants focused on two critical signs that the system is untenable in the long run: traditional farming practices and a broken water cycle (Supplementary Material II). Workshop participants were divided into six groups, each of which selected one key issue and discussed driving forces that lead to these negative outcomes (Fig. 1, W1.2). This short exercise exploring direct and indirect drivers for these two situations highlighted the complexity of the issues involved by showing how the two issues are interrelated and how different drivers influence those issues in different ways. The influence diagram created by the researchers after the workshops (Supplementary Material II) showed how interconnected the different drivers are in participants' understanding across social, governance and management, economic, technological and biophysical aspects.

Participants felt that there were several aspects that should be retained from the current system (Fig. 3, 'Elements to keep'). This included the skills of farming communities in handling technology and their openness to adopt new technologies. Maintaining environmental stewardship and cultural heritage was a specific reference to farmers' desires to take care of the environment, biodiversity and
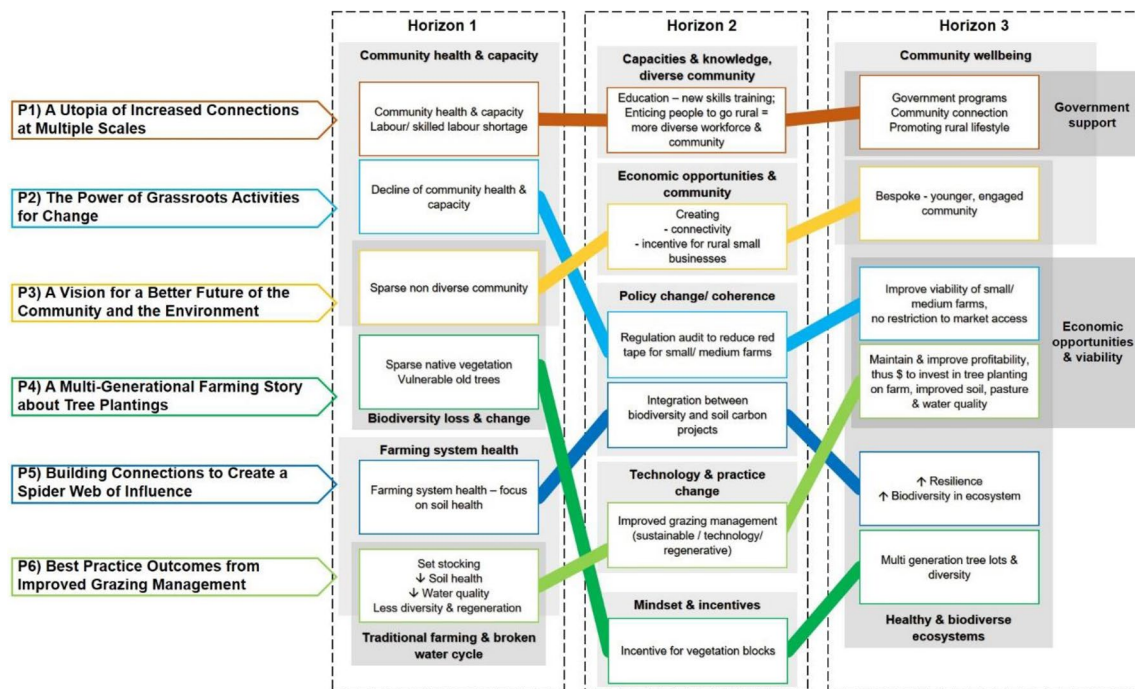
Fig. 4 Overview of the six pathways (P1–P6) that participants developed during the second workshop. The figure shows how the signs of a non-viable system (Horizon 1), innovative ideas, new ways of doing or technology (Horizon 2) and desirable characteristics of the future (Horizon 3) are connected. Grey boxes are main themes identified through thematic clustering. The coloured boxes were written down by the groups prior to developing the pathways resulting in minor textual differences compared to the final narratives

cultural heritage on their farms. Participants wanted to maintain food production which includes farmers' rights and ability to produce food, especially locally. Family farming was seen as important given its association with intergenerational management and a stewardship commitment to the land. Vibrant communities should be preserved, e.g. by maintaining the regional population or government support through legislation and funding. Participants also wanted the government to maintain their role in providing funding for local land management outcomes to enhance community well-being and to put in place good biosecurity legislation. At the same time, participants also valued independence from government, i.e. the right to farm and the freedom to choose the way of farming within community expectations. Finally, other aspects to be retained were the equality of women in farming and the farming lifestyle.

Horizon 3

Participants identified a broad range of aspects that characterise positive futures (Fig. 3, 'Desirable futures'). This includes science and technology in farming, e.g. that farming systems should be based on science or use renewable energy to reduce reliance on fossil fuels. Capacities and

knowledge should include anticipatory capacity of the community to plan for change and real time education and knowledge. Regarding ethical or responsible farming, participants wanted to see traceability and accountability in farming. Participants also discussed a range of properties that related to ecosystems and farming systems. Healthy and biodiverse ecosystems were desirable to participants and included healthy and biodiverse aquatic ecosystems and increasing soil carbon levels and soil health. Balanced farming systems meant that there should be a balance between production and natural systems and a better match of inputs and outputs in farming. Desirable system properties were their resilience and the diversity of people, enterprises and ecosystems therein. Community well-being meant that there should be a better standard of living for all in the communities. Economic opportunities and financial viability encompassed stabilised markets, ecotourism and an economic value for biodiversity. Finally, other desirable aspects were well-resourced government support staff and farming being seen as a good industry to be involved in despite a challenging climate.

Some of the aspirations towards the future can already be found in the present system (Fig. 3, 'Seeds of change'), including technological innovations such as hydroponics and

Table 1 Barriers (B) and enablers (E) identified by the groups prior to developing the storylines

		P1 Utopia	P2 Grass-roots	P3 Vision	P4 Farming Story	P5 Spider Web	P6 Best Practice*
Governance & Policy	B		X	X	X	X	
	E		X	X	X	X	X
Individuals & mindsets	B	X		X	X	X	X
	E				X	X	
Markets & industry	B	X	X	X	X		
	E	X		X		X	
Education & knowledge	B	X	X				
	E	X	X		X		X
Collaboration & connections	B	X					
	E			X	X		
Farming systems	B	X				X	
	E				X		
Technology	B						X
	E	X			X		X

The areas shaded in yellow indicate that the groups mentioned aspects that relate to an overarching factor both being a barrier and an enabler

*This group did not produce a written output of the barriers and enablers discussed. They were instead derived by the researchers afterwards based on the presentation of the storyline

glass houses, electric fences, virtual animal tags or robotic services. Education, knowledge and science related aspects that exist today were access to agriculture in the education system and research into practice change. Ethically responsible farming included honesty in labelling, animal welfare and humane practices but also technology-assisted paddock-to-plate traceability. Participants expressed a desire that environmental stewardship be put into practice and that landholders are rewarded for doing so. Non-traditional farm management related to cell or rotational grazing instead of set stocking, cover crops and support for carbon and solar farming. Other aspects included agritourism and equal participation of women in farm management.

Horizon 2

In total, there were six groups with each choosing an issue or set of issues in the current system (Horizon 1) that they wanted to address and associated future aspirations that they wanted to move towards (Horizon 3). Through storytelling, they charted pathways into positive futures (Fig. 3, 'Pathways'; Fig. 4). Here, we briefly outline the narratives (see full narratives in Box 1 and Supplementary Material III):

Utopia pathway: In this pathway, the key issues recognised are disconnects at different levels, especially locally, but also between rural and urban areas, and decreasing community health due to fewer people in the communities. The group recognised that improving education to create a more diverse and skilled workforce was the key to overcoming this challenge to a large extent. Positive change is also expected to happen through making stronger connections between producers and consumers through technology. This includes social media, paddock-to-plate marketing, which brings food from farmers directly to consumers, and agritourism. Such connections are expected to increase understanding of the agricultural landscape among urban residents, while strengthening local food production.

Grassroots pathway: In this pathway, the key issues addressed are decreasing community health and capacity. The group felt that a key lever for change involves making the regulatory framework more conducive to supporting viability of small and medium-sized farms. Change at the local level is seen to happen through bottom-up means such as grassroots initiatives or 'kitchen table' conversations. The group recognised mixed farms and bringing family members back to the farm as enablers for change that lead to improved viability for small and medium-sized farms and enhance capacity for ethical, semi-intensive agriculture. These developments over time are believed to improve the health of the Muttama Creek and the landscape.

Visions pathway: In this pathway, two intertwined issues are considered: decreasing community health and well-being, particularly a lack of diversity of people; and partly depleted ecosystems. The group saw change coming from increasing connectivity (between farmers and consumers and with the land), networking, support for micro projects, more incentives for small rural businesses and farm diversification. This is expected to lead to a bespoke, young and energised community where people live in harmony with the land, farmers are paid for conservation, sustainable practices and net zero carbon emissions.

Farming Story pathway: In this pathway, the key issue concerns unhealthy and non-diverse ecosystems, e.g. sparse native woody vegetation. The group focused on change that started with just one farmer with the right mindset and incentives at the community-level through Landcare and improved environmental education. As a result, the farmer was expected to start on-farm improvements through revegetation, tree plantings and fencing off the creek. Over several generations, ecosystem and livestock health were believed to improve by planting multi-generational tree lots. Eventually the group expected this to have a trickle-down effect on the rest of the community.

Fig. 5 Artworks created by a local artist based on the workshop discussions. They represent each of the three horizons. Artist: Julia Roche. Photos: Jack of Hearts/Jackie Cooper

Spider Web pathway: In this pathway, the key issue addressed is a disconnect between the federal and state system regarding soil carbon and biodiversity projects. The group believed that better collaboration and integration between state and federal level governments—supported by government representatives in the communities and farmers championing changes—would help increase community buy-in. This was expected to lead to more resilient and biodiverse ecosystems (Box 1).

Best Practice pathway: In this pathway, the key issues recognised were reduced soil health, water quality and loss of biodiversity as interlinked problems. The group felt that widespread implementation of practices that already exist on a small scale such as rotational grazing together with virtual fencing and other technological innovations, e.g. using drones for feed calculations, would help bring about change. Participants expected this to help improve farm viability, which would also lead to better environmental outcomes.

Prior to and while they were developing the storylines, the groups considered aspects that would inhibit or support the realisation of their pathways. When discussing barriers and enablers, the most prominent across all six pathways was the aspect related to the governance and policy context (Table 1, Supplementary Material IV).

Based on the workshop discussions following the guiding questions, the local artist created abstract artworks representing each of the three horizons (Fig. 5).

Participants' assessment of the three horizons workshop process

Overall, participants' assessment of the workshops regarding the five key futures studies aspects were very positive (Fig. 6). The second workshop involving the pathways narratives was ranked more positively than the first workshop, except for the complexity dimension. On average, 64% of the responses were in the 'strongly agree' section for workshop 2, compared to 52% for workshop 1. The empowerment dimension generally received the most negative responses, i.e. 11% and 12% of the responses in the 'strongly disagree' section for the first and second workshop respectively. The creativity dimension received the overall most positive assessment with 72% and 94% of participants selecting the 'strongly agree' response for workshops 1 and 2, respectively. The future thinking dimension received the lowest percentage of 'strongly agree' responses for both workshops.
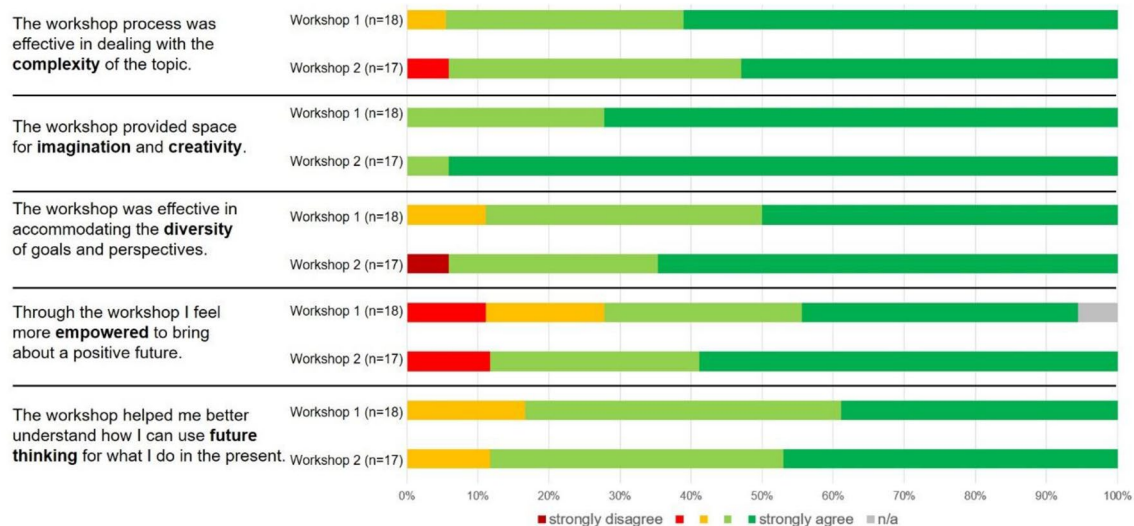

Fig. 6 Participants' assessment of the two workshops based on five key topics in futures studies on a five-point Likert scale from strongly disagree to strongly agree. For more detail see Supplementary Material V

Box 1 Example of a storyline and the corresponding storyboard. See Supplementary Material III for the other five storylines.

(P5) Building Connections to Create a Spider Web of Influence.

The key issue that this pathway addresses is the disconnect between the federal and state systems (*top left in the drawing*), with specific reference to the federally funded soil carbon projects and projects funded by state government such as the Biodiversity Conservation Trust. In particular, when there are in-perpetuity agreements for land on a property set aside for biodiversity conservation, that property is excluded from soil carbon projects.

As a result of this lack of coherence, legislation blocks synergies between projects and creates red tape. People's mindsets, especially a fear of change, stand in the way of creating better connections between biodiversity and soil carbon projects (*top right*). For example, many landholders feel that moving away from traditional to more sustainable farming practices and embracing long-term projects, e.g. biodiversity conservation and soil carbon projects, is a huge and risky commitment.

"… the fear of engaging and the fear of the unknown is a big thing to overcome."

Synergies between the projects regarding biodiversity, food production and farmers' income exist. However, for these synergies to emerge, federal and state agencies need to collaborate and help create a spider web of influence. This in turn helps to improve connection with research and funding opportunities. Government agency representatives located in the community are important for influencing the direction of change. Farmers who are passionate about these synergies and champion them can increase buy-in from the rest of the community by demonstrating that it is worthwhile to do these projects on their property. Soil carbon markets provide another opportunity for changes to farming practices.

"… we need to get everyone around the table trying to figure out a way that [the federal and state systems] can work together."

Eventually, these changes lead to a healthy and sustainable environment (*bottom left*)
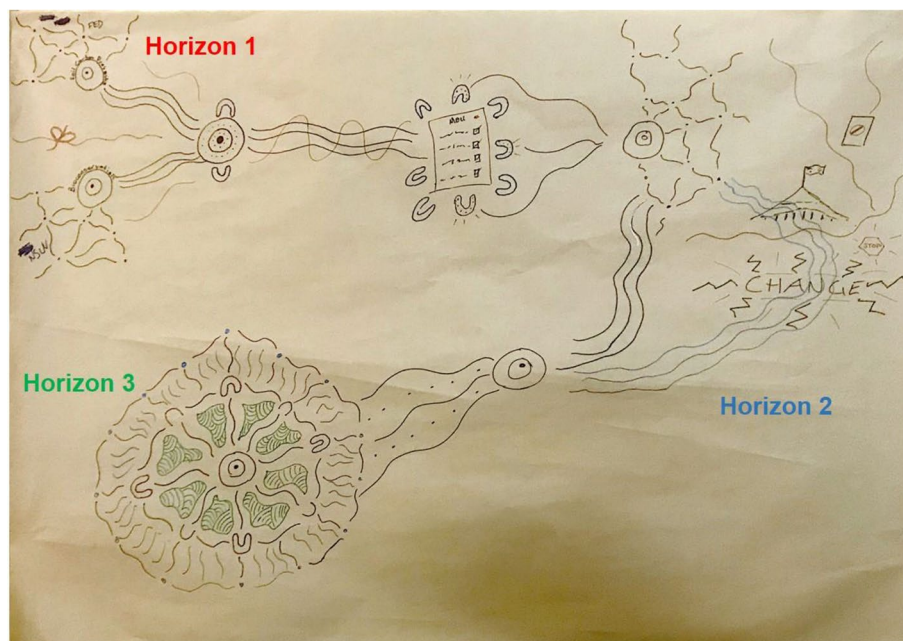
This storyboard uses Indigenous symbolism and was drawn by a Wiradjuri workshop participant

Discussion

Combining the three horizons framework with a storytelling approach helped elicit six pathways towards future visions and explore anticipated changes, including to biodiversity in the local area. The three horizons approach provides a structured way to talk about different dynamics that give rise to different futures, while storytelling helped participants connect their ideas into narratives of change. Our approach to explore futures can be classified as imaginative, participatory and qualitative (c.f. Bengston 2019) and contributes to a growing body of literature on local or regional pathways and actions towards positive futures (Bennett et al. 2016; Pereira et al. 2018; Mangnus et al. 2019). While futures methods to develop pathways often focus on a limited or pre-defined number of visions (e.g. Mangnus et al. 2019; Raudsepp-Hearne et al. 2020), the flexibility of our approach offered the opportunity for a broader range of different pathways to emerge. Moreover, in contrast to vision-driven approaches such as backcasting, the three horizons framework is focused on exploring systems dynamics by considering perceptions of current issues, future aspirations, and innovations simultaneously. In the following, we first contrast the six narratives before discussing implications for conservation in farming landscapes. We then present our reflections on benefits and limitations of our approach in terms of plural values and perspectives in conservation research, creating actionable knowledge and the role of policy and governance.

Comparison of the pathways

The six narratives reveal a diversity of problem framings, future aspirations, and mechanisms of change to move towards positive futures. The pathways addressed issues related to community health, farming systems and landscape health, and lack of policy coherence. Conservation objectives were embedded in the broader context of rural development, allowing us to consider community needs that are not always considered in approaches that focus only on agriculture or nature conservation. In most of the six narratives, change came from a combination of elements within the control of the community and from outside the focal system. Farmers were key actors for change in most of the pathways (*Grassroots*, *Vision*, *Farming Story* and *Best Practice* pathways). The community or community organisations also played a vital role in many of the pathways either to bring about or to support changes (*Utopia*, *Grassroots* and *Farming Story* pathways). Institutional changes were vital for the *Spider Webs* pathway and to a lesser extent in providing incentives in the *Best Practice* pathway. In the

latter, technology was a key driver of change for realising a positive future.

The pathways also relied on different types of innovations for system change. We understand innovation here broadly as "the (re)integration of new or existing information in innovative ways" (McKenzie 2013, p. 83). This means that whilst something might be an established practice elsewhere, it can count as new in a particular location. The *Best Practice* pathway focused particularly on technological innovations. In contrast, the *Farming Story* and the *Utopia* pathways pursued a different avenue by focusing on education. Environmental education and awareness-raising help mobilise human resources and enable innovations for transformative change (Pereira et al. 2021). The *Vision* pathway provided the most comprehensive account of strategies to establish alternative food systems such as direct marketing, diversified production or producing on a smaller scale. In sum, our narrative approach to pathways highlights different system framings and values (c.f. Leach et al. 2010) as well as different priorities and perceptions of key problems and solutions proposed to overcome these challenges (see also Krauß 2020).

Implications for biodiversity conservation in farming landscapes

The six pathways represent different understandings of the relationship between farming and biodiversity. For example, in the *Best Practice* pathway, local stakeholders imagined that improved profitability would provide the means to protect on-farm biodiversity through use of new technologies combined with changed practices. In contrast, the *Vision* pathway focuses on a changed relationship with nature, i.e. living in harmony with the land, which IPBES (2019) refers to as an element of a good quality of life. Prominent academic debates about conservation in agriculture, such as land sparing versus land sharing (Green et al. 2005) or the prospect of sustainable intensification (Loos et al. 2014; Tilman et al. 2011), did not play a major role in the pathways. Instead, the approach of storytelling helped workshop participants identify a variety of ways to protect biodiversity in their south-eastern Australian farming landscape context, such as rotational grazing or planting tree plots.

IPBES (2019) suggests five levers for transformative change to avoid the destruction of nature, some of which the five pathways refer to. With regard to incentives and capacity building (lever 1), the *Farming Story* and *Vision* pathways focused on environmental education, e.g. about the benefits of tree plantings, and education through community-based organisations. With regard to cross-sectoral cooperation (lever 2), the *Spider Webs* pathway pointed to the need for integration of biodiversity and soil carbon projects across administrative levels. This lack of integration

between agricultural and conservation policies in Australia has been identified elsewhere (e.g. Bardsley et al. 2019). Our findings highlight how this lack of coherence is perceived to be a barrier for change on the ground. Carbon credits as a form of environmental policy (lever 5) were brought up as enablers for change by two groups. Research shows that in addition to storing carbon in the soil, vegetation projects can improve biodiversity outcomes if they are well designed (Standish and Prober 2020). Our findings highlight a willingness among farmers to engage in carbon farming and tree planting and suggest an underexplored potential for synergies.

Dealing with a diversity of perspectives and values

Our application of the three horizons approach is specifically designed to include a range of different perspectives and problem framings. Guided by the overarching workshop question, participants could explore the plethora of topics relevant for their community, thus opening up their thinking to various issues, visions and innovations which was vital for the subsequent development of different pathways. Although the overarching question for the workshops was framed around community well-being, profitable farming, and rich biodiversity, the number or exact nature of narratives was not pre-defined. As researchers, we designed the guiding questions, the structure of the storytelling and clustered emerging topics. However, the workshop process was highly participatory, giving participants the freedom to explore a vast array of different change dynamics. Pereira et al. (2018) argue that imagination, a diversity of viewpoints and storytelling are important for creating spaces for transformative thinking. The questionnaire responses in our case suggested that the workshops were successful in fostering creativity and imagination and offered participants a useful process to think about the future. We found that combining three horizons with a storytelling approach provided a space to discuss current issues, sketch multiple visions and elicit pathways towards them. Peoples' imagination is influenced by how the social and natural world are experienced by individuals (Moore and Milkoreit 2020) and groups of participants that worked on the pathways were self-selected. The narratives of change elicited through the storytelling exercise thus revealed shared ways to identify meanings about key issues and how those can be overcome (c.f. Veland et al. 2018).

Feedback provided by participants through the questionnaires suggests that dealing with complexity and integrating different perspectives fully into the discussion remained challenging. An option to further explore tensions and trade-offs between different perspectives in the transitional space between the first and the third horizons could be through tools such as dilemma thinking (Sharpe et al.

2016). Moreover, our workshop approach could be extended by exploring areas of convergence and divergence across the different pathways (e.g. Harmáčková et al. 2021) to identify how the different pathways mutually reinforce or hinder each other. Whilst this might have helped to better address value conflicts, we do not want to suggest that the pathways are mutually exclusive or that any one pathway necessarily negatively impacts on another pathway. The pathways can be pursued simultaneously and there is potential for synergies among them. Our template could be extended to include a session to further test and explore the pathways, and their different aspects could be recombined or integrated into new emergent pathways. This could have been achieved by exploring common aspects between the pathways (e.g. Raudsepp-Hearne et al. 2020), thus highlighting similar change rationales and shared values. For example, there are areas of overlap regarding increasing more direct selling to consumers, more networking and support for community-based organisations.

The pathways explored by our participants highlight system dynamics that are mostly within the control of individuals or the community in the focal system. In the pathways, some of the identified drivers are beyond the control of individuals, e.g. increasing policy coherence in the *Spider Webs* pathways, but in most pathways individuals or the community play a key role for change, e.g. in the *Vision* and *Farming Story* pathways. The storyboards and narratives that the groups presented reflect shared expectations, goals and values pertaining to the future. This can help create agency and collective action (Galafassi et al. 2018; Charli-Joseph et al. 2018) and such collective sensemaking is important to prepare for change in social–ecological systems (Moore et al. 2014; Olsson et al. 2006). For example, narratives can be a powerful tool to engage other people if the narrative, and thus how problems and solutions are framed, resonate with other peoples' experiences and understandings (c.f. Wittmayer et al. 2019). To ensure that workshop outcomes provide a resource for future action, they were documented in detailed workshop reports and form part of a printed project booklet with policy recommendations (Schaal et al. 2022a). The booklet includes the artworks created by the local artist and thus offers an additional means of engagement with the three horizons. The structured yet highly participatory nature of the workshop approach described in this paper makes it a suitable approach to meet calls to include plural values of biodiversity (c.f. Pascual et al. 2021).

Creating actionable knowledge

Actionable knowledge—i.e. "knowledge that enables action, or intervention, in concrete situations" (Bartels 2012, p. 435)—plays an important role not only in transformation research (Wittmayer et al. 2018), but also in conservation

on privately owned land (Cortés Capano et al. 2019). Such knowledge provides insights into the different options available and supports decision-making about actions (Hölscher et al. 2021). Our use of storytelling to articulate desired future pathways created actionable knowledge driven by inspiration and positive thinking. This positivity enabled discussions about concrete activities during the workshops and feedback from participants and from the Landcare Group afterwards highlighted that the pathways could be used for strategic planning and as design criteria for future community projects. We are also aware that the Landcare Group has applied for funds to pursue actions that were discussed at the workshop, and subsequently further developed. Additionally, the six project narratives propose concrete interventions and innovative approaches at the individual and collective level. However, establishing consequential links between research and social impact is challenging (e.g. Hölscher et al. 2021). Since the conclusion of the workshops, we have not evaluated which on the ground actions are a direct result of the two workshops. Nevertheless, discussions with people from the study area during and after the workshops suggested that the workshops and the three-year research project in which they were embedded increased awareness about the topic of biodiversity in farming landscapes among people in the area and that the workshop process is a stepping stone for future on the ground activities.

Despite contributing to increased awareness about the topic, the questionnaire responses related to empowerment and future thinking point to limitations of our approach in terms of future literacy, i.e. "the capability of offering insights on how to approach unforeseeable challenges by using the future to innovate in the present" (Pereira et al. 2019b, p. 9). Whilst developing a future vision is important to prepare for change, navigating the transition requires selecting which innovation or activities should be taken up (Moore et al. 2014). Effective leadership is an important element for conservation action (Sterling et al. 2017) and it helps preparing for and delivering change (Olsson et al. 2006). Discussions during and after the workshops confirmed that leadership, e.g. by governmental agencies, and provision of financial resources are critical for bringing about the changes described by the pathways. However, our research team's resources were limited because the workshops were part of a research project with pre-defined aims and a set timeframe. Such time-limited project contexts present challenges in terms of trust building, inclusion of all relevant stakeholders, and reflection that enables ongoing learning and delivery of the project's longer-term desired outcomes (Allan 2012; Papp et al. 2022). Our experiences in applying the three horizons framework with storytelling indicates that while it was very useful to explore a range of (management) options at the local level, it does not produce strategies and actions as directly as backcasting does

(c.f. Hichert et al. 2021). The workshops and their outcomes do, however, offer multiple points to engage with change, allowing different people depending on their values, skills and agency to decide where and how they will engage. For example, this might be experimenting with innovative ideas, nurturing existing seeds of change or just maintaining good aspects that should not be lost. This highlights that the approach described in this paper is particularly useful for scoping and eliciting different context-specific opportunities for systems change.

Researchers applying our three horizons storytelling workshop template in other contexts could devote extra time to identifying next steps and assign responsibilities for implementation of the project ideas. The three horizons framework focuses on how transitions can be managed (Sharpe et al. 2016). To further increase the operationalization of the pathways, researchers applying our suggested workshop guide could include an additional workshop session for developing sequences of activities, identifying how those are linked to the levers of change, and assigning responsibilities which could support the community in developing a theory of change (see also Colloff et al. 2021). In our case, increasing this action-oriented planning focus would either have been at the expense of existing workshop achievements or require increased time commitment from the project team and participants. We instead encouraged the action agenda to be developed by organisations who had sent representatives to the workshops. Indeed, our experiences from the application of the three horizons approach suggests two key criteria for selection of participants. Stakeholders should not only be selected to represent a broad range of perspectives on the topic. More strategically, local change agents, community leaders and actors that can institutionalise the workshop outcomes should be invited to help increase the potential for post-workshop pursuit of actions inspired by the future visioning activities. Embedding the workshop process and the research project in a longer-term project or local program and institutionalising the workshop outcomes, e.g. with the local Council, could be important aspects to ensure that the three horizons workshops serve as stepping stones for a longer-term agenda of community change and not a one-off exercise.

The role of governance and policy context

Aspects relating to governance and policy were seen as both barriers and enablers of change across almost all pathways. The governance context can enable sustainability transformations by, for example, supporting the emergence of markets for innovations, but can also provide a barrier for transformation, e.g. because regulations influence what is more or less profitable (Pereira et al. 2021). Though barriers and enablers were discussed at

the second workshop, a session identifying innovations that help transition to the third horizon and innovations that lead back to the first horizon respectively—so called H2 + and H2− (Sharpe et al. 2016)—could have helped further identify drivers strengthening the current system and hindering system change, a reflective exercise that would have strengthened action planning. The pathway narratives reflect different problem framings and propose subsequent solutions to address those issues. Governance processes influence which narrative(s), i.e. pathway(s), become(s) dominant by framing the system, the goals and problems in a certain way (e.g. Leach et al. 2010). For example, Pigott (2018) analysed imaginaries about socio-ecological transformations in Welsh government policy and highlighted how the concept of resilience, framing of time and notions of crisis provide opportunities and obstacles for buy-in from local people and opportunities for alternative imaginaries to occur. The three horizons approach can be viewed as an enabling approach in sustainability transformations in that it helps communities develop pathways into positive futures and thus engage with collective action (c.f. Scoones et al. 2020). However, as Scoones et al. (2020) note, such approaches may fail to integrate structural or political obstacles to transformations. This points to challenges related to cross-scale governance to bring about change. In our study, cross-scale governance mechanisms and advocacy to influence funding policy and funding priorities may be required to see substantial actions on the ground. Such actions could create incentives and reduce the risk for individual farmers.

Conclusions

In view of the projections of future ecological and social decline, novel, inspirational and positive futures are urgently needed to provide direction for change and help build momentum for collective action. We showed how combining three horizons with a storytelling approach can be used to create pathway narratives towards positive futures that bring about improved biodiversity outcomes. We applied our approach with a farming community in south-eastern Australia. We unpacked the resulting narratives of change to show differences in how problems are framed, how desirable futures are imagined and how technological, institutional, and social changes can lead to desired outcomes. Across the pathways, a recurring theme involved disconnects in the system, with the pathways highlighting ways to (re-) build connections. This referred to connections between farmers and consumers, between rural and urban areas, with the land and the landscape, and between different policies.

Though the pathways narratives are specific to the south-eastern Australian farming context, they highlight opportunities for improving conservation outcomes in farming landscapes, such as carbon offsetting mechanisms and environmental education. By fostering collective sensemaking about key issues and desirable futures, our research approach may help the rural community in our study area to prepare for change. Moreover, the workshop process and the resulting six narratives of change created actionable knowledge about the options that individuals and the community have available to shape the future they want. However, the pathways also showed inhibitors for innovation and change, in particular local leadership and the policy and governance context.

Author contributions Conceptualisation and methodology: TS, MM, BCS, PR, JH; investigation: MM, BCS, PR; formal analysis: TS, MM, BCS, PR, JH; writing—original draft preparation: TS, JH; writing—review and editing: TS, MM, BCS, PR, JH; funding acquisition: JH; supervision: JH.

Data availability The transcripts of the workshops analysed for this article are not publicly available due to participants being promised confidentiality as part of their informed consent. When all information that could identify individuals or their organisation is removed from these transcripts, they no longer have much value as research data due to the context-specific nature of the information. The questionnaire data is available in the Supplementary Material.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical statement The research was approved by the Human Research Ethics Committee of the Australian National University protocol number 2019_913. All workshop participants were familiar with and provided oral consent confirming that they were sufficiently informed about the content of the research, were willing to participate in the project, agreed with further use of workshop materials for research purposes, and agreed to be audio-recorded.

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