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Transformational adaptation on the farm: Processes of change and persistence in transitions to 'climate-smart' regenerative agriculture

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ABSTRACT

Regenerative agriculture, an alternative form of food and fiber production, concerns itself with enhancing and restoring resilient systems supported by functional ecosystem processes and healthy, organic soils capable of producing a full suite of ecosystem services, among them soil carbon sequestration and improved soil water retention. As such, climate change mitigation and adaptation are incidental to a larger enterprise that employs a systems approach to managing landscapes and communities. The transformative potential of regenerative agriculture has seen growing attention in the popular press, but few empirical studies have explored the processes by which farmers enter into, navigate, and, importantly, sustain the required paradigm shift in their approach to managing their properties, farm businesses, and personal lives. We draw on theories and insights associated with relational thinking to analyze the experiences of farmers in Australia who have undertaken and sustained transitions from conventional to regenerative agriculture. We present a conceptual framework of "zones of friction and traction" occurring in personal, practical, and political spheres of transformation that both challenge and facilitate the transition process. Our findings illustrate the ways in which deeply held values and emotions influence and interact with mental models, worldviews, and cultural norms as a result of regular monitoring; and how behavioral change is sustained through the establishment of self-amplifying positive feedbacks involving biophilic emotions, a sense of well-being, and an ever-expanding worldview. We conclude that transitioning to regenerative agriculture involves more than a suite of 'climate-smart' mitigation and adaptation practices supported by technical innovation, policy, education, and outreach. Rather, it involves subjective, nonmaterial factors associated with culture, values, ethics, identity, and emotion that operate at individual, household, and community scales and interact with regional, national and global processes. Findings have implications for strategies aimed at facilitating a large-scale transition to climate-smart regenerative agriculture.

1. Introduction

The last decade has seen growing interest in the global change research community in incorporating insights from the environmental humanities and social sciences into understanding of transformations to sustainability (International Council for Science (ICSU), 2010; Chapin et al., 2010, 2011; Folke et al., 2011). Research on transformational adaptation, for example, has primarily considered the role of technologies, institutions, policies, incentives, social movements, and financial systems in sustainability transitions of various types (Kates et al., 2011; Park et al., 2012; Rickards and Howden, 2012; Dowd et al., 2014). With some important exceptions, there has been less attention paid to subjective, nonmaterial dimensions of transformation associated with beliefs, values, emotions, worldviews, structures of meaning-making, and consciousness more generally (but see Adger et al., 2009, 2011; Brown et al., 2019; Castree et al., 2014; Castree, 2015; O'Brien and Wolf, 2010; O'Brien, 2012, 2013; Hulme, 2014; Marshall et al., 2019, 2012). Fresque-Baxter and Armitage (2012, 251) argue that "further effort is required to develop and test frameworks that facilitate a systematic examination of the subjective attributes of climate change adaptation." These attributes comprise the crucial (but understudied) "middle bit" (Macy and Johnstone, 2012) between perception/awareness on one hand and behavioral change involving inspiration, enthusiasm, curiosity, and other subjective nonmaterial aspects on the other, alluded to but not fully developed in literature on cultural aspects of adaptation and transformation (Adger et al., 2013; Brown et al.,

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2019; O'Brien, 2013; Moser, 2012; Hulme, 2014). Such research has the potential to further elucidate links between perceptions of climate change and effective mitigation and adaptation (Clifford and Travis, 2018).

The type of integrative, transdisciplinary research called for demands a more robust elucidation of processes of social-ecological transformation, and a new kind of evidence base including subjective as well as objective forms of knowledge. Such research has the potential to reveal innovative yet practical interventions, including new approaches to facilitating transformative learning (Armitage et al., 2008) and the making of earth stewards, challenging conventional notions of "actionable" research (Castree, 2015).

To facilitate exploration of the role of these subjective dimensions of transformation we adopt a framework that delineates three 'spheres' of transformation – practical, political, and personal (Sharma, 2007; O'Brien and Sygna, 2013). More specifically, we examine the argument that the personal sphere is especially critical to understand since transformations in the personal sphere have more powerful consequences than transformations in other spheres. That is, personal transformations "shape the ways that the systems and structures (i.e., the political sphere) are viewed, and influence what types of solutions (e.g., the practical sphere) are considered 'possible'" (O'Brien and Sygna, 2013, 5; Table 1). Understanding transformation requires improved insights regarding interactions among the three spheres and the different sustainability outcomes they produce.

This paper contributes new insights to existing knowledge on transformational adaptation by focusing on the ways in which farmers produce food and fiber. A growing number of scholars argue that a fundamental transformation in agriculture is needed encompassing economic, social, and psychological dimensions of decision-making aimed at enhancing the overall resilience of the social-ecological systems in which farms and farmers are embedded (Howden et al., 2007; Stafford-Smith et al., 2011; Marshall, 2010; Marshall et al., 2012; Park et al., 2012; Rickards and Howden, 2012). Knowledge and understanding regarding how and why transformation at the farm scale occurs is limited, however (Marshall et al., 2012; Park et al., 2012). A key need is greater understanding of processes of change in agricultural production systems that facilitate the "adaptation journey" – not only adaptation actions, but the factors that shape actors' decision-making regarding actions that could lead to "longer term, strategic transformative change in all levels of agricultural production systems" (Park et al., 2012, 116). Hayman et al. (2012) also point to the value of studies focused on local farming systems aimed at linking research on soils, plants, and animals with societal and landscape scale aspects of climate change adaptation.

We seek to contribute to this conversation by documenting and analyzing the experiences of sheep and beef farmers in Australia who have undertaken and, more importantly, sustained fundamental transformations from conventional to regenerative, 'climate-smart' agriculture that supports climate change mitigation as well as adaptation involving both cognitive and behavioral change driven by regular monitoring and embodied, experiential learning. We build on recent Australian research that examines the importance of communities of practice in agro-ecological innovation (Cross and Ampt, 2016) and processes associated with farmer innovation (McKenzie, 2013). We similarly focus on farm-level experiences but consider these through the prism of transformation, defined by O'Brien (2012, 670) as "physical and/or qualitative changes in form, structure or meaning-making" that can also involve "psycho-social process[es] involving the unleashing of human potential to commit, care and effect change for a better life." In particular we consider the ways in which change in the practical sphere is influenced by fundamental transformation in the personal sphere associated with the adoption of a holistic approach to planning and decision-making and a shift to resilience thinking (Folke et al., 2010). We also consider the importance of negotiations in the political sphere that shape norms and institutions, particularly those that dictate what it means to be a "good farmer" (Burton, 2004, 2012).

We draw on theories and insights from recent sustainability transition research to examine the processes by which farmers enter into, navigate, and sustain a paradigm shift in their approach to managing their properties, farm businesses, and personal lives, and present a conceptual model that illustrates what we see as a regenerative, self-sustaining process of learning, change, and growth. We consider triggers that catalyze reconsideration of their approach to farming (and life more generally); conditions and experiences that influence awareness of and receptivity to an alternative management paradigm; and strategies, resources, and cognitive habits that support *and* sustain the transformation process. Our framework draws on the idea of "zones of friction and traction" (Head et al., 2013) across personal, practical, and political spheres of transformation to serve as a tool to delineate key areas or points at which transformation and the persistence of new thinking and practice is facilitated or impeded (Westley et al., 2011). Sources of friction and traction, which include ecological, economic, social, and psychological factors, mediate the process of transformation across all three spheres (Fig. 1). In regard to the personal sphere, our findings illustrate the ways in which deeply held values and emotions influence and interact with mental models, worldviews, and cultural norms as a result of regular monitoring leading to transformational learning experiences; and how behavioral change is sustained through the establishment of new positive feedbacks involving biophilic emotions, a sense of well-being, and an ever-expanding worldview. We present a conceptual model that illustrates how these self-amplifying feedbacks support persistence on the regenerative agriculture path (Fig. 2). Our findings also contribute new knowledge about the ways in which transformation can be catalyzed through "induced epiphanies" resulting from the holistic decision-making process commonly used by regenerative farmers.

Before delving into results, we first review methods and provide an

Table 1
The spheres of transformation and their characteristics (O'Brien and Sygna, 2013, 4–6).

	Practical	Political	Personal
Definition	"The practical sphere represents both behaviors and technical solutions" – the 'outcome' sphere"	"economic, political, legal, social and cultural systems"	"where the transformation of individual and collective beliefs, values and worldviews occur"
What does it encompass?	"changes in management practices, the introduction of new technologies, and socio-technical and cultural innovations. It also includes changes in strategies, practices and behaviors"	Where the "rules of the game" are set; "where social movements, collective action campaigns, lobbying, electoral politics, and revolutions respond to them, and where threatened interests resist or quash pressures to change"	"Discourses and paradigms emerge…influence the framing of issues, the questions that are asked or not asked, and the solutions that are prioritized in the political and practical spheres"
Role in transformation	By itself can be an ineffective lever for system change; pathways/options limited by the other spheres	Represents the "enabling/disenabling conditions"; defines the constraints and possibilities for transformation	Changes here generate different ways of "seeing" and influence the parameters of the possible in the practical sphere

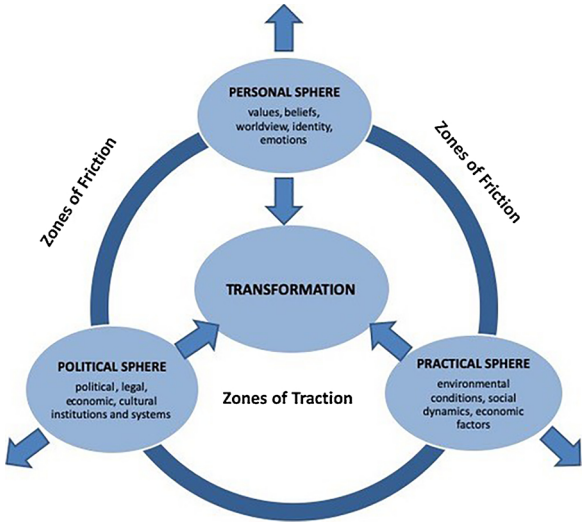

Fig. 1. A diagram depicting the conceptual framework guiding our analysis. Transformation takes place in personal, political, and practical spheres, and is often catalyzed by crises which "open the gate", creating openings for change. Zones of friction and traction exist in all three spheres of transformation, impeding and/or facilitating the transformation process.

overview of principles and practices associated with climate-smart, regenerative agriculture. We then introduce a number of theories and concepts from relational thinking in geography that have relevance to nonmaterial, subjective aspects of transformation processes involving farm management, and present our conceptual framework. Our discussion focuses on interactions between the personal, political, and practical spheres and the significance of personal dimensions to sustainability transformations. We conclude with a consideration of what these findings mean for the larger project of transforming agricultural systems.

2. Methods

Methods included semi-structured interviews, participant observation, and document analysis. Interviewees were selected through purposive sampling (Bernard, 2006) informed by suggestions from representatives of various relevant farmer organizations. Initially we asked for the names of people involved in 'climate-smart' agriculture, people who self-identify as 'carbon farmers' and/or people who are seen as innovators in the area of regenerative agriculture. As it turned out, the large majority of people to whom we were directed self-identified as 'regenerative farmers' and/or 'Holistic Management practitioners' rather than carbon farmers, since their interests all went well beyond soil carbon sequestration to include managing for overall farm resilience in anticipation of climate change or any other number of shocks and disturbances.

Since so many of our interviewees were practitioners of Holistic Management (HM; Savory and Butterfield, 1999, 2016) or variants of it, we included in our study a number of HM educators who offer in-depth training to farmers to gain insight into their approach and their students' experiences transitioning out of conventional farming. With the exception of one, all of the educators we interviewed were also practicing HM sheep and beef farmers. In our presentation of results, we indicate whether interviewees were farmers (F), or farmer-educators (FE). While we use the term 'farmer' to refer to the interviewees, the primary business of all our interviewees was grazing sheep or cattle. In the U.S., they would generally be termed 'ranchers' while in Australia, such temperate zone landholders could also be referred to as 'graziers'.

Interviews covered farmer decision-making and behavior and were informed by concepts such as identity, trust, ideology, emotion, and transformative learning (Burton, 2004; Burton and Wilson, 2006; Adger et al., 2011; Scannell and Gifford, 2010; Mezirow, 2000). Questions focused on farmers' management philosophies; how they came to be interested in alternatives to conventional agriculture; the nature of their transition and how they experienced that; the benefits, challenges, and everyday practices associated with their new approach to farming; the social networks on which they relied for support and information; and their thoughts on how a more adaptive approach to agriculture might be scaled up and mainstreamed. We interviewed to the point of saturation, 28 interviews throughout the "wheat and sheep belt" of the state of New South Wales (NSW), Australia. Interviews lasted from one to three hours and were conducted primarily in person, with a few telephone interviews. Interviews were recorded and transcribed and detailed field notes were written following each interview. Analysis of the interviews was conducted using a thematic analysis approach whereby repeated coding, sorting, and categorising were conducted using NVivo qualitative analysis software (Miles and Huberman, 1994; Patton, 2002; Maxwell, 2005; Creswell, 2009). Exemplar quotes in the Results section shed light on recurring themes we identified.

3. Conceptualizing the transition to climate-smart, regenerative agriculture

Transformation on agricultural landscapes is critical to understand since conventional agricultural practices have been linked with various processes of global environmental degradation, including land use changes associated with soil erosion, desertification, and climate change (Thornton and Herrero, 2014). Transitions to more climate-friendly forms of agriculture have the potential to support ecosystem-based adaptation to climate change as well as mitigation through soil carbon sequestration (Lal, 2015; Scherr et al., 2012; Paustian et al., 2016; McHenry, 2009; Olsson and Ardo, 2002; Lipper et al., 2014).

In support of such a transition, the Food and Agriculture Organization (FAO) of the United Nations coined the term "climate-smart agriculture" (CSA), which refers to a "toolbox" of principles and practices aimed at facilitating "a significant transformation in order to meet the related challenges of achieving food security and responding to climate change" (Food and Agriculture Organization of the United Nations (FAO, 2010a, 2010b, 2013, ii). CSA is increasingly seen as a

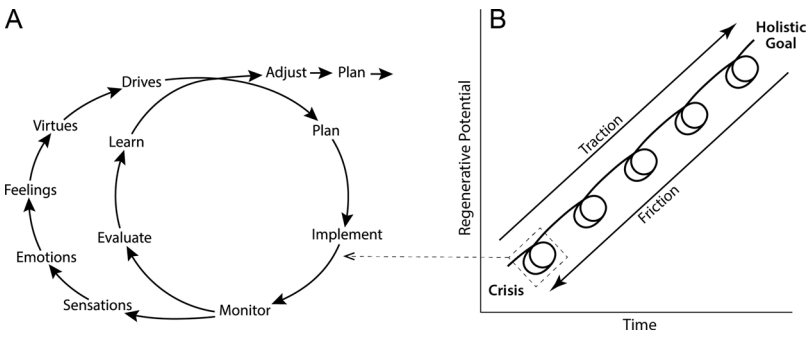

Fig. 2. Conceptual model of transformation associated with adoption of regenerative agriculture. Feedbacks associated with daily monitoring occur in both cognitive and emotional spheres and drive adaptive/proactive management (Fig. 2a). Over time, self-amplifying positive feedback loops fueled by traction in personal, practical, and political spheres increase regenerative potential, leading to persistence and alignment with one's most deeply held values. Friction in these spheres can impede the growth process (Fig. 2b).

means to reduce the vulnerability of farmers to climate change. Topics of particular concern in the burgeoning CSA literature include crop physiology and genetics, livestock management, nitrogen management, energy and biofuels, water management, and strategies for improving soil quality (Lipper et al., 2014; Scherr et al., 2012). We seek to contribute to the CSA dialogue by elucidating the ways in which regenerative agriculture transcends CSA in terms of triple bottom line sustainability considerations.

3.1. Regenerative agriculture

Since practices that support climate change mitigation and adaptation do not necessarily preclude the use of synthetic fertilizers and other chemicals, there have been efforts among supporters of more ecologically-oriented approaches to CSA to differentiate themselves in terms of their commitment to soil regeneration and, in some cases, a larger purpose, which has an ethical element (Neufeldt et al., 2013; Soloviev and Landus, 2016; Rhodes, 2017). Variously identified with ecological agriculture, biological agriculture, conservation agriculture, permaculture, Holistic Management, and carbon farming, the umbrella concept of "regenerative agriculture" goes above and beyond CSA in that its focus is on enhancing and restoring holistic, regenerative, resilient systems supported by functional ecosystem processes and healthy, organic soils capable of producing a full suite of ecosystem services, among them soil carbon sequestration and improved soil water retention. As such, climate change mitigation and adaptation are incidental to a larger enterprise that employs a systems approach to managing landscapes and communities.

The regenerative agriculture movement originated in the 1980s and has, in recent years, grown into a "soil revolution" of sorts as consumers as well as producers increasingly support regenerative products and respond to emerging niche markets and certification schemes[1] (Montgomery, 2017). The term was originally coined by Robert Rodale, who saw the need for an approach that would not merely "sustain" dysfunctional approaches to food and fiber production that destroy and deplete resources but rather improve and regenerate the resources it uses: "a holistic systems approach to farming that encourages continual innovation for environmental, social, economic and spiritual well-being" (Francis and Harwood, 1985). Soloviev and Landus (2016) identify different levels of regenerative agriculture, saying that at its best it is "an ecosystemically vibrant, socially equitable, culturally diverse, and spiritually meaningful global system of regenerative potential." There are a number of organizations around the globe that promote regenerative agriculture in its various forms (e.g., Soil Health Institute, Common Ground, Terra Genesis International, Savory Institute, The Real Organic Project, Carbon Underground).

This more holistic way of thinking about farming deserves attention, since, as we argue in this paper, its rewards provide positive feedbacks that sustain commitment to CSA (Fig. 2), and, following Chapin et al.'s (2009) logic, sustaining the adoption of climate-smart practices may be difficult without the shift in thinking and larger purpose associated with regenerative agriculture. Proponents of a transition to climate-smart agricultural landscapes should invest in understanding what facilitates the shift in thinking, since the climate-smart practices will logically follow, rather than trying to merely incentivize new practices with rational arguments about climate change mitigation and adaptation, or payments for enhanced soil carbon sequestration associated with carbon markets, which may have more limited or temporary success (Gosnell et al., 2011).

Most climate-smart practices have to do with leveraging ecosystem processes to increase soil organic matter and soil biodiversity which serves the dual purpose of fostering forage growth without chemicals and increasing water holding capacity in order to reduce vulnerability to droughts and floods. Managing soil carbon is a major focus and is accomplished through a number of techniques including reducing or eliminating tillage; increasing soil organic matter through spreading compost; planting cover crops to reduce bare ground (and tolerating weeds); and diversifying crops to reduce vulnerability to disease and pests (Toensmeier, 2016; Montgomery, 2017; Brown, 2018). Regenerative farmers also reduce or eliminate the use of chemical inputs such as synthetic fertilizer, herbicides, and pesticides, and those with livestock typically use strategic (or holistic) planned grazing to increase soil biodiversity, soil moisture retention, soil fertility, and soil carbon, moving livestock frequently between habitats and across elevational gradients to follow optimal forage conditions as they shift during the growing season (Teague and Barnes, 2017; Scherr et al., 2012; Fynn, 2012; Briske et al., 2011; Waters et al., 2017).

Managing grazing to promote deep rooted native perennial grasses and reduce bare ground is beneficial (Diaz et al., 2009) because root biomass is essential for the many adaptive capacities that soil offers on rangelands. In most cases, managing for root biomass means keeping grazing at levels that encourage rather than suppress plant productivity (Diaz et al., 2009), but managing these systems necessitates an understanding of the local spatial heterogeneity, soil morphology, and social ecological context in which grazing is occurring (Briske et al., 2011; Sherren et al., 2012; Teague et al., 2013; McSherry and Ritchie, 2013; Hodbod et al., 2016).

Like their counterparts around the world, regenerative farmers in Australia engage in many of these practices and this is what sets them apart from conventional graziers in the region (Massy, 2017, Sherren et al., 2012, Doherty and Jeeves, 2016). Conventional agriculture in Australia is characterized by dependence on inputs including superphosphate, pesticides, herbicides; use of heavy machinery; and land clearing aimed at eradicating native vegetation (Evans, 2016). The vast majority of Australian farmers remain engaged in productivist forms of agriculture (Argent, 2002; Holmes, 2012; Dairy Australia, 2012; Lawrence et al., 2013; Bell et al., 2014; Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), 2016).

The rift between conventional grazing practices and those that purportedly promote soil regeneration suggests the need for a different way of thinking about the landscape and the farmer's relationship to it. While the aforementioned practices are likely to improve soil conditions and enhance resilience to climate variability involving both drought and floods, most agree that being climate-smart involves more than a set of management actions; it necessitates understanding major ecosystem processes and adhering to a set of principles associated with resilience thinking, systems thinking, and design thinking (Walker and Salt, 2006). Olsson et al. (2014) argue that for a system to be sustainable there must be functional feedback loops between social and ecological systems involving increased attention to ecosystem processes, and an attendant understanding of how to monitor and respond to feedback. Land managers need to think about "designing" their landscape in a holistic, integrated way so as to fully utilize local spatial variability by managing land use interactions at a landscape scale (i.e., across public/private boundaries); they track social and ecological change to determine if social and climate goals are being met at different scales (Scherr et al., 2012). In a special issue of *Rangelands* on "Strategic Grazing Management for Complex Creative Systems," Provenza et al. (2013) observe that being adaptive and resilient in the context of a ranching enterprise means that instead of relying on grazing prescriptions, truisms, and "rules of thumb," ranchers must recognize that management is a process involving ongoing creative responses to dynamic, ever-changing assemblages of lifeforms.

Montgomery (2017) notes that regenerative farmers "see" soil differently, as a biological system rather than a chemical reservoir and this is why they work to support subterranean life rather than kill and

[1] Certification schemes associated with regenerative agriculture include the Savory Institute's Land to Market Program https://www.savory.global/land-to-market/ and the Rodale Institute's Regenerative Organic Certification https://rodaleinstitute.org/regenerativeorganic/.

replace it, fostering a "subterranean symbiosis" between mycorrhizal fungi and plants in order to bring soil back to life. They also think differently about water – drought is not just determined by what falls from the sky, it has to do with what is in the soil and whether the ground can hold water. Rather than reactively depending on precipitation, regenerative farmers proactively manage landscape and soil processes to improve water storage and availability, e.g., through keyline farming (Doherty and Jeeves, 2016).

Regenerative farmers value animals not just for the food and fiber they produce, but (primarily) for their role as a tool to build soil (Teague et al., 2016). Livestock breeds are chosen for their compatibility with local environments in order to improve forage utilization across elevational gradients and spatial heterogeneity (Steenwerth et al., 2014). Dryland-adapted breeds such as Corriente or Criollo cattle are often used as they have been shown to use the landscape differently, especially in areas of poor or low forage and to access and use water resources differently (Anderson et al., 2015).

As stated above, many farmers who embrace principles and practices associated with regenerative agriculture have been trained in Holistic Management (HM) as conceived of by wildlife biologist Allan Savory (Savory and Butterfield, 1999, 2016), or various offshoots such as Grazing for Profit. Indeed, as we argue in this paper, the strategies used by HM educators and mentors to help farmers align their behaviors and decision making with their values and long-term goals and understand the role of functioning ecosystem processes in the attainment of those goals are key enablers of transformation in personal, practical, and political spheres.

3.2. Conceptualizing processes of transformation and persistence

How do routine dispositions, norms, ways of "seeing", and associated practices that have bearing on practices (the practical sphere) come to be disrupted to the point of change, and what needs to be in place in the personal and political spheres for this to happen? For agriculture, including regenerative agriculture, there remains a dearth of insights into cognitive and behavioral change associated with adopting and sustaining these approaches as part of transformative rather than incremental change (Darnhofer et al., 2016). Indeed, existing understandings of farm units, farmer agency and decision-making processes, socio-cultural contexts, and biophysical elements of farms, and their collective interrelationships and influence on policy, programs, and practice may themselves be complicit in fostering incremental change where transformative change might otherwise occur or be considered (Darnhofer et al., 2016; Panda, 2018). Incremental, rather than transformative change, is fostered because the focus, variously, is on addressing existing preferences and goals, adapting to preserve existing systems and social relations, maintaining stability, delineating relations of cause and effect in farming and farmer decisions, and achieving rational choice among predetermined options (Darnhofer et al., 2016). Collectively, existing approaches treat nature and culture as separate, treat the environment as a backdrop, tend to treat the farm as a bounded entity, and focus on human agency only. This narrow, reductionist focus obscures the myriad and intertwined everyday and episodic relationalities with nature that are central to constituting and iteratively renewing and reshaping farmers' identities and relationships to land, farms, plants and animals (Gill, 2014; Herman, 2015). In contrast, a relational approach positions the farm and farming as being comprised and iteratively shaped by diverse processes, actors (humans and non-humans), and entanglements, all of which exist and occur at various scales and temporalities (Darnhofer et al., 2016; Carolan, 2017; Gill, 2014; Head et al., 2011; Higgins et al., 2017).

This relational turn in agricultural research has many parallels with research into the adoption of sustainability practices more generally. Similar to some adoption research in farming (Pannell et al., 2006), household sustainability researchers, for example, have asked why households do not adopt practices that lead to reduced water use and energy consumption that, for those promoting them, appear rational and straightforward (for example see Gibson et al., 2013; Shove, 2003). These scholars ask us to consider the consequences of framing sustainability campaigns around incremental steps to 'responsible consumption' rather than more transformative measures that might question the very social and economic role, ethics, and politics of consumption (Gibson et al., 2013; Hobson, 2006). A significant thread in this rich body of research has been to question conceptions of the household as an undifferentiated, bounded site of rational decision-making and to instead conceive of it in relational terms.

In household research, this means understanding household decisions and actions as facilitated or constrained by networks comprised of social, cultural, and financial relations, as well as the materiality and agency of existing and new technologies, design, materials, and construction (for example see Gill et al., 2015). Critically, the home or household is permeable; it is not a stand-alone unit, but is characterised by flows of energy, commodities, knowledge and information, people, and influences of all sorts across and through porous boundaries (Gibson et al., 2013). A farm can be seen in the same way, and as being brought into being, constituted, by the same kind of flows. The nature of the flows themselves embody the sort of farm it is, the type of farming that is practiced, and the identities of the people who operate it and live there. For a farm, these flows may be debt, income, machinery, advice and information, social norms and expectations, ideas and norms regarding farming practice, consultants, peers, fuel, inputs such as fertilisers or herbicides, stock, and seeds. As these things change in composition and role, the farm changes what it is; transformation on the farm requires dealing with - changing, abandoning, confronting, redirecting - all these flows.

Thus, as with the household, the farm does not exist *a priori*, it does not precede its relations; rather it becomes (Gibson et al., 2013; Darnhofer et al., 2016). At any given point in time, the farm is 'but a stabilized moment in a process of becoming' (Darnhofer et al., 2016, p. 117). In this sense, becoming is an ongoing dynamic process, where the way of being on a farm or while farming is not stable, but a function of relations which are contingent and comprise interactions with multiple objects or beings (Deleuze and Guattari, 1988). Any state of stability depends on these relations being reliably enacted. When this inevitably does not occur, such as when drought or other problems cause the farm environment to cease 'acting' in familiar ways, or when a farmer is exposed to alternative farming paradigms at the right time, the possibility of the farm and farmer becoming something different is opened up.

So, how do these theories help explain how routine ways of doing things, including how one farms, are disrupted such that transformation in practice occurs? In a relational perspective, the process of becoming is not deterministic. Becoming is an outcome of dynamic networks comprised of heterogeneous relationships and actors existing and exerting agency at multiple scales and across time. Analysis of these relations and of their outcomes is not so much a matter of looking for discrete lines of explanation and association – a line of research characterised by inconsistent findings (Burton, 2014) – as analysing how multiple practices and networks collectively work to create, sustain or disrupt particular outcomes or configurations of actors, technologies, and relationships. Thinking in terms of becoming leads us to consider constellations of influence, how actors in their relations constrain and enable practices, or how heterogeneous materialities variously shape knowing and practice (Carolan, 2017; Darnhofer et al., 2016; Gibson et al., 2013; Higgins et al., 2017).

To facilitate analysis that is consistent with such broader and interconnected thinking about influence in relational networks while also seeking to identify potential points of intervention to assist change or, indeed, transformation, Head et al. (2013) have proposed that change in practices or lack thereof can be analysed in terms of zones of "friction" and "traction". Zones of friction and traction are pathways of

decision-making and action where materialities, norms, values, and practices inherent in everyday personal, social, and economic life intersect to shape the form and direction of those paths. Zones of friction can be either "pathways of resistance to more sustainable outcomes, or contradictory practices which entrench less sustainable outcomes. Zones of traction [are] pathways towards more sustainable outcomes" (Head et al, 2013, 6). Friction constrains or hinders transformational change, and occurs where norms, dispositions, and everyday routines do not align with practices that will lower resource use. For example, friction is evident where young adults who identify with "green" attitudes have access to plentiful hot water and are subject to relatively high expectations of cleanliness amid complex daily lives (sport, jobs, study). Cleanliness norms, the complexities of juggling everyday demands, and the material system of hot water provision intersect such that a common pathway of decision and action is to shower several times each day and frequently wash their clothes (Head et al., 2013). The friction that mitigates against more sustainable behavior lies in the relations among their 'pro-environmental' attitudes and the material and social contexts they inhabit - relations that, in this case, generate high levels of water and energy consumption. Conversely, traction facilitates or enables transformational change and can occur where practices of lower resource use line up with norms, dispositions, everyday practices, and material conditions. Traction was seen, for example, in the water saving efforts of Australian households amid the millennial drought. A lack of rain, dying gardens, water restrictions, and the promotion and acceptance of a common need to reduce water use collectively engendered a pathway of developing adaptive capacity in water (re)use, gardening in dry times, and reduced overall water consumption (Head et al., 2013).

Significantly, traction can be seen as occurring with moments of deroutinization – moments of change or crisis, during which relationships and flows can be reappraised, interrupted, and reconfigured to be consistent with changed circumstances, changed or existing values, or insights from self-reflection (Gibson et al., 2013). Such moments might be deaths, births, selling or buying property, moving house, economic change, business fortunes, or environmental changes. Changes that happen at such moments are more likely to be sustained if new routines, norms, identities, emotions, and practices are developed in ways that are internally consistent. For regenerative farmers, this might mean the moment of crisis and reappraisal leading them to new ways of understanding and interpreting their land in daily farm practice and thus farming in ways that are more consistent with their sense of farmer stewardship (Massy, 2017).

For example, as regenerative farmer Charles Massy (2017) argues, "listening to the land" in the manner engendered by regenerative agriculture fosters a reformed sense of connectivity to nature and community, and a renewed sense of partnership with the land that is consistent with farmer stewardship more generally.

By 'telling the story' of their transformational journey the interview participants allowed us to identify commonly mentioned barriers, hurdles and constraints to change, as well as the processes, events and conditions which precipitated, facilitated and enabled change to occur. Tracing the contingent formation and consequences of such pathways across relationally conceived farms and ways of farming is the means by which we identify and delineate various zones of friction and traction and their roles in facilitating or hindering transformation for our interviewees. The process of transforming farming practice or not achieving this is one of farmers navigating conterminous and contingent zones of friction and traction and reaching an outcome. Therefore we were interested not just in a simple 'categorization' of zones of friction and traction, but also in how these zones of friction and traction inter-relate, precede, mediate or influence each other to determine the transformation trajectory. For example, a farmer may experience forms of traction via a crisis as we describe below, be open to change, and be exposed to an alternative but not be able to overcome frictions such as peer pressure or family resistance. Another may have a similar experience but find traction provided through the support of new networks enough to remain on a transformation trajectory.

We propose a conceptual framework (Fig. 1) that draws on friction/traction theory and applies it to the three spheres of transformation to facilitate exploration of these issues. The three spheres are critical to addressing our concern with farm-level, subjective experiences of, and influences on, transformation, i.e. the role of emotions, values, consciousness, and meaning. More than a way to categorise zones of friction and traction as constellations of influence, our framework allows us to explore O'Brien and Sygna's (2013) argument that transformation in the personal sphere is foundational, and critical to transformation more generally.

In our results section, while also considering friction, we focus on how zones of traction in personal, practical, and political spheres create self-amplifying positive feedbacks for the interviewees (Fig. 2). Central to the success of regenerative agriculture for our interviewees is self-sustaining change arising from the interaction of the spheres via zones of friction and traction. Positive feedback in the form of farm and other outcomes inspires further action and long-term persistence, supported not only by a sense of alignment with one's most deeply held values in the personal sphere but also by communities of practice and factors in the practical and political spheres.

4. Results: processes of change and persistence in personal, practical, and political spheres

All of our interviewees had a story to tell about how they came to adopt this form of regenerative agriculture. None of them had started farming in this way. In most cases, their stories involved a significant transformation in both farming practices and mindset from a more conventional approach. This transformation involved not only new management practices but also new mental models and shifts in values, norms, and identity; and changed relations with friends, family, community, and peers. The stories all touched on similar themes, including the factors that triggered the transformation, the challenges, and rewards they encountered in the initial stages, and their strategies for maintaining enthusiasm for this approach to farming over the long run. We discuss the farmers' experiences highlighting some of the more important zones of friction and traction in personal, practical, and political spheres. Table 2 includes a more comprehensive compilation of our findings.

4.1. Friction and traction in the personal sphere

Transformation dynamics in the personal sphere have to do with cognitive processes related to beliefs, values, worldviews, and paradigms (O'Brien and Sygna, 2013) but also with more visceral sensations, emotions, and feelings that relate to virtues, drives, and motivations (Fig. 2a). For the majority of the farmers interviewed, the trigger which opened their mind to the possibility of a different way of managing their property was some form of personal or business crisis, be it environmental, economic, health, or psychological. The crises that the farmers experienced, often a series of events, led to feelings of desperation and vulnerability which forced them to reappraise themselves and their farming practices in a critical light. Economic problems were often related to environmental stressors, such as drought and associated land degradation. It was such seemingly perennial environmental problems and a developing sense that their approach to management was not adequate to deal with them that created space and traction for change.

> *So, it was experiences like that, the drought of '87, the drought of '82, '83, just made me feel powerless, and then we got the big fire in 1990, and then we had eight years of drought. We just didn't get any winter –*

Table 2
Processes and mechanisms influencing graziers' long-term commitment to regenerative agriculture in personal, practical, and political spheres, including zones of friction and traction. Arrows indicate that practical sphere dynamics are influenced by factors in the personal and political spheres.

		Friction	Traction
Personal Sphere		• Fear of change • Habit, tradition • Ego and pride • Lack of willingness to acknowledge past mistakes and damage • Masculine farming culture, identities, and practice • Notions of farming 'success' that lie in production measures • Aesthetics involving preference for a 'tidy' farm	• Experience of an environmental, business, or personal crisis or significant event that "opened the door" • Newfound humility • Questioning one's approach to farming • Articulating a long-term holistic goal • Sense of alignment between values, goals, and behavior • Sense of control from having a plan and tools to enact it • A focus on happiness and relationships • Renewed connection to nature and community • Enthusiasm and renewed interest in one's land associated with a new way of "seeing" the land • The prospect of leaving a legacy • New identity as an earth steward • Sense of 'right livelihood' • Sense of integrity • Less stress, e.g. better relationship with livestock, fewer chemicals • Sense of awe, wonder, empathy for all beings • Better health • More free time
		⇩	⇩
Practical Sphere	Ecological	• Steep learning curve to understand ecosystem processes, get monitoring system going • Challenging to quit chemicals and trust ecological processes • Tolerating weeds • Learning to coexist with predators • Time commitment for daily ecological monitoring	• Observation of soil and pasture improvement • Improved soil moisture retention • Increased resilience to drought • Enhanced presence of native perennial grasses • Fewer problems with weeds • More biodiversity in pastures
	Economic	• Challenge in shifting focus from yield to profit • Initial investment in fencing and water infrastructure, hiring consultants, paying for training • Frequent stocking/destocking • Time commitment for meticulous bookkeeping	• Reduced inputs and expenses • Less financial risk • High value products (nutrient dense, grass finished, organic/low input) • Ability to participate in niche marketing, certification schemes, carbon markets and other 'payments for ecosystem services' • Fewer veterinary expenses
	Social	• Pressure to conform to cultural norms re: farming and what it means to be a 'good' farmer • Peer/industry/family pressure and antagonism • Getting family agreement to change practices • Social isolation and the need to make new friends and colleagues	• Communities of practice and peer support • Sense of community • Ongoing social learning, e.g. microscope clubs • Maintenance of interest and enthusiasm • Conservation awards, public recognition for stewardship
		⇧	⇧
Political Sphere		• Role and influence of conventional agri-business • Farmers lack knowledge to challenge the status quo • Skepticism from research community • Local politics related to peer dynamics • Pressure from representatives of chemical companies, salesmen	• Some supportive government programs and training • Niche markets, consumer demand, certification schemes • Academic degree programs in universities • Tertiary training courses (e.g. NSW Riverina Institute of TAFE) • Network of private training providers • Supportive network of non-profit organizations • Validation of regenerative ag practices by IPCC

> *the normal winter rainfall pattern deserted us, and we just survived on summer storms, and the country was just forever blowing. And I thought, "There's got to be a different way." (F7)*

It was such crises, and interrelated business and personal struggles, which caused farmers to question the way they had been farming. Such moments enabled them to overcome friction, be it associated with the fear of change – the "biggest hurdle" (F6) – or with ingrained ways of thinking associated with the "production paradigm" (F7).

Interviewees came to perceive that their practices did not make sense in light of their personal, environmental, or financial circumstances. This allowed them to be open to change and to different ways of living and of being farmers. As one farmer-educator put it (FE3), these are things that "open the gate", leading farmers to be receptive to alternatives. However, while "opening the gate" to the possibility of change is necessary, it is not sufficient to bring about change; it was not until an alternative vision was presented that transition could begin.

> *The process is not just working out where your discontents are but working out where you want to move towards that would make you content.* (F6)

A critical step for all of the farmers was translating their feeling that past ways of farming did not "make sense" into a realisation that this was because their actions were not in alignment with their most deeply held values. For most interviewees, exposure to HM, either in a public talk or in conversations with peers, provided the needed alternative approach. It also promised a more fulfilling, prosperous life that aligned with their ideas about the kind of farmer they wanted to be. Indeed, most of the farmers interviewed felt that the farming techniques "made sense" to them almost immediately and the introduction to HM

principles was often linked with a moment of epiphany, which inspired openness to the quite radical behavioral and cognitive changes associated with regenerative farming.

> *I was sitting in this room, and when he was talking it was just like little bells going off. Yes! That answers that! This answers that! That's why this is happening! That's why I've got all these weeds! That's why our grazing is not in sync, because we're set stocking when they should be moving*! (FE7)

The quote above underscores the important role that cognitive factors play in the transition from conventional to regenerative farming and elucidates the linkage between learning about ecosystem function and "seeing" the land differently, which results in new mental models, attitudes, beliefs, and, ultimately, behavioral change (Fig. 2). On-the-ground experiential learning involving practical farm assessment also contributed to epiphany, as well as feelings of enthusiasm for the new way. For example, one interviewee related how his initial curiosity about regenerative farming arose from doing some work for a farmer and noticing the excellent condition of his soils. That farmer then visited the interviewee's property:

> *He said, "Let's go for a drive around the property." Which we did, and he saw things that I'd never seen before, and got all excited about it. Dung beetles and grasses that were growing… all these native grasses that I'd never thought anything about – and he was quite enthralled and quite enamoured with what we had. I said, "What are you talking about?" (laughs) And then he started to explain. And I started to, you know – just looking at it completely differently*. (F6)

Once the farmers were open to change and had decided to pursue regenerative farming, they then embarked on a process of learning to "see" and to be farmers differently; in this process, regenerative farmers come to see the interrelationships between themselves, their families, and their land in a new light. Most regenerative farmers go through a similar training process, generally by taking a HM course or working with a farmer-educator, one of whom described the process as follows:

> *Yeah, well I think the process of change is about, you have to de-install some software. And then you have to re-install the new program. Okay, and then you have to debug it and how it interrelates. And part of the new software is starting to understand ecosystems and start to see land ecosystem function and see land in a new light. And it's sort of like "Oh I didn't know that" or "I'd seen that and I didn't know why*." (FE6)

Farmers who take a formal HM course are asked to articulate their most deeply held values and spend time articulating a holistic goal, taking into consideration ecological, economic, and social aspects of their current situation and desired future. In this way, their "success" as farmers comes to be measured not just in terms of their profitability or productivity but also on the amount of time they have available to nurture community and family, or pursue interests and recreational activities. Tapping into emotional drivers, such as the desire to be happy, successful, or respected in their communities, primes the student to envision and work towards a better reality. This explicit articulation of what the farmer wants out of life then drives shifts in behavior and sense of self (Fig. 2). The importance of this experience in their journey to transformation was raised by the majority of the farmers interviewed, and many of the educators talked about their experiences facilitating the goal setting process with students.

> *Let's start with you first and what makes you tick and then let's move in to what you're doing and why and create some meaning around that and a sense of purpose and then let's move in to what's the right production technique and level of profit that you need to keep yourself and your family happy. Not happiness as the last thing but as the first thing.* (FE6)

These feelings and emotions and associated drives and motivations associated with the personal sphere extend beyond individual or family improvements in happiness per se. They also extend into the farmers' sense of morality and the virtues of contributing to a larger purpose through the practice of farming. During their HM training, farmers are encouraged to consider their wider purpose and contributions in life. Perhaps most significantly, farmers reported that adopting holistic decision-making led them to reflect on whether their management practices were in line with their stewardship ethic. Land stewardship is a core value held by many farmers and it is commonly seen as self-evident among farmers, although its forms and relationship to practice are contingent (Burton, 2004; Gill, 2014).

Among our interviewees dissonance between what they said they wanted for the future and what they were doing in the present was a common element to the "crisis" that led them to regenerative farming. The adoption of holistic decision-making facilitated alignment between strongly held stewardship values and farming practice. This alignment itself provides a source of direction, energy, and enthusiasm that sustains them through the work of transformation and of then maintaining regenerative practices.

> *But if you ask those neighbors… what their goal for their farm is, it's exactly the same as mine… And they're all absolutely sincere… they all say the same thing: "I want to leave it in better condition for my grandchildren." But then you look at what they're getting, and it's light years away from what they say they want…That's what Holistic Management makes possible: to actually achieve what you want, because it gives you a decision-making package that makes it possible.* (F5)

Revisiting fundamental goals and values also created space for a new-found humility among farmers which facilitated a willingness to admit past mistakes. Doing so under guidance allowed them to critically examine their management practices, identify dissonance, admit to gaps in their knowledge, to always reflect on their decision-making, to ask if they might be wrong, and to look for new approaches more in keeping with their stewardship ethic. This meant relinquishing a masculine approach to farming based around control, simplification, and domination of nature and embracing a more nurturing management style in which the farmer is decentered.

> *It's becoming humble and accepting that nature's probably more likely to have solutions than we have, or Monsanto has, so it's working with the land and reading the land.* (F11)

Crucially, the HM courses provided space where experienced farmers could put aside pride, make themselves vulnerable, and admit that they did not understand important aspects of their land, including pasture composition. Over time, adoption of new practices led to validation of the new way of thinking and seeing, largely through outcomes that themselves helped maintain the process of transformation *and* supported persistence with regenerative practices through positive feedback, illustrating links between the practical and personal spheres of transformation (Fig. 2).

4.2. Friction and traction in the practical sphere

In our interview material, the personal and the practical can be difficult to neatly delineate. Notwithstanding this, in this section we focus our discussion of the practical on zones of friction and traction associated with behavioral change in the management of ecosystems, finances, and relationships with family, friends, and farmer peers. We highlight tangible outcomes associated with behavioral change that play an important role in validating the shift to regenerative farming and in supporting farmers to persist amid challenges, including those from the political sphere.

4.2.1. Managing ecosystems: reducing inputs and working with nature

Accepting the idea that natural processes rather than a reliance on conventional inputs could support production goals and financial goals was a difficult hurdle for many. Adopting regenerative practices was couched by most farmers in terms of moving from "fighting" the land

and maintaining it in a simplified state through continual pasture, labor, and chemical inputs to facilitating and relying on ecosystem change and complexity. Not surprisingly, this is a difficult change and requires commitment to persist. For example, one farmer said "having enough confidence to step back and let nature drive it for us is one of the big hurdles" (F4) and another was challenged by the time it took for their pastures to transition.

> *And these paddocks were still coming out of probably a simple pasture system…So that was all sort of moving out and the native perennials were moving in, so it was pretty much a transition for a lot of years. And yeah, it took a lot longer than I thought to start seeing a bit of soil health activity. (F1)*

For farmers who persisted on this path, one of the key outcomes was visibly improved soil cover. Interviewees monitor their pastures carefully and often talked of comparing their soil cover with neighboring properties as a key indicator of their improved resilience to extreme weather events such as drought and flood. These visual comparisons not only provided an indicator of success to the farmers, supporting persistence; many also believed they were crucial in demonstrating the value of such farming techniques to the wider community.

> *My neighbor across the road here…his son came over…and we're walking across my paddock with grass up to our boots, the top of our boots…and he looks back across the road at his hills there, and looks back at my grass and he said, "You're so lucky you haven't had the drought we had." And I laughed at first, and looked around at him, and he was deadly serious. Where do you start? He really thought that he had a drought, and I didn't have a drought, and he couldn't see that it was grazing management.* (F11)

Such positive feedback in the form of improved pastures and soils provided farmers with tangible evidence that their approach and methods were effective, doable, enhanced sustainability and regenerative potential, and could help them meet their personal and business goals in a manner consistent with their values and identity as a land steward (Fig. 2a).

These landscape outcomes are key to validating the shift to regenerative farming and highlight the role of positive emotions in sustaining transformation. Other important land management factors associated with transformation in the practical sphere highlighted by interviewees included learning low stress livestock handling techniques, using more flexible fencing and water infrastructure, and, for some at least, shifting to less or almost no ownership of heavy machinery. Such changes were associated with positive outcomes including greater ease in moving stock and a transition to lower farm business cost structures.

4.2.2. Economics: shifting the management focus from animals to ecosystem processes

Perhaps the most significant difference between conventional and regenerative farming is the latter's focus on the health of fundamental ecosystem processes that support livestock production, making profitability possible.

> *Your mind changes from a focus on the livestock and the business onto the thing that makes the business possible, which is the landscape. So, it's all about how the landscape's functioning. (F5)*

Many of the farmers we interviewed reported a change in their conceptions of economic success, forgoing the idea that ecologically sound and economically profitable behaviors were mutually exclusive; rather, traction occurred when they realized they could be more profitable by working with nature with low input methods. Regenerative agriculture emphasizes that the key to success is in healthy living soils that do not rely on the inputs of conventional farming for their productivity. This new understanding for the farmers of the value of natural capital was accompanied by a shift in focus from yield to profit; the dramatically reduced cost of low input farming techniques balanced losses in productivity so that they could "still make the same money… without the risk" (F12). Accepting the idea that natural processes could support production goals as well as or better than synthetic chemicals was a difficult hurdle for many (a source of friction), but once it was surmounted, it led to a different way of thinking about nature that helped fuel the transformation.

4.2.3. Social dynamics: peer pressure and new social learning networks

A major challenge to agricultural transformation is going against established norms and risking tension, discomfort, conflict, and unpopularity (Pannell et al., 2006). The way in which regenerative farming challenges conventional conceptions, institutions, and practices of farming makes adoption and persistence a challenging process for farmers steeped in using conventional, high input techniques. This means that a degree of courage is required to step outside cultural norms and embrace being different. Interviewees had experienced ridicule and even anger from other farmers who were upset, possibly threatened, by what they were doing or promoting; and they had also received criticism from agronomists and extension staff (see also McKenzie, 2013).

> *There was a lot of peer pressure on you to toe the line in what they were doing in that district. "You need to be doing the same things we're all doing, because we don't like what you're doing," is pretty well what you get. "We're uncomfortable that you're grazing that way." And anger. Like, I had farmers who were angry. What I was doing had nothing to do with their property, but they were angry that I was doing a certain thing. (FE7)*

Admitting that past practices, far from representing land stewardship, had in fact caused damage can be particularly challenging for farming families involving multiple generations of farmers. In these situations, moving away from conventional farming techniques can be resisted by older generations and interpreted as a criticism of the methods of parents and grandparents (see also Richards and Lawrence, 2009).

> *The people who have the most difficulty with it are those who…are themselves of a younger mature age, but father still holds the chequebook…People who are still under the influence of old thinking and resistance to change. (FE8)*

The challenges involved in transformations of this nature extend into other areas which define a farmer's self-worth, including established norms and indicators of "good farming" such as visual amenity (Burton, 2012). "Tidy" paddocks, often monocultures maintained using large machinery and inputs such as pesticides and fertilizers, demonstrate a measure of a farmer's success to neighbors and the community.

> *Most people in our area mow and spend a huge amount of their time mowing. So conventionally it's good management to have your place looking like a golf course. It's pleasing – it is, it's pleasing to your eye. I mean, [even] I look at it and go, "Oh, that looks quite nice." (FE1)*

Persisting with regenerative farming in the face of such criticism and peer pressure is a challenge for agricultural transformation and a key source of friction. Regenerative farmers require confidence and a strong sense of a different kind of "good" farming practice to cope with this peer and family pressure and to maintain their regenerative approach.

With respect to social dynamics, regenerative farmers are supported by three sources of traction. First is the positive responses to their practices, for example, from formerly skeptical neighbors taking an interest once they observe the relative impacts of drought. Second, is where their new practices yield tangible results. Thirdly, and perhaps, most significantly, regenerative farmers build their own educational and peer support networks which operate from the global to the local scale (see also Cross and Ampt, 2016).

Locally, regenerative farmers are typically part of a group of landholders from their own region. These may be groups that derive from the training they signed up for, looser affiliations of like-minded farmers who have met each other through regenerative agriculture events, or they may be small groups that are supported by farmer-educators on a fee for service basis and which meet several times a year. The farmers interviewed had all participated in such groups and most were still part of at least informal groups or networks. The more informal, self-run groups might meet twice yearly and present farm management and business issues for discussion and collective problem solving. Such groups provide a peer support network to help members manage criticism and support an ongoing process of learning and self-reflection where the mechanisms and institutions that exist for conventional agriculture are no longer relevant. The pleasures associated with regenerative farming are both individual and everyday, and also collective, where groups of farmers who trained together still meet.

> *Our group is still getting together seven years later, and we go out in each other's paddocks, and we're still identifying grasses and looking at them and discussing, and it's an exciting process. (F11)*

As in the case of this farmer, such interactions and their development over time are an important part of maintaining the enthusiasm associated with seeing and learning anew.

4.3. Friction and traction in the political sphere

O'Brien and Sygna (2013, 7) argue that without attention to the political sphere, "large-scale transformations are unlikely to take place at the rate and scale called for in response to issues such as climate change." When interviewees were asked about the potential for systemic change that could make regenerative agriculture the "new normal" and barriers to scaling up, the most common response had to do with the power of industrial agriculture to maintain the status quo through control of core agricultural institutions as well as norms around using technology to improve on nature. Transitioning to regenerative agriculture involves giving up conventional agricultural chemicals and learning how to cultivate fertility through strategic land management and natural inputs, like organic compost. Lack of training in ecological processes and understanding of how chemicals affect soils makes farmers vulnerable to arguments for the need for chemicals. Fear of the unknown is a major source of friction that can challenge the transition process (see also McKenzie, 2013), and chemical companies seek to perpetuate that fear.

> *So actually, we stopped all inputs, and in ten years no major problems with animal health or anything. That's very threatening, when companies see that happening. These people are feeding off farmers, and they feed off farmers' fear. They need farmers to be frightful that if they don't use their products, they're going to lose money. (FE7)*

These powerful interests employ strategies to reproduce farmers' vulnerability (Eriksen et al., 2015), including funding research.

Skepticism from the range and grazing science community about the benefits of regenerative agriculture, farming without inputs, holistic planned grazing, and HM more generally also creates friction (Briske et al., 2008; Sherren and Kent, 2017). We found that farmers were sometimes reluctant to self-identify as practitioners of Holistic Management due to a perceived stigma deriving at least in part from academia.

Traction in the political sphere occurs at multiple scales, beginning with the confidence associated with improved knowledge and understanding of soil biology. Farmers' changed way of seeing eventually leads them to see interests in agriculture differently and to perceive that the interests and values of the institutions of conventional agriculture are not necessarily aligned with theirs. This understanding generally comes from HM training, but a growing number of universities are beginning to include regenerative agriculture in their curricula in the form of certificates and degree programs. New knowledge enables farmers to contest powerful interests and stand up to pressure to continue buying chemicals from family members, peers, extension officers, and salespeople. At a broader scale other major sources of traction include government support for regenerative agriculture, which is becoming more common around the globe (Park et al., 2012; Rickards and Howden, 2012), including in Australia where organizations such as catchment management bodies have supported training. Also significant are the growing number of non-governmental organizations that are increasing public awareness of links between soil health and human health (including "gut health"), which is translating into consumer demand for regenerative agriculture products and the growth of niche markets and certification schemes. These developments are all providing traction for scaling up regenerative agriculture, potentially facilitating a paradigm shift.

5. Personal, practical, political: interactions across spheres

We have identified drivers of change and zones of friction and traction in and across the personal, practical, and political spheres that inhibit or facilitate growth, change, and persistence. In the personal sphere, traction is associated with holistic inventory of one's most deeply held values, articulation of a holistic goal, adoption of the holistic decision-making framework, and alignment of behavior and values sustained by ongoing embodied, experiential learning. In the practical sphere, traction is associated with regular environmental, financial, and social monitoring, setting up communities of practice and learning. Finally, in the political sphere, traction is associated with access to niche markets, certification schemes, and government support.

Understanding sustainability transitions, what facilitates and constrains them, and what points of intervention might be most effective requires understanding interactions across such spheres (Head et al., 2013; O'Brien and Sygna, 2013). For example, without attention to the practical sphere, researchers may focus on "abstract ideals and goals" (O'Brien and Sygna, 2013, 7), missing crucial interactions that may generate conflict, or missed opportunities for change. Our findings reveal a number of points of interaction or traction across the spheres. In some instances, these also embody friction such as when uncertainty about farmer identity (in the personal sphere) erodes persistence with regenerative farming practices due to peer pressure in the practical and political spheres. We focus, however, on how regenerative agriculture processes work to support transformation and persistence across spheres, forming self-amplifying positive feedback loops (Olsson et al., 2014) (Fig. 2b). For example, tangible and "practical" business and landscape outcomes not only generate confidence and positive emotions in the personal sphere but also validate the adopted new way of seeing and thinking in the political sphere. This has the effect of meeting personal goals and values such as land stewardship and generating the internal strength to resist peer pressure and criticism while persisting on the path towards their holistic goal and ultimately contributing to systemic change.

The personal sphere is crucial to generating and maintaining change in the practical sphere and then persisting with it. Interviews revealed that uncomfortable emotions related to crisis can be a source of traction leading to a desire to try out new behaviors, a shift in the mental model of prosperity, and epiphany regarding the power of natural capital (the links between ecosystem processes and prosperity). The end result is a different business strategy: reduce costs, focus on profit, reduce risk. Our results suggest that increase in self-awareness in conjunction with daily monitoring results in multiple loop learning fueled by biophilic emotions (Tidball, 2012) that connect the farmers' passion and values to everyday decisions (Fig. 2a):

> *I think you've got to go to that higher level of thinking. Because a lot of it is hard work. And to sustain that hard work you've got to have passion. And how do you have passion if you don't have a feeling for what you're*

doing? So, to me that's part of Holistic Management, is actually getting people to think about what drives you, what motivates you, and connect that to your environment. (FE1)

Before transitioning, key elements and details of the pasture and the condition of the soil were not perceived by interviewees; once the transition had occurred such conditions were apparent to them and, in time, seeing results provided positive feedback in the personal sphere in the form of positive sensations, feelings, and emotions that fueled the drive and motivation to persist (Fig. 2a). Business outcomes validated their practices and generated confidence, which in turn empowered them to resist peer pressure and demonstrate enhanced resilience.

Change in the practical sphere influences the political sphere in that new behaviors thrive and scale up through communities of practice, as well as with new educational programs. The introduction of niche markets and new institutions leads to a new paradigm in agriculture as regenerative agriculture becomes more mainstream. As one farmer stated:

You can't improve this without helping someone else. Like, on any level you want to look at, if we earn more money from this, we're going to pay more tax and contribute more to the economy. If we improve our water cycle here, there's going to be less flood damage downstream. If we increase our biodiversity, we inspire other people to increase their biodiversity and increase their profitability. It just helps everything. You can't do good without creating more good. (F8)

Change in the personal sphere influences the political sphere, in that the alignment of values and confidence in goals can facilitate the ability to cope with peer and industry pressure.

There are implications of this research for supporting and facilitating large scale transformational adaptation in agriculture since, as we have shown, the personal sphere matters. Eriksen et al. (2015) call for research to "identify how emancipatory subjectivities – and thus the potential for transformational adaptation – can be supported." Our findings suggest that educators, consultants, and mentors can facilitate "induced epiphanies" through a sequence of activities designed to increase consciousness and self-awareness and facilitate multiple loop learning (Armitage et al., 2008). There is also a need for more training, learning, and mentoring programs. These include resources and networks that provide avenues for self-reflection and consideration of alternatives that aligns values with practice; resources that can connect ideals and a desire for change to strategies and actions. Since many are hesitant to talk about these topics in public, there is a need to normalize conversations about nonmaterial subjective phenomena.

You know, you and I are talking about issues in a way that just would not be possible with most folks, so when I'm out delivering a course…I really have to amend – I don't share with folks all the stories that we've got, and all that we're doing, because that would just make it impossible, impossible for them to relate. (F2)

We have shown that, in addition to consumer awareness and market demand, communities of practice also matter. Social learning networks and peer support allow for sharing even financial outcomes (and other issues) for mutual benefit, as well as for dealing with peer pressure and social isolation.

Implications of these findings include the need to consider what role government can and should play in supporting this type of transformational adaptation (Kates et al., 2011). Sherren et al. (2012) suggested that HM should be supported by the Australian government but were strongly criticized by Briske et al. (2013) because of concerns about the ecological implications of broadly supporting certain land management practices without being able to ensure proper training. This debate highlights the risks associated with prescribing simple strategies to facilitate transitions in the practical sphere emanating from the political sphere (e.g., top down policy that is not sensitive to context). It is not our aim in this paper to endorse any particular grazing system. As reported in this paper, the process of becoming a regenerative farmer really originates in the personal sphere, and involves a commitment to ongoing experiential learning and adaptive management; explicitly identifying, and reflecting and acting on values; and linking the personal, financial, and ecological in farm and business management. The training undertaken by our interviewees, largely under the banner of HM, guided them through these processes and equipped them with tools and dispositions to engage and participate in ongoing monitoring, reflexivity, and communities of practice. Consequently the personal sphere was mobilized as a site of constructive negotiation of crises and remained a key resource supporting transformation in the practical and political spheres and, importantly, sustaining this change.

6. Conclusion

By applying relational thinking about sustainability transitions, farms, and farming to farmers' experiences of transitioning to regenerative agriculture, we generate new insights into transformational adaptation and the role of transformation in the personal sphere specifically. We also address dynamics in the practical and political spheres, by examining how agriculture is situated within the broader social, cultural and political environment. Together, the findings contribute to insights from agricultural research that support transformational adaptation on the farm.

This research has implications for our understanding of "individual and collective capacities to deliberately transform systems and structures in a manner that is both ethical and sustainable" (O'Brien, 2012, 667). Overall, our findings suggest that (1) transformational adaptation on the farm can be triggered by crisis, epiphany, and exposure to alternative pathways; (2) that decisions to transition to regenerative farming involve important nonmaterial subjective factors associated with feelings, emotions, virtues, drives and motivations; (3) that sustained adoption is influenced by a range of environmental, economic, social/cultural, and personal/psychological factors; and (4) that certain types of traction can support self-amplifying feedback loops that involve ongoing experiential social learning and increasing consciousness which plays out on the landscape and in surrounding communities.

By presenting these in terms of traction and friction in the personal, practical, and political spheres, we have shown how these various pathways and factors can influence on-farm transformation and persistence via an approach to farming that arguably goes beyond mainstream approaches to sustainable and climate smart agriculture. Regenerative farmers, especially those trained in holistic decision-making, typically demonstrate a willingness to consider even radically alternative ways of thinking and practice, a shift to social-ecological and systems thinking, critical personal and professional self-reflection, openness to others and their ideas, participation in supportive communities of practice, willingness to learn, and enhanced knowledge and observation of key resources such as soil and pasture. Collectively, these characteristics of regenerative agriculture are good examples of the "outside-in" and "inside-out" cultural transformations that need to be fostered (Adger et al., 2013, O'Brien and Sygna, 2013, 8). Through its learning processes and support mechanisms, regenerative agriculture embodies a way to navigate constraints associated with current agricultural cultures, institutions, and economies.

This research suggests that scaling up the regenerative agriculture movement will require governance strategies that reduce the influence of chemical companies in farmer decision-making as well as incentive programs that go beyond the practical sphere to more effectively engage farmers in the personal sphere. As Plummer and Fitzgibbon (2006) argue, "resource managers need to understand they may well need to facilitate social interactions that on the surface appear to only superficially address resource issues." Future research should investigate the effectiveness of different strategies for facilitating multiple loop learning about the social and psychological benefits of regenerative agriculture through "induced epiphanies" related to the alignment (or

lack thereof) between deeply held values and farming behavior. Such research would support arguments that insights from relational approaches to understanding nature-society dynamics have important contributions to make to actionable global change research.

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