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Healthier land, healthier farmers: Considering the potential of natural resource management as a place-focused farmer health intervention



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ABSTRACT

Farmers have particular wellbeing-related vulnerabilities that conventional health interventions struggle to address. We consider the potential of natural resource management (NRM) programs, which reach large numbers of farmers, as non-conventional place-focused wellbeing interventions. Although designed to address environmental degradation, NRM can influence the wellbeing of farmers. We used qualitative meta-synthesis to reanalyse studies examining social dimensions of NRM in Australia and generate a theoretical framework identifying potential pathways between NRM and wellbeing, intended to inform subsequent empirical work. Our results suggest NRM programs influence several important determinants of farmer wellbeing, in particular social capital, self-efficacy, social identity, material wellbeing, and health itself. The pathways by which NRM influences these determinants are mediated by distal factors such as changes in land conditions, farmer skills and knowledge and resources accessible to farmers. These, in turn, are moderated by the design and delivery of NRM programs, suggesting potential to enhance the health benefits of NRM through specific attention to program design.

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1. Introduction

The occupation of farming is 'associated with a unique set of characteristics that is potentially hazardous to mental health' (Fraser et al., 2005, p. 340), a sensitive indicator of poor overall wellbeing. Many, but not all, studies comparing farmers and non-farmers have identified that farmers have higher rates of mental illness than non-farmers (Fraser et al., 2005; Berry et al., 2011a; Hounsome et al., 2012) and it is well accepted that at least some groups of farmers (defined here as all people involved in managing rural properties for commercial agriculture) have demonstrably poorer mental and physical wellbeing than non-farmers (Berry et al., 2011a). Strikingly, even farmers scoring positively on mental health or wellbeing measures appear more likely than non-farmers to feel hopeless about the future, have suicidal ideation or complete suicide, a contradiction not yet fully understood but apparent in several countries (e.g. Boxer et al., 1995; Thomas et al., 2003; Berry et al., 2011a).

Farmer uptake of mental health support services is low (Hart et al., 2011), reflecting both limited or inappropriate provision of services in rural areas and social stigma about accessing them (Boxer et al., 1995; Gregoire, 2002; Robinson et al., 2009; Polain et al., 2011). Increasing

attention is being given to novel health interventions delivered outside the mainstream health sector that may better reach farmers, as evidence builds that these can be effective. For example, Kilpatrick et al. (2012) found that health interventions were most successful if access to them was facilitated by local community groups and industry associations.

In this paper we examine the potential of natural resource management (NRM) programs to serve as human health interventions focused on place (the farm and farming landscape), concurrently with their benefits for the environment. By 'health intervention', we are not suggesting that current NRM practitioners – largely trained in environmental science – should be expected to take on the role of health professionals. Rather, we are examining whether and when the wellbeing co-benefits of NRM may warrant further action, such as establishing a dialogue between the health and NRM sectors to ensure that both are aware of the activities they deliver to the same groups of landholders, and identify opportunities to cooperate to better meet both goals. Precedents already exist for this. For example, many Australian NRM networks now deliver frontline mental health training in recognition of the fact that, with farmers often unwilling to seek medical assistance, NRM professionals are often confronted with farmers in severe distress, and need skills to recognise these issues and refer farmers to appropriate assistance services (see for example Perrie, 2012). NRM groups are also used to deliver mental health courses to landholders (Kilpatrick et al., 2012). Our contention is that, by recognising and leveraging any identified co-benefits of NRM so

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Box 1–Types of NRM action.

Natural resource management (NRM) aims to address environmental degradation. Common ways in which NRM action is taken include (Marshall, 2011; Schirmer et al., 2012):

- **Group-based collaborative action:** Groups of farmers and other stakeholders work together to address land degradation, often with the support of government funding or government-appointed group facilitators. The best known example is the Australian ‘landcare’ movement.
- **Grants:** The provision of funds to farmers by governments or non-government organisations to undertake land rehabilitation activities such as tree planting, fencing of sensitive areas, etc. These grants vary in form and design: some cover costs of materials; some of labour; others of both; many European schemes provide annual payments to farmers in return for managing their land to provide environmental services. Recipients are determined in a range of ways, from market-based instruments such as auctions, to direct delivery of grants to pre-identified landholders
- **Extension, education and training:** The provision of external expertise to advise and train landholders in managing their land to improve its environmental condition
- **Government regulation:** Regulation constraining how landholders may manage their land or the resources they can access
- **Landholder action:** Independent action by landholders without assistance from other organisations.

In many regions, a combination of these methods is used. In Australia, for example, state and federal governments have changed regulations; funded collaborative NRM action in the form of landcare groups (with over 4000 landcare groups established by 1998, and 30% of all Australian landholders involved in a group) (Sobels et al., 2001, p. 266); and supported both individual landholders and collaborative NRM groups through provision of extension and funding grants. A bewildering variety of mechanisms have been used to allocate funding grants, and to determine who receives NRM funding, and for what purpose. In this paper we do not attempt to review the pros and cons of different approaches, but rather identify when a particular method of NRM delivery is likely to confer different pathways to wellbeing.

they complement conventional health interventions, there is potential to enhance wellbeing outcomes in rural and regional areas.

The term ‘NRM’ refers to policies and programs, delivered by government or non-governmental organisations, which help farmers address environmental and land degradation through actions such as revegetating areas of land, protecting streams, or altering their farm management practices (Box 1 describes various forms of NRM). As a potential intervention, NRM has a broad scope because it reaches large numbers of farmers. Across Europe, 20% of utilised agricultural land is under some form of agri-environmental scheme, with over 20 billion euros invested between 2007 and 2013 (Espinosa-Goded et al., 2013); in Australia, more than 30% of farm businesses have participated in ‘landcare’, one particularly prominent NRM program (Curtis and DeLacy, 1998).

Although NRM is not concerned with human health, studies have established that farmers are often highly sensitive to changes to their land and their relationship with it, as we identify further below (Albrecht et al., 2007; Higginbotham et al., 2007; Berry et al., 2011b). Farmer identity tends to be strongly linked to specific place, and farmers’ sense of worth (and mental health) dependent on their success as a steward of land and agricultural producer (Burton and Wilson, 2006; Polain et al., 2011). Further, farmer wellbeing is influenced by several occupation-specific stressors that, while also influencing other groups, affect farmers in specific ways (Malmberg et al., 1997), including drought, flood and pest/weed outbreaks; farm economic pressures, such as rising farm input costs and volatile agricultural commodity prices; complex government bureaucracy and regulation of farming; and social isolation of farmers (Ragland and Berman, 1991; Boxer et al., 1995; Malmberg et al., 1997; Gregoire, 2002; Thomas et al., 2003; Fraser et al., 2005; Judd et al., 2006; Freeman et al., 2008; Hossain et al., 2008; Berry et al., 2011a; Brumby et al., 2011; Das, 2011; Polain et al., 2011; Hanigan et al., 2012). Thus, it is reasonable to hypothesise that programs designed to address environmental and land degradation may also have co-benefits for farmer wellbeing.

There are compelling reasons to explore the potential of such co-benefits, and to consider the idea of NRM as a place-based health intervention. Environmental degradation has been shown to have negative impacts on farmers’ mental health (Higginbotham et al.,

2007). For example, Albrecht et al. (2007) found that farmers exposed to persistent drought in rural Australia experienced higher levels of psychological distress as a consequence, while Speldewinde et al. (2009) identified an association between higher incidence of dryland salinity, and incidence of depression in Western Australia. This suggests that addressing degradation through NRM may improve wellbeing. NRM may also provide wellbeing benefits beyond those associated with reduced environmental degradation, with previous studies reporting findings suggestive of NRM building increased social capital and higher self-efficacy (e.g. Mortlock and Hunt, 2008; Roche and Rolley, 2011), and improved material wellbeing (Greiner and Stanley, 2013). Overall, NRM has potential for wellbeing benefits that may achieve ‘substantial direct savings of health care costs and avoided and reduced individual and social impacts’ (Johnston et al., 2007, p. 496, citing Baker et al., 2005). Equally important, NRM has potential to worsen wellbeing and thus counteract other health or social interventions (Greiner and Stanley, 2013), with multiple studies identifying trade-offs between human wellbeing and reversing environmental degradation (e.g. McShane et al., 2011). For example, landholders may be asked to participate in activities that improve the ecological condition of their land but also reduce the area available for agricultural production, with attendant reductions in farmer income.

Despite the documented potential of NRM to influence farmer wellbeing, the pathways by which it may do so are not well understood (Dyack and Greiner, 2006). In fact, we identified only one study that examined *how* NRM programs that address environmental degradation influence farmer health and wellbeing (GSAHS, 2010). This task is particularly important given that some studies have identified trade-offs between reversing environmental degradation and human wellbeing (Greiner and Stanley, 2013), arguing that addressing degradation sometimes involves reducing the wellbeing of some groups (e.g. McShane et al., 2011).

In this paper, we begin to address this gap by identifying the likely pathways through which NRM influences farmer wellbeing and factors that may moderate these relationships, an essential first step in exploring the potential of NRM as a health intervention. While almost no research directly examines *how* NRM influences farmer wellbeing, multiple studies allude to it, including research examining farmer and volunteer engagement in NRM, the health

and social impacts of environmental degradation and climatic variability and linkages between Indigenous people's wellbeing and NRM. To integrate and synthesise the findings from these different areas of research, we use the emerging research methodology of qualitative meta-synthesis (QMS).

2. Methods

QMS is a qualitative method that uses thematic, systematic coding to generate new ideas and theory from a diverse body of existing evidence that would not otherwise be brought together (McCormick et al., 2003; Mays et al., 2005; Bondas and Hall, 2007; Zimmer, 2006). We chose this approach because it can be used to synthesise the results of studies that have used diverse methodologies and different fields of research, unlike meta-analysis or systematic reviews, which compare the results of quantitative studies with near-identical methods and objectives (Walsh and Downe, 2005). The QMS methods are described in detail below, followed by our results, which detail and order the various relationships between NRM and farmer wellbeing identified in our analysis. We then synthesise our results into a proposed model for understanding linkages between NRM and farmer wellbeing, discuss the implications of our findings for using NRM as a health intervention and identify areas for further research.

We used a systematic four-step approach to QMS: defining the question, selecting studies, analysis, and synthesis (Noblit and Hare, 1988; Paterson et al., 2001; McCormick et al., 2003; Walsh and Downe, 2005; Zimmer, 2006; Thomas and Harden, 2008).

2.1. Defining the question

We defined our question as: 'what are the linkages between NRM and farmer wellbeing?' We focused on wellbeing (rather than its close relation, mental health) because wellbeing is a more general concept that provides a global perspective on NRM's potential as a non-traditional health intervention and because promoting wellbeing is a critical means to supporting mental health.

The generic term wellbeing is usually conceptualised as the extent to which a person is satisfied or fulfilled with life (Costanza et al., 2007), and various domains of life, and is thus often defined as 'overall life satisfaction' (Cummins et al., 2003). Overall life satisfaction is an outcome of multiple physical, social, psychological and spiritual factors influencing a person's quality of life (Cummins et al., 2003; Larson et al., 2006; Costanza et al., 2007). While the nature and relative influence of these determinants, and the direction of causal relationships between wellbeing and factors often correlated with it, are topics of ongoing debate (e.g., O'Brien et al., 2012), it is widely agreed that one of these factors is the natural environment in which a person lives (MEA, 2003). This has obvious relevance to NRM, which involves actions that change the natural environment. However, other determinants of wellbeing may also be influenced by NRM. To identify these, it is necessary to consider factors known to influence wellbeing in general, and examine whether NRM is likely to influence these. Epidemiological evidence shows that demographic, social and economic factors, particularly social status, powerfully shape health and wellbeing (Marmot, 2005), and that such factors combine in distinct and systematically patterned ways to produce lives characterised by overall wellbeing or pervasive illbeing (Berry et al., 2008a). While labelled and conceptualised in varying ways, the core factors or domains that are generally agreed to influence wellbeing broadly fall into the following categories (ABS, 2001; Cummins et al., 2003; MEA, 2003; Marmot, 2005; Larson et al., 2006):

- Social capital and community connectedness.
- Self-efficacy.

- Mental and physical health.
- Standard of living (income, satisfaction with material needs).
- Freedom, personal safety and security.
- Equality and equity of access to resources.
- Health of the natural environment.

Two of these domains – social capital and self-efficacy (connectedness and effectiveness) – are typically most strongly related to a person's self-assessed life satisfaction (O'Brien et al., 2012). A person's social identity also influences their wellbeing, for example, by structuring their social relationships, self-efficacy and behaviours related to physical and mental health (Haslam et al., 2009; Jetten et al., 2012). Having identified the core domains known to influence wellbeing, we next identified studies that could be reanalysed to identify whether there is evidence that NRM influences any of these – for example, whether participating in NRM influences a farmer's social capital.

2.2. Selecting studies

We included only Australian studies in our analysis because focusing on one country reduced problems of generalisation across political, economic and cultural contexts. Moreover, Australia's NRM programs are recognised worldwide as 'state of the art' and have been studied more thoroughly than NRM in most other regions, providing substantial evidence to draw upon.

QMS is a qualitative methodology which can be applied to both qualitative and quantitative studies, and we included both. Synthesising data generated using differing methodologies and/or ontologies can be challenging (Walsh and Downe, 2005; Thomas and Harden, 2008) but, as a logical extension of mixed-method research (Mays et al., 2005), is worth the effort. For similar reasons, we included both academic and 'grey' literature, prioritising inclusiveness over rigour when selecting studies (Walsh and Downe, 2005) because our objective was to generate a theoretical framework for subsequent empirical testing, rather than to evaluate the quality of existing theories. A purposive rather than exhaustive process was used to identify studies for inclusion, with new studies included until 'conceptual saturation' was reached (Thomas and Harden, 2008). Table 1 identifies the search terms used to identify and select the 45 studies ultimately included in the QMS. Table 2 categorises these studies by methodology and topic.

2.3. Analysis

We used thematic coding, a common QMS analysis process, to synthesise data (Thomas and Harden, 2008). The results and discussion sections of each study, or their equivalents in non-traditionally structured papers, were included in the QMS. This text, including numeric results of statistical analysis, was treated as qualitative text to be coded. In the first coding round, findings relevant to the relationship between NRM and wellbeing determinants (social capital, self-efficacy etc.) were identified as 'free codes', i.e. unrelated to each other, and the differing terminologies used in each study translated into a common set of qualitative codes. The codes from the first round were then reviewed and reorganised into hierarchical, thematic groups to reveal specific links between NRM and wellbeing. Specifically, we organised these groups based on their linkage to wellbeing. We considered the wellbeing domains identified earlier (social capital, self-efficacy, etc.) to be *proximal* determinants of wellbeing, as they are the most direct influences on wellbeing. We examined the pathways that led to each of these proximal factors, in order to identify NRM-driven *distal* causes of changes in these proximal factors. We thus identified distal factors that NRM affects which, in turn,

Table 1
Search and selection criteria used to identify studies for the QMS.

Step	Criteria and outcomes	Results
1. Identify boundaries of studies to be included	<ul style="list-style-type: none"> – Include only studies providing insight into linkages between NRM action and farmer wellbeing (limited to studies examining social dimensions of NRM, linkages between environmental degradation/climatic variability and wellbeing, and NRM and wellbeing of groups other than farmers). – Include studies with empirical evidence. – Include theoretical and discussion papers with relevance to topic. – Include papers with data relevant to question 'linkages between NRM action and landholder wellbeing'. 	
2. Identify search terms and databases	<p>The following search terms were tested in four databases (Google Scholar, CAB Abstracts, Agriculture and Natural Resources Index, Web of Science):</p> <p>Any one or more of the following: "natural resource management", "landcare", "bush heritage", "revegetation", "soil conservation", "land conservation", "land degradation", "coastwatch", "fishwatch", "riverwatch", "caring for our country", "natural heritage trust", "salinity".</p> <p>AND</p> <p>Any one or more of the following "social", "health", "wellbeing", "psychological/psychology", "stress", "social capital", "equity", "self-efficacy", "standard of living", "income".</p> <p>Google Scholar was the most comprehensive in terms of search results, and included some relevant 'grey literature' not found in other databases, and was thus used, consistent with recommendations to use databases that most comprehensively sample the relevant work (Walsh and Downe, 2005).</p>	8610 search results
3. Select specific studies	<p>Studies were screened, and those not falling within parameters specified in Step 1 excluded. For example, studies that focused on health of land rather than health of people, were excluded, as were those that referred to wellbeing issues only when setting the context for a study and not elsewhere in the paper. We continued this process for the first 500 of the 8610 results obtained. At this point, very few new studies of relevance were being identified. We stopped searching for more, and focused on analysing the studies obtained. From this point, new studies were only added if they were referenced in the studies already identified. This process continued throughout the analysis, and was stopped when no new concepts of ideas were being identified in the literature.</p>	Scholar Google studies: 102 Subsequently identified studies: 22
4. Evaluate quality and relevance of studies, and classify them	<p>Initial stages of synthesis involved evaluating the quality and relevance of studies for inclusion in the analysis process, and classifying them by type (see Table 2). Studies were also compared to identify underlying assumptions or implications of methodological approach. All studies had a shared philosophical underpinning (Zimmer, 2006), falling broadly into the 'interpretive' paradigm in which there is a view that an objective reality exists, but that this can only be understood through interpretation of this world via language, symbol, culture, identity etc.</p>	45 core studies identified, described in Table 2

influence proximal factors and, through this, wellbeing. The entire dataset was then recoded using this re-organised set of thematic codes. The two rounds of coding were conducted by the lead author and then reviewed by the other authors.

2.4. Synthesis

Synthesis is the endpoint and particular benefit of QMS, the step that adds value beyond the specifics of the original studies (Thomas and Harden, 2008). Most studies included in our QMS examined only one or two of the multiple factors likely to link NRM and wellbeing. It was, therefore, inappropriate to assess whether the weight of evidence confirmed particular linkages. Instead, we identified multiple potential pathways of influence based on our analysis (see Step 2.3 above), drawing on established theories of wellbeing to synthesise these into a theoretical framework.

3. Results

The QMS coding identified evidence that NRM ultimately impacts on five proximal determinants of wellbeing: social capital, standard of living, health (physical and mental), self-efficacy and identity. Table 3 documents the specific pathways identified between NRM and these proximal factors. Other factors often considered in the wellbeing literature to be proximal determinants of wellbeing – equity/justice, security and the natural environment – were also important, but acted either as moderating factors or as distal factors that, in turn, influenced one or more of the five proximal factors. In addition to wellbeing determinants that acted as distal factors, four additional distal factors were also identified:

changes in land condition; change in farmer skills and knowledge; change in farmer resources, such as finances and time; and changed access to resources external to the farmer.

Evidence for qualitative analyses is typically presented in the form of quotes (Sandelowski, 2007) but the diverse sources of secondary data included in QMS are not easily summarised in quotes. We therefore document our supporting evidence in three ways. First, we present a limited number of direct quotes from the studies we analysed. Second, Table 3 presents the specific pathways identified, the number of studies in which they were identified, and the synonymous or closely related terms that we translated into a common terminology in the QMS. Third, in Appendix A, we list the studies in which we identified evidence of particular pathways linking NRM and wellbeing. Studies included in the QMS are referenced when they are directly quoted; Table 3 and Appendix S1 detail the source/s of all other evidence described in the results.

3.1. Proximal factor (i): social capital

Social capital is '...the processes between people which establish networks, norms and social trust, and facilitate co-ordination and co-operation for mutual benefit.' (Cox, 1995, p. 15). It is often conceptualised as a combination of the nature and extent of a person's formal and informal community participation (e.g., with friends, family, civic and political groups), and the social cohesion created by this participation (Harpham et al., 2002). Overall, social capital, when appropriately measured, is linked with mental health (Berry and Welsh, 2010) and with subjective well-being 'through many independent channels and in several different forms' (Helliwell and Putnam, 2004, p. 1435). For example, social capital can improve productivity of groups and, hence, material

Table 2
Classification of studies included in the qualitative meta-synthesis.

Topic of study	Study method			
	Qualitative	Quantitative	Mixed methods	Review/synthesis/argument
Studies examining linkages between NRM action and landholder wellbeing	1. GSAHS, 2010	16. Speldewinde et al. (2009)		
Studies examining how to encourage NRM through increasing adoption, improving policy, or addressing barriers to uptake	2. Aitken (2001)	17. Holmes and Day (1995)	26. Munro and Moore (2005)	32. Cary and Webb (2000)
	3. Sobels et al. (2001)	18. Curtis and Van Nouhuys (1999)	27. Pero and Smith (2006)	33. Morrissey and Lawrence (2000)
	4. Carr (2002)		28. Compton et al. (2009)	34. Curtis et al. (2002)
	5. Moore et al. (2001)	19. Byron et al. (2001)	29. Compton and Beeton (2012)	35. Webb and Cary (2005)
	6. Gooch (2003)	20. Byron and Curtis (2001)		36. Curtis et al. (2008)
	7. Gooch (2005)	21. Byron and Curtis (2002)		37. Kingwell et al. (2008)
	8. Farrelly (2006)	22. Taylor (2009)		38. Curtis and Lefroy (2010)
	9. Rockloff and Moore (2006)	23. Simpson and Clifton (2010)		39. Barr (2011)
	10. Farrelly and Conacher (2007)	24. Marshall (2011)		40. Pannell et al. (2011)
	11. Davidson and Lockwood (2009)			
	12. Gooch and Warburton (2009)			
	13. Flick et al. (2010)			
	14. Greiner and Gregg (2011)			
	15. Brown et al. (2012)			
Linkages between environmental degradation or climatic variability and human wellbeing		25. Berry et al. (2011b)	30. Buckley (2007) 31. King et al. (2009)	41. Horwitz et al. (2001) 42. Cox et al. (2005) 43. Berry et al. (2008b) 44. Drought Policy Review Expert Panel (2008)
Indigenous wellbeing and 'caring for country' activities	We identified 10 studies examining links between Indigenous wellbeing and NRM activities involving engaging with 'caring for country' (3 qualitative, 3 quantitative and 4 review/synthesis/argument). Rather than include all these, we included one in our review which reviewed all the other studies identified and synthesised their findings. 45. Davies et al. (2011)			

wellbeing; enable learning and information dissemination and, through this, self-efficacy; and increase access to resources (Sobels et al., 2001; Ziersch, 2005). However, studies examining social capital and wellbeing produce somewhat inconsistent findings depending on their design and methods (Berry and Welsh, 2010) and there remains debate over the conceptualisation, measurement and differentiation of 'types' of social capital (Niemininen et al., 2008). Further, while empirical studies do suggest that a person's social networks impact on wellbeing via their effects on social cohesion (Berry and Shipley, 2009; Berry and Welsh, 2010), they also suggest that (i) not all types of social participation are related to greater wellbeing (Berry et al., 2007; Berry and Welsh, 2010), and (ii) social capital can be associated with worse wellbeing (Mitchell and LaGory, 2002), including in NRM contexts (Ballet et al., 2007). Negative effects on wellbeing may result from the reciprocal burden resulting from social participation for those with poor resources or resilience (Berry, 2008), reduced openness of social network members to new ideas and people (Gargiulo and Benassi, 2000) or, possibly, from the 'dark side' of social capital in which excessively strong social bonds promote misuse of social capital resources (Schulman and Anderson, 1999).

Social capital as a proximal determinant of wellbeing: 36 studies included in the QMS suggested that NRM was associated with changes in social capital. The linkage was usually simple, with NRM found to lead to increased social cohesion, trust and/or reciprocity between farmers and other groups. While in most cases the NRM activities strengthened social capital, decreased trust was identified in two studies, increased social conflict in three and, in three studies, NRM was found to place high demands on reciprocity that led to stress and burnout. The only distal factor identified that mediated the linkage between NRM and wellbeing was 'social learning': five studies described social capital as emerging from social learning processes (learning that happens wholly or largely through group processes) that were triggered by NRM. Notably, only group-based forms of NRM (such as 'landcare') in which farmers collaborated to address land degradation issues, led to changes in social capital.

Social capital is both an important ingredient in explaining landcare's success and an outcome of landcare group and network activities. Social capital generated by landcare is then available to contribute to the achievement of NRM and other

Table 3
Studies in which evidence was identified for different pathways by which NRM may influence wellbeing.

Pathway to proximal wellbeing determinant, including distal variables [brackets indicates the variable was identified in some but not all studies in which the other elements of the pathway were identified]	Number of QMS studies in which results consistent with this pathway were identified	Relevant synonyms and translation terms
NRM → Social capital (proximal wellbeing determinant)	36 studies	Trust, social cohesion, social networks, social conflict, social learning in groups, reciprocity
NRM → Social learning → Social capital	5 studies	
NRM → Farmer identity (proximal wellbeing determinant)	22 studies	Identity, sense of self, social norms
NRM → [social capital] → Social identity creation, fulfilment or threat	Fulfil identity: 5 studies New identity: 6 studies Identity threat: 2 studies	
NRM → Self-efficacy (proximal wellbeing determinant)	23 studies	
NRM → Land conditions → [Identity] → Self-efficacy	2 studies	Self-esteem, control, outcomes, empowerment, decision-making control, power, achievement of goals, confidence
NRM → Social capital → Access to resources → Self-efficacy	8 studies	
NRM → [social learning] → Farmer skills & knowledge → Self-efficacy	5 studies	Mental health, physical health, depression, accomplishment, disillusionment, helplessness, hopelessness, health services, medication, stress, burnout
NRM → Health (proximal wellbeing determinant)	25 studies	
NRM → Land conditions → [identity or self-efficacy] → Health	12 studies	
NRM → Farmer skills & knowledge → [access to resources] → [self-efficacy] → Health	1 study	
NRM → [social capital] → Farmer resources → Health	8 studies	
NRM → Standard of living (proximal wellbeing determinant)	19 studies	Standard of living, income, employment opportunities, farm finances, profitability, material wellbeing
NRM → Land conditions → Farm productivity/profitability → Standard of living	8 studies	
NRM → Farmer resources → Standard of living	9 studies	
NRM → [social capital] → Farmer skills & knowledge → Standard of living	4 studies	
NRM → Employment opportunities → Standard of living	1 study	
Moderating variables	Studies documenting this moderating factor^a	Relevant synonyms and translation terms
Equity/fairness of NRM decision making and processes	14 studies	Fairness, justice, distribution, equity, burden, sharing, access to funds, social loafing
Complexity of administration of NRM programs	13 studies	Red tape, bureaucracy
Security/certainty of NRM programs	9 studies	Short-term funding, insecurity

^a In many cases, studies used parallel terms, and did not explicitly identify that these linkages were associated with a change in wellbeing but reported findings suggestive of a change in the relevant wellbeing domain (e.g. a study might describe farmers feeling 'more confident' as a result of NRM action, suggestive of increased self-efficacy).

social objectives... [previous studies have found that landcare]: ... increased levels of trust ... enhanced communication that enabled complex and difficult issues to be explored with little conflict ... [involved] new norms of behaviour ... [and] reciprocal relationships where landholders, leaders and agency staff could expect support to access money or materials, labour or information (Compton and Beeton, 2012, p. 15, citing Sobels et al., 2001).

The strong internal ties and social relations among community landcare members may result in the group developing 'group-think' characteristics... Another negative consequence of high levels of bonding [social capital] may be excessive demands made upon the group's members... Where excessive demands are made... they may experience burnout. ... (Webb and Cary, 2005, p. 124).

3.2. Proximal factor (ii): identity

Social identity is 'the sense of self that people derive from their membership in social groups' (Jetten et al., 2012, p.4), including abstract groups (e.g., "farmers"), and groups of personally known others (e.g., a local landcare group) (Tajfel and Turner, 1979; Turner et al., 1987). People who share a social identity have similar attitudes, values and behaviours on matters relevant to the group. These views and behaviours are validated by seeing, hearing and, especially, interacting with other group members (Turner et al., 1987; Hardin and Higgins, 1996). Group membership thus becomes a basis for social trust (Tanis and Postmes, 2005) and hence for greater social capital. While further work is needed to better understand the linkages between identity and wellbeing, the emerging research in this area does confirm a strong linkage between the two (Jetten et al., 2012). Wellbeing is promoted by

behaving according to the values and attitudes that are central to a salient social identity, which reinforces a positive sense of self and connection to other people who share the same identity (Jetten et al., 2012). Thus, to the extent that NRM supports what it means to be a 'proper' farmer, it affirms farmers' positive worth and may even provide an opportunity for farmers to solidify their standing within the farming community (Blader and Tyler, 2009). In contrast, actions that challenge social identity threaten a deeply experienced sense of self and also threaten the basis of positive connections with others who share that identity (Hogan et al., in press; Jetten et al., 2012); this has serious implications for wellbeing, including anxiety and social exclusion. Consequently, challenges to social identity tend to be actively repelled and so are often met with derogation and distrust, particularly when they come from outside the group (Branscombe et al., 1999). This means that, if NRM challenges normative behaviours, farmers may well dismiss or disregard it, or some may accept while others reject it, creating conflict between sub-groups of farmers (Compton and Beeton, 2012).

Farmers have multiple on-farm and off-farm social identities (Johnsen, 2004; King et al., 2009). Two commonly reported place-focused identities (Worster and Abrams, 2005; Walker, 2007) are particularly relevant to NRM: in the 'production' identity, farmers (in Australia and internationally) achieve a sense of fulfilment from the economic and moral rewards associated with producing agricultural goods for wider society (Burton and Wilson, 2006; Buckley, 2007; King et al., 2009). In the 'stewardship' identity, farmers view themselves as responsible caretakers for their land (Curtis and DeLacy, 1998; Buckley, 2007; Flick et al., 2010). Stewardship identity is not reliably correlated with farmer engagement in NRM (Curtis and DeLacy, 1998; Flick et al., 2010; Gosling and Williams 2010), likely because NRM is not a necessary

component to fulfil this identity; that said, NRM will influence whether farmers feel able to fulfil their stewardship identity, or feel they have failed it. The importance of both production and stewardship identities to wellbeing is illustrated by previous studies: for example, older farmers who feel they have failed in production and stewardship during prolonged drought report distress and significant loss of wellbeing (Polain et al., 2011).

Identity as a proximal determinant of wellbeing: The QMS results suggest NRM can (i) help form relevant new social identities (6 studies), (ii) fulfil the needs of existing social identities (5 studies), or (iii) threaten existing social identities (2 studies). New identities formed primarily when a person took part in collaborative NRM, which supported emergence of identities focused on the place in which NRM occurred. This could impact wellbeing positively or negatively, depending on whether the obligations associated with that identity were fulfilled:

The group-identity developed through [a regional NRM policy process] gave members standing in their communities and a sense of belonging to an important group ... (Moore et al., 2001, p. 96).

Some volunteers spoke of their [NRM volunteering] experiences almost entirely in terms of their identity, and the consequences (both positive and negative) of being identified in certain ways by members of their group or by parties external to their group. Through friendships developed while working [on NRM projects], and through regular visits to the same locations, many volunteers developed a strong affinity with the land or waterway where their work continues to be undertaken (Gooch, 2003, p. 23).

Consistent with social identity theory, where farmers' existing social identities were supported, reinforced or fulfilled by NRM, it was likely to increase wellbeing.

Through reliance on peer groups, networks and social expectations ... [landcare-based NRM] encouraged many farmers to adopt or maintain their role as landscape stewards (Kingwell et al., 2008, p. 903).

Sense of place was strengthened in Downside through landcare members' feelings of identity with and commitment to people sharing a common landscape. These feelings of commitment and identity are shared not just with other members of the group, but are perceived as attachments to the very ground itself. This concept of rootedness goes beyond simply "caring" for a place to also imply a real responsibility and respect, hence "stewardship" (Carr, 2002, p. 158–159).

Conversely, also consistent with social identity theory, two studies recorded instances in which farmers rejected or co-opted NRM when it challenged their values. For example, in one study, farmers rejected new information about environmental degradation that challenged their existing knowledge (Compton and Beeton, 2012).

3.3. Proximal factor (iii): self-efficacy

Self-efficacy is a person's capacity for autonomy or 'mastery' over their life, evidenced by a person feeling able to successfully overcome challenges, achieve their goals and have positive self-esteem (Sobels et al., 2001; Compton and Beeton, 2012). Self-efficacy is connected to wellbeing via multiple pathways including improved mental health and standard of living, and ability to achieve goals that validate identity.

Self-efficacy as a proximal determinant of wellbeing: Claims and counter-claims are made about the 'empowering' nature of NRM (Taylor, 2009). 23 studies identified links between NRM and self-

efficacy, with four unique pathways identified. First, some studies linked NRM directly to improved self-efficacy, documenting a positive effect on areas such as farmers' empowerment, self-esteem and sense of control over their life, with no mediating concepts. Second, NRM that reduced land degradation led to an increase in farmers' sense of control in being able to successfully care for their land; conversely, if NRM failed, this damaged self-efficacy. Third, improvements in social capital associated with NRM increased self-efficacy. In particular, the social networks created by collaborative NRM enabled farmers to leverage resources, in turn increasing self-efficacy. Finally, NRM often increased farmers' skills and knowledge and, through this, self-efficacy.

the social interaction during the [NRM] extension service had an immediate positive impact on motivation and self-esteem... [however] extension activities may place additional expectations and pressures on farmers and may lead to feelings of less power, poorer self-efficacy and potentially increased distress (GSAHS, 2010, p. 18).

... the two Landcare Networks have ... increased the learning capacity of individuals and groups, resulting in an increased capacity to deal with bureaucracy, an increasing confidence in discussing more complex concepts and information, and an increased ability to adapt to change. (Sobels et al., 2001, p. 268).

3.4. Proximal factor (iv): health

Health covers a broad range of domains related to a person's physical and mental condition and capacity which cannot be described in detail here. Of direct relevance, physical and mental health are highly interrelated so that one affects the other (Herrman, 2001), as are health, wellbeing and life satisfaction (O'Brien et al., 2012). Health is both a contributor to and an outcome of wellbeing, similar to other wellbeing determinants.

Health as a proximal determinant of wellbeing: 25 studies identified four linkages between NRM and health. First, NRM may directly encourage physical activity and interaction with the natural environment, and hence benefit health. This was identified only in studies examining linkages between 'caring for country' by Indigenous peoples and social and emotional wellbeing, and not in other studies. Second, NRM can influence health through reducing environmental degradation in a given place (e.g. improving water quality or environmental amenity). This improves the health of people living and working in that place, through reducing exposure to environmental health risks and improving identity fulfilment and self-efficacy.

Disruption to places, as in environmental degradation, is also associated with higher levels of stress, feelings of marginalisation, avoidant coping, and lower levels of self-esteem. The intractable and relentless nature of environmental degradation may lead to feelings of hopelessness and helplessness... (Horwitz et al., 2001 p. 258).

Engagement with land management can lead desert Aboriginal people to feel that their own actions are consistent with their own sense of the right and proper way for them to behave towards land, family and community. This increased 'sense of control' impacts positively on health ... (Davies et al., 2011, p. 417).

Third, one study identified that the increased awareness of environmental degradation that accompanies engagement in NRM can, if unaccompanied by means to address degradation, leave farmers feeling profound helplessness, harming their mental health.

Feelings of reduced personal accomplishment are likely to be a result of, and will be exacerbated by, a growing awareness of the scale of environmental issues facing [l]andcare participants

and the increasing reliance on voluntary approaches to their management (Byron and Curtis, 2001, p. 323).

Finally, NRM affects health by influencing the farmers' personal resources, particularly their time and income. NRM may increase these resources by providing access to funds or labour; but can also place demands on farmer's time and funds that lead to stress, burnout and poorer mental health, particularly where farmers have strong stewardship identity. The impacts of this are likely to be non-randomly distributed, with resource-poor farmers less able to adopt practices such as NRM, though some studies suggest they are just as likely to want to as other farmers (Berry et al., 2011b).

Many farmers are more than willing to continue suffering varying degrees of social deprivation to maintain their generational bond to the property. Some male farmers are clearly putting the land before themselves and their families with a belief that the wellbeing of themselves and families should only be addressed once the wellbeing of the farm is attended (DPRESP 2008, p. 11).

3.5. Proximal factor (v): standard of living

Being able to achieve a minimum standard of living (having access to adequate income, material goods and other material goods and services) is essential for wellbeing, although the benefit of increasing material wealth diminishes upon attaining a wealth threshold (Cummins, 2000). Internationally, multiple studies have found that NRM can have positive impacts on standard of living (Greiner and Stanley, 2013).

Standard of living as a proximal determinant of wellbeing: 19 studies included evidence that NRM influences farmers' standard of living, with four pathways identified. First, through addressing environmental degradation, NRM can increase farm productivity and, in turn, farmer income; conversely, the time and resources required for NRM can reduce farmers' standard of living. Second, receiving an NRM grant or access to equipment to undertake NRM can increase farmers' resources, improving their ability to earn income and generate material assets and their standard of living. Third, participating in NRM can increase farmers' skills and knowledge through providing opportunities to learn from other farmers or access to training courses or expert advice. These skills and knowledge can be used to improve standard of living. Finally, NRM sometimes provides income-earning opportunities and hence improved standard of living. For example, a farmer may be paid to undertake NRM activities such as weed spraying.

It appears that an important motivation for many [I]andcare members is to access government and group resources likely to assist them in increasing production and income, or to protect and enhance their property values (Curtis and van Nouhuys, 1999, p. 101).

3.6. Distal determinants of wellbeing

The proximal determinants of farmer wellbeing described above suggest six distal linkages between NRM and wellbeing. Four of these are NRM-specific changes that influence proximal wellbeing determinants:

- *Land condition:* The impacts of NRM on environmental health. This outcome of NRM was linked to changes in standard of living, health, self-efficacy and identity. Thus, the principal objective of NRM – reducing environmental degradation – has a potentially powerful influence on wellbeing.
- *Farmer resources:* NRM impacts farmers' personal resources, particularly time and income, and this in turn influences standard of living and health.

- *Skills and knowledge:* NRM can increase farmers' skills and knowledge in areas including land management, grant writing and engaging with government programs. This influences health and self-efficacy.
- *Access to (external) resources:* NRM can increase access to external resources such as grants, equipment and expert advice that in turn influence health and self-efficacy.

In addition, a small number of studies identified that *social capital* acted as a distal mediator that contributed to wellbeing by influencing standard of living, self-efficacy and farmer identity, while some studies described *self-efficacy* as leading to changes in mental health. These relationships suggest a range of reciprocal relationships between different factors, with feedback loops sometimes occurring between proximal and distal factors.

3.7. Moderating factors

The QMS identified multiple moderating factors for the NRM-wellbeing relationship. All focused on the equity/fairness, complexity, security and capacity of NRM. Because these are all direct outcomes of the design and delivery of NRM, the wellbeing effects of any individual NRM program are likely to depend in large part on how that NRM program is designed and implemented.

Equity/fairness: 14 studies identified inequities resulting from the design or delivery of NRM. Most involved the dominance of NRM decision-making processes (for example, decisions about the distribution of funding) by elite interests, with negative consequences for the wellbeing of excluded groups.

Three studies identified that collaborative NRM groups sometimes exclude particular farmers (intentionally or unintentionally), or place inequitable demands on members, with some members 'loafing' while others do an unfairly large share of NRM work. Six studies argued that NRM funding processes reinforce inequity, with disadvantaged groups less able to successfully negotiate the often complex processes involved in applying for and managing funding, particularly farmers who were Indigenous, poorer, less educated, women, from non-English speaking backgrounds or who had smaller properties. This issue has also been identified in the international literature on NRM (Greiner and Stanley, 2013). These characteristics are also among the defining features of broader social marginalisation, in which people experience multiple interacting disadvantages which perpetuate a chronic lack of opportunity and social exclusion (Berry et al., 2008a). The linkages between social disadvantage and land degradation have been the subject of multiple studies, as land degradation and social disadvantage often coincide (Fisher and Christopher, 2007), meaning that marginalised farmers are more likely to be farming degraded land than others. Social disadvantage, particularly poverty, has been widely hypothesised as a primary cause of land degradation. However, multiple empirical studies have demonstrated this assumption to be false: while poorer people often manage land with greater degradation, poverty is as likely to be a consequence as a cause of this degradation, and both land degradation and poverty emerge from a complex mix of interacting factors (Jones, 2008). Indeed, poorly resourced farmers have been found to be among those most likely to want to engage in environmentally-friendly farming practices, hampered only by their lack of financial and other resources (Hogan et al., 2011).

At a larger scale, three studies argued that the premise of NRM – the devolution of responsibility for reversing environmental degradation to farmers – is unfair, as this devolved responsibility is not accompanied by devolution of decision-making power or resources.

Some respondents noted how they floundered in the political environment of natural resource management, often feeling left out of important decision-making processes. The end result can erode group resilience, as individuals felt let down and exhausted by the process (Gooch and Warburton, 2009, p. 165). ... devolving [NRM] plan-making and engagement functions to the sub-regional level may be initially effective in garnering local ownership and involvement. Where this is done on a short-term basis, however, without the transfer of decision-making powers, frustration, uncertainty, and high social transaction costs appear (Taylor, 2009, p. 39).

Complexity: Excessive ‘red tape’– overly complex, time-consuming and unclear processes for applying for and managing NRM resources – was associated with increased stress and burnout for farmers, and reduced self-efficacy. Four studies specifically identified this link; 9 others described NRM administrative processes as being onerous or overly complex without linking it to wellbeing.

... [I]andcare involves a lot of ‘red tape’. ... many farmers, both in and outside of [I]andcare groups, believe that there is a lot of ‘stuffing around’ inherent within the system. The inordinate amount of time spent in meetings, workshops etc generated by the bureaucracy supports this belief and is seen to detract from the time spent on ‘necessary’ activities (Morrissey and Lawrence, 2000, p.155–156).

Security and capacity: Nine studies identified lack of continuing or adequate NRM funding as a barrier to reversing environmental degradation. ‘Stop-start’ cycles of funding are common in NRM, with many programs funded for a one to two year period. This reduces the success of NRM and any associated wellbeing benefits. This issue is also consistently noted with respect to funding for rural wellbeing programs (Hart et al., 2011). Three studies argued that a lack of adequate NRM funding results in farmer disillusionment due to high failure rates in application for NRM funding, similarly negatively impacting wellbeing.

3.8. Synthesis

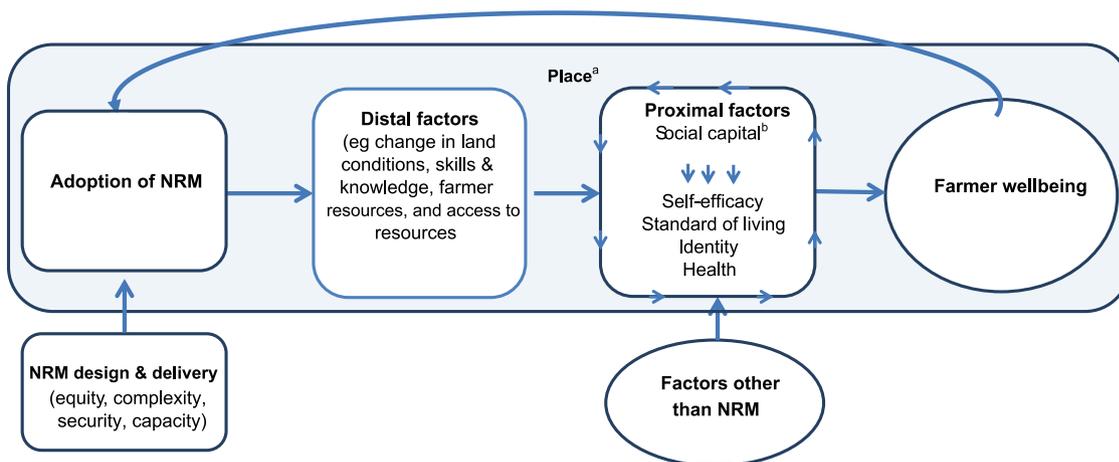
In the final stage of our analysis, we took the varying and often complex relationships between NRM and wellbeing identified in the QMS to this point, as well as broader theories on the

determinants of wellbeing, and synthesised these into a theoretical model intended to guide future exploration in this area (Fig. 1). Table 3 lists the multiple specific linkages between NRM and wellbeing identified in the QMS. Because the studies we included did not systematically examine issues related to wellbeing, we may not have captured all possible paths linking NRM and wellbeing and cannot identify which specific pathways are most influential or common. Reflecting these limitations, Fig. 1 leaves open the possibility of multiple combinations of the factors linking NRM and wellbeing, including the likelihood of pathways not identified in the QMS. Our analysis did, however, allow us to shape the overall parameters of the model and to decide how deterministic each part of the model could be.

Our model begins from the point at which a farmer engages in NRM. While the choice to engage in NRM is itself influenced by the wellbeing of the farmer (as indicated by the feedback from wellbeing to adoption of NRM), our interest is in exploring the specific effects of NRM on wellbeing. The moderating effect of the design and delivery of NRM influences the initial choice to engage in NRM and, therefore, all subsequent effects on wellbeing.

The influence of NRM on wellbeing, like other determinants of wellbeing, is mediated by distal and proximal factors. Proximal factors were defined as being those identified in the QMS as directly influencing wellbeing and which had a strong evidence base in the broader determinants of wellbeing literature. While only some of these factors were found to be inter-related in the QMS, the broader literature suggests that there are strong inter-linkages between all proximal factors; this interaction is indicated by arrows cycling around the proximal factors. Because our present analysis and the broader wellbeing literature both highlight the importance of social capital in influencing wellbeing both in and of itself and via its impacts on self-efficacy, standard of living, identity and so on, it is separated and highlighted as being of particular importance.

The distal factors we identified were all defined, shaped and constrained by place (for example, land conditions determine what knowledge is needed, what resources are available and consumed). These place-related factors have flow-through effects on the proximal factors. Hence, while efficacy, identity and social capital may not seem place-based, for farmers, they are shaped by place-related factors. This is one way in which farmer health is powerfully related to place and, because place is embedded



^aPlace here refers to the geographical places with which the farmer interacts and which help determine the farmer’s income, identity, and social networks, amongst other factors

^bThe model is focused on individual farmer wellbeing but includes factors that depend on actions and characteristics of the broader places and community the farmer interacts with, such as social capital.

Fig. 1. Theoretical model of linkages between NRM and individual farmer wellbeing.

throughout the process of caring for land through NRM and deriving health benefits from this situated experience, we have explicitly included geographical place in our model.

Finally, NRM will be just one of multiple factors influencing a farmer's wellbeing and we include 'factors other than NRM' as a specific element of the model; these other factors will interact with NRM-related influences on wellbeing to produce ultimate wellbeing outcomes for any individual.

4. Discussion

Our goal was to explore the potential of NRM as a place-focused, non-conventional health intervention that operates through the social relationships enacted in specific landscapes, and farmers' capacity to successfully care for their land. While the literature analysed for this paper was limited to a set of regionally-specific studies, it suggests that NRM has the potential to positively influence farmer wellbeing, in some cases, profoundly. Equally important, it also suggests that NRM activities can have negative effects under certain circumstances. A strength of our analysis is to introduce relevant theories (such as social identity theory and the theory behind social capital) which go beyond description to explain why NRM may have a small or large effect on wellbeing and to predict when this will be for better or for worse. This capacity to predict is extremely important for developing policy and programs that are likely to have substantive and positive outcomes.

Our findings reinforce that the effects of NRM on wellbeing are enacted through, and depend on, place. Place here refers to a complex dynamic whereby the geographic space in which farmers live and work shapes their identity, social networks, physical and mental health and other wellbeing determinants. While the objective of NRM is to improve the physical environment of the agricultural landscape, our findings show that it has impacts that go well beyond this to affect multiple determinants of wellbeing.

The nature of our analytic approach and the coverage and nature of the literature place some constraints on the conclusions that should be drawn from our study. Many of the studies reviewed had limited evidence to support their claims of causal relationships and, thus, our proposed explanatory framework is necessarily speculative. Our findings may also exclude some important linkages between NRM and wellbeing simply because not all types of NRM were represented in the studies analysed. Limiting our study to Australian evidence may also limit the applicability of our framework to other countries and cultures. However, the Australian literature in this space is recognised as particularly strong; and the linkages we propose are based on theories of health and human behaviour for which there is sound international empirical evidence, suggesting a high likelihood of broader applicability.

Our analysis was intended to hypothesise relationships in order to inform more systematic investigation of NRM as a potential health intervention. The common themes emerging across multiple studies suggest implications for using NRM as a health intervention, each of which warrants further research.

First, NRM impacts different farmers in different ways, and our analysis suggests that NRM may often exclude marginalised farmers. If this is the case, it has negative implications for both farmers and the environment. While farmers with greater resources may be able to achieve greater reversal of environmental degradation for a given investment of NRM funding compared to marginalised farmers, a concentrated lack of support for marginalised farmers will concentrate land degradation on their farms, further marginalise already struggling farmers, and further reduce their wellbeing. Additionally, they tend to farm more marginalised land which has a greater need of remediation. Providing support for

marginalised farmers to participate in NRM may have a range of beneficial outcomes for both the health of land and the wellbeing of farmer. The potential of targeting NRM towards marginalised landholders requires further exploration, to identify whether it can provide farmers with benefits that reduce their level of marginalisation, either through enabling them to farm more profitably and sustainably, or providing them with greater opportunity to exit farming, as land in better ecological condition is more readily saleable. Further research in this area could have important implications for governments' environmental, social and health policies.

Second, the design of NRM is critical to whether it supports wellbeing. In our model, we were not able to distinguish how different types of NRM impact on wellbeing: although the evidence we analysed clearly demonstrated the importance of the design and delivery of NRM, it was not sufficient to draw exact conclusions about the specific wellbeing impacts of particular types of NRM. Much previous research has focused on how changes to the natural environment impact wellbeing, without examining how this relationship is moderated by the design of the policy instruments used to enact change the natural environment.

However, there is currently insufficient evidence to guide identification of optimal NRM design with much specificity. In our model we were not able to distinguish or properly classify how different types of NRM impact on wellbeing. Although the evidence we analysed clearly demonstrated the influence of the design and delivery of NRM, it could not be used to draw exact conclusions about the specific wellbeing impacts of particular types of NRM, largely because previous studies have not explicitly considered how design of NRM impacts its outcomes. Our findings clearly show that project design shapes impact on wellbeing, and in ways not necessarily isomorphic with positive environmental outcomes (see [McShane et al., 2011](#)), but our analysis cannot say why, because studies have not systematically investigated this question. Our synthesis suggests that the design of NRM influences its equity/fairness, complexity, security and capacity, each of which moderates the capacity of NRM to achieve wellbeing outcomes. Additionally, some of our other findings suggest that the particular NRM policy instrument used will in part determine whether social capital benefits are achieved, with links between NRM and social capital largely identified in relation to collaborative NRM, and not NRM delivered using other approaches. However, these findings are not conclusive because studies have tended to refer in general terms only and have not analysed which components of social capital or in what combination produce particular outcomes. There has, similarly, been mention of social identity but no theory-based analysis, and so knowledge about how and when positive social identities will be produced is lacking. These matters require further investigation to identify the extent to which the mode of NRM design and delivery influences the wellbeing benefits achieved.

NRM is currently delivered – in Australia and internationally – using a bewildering array of policy instruments and implementation processes. For NRM to succeed as a health intervention, it must reverse environmental degradation *and* simultaneously facilitate wellbeing. Clearly, in some cases, it achieves these linked goals, while in others it fails on one or both counts. Identifying the policy instruments and approaches that work to achieve both can go a long way toward achieving healthier places *and* healthier farmers, creating a self-sustaining virtuous cycle. This is an important area for further exploration, and one where there is potential for the NRM and health sectors to work more closely with each other.

Third, we do not understand the relative strength of influence of NRM versus other factors on wellbeing, either in general or via any of the multiple pathways of influence proposed. While NRM's influence on wellbeing will vary in different situations, it is nevertheless critical to identify whether NRM can have a 'large enough' impact on wellbeing, relative to other factors, to warrant

considering it as having significant co-benefits for wellbeing. This requires controlled intervention studies that track wellbeing before, during and after farmers participate in NRM to describe the direction and magnitude of any changes.

5. Conclusion

Farmers' land is part of who they are and caring for their land is part of caring for themselves. Their close relationship with the land they work creates a special vulnerability for them when that land is degraded. Consequently, well designed and delivered NRM programs to counter land degradation offer a unique opportunity to serve a dual purpose of effective health interventions. We have used QMS methodology to assemble and interpret existing evidence to develop an explanatory framework that conceptualises the relationship between NRM and well-being. This provides a starting point for systematic research to better articulate when, why and how NRM may have an influence on wellbeing of sufficient significance to warrant consideration of these wellbeing impacts in its design and delivery.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.healthplace.2013.08.007>.

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