Understanding landholder participation in biodiverse carbon plantings

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis/project is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

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I would also like to acknowledge landholders who kindly participated in this research. I was able to undertake this research only with their willingness to share their stories and experiences. I appreciate policy makers and academics providing insight in to my work.
Abstract:

The management of biodiverse carbon forests on private land has emerged as a potentially significant conservation activity to tackle both climate change and biodiversity loss. Biodiverse forests can act as carbon sinks, improve biodiversity condition, tackle salinity and erosion and improve soil quality. They can also increase productivity rates for agriculture by acting as shelter belts and may increase climate change resilience in the local landscapes. In Australia, 70% of land is privately owned or leased, with 53% utilised for agriculture. These figures highlight the need to engage with farmers and land managers if we are to effectively pursue conservation activities across the landscape.

Despite the great potential for biodiverse carbon forests, global participation in bio-sequestration schemes has been limited. There is a lack of information regarding the perspectives of various actors in biodiversity management and bio-sequestration projects, both in the Australian context and internationally. Hence there is a need for research into the drivers and barriers for landholders to integrate biodiverse forests into agricultural landscapes. This thesis seeks to unpack the roles of socio-cultural drivers and how they relate to program design with the aim of improving participation rates in biodiverse carbon plantings.

Using a mixed-method research approach, I interviewed and surveyed 17 landholders who participated in a voluntary biodiverse carbon planting scheme in Victoria, Australia. I recruited the research participants through Greenfleet, a not-for-profit environmental organisation that plants biodiverse forests across Australia to offset greenhouse gas emissions (for companies and individuals). Drawing on adoption theory, I analysed interview and survey data at each stage of program adoption: awareness, non-trial evaluation, trial evaluation, adoption and post adoption. I have presented two groups of factors that impact landholders’ participation: landholder-related factors (e.g. cultural drivers) and external (e.g. political uncertainty). My results highlight the important role of social capital, trust and social networks in particular, in the success of biodiverse carbon plantings.
Furthermore, I explored the opinions of other stakeholders (policy makers and academics) in the field of carbon and biodiversity. In doing so, I examined different scenarios for bundling and stacking ecosystem services credits. These findings have important implications for the design and implementation of carbon and biodiversity-related programs, and indeed for any incentivising policies that look at bundling or stacking multiple ecosystem services credits. The synergies between ecosystem services driven by biodiverse carbon plantings make it appealing to both buyers and sellers. Hence, fostering the trade-offs and synergies in a careful policy design could reinforce achieving both biodiversity conservation and carbon sequestration objectives.

I also developed a Bayesian Belief Network model to represent landholder participation in biodiverse carbon planting schemes to determine factors most likely to influence program participation, based on financial incentives, program attractiveness and the value of co-benefits. I explored different policy scenarios that aim to provide more financial incentives to landholders, including stacking, bundling and payments for carbon credits. Results from the BBN model indicate that the rate of landholder participation is most sensitive to changes in program attractiveness (including administration procedure and committed time for participation). Hence, a more flexible program design that offers different options for landholders to choose from, based on their own knowledge and available resources (e.g. time) seems to provide the optimal option for improving landholder participation rates. These results could assist policy designers to achieve biodiversity conservation, carbon abatement goals and resilient rural communities.
Contents
Declaration ....................................................................................................................................... 2
Acknowledgment ............................................................................................................................. 3
Abstract: ........................................................................................................................................... 4
Preface: .......................................................................................................................................... 11
Chapter One: Introduction ............................................................................................................. 12
  Rationale: Why research socio-cultural drivers? ................................................................. 14
  Research Questions ............................................................................................................. 15
  Significance ........................................................................................................................ 16
  Overview of the Thesis ........................................................................................................... 16
Chapter Two: Methodology and method ...................................................................................... 18
  Introduction ............................................................................................................................... 18
  Philosophical context and position of my research .......................................................... 19
  Conceptual framework ......................................................................................................... 20
    Diffusion of Innovation and Adoption theory ................................................................ 20
  Research Methods ..................................................................................................................... 23
    Case study rationale and characteristics: Greenfleet and Carbon Farming Initiative ........ 23
    Data Collection ....................................................................................................................... 25
    Data Analysis ....................................................................................................................... 29
    Developing prototype Bayesian Belief Networks .............................................................. 30
    Ethical considerations ......................................................................................................... 32
    Politics .................................................................................................................................. 33
    Role of the researcher ......................................................................................................... 34
    Validity and reliability of the research .............................................................................. 34
    Triangulation ......................................................................................................................... 35
    Limitations of this study ..................................................................................................... 35
Chapter Three: Biodiverse carbon plantings as a tool for mitigating and adapting to climate change

Climate change
Mitigation outlook at the global level
Adaptation
State of GHG emissions in Australia
Carbon offsets and biodiversity
Policy setting

Chapter Four: Socio-cultural drivers of landholders participating in biodiverse carbon schemes

Introduction
Profile and demographic characteristics of landholders
From awareness to post-adoption of biodiverse carbon plantings
Step One: What are the important elements in raising awareness among landholders?
Second Step: Non trial evaluation of biodiverse carbon planting schemes by landholders
Third Step: trial evaluation (decision phase) of biodiverse carbon planting by landholders
Step four: Adoption of biodiverse carbon planting
Step Five: Post-adoption of biodiverse carbon planting
Conclusion

Chapter Five: The role of social networks and trusted peers in promoting biodiverse carbon plantings

Abstract
Introduction
Landholder stewardship and social capital
Methods
The study area
Sampling procedure
Data collection
Appendix IV- BBN model in the neutral state ................................................................. 217

Appendix V- Landholder survey ..................................................................................... 218

Figures

Figure 1: Case Study locations within Catchment Management Authority boundaries (biodiverse carbon planting sites) .......................................................... 25
Figure 2: Australia’s emissions trends, 2000 to 2020 and the abatement challenge (Commonwealth of Australia 2013a) ................................................................. 40
Figure 3: Participation steps in the ERF (Commonwealth of Australia 2014) ......................... 42
Figure 4: CMAs in which the research is conducted ........................................................................... 57
Figure 5: Case study location in Victoria, Australia. Dark grey CMAs represent the study areas where interviews took place .................................................................................. 102
Figure 6: Research interviewees by industry. CSIRO refers to the Commonwealth Scientific and Industrial Research Organisation .......................................................................................... 125
Figure 7: The broad position of interviewees on various options of integrating carbon and biodiversity markets. 'P' identifies policy-related interviewees and 'S' scientific experts .................................................................................. 135
Figure 8: Steps undertaken to develop and run the BBN model to test policy implications .................................................................................................................. 149
Figure 9: Influence diagram depicting the causal web of key correlates affecting landholder participation rate .................................................................................. 153
Figure 10: A wizard’s hat diagram showing the sensitivity of the ‘Landholder participation rate’ output node to each one of the model’s parameters .................................................................................................................. 157
Figure 11: Influence of different scenarios on ‘Landholders’ participation rate. Scenarios are a combination of the type of incentives (X Axis) and the permanence of the agreement (Y Axis). .................................................................................................................. 159
Figure 12: The role of social networks and trust in program uptake and implementation through time .................................................................................................................. 166

Tables

Table 1: The number of eligible offset projects and Australian Carbon Credit Units issued since the beginning of this scheme until August 2015 (Australian Government 2015) .................................................................................................................. 42
Table 2: Landholder profiles: Pseudonym, type of land use, their CMA and plantation size .................................................................................................................. 56
Table 3: Socio-demographic characteristics of landholders .................................................................................................................. 58
Table 4: Conservation activities undertaken by landholders .................................................................................................................. 63
Table 5: Tender-based programs that interviewed landholders participated in .................................................................................................................. 65
Table 6: Related conservation activities in the CMAs within which interviews took place .................................................................................................................. 66
Table 7: Description of each node of the BBN, the states each node can be classified as and relevant data sources .................................................................................................................. 154
Table 8: Description of each scenario, mean and confidence intervals (2.5% and 97.5%). Scenario 7 is the status quo .................................................................................................................. 158
Table 9: Sensitivity analysis showing expected reduction in entropy in changes to landholders’ participation rates due to changes in other variables in the model .................................................................................................................. 163
Preface:

The design and execution of this thesis is substantially my own. I collected and analysed the data and undertook more than 80% of work in each paper. This work has been enriched by contributions from others, which need to be stated.

Three chapters in this thesis are in forms of papers. One of the chapters is published and two are under review:

Chapter Five:

**Torabi, N.,** Cooke, B., Bekessy, S. *The role of social networks and trusted peers in promoting biodiverse carbon plantings.* Submitted to Australian Geographer Journal.

Chapter Six:


Chapter Seven:


Chapter Seven has more co-authors as the topic of Bayesian Belief Networks is a complex probabilistic field and needed the feedback of people specialised in this topic.

I also intend to publish Chapter Four after submitting this thesis for examination. Part of this chapter has already been written as a paper:

Chapter One: Introduction

“... Most of the potential risks and surprises affecting biodiversity also present opportunities if Australians think strategically, anticipate, prepare and act.” (Hatton et al. 2011, p.39)

The issue of climate change has received substantial public and scholarly attention and is now a strategic part of the global economic and ecological consideration (Capon & Ambrosi 2008). As the human-induced change in climate continues (IPCC 2007)(IPCC & Cambridge University Press 2007), impacts on ecosystems and society will become increasingly problematic, particularly if Greenhouse Gas emissions (GHGs) are not halted (Wise et al. 2014). As a hot and dry continent, Australia will be much affected by climate change with more frequent droughts and fire (Garnaut 2008; Buys et al. 2011). Hence, immediate actions to mitigate these impacts are necessary (Wise et al. 2014).

In Australia, biodiversity is in a parlous situation and biodiversity loss is among the most important ecological issues (Hatton et al. 2011; Vanclay & Lawrence 1995). The State of Environment Report 2011 (Hatton et al., 2011) concluded that human activities such as land clearance in addition to population growth are responsible for the situation. Currently, public conservation areas encompass nine per cent of Australia but are not considered adequate to conserve biodiversity given their size and the ecological systems they represent (Cowell & Williams 2006). Therefore, biodiversity conservation on private land (two-thirds of Australia) requires more attention and the participation of landholders is essential (Stephens 2001).

Biodiverse carbon planting is a key private land conservation practice that needs active stakeholders’ involvement to deliver successful policy design and implementation. In addition to storing carbon, tree planting has the potential to preserve vital ecological processes and provide suitable habitats for wildlife (Bauhus et al. 2010; Campos et al. 2005; Carswell and Burrows 2006). Biodiverse plantations will potentially increase the availability of resources for native animals, function as seedling banks and enhance the resilience of the
ecosystem against climate change and pest invasion (Crossman et al. 2011; Pearce, 2005). Such plantations can be incorporated into existing farming systems through wind breaks, riparian zones and native woodland plantations (Sabto & Porteous 2011).

Many private land conservation programs fail to achieve sufficient landholder uptake (Comerford 2014). In the case of biodiverse carbon plantings, a better understanding of landholders’ socio-cultural drivers (non-market values) and how these relate to program design and financial incentives could assist with delivering a scheme that could better achieve biodiversity conservation and carbon sequestration objectives. Such considerations could lead to higher participation rates and help to close the policy-implementation gap (Kragt et al. 2014), hence improving the projected outcomes of policies. Schemes that consider landholders as change agents in program design and implementation are likely to be more successful (Blackmore and Doole 2013).

Market approaches and payments for ecosystem services aim to increase biodiversity conservation by providing financial incentives to landholders. Biodiverse carbon planting is one of these market mechanisms that have the potential to stimulate investment in biodiversity conservation alongside carbon sequestration. However, there has been some criticism of the lack of ecological considerations including proper monitoring of biodiversity outcomes (Burns and Lindenmayer 2012). Furthermore, social and cultural factors have the ability to influence these market approaches to biodiversity management, yet they are often overlooked in the design of programs (Bekessy and Cooke 2011). Indeed, Walker et al. (2009) questioned the ability of market-based schemes to achieve preferred biodiversity outcomes in dealing with complex socio-ecological systems. Failing to appropriately address the socio-cultural drivers will reduce investment effectiveness (Bekessy and Cooke 2011).

In addition to social, environmental and cultural drivers for participation, the attractiveness of a program to landholders could influence participation rates. McCann (2013) states that there is a lack of research in areas related to the design of environmental policies. The success and effectiveness of policies that aim to provide payments for ecosystem services...
(i.e. biodiverse carbon planting) depend on the design of the program offered to
landholders (Engel et al. 2008). When a carbon farming program is offered to landholders,
its characteristics could influence the likelihood of landholders participating. For example, a
more flexible program could fit more easily with existing land management approaches and
hence may be more appealing (Blackmore and Doole 2013).

Financial incentives are traditionally considered a strong motivation for landholders to
participate in private land conservation schemes (Rode et al. 2015). However, recent
research suggests that such incentives may have minimum impact on landholders’ decisions
to participate in carbon planting programs (Kragt et al. 2014; Blackmore and Doole 2013).
Although monetary incentives could offset transaction costs including establishment and
ongoing monitoring expenses (Cacho et al. 2013; Cacho and Lipper 2007; Bigsby 2009), they
are not necessarily driving landholders’ willingness to participate. Considering incentives to
be the main motivation could ‘crowd out’ the primary drivers for participation (Luck et al.
2012; Rode et al. 2015). This issue highlights the potential for complex socio-cultural factors
to influence program uptake and implementation success.

In this thesis, I investigate the various elements that are involved in landholders’ decisions
to participate in such practices including their socio-cultural drivers, the characteristics of a
program and financial incentives offered.

**Rationale: Why research socio-cultural drivers?**

Whilst some research has begun to examine the economics and ecology of bio-
sequestration schemes (Sanders 2008; K. I. Paul et al. 2013; Crossman et al. 2011a; Hunt
2008; Bradshaw et al. 2013), little attention has been paid to the social and cultural drivers
of private landholders who participate in bio-sequestration projects on their land. This
research aims to undertake a detailed study of the social and cultural drivers behind
biodiverse carbon planting projects on private land. There is a lack of information regarding
the perspectives of various actors in biodiversity management and bio-sequestration

PhD thesis
projects both in the Australian context and internationally. I will focus on developing an interdisciplinary research approach that “integrates multiple methods and disciplines into analysis as well as data collection and has some characteristics of public good” (Poteete et al. 2010, p.263). I believe that this approach to research will result in the multidisciplinary insights that are required to provide meaningful policy recommendations. It allows me to more deeply inform interventions in public policy by understanding the participants’ experiences.

According to Marshall and Rossman (1999, p.2), “Initial curiosities for research often come from real-world observations, emerging from the interplay of the researcher’s direct experience, tacit theories, political commitments, interests in practice and growing scholarly interests.” This research will continue my personal experience and professional practice in this field. I recently worked for Greenfleet, a not-for-profit organisation that plants biodiverse trees on properties around Australia to offset greenhouse gas emissions. Being in contact with private landholders made me aware of social and cultural drivers that motivate tree planting, which often requires a shift from a ‘business as usual’ approach to land management. A key question that drives this research is how policy can be changed to enable private landholders to earn both biodiversity and carbon credits.

**Research Questions**

The aim of this study is to explore social and cultural elements at play in various stages of biodiverse carbon planting adoption and apply the lessons learned in designing market-based conservation instruments for bio-sequestration schemes. To achieve this aim, the following research questions are posed.

- How do social and cultural influences identified by landholders impact decisions about biodiverse plantings for carbon sequestration on private land?
- How would the program better incentivise biodiverse carbon plantings (feasibilities and opportunities) and what are the prospects for integrating carbon and biodiversity markets?
What are the key opportunities for policy intervention to obtain a higher level of private landholder participation in biodiverse plantings for carbon sequestration projects?

In this PhD project, I have explored how objectives for biodiversity conservation and carbon sequestration on private land can be combined in the design of policy instruments. I will explore landholders' social and environmental values and drivers for participation in a voluntary scheme. I believe that, due to the voluntary nature of these schemes, it is important to understand how programs are taken up by the community and adapt policy design and implementation where necessary. The lessons learned can assist the design of market based instruments (MBIs) to stimulate investment, focussing in particular on the role of behavioural and cultural influences (key factors that drive adoption) in delivering successful outcomes.

**Significance**

Significant outcomes of this research will include: (i) improving the decision-making capacity of government and policy makers involved in managing carbon and biodiversity markets; (ii) helping to choose a particular course of action to engage landholders in more effective land conservation, and (iii) generating enhanced biodiversity outcomes by considering socio-cultural drivers. At the national level, this research will explicitly tie into two Federal Government National Research Priority Goals, namely “Australia’s Biodiversity Conservation Strategy 2010–2030”, which aims to double the value of markets for ecosystem services by 2015, and “An Environmentally Sustainable Australia”, the national research goal of sustainable use of Australia’s biodiversity (Department of Sustainability, Environment, Water 2010). The project will broadly contribute to our knowledge of the extent to which biodiverse plantings for carbon sequestration are influenced by landholders' social drivers.

**Overview of the Thesis**

This dissertation comprises eight chapters. Following this introductory chapter, Chapter Two addresses the method and methodology of this study, including discussion of the theoretical
framework and case study characteristics. Ethical considerations and research design are also discussed in Chapter Two. In Chapter Three, I present a review of the rich literature on each of ecological, social and economic issues that need to be considered in designing programs for bio-sequestration and biodiversity management. Policies relevant to greenhouse gas abatement in Australia will be discussed in detail in this chapter. I also review the literature in the field of landholder adoption of conservation practices. In Chapter Four, I outline the socio-cultural factors driving landholders’ participation in biodiverse carbon plantings. This is based on a survey of landholders and interview results. Surveys reveal demographic data while interviews provide a deep understanding of various aspects of adoption. This chapter aims to answer the first research question. Chapter Five focuses on social networks and trusted peers and their roles in program uptake. Based on interviews with landholders, I explore how the concepts of trust and trusted peers assisted landholders to engage in the program. This chapter also continues to explore the first research question. Chapter Six focuses on other actors in the field of carbon sequestration and biodiversity conservation. The focus is on outcomes of interviews with policy makers and academics. Challenges and opportunities presented by the carbon market and the prospect for integrating carbon and biodiversity markets are explored. This chapter is developed to answer the second research question. In Chapter Seven, I present a Bayesian Belief Network and test different scenarios to examine various options for incentivising landholders to participate in biodiverse carbon plantings. This chapter answers the third research question. Chapter Eight presents a broad discussion of findings, including recommendations for policy development and future research. It concludes the thesis, seeking to broaden findings to environmental management in other contexts.
Chapter Two: Methodology and method

Introduction

Both landscapes and landholders in rural areas are affected by climate change. The former is well recognised within the disciplines of ecology and environmental science, and the ecological benefits of revegetation for both carbon sequestration and biodiversity conservation are well studied (Hulvey et al. 2013; Standish & Hulvey 2014). Some impacts on landholders are also well studied, for example, financial (Lin 2011; Rochecouste et al. 2015), social and health-related impacts (Adger et al. 2005; Addison 2013). However, one impact on landholders that is relatively understudied is the growing need for them to participate in mitigation projects, such as private land conservation schemes. As explained in the previous chapter, this research aims to understand how landholders have responded to the growing pressure to participate in schemes, gain insight into the social and cultural factors driving their involvement in biodiverse carbon planting, and predict the uptake of schemes based on pre-existing drivers.

This chapter presents the methodology and research design to answer the research questions presented in Chapter One. I begin by presenting the philosophical context of my research and the theoretical framework that guided my approach. I follow this with a detailed description of methods including the research design of different phases of data collection. I discuss the justification for the choice of each method used to collect and analyse data. I then explore ethical considerations and the political aspects of the research. I conclude this chapter with a discussion regarding the role of the researcher and the credibility, reliability and limitations of my research design.
Philosophical context and position of my research

“You cannot save the land apart from the people or the people apart from the land. To save either, you must save both” (Wendell Berry 1995, p.56)

I take the position that techno-political issues, such as setting targets for carbon abatement in Australia, are inextricably intertwined with socio-ecological systems; for example, how primary land use objectives are balanced and managed with new conservation schemes in an inhabited landscape. Yet policies are typically set with solely ecological targets; for example, to reach the GHG abatement of 131 Mt CO2-e (Commonwealth of Australia 2013a). An unintended consequence of this is that the human agents whose efforts and actions will determine the policies' success or failure often go unacknowledged.

Tackling the interdisciplinary problem of managing ecological issues that have socio-political roots requires, almost by definition, interdisciplinary methods. Borrowing methods from different disciplines is sometimes referred to as ‘multi-methods research’ or, more commonly, a ‘mixed methods’ approach. One advantage of a mixed methods approach is that it reduces the risk that the observations and resulting insights are simple artefacts of the method used. This is sometimes called ‘triangulation’ (Decrop 1999).

However, a serious threat to a sound mixed methods approach is that, in addition to adopting multiple methods (e.g., interviews and experiments) one might unwittingly also adopt multiple methodologies (i.e., research philosophies). This can lead to an incoherent position when those methodologies do not share the same ontology — one cannot be a constructivist or interpretivist at one turn, and a positivist at the next. My own research overcomes the trap of incoherency by subscribing to a pragmatic methodological approach (Feilzer 2010).

In common with constructivist approaches, pragmatism has an “antirepresentational view of knowledge” (Rorty 1999 p.xxvi). This means the research does not aim to represent or
describe reality in a single, most accurate way. However, like positivism - and so differing from constructivism - pragmatism does acknowledge a real world that needs to be dealt with; for example, problems that need to be solved, actions that need to be taken, etc. The goal of research in a pragmatist tradition, including my own, is therefore not to provide an “accurate account of how things are in themselves” but rather to be useful; to “aim at utility for us” (Rorty 1999 p.xxvi). As Feilzer (2010, p.8) explains: “pragmatism allows the researcher to be free of mental and practical constraints imposed by the “forced choice dichotomy between post-positivism and constructivism” (Creswell & Plano Clark 2007, p.27), and researchers do not have to “be the prisoner of a particular [research] method or technique” (Robson 1993, p.291).

In my own research, the pragmatic approach can be seen in both multiple methods of data collection, e.g., surveys and interviews, but perhaps most profoundly in the analysis of data. For example, I conducted interviews asking landholders about their adoption of biodiverse carbon planting practices. The data from these interviews were analysed in two ways. First, I took an in-depth approach, searching for emerging themes in each stage of their adoption of the program. I looked for different motivating factors and drivers for participation in the program. Second, I grouped their responses to form nodes in a Bayesian Belief Network (BBN) to quantitatively predict the probability of participation from the pre-existing conditions thus identified. The overarching purpose of both analyses was to help address the real world problem of increasing participation in private land conservation schemes.

Conceptual framework

**Diffusion of Innovation and Adoption theory**

“As long as the idea is perceived as new to the people involved, it is an ‘innovation’ even though it may appear to others to be an ‘imitation’ of something that exists elsewhere” (Van De Ven 1986, p.592).
In one sense, there is nothing new about revegetation on private property. Landholders may undertake this without being involved in formal schemes — they may simply plant trees! This hardly qualifies as an ‘innovation’, and explanations evoking adoption theory or diffusion of innovation would seem to be over-theorising. However, I submit that when a landholder makes a binding agreement to participate in a formal scheme, the game changes. Now the landholder is faced with the prospect of learning new rules and regulations around the biodiverse carbon plantings, perhaps choosing among a number of schemes and finally committing to a new set of complex farming practices. This undertaking is substantially different to simply ‘planting a tree’, and examining the practices through the theories above now seems more worthwhile.

Rogers' theory of diffusion, first published in 1962 and now in its fifth edition (2003), explains how new innovations are communicated across social channels and eventually achieve widespread uptake - or not. He defines five steps in the diffusion of a new practice among communities: knowledge (awareness), persuasion (interest), decision process (evaluation), implementation (trial) and confirmation (adoption). Factors influencing the success with which an innovation passes through those steps include the quality of communication channels, the existing social system, time and, crucially, the nature of the innovation itself. He identified an important aspect of the latter factor as its “compatibility with the values, beliefs, and past experiences of the social system” (1983, p.4). This acknowledgement has done little to deter critics of the theory, who continue to claim that the theory is uncritically ‘pro-innovation’ with an “individual-blame bias” (Stephenson 2003). I draw on diffusion theory here with a strong awareness that the characteristics of both actors and practices and the socio-political context in which the innovation is being introduced also require study. To meet this challenge, I have examined landholders’ socio-cultural characteristics; the opinions of other stakeholders (e.g. scientists and policy makers) and the broader political context of biodiverse carbon plantings.

Similar to Rogers, Pannell et al. (2006) defined adoption of a new practice process among landholders as a dynamic learning cycle evolving, like my own work, on a smaller scale. Pannell’s framework considers social and cultural characteristics and acknowledges that the
experience, knowledge and culture of landholders play an important role in the program uptake. Pannell et al. (2006) identified the following stages of adoption: awareness of the problem or opportunity, non-trial evaluation, trial evaluation, adoption, review and modification and non-adoption or dis-adoption. My own research uses Pannell’s stages of adoption to examine how landholders develop awareness and interest, their decision-making and evaluation processes and the obstacles they face in implementation. In my context, however, the dis-adoption phase is not applicable because of the nature of the scheme and the agreement between landholders and agencies. Instead, I also explored a post-adoption phase. This is when landholders start experiencing the benefits of the trees and also introduce the scheme to others (that is, act as a change agent themselves).

Rogers was the first to identify how early adopters could be considered as role models for non-adopters or potential adopters (Rogers 2003; Valente 1996; Feder & Umali 1993). Pannell et al. (2006) argued that early adopters play a more important role in the first phases of adoption (i.e. up to the trial phase) after which they become less critical as others begin to become motivated by their own experiences rather than by others. My own results, described in Chapters Four and Five, show an extended influence of early adopters (trusted peers) continuing through to post-adoption phases.

I explore the way early adopters influence other landholders through social network theory (Bodin et al. 2006). I discuss early adopters as ‘trusted peers’, drawing on Mayer’s concept of trust (Mayer et al. 1995). Peer-to-peer learning and social networks are identified as the most influential channels of communication and are therefore the most influential factors in landholders’ uptake of new conservation practices (Bodin & Prell 2011). This is explained in detail in Chapter Five.
Research Methods

As mentioned above, the empirical research in this thesis takes a mixed method approach underpinned by a pragmatic philosophy. I focused on a case study of biodiverse carbon planting in Victoria, Australia. I approached a key offset provider (Greenfleet) to determine the availability of existing data and willingness to participate in the research. Greenfleet is a not-for-profit environmental organisation that has planted more than 8 billion biodiverse native trees across Australia since 1997, on both public and private land, to “create healthy forests that recapture carbon from atmosphere” (Greenfleet 2012). The background and rationale for choosing Greenfleet is described below. This is followed by a description of my primary data collection methods: surveys, interviews and observation.

Case study rationale and characteristics: Greenfleet and Carbon Farming Initiative

There are practical issues in choosing case studies including geographic and temporal scope. Most of Greenfleet’s private revegetation sites are located in Victoria, which made the geographical scope of this case study feasible. Focusing on Victoria was also driven by conservation concerns — the State has lost more than half of its native vegetation due to land clearance (Department of Sustainability and Environment 2006); 29 per cent of remaining vegetation exists on private land and 60 per cent of it is categorised as threatened (Department of Sustainability and Environment 2011a). The remaining vegetation continues to experience pressures from land use alteration, mostly for housing and intensified agriculture (SoE 2008). Victoria has fertile soil and a moderate climate, which favour agricultural production, and the State produces one quarter of the national food export (Department of Primary Industry 2012). Increasing climate change resilience within the State’s rural areas has been identified as a priority to support rural communities and to preserve ‘natural capital’ (Department of Primary Industries 2011; Department of Agriculture Fisheries and Forestry & Australia 2007). Natural capital is defined as “an economic metaphor” for ecological resources of the Earth (Millennium Ecosystem...
Assessment 2005; Kumar 2010). Another reason to focus in activities within one state is that policies are designed and implemented within state boundaries.

Yet another reason to focus on Victoria is that the uptake of Carbon Farming Initiatives (CFIs) in Victoria has been relatively low. Given the history of extensive land clearance and ecological restoration co-benefits of such programs (Standish & Hulvey 2014; Hulvey et al. 2013), the State could certainly benefit from a higher uptake of CFI projects. CFI was introduced in Australia as a regulatory mechanism to achieve carbon abatement in 2011. To date, 203 projects have been registered (Australian Government 2015) in the context of agricultural change, vegetation restoration and landfill practices. Yet only 19 of those projects are in Victoria and only 7 of those are biodiverse carbon plantings (3 registered by Greenfleet) (Australian Government 2015).

Greenfleet’s involvement in carbon farming pre-dates the CFI. Prior to the CFI, Greenfleet was mainly involved in the voluntary carbon market and through the provision of Australian Carbon Credit Units (ACCU) to buyers in the carbon market, as a recognised offset provider. Greenfleet has planted over 8.5 million trees in 400 different locations in Australia. Each tree is predicted to sequester approximately 268 t CO$_2$-e per hectare over 20 years. To meet Kyoto Protocol requirements for carbon plantings, the land should have been cleared prior to 30 December 1981; the minimum parcel size should be 0.2 hectares with at least ten metres in width. Furthermore, the species planted need to reach at least two meters in height with canopy coverage of 20% (Sparkes et al. 2011). The voluntary nature of landholders’ participation in these schemes means that landholders need to be willing to take some preparatory steps on their property (fencing and weed management) in advance of planting. However, trees and labour are provided by Greenfleet. Furthermore, landholders are obliged to permanently maintain the trees on their properties (Pannell & Wilkinson 2009). This requires a binding agreement between the landholder and Greenfleet.

Over the past 15 years, Greenfleet has established native trees on 73 privately-owned sites across Victoria. These biodiverse carbon planting sites belong to 47 different private
landholders. *These are the landholders I targeted in this research.* They range from dairy, livestock, sheep (wool) farmers and cropping farmers to lifestyle and tourism property owners. Some of the private landholders own small farms (so called lifestyle landholders) and some are commercial landholders; there is also a group of hybrid properties. As a result, purposeful sampling from a broad spectrum of private landholders was necessary to avoid systematic bias in the sample. Figure 1 reflects biodiverse carbon planting sites on private land across Victoria.

![Figure 1: Case Study locations within Catchment Management Authority boundaries (biodiverse carbon planting sites)](image)

**Data Collection**

Data was collected using an initial survey and then through interviews with private landholders who are participating in a biodiverse carbon planting scheme in Victoria, with the aim of exploring the social and cultural drivers of participation in bio-sequestration projects. I chose to only survey and interview landholders who were already participating in the planting scheme. This is because the primary aim was to explore what results in
participation in each step of program adoption. Whilst including non-participants could have helped to identify obstacles to the early stages of adoption (e.g., awareness, interest), by definition their non-participation in the scheme meant that they had no experience in the later stages of adoption (e.g., adoption, post-adoption). Including non-participants would therefore have presented an uneven focus on the early stages of adoption. In addition, accessing non-participants presented logistical problems. The non-participant population was much harder to access — my initial attempts to make contact identified only two landholders in this category. In total, I surveyed and interviewed 17 landholders, and interviewed 14 other stakeholders (scientists and policy makers).

**Survey, Interviews and Observational Studies with Landholders**

Initially, surveys were distributed as they provide a broad understanding of the research sample. A range of open and closed questions (including some scales, yes-no) were included to obtain a better understanding of landholders’ demographic and socio-economic profiles and their environmental concerns. Bryman (2004) argued that closed questions (e.g. Have you ever participated in any conservation activities?) have a role to play in collecting factual and demographic information. Closed questions are more convenient for the researcher to process, whereas with open questions rich responses can be expected (Bryman 2004; Dohrenwend 1965). This is because closed questions offer “fixed choices” for the participants (Balnaves & Caputi 2001, p.78). The survey was mailed by Greenfleet to all private landholders who participated in biodiverse carbon plantings on their properties in Victoria. A series of demographic questions sought to obtain information about landholders’ ages, education and property size. In addition, the survey included questions about the value landholders placed on co-benefits of biodiverse carbon plantings (e.g. the important factors influencing planting those trees and the value of trees on their properties).

My rationale for conducting in-depth semi-structured interviews was to obtain comprehensive individual data about their experiences, perceptions and opinions on which to build a more credible social conceptual model. Bryman and Burgess (1999) state that interviews can be considered as “special conversations” about people’s experiences.
(Holstein & Gubrium 2003). In-depth semi-structured interviews could lead to the understanding of “social actors’ meanings and interpretation” of their involvement with the studied phenomena (Blaikie 2000, p.234). Semi-structured questions allowed the clarity of process to be an unfolding evolution through a team of participant and researcher.

To obtain an in-depth understanding of the context (in this case, the socio-cultural drivers of the landholders), face-to-face, semi-structured interviews were undertaken. Survey participants interested in a one-to-one interview were requested to contact me. Individual interviews (17 applicants) were held at the participants’ properties between January and September, 2013. Each interview took between 90 to 120 minutes. Interviews continued until I reached the data saturation point (Glaser and Strauss 1967) where no new themes were emerging. Interviews were tape-recorded and transcribed verbatim.

I prepared an ‘interview guide’ (Bryman 2004) consisting of questions about the process by which the participants joined Greenfleet and their motivation for doing so, their knowledge of the carbon and biodiversity markets, their ideas about opportunities to integrate both markets, the degree to which biodiversity is valued, and their likely responses to integrated biodiversity and carbon planting policies. To capture their stories, I started asking about the history of their property and conservation activities, their experiences with nature, and conservation activities as children. Later, I asked about their current land management practices, the process of joining the voluntary biodiverse carbon planting and their future planned conservation activities.

A few examples of interview questions are listed below.

- Let’s talk about your property.
- How did you come across Greenfleet? [Did someone recommend them to you?]
- Have you recommended plantings to anyone else? If yes, have they commenced biodiverse carbon plantings?
- Have you been involved in any other conservation schemes (Land care, Bush Broker)?
• Were there any changes associated with management of your property since these trees were planted?
• What made you so passionate about the environment?

After undertaking the in-depth semi-structured interview, I walked through landholders’ properties and carbon planting sites to help me better understand the study area. My rationale was to have an opportunity for closer observation of my case study sites (Blaikie 2000). Together with the landholders, I walked through their properties and gathered field notes, spending time in their ‘naturalistic’ setting (Cooper et al. 2009). This helped me to gain a better understanding of their sense of biodiversity and their feelings towards the carbon planting itself that they could not explain during the interview. This also assisted me to find out why and how they chose the spatial position of the carbon plantings.

**Interviews with other stakeholders**

Participants discussed their ideas and concerns about different aspects of biodiverse carbon plantings. This provided me with the opportunity to add the thoughts of policy makers to those of practitioners and landholders in my research. I interviewed 14 stakeholders (eight policy experts and six academics) from October 2012 to September 2013. I recruited participants through a workshop about ‘biodiversity offsets’ held in November 2011 and through snowball sampling as many of my interviewees introduced and recommended other experts in the field. I chose interviews over fixed response surveys in an effort to capture rich, nuanced details which are difficult to elicit in more structured methods. The sample size is justified by a ‘sampling to saturation’ philosophy, whereby interviews continued until no new themes were emerging. I was careful to select different actors in the various public and private agencies to capture as much diversity as possible and not to reach saturation prematurely (Glaser & Strauss 1967). A few examples of interview questions are listed below.

• What do you think of different carbon planting schemes, both voluntary and paid programs?
• How do you think private landholders’ participation in carbon planting could be increased?
• What additional incentives would help (monetary and non-monetary)?
• Which of these incentives are politically feasible both in an Australian context and internationally?
• What could be changed in the science-policy-public landscape in favour of carbon planting (in both design and implementation)?

Data Analysis

Surveys

From the surveys I calculated descriptive statistics of socio-demographic data. These are reported in Chapter Four. These also partly informed the conceptual BBN model in Chapter Seven.

Interview materials

I started coding the materials immediately after conducting the first interview. NVivo 10 qualitative analysis software (QSR International 2012) was used as a platform to analyse the interview data. Coding interview materials refers to recognising ‘concepts’ and ‘categories’ in the data (Blaikie 2000). Saldaña (2009, p.51) argued that, in undertaking the coding process “new discoveries, insights and connections about your participants, their process, or the phenomenon under investigation” are being made. Hence, data analysis was informed by a thematic approach (Boyatzis 1998) which helps to discover and present the patterns found in the interviews (Braun and Clarke 2006).

Landholders’ interviews were coded to explore the patterns in different stages of the adoption process: awareness, non-trial evaluation, trial, adoption and post-adoption (Pannell et al. 2006). Considering the research questions and theoretical frameworks (Auerbach & Silverstein 2003), interview materials were coded line by line using an open
Coding technique (Glaser 1998). Hence, these codes demonstrated “the essential relationship between data and theory” (Glaser 1978, p.55). In doing so, findings emerged from the interview data.

Policy makers' and academic stakeholders’ interviews were coded in particular to look for themes around more effective policy design (considering both program and other incentives) to attract more landholders into the biodiverse carbon planting realm. I was also looking for themes discovering challenges and opportunities in carbon and biodiversity markets and policies. More details of the coding process for interviews with other stakeholders are presented in Chapter Six.

**Developing prototype Bayesian Belief Networks**

Bayesian Belief Networks (BBNs) are a powerful modelling technique that draws on probabilities to help decision-making under uncertainty in a broad variety of domains (Jensen 1996). BBNs use graphical demonstration to show cause and effect: in each graph, nodes are random variables and links show causal relationship between two nodes (Jensen 1996; Jensen and Nielsen 2007). The dynamic nature of BBNs means that once the model is computerised, it is easy to add more information and to modify it over time (Starr et al. 2004; Charles River Analytics 2008; Cooper 1990). BBNs are a good fit with my research methodology because they allow the synthesis of many different types of information (qualitative data, with prior knowledge from literature etc.) (Pearl 1988). Being Bayesian means they fit within a pragmatist philosophy.

BBNs are often used as a tool in Environmental Decision Support Systems (EDSS) because of their ability to work with interlinked factors and the simplicity of communication with stakeholders (Henriksen et al. 2007; Burgman et al. 2010). In addition, the ability of BBNs to undertake both future forecasting and current situation analysis makes them applicable in dealing with phenomena in a variety of contexts and socio-ecological systems (Liedlof and Smith 2010; Haines-Young 2011). The flexibility of BBNs to be modified and validated as
new data becomes available has also made them practical decision-making tools (Smith et al. 2007).

The aim of using BBN is to develop a model to predict landholder participation rates in biodiverse carbon planting. This task involves developing an operational Bayesian network and demonstrating the best way to use it. To avoid repetition, here I present a snapshot of the stages advanced in detail in Chapter Seven. To develop the BBN model the following three phases were conducted.

Phase 1: Based on a review of the literature, a preliminary BBN was developed (by identifying “nodes” and “links”) for socio-cultural drivers of participation in biodiverse carbon plantings. It included known social and cultural motivations for private landholders to engage with biodiversity conservation (Bekessy and Cooke 2011). Survey results and interviews with landholders and other stakeholders informed model modification. The model was further enhanced by taking into account the elements related to the program design and financial incentives for landholders identified through interviews with science and policy stakeholders.

Phase 2: Experts were identified from the field to help finalise and parameterise the model. An expert elicitation workshop was held to distil the experts’ opinions about the preliminary model and finalise the model. The final model was parameterised based on the expert-elicited data.

Phase 3: Through sensitivity analysis I identified the key drivers of the system. I explore these phases in detail in Chapter Seven.

BBNs guided the best policy design by identifying the probability of achieving our desired outcome, and also altering various inputs to find how the outcome will change. This methodology provides an opportunity for policy makers and managers to observe the
influence of their decisions on the success of the programs. This technique also illustrates the factors that could increase the participation rates.

**Ethical considerations**

Establishing the rationale for research is the first ethical consideration in conducting a study (Kylmä et al. 1999). Angen (2000, p.389) suggested that ethically valid research should pose “practical, generative, possibly transformative” answers to research questions. In this study, I focused on the social and cultural drivers of biodiverse carbon planting on private land and I sought to undertake research that would enhance our capacity to mitigate and adapt to climate change and enhance prospects for biodiversity.

Collecting qualitative data means gathering “personal emotional data that reveals the details of life” (Creswell 2007). This urges moral responsibility, as participants [hopefully] trust the researcher (Damianakis & Woodford 2012). Prior to any data collection, ethical approval from RMIT University’s Ethics Committee was sought (application numbers: CHEAN B—2000744-07/12 and CHEAN B- 0000018829-07/14). I interviewed private landholders participating in biodiverse carbon plantations on their properties. Tree planting on private land is not a high risk ethical issue. In addition, while interviewing other stakeholders (policy experts and academics) I attempted to minimise the impact of my research on their work by arranging the interviews at a time and place convenient to them. I also recognised the fact that some participants could only communicate their organisations’ policies and not their personal opinions.

As Kellehear suggested, social research is about “interfering with people”(1989, p.71) and we are ethically responsible for the minimisation of the research disturbance and effects on people’s lives. Confidentiality was considered throughout the research process and participants were given pseudonyms. In my reporting, I have removed any town or specific place names that could potentially identify participants. I have also represented the maps (landholder participants) in Catchment Management Authority borders without the
township names. Interview participants were contacted through Greenfleet with an introductory letter which presents the research and researcher to the landholders. This informed their understanding of the research context. It also built on an existing relationship with Greenfleet. Any publications arising from the Greenfleet’s data will include an acknowledgment of its contribution. A copy of all publications and results has been sent to Greenfleet and I have given regular presentations about the research outcomes to Greenfleet.

**Politics**

Hammersley argued that “research cannot be value free and politically neutral” (1995, p.x) as it works towards the goal of knowledge production. The other point that Hammersley mentioned is that “on the broad definition, all human activities are political, to one degree or another” (1995, p.117). Forsyth (2003, p.1) also emphasised the current demand “for re-evaluating the political basis of environmental explanations.” Drawing on these thoughts, my research can be seen as political, as it aims to provide meaningful policy recommendations to solve what I believe to be an important environmental challenge. Landholders have a responsibility to conserve land and as a researcher I have strong ethical responsibility to support that.

I firmly believe that research findings need to be transacademic (Oberg 2011; Mushakoji 1978) (public and government) and, where possible, planned to be implemented (Knight et al. 2008). Transacademic research relates not only to academic audiences but also to policy makers and the wider society (Mushakoji 1978). Although conservation research has been developed from the demand for intervention to reduce biodiversity loss (Milner-Gulland 2012), only one-third of academic peer-reviewed publications in conservation science address any implementation of their findings (Knight et al. 2008). Therefore, political implementations need to be recognised and embedded in research that aims to pursue conservation goals. I hope that my research results in the multidisciplinary insights which are required to provide meaningful policy recommendations.
Role of the researcher

Understanding the researcher’s role in conducting social research is important. As Shipman (1997, p.6) argued, “Social researchers are part of the world they research.” As researchers, we enter the interview settings with our own ontology and epistemology and a critical view of the subject of the enquiry. However, we need to recognise the perceptions participants bring to the domain studied (Bryman 1988). I undertook interviews recognising both aspects of my role as a social researcher; the role of my experiences in shaping my view and trying to observe the lived experiences of landholders the way they appreciate it. Having my own experiences and opinions about the topic and attempting to understand the landholders’ drivers and motivations in their context assisted me to conduct the research into socio-cultural drivers of private landholders participating in biodiverse carbon plantings. While interviewing other stakeholders (policy experts and academics) it was also essential to consider separating and balancing my understanding of the carbon and biodiversity policy or market related issues with the perceived opinions of research participants.

Validity and reliability of the research

As previously explained, the rationale for applying mixed methods in this research is to answer the research questions and to obtain the best possible results. The methods are adequately flexible to allow for changes to be made as the research progresses to achieve the highest probability of success. In terms of reliability, while coding the landholders’ interview materials, I analysed each line looking for themes related to different stages of biodiverse carbon planting adoption. This was to ensure the reliability of the research. Other stakeholders’ interviews were analysed using the same approach, going through the transcripts line by line and looking for the emergent themes related to landholder motivations and incentives, challenges and opportunities in carbon and biodiversity markets and policies. Furthermore, triangulation of data collected from landholders with those from other stakeholders provided a way to ensure the reliability of the research (Golafshani 2003).
Triangulation

To avoid bias in qualitative research, triangulation is necessary (Henderson 1991). Triangulation is defined as “combining data sources, methods, investigators, and theories for richer and potentially more valid interpretations” (Decrop 1999, p.159). I incorporated multiple data sources and methods in this study to provide a richer interpretation of findings. Interviewing landholders who participated in a voluntary biodiverse carbon planting scheme provided their perspectives on influential factors and barriers for participation. In addition, empirical data was collected by interviewing policy makers and academics in the field of carbon and biodiversity. This informed and confirmed some of the themes that were shaped by analysing landholders’ interviews, in particular regarding the barriers for participation and the complexity of socio-cultural drivers. Furthermore, findings from interviews, surveys and the related literature review shaped a BBN model to predict landholder participation. This model was further developed and parameterised through an expert elicitation workshop. The experts involved in this process were practitioners in the field with extensive knowledge about the socio-cultural, economic and policy-related elements of participation in biodiverse carbon planting schemes. Their opinions not only provided insights for the BBN model but validated the empirical findings from landholders’ interviews and surveys and interviews with science and policy experts.

Limitations of this study

This research faced several key challenges. First, I studied a voluntary biodiverse carbon planting program relying upon a relatively small sample size. My aim was to explore landholders’ socio-cultural drivers for participation. Forty per cent of the Victorian landholders who participated in the biodiverse carbon-planting scheme under investigation replied to my survey. Despite this limitation, the 17 landholders I interviewed provided an in-depth understanding of the adoption process. I also reached saturation where no new themes were emerging. The use of experts to refine and validate results (in particular the BBN model) further improved the robustness of the key findings of this study.
The BBN model presented in this thesis is clearly not a complete reflection of reality. For the purposes of this study I simplified some of the complicated relationships between parameters. First, I had to deal with market, policy and political uncertainty. The BBN model was developed considering existing uncertainties. As a result of this limitation, future research is needed to model uncertainties and understand the influence of different scenarios (e.g. changes in market and political certainties) on landholder participation rates. Second, the social network has an important impact on participation rates. However, I did not have adequate data to develop a model representing the direct impact of social networks on the adoption rate in the BBN model. I have captured the impact of social networks and trusted peers on other nodes (e.g. knowledge and skills); hence their direct impact could be much stronger in the model. A detailed social network analysis could help to further refine the social hotspots for biodiverse carbon planting adoption in communities.
Chapter Three: Biodiverse carbon plantings as a tool for mitigating and adapting to climate change

“We can solve the climate crisis. It will be hard, to be sure, but if we can make the choice to solve it, I have no doubt whatsoever that we can and will succeed” (Al Gore 2009, p.15).

This chapter analyses the literature surrounding the issue of climate change and biodiverse carbon plantings as a tool for mitigating and adapting to climate change. It discusses the policy settings around both carbon and biodiversity management. Furthermore, it reviews the different dimensions to biodiverse carbon planting that will influence outcomes; ecological, social, economic and the important interactions among these. Finally, this chapter describes tools and methods for making decisions in this policy context, given the large amount of uncertainty that exists.

Climate change

The wicked problem of climate change conveys an urgency for decision-oriented studies seeking to specify immediate mitigation and/or adaptation actions (Wise et al. 2014). Mitigation refers to those aiming to reduce greenhouse gas (GHG) emissions either at their sources or by using sinks to sequester the emissions (Cole et al. 1997). Adaptation actions are “adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC 2011, p.72).

Tree planting is considered an important means to pursue both mitigation and adaptation to climate change. Hence incentives to accelerate tree planting have become an important component of climate change policy. This is because of the ability of trees to sequester carbon more than other terrestrial ecosystems (Gibbs et al. 2007). Thirty per cent of the
Earth is covered by trees and 45 per cent of terrestrial carbon is stored in forests (NASA Earth Observatory 2012). Forests contribute to 50 per cent of net primary production in the world (Sabine et al. 2004).

**Mitigation outlook at the global level**

The role of market-based mechanisms to encourage greenhouse gas (GHG) emissions reduction was highlighted in the Kyoto Protocol (Niesten et al. 2002). Endorsed by 182 countries, the Protocol is a legal agreement with commitment from developed countries to reduce their GHG emissions 5.2 per cent below 1990 levels between 2008 and 2012 (Bayon et al. 2007). The most significant outcome of this protocol to mitigate global warming is the establishment of a carbon market (Captor & Ambrosi 2008). However, the commitment period of the Kyoto Protocol ended in 2013 and the Durban Climate Change Conference 2011 focused on finding various methods of emission reduction based on international negotiation (UNFCCC 2011). It is regarded as a “road map” towards a global agreement (Hill 2011). “… It enables a second commitment period to start on 1 January 2013 as part of a transition to a wider single global and comprehensive legally-binding agreement” (COUNCIL OF THE EUROPEAN UNION 2012, p.3).

The global carbon market falls into two categories: regulatory and voluntary markets. Voluntary markets focus on project-based offsets (forestry, methane destruction) whereas regulatory markets operate under the cap-and-trade and baseline and credit schemes (Bayon et al. 2007). Some examples of regulatory markets are the European Union Emission Trading Scheme, the Chicago Climate Index, the New South Wales Greenhouse Gas Reduction Scheme (GGAS) and the Alberta Offset System (Bayon et al. 2007, Brohé et al. 2009). The global carbon market was valued at US$142 billion in 2010, including a US$424 million share of the voluntary market (Peters-Stanley et al. 2011; Linacre et al. 2011). REDD projects (Reducing Emissions from Deforestation and Forest Degradation) constituted 29 per cent of the voluntary carbon market (Peters-Stanley et al. 2011). REDD is a United Nations program to reduce emissions from forested plots by providing incentives and valuing the carbon sequestered in trees in developing countries (FAO UNDP UNEP, 2008).
However, critiques of the program demand for an improved governance system to regulate and protect forests (Adelman 2015).

**Adaptation**

Historically, climate mitigation had been the principal mechanism considered by researchers and policy makers to tackle climate change (Heller and Zavaleta 2009). However, climate change adaptation is gaining more attention as reliance on mitigation methods is manifestly inadequate in the face of current impacts and climate projections in the immediate future (Wise et al. 2014). Adaptation aims to reduce the climate change vulnerability (Spittlehouse and Stewart 2003). Adaptation occurs as a dynamic practice in the societies and it could help to provide economic improvement over cases where no adaptation takes place (Adger 2013). These actions happen at different social and institutional levels, and on socio-economic and political scales.

Carbon plantings are considered to be both mitigation and adaptation strategies. The practice helps to mitigate GHGs and reduces the vulnerability of ecological and social systems to climate change (Van Noordwijk et al. 2011). However, it is important to be aware of the uncertainty involved in undertaking such plantations as climate is changing (Hulme 2005) at the same time the socio-ecological and the political contexts are (Adger et al. 2005). Actions that are taken now need to take into account climate change projections to make sure different species will survive under new climate projection scenarios (Hulme, 2005). It is also essential to understand the context, management requirements and institutional and societal necessities of successful outcomes (Spittlehouse and Stewart 2003). The various drivers for environmental degradation also requires further investigation as they relate to socio-ecological context (CSIRO (Commonwealth Scientific and Industrial Research Organisation) 2003).
State of GHG emissions in Australia

Australia is the world’s 15th highest GHG emissions polluter and contributes 1.3 per cent of global emissions (Commonwealth of Australia 2014). Figure 2 illustrates that there will be 421 Mt of CO2 emissions from the current levels by 2020, and abatement to reach the current target of at least 5 per cent reduction (of the 2000 level) will be 131 MtCO2-e (Commonwealth of Australia 2013a).

Australia’s emissions by sectors

The energy sector (stationary, electricity, transport, fugitive) followed by agriculture and deforestation are the main sources of GHG emissions in Australia (Commonwealth of Australia 2013b). As shown in the National Greenhouse Gas Inventory, both agriculture and deforestation emissions have increased from March 2012 to March 2013, respectively 3% and 14.4% rises (Commonwealth of Australia 2013b).

Carbon offsets and biodiversity

Carbon offset products are divided into two groups: reducing GHGs into the atmosphere through investing in energy efficiency or renewable energy projects and bio-sequestration
offsets that capture carbon from the atmosphere through tree planting (Bekessy & Wintle 2008; Carbon Offset Guide Australia 2010). Offsets are primarily aimed at reducing GHGs in the atmosphere but these schemes also aim to provide some co-benefits such as reducing other pollutants, strengthening economies by reducing the reliance on fossil fuels and habitat enhancement for biodiversity (EPA Victoria 2008).

Bio-sequestration offsets are the most popular type of carbon offset (EPA Victoria 2008). Bio-sequestration is a natural process where carbon dioxide is captured from the atmosphere and stored in trees and vegetation by photosynthetic processes (EPA Victoria 2007). Forty-five per cent of terrestrial carbon is stored in trees (Lederer 2011).

**Policy setting**

**Carbon policy**

The carbon market in Australia has been voluntary (excluding the NSW Greenhouse Gas Reduction Scheme) and there was no national cap-and-trade mechanism. However, carbon offset providers have been offering a range of products around Australia (carbon plantings, renewable energy). A carbon tax was approved by the Australian parliament to affect the top 500 polluters, with an initial carbon price of $23 a tonne in July 2012, moving to an emission trading scheme in 2015 (Australian Government 2011b). The carbon tax was repealed as of July 2015 and a Direct Action Plan is proposed by the new government as its climate action policy.

As a central part of Direct Action Plan, the Emission Reduction Fund (ERF) White Paper was released in April 2014, aiming to serve both the economy and the environment (Commonwealth of Australia 2014). It works based on the reverse auction mechanism for businesses and communities to sell emission reduction projects to the government, meeting Australia’s five per cent target below 2000 levels by 2020; with the aim of a total of $1.55 billion allocated funding (Commonwealth of Australia 2014). Approved methods under the ERF include land sector methods such as biodiverse carbon plantings and reforestation.
The Carbon Farming Initiative (CFI) was enacted in the Australian Federal Parliament in August 2011 aiming to reduce emissions and establish tradable carbon credits (Australian Carbon Credit Units, or ACCUs) through enhanced land management practices (Australian Government 2011b). CFI aims to achieve 4 Mt CO2-e of abatement from activities such as deforestation and reforestation (Commonwealth of Australia 2012). Since the start of the scheme, 14,591,415 ACCUs have been issued (Australian Government 2013). Table 1 shows the number of eligible offset projects and the number of ACCUs issued since the start of CFI (Australian Government 2015).

Table 1: The number of eligible offset projects and Australian Carbon Credit Units issued since the beginning of this scheme until August 2015 (Australian Government 2015)

<table>
<thead>
<tr>
<th>Register updates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligible Offsets Projects</td>
<td>204</td>
</tr>
<tr>
<td>Australian carbon credit units issued</td>
<td>14,591,415</td>
</tr>
</tbody>
</table>

Under the ERF, the CFI applies: landholders have two permanence options, 25 years or 100 years and the crediting period for reforestation project will be 15 years (Commonwealth of Australia 2014). Furthermore, landholders will be paid once the measurement and verification phases are done and there will be no upfront payments (Commonwealth of Australia 2014). In addition, incentives will be made available for “new projects [which] are not implemented before they have been registered with the Clean Energy Regulator” (Commonwealth of Australia 2014 p.30). Figure 3 illustrates the stages from registering a new project to the auditing and receiving the payment under the ERF.

Figure 3: Participation steps in the ERF (Commonwealth of Australia 2014)
**Biodiversity policy in Australia**

The *Environment Protection and Biodiversity Conservation Act, 1999* (the EPBC Act) is an important environmental legislation in Australia. It aims to protect Australian biodiversity and nationally and internationally significant species (Commonwealth of Australia 2013d). It affects developments that have ecologically significant impacts. Australia’s Biodiversity Conservation Strategy 2010-2030 values biodiversity conservation for both its intrinsic importance and for the ecosystem services it supplies to human beings. As one of its national goals it aims to “achieve a doubling of the value of complementary markets for ecosystem services by 2015” through public and private partnerships, increasing the use of incentives and considering biodiversity management into land use-related decisions (Australian Government 2010). Increasing public awareness and participation in biodiversity conservation activities is another major goal this strategy is pursuing. Managing private land for biodiversity protection is one of the targets in the strategy.

**Markets for biodiversity**

Increasing biodiversity loss has become a pressing global issue, not only for its own sake but also for its negative effects on the economy and human well-being (SCBD 2010). Achim Steiner, Executive Director of UNEP, (2010) said:

> “Annual losses as a result of deforestation and forest degradation alone may equate to losses of US$2 trillion to over US$4.5 trillion alone. These could be secured by an annual investment of just US$45 billion: a 100 to 1 return” (Secretariat of the Convention on Biological Diversity 2010 p.6).

To tackle biodiversity loss, different mitigation methods have been undertaken around the globe, from biodiversity banking to one-off offsets (Madsen et al. 2011). Among mitigation methods, biodiversity offsetting is one policy tool to conserve endangered and threatened species on private land (Gordon, Langford, White, et al. 2011). “Biobanking”, a new initiative by the NSW government and “Bushbroker” in Victoria are two examples of such programs in Australia. Private landowners can generate “Biodiversity Credits” and “Native Vegetation
Credits” by enhancing biodiversity outcomes on their properties through Biobanking and BushBroker agreements (Office of Environment and Heritage 2011).

The increasing public attention on climate change is expected to generate a market for greater investments in bio-sequestration projects and the restoration of biodiversity (Bekessy & Wintle 2008). To encourage participation in biodiverse plantings for carbon sequestration, private landholders and investors should be able to take advantage of both ecosystem service markets (the carbon market and biodiversity market) on the one piece of land (Bekessy & Wintle 2008). The global market for biodiversity is at least US$2.4-4.0 billion annually, but 80% of current projects are too vague to evaluate their market size (Madsen et al. 2011). These two global environmental service markets have the potential to help private landholders generate income while benefiting both climate change abatement and biodiversity management.

Although biodiverse carbon planting is an environmental practice, it is important to consider its social and economic aspects. A successful policy design needs to consider social-cultural factors in landholders’ acceptance and participation in a new scheme. Here, I present a review of the rich literature available on each of ecological, social and economic issues that need to be considered in designing programs for bio-sequestration and biodiversity management.

**Ecological considerations**

Deforestation and forest degradation are contributing to climate change (the second highest human-made source) and to the loss of biodiversity (IPCC 2014b; IPCC 2007; Totten et al. 2003; Lederer 2011). Therefore, it is essential to understand the relationship between these pressing global issues and to explore opportunities to address both climate change and biodiversity with one policy instrument (Totten et al. 2003). Currently, there is a lack of policy or standards to guide synergistic biodiversity-carbon projects in Australia (Kapambwe & Keenan 2009).
Australia is a signatory to both the United Nations Framework Convention on Climate Change (UNFCC) and the United Nations Convention on Biological Diversity (CBD). The Kyoto Protocol required “stabilisation of greenhouse gas concentrations in the atmosphere within a timeframe sufficient to allow ecosystems to adapt naturally to climate change” (United Nations 1992; Article 2). Under the CBD, signatories have a responsibility to “Develop or maintain necessary legislations and/or other regulatory provisions for the protection of threatened species and populations” (United Nations 1992a; Article 8). However, neither of these legally-binding agreements provide incentives to generate markets that benefit both carbon sequestration and biodiversity at the same time (Totten et al. 2003). As a result, the opportunity to mitigate the impact of climate change on biodiversity via carbon sinks (trees and vegetation) (Department of Environment Climate Change and Water NSW 2010) may well be missed. Therefore, the Kyoto Protocol should support activities with multiple benefits and reduced trade-offs (Bekessy & Wintle 2008).

A recent study by the Victorian Department of Sustainability and Environment investigated “biodiversity outcomes of bio-sequestration” using survey results from a selection of the Australian offset providers (Kapambwe and Keenan 2009). The study revealed that offset providers who are involved in bio-sequestration believe there is a lack of incentives or clear set of standards for biodiversity outcomes of bio-sequestration projects (Kapambwe and Keenan 2009). However, there are some international standards that aim to report biodiversity benefits of bio-sequestration projects, namely Climate, Community & Biodiversity Standards (CCBS), CarbonFix Standard (CFS), Plan Vivo System and Standards, and the Voluntary Carbon Standard (Kapambwe and Keenan 2009). EBEX21 in New Zealand has also added biodiversity measurements to its system for carbon crediting in forests (Carswell and Burrows 2006). Therefore, while standards in Australia are currently lacking, there are plenty of international examples from which to draw recommendations. Thus, biodiverse plantations can add value to the carbon sink credits, if a specific standard is developed to reassure the investors about the sustainability of forest sinks (Carswell and Burrows 2006).
There are complicated synergies and trade-offs between carbon offsets and biodiversity management (Kapambwe and Keenan 2009). Sanders (2008) argued that from a carbon perspective, monocultures that capture greater amounts of above-ground carbon are financially more favourable than environmental plantations. Sanders (2008, p.4) also argued that “Market signals alone – particularly with imperfect information available to landowners and uncertainty about risks and returns – may deliver new plantations, but there is no reason to expect that these will be for conservation or biodiversity purposes”.

Heller and Zavaleta (2009) reviewed 524 recommendations in 113 papers about managing biodiversity in a changing climate and found that nearly one-third of papers advocated that biodiversity conservation should be aggregated to its associated ecosystem services (i.e. forest products). Furthermore, there were seven articles that argued that projects that negatively impact on biodiversity should be specifically avoided (Heller and Zavaleta 2009 p.19). Crossman’s study in South Australia revealed that biodiverse plantations sequester on average 2.9 tonnes CO₂-e/ha/year less than monocultures (Crossman et al. 2011a). These differences may be offset by the fact that biodiverse plantations are expected to be more resilient to negative impacts of drought, fire, pest and disease (Kapambwe and Keenan 2009). There are several advantages to biodiverse plantations. First, biodiverse plantings can potentially act as a compensation method for “offsetting” the vegetation loss as a result of current or future economic developments (Bekessy et al. 2010). Second, from a biodiversity perspective, mixed-species plantations are more favourable than monocultures (Hartley 2002). Although monocultures are less expensive to establish, they have little biodiversity value and will occupy marginal land that can be used for plantations of biodiverse trees (Hunt 2008). Third, there are potentially negative environmental consequences of fertilizer and water use to grow non-native, mono-culture plantations for the sake of carbon, that may end up affecting native flora and fauna (Totten et al. 2003).

The Carbon Farming Initiative (CFI) (Australian Government 2011a) has the potential to produce greater synergy between carbon farming and biodiversity management. When first introduced, the CFI favoured environmental plantations as its positive activity list included “Establishment of permanent environmental (mixed native species) forest greater than 1 ha
after 1 July 2007 and Management of vegetation to increase carbon by promotion of residual seed sources” (Department of Climate Change and Energy Efficiency 2011). However, the recent changes reveal that reforestation and afforestation are among the approved sequestration methodologies; “The forest may consist of any species (except for declared weeds) and the project must be consistent with any planning requirements” (Department of Environment 2014).

However, landholders’ attitudes along with setting-up expenses, water and seedling availability and alternative land use options will potentially affect the success of these projects (Sabto and Porteous 2011).

Social considerations

“One of the real mistakes in the conservation movement in the last few years is the tendency to see nature simply as natural resources: use it or lose it. Yet conservation without moral values cannot sustain itself. Unless we reach people through beauty, ethics, spiritual or religious values or whatever, we’re not going to keep our wilderness areas” George Schaller in (Bond 2007, p.47).

Agricultural activities such as cattle farming, crops and soils and land use alteration contributed about 23 per cent to Australia’s net GHGs in 2009 (Sparkes et al. 2011). Given that 70% of Australia where individuals, private companies or Aboriginal organisations have significant decision-making ability over natural resource management, the practices that landholders implement will play a significant role in determining the sustainability of landscape management (Australian Government Land and Coasts 2011). A large fraction of threatened and degraded species occur on private land (Stoneham et al. 2000; Gordon, Langford, White, et al. 2011). In Victoria, for example, one third of threatened species are on private land (Stoneham et al. 2000).

The Australian Biodiversity Conservation Strategy described its first action priority as “Engaging all Australians” to contribute in biodiversity conservation; the goal is described as a 25% growth in Australian’s participation in biodiversity conservation by 2015 (Department of the Environment Heritage and the Arts 2009). The challenge is how to achieve these goals and how to integrate biodiversity concerns in private landholders’ decision-making processes.
Landholder’s social drivers

There is little understanding of the social and cultural motivations behind planting trees on private land which could potentially be used for agricultural purposes. I believe research into such drivers can facilitate the success of bio-sequestration projects and biodiversity conservation programs. Social and cultural values in this study refer to landholders’ “non-market values”: these values are not financially triggered and are more of preservation morals and aesthetics (Kauneckis & York 2009, p.468). Education, political attitudes (Kauneckis and York 2009) and ecologistic and naturalistic values (Clayton and Myers 2009) are among the landholders’ drivers for voluntary conservation on their property. Amenity and aesthetic and recreational outcomes (Kauneckis & York 2009) of biodiverse tree planting could be some of the socio-cultural drivers of landholders who participate in such schemes.

Landholders’ socio-demographic characteristics as a key driver for undertaking conservation practices on private land has been widely examined (Moon & Cocklin 2011a; Morrison et al. 2008; Ahnström et al. 2008). Allan et al. (2001) found that values and local knowledge affect landholders’ decisions for participation in natural resource management actions. Social dynamics such as values, social identity, culture, belief and personal motivation (Hogan et al. 2010) are likely to be among socio-cultural factors that pertain to the landholders’ decisions for participation in bio-sequestration schemes. Pannell and Wilkinson (2009) studied life style landholders’ attitudes and motivation towards environmental measures on their properties. Their motivations are categorised into five groups: ‘productive use, lifestyle, landscape goal, healing the land and personal identity’. The major conservation activities undertaken by these landholders were tree planting and perennial pasture.

The Australian government conducted a study of 4,000 landholders to determine their climate change adaptive capacity. The results showed that concentrating on “farmers’ sense of social or moral responsibility” can help policy makers to reach the “long-term sustainable practices” (Hogan et al. 2010, p.x). Maraseni and Dargusch (2008) interviewed 14 farmers in southern Queensland to find the important constraints for expanding woodlands in their
properties. They found that three groups of limitation exist: uncertainty about the current policies in carbon trading; lack of information about how they can measure and sell the generated carbon credits, and the question of profitability of such plantations for the farmers (Maraseni and Dargusch 2008).

**Landholder stewardship**

Reimer et al (2011) argued that landholders who think about the farm profitability are less likely to adopt environmental practices whereas farmers who consider land stewardship values and think about ecological benefits beyond their own property are more likely to undertake such practices. Stewardship is defined as considering benefits beyond the property’s boundary in a conservation action (Kabii & Horwitz 2006). Attachment and connection to land could develop stewardship values in landholders (Lokocz et al. 2011). Atwell et al. (2009) emphasise on the importance of stewardship and its impact on decisions landholders make regarding the land management. Valuing stewardship can motivate landholders to participate in conservation practices on their properties (Lokocz et al. 2011). Ahnström et al. (2008) explored the relationship between stewardship values and participation in conservation activities. They emphasised the importance of landholders’ ‘soft values’ in the success of private land conservation. They argued that there is an urge to change the focus of conservation schemes to targeted landholders to deliver successful outcomes.

**Cultural drivers**

Cultural factors including history of conservation on private land and undertaking conservation activities as children could influence landholders’ willingness to uptake conservation activities. Living or frequently visiting a rural setting provides an opportunity for more experiences in nature. These experiences not only relate to the “appreciation of the natural environment” (Drescher 2014, p.127) but also provide an opportunity to observe and participate in conservation activities undertaken by family members. Farmer et al. (2011) argued that pro-environmental behaviours (e.g. conservation activities) are partly influenced by childhood experiences and active engagement in nature.
Economic considerations

A price on carbon will create greater supply within the carbon market, and offset scheme providers and investors may prefer monoculture plantations that are higher in carbon yields to biodiverse cultivation of native trees (Crossman et al. 2011a). This raises the question of whether such trade-off is justified.

There is a nonlinear trade-off between biodiversity protection and emissions reduction, which means there are ways to optimise both goals (Venter, Laurance, et al. 2009). Credits from “Biobanking” and “BushBroker” programs can produce income for those private landholders who participate in these initiatives (Department of Sustainability and Environment 2011b; Office of Environment and Heritage 2011). Bekessy and Wintle (2008) argued that a biodiversity bank and its credits can be employed as an economic instrument to encourage investors in biodiverse plantings for carbon sequestration. They also argued that accounting for soil carbon and GHG emissions related to deforestation will further favour biodiverse plantations.

Crossman et al. (2011) suggested that by paying a small incentive to landholders, biodiverse plantations will be economically viable in places where ecological restorations are most needed. The problem is how policy makers can help landholders to earn multiple sources of income from the biodiversity and carbon markets without sacrificing one ecosystem service for another. Markets need to be planned to offer the right incentives, if they aim to produce welfare (Campos et al. 2005).

A study conducted by CSIRO examines carbon forestry opportunities in Australia under different scenarios, and the modelling results suggest that only under higher carbon prices will tree planting be financially viable (Polglase et al. 2011). Furthermore, this research suggested the high establishment cost of tree plantings for landholders and water availability and its cost could be a major constraint for Australian government to meet its five per cent emission reduction target for 2020 (Polglase et al. 2011; Department of Climate Change and Energy Efficiency 2011). Biodiversity incentives can facilitate the
establishment of additional trees to offset more emissions in the longer period, potentially by 2050 (Polglase et al. 2011; Bekessy and Wintle 2008).

**Integration of ecological, social and economic aspects to evaluate policy approaches**

“Societal and ecological problems facing the planet are both systemic problems and management problems. They are systemic because they arise from deep-rooted, complex, interrelated processes that operate across and between different scales from global to local. They cannot be understood by separating them out for analysis by single academic disciplines” (Halliday & Glaser 2011, p.1).

Evaluating the effectiveness of policy to stimulate investment in biodiverse plantings for carbon sequestration is necessarily an interdisciplinary task (Sayer & Campbell 2003). Interdisciplinary research that integrates social and ecological knowledge is gaining popularity (Poteete et al. 2010; Oberg 2011; Ostrom 2009). The term “Social-ecological” was introduced by Berkes and Folke (1998) to show the importance of integration of human aspects in nature and to elaborate that a sustainable outcome is more likely obtained as a result of such incorporation (Folke et al. 2005). There is growing awareness of the need to study the environment as a socio-ecological system (Collins et al. 2011; Cooke et al. 2009). Greater acknowledgment of the significance of socio-ecological science has led to the recent interdisciplinary evolvement and the demand for better integration of the social and biophysical research fields (Collins et al. 2011; Folke et al. 2005).

This research aims to facilitate decision-making about possible scenarios for biodiverse carbon plantings considering the dynamic needs of stakeholders using Decision Support Systems (DSS). DSS are flexible and interactive computational systems that facilitate decision-making processes based on programmed data and models (Power & Sharda 2009; Matthies et al. 2007). Successful design of a DSS depends on the “integration of various sources of knowledge, intelligent techniques and numerical tools” (Poch et al. 2004, p.872).
Decision-making in the face of uncertainty

“Under conditions of ... uncertainty, it is sensible to ask whether it would be better to delay decisions while information is gathered and analysed. However, it is as much a decision to do nothing, or to delay action, as it is to decide to take early action. The issue is whether delay would be a good decision” (Garnaut 2008, p.2).

An increasing body of literature has focused on decision-making in the face of uncertainties (Haasnoot et al. 2013). These uncertainties include both ecological and socio-political change in systems in various contexts (Van Der Brugge et al. 2005). As climate change projections vary under different future scenarios and pathways (IPCC 2014a), ecosystems across the globe face diverse levels of change. With such changes in ecological systems, social and economic structures that rely on ecosystem services for their survival will face variation and uncertain futures. As an example in Australia, climate change makes more productive farming lands marginal, opening an avenue for alternative land use (i.e. conservation activities) (Higgins & Dibden 2010).

Such uncertainties can be expressed by both quantitative measures (i.e. models' outputs) and qualitative statements (i.e. expert opinions) (IPCC 2012; Watkiss & Hunt 2013). However, dealing with such uncertainties needs “a shift away from equilibrium thinking into the complex, adaptive, and unpredictable behaviour of ecosystems” (Van Der Brugge & Raak 2007, p.2). This requires planners to design and implement their policies in a more strategic way (Haasnoot et al. 2013). Therefore, there are methods available for decision-makers to plan in different situations. In many circumstances Cost-Benefit Analysis (CBA), Cost-Effective Analysis (CEA) and Multi Criteria Analysis (MCA) are widely used (Watkiss and Hunt 2013). While CBA uses economic appraisal of different options, CEA compares options that result in achieving the same objective and MCA applies a systematic method of analysing both qualitative and quantitative data to rank options. However, the critics of economic rational models (CBA) believe, “Complexity implies that causal connections between a multitude of potential factors and effects cannot be identified, let alone be quantified” (Van Der Brugge & Raak 2007, p.389). As the systems and their characteristics
become more uncertain, other methods can be applied in decision-making, such as Real Options Analysis, Robust Decision Making, and Adaptive Management (Watkiss & Hunt 2013).

Each of these methods aided by some analytical and software tools streamline the analysis (Liedloff & Smith 2010). Statistical models aim to find empirical relationships by analysis of datasets and rely heavily on assumptions (Liedloff & Smith 2010). BBNs as causal explanatory model to overcome limitations of traditional statistical analysis (Fenton and Neil 2013) have been widely used as a technical tool to assist decision-makers when uncertainty exists. In addition to BBNs, other tools such as agent-based modelling have the ability to model human or institutional behaviour depending on the state and behaviour of agents, their environment and their spatial locations (Voinov and Bousquet 2010; Liedloff and Smith 2010).

Recently, the application of BBNs in other analytical methods such as Multi-Criteria Decision Analysis has become popular. This aids the decision-making process in the face of uncertainty (Watthayu & Peng 2004). BBNs are being used in modelling with stakeholders studies, requiring experts to determine and weight the variables and influences; variables can be either model, expert elicitation or data-based (Voinov & Bousquet 2010). Limitations that Voinov and Bousquet (2010) mentioned in the process of designing such BBNs are their debility in incorporation of feedbacks and lack of temporality. The issue with feedbacks could be addressed by restarting the BBN with a new condition to handle the feedback issue. Temporality issues can be addressed by using software that deals with time series (e.g. Hogans) or redefining the variables to represent the new values in different time series. Furthermore, Environmental Decision Support Systems (EDSS) have been applying BBNs as a tool because of their ability to work with the interlinked factors and the simplicity of communication with stakeholders (Henriksen et al. 2007).

In addition, the ability of BBNs to undertake both future forecasting and current situation analysis makes them applicable in dealing with phenomena in a variety of contexts and socio-ecological systems (Liedloff and Smith 2010; Haines-Young 2011). Another
characteristic of BBNs that made them popular in holistic environmental analysis approaches is analysing various data types (Smith et al., 2012). BBNs facilitate the decision-making process where policy makers have the chance to rationally choose among various actions, considering socio-economic and ecological outcomes (Henriksen et al. 2007).
Chapter Four: Socio-cultural drivers of landholders participating in biodiverse carbon schemes

Introduction

"I am deeply passionate about it, I just keep reading and learning and reading and adopting and doing everything ... every opportunity... I mean it’s a varied response. It’s not like it’s a sort of a sparkle moment where everything changed, it’s a continual learning curve“ (Oliver, one of the interviewed landholders)

Encouraging landholders to adopt new land management practices is an important element of the design of biodiverse carbon sequestration schemes. Based on the theoretical framework developed in Chapter Two and the literature reviewed in Chapter Three, this chapter explores the social and cultural drivers of landholders that impact on their decisions about participating in biodiverse carbon schemes, presenting the findings from the socio-demographic survey and landholders’ interviews.

This chapter begins with a description of participating landholders’ profiles and their socio-demographic characteristics. It provides a portrait of interviewees whose participation will be illustrated in detail. After introducing the research participants, I apply adoption theory (Pannell et al. 2006) to examine the drivers for each step of participation: awareness, non-trial evaluation, trial, adoption and post-adoption. As the participant quoted at the start of this chapter noted, participation in biodiverse carbon plantings is usually an ongoing process. The five steps of adoption theory are considered to be a constant learning space both for individual landholders and for their community. This chapter reflects on landholders’ experiences at each step and seeks to identify the barriers and drivers of participation through this process. Findings of each step of the adoption theory will be presented in a Bayesian Belief Network in Chapter Seven.
Profile and demographic characteristics of landholders

As this chapter focuses on the landholders’ voice and lived experiences, a useful starting point is to characterise their profiles and socio-demographics. Table 2 contains landholders’ pseudonyms adopted for this study, the Catchment Management Authority (CMA) in Victoria within which their properties are located, the type of land use they associate themselves with and the size of their biodiverse carbon plantings.

<table>
<thead>
<tr>
<th>Name</th>
<th>Land use</th>
<th>CMA</th>
<th>Plantation size (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve</td>
<td>Cattle grazing</td>
<td>North Central</td>
<td>40</td>
</tr>
<tr>
<td>Laura</td>
<td>Lifestyle</td>
<td>North Central</td>
<td>37</td>
</tr>
<tr>
<td>Noah and Linda</td>
<td>Lifestyle (dog breeding)</td>
<td>North Central</td>
<td>28</td>
</tr>
<tr>
<td>John</td>
<td>Cattle grazing</td>
<td>North Central</td>
<td>8</td>
</tr>
<tr>
<td>David</td>
<td>Cattle, sheep grazing</td>
<td>North Central</td>
<td>6</td>
</tr>
<tr>
<td>Mat</td>
<td>Wool, beef, lamb</td>
<td>Goulbourn Broken</td>
<td>9</td>
</tr>
<tr>
<td>Andrew</td>
<td>Cattle grazing</td>
<td>North Central</td>
<td>2.5</td>
</tr>
<tr>
<td>Luke</td>
<td>Cropping, sheep and cattle grazing</td>
<td>North Central</td>
<td>47</td>
</tr>
<tr>
<td>William</td>
<td>Lifestyle</td>
<td>West Gippsland</td>
<td>15</td>
</tr>
<tr>
<td>Barbara</td>
<td>Lifestyle</td>
<td>North Central</td>
<td>19</td>
</tr>
<tr>
<td>Anna</td>
<td>Lifestyle</td>
<td>Goulbourn Broken</td>
<td>7</td>
</tr>
<tr>
<td>Ryan and Owen</td>
<td>Wool, cattle grazing</td>
<td>North Central</td>
<td>2.7</td>
</tr>
<tr>
<td>James</td>
<td>Cattle grazing</td>
<td>West Gippsland</td>
<td>8</td>
</tr>
<tr>
<td>Jacob</td>
<td>Recreation- tourism</td>
<td>West Gippsland</td>
<td>43</td>
</tr>
<tr>
<td>Oliver</td>
<td>Wool, beef, lamb</td>
<td>Glenelg Hopkins</td>
<td>189</td>
</tr>
<tr>
<td>George</td>
<td>Cattle grazing</td>
<td>West Gippsland</td>
<td>10</td>
</tr>
<tr>
<td>Daisy</td>
<td>Lifestyle</td>
<td>North Central</td>
<td>25</td>
</tr>
</tbody>
</table>

I have identified properties within CMA boundaries as conservation plans and policies are designed and implemented within those boundaries. In the ‘awareness’ section of this chapter, I will reflect on the various large landscape and biodiversity conservation plans in...
each CMA and the link between participation and awareness of such plans. Figure 4 presents the location of CMAs in which surveys and interviews were conducted.

Socio-demographic features of landholders who participated in this research were obtained through a written survey, as described in Chapter Two. Seventeen people participated in the initial survey. They were interviewed in detail in the follow-up stage of the research. Age group, type of land use, type of income and education level are presented in Table 3. Most participants were 40 to 54 years old (41%) and run commercial and semi-commercial properties (59%). In this study, 59% of the respondent landholders rely on off-farm income sources. Furthermore, 70% of them have university education.
Table 3: Socio-demographic characteristics of landholders

<table>
<thead>
<tr>
<th>Age groups (year)</th>
<th>Number of Respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25 to 39</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>40 to 54</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>55 to 69</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>More than 70</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land use</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>Semi-commercial</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Hobby farmer</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Lifestyle landholder</td>
<td></td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of income</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Off farm</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>On farm</td>
<td>7</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of education</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High School</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>TAFE</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>University</td>
<td>12</td>
<td>70</td>
</tr>
</tbody>
</table>

From awareness to post-adoption of biodiverse carbon plantings

My objective in this section is to explore the factors influencing landholder participation in biodiverse carbon plantings at each step of the adoption process. Empirical data will be presented, along with the supporting literature as the chapter progresses.

In natural resource management, the adoption process has been shown to be unpredictable, uncertain and non-linear (Morris et al. 2000; Öhlmér 1998). Political uncertainty and institutional changes can have negative impacts on the likelihood of adoption (Morris et al. 2000), and low participation rates will reduce the anticipated ecological benefits (Comerford 2014). This leads to inefficient spending (time and money) by the responsible institutions and may create negative public perceptions of other policies to
be introduced in the future (Mankad et al. 2015). Hence, it is essential to understand the adoption process and landholders' social and cultural values at each step, and how these values affect their decisions to participate in biodiverse carbon schemes.

**Step One: What are the important elements in raising awareness among landholders?**

The awareness phase refers not only to the knowledge and recognition of the existence of a program, but to the degree to which landholders perceive it as feasible and applicable to their current business (Pannell et al. 2006). In addition to landholder characteristics, context (e.g. social settings and norms in the community) and external factors (e.g. policy settings) were specified in the literature as influential factors in the awareness phase (Morris et al. 2000).

**Cultural motivation**

“Culture is worth a second look, because it envelopes both problems and solutions” (Rankin 2014, p.15).

Cultural motivation is one of the prior conditions described by Morris et al. (2000) that facilitate the early stages of adoption. Cultural capital is formed through social norms, laws and ideologies (Pannell et al. 2006) together with other human factors that influence behaviour, such as skills and experiences (Burton and Paragahawewa 2011). Cultural legacy is another potential motivator and can be translated through considering land as a family asset (Fischer & Bliss 2008). As a direct question about culture seems intangible to many, I used the family tradition of conservation and childhood experiences as a proxy to define cultural elements. Almost 60% of landholders surveyed in this study grew up on a farm and undertook conservation activities like tree planting in their childhood. This cultural motivation possibly helped some landholders to take their first steps towards biodiverse carbon plantings.
Two important elements of cultural experience were observed in this research. First, having a role model and social learning from the very early stages of life was a key element driving participation. Family influences have been recognised as a significant factor in conservation practices (Chawla 1999). John recognises his father’s conservation work: “Dad did a lot of soil conservation work. Did a lot of tree planting too…” Laura also expressed her father’s beliefs about revegetation and balance in agricultural landscape as her role model.

“...Dad was before his era. He already believed that there had to be a balance, like nature helped us. He always encouraged birds and certain wildlife as he felt that they were a benefit in some ways to have around as well as just being good to look at. So he would have agreed with some revegetation” (Laura)

Second, the opportunity of growing up on a farm and building a connection with nature is a major driver for some participants. Daisy reflected on her experience as a child growing up in the bush and the willingness to restore and conserve native species.

“We both grew up in the bush and we just know how important it is to bring it back, so to have that opportunity to plant something that will suit the area so it will grow better because it’s always grown here, and then it also has those benefits of yeah, providing a habitat. And we wanted to enjoy the habitat you know knowing we wanted to have kids, we wanted to be able to see the kangaroos and the birds and the honey-eaters”

This echoes the relevant literature about the importance of nature encounters and childhood learning about environmental conservation (Chawla 1999; Louv 2010). Anna also expressed her passion for conservation activities as a result of her childhood experiences in nature and their rural property: “So we would go up there [family’s rural property] every weekend and look after the cows and do fencing and put out hay and all those things that you do... Ride ponies, so I was very much connected to landscape” (Anna).
The interview responses illustrate that landholders gathered knowledge and values as they grew up and built up a culture for conservation within them. “I also have just knowledge from growing up the way that I did” (Anna). It echoes the array of literature representing the role of nature in children’s wellbeing and learning process (Kahn et al. 2009; Louv 2010; Kahn & Kellert 2002). Such exposure to nature and conservation activities encouraged them to participate more in environmentally beneficial land management practices as adults.

**Formal and informal education**

Many studies identify the impact of formal education on participation in conservation activities (Ma et al. 2012; Comerford 2014; Ecker et al. 2012). The probability of participation in conservation activities is higher for landholders with higher levels of education (Ahnström et al. 2008). As indicated in Table 3, 82% of participants have TAFE qualifications or university degrees. Landholders’ reflections on the role of formal education in raising their awareness about private land conservation practices are documented in this study. “Well, the Whole Farm Planning Course gave me a really good base” (William). Research also reveals that it is not only landholders’ education that is significant but also their spouses’ level of education is related to their participation in community-based natural resource management programs like Landcare (Ecker et al. 2012). As Barbara mentioned, “Well, my husband’s actually doing a Bachelor of Agricultural Science at the moment. So he gets quite a lot of information that we use from his course as well as just using the web” (Barbara). This emphasises the importance of formal education in the conservation-related field for raising awareness.

Kilpatrick and Johns (2003) argue that in addition to formal education, informal learning (e.g. other farmers or friends) is an essential factor in increasing landholders' knowledge of sustainable land management. Inspirational figures, community members, neighbours, reading various related sources and Landcare groups are among the various informal learning sources mentioned by landholders in this study. Mat, one of the landholders mentioned the presence of an inspirational figure regarding land conservation practices in the early stages of his life.
“I used to jackaroo. This was just back in the seventies, and my boss there, he’d just been made the Landcarer of the month, but he’s got a place you would have come past, and he’s .. I suppose he had an influence on me when I was younger, and you know the place that he manages now, he’s very much the son, he’s an inspiration.. and he’s fifteen years older than me, but he’s been doing it and in a lot harsher environment than me, but you know, he’s one who’s done a lot, yeah” (Mat)

Other landholders mentioned different methods of receiving information and becoming aware of new schemes in their area. Anna mentioned some of these conduits, such as courses, book and related government websites and local farmers.

“I did some day courses through Greening Australia about seed collection and propagation. I attend quite a number of things, and I talk to quite a lot of people and so I garner information from all of those sources. I also have a collection of books that I get material from, and I also look from time to time, especially around things like weed management, I’ll look on the DPI website or talk to the local farmers” (Anna)

This finding echoes previous research about informal learning; Latchem (2014) argues that 70 to 90% of human beings’ learning is informal.

Social learning in the workplace and being engaged with conservation practices in natural resource management is influential in understanding social-ecological systems (Pahl-wostl et al. 2008). Professional experience as part of informal learning was observed in some interviews. Some participants stated that their knowledge partly came from their involvement in similar activities in their profession. “I was working for the […] Catchment Management Authority, so I had the role of bush care facilitator and had the task of bringing out a draft native vegetation plan for the region” (George).
Emergent stewardship: Conservation activities on the property

Land stewardship values may be developed in landholders once they care for their property beyond consideration of farm benefits and monetary values. Such landholders are more likely to participate in tender-based conservation schemes (Blackmore & Doole 2013). Landholders also can develop a sense of stewardship as a result of their everyday agricultural practices (Trigger et al. 2010). In addition, undertaking conservation activities independently (i.e. revegetation) makes biodiverse carbon plantings fit with existing land management or farming practices (GFIT) (Pannell et al. 2006; Blackmore & Doole 2013; Wilson & Hart 2001).

Many of interviewed landholders were undertaking different conservation activities and practices on their properties before engaging with biodiverse carbon planting schemes. Based on the initial survey, these activities are listed in Table 4. As this table illustrates, most participants were actively engaged in revegetation practices.

Table 4: Conservation activities undertaken by landholders

<table>
<thead>
<tr>
<th>Conservation activity</th>
<th>None</th>
<th>Some</th>
<th>Quite a Bit</th>
<th>An Extreme Amount</th>
<th>Total Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlling weeds</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Controlling pest animals</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Fencing re-vegetated areas</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Erosion control</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Re-vegetation</td>
<td>1</td>
<td>0</td>
<td>9</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Grazing strategies</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Others: ecological burns, farm forestry</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>
The interview materials also demonstrate some of the conservation practices undertaken by landholders. Mat reflects on the type of work he has been doing to run his agricultural business. “We’ve done a lot of native pasture regeneration, so that’s sort of managing how we graze the paddocks to encourage native pastures as opposed to exotic introduced ones, and we’ve done a lot of recovery work, there were a lot of blackberries when we first came here...” (Mat). This keeps landholders constantly engaged with conservation activities and seeking information regarding any new practices and schemes (Cooke & Lane 2015). Interestingly, John calls the soil enhancement practices part of agriculture rather than real conservation activity.

“I’ve done a lot of soil erosion work... yeah, and we’ve done a lot of other planting that isn’t carbon related. Yeah. And there’s still more to be done, but yeah... Soil enhancement, but I mean in terms of putting lime on to decrease acidity and stuff like that, but you know that’s really agricultural rather than conservation” (John)

Andrew also undertakes conservation activities on his property as a means to improve environmental conditions.

“The creeks were all washing out and I planted all along the creeks thousands of trees. There’s 1800 metres along the back – we did the same because there’s a creek next door that’s cutting into my place, and so we planted all the trees along there and it stops erosion as well as creates birdlife and corridors”.

Emergent stewardship was observed in the course of this research. It reveals that landholders start conservation activities on their properties as a means to survive and prosper in their agricultural business. Once they become proficient in such activities, they search for new practices and innovative ways to conserve the landscape. This provides opportunities for experimental learning that could develop conservation values (e.g. emergent stewardship) among landholders (Cooke & Lane 2015). It echoes the research undertaken by Trigger et al. (2010) that focuses on the emergence of stewardship values as a result of undertaking conservation practices embedded into agricultural business.
In addition to undertaking land management practices on their properties, landholders have participated in conservation programs like Bush Tender and Trust for Nature. Stoneham et al (2003) state that such programs alter environmental awareness among communities. Table 5 shows different conservation programs that landholders have participated in.

<table>
<thead>
<tr>
<th>Program type</th>
<th>No of Respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA programs</td>
<td>7</td>
<td>54%</td>
</tr>
<tr>
<td>Caring for Country</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>Bush Broker</td>
<td>3</td>
<td>23%</td>
</tr>
<tr>
<td>Bush Tender</td>
<td>3</td>
<td>23%</td>
</tr>
<tr>
<td>Land for Wildlife</td>
<td>6</td>
<td>46%</td>
</tr>
<tr>
<td>Land stewardship scheme</td>
<td>1</td>
<td>8%</td>
</tr>
<tr>
<td>Others: Bush Heritage, Landcare, Trust for Nature Covenant</td>
<td>4</td>
<td>31%</td>
</tr>
</tbody>
</table>

The interviews also reflect the conservation programs that landholders are participating in.

“We have a Trust for Nature covenant on the component and we’ve strategically re-vegetated to link the three main patches of bush and encouraged all our neighbours to do the same” (George). This constant engagement with ecology also reflects the emergent stewardship concept (Cooke & Lane 2015).

**Related conservation schemes in the area**

Some landholders were aware of the presence of carbon and/or biodiversity conservation activities in their CMAs. They undertook plantations as they saw themselves as a part of a larger landscape connectivity program in the area. As John expressed it: “There’s some connection here. We did have a big project which was to link.... it was originally conceived as part of a much bigger project which was the Campaspe [river] to the Cobaw [State forest] project”. This reveals that landholders were feeling connected to a bigger picture in the landscape. This awareness and participation in related conservation practices have provided landholders with the opportunity to develop stewardship values, as supported by previous research (Ahnström et al. 2008).

Furthermore, awareness and raising interest could happen when CMAs are active in promoting their carbon and biodiversity related schemes among landholders (Meadows et
al. 2014). This can assist landholders to keep up with information about other new land conservation schemes (e.g. biodiverse carbon planting). Table 6 shows the relevant conservation activities in the study area.

Table 6: Related conservation activities in the CMAs within which interviews took place

<table>
<thead>
<tr>
<th>CMA</th>
<th>Conservation (carbon and/or biodiversity) plans in the CMA</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Central</td>
<td>Kyneton Woodlands</td>
<td>To provide incentives for landholders to undertake biodiverse carbon stores on their properties.</td>
</tr>
<tr>
<td>West Gippsland</td>
<td>Red Gum Grassy Plains</td>
<td>• To undertake recovery of Red Gum Grassy Plains through Caring for Our Country (CFOC) funding</td>
</tr>
<tr>
<td>Goulburn Broken</td>
<td>• The Broken Boosey Conservation Management Network (CMN)</td>
<td>• To protect Box Ironbark forests</td>
</tr>
<tr>
<td></td>
<td>• Climate change strategy</td>
<td>• Support mitigation and sequestration activities aiding from Biodiversity Fund, Land sector package</td>
</tr>
<tr>
<td>Glenelg Hopkins</td>
<td>Connecting the catchments</td>
<td>To manage environmental threats (e.g. by vegetation along creeks)</td>
</tr>
</tbody>
</table>

**Participation in a Landcare group**

Landcare groups are perceived as “community process based on a learning group” (Martin 1997, p.51). They play a role in empowering social capital, assisting landholders to learn about new land management practices and acting as a conduit for communication (Sobels et al. 2001; Compton & Beeton 2012). Fifty three per cent of landholders were involved in their local Landcare group. They attend it to receive information regarding grants and land management initiatives, and to get engaged in their community socially. As Andrew noted:
“Well, I belong to the […] Landcare and in fact I was in it for about ten years, eleven years, backed out now, but I’m nearly 75, and the governments were still giving grants out so we all applied for different grants. And fortunately we got a fairly good grant which did a lot of the fencing; I couldn’t have afforded to do it otherwise”.

Some landholders also received information about biodiverse carbon plantings from Landcare presentations. As James mentioned: “When I was president of Landcare, they wanted to come and talk to the group. Well, most of the neighbours and things were in Landcare so they all were at the presentation by Greenfleet” (James). This finding is aligned with previous research about the higher rate among landholders who belong to a Landcare group choosing to participate in private land conservation activities (Jellinek et al. 2013). However, Compton and Beeton (2012) argue that Landcare leaders’ skills and experiences as a change agent enables landholders to move from the status quo and participate in conservation programs.

**Social networks and trusted peers**

Collaborative interactions among landholders to share knowledge and resources has been well documented (Lauber et al. 2008). Social connectedness assists landholders in rural communities to access information regarding conservation practices (Baumgart-Getz et al. 2012). They can keep their knowledge about conservation activities up to date, which may lead to higher rates of program uptake (Morrison et al. 2008). Connectedness of landholders to early adopters of carbon farming practices increases participation rates among landholders (Kragt et al. 2014). The role of social capital (trust and social networks in particular) at different stages of biodiverse carbon planting adoption (and post-adoption) is unpacked further in Chapter Five.
Second Step: Non trial evaluation of biodiverse carbon planting schemes by landholders

Once landholders become aware of the scheme through their social networks or through seeking advice about other conservation practices on their properties, they enter the non-trial evaluation stage (Pannell et al. 2006) of biodiverse carbon planting. In this phase landholders appraise their drivers for participation. They also consider the compatibility of the new practice to their property management (Blackmore & Doole 2013). Increasing farm productivity and the environmental co-benefits are among the drivers that accelerate landholders’ participation in private land conservation schemes (Jellinek et al. 2013).

The primary aim of policies like the Carbon Farming Initiative (CFI) or any other monetary or paid carbon farming scheme is to sequester carbon from the atmosphere (Australian Government Clean Energy Regulator 2014). Carbon sequestration and emission abatement are the principal messages communicated within policy documents and with landholders. In the course of this research, carbon sequestration was not mentioned by any landholder as a primary driver for participation in biodiverse carbon planting schemes. Landscape-related co-benefits were unambiguously the major drivers for landholders to participate in these programs.

Co-benefits of biodiverse carbon plantings

‘So there’s a range of reasons. So there’s the economic and production side; there’s the biodiversity side, and then on top of that there’s also the land repair side I suppose, for want of a better world’ (Oliver). As summarised in this quote, there is a range of reasons for participating in biodiverse carbon plantings: productivity gains, biodiversity conservation and land rehabilitation are among the main drivers why landholders participate in such schemes (Jellinek et al. 2013).
Biodiversity conservation

Biodiversity conservation working alongside agriculture

Landholder interviews reveal the importance of biodiversity conservation as one of the drivers for landholders to undertake biodiverse carbon plantings on their properties. Participants recognised preserving diversity of species as one of the co-benefits that such re-vegetations would have. “Well probably the main benefits are biodiversity benefits. So we’ve got a sort of a commitment and a desire to see conservation and agriculture both working” (John). John, one of the landholders, explains that balancing agriculture productivity or amenity benefits with conservation seems critical to landholders. It also reveals that they do not consider conserving biodiversity as a barrier to agricultural productivity, recognising agriculture as an ‘ecological enterprise’ (Saunders & Walker 1998).

Market-based instruments (MBIs) have been extensively used in agro-environmental contexts (Moon & Cocklin 2011a; Morrison et al. 2008; Doole et al. 2014). They provide financial incentives to landholders to undertake desired activities (Stern 2008). Jack et al. (2008) argue that, in designing a successful incentivising program, socio-environmental contexts need to be considered. In doing so, this study reveals that landholders are not necessarily profit maximisers and they have a strong commitment to conserve the landscape. “But right at the start we were going to protect the bush anyway, whether it cost us or not” (George). This illustrates that stewardship motivations can be stronger than monetary ones. This echoes Kragt et al. (2014) who found that the financial incentives are not the main drivers for the uptake of carbon plantings among landholders in Western Australia.

Recognising intrinsic values: mixed species value on its own and as habitat for wildlife

The value of mixed species revegetation to halt flora extinction and as a habitat for wildlife has been the subject of previous research (Hartley 2002; Bigsby 2009; Bowen et al. 2007). However, in addition to recognising and appreciating biodiversity as mixed species (Saunders & Walker 1998), the habitat they provide for wildlife is valued intrinsically (Lockwood 1999) by landholders. “Well you know the whole country needs it in the sense that if you don’t have the mixed species, what does the birdlife and the animal life live on?
You’re limited in what .. in the corridors of what animals can exist” (Andrew). As Andrew explained, the biodiverse carbon plantation provides several ecological benefits to fauna and flora on his property that he values intrinsically. In a similar example, Luke emphasises that increasing wildlife abundance has been one of the drivers to participate in such schemes. “We were also interested in creating an increase in wildlife through the farm and providing a habitat for that, which is always good to see a bit of birdlife and that sort of thing” (Luke).

**Habitat corridors and landscape connectivity**

Intrinsic values for the ecosystem as a whole and considering broader landscape restoration are considered ‘ecocentric values’ (Lockwood 1999). These types of values and ethical considerations could refer to the sense of stewardship when landholders think about public goods beyond their own properties’ boundaries. When I asked Laura about her motivations in the non-trial evaluation phase, her response revealed both the intrinsic values for biodiversity and habitat restoration, and aggregating her local action to a broader restoration context in the landscape (Menz et al. 2013).

“One end of my property is a small Crown area of bush that was maybe an old school reserve or something, and then on the other side we have another one, and in the middle of my dam, dad has always maintained these tree groups anyway for birdlife and so forth, so I thought if I re-vegetate and try and join the whole lot up so that will then give birdlife and perhaps the smaller animals a chance to get from one place to another” (Laura)

The ability of landholders to see themselves in a broader picture of the landscape and the desire to be part of larger landscape connectivity programs could assist in the success of the latter. Such programs often require actions on a broader scale across the landscape (Briggs 2001). Land rehabilitation is another driver for landholders to consider participation in biodiverse carbon plantings. The aspiration to restore landscapes reflects the ethical consideration and stewardship values that landholders hold. As Daisy explained, some of the landholders had
the idea of restoring land to provide a more suitable habitat for the native fauna. “We just... we wanted to rehabilitate the land I suppose, so we wanted to bring back what would have been here with the habitat to the local fauna” (Daisy).

Another key point that can be gleaned from landholders’ comments is the fact that they tend to hold a living with nature” approach towards land (Thompson et al. 1994). “So it’s just we kind of feel like that that we’re doing something for the health of the land and giving something back instead of just taking stuff away from it” (Barbara). Other landholders like Barbara reflected an ecocentric approach (Buijs 2009) to their property management. This approach encompasses moral aspects of caring for land and re-emphasises the findings of (Gill 2013) who considers stewardship as an ethical element of land management.

**Farm-related drivers**

These groups of drivers refer to factors that are mainly related to farm productivity. Increasing farm productivity has been documented as one of the drivers for landholders to participate in private land conservation (Ahnström et al. 2008; Jellinek et al. 2013). Wind breaks and shelter belts to assist the livestock in extreme weather conditions, erosion and salinity control are among these motivations.

**Wind breaks and shelter belts**

One of the drivers landholders mentioned was to create wind breaks and shelter belts for the benefit of their stock. This is not only a driver but a determining factor for choosing where to spatially plant the trees. In the course of the interviews (particularly while walking/driving around their properties), I asked landholders about the spatial location of trees they planted and the justification for the choice of location; ecological and biophysical explanations. In addition to strategically locating them in a way to connect to the Crown land or existing adjacent remnant vegetation (discussed earlier in this chapter), the prevailing direction of wind and protection of livestock was an important factor for landholders. “We’ve put them there more or less for wind, because we get all the wind from
in winter it’s cold so you create shelter belts for the stock” (Andrew). David also recognises the fact that wind breaks are essential in the sheep grazing areas.

“It’s definitely a plus for sheep people that the biggest loss of mortality of lambs is not having shelter... like it’s cold wind and rain together is the biggest lamb killer. So if you have shelter from that exposure, and whether that event comes and you’re lambing, if you happen to be lambing right then and it’s windy and rainy, you’ll lose a lot of lambs, and the shelter would prevent a lot of that” (David)

**Erosion and salinity control**

Erosion and salinity control have implications for on-farm conservation and also benefits for a broader landscape health (Johnson et al. 2007). From a landscape restoration point of view, Steve reflected that biodiverse carbon plantations on his property play an important role in absorbing salt from the downstream lake. “It’s right at the top of the catchment for Lake [...], and we’re saving up a lot of the water so fighting the salt and we have the benefit of grazing” (Steve). From an on-farm perspective, many landholders mentioned similar points, including Oliver: “I suppose there’s also where we’ve had... There’s some salinisation issues we’ve had at different areas which we’ve actually redressed by planting trees.” Fighting erosion, as Noah and Linda mentioned, has been an important driver for landholders to revegetate their properties by up taking a biodiverse carbon planting scheme. “We would like to think that the planting we did would help with the erosion in this area, and I think that has helped because there was a fair bit of erosion – it’s a fairly dry area, as you probably gathered. There’s a fair bit of erosion around”. Again, it is not only considered an on-farm related issue but from the perspective of restoration of a broader landscape. William explained his passion for fighting erosion and restoring landscapes as follows. “The erosion is shocking and I mean the magnificent trees that they cut down there in the first place is a crime in itself. So I suppose I’m trying to do something to reinstate what was there in the past”. 
Aesthetic

Consistent with previous research, amenity reasons are often a strong motivation for landholders to participate in conservation programs (Ma et al. 2012). Both amenity migrants (Gosnell & Abrams 2009) and commercial landholders considered biodiverse carbon plantings as a way of increasing aesthetic values of their properties. “It was about visual ... when you look... doing something to lift the quality of the paddocks, a bit of visual amenity I guess, it was a pretty bare rock farm prior to that”(Noah and Linda). Noah and Linda regard themselves as amenity migrants or ‘blockies’ as they are called by farmers in their area. The enhancement of the visual amenity of their property has been one of the major drivers for their participation. “I don’t know how you measure that or say it but it’s nice. People like to plant trees. They don’t like an open plain” (David). David, a commercial cattle grazer, thinks that beautifying properties is subjective and there is not a specific metric to gauge the result. To enhance the visual quality of their properties, aesthetic benefits encourage landholders to join the biodiverse carbon planting scheme.

Third Step: trial evaluation (decision phase) of biodiverse carbon planting by landholders

Following the awareness and non-trial evaluation phases in which landholders appraise their motivations for participation in biodiverse carbon planting, trial evaluation is the third phase. Pannell et al. (2006) refer to this phase as including both decision-making and small-scale trials of the new practice. In this phase, landholders will also gauge whether they have adequate skills to undertake the new practice. The trial evaluation (decision phase) leads landholders to the uptake of the program (Korhonen et al. 2013). In addition to factors related to landholders’ characteristics, external factors (such as the socio-political context) also impact on their decisions to participate in biodiverse carbon planting.
Decision process

The impact of human decision-making on the conservation of biodiversity is insufficiently studied (Milner-Gulland 2012). Such studies would assist policy makers to understand the potential outcomes of land management policy (Milner-Gulland 2012) by changing the focus of such schemes from a focus on environmental outcomes exclusively to including consideration of the landholders' decision-making (Cooke et al. 2011).

Decision-making by landholders related to conservation practices on their properties are influenced by the conservation values they assign to their properties and also their confidence in possible positive outcomes (Brain et al. 2014). However, interview results reveal that the decision process has been easier for landholders who have already been involved in similar conservation practices, such as revegetation. They also expressed that they felt certain about what was involved in the process of joining the program to plant trees on their properties. “Well it was easy for us to make the decision in that we already understood what was involved; we were already doing that sort of work. It was more for us to use Greenfleet” (George). In the process of decision-making for participation, a few landholders who were living with their older family members had to reach an agreement about biodiverse carbon plantings. As Daisy explained: “It was like I think I just told mum what we were doing and waited for the.. and I still get it.. she still comes in, because my mum, you’ve got to understand is nearly 92, so she still comes and says, I don’t know why you did it. Why did you do it?” The findings of this study support the assertion of Pannell, et al. (2006) that decision-making is complex when the property is run by a team of family members.

Time to invest

Another factor affecting landholders’ decisions is the time to invest in planting trees. Lack of time is one of the major barriers for landholders to participate in conservation programs, especially if such participation requires them to change their property management from status quo (Moon and Cocklin 2011b; Moon et al. 2012; Pannell et al. 2006). Non-participants in biodiversity conservation programs in North Queensland stated that they had...
less free time to participate in those programs (Moon et al. 2012). Some landholders like William indicated that they joined Greenfleet as their own attempts at biodiverse plantings had failed and he lacked the time to invest personally in revegetation. “The main reason was, as I said, I had a go at it myself, and it was very time consuming and it failed”. Landholders not only consider the investment time but take into account the opportunity for more successful outcomes within a shorter time frame.

“Like I said before, it was just an opportunity. For us it just suited us: to get those areas all done out there would have taken probably ten or twelve years to have got to that stage and we did it all in... I think we were told about it in April or something, and it was four months from go to whoa. It put a bit of pressure on getting it all done, but the actual planting was no problem because there was a hundred odd scouts going planting trees like mad” (Mat)

Landholder surveys also revealed that all of the participants believe that time to invest impacts on their ability to participate in conservation activities on their property.

External factors

External factors here refer to the context and socio-political settings that have an impact on the decision to participate in the program (Morris et al. 2000). Some of these factors relate directly to the nature of policy and the political situations at the time such schemes are introduced to landholders. Other factors influencing landholders’ decisions relate to the nature of national and global carbon markets and the future prospect of these markets. Both categories will be elaborated in the next section.

Uncertainty

Landholders revealed that uncertainties are one of the major barriers for their participation in the regulated market for biodiverse carbon plantings. Uncertainty, in both political and policy contexts, refers to doubt or confusion which might attend the direction or duration of a policy position, its efficacy or the implications of the ideological perspective of the government of the day. In recognition of the very real implications of this uncertainty for agricultural communities, it must also be noted that uncertainty is the inevitable
consequence of the urgent environmental threats of climate change and biodiversity loss (Rockström et al. 2009). Key categories of uncertainties identified in the interviews include program design (administrative burden), political and carbon market related.

**Administrative burden**

Finding and accessing information, especially at the beginning of a new scheme, is time-consuming for landholders. It may be considered as a burden during the decision-making process for landholders to participate if the administration process seems complicated and if they have problems accessing relevant information in an efficient way.

“I think sometimes people don’t know where to go to start finding the information. It does seem to be you know there’s DPI and now that’s merged with DSE, and you know there’s all these government departments and it can be hard for people to know who do I ring? And often when you do ring, you get shoved around within the department. Yeah, so it’s probably the more places you can approach, the better really, because a lot of people are a bit threatened I think by ringing government departments” *(Daisy)*

The nature of policy instruments in carbon sequestration and biodiversity conservation matters to landholders. Such programs would be more attractive to them if delivered with clear rights and responsibilities for landholders. The need for a more appealing and straightforward program was mentioned by several landholders in this research. “Farmers aren’t interested in anything that’s too bureaucratic, so it’s got to be reasonably straightforward. So I think it does need to be a partnership and a clear partnership with clear responsibilities” *(George)*.

This echoes Lovell (2010, p.361) who emphasises the need for “balancing bureaucracy with speed and transparency” in carbon market policies.

Jacob also emphasises the role of a personal contact or a familiar face in facilitating landholders’ access to information. “The trouble is that the whole system is so much red tape now. A lot of the old fellas, you don’t talk to a person, it’s the same person... personal
contact – you can get more information in ten minutes than an hour-and-a-half on the computer”.

Sixty seven per cent of landholders also revealed in the survey that administrative burden is an important factor impacting on their participation in the regulated carbon market.

Political uncertainty

I have undertaken this study during a time of rapidly changing policy. Interviews were conducted during the 2013 Federal pre-election period when the nation was concerned about the future of climate policy in Australia (Holmes 2014). The uncertainty about the electoral outcome leads to doubt about policy priorities in the future. Kragt et al. (2014) argue that political uncertainty is one of the major barriers for landholders to participate in carbon farming practices. The lack of a robust institutional framework in carbon policy increases uncertainties in political settings (Paiva and Gomes 2014). Landholder interviews reveal that political uncertainty is one of their major concerns for participation in any regulated carbon planting scheme such as the Carbon Farming Initiative (CFI).

“You know the carbon literacy needs to improve dramatically from our politicians before they’ll even move to that space... They’re a relatively ignorant group of people in this regard. But I think... I’m talking generational shift here. I think it will happen, but I don’t think it’s going to happen in the next few years... especially if we have a Coalition Government coming in. I don’t hold much hope of that” (Oliver)

The uncertain political setting is a hurdle for landholders to participate in biodiverse carbon plantings. They considered the possibility of a change of government as a threat to carbon abatement activity. Hence, any further involvement in such schemes would be very uncertain from their point of view. Mat explained his scepticism towards the policy as a result of such uncertainty.

“I’d say I’m sceptical because I think it’s... I reckon we’ve got about a 90% chance we’re going to have a change of government, and that will mean there’s going to be a change in the carbon farming initiative. So eventually it will settle down into
whatever it’s going to do, but quite often with these, they take a long time before
they become... what would you say?.. user friendly”.

There is also a general lack of regulatory assurance in private land conservation-related
policies (Raymond and Robinson 2013). Changes of government in Australia can impact on
conservation-related strategies. The presence of such uncertainty acts as a barrier for
landholders to participate in schemes. “So what you do today, there’s no guarantee of what
you’re going to be able to do in twenty years if you do something for an investment or a
planning... so what I’ve done is just to create weather breaks and corridors for birdlife and
animals”. (Andrew)

As Andrew reflected, landholders have undertaken voluntary biodiverse carbon plantings to
benefit from landscape restoration and farm and productivity-related effects. They assumed
if they were tied to a regulated market-based scheme, the lack of regulatory assurance and
certainty in the policies would act as a barrier.

Market uncertainty

In addition to the existing political uncertainty in Australia, uncertainty about carbon
markets and the future of the carbon price is another barrier for landholders to take up
carbon farming practices (Maraseni & Dargusch 2008; Kragt et al. 2014). Deficiencies in the
market for carbon stem from the failure to set a price on carbon and the lack of a global
carbon market; a well-functioning global carbon market develops flexibility and liquidity
(Fankhauser & Hepburn 2010). This needs collaborative work at the international level.
Some landholders like Luke expressed their concerns about the uncertainty in the carbon
market related to the carbon price and the impact of a reasonable price on landholders’
participation.

“No one seems to be able to work out what the actual carbon is worth. I mean, if you
got a reasonable price for the carbon credits or whatever it is, you’d probably find
farmers would go to more trouble and plant a few more trees, I think. It’s a bit
uncertain where that’s going to go, where that’s leading”.
Sixty-seven per cent of landholders considered carbon market stability as a significant factor for their future uptake of carbon farming practices.

**Permanence rule**

One of the possible barriers for participation in carbon farming mentioned by landholders is the permanence rule. According to the Kyoto Protocol and the legal aspects of carbon sequestration process, planted trees need to stay on properties for 100 years (Bradshaw et al. 2013). Some landholders were not willing to sign a 100-year agreement.

“Greenfleet gave me two contracts to sign, or a contract to sign, which I did, only too pleased to hand over the carbon credits. They’ve subsequently come back to me and said, ‘No, these contracts don’t hold any legal rights now. Will you sign another one?’ And that’s putting a covenant over the land which they’ve planted. I said no, that wasn’t the original agreement. I’ll honour my commitment that you’ve got the carbon credits but there’s no way I’m going to put a covenant on the land because there are parts of the land where I could put gypsy caravans on or something like that when and if the resort ever gets going. So there’d be temporary bird hides, temporary accommodation and those things” (Jacob)

Contrary to the experience of Jacob, many landholders have undertaken carbon planting for its co-benefits (Paiva and Gomes 2014) and they were satisfied with having a covenant on their property, guaranteeing the existence of co-benefits (e.g. biodiversity, salinity control) over time. For example, William reflects that he thinks legal binding aspects of carbon plantings are necessary. “So I thought they sort out all the legals as far as covenants on the land go, which I’m a big fan of, because once the trees are in they can’t be removed“.

**Step four: Adoption of biodiverse carbon planting**

Pannell et al. (2006) emphasised that adoption of a new land conservation practice is a ‘continuous process’; it takes time for landholders to incorporate the practice into their existing land management. Landholder interviews revealed that the key factors influencing
their involvement in biodiverse carbon planting during the adoption process include land management alteration, native species preferences and risks (fire and feral/pest animals).

**Land management alteration**

The extent of land management alteration depends on the degree of integration of conservation practices with the existing farming or lifestyle business (Pannell et al. 2006). Blackmore and Doole (2013) found that when a new conservation activity is easy for landholders to adopt, they are more keen to undertake the activity themselves rather than joining a conservation scheme. Landholders who have already been undertaking conservation practices integrated the biodiverse carbon plantings into their agricultural or lifestyle property with less effort.

“What we’ve done is, as we learnt more about both managing native vegetation and managing pasture, we’ve renovated the pasture, improved the pasture, improved the water supply and the fencing, set up lane-ways through the property for ease of management so the investments that we’ve made there have meant that we can run a lot more stock. So although we don’t allow any stock to graze the native vegetation, we’ve actually doubled our stocking rate from the past” (George)

George expressed his prospect about the success of adoption of biodiverse carbon planting and considering it as a way of increasing productivity. This is because he regards it as a part of the bigger picture of managing his property. However, to participate in a regulated market-based scheme like CFI, landholders consider transaction costs such as management, monitoring and verification costs in the adoption phase (Cacho et al. 2013). These could be regarded as barriers to participation in such schemes and need to be incorporated into the policy design (McCann et al. 2005).

Transaction costs for landholders to take up a carbon sequestration scheme such as Greenfleet include fencing the revegetated area and controlling weeds and feral animals. Fencing is the major issue for landholders; they need substantial fences to keep the stock away from their new biodiverse carbon plantings. Like many landholders, David expressed his concerns about establishing fences and changing stock management in favour of the
planted area on his property. “Well, you do have to build about the strongest fence on the farm because on the other side where there’s a lot of grass it’s a temptation for the stock. So it’s probably got to be the strongest fence you have really”. Laura also mentioned the elements of management procedures she needed to undertake to integrate the new plantation to her property management: “Well, only the agreement with them is you know it was basically weed control, pest control, keeping the stock out until the trees got going. I’ve done all that, and the trees have grown quite nicely, and so now we’re just sort of getting ready to, as I said, put the stock back into it”. However, the transaction costs involved seemed like a massive hurdle for a cohort of landholders. As James expressed, to integrate the new revegetation areas with his existing farm management, he had to resolve some of the management alterations, like putting guards around trees. He also expressed some of the issues with electric fencing; disturbance by falling trees in particular.

“Well there are some downsides. We rely on electric fencing; the property basically has electric fencing so the trees are something of a nuisance in that respect because they quickly fall over the fences and that short-circuits your electric fencing system. I mean I accept the fact that you can have 20% of your farm in trees and not affect your stocking rate but it’s hard country to get established in down there; it’s pretty unforgiving. Like the first Greenfleet plantation, they put in 4,000 and I think about 50 grew. So to be fair to Greenfleet, they came and did it again and now they’ve had a pretty good strike rate, but only because we were prepared to put guards around all the trees they planted and watered them through the summer, which is far more than we probably anticipated with the initial program, but we got them going and we’re happy about that. But there’s a lot of work involved if someone wants me to put another 40 hectares into land; there’s a lot of work”.

Survey result also shows that 67% of landholders think that establishment costs like site preparation and fencing are important factors that they would consider if they were to participate in a regulated carbon trading scheme like CFI.
**Native species preferences**

Australians have historically praised native species of fauna and flora for their productivity and aesthetic benefits, from early bird-watchers to choice of native trees by urban planners (Trigger et al. 2008). The concept of “Australian bush” and landholders’ willingness to restore and reconnect with that element of the landscape was clearly stated by interviewees. Gum trees are treated as a flagship species for the bush.

“We would certainly have liked more gums because gum trees are very native to the area, very Australian, if you know what I mean. It’s part of life in the bush in Australia I guess, so we were a bit disappointed in that aspect, we would have liked a better diversity of.. as I say, more gums and less wattle, but that wasn’t to be” *(Noah and Linda)*

Interestingly, the concept of bush is associated with having gum trees on their properties, reflecting their sense of identity and the complex perceptions of Australian native species (Trigger et al. 2010; Rogan et al. 2005). Participants in this study similarly expressed sentiments towards ‘bush’ conservation and the spiritual value that the bush encompasses (Rogan et al. 2005). It could relate to the cultural and aesthetic preferences of the type of trees planted.

In addition to appreciating native species as a way of connecting to the concept of ‘Australian bush’, the higher survival rate of native trees also matters to landholders. Recognition of the fact that only native species could survive in the harsh environment was observed among landholders. “*The only ones that grow down there are the ones that grow naturally. Anything else is not very successful*” *(James)*. Jacob also acknowledges the fact that local seeds were the reason for the biodiverse carbon planting surviving the adverse climate condition on his property. “*It was all sourced from local seed, so it was very easy for it to survive. And surviving... it’s a pretty windy block and it’s a very wet block and I thought a lot of the trees would have died because they would have root rot but they haven’t, they’ve survived quite well*”.

All landholders in the survey stated that native trees with a diversity of species are the only option that they will choose for any future revegetation activities on their properties. This is
because of cultural connectedness to the land and ecological benefit of those species (Trigger et al. 2008).

**Risks**

Once trees have been established, landholders can be confronted by risks of fire and feral animals associated with revegetation.

**Fire risk**

Victoria is one the most fire prone areas of the world (Fire Services Commissioner Victoria 2012). Landholders recognise fire as a natural part of the Australian landscape (Halliday et al. 2012). However, the findings of Jellinek et al. (2013) illustrates that non-adopters of revegetation activities were concerned with the increased fire risk on their properties.

“It’s no real... it’s not worse than if you’ve got long grass up there. It’s quite a temperate climate. It’s only really the couple of months of summer that would be an issue. Look, it’s an endemic thing in Australian society I suppose, fire risk, and I mean, what do you do? Cut all the trees down and cut down the fire risk? Probably not a great idea is it, because then you’ve even more risk of fire because the bloody planet’s warming up. Yeah. No-one’s really mentioned it. When I was on Council we had a few objections to people who had plantations and stuff about the extra fire risk and that, but it’s negligible really, and it’s a risk... and you manage that risk as best you can. People have to have fire plans and the like, whether it’s grass fire or a bushfire” (William)

William emphasised that destruction of the natural environment (e.g. cutting trees) contributes to global warming and a higher fire risk as a result. He also mentioned that fire risk in grassy areas is higher than the revegetated area. Laura explains the inherent risk of fire in Australian landscape; however, the presence of thick grass in the revegetated areas increases the fire risk. “But you know like it doesn’t matter whether you’ve got re-vegetation or not, you’re still going to run the risk. It’s just that with that re-vegetation there’s so much
grass in it, it would just flare up so easily”. The survey results show that only 25% of landholders stated that revegetation on their property will increase the fire risk.

While Oliver believes that the fire risk from revegetation exists, he also believes that the benefits from revegetation outweigh the risks associated with them.

“The fire risk is a bit of a moot point – it can act as a fire corridor, but at the same time it can also act as a fire break. So one may discount the other, but yeah, there are risks, but there are risks about running a cropping system where you allow standing stubble for too long too. So I mean there are risks with all of them... You make a decision that the risks far outweigh by the benefit, and that’s ultimately why we do what we do”.

The findings of this study support the assertion of (Halliday et al. 2012) about the complex nature of conserving biodiversity and the fire risk associated with such actions.

Wildlife/feral animal risk

The risk of increasing feral animals or unwanted wildlife could be seen as a barrier for participation in revegetation programs. Indeed Jellinek et al. (2013) found that the number of landholders were concerned about the increasing abundance of pest animals in the revegetated and remnant vegetation areas. Trees act as a suitable habitat for unwanted wildlife like foxes, kangaroos and rabbits. “Oh, there’s wildlife risk, there’s vermin control – if you don’t, you can end up with a harbour for foxes, and we have increasingly this last summer, we’ve noticed in a lot of the bigger plantations there’s a lot more kangaroos coming out of them than there were before in the open country” (Oliver). Andrew also considers the increased number of kangaroos as a risk to his property management. In addition, he raises the issue that neighbours could be affected as a result of that change in his property.

“Oh we’ve got lots and lots of kangaroos, which we will have to cut their numbers back because they destroy fences. That’s the only thing. I mean I don’t mind the kangaroos grazing, but destroying fencing is a big problem, a big problem. And of course we have a few foxes, which doesn’t cause me any trouble, but my neighbour
runs sheep and he has a bit of trouble with when his lambs are happening, the foxes get there, and the odd rabbit”

Jacob appreciates the fact that biodiverse carbon plantings have provided a suitable habitat for wildlife, but he thinks that it has also become a habitat for feral animals. “It’s turned into a very good habitat for deer and wombat, unfortunately foxes, kangaroos and these things”.

However, the survey result reveals that only 19% of the participants think that the biodiverse carbon plantings on their properties have increased the risk of rabbits and pest animals. This view towards the pest animals in revegetated areas was expressed much more strongly by participants in the previous studies (Jellinek et al. 2013).

**Step Five: Post-adoption of biodiverse carbon planting**

Post-adoption in this study refers to the time when trees are established and landholders start experiencing the benefits. This section focuses on the potential benefits which landholders consider regarding their participation in biodiverse carbon plantings, including socio-ecological resilience and variation in property values. Pannell et al. (2006) argue that the final stages after adoption of the practice could include ‘modification and non-adoption’. Non-adoption was not applicable in the case of biodiverse carbon planting and the participants in this study. This is because once trees are planted they stay on the properties for 100 years as stated in the signed binding agreement between landholders and the offset provider.

**Experiencing the benefits**

Landholders undertake biodiverse carbon plantings with a range of different motivations. Some of the benefits experienced in the post-adoption stage are additional to the motivations they had to participate. Some, like Daisy, have participated in biodiverse carbon planting to enhance the biodiversity conservation on their properties but in the post-adoption phase, they could experience other benefits as well. “Yeah, so it will definitely benefit our land because it was just... yeah the soil was just sort of sitting there getting tilled every few years and probably not getting much chance to sort of recover every year”. Anna
also reflected on the fact that she started with the motivation of improving biodiversity conservation but in the post-adoption phase she has been experiencing the satisfaction of being part of a program in addition to the aesthetic gains. “Oh, just the amenity, and more birds and the personal satisfaction that I’ve been part of something. I think that’s ... I think it’s important”.

In addition, some landholders were motivated to participate by increasing the visual amenity on their property. Their reflection on the benefits they have been experiencing was the same as their motivation.

“It no longer looks just like a rock farm. There is a fair bit of visual amenity to it. You can see why they bring people to come and have a look at it. And they keep telling us it’s one of the most successful plantings they’ve ever done. And you can believe it. And you haven’t actually seen it when there was nothing there, but the difference is quite stark” (Noah and Linda)

Other landholders who took into account other farm related benefits (salinity and erosion control, pasture improvement) also mentioned experiencing those benefits in the post-adoption phase. George summarised the farm related benefits of trees. “The benefit from the bush is from an agricultural point of view of shelter for stock, and particularly when we were calving cows down, virtually every paddock had good shelter and in winter when it is wet and windy and it’s quite cruel for animals”.

Furthermore, the long-term nature of returns from participation in carbon farming schemes requires more recognition (Mitchell et al. 2012). Some landholders also mentioned the need to recognise that benefits from biodiverse carbon plantings are long-term. The benefits landholders will experience would not be limited to visual amenities and have both biodiversity and productivity-related advantages on their property.

“But you know like he [a neighbour] would love to do things like that too, and there are people around who, I think if they realised the benefits of doing it, not just aesthetic reasons, but the actual benefits to their pastures and stock feed. You know, it all doesn’t happen overnight, and you know I’m just going to start seeing some
benefits now, but I look back and I think well it’s been worth it, even if it’s only just for the wildlife, it’s been worth it for me” (Laura)

Communicating such understanding among landholders could have an impact in the success of program diffusion.

**Changes in property value**

While some previous studies have argued that planting trees on a property could add to its financial value (Polyakov et al. 2015), some landholders expressed that biodiverse carbon plantings have not added financial value to their properties. “Not really. I think aesthetically they do and for wind protection they do but there’s no economic value”. As Jacob expressed the visual amenity and farm productivity are the main benefits of those trees on his property. There is also a great concern about the future buyers of their properties among landholders. Many expressed that in a farming society, traditional farmers would prefer to have fewer trees and more agricultural land. Whereas, if they were to sell their property to a lifestyle landholder, those trees would be considered an added value to the property. In addition, some landholders like William reflected that the increased values they see from the established trees are quite different from the monetary value. Those values they assign to the revegetated areas relate to amenity and broader landscape benefits in the face of climate change.

“If you talk to some of my cousins and blokes like […], they say, why are you planting the property? It’s useless now, you can’t run stock on it, and you’re just devaluing it, but you’ve got to look at the bigger picture I suppose. You don’t know when legislation will change, and the climate the way it is, how valuable these particularly parcels will become into the future. **So maybe now it’s probably not making the property any more valuable, but I doubt whether it’s making it any less, and my argument would be it looks better as well. So it depends what you put value on.** So there’s different ways of looking at value and value to the community and the climate and the fauna around the area…. But from a monetary point of view, I don’t
think it is. I can’t see it really changing the value of the property much, it just changes the use really.. you’re farming trees instead of farming animals”.

The findings in the post-adoption phase support those mentioned in other stages; that landholders did not hold purely utilitarian stances towards participation in biodiverse carbon plantings. It also reveals how this program may have influenced the way landholders see themselves and their role as “farming trees”.

**Changes in the fauna and flora**

Biodiversity conservation, habitat and wildlife restoration were among the motivations that drove landholders’ participation. In the post-adoption phase, landholders mentioned the changes they have noticed in the abundance of both fauna and flora species on their properties, with an emphasis on changes to bird species.

“Monitoring of birds, so we’ve got a fair idea of what we have there, and I think the ... certainly the biomass of wildlife has increased with the increase in habitat, and it’s hard to know whether we’re more tuned in, but I think... I’d like to say we have more or greater diversity. We haven’t got any evidence of greater diversity, but there’s certainly more individuals of particularly bird species. So the health of the environment, the habitat has certainly improved enormously over the years” *(George)*.

Apart from the growth in wildlife abundance, the improved habitat on George’s property has been a substantial benefit in the post-adoption phase. Andrew also claims the increased number of birds on his property, noticing the bird species which had not existed on his property prior to the plantation. This is as a result of improved habitat on his property.

*We’ve planted all the trees, it’s 45 species.. more than 45 species of birds here now. Birds turn up all the time that I’ve never seen before because we’ve got all the gardens here and the nectars and the gum trees and the shelter belts, and it just goes on. You know we’ve hawks and eagles and there’s dozens of little wrens. And we never had a wren on the place, and I think we’ve got hundreds of little wrens around now. They come in to feed. I put out feed for them almost every day too*. 
This finding is aligned with the previous research on the role of habitat and revegetation structure in the increase of the population size and diversity of bird species (Martin et al. 2006; Bowen et al. 2007).

Furthermore, the increase in the rate of natural regrowth occurred as a result of existing biodiverse carbon planting. This is because of the change in the property management, especially in the fenced areas for those trees (e.g. stopping grazing). Steve noticed the increase in both woody and grassy habitat elements.

“Together with what’s been planted, there’s a lot of natural stuff coming back, you know... where there were existing trees that never got burnt down, obviously they throw their seeds out and it’s flourishing up, yeah mostly lots of trees and native grasslands. It’s native grasslands because it’s so steep you can’t work there, you’ve got to walk around. It’s just unbelievable”

This provides a balance between ecological and economic benefits of planted trees (MacLeod & McIvor 2006) and has an impact on land rehabilitation and biodiversity conservation on their properties. In addition, Possingham et al. (2015) argue that land restoration (e.g. revegetation) is more cost-effective than protecting habitat.

However, the lack of a fauna and flora survey to provide evidence for the biodiversity benefits was among landholders concerns in the post-adoption phase. “I mean the one thing being a bird-watcher that I probably wish I had done a little bit more was do some surveys on my own land of the birds to track those changes”. As Daisy explained, undertaking surveys to set the base line prior to the plantations and in the post-adoption phase to demonstrate the biodiversity gains of carbon plantings could assist stakeholders. Landholders would then have solid evidence of benefits on their properties and in the broader landscape. It could also provide more opportunities for informal learning through increased involvement in the program (Couvet & Prevot 2015). Furthermore, scheme administrators would have tangible landscape outcomes to communicate to landholders in the awareness phase. To achieve the mentioned objectives, some biodiversity monitoring
could be incorporated into the regular monitoring of carbon on the properties, followed by some set standards to showcase the conservation outcomes of biodiverse carbon plantings.

**Resilience**

Resilience has been widely referred to as the ability of socio-ecological systems to recover after any fluctuations occurring in that system (Cosens 2013; Holling 1973). Given that Victoria has experienced many recent extreme events in the face of climate change (e.g. drought and fire), it is important to consider private land conservation practices as one of the means to increase the socio-ecological resilience in agricultural landscapes (Lin 2011; Tang et al. 2012). The resilience benefits of the biodiverse carbon planting could include diversifying income (in the case of regulated markets only) and improvements in ecological resilience.

“Now historically, if you look at things like the Federation Drought, which I think went for four or five years back in ’91. If that happened again today, and it will, a huge percentage of farmers will just go broke, you know they’ll walk off the properties, and that’s their income gone as well. You know there’s a very important social component – suicide rates go up under those times of high stress, and that’s where you know you can argue that plants in the landscape are going to give some level of resilience and even where... and it’s not desirable ecologically, but farmers have put cattle into bush areas and it’s saved them” *(George)*

George explained the economic resilience those planted trees provide for the farm when extreme events happen is a means to assist farmers to survive.

Some landholders highlight the importance of scale in considering resilience in the socio-ecological system.

“*Oh we’re not planting enough acres to affect the weather, I don’t think, so it’s not really going to have any influence on whether drought happens or not. No, I think you potentially can increase your... Well you don’t affect your stocking rate because the more protection you give your stock the better, so there’s a benefit there and if*
you really want to set up these biodiversity connections through the area and involve significant acreages of land they’re going to have to... somebody’s going to have to put in a lot of money” (James)

As James mentioned, ‘scale’ is an important factor to consider in undertaking biodiverse carbon plantings to achieve a meaningful outcome across a landscape in terms of both increasing resilience and enhancing biodiversity benefits. Recognition of the complexity of socio-ecological systems urges a move from an ‘optimisation ‘ management method to a more adaptive way of managing both ecological and social benefits to achieve resilience (Cosens 2013). To achieve the scale of biodiverse carbon plantation which affects resilience, ‘adaptive governance’ in multiple scales across landscape seems crucial (Cosens 2013).

**Adoption as a continuous process**

In addition to recognising the long term benefits of biodiverse carbon plantations, landholders contemplate the fact that conservation activities continue even in the post-adoption stage. This means landholders possibly undertake more conservation ( revegetation) activities and do not see adoption as an end-point and ‘review and modification’ of land management occurs continuously (Pannell et al. 2006).

“...We’ve been planting corridors from already established areas so they link up so the wildlife can move quite happily all over the property. And each paddock, whether it is a paddock of trees or a paddock of grass, is treated as an individual paddock and we try and manage them as such. So it’s just an ongoing management program. There’ll be more trees go in, we’ll plant out 1,500 to 2,000 trees every year and we’ve got a few bits and pieces, bits of creeks to finish off. You know we’ve changed... some of the original plantings we did, some of the creeks we’re changing the fence-lines of those creeks because they don’t suit either where the trees are or where the paddock is, you know. We just have to work... it’s a continual adaption of things”.

As Mat explained, even when the formal adoption stage is over, landholders can alter their property management to fit the trees they have planted. This echoes the findings of Pannell
et al. (2006) about the review and modification stage. In the adoption process, there is continuous revision of land management and conservation activities.

Furthermore, landholders seek other sources of funding to undertake more biodiverse carbon plantings to connect to the existing works and enhance the biodiversity and landscape connectivity benefits on their properties.

“I think we definitely will. Some of the tops of hills... do some more connectivity stuff, re-fence some more of the remnant vegetation. Actually we’ve got a plan to do some of that this year, so yeah we definitely will.. and some of that will be Biodiversity Fund .. not Biodiversity Fund.. biodiversity market funded, because we will do some large old trees. You know the biodiversity market? Yeah, you know how that works, yeah, so we’ll do some large trees on this place”.

As John reflected, the conservation activity on landholders’ properties is a continuous practice (Pannell et al. 2006).

**Conclusion**

In this chapter, I applied adoption theory (Pannell et al. 2006) to explore motivations and barriers for landholders to participate in biodiverse carbon planting at each stage of adoption. I identified important factors identified by landholders that assisted them to become aware of biodiverse carbon planting schemes in the awareness phase. Cultural motivation, the roles of formal and informal education, emergent stewardship, participation in Landcare groups and social networks are among the drivers explored in this stage. Experiencing nature as a child (Louv 2010) and social learning from role models and influential figures in landholders’ lives were major cultural motivations for them to participate in biodiverse carbon planting to rehabilitate land. Furthermore, through their participation in a Landcare group or suggestions from a trusted peer within their social networks, landholders became aware of the scheme.
In the non-trial step, I discussed factors such as co-benefits of biodiverse carbon plantings that have an impact on landholders’ decision-making processes. Both biodiversity and farm-related co-benefits were held to impact on the program uptake in this stage. Landholders’ desire for biodiversity conservation alongside running their property increased their interest in participating. Furthermore, landholders’ ‘ecocentric’ stances (Lockwood 1999) towards landscape connectivity and habitat restoration was an influential factor in their participation. The intrinsic value of native flora as a way of conserving diversity of species and also for its wildlife habitat benefits were also influential factors for landholders. Farm-related co-benefits (Jellinek et al. 2013) like salinity and erosion control, pasture and livestock improvement acted as drivers to motivate landholders to participate.

I presented two different groups of factors that impact on landholders’ uptake of the program: landholder-related and external factors. Landholders’ time to invest and the individual or family setting had a profound impact on their decisions to participate (Reimer et al. 2011). External factors comprised of various types of uncertainties related to the carbon market and political environment. Another influential barrier identified by landholders was the administrative burden of carbon farming programs. There is also a general lack of regulatory assurance and scepticism of private land conservation policies that governments offer (Reimer et al. 2011). Landholders appreciated the type of biodiverse carbon planting program they were already involved in as it seemed straight-forward and more appealing than the regulated carbon trading schemes (less uncertainty involved).

My analysis of the adoption stage focused mainly on factors related to land management alteration that landholders faced while adopting new land conservation practices. Risks related to planting trees on properties, such as pest animals and fire (Jellinek et al. 2013) were documented in previous studies as barriers for participation in private land conservation. In this study, landholders recognised such risks but did not consider those factors as barriers to their participation. Fire was considered an “endemic thing in Australian society” [William] to landholders. Their choice of native species and recognition that those species are the only ones that will survive in the area were also documented in this stage.
The post-adoption phase focussed on how landholders experience benefits both on their farms and related to the broader landscape (Polyakov et al. 2015). Property-related benefits included changes to the fauna and flora on their properties after the trees are established. The additional visual amenity that these trees provided (Polyakov et al. 2015) are valued by landholders. Issues such as property price alteration in the post-adoption phase were discussed in the course of this research. Landholders believe that from a traditional farming point of view, biodiverse carbon plantings could be considered to have a negative impact on the monetary value of their property. However, they also believe that the planted trees have a positive impact on the wildlife and property value for a future like-minded buyer. Many studies have focused exclusively on program awareness and adoption phases (Riley 2006; Tarnoczi and Berkes 2009). However, this research looks at various aspects of post-adoption of a private land conservation practice. This could assist the higher rate of program uptake in rural communities, which is necessary for meeting both carbon abatement and biodiversity conservation goals. In addition, it could inform policy design to consider such factors when aiming for the success of a carbon farming scheme like CFI. Apart from landscape connectivity that acted as a driver to participate in the scheme in the earlier stages of adoption, resilience and broad landscape benefits were mentioned by landholders.

In the next chapter, I will focus on the role of social capital, trust and social networks in particular, in the success of biodiverse carbon plantings. Again, I will apply the adoption theory (Pannell et al. 2006) to analyse interviews with landholders to present the impact of social networks and trusted peers in each stage of adoption process. I will also discuss how programs could be introduced by early adopters to others in their communities. I will include an analysis of landholders communicating the program to other potential participants as part of the ‘post-adoption’ phase.
Chapter Five: The role of social networks and trusted peers in promoting biodiverse carbon plantings


Abstract:

Social capital has the potential to influence the success of biodiverse carbon plantings in the face of uncertainty amongst rural landholders about the need or efficacy of efforts to address climate change through tree planting. We conducted 17 face-to-face semi-structured interviews with landholders in Victoria, Australia who voluntarily participate in biodiverse carbon plantings on their land, focussing in particular on the role of social capital for understanding how ‘early adopters’ can advocate for programs locally. The interviews revealed the importance of social networks and the profound impact of trusted peers on the diffusion of carbon planting schemes. These social capital dimensions are especially important for shaping ongoing participation and the ways that participants become active agents in trusted relationships that influence the participation of others. Our results suggest that the positive impact of social networks can counteract doubts about the validity of climate adaptation responses like carbon planting, and enable landholders to connect the program with their existing stewardship motivations. The ability for early adopters of the program to demonstrate the physical materialisation of their plantings to others was vital to this process. We propose that targeting champions and trusted peers in local communities could accelerate the proliferation of biodiverse carbon planting schemes.
**Key words:** Biodiversity conservation; Carbon farming; Biodiverse carbon plantings; Private land conservation; Social capital; Social networks; Trust

**Introduction**

Sequestering carbon through tree planting has become a key element of policy efforts to limit climate change (Torres et al. 2010), given forty-five per cent of terrestrial carbon is stored in trees (Lederer 2011). In addition to storing carbon, tree planting has the potential to preserve vital ecological processes and provide suitable habitat for wildlife (Bauhus et al., 2010, Campos et al., 2005, Carswell and Burrows, 2006). Biodiverse plantations can increase habitat for native animals, function as seed banks and enhance the resilience of ecosystems against climate change and pest invasion (Crossman et al. 2011b; Pearce 2005). The potential for plantations to be incorporated into existing farming systems through wind breaks, riparian zones and native woodland plantations has seen the emergence of programs aimed at sequestering carbon on private land (Sabto & Porteous 2011). Internationally, environmental plantings have become widely adopted as an element of climate change policy (Bäckstrand and Lövbrand 2006). In Australia, the majority of carbon planting programs targeting private land are voluntary, meaning they require interest and consent on the part of landholders in order to be implemented (George et al. 2012). Many carbon planting programs have been established by privately owned offset providers to offset greenhouse gas (GHG) emissions related to individuals and businesses in a non-compliance market (Hunt 2008).

Given that biodiverse carbon planting schemes are new and emerging policy instruments that are gaining social and political interest across the globe, understanding how these schemes are taken up and diffused amongst landholders is critical. Making the case to landholders for participation in a program that involves environmental plantings for carbon abatement may be challenging for institutions, given the potential for scepticism about the existence and severity of climate change amongst rural farming communities and what (if
anything) needs to be done to address the potential consequences of climate change (Buys et al. 2011; Safi et al. 2012; Rejesus et al. 2013; Arbuckle et al. 2013). While a substantive literature on agri-environment and conservation program adoption already exists for private rural land (Rochecouste et al. 2015; Baumgart-Getz et al. 2012; Smith 2008), the complex social relations around climate change that may influence biodiverse carbon planting schemes warrant a specific analysis for understanding program adoption and diffusion in this context. It is also important to explore how the climate change focus of carbon planting schemes interacts with the diversity of existing land management and environmental stewardship motivations possessed by landholder, which can shape and even reinterpret program intentions around the stewardship experiences of rural landholders (Gill et al. 2010).

We suggest there is a specific need for research into how the early adopters of these programs might act as agents for encouraging the wider uptake of carbon planting schemes in rural regions. The role of informal, non-institutional knowledge sharing around carbon planting programs is particularly important given the strength of existing landholder stewardship motives and a potential lack of trust in more formal advocacy from government institutions around climate mitigation and adaptation in rural areas (Liu et al. 2013; Robertson & Murray-Prior 2014; Whitmarsh 2011; Safi et al. 2012).

In this paper we borrow from the adoption theory tradition in research into agricultural innovation and adoption to explore the participation of 17 landholders in a biodiverse carbon planting scheme in Victoria, Australia. Following adoption theory, participation is broken into five phases; awareness, non-trial evaluation, trial evaluation, adoption and post-adoption (after Pannell et al., 2006). Awareness refers to obtaining information about the environmental planting scheme and understanding its relevance to the landholder. Adoption is the process of commencing tree planting and experiencing the changes through time. Post-adoption in this study relates to when landholders have well-established biodiverse plantings and are experiencing their benefits. While we acknowledge that, when narrowly applied, adoption theory can be overly focused on technological innovation and blind to socio-cultural and biophysical dimensions of farming and rural life (Stephenson...
2003), we use this framing for the specific purpose of teasing out the relevance of certain phases of landholder adoption – namely post-adoption – for creating awareness and adoption amongst other rural landholders. We aim to soften the instrumental dimensions of adoption theory by focusing on how social capital, in the form of social networks and trust relations, might serve as the mechanism for enabling early program adopters to become active agents for program proliferation in this post-adoption phase amidst existing stewardship motives and potential climate scepticism.

**Landholder stewardship and social capital**

In exploring landholder participation in a biodiverse carbon planting program, it is important to recognise the underlying stewardship and land management motivations already present in rural communities (Gill et al. 2010; Gill 2013; Cooke & Lane 2015) Here we adopt a broad definition of stewardship, acknowledging that a desire to be a custodian of the landscape is often bound-up with a desire to be a steward of farming traditions associated with productive agriculture, like animal husbandry and pasture management (Gill et al. 2010). In this sense, initiatives that offer tree planting on private property (whatever that program’s intention) must accommodate a landholder stewardship ethic that encompasses a mixture of primary production, biodiversity conservation and land rehabilitation objectives (Smith 2008; Measham 2007).

The emergence and persistence of stewardship amongst rural landholders is shaped by both the tangible experiences of ecological change and the social interactions that occur as part of everyday rural life (Cooke and Lane, 2015; Harrington et al., 2006). The stories, knowledge and experiences of others, including family, friends and neighbours, can all shape the stewardship trajectory of individual landholders (Gill 2013; Knapp & Fernandez-Gimenez 2009). These social-ecological interactions around stewardship perspectives will likely direct the way rural landholders interpret the potential value and contribution of carbon planting programs for their property (Riley, 2006). It might be anticipated that early adopters of carbon planting schemes have a close alignment between their land management and stewardship motives and the intention of the program (Fischer & Bliss 2009). We are
interested in whether early adopters can be effective agents for program diffusion through
their social networks and interactions in the face of a diversity of stewardship aspirations
and uncertainty about climate change and its impacts.

Social capital has gained increased attention in recent decades for its role in shaping the
outcomes of community-based natural resource management (CBNRM) programs
(Fukuyama 1995; Sutherland and Burton 2011; Fisher 2013). Here ‘social capital’ refers to
how community members benefit from their relationships with others and how this further
generates group benefits (Adger 2013). Private land conservation policies in particular have
been shown to benefit from investing in the multiple aspects of social capital to increase
landholder participation in conservation practices. These include ‘bonding’ (peer to peer),
‘bridging’ (landholders and their community) and ‘linking’ (landholders and agencies) social
capital (Putnam 1993) in (Mills 2012). Building capacity for CBNRM has meant strengthening
existing social capital at all three levels; for example, Landcare in Australia plays a role in
assisting landholders to learn about new land management practices and acting as a conduit
for communication with other landholders and environmental professionals (Sobels et al.
2001; Compton & Beeton 2012; Curtis et al. 2000; Curtis et al. 2002; Campbell 1995). Our
aim is to build from this literature to explore the role of bonding social capital in particular,
for overcoming any hesitancies about participating in new and emerging carbon based
schemes.

The two elements of social capital that we focus on here are social networks and trust.
Social networks are an important component of social capital (Abbott & Freeth 2008;
Almedom 2005), with research illustrating that feeling connected to the community
facilitates farmers to better support climate change adaptation policies (Hogan et al. 2010).
Bodin et. al (2006) argue that social networks are important in coordinating actions in
natural resource management. Strong social networks make it more convenient for the
landholders in regional areas to access information regarding land conservation issues (Prell
et al. 2009). Trust is also a key characteristic of an effective social network (Bodin et al.
2006). While trust is a ‘very complex concept’ (Abbott and Freeth 2008 p. 875),
understanding trust and how agents interact is an essential part of any study on the role of
social capital and managing natural resources (Prell et al. 2009). Farmer-to-farmer interaction has a profound impact in accepting a new innovation (Tarnoczi & Berkes 2009). In the natural resource management context, trust has been mainly studied as the relationship between community and agency and how building trust could result in more effective involvement in conservation schemes (Smith et al. 2013; Meadows et al. 2013; Lachapelle and McCool 2012). In addition, trust happens in social networks as actors know each other directly or through a known social structure (Pretty and Ward 2001). The interpersonal characteristics of individuals have an impact on their risk-taking and trusting behaviours in the relationship they have with natural resource management agencies (Smith et al. 2013).

Ability, benevolence and integrity are described as elements that make people trustworthy (Mayer et al. 1995). The ability to demonstrate successful outcomes of a practice, being caring and fair (Fisher 2013) and credible (Sharp et al. 2013) are essential components of a trusting relationship. Institutions have used contractors or local landholders who are trusted by the community to help attract landholders to conservation schemes, as they are more likely to trust the information they receive (Breetz et al. 2005). Landholders may also want to see the program implemented elsewhere in their community to be sure it will be implemented as it is represented before they participate (Pannell et al. 2006). These points suggest the importance of understanding how similar social dynamics work in the context of tree planting schemes that relate to carbon sequestration.

It is important to also highlight that social networks are not always encouraging or positive (Sobels et al. 2001); social networks can have negative impacts on program uptake if neighbours or other community members with constant interactions are sceptical about a specific program (e.g. soil conservation practices) or policy (Willy and Holm-Müller 2013). In addition, social networks can have negative impacts by ‘imposing normative restrictions’ on actions that could benefit both community and environment (Coleman 1988; Sutherland and Burton 2011 p.239). For this reason it is vital that we explore social networks’ function across conservation programs targeting issues that can be divisive, such as climate change.
Following the methodology we begin by exploring how trusted peers in a social network help in the introduction of biodiverse carbon planting initiatives to other landholders. We also examine how trusted peers are central elements in determining the effectiveness of programs in the post adoption phase, as landholders consider those peers as a source of advice through their participation journey, in favour of maintaining contact with program coordinators. To conclude, we reflect on the research and policy implications of our findings and future opportunities for research.

**Methods**

**The study area**

Our case study is based in Victoria, Australia. Over 60 per cent of Victoria is privately owned (SoE 2013). Of this, some 80% of tree cover has been lost (SoE 2008). Many threatened species only occur on private land with approximately 29% of known threatened species populations occurring on such land tenure (Department of Sustainability and Environment 2011a). The remaining vegetation continues to experience pressures from land use alteration including agricultural intensification and expansion of the urban fringe (SoE 2008).

**Sampling procedure**

We recruited research participants for our case study through Greenfleet, a not-for-profit environmental organisation in Australia (Greenfleet 2012). Landholders were eligible to be involved in the Greenfleet program on the basis of the ecological suitability of their property for revegetation; this required a preliminary investigation of their property. Landholders require undertaking weed and pest control, fencing prior to revegetation. They also keep their livestock out of the revegetated areas for five years. Greenfleet undertakes regular carbon monitoring and replants trees in case of fire or drought. Financial incentives in the form of direct payments were not offered to landholders through this program. Greenfleet has established native biodiverse trees on 73 privately-owned sites across Victoria,
belonging to 47 different private landholders. Landholders range from dairy, livestock, sheep (wool) farmers and cropping farmers to lifestyle and tourism property owners. Some private landholders own small farms, so called lifestyle landholders, and some are commercial landholders; there is also a group of hybrid properties. As a result, a broad spectrum of private landholders was included in the study. The focus of this study was on those landholders who adopted the voluntary biodiverse carbon planting through Greenfleet; we chose not to explore the experiences of non-adopters, given our focus on how trust and social network shape ongoing participation. Figure 5 highlights the four Victorian Catchment Management Authorities (CMAs) in whose areas the interviews took place.

Figure 5: Case study location in Victoria, Australia. Dark grey CMAs represent the study areas where interviews took place
**Data collection**

Initially, questionnaires were distributed to landholders (n=47) as they provide a broad understanding of the participants in the research sample. Survey participants (n=17) interested in one-to-one interviews were requested to contact us. To obtain an in-depth understanding of the role of social capital and trust in social diffusion of a program among the landholders, 17 face-to-face taped interviews were undertaken on the properties of landholders between January and September 2013. The semi-structured interviews aimed to capture people’s lived experiences (Holstein and Gubrium 2003). The interviewer also walked/drove through participants’ properties, gathered field notes and spent time in their ‘naturalistic’ setting (Cooper et al. 2009). Landholders had the opportunity to guide the research encounter, with participants occasionally preferring to walk around their property and identify important sites for discussion, while some preferred to conduct the formal interview at the outset. This helped to gain a better understanding of their sentiments towards the carbon plantings which could not be explained during the formal interview.

Verbatim transcriptions of interviews were undertaken, coded and studied in NVivo 10 qualitative analysis software (QSR International 2012). Data analysis was informed by a thematic approach (Boyatzis 1998) which helps to discover and present the patterns found in the interviews (Braun and Clarke 2006). The themes emerged from the interviews through ‘careful reading and re-reading of the data’ and identification of main categories (Liamputtong & Ezzy 1999, p.258). The data analysis process was undertaken by the lead author of this study but other authors were actively involved in the discussions and development of key themes during the coding process. We specifically looked for themes related to the landholders’ experiences in each stage of the program; awareness, adoption and post-adoption (Pannell et al. 2006). We started coding the interviews after the first interview had been conducted. Interviews continued until we reached the data saturation point (Glaser and Strauss 1967) where no new themes were emerging. Confidentiality has been considered throughout this research process by giving participants pseudonyms. We have removed any town or specific place names that can make the participants identifiable.
Results

In our results we have contracted the five broader phases into three to allow us concentrate on post-adoption given the focus on this phase for our research. As a result, we combined the findings of awareness and persuasion (‘non-trial evaluation’) and report these findings as one phase (‘awareness’). In addition, the findings of trial evaluation and adoption are grouped as the ‘adoption phase’.

Awareness Phase: Receiving information from social networks and trusted peers

In this study, three sources of receiving were observed as conduits for landholders to gain knowledge and persuasion to participate in environmental plantings. This includes trusted peers, community-based natural resource management and media. As we will discuss, trusted peers and a strong social network were the main sources of raising awareness and overcoming the general scepticism among rural communities about climate change and its mitigation and adaptation programs introduced by government agencies.

Elements of trust in the social network

A ‘highly centralized network’ (Bodin & Crona 2009) was observed in two of the study areas. The centre of this network (which goes beyond CMA boundaries) is a well-known landholder in the area who has been very active in land conservation practices and signed up to the Greenfleet program three years after it was rolled out and was one of the first to adopt it in his district. John, who is considered a trusted peer in his network, stated that the trust has built up as he has been a consistent and long-term member of his social network and has demonstrated successful land conservation practices on his property:

So our family’s lived in this area since the 1860s ... So a long time. So most of these landholders I’ve known... I’ve sort of grown up with them and known of them or known them all my life. So that’s the connection ... the personal connection.

Local landholders trust John as he demonstrates characteristics such as ability, benevolence and integrity (Mayer 1995). Steve was one landholder who noted these trustworthiness
characteristics when discussing being approached by John to consider entering the carbon planting scheme.

    I was approached by John who is a local guy. ... John came along and said, “Let’s plant trees,” and I said, “Yeah, let’s plant trees.” So that’s what we did. ... I just see John as a very trustworthy person, and he’s not out to take me down, and I just sort of ... Let’s go ahead with it.

Steve wanted to plant trees as the old plantation he had was burnt out in a fire and John’s suggestion encouraged him to replant that vegetation through the Greenfleet. This decision was made easier by John’s trustworthiness, which helped to overcome any uncertainty Steve had about the program. Noah and Linda mentioned that John helped raise awareness and connect them to the scheme.

    It was a neighbour who put us onto this Greenfleet, well, put Greenfleet onto us. The Greenfleet came through the area and they spoke to one of our neighbours first, and John rang me up.

Another landholder in the region, Ryan, mentioned that trust in the person introducing a new scheme is an essential element in the acceptance of it. ‘...That is the nature of human beings, you need to know someone and trust them to participate in the scheme....’ Aside from any scepticism about climate change impacts, the long-term commitment associated with some carbon planting initiatives means that the advice of trusted peers is of greater importance than in other private land conservation scheme. As a legal element of carbon planting the permanence rule exists and some plantings should must remain on the properties for 100 years (Bradshaw et al. 2013). It is a permanent land use change and requires significant motivation for adoption; especially, compared with other revegetation activities like farm forestry, which has a 10 year commitment for landholders (Barlow & Cocklin 2003). Long-term issues like survival rates of plants, fire risk and increased pest animals (rabbits) as a result of habitat creation are among the concerns landholders raised regarding this program. Experienced, trusted landholders who adopt a scheme become critical agents for encouraging others to participate in such a circumstance.
Value of local knowledge

Furthermore, trusted friends and neighbours (who are not part of the scheme) are another source of recommendation. Landholders tend to trust their friends’ professional knowledge and view their knowledge as legitimate. When Laura was asked where she seeks information regarding the conservation activities on her property she responded, 

...It’s handy for me, the fact that one of my friends... she used to work at DSE (State government environment department) and you know she was the one who suggested the revegetation and how to go about it in the first place, so she’s a bonus.

Landholders also mentioned the value of local knowledge and local contacts (networks) as a means of program awareness. In response to the question of how Luke came across Greenfleet, he responded: ‘There’s a fellow locally who works for them (Greenfleet), so we have got contact through them.’ Having people within your social network with knowledge of your land management interests meant these peers were able to connect their awareness of the scheme to participants’ existing stewardship motives.

Overcoming uncertainty

Overcoming uncertainty about program participation appeared to be driven by two primary factors: stewardship values that were not directly related to program intentions, and trusted peers who were already enrolled in the program, or who had knowledge of landholders’ stewardship and were able to recommend the scheme. Stewardship values and motivations like biodiversity conservation assisted landholders in undertaking planting. “Well probably the main benefits are biodiversity benefits. So we’ve got a sort of a commitment and a desire to see conservation and agriculture both working” (John). John explains that balancing agriculture productivity or amenity benefits with conservation seems critical to landholders. Like many other landholders, he also recognises agriculture as an ‘ecological enterprise’ (Saunders and Walker, 1998) that requires caring for the land.

In addition, the advice of a trusted peer allowed some landholders to overcome their concern about government policies and the existence of climate change. The following
quotes by two of the study participants exemplify climate change scepticism and lack of trust in climate change-related policies from government.

Steve said, ‘... I am not convinced by the fact that climate change exists but if it is true I have done something that my grandchildren and your children will see the benefits...’.

When Andrew was asked about his opinion of carbon planting initiatives in Australia, he mentioned, ‘... Every day we hear about (climate change), and she [former prime minister]... talked big about this carbon trading and all that... Nothing’s happened.’

The localised experience of weather cycles and long temporal arc of climate change are perhaps a partial explanation of the attitudes noted above (Connor & Higginbotham 2013; Knapp & Fernandez-Gimenez 2009). Most pointedly, however, was that uncertainties landholders had about participation could not easily be overcome through engagement with the agency offering the scheme. They needed a change agent outside the organisation with whom they were familiar to help overcome their doubts about participation.

To move from the status quo and undertake permanent revegetation activities on private land on the recommendation of a well-known and trusted local community member seems to have been essential for the participants in this study. Overall, 14 of 17 interviewed landholders stated that they pursued carbon planting schemes as a direct result of recommendations through their social networks.

Implementation (Adoption) Phase:

Elements of trust in the social network

The adoption phase is a ‘continuous process’ (Pannell et al. 2006). It is a learning space for landholders and given the presence of a locally trusted peer they have the assurance that there is always someone to rely on and seek answers from regarding their plantations. The interviews reveal that the trusted peer’s presence is more efficient than the support provided by the responsible agencies. Some of those agencies (e.g. local CMAs) may be local but the fact that a landholder’s perception of distance is not just physical but also a social relation (in terms of how well they know the knowledge source), makes the trusted peer’s role critical. This is because of the perception of ‘ability’ and ‘benevolence’ concerning
trusted peers on the part of participants, as well as the value of their local landscape knowledge. Landholders did not mention that they sought advice from the relevant local government authorities. Steve stated, ‘Anything to do with this [biodiverse carbon plantings on his property], John’s always looked after.’

David thinks that landholders who do not have access to a trusted peer need to seek agency advice but he has the opportunity to rely on John in the implementation phase of the program.

\[\text{John can do ours. So you’d probably have to be slightly more in touch with the Landcare group to find out what’s going on, but I don’t have to because John’s there. So it’s a bit easy, a bit easy.}\]

Ryan and Owen also knew John as a great source of information along the way. ‘There’s definitely people who are more leaders in that field but we would ask John questions definitely.’ It gives them the confidence and assurance that the continuous support exists during the adoption phase. In addition, it reveals that the element of trust distinguishes John from other experienced landholders in private land conservation.

While John represented a clear example of a central point in a social network, there were a number of other landholders who proved to be similarly influential trusted peers in their social networks in other CMAs. As George (one of the influential trusted peers in his network) reflected:

\[\text{We have strategically re-vegetated to link the three main patches of bush and encouraged all our neighbours to do the same... Many different groups have taken that project [a specific landscape connectivity project] on over the years and people are still re-vegetating, particularly steep gullies to contribute to that.}\]

As a trusted peer, George advocates not only carbon plantings but also other private land conservation practices. His practices here are also relevant to the post-adopter phase – a point we return to later.

**Value of local knowledge in a social network**

In response to a question about how the mix of species for a planting was chosen, Laura noted, ‘...Look, I basically left it to Elle. Like she knows this area very well and you know she...’
knew my paddocks quite well.’ Elements of understanding and the value of local knowledge could be observed in Laura and Elle’s relationship. Luke mentioned that his social networks, including friends and neighbours, are a great source of information.

Friends and neighbours are doing a lot of work as well. We get together and discuss it, have a look at what they’re doing and what I’m doing and learn from one another. This relationship revealed the importance of local knowledge and trusted peers at different stages of program adoption, not only the awareness phase.

**Post-Implementation Phase: Dissemination of the practice by landholders**

Once the biodiverse carbon plantation is well established, landholders who were not amongst the earliest of program adopters start suggesting the idea to other landholders in their social networks. The ‘roll-out’ of a carbon planting scheme is necessarily an ongoing project, as more landholder participants are sought to achieve the biodiversity enhancement and carbon reduction goals that are required through the continued operation of the scheme; continually recruiting new participants is therefore vital for achieving program goals.

**Building trust characteristics within and outside the social network**

Early adopters in a scheme can become agents who either help or hinder the broader uptake of such a program, as they are likely to share their experiences with others – good or bad. Noah and Linda mentioned:

…I’ve spoken about it to my friends and neighbours and that we’re very happy with the planting and it’s lifted the block and we’ve certainly made it known amongst our friends and neighbours that we’re happy with it...Quite often they [Greenfleet] bring people to see how our block looks and they believe this is one of the most successful plantings they’ve ever seen.

The opportunity to observe the progress of existing participants before deciding whether or not to participate can be critical in voluntary conservation schemes (Tarnoczi & Berkes...
2009). It is a living example that helps defuse fear by allowing landholders to observe success stories. For this reason, George promoted the importance of showing other landholders how well early plantings were doing through property:

*We do two-hour farm walks, which gives people the opportunity of showcasing their properties, and that’s been extremely popular. ...We’re in a district where the attitude towards trees has certainly changed enormously over the years.*

This highlights the importance of being able to see the physical manifestation of program participation for reassuring potential participants that, whatever their feelings about climate change or government initiatives, they can ‘reinterpret’ (Trigger et al. 2010, p.1070) the program to achieve their wider stewardship aspirations.

As landholders start to introduce the scheme to other members of a community (within or outside their own social networks) a more decentralized social network which includes a mix of actors starts to take shape that will help the longevity of the program. Oliver is another landholder who promotes the program by having open days at his property. ‘*We have had two and a half thousand people come through the farm for tours and stuff, so by default we have [promoted the program].’*

The early adopters see themselves as champions in their community once trees are well-established. George thinks that he needs to advocate his success and the environmental mindset among other landholders by educating them.

*We have a philosophy that we believe in sustainable land use, so we’re working towards that all the time...So I work with a wide range of people, trying to educate and try to foster that sort of view.*

This opportunity provides a transition for some participants from a trustor to a trusted peer (Sharp et al. 2013) in the program’s proliferation. This transition can happen as a result of gaining more certainty and experience about the scheme, and demonstrating successful outcomes of the scheme to other landholders.

**Time: Transferring from awareness to adoption and post adoption**

When landholders became aware of the program through the trusted peers in their social networks, the decision to adopt the scheme was often straightforward. Ryan stated “I think it was pretty instant” and Noah and Olivia reflected that “We decided pretty much
Once landholders adopt the practice, they suggest it to their neighbours and close friends because they have already experienced how the administrative process works for them and how it could fit their property management and stewardship goals. At this point landholders were generally satisfied with the process. As Daisy reflected:

*I know when we’ve had different people here and they’ve sort of looked at our plantings and said, oh wow what a lot of work you’ve done, and we’ve said, no, we didn’t plant them ourselves, you know, we had this great opportunity where Greenfleet wanted land, they would provide all the labour. We wanted the trees, the trees cost us nothing. And they went wow! How did you get onto that?*

To build the confidence to recommend plantings to a broader public and social network, time may be required for trees to mature and for landholders to feel comfortable about demonstrating their success to others. Apart from the element of confidence, credibility and ability to deliver the successful outcome matters greatly to landholders. Hence, at least three to five years (depending on the ecological characteristics of each landscape) may be needed until trees are mature enough to demonstrate the type of ‘ability’ referred to in the literature on trust in social networks (Mayer et al. 1995).

*We’ve had field days here; people come to have a look to see what we’ve done and why we’ve done it. So yeah, we’ve had probably three or four of them here. And it’s getting the word out there too. It’s a matter of getting it out to people…. Mat*

A number of landholders mentioned that field days are a great way to introduce the scheme and to demonstrate their success to others.

**Overcoming negative perceptions through social networks**

Although some of the participants encountered negative community perceptions of revegetation in agricultural land, the positive influence of their social networks allowed them to overcome this negativity, leading to program adoption. Noah and Linda reflected on the public perception of their plantation that: ‘*The vast majority of them probably wouldn’t necessarily approve of it because we’ve probably taken up 60 acres that otherwise could have been grazed’*. Daisy had comments from neighbours about the change of land
use she has undertaken on her property. ‘...I think we did have the comment that it was a very good cropping paddock and what a shame that it was now ( revegetated)’. Social networks encouraged landholders to participate in a tree planting scheme in the face of any negative perception in farming communities’ towards revegetation.

**Discussion**

While much of the literature around trust in natural resource management focuses on the relationship between communities and government or non-government agencies (Uphoff 1993; Lachapelle & McCool 2012; Meadows et al. 2013), this study explored trust among community members within a social network. Trust in this context can play a role in driving the acceptance of novel interventions, such as biodiverse carbon plantings, showing some potential for informing future policy development. Further, previous research has mainly focused on awareness and adoption phases (Riley 2006; Tarnoczi and Berkes 2009). We confirm many of the findings regarding the positive role of trust and social networks in the awareness and adoption stages of conservation programs, but extend the literature on the post-adoption phase, which is important in sustaining the new practice among communities. The adoption theory framework assisted us in unpacking the importance of social capital in different phases of program participation. The nature of assistance that landholders received from their trusted peers differs as time progresses, which adoption theory helped us to illustrate.

Our study reveals the importance of social networks in mobilising program uptake, facilitating the provision of information about carbon plantings to potential participants. Furthermore, social networks assisted landholders in the implementation phase and subsequently encourage participants to become agents themselves in recommending the scheme to others in their networks. This resonates with research on social connectivity and its impact on rural communities’ adaptive capacity towards climate change impacts (Lemos et al. 2013).

Trusted peers are one of the key players in transferring knowledge within a network of people. Peers were shown to be more popular than agencies; even a local agency can be
less favoured than a trusted friend who demonstrates enough knowledge about their properties. This confirms results of other studies that have demonstrated the importance of local knowledge and proximity (Bathelt et al. 2004; Meesham 2007; Moore and Westley 2011) for program uptake.

This study builds on research about the trustworthiness characteristics described by Mayer et al. (1995): ability, benevolence and integrity. Trusted peers were either well known in the area and had demonstrated a history of successful land conservation practices (ability) or friends who have academic and local knowledge of the landscape (benevolence and ability). The continuous presence of the trusted peer and trusting relationship provides the participants with the assurance that there will be someone to help if any questions or issues arise during the process (integrity and benevolence). Once landholders demonstrate a successful outcome of carbon plantings, they can showcase their successes (ability) to other landholders and build a decentralized network which is more sustainable for program proliferation over time (Reed et al. 2009).

The ability to ‘showcase’ established plantings to prospective participants revealed the importance of social networks and trusted peers for demonstrating how the plantings can be achieved in ways that satisfy their wider stewardship motives. In this sense, the materialisation of the program through plant growth and the sharing of the experience of program participation aligned closely with the social relations and experiential practices that inform landholder stewardship (Cooke & Lane 2015; Gill et al. 2010). This process appears important for overcoming climate scepticism, which not only shows how the ‘messenger may be as important as the message’ (Safi et al. 2012, p1056) concerning advocacy around carbon planting programs, but also the setting and time at which that message is delivered (Liu et al. 2013). For this reason the post-adoption phase of current participants, when plants have established, is particular important for influencing prospective participants.

Our findings have potential implications for the future design of policies for biodiverse carbon plantings and other environmental initiatives targeting private landholders. As we have shown, paying attention to champions (trusted peers) in the community can assist in the introduction of new schemes (Van Noordwijk et al. 2011). Actively engaging with
champions in local communities can enable environmental organisations to increase awareness and willingness to participate in biodiverse carbon planting schemes through the social networks of existing participants. This is especially important when there is the potential for landholders to doubt the need or legitimacy of a program.

Government agencies should identify where strong social networks already exist and preferentially introduce programs in these areas. Trusted peers, like John in this study, can assist the uptake of schemes and can improve implementation by providing advice post-adoption, particularly when landholders might be reluctant to seek out the coordinators of programs for advice and assistance. Building social capital in regional areas, strengthening existing networks and organising open days in properties for other landholders to observe on-ground activities will assist the efficient delivery of related policies.

Conclusion

In addition to the ‘bridging’ and ‘linking’ social capital (Mills 2012), social networks and trusted peers within them have an important role in the diffusion of innovation. Of course not all networks produce a positive outcome. It can be hard to introduce a new land conservation practice in areas where public perception of an innovation is negative and the majority of the landholders in a network are reluctant to participate. To achieve a better outcome in programs like the one studied here, the emphasis on the role of trust and trusted peers within a social network is essential. It is gradually being recognised by researchers and policy-makers that targeting ‘local champions’ for participation, who are a source of advice and guidance in a given community, may help to ease the participation concerns of landholders who are potentially sceptical about initiatives related to climate change (Liu et al. 2013).

We found that a trusted peer in a community could aid other landholders in their network to understand how a carbon planting program can be implemented in a way that meets the existing stewardship and thus overcome their uncertainties about the programs’ stated objectives. As program implementation evolves, transition from trustor to trusted peer was
observed among some of the interviewees who then acted as agents to recommend the scheme to others within their social networks. In light of our exploratory study, further research is needed, which should encompass the social mapping of opportunities for implementing biodiverse carbon planting. There is a need to explore the various dynamics associated with rural communities that might mean they are more or less likely to take up schemes, considering factors like the strength of their social networks. This will require a detailed quantitative social network analysis to examine how landholders as social actors relate to others in their network.

In conclusion, designing policies that recognise existing stewardship and make better use of social networks and trusted peers for promoting and supporting participation in biodiverse carbon planting programs may provide an opportunity for improving program outcomes, ultimately enhancing biodiversity conservation and greenhouse gas abatement.

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Chapter Six: Bundling and stacking in bio-sequestration schemes: opportunities and risks identified by Australian stakeholders

Abstract

The stacking and bundling of ecosystem services credits has emerged as mechanisms to promote the conservation of biodiversity in carbon sequestration schemes. Globally, apart from a few certification standards in the voluntary market, little genuine action has eventuated, but actors in these markets are continuing to examine the idea of combining carbon and biodiversity credits. This paper provides the first empirical analysis of the opportunities and barriers of bundling and stacking carbon and biodiversity credits as articulated by policymakers and academics, in Australia. Corporate social responsibility (CSR) acts as a driving force for business interest in the co-benefits of carbon plantings; however, uncertainty in the market and policy settings act as barriers for both buyers and sellers. Interviewees highlighted substantial benefits of both bundling and stacking, including easing transaction costs for landholders, reduced monitoring costs for regulators. Nevertheless, there is a risk that stacking can affect the perceived additionality of carbon plantings, which has the potential to erode the integrity of carbon markets. Obstacles to the establishment of stacked/bundled markets include the lack of standards to show that co-benefits are real, dealing with the additionality rule, and designing scenarios to achieve genuine outcomes for both biodiversity conservation and carbon abatement.

Keywords: Biodiversity conservation, bio-sequestration, bundling credits, stacking credits, ecosystem services, trade-offs

Highlights:

- We investigated various carbon and biodiversity market options in Australia
- Interviewing stakeholders revealed bundling is currently the most promising option
- Accurate measures and standards demonstrating achievement of co-benefits are needed
- Uncertainties in the carbon market & political setting restrict bundling/stacking
- It is essential to establish clear objectives for bundled/stacked markets
Introduction

Increasing public concern about climate change has generated a market for greater investment in bio-sequestration projects (the capture and storage of atmospheric carbon through tree planting); (Bekessy and Wintle 2008; Venter et al. 2009; Crossman et al. 2011). Payment for ecosystem services enables landholders to reap the benefits of two or more services on the one piece of land while also providing benefits to the public (Deal et al. 2012). Biodiverse plantings for carbon sequestration, where a diversity of tree species are planted, is an example of a potentially synergistic service whereby greenhouse gas emissions are sequestered and biodiversity is conserved. To encourage participation in biodiverse plantings for carbon sequestration, private landholders and investors should be able to take advantage of both ecosystem service markets (the carbon market and biodiversity market) on the one piece of land (Bekessy and Wintle 2008). These two global ecosystem service markets have the potential to help private landowners generate income while benefiting both climate change abatement and biodiversity conservation (Venter et al. 2009).

High transaction costs in establishing carbon plantings (Cacho et al. 2013) and carbon market uncertainty among landholders (Kragt et al. 2014; Maraseni and Dargusch 2008) are likely to reduce the uptake of carbon planting schemes. At the start of any new scheme (e.g., the Carbon Farming Initiative in Australia (Australian Government 2011a)), obtaining information is a costly first step, and is followed by establishment costs (labour, seedlings), project approval, monitoring and ongoing related costs (Cacho et al. 2013; Crossman et al. 2011a; Galik et al. 2012). Under higher carbon price scenarios, the opportunity cost for landholders to plant trees instead of grazing or cropping will impact their decisions (Cacho et al. 2013). However, if the price of carbon is insufficient to cover all of the transaction costs, landholders will need additional incentives to cover their expenses and encourage them to participate (Crossman et al. 2011a).
To better incentivise landholders for the biodiversity outcomes of carbon plantings, standards and a process for monitoring biodiversity outcomes are needed (Carswell and Burrows 2006). This was confirmed in a Victorian Department of Sustainability and Environment investigation of the biodiversity outcomes of bio-sequestration schemes by surveying a selection of Australian offset providers (Kapambwe and Keenan 2009). The study revealed that offset providers involved in bio-sequestration are concerned about a lack of incentives and a clear set of standards for biodiversity outcomes of bio-sequestration projects (Kapambwe and Keenan 2009). Once developed, such standards would require consideration of the restoration outcomes of biodiverse plantations (compared to a “reference ecosystem benchmark”) to achieve the delivery of large-scale conservation co-benefits (Standish & Hulvey 2014, p.27).

Bundling and stacking credits from different ecosystem services are concepts gaining global attention (Robertson et al. 2014; EPRI 2011; Van der Biest et al. 2014). Both bundling and stacking have the potential to be utilised as mechanisms to better incentivise landholders and to provide improved options for buyers in ecosystem services markets (Deal et al. 2012). *Stacking* ecosystem service credits refers to multiple credits generated from one piece of land being sold separately in the relevant markets (Robertson et al. 2014). For example, biodiversity gains, controlling water regimes and carbon sequestration benefits from biodiverse plantations can be stacked (Deal et al. 2012). Carbon and biodiversity credits could be sold in their respective markets separately (unstacked) to meet specific regulatory requirements. Stacking could provide incentives for landholders to deliver higher quality projects; for example, in addition to planting riparian vegetation, wetlands could be restored to provide multiple ecosystem services credits (water quality, wetland restoration, biodiversity conservation) (Cooley & Olander 2011). However, care must be taken to ensure that these services are discrete and additional to avoid the common concern of regulatory bodies for the potential for ‘double-dipping’ (Woodward 2011).

* Bundling credits refers to selling multiple ecosystem services from one piece of land (i.e. biodiverse carbon credits) as a combined ‘ecosystem credit’; it is up to the structure of the market to allow such transactions (Deal et al. 2012). Bundled credits cannot be sold
separately in their respective markets. An example of bundled credits is ‘premium carbon’ whereby buyers pay a higher price for carbon that is sequestered with the co-benefit of biodiversity conservation.

Schemes for encouraging bundling and stacking credits for ecosystem services need to be designed carefully to achieve the desired ecological outcomes (Bryan 2013; Venter et al. 2009). This is partly because of the complexity of trade-offs between different ecosystem services (Bryan 2013; Baral et al. 2014). In the case of carbon and biodiversity, it is possible that greater amounts of carbon could be sequestered with monoculture plantations, but biodiversity conservation objectives would not be met (Kanowski & Catterall 2010). However, biodiverse plantings for carbon sequestration could increase the biodiversity co-benefits and indeed have the potential to sequester equivalent carbon when uncertainties surrounding fire, drought and pests are considered (Bekessy and Wintle, 2008; Lin et al., 2013). Kinzig et al. (2011, p.604) also argued that in the case of producing multiple ecosystem services from one piece of land, “paying for only one service can be as damaging as paying for none”. This is because paying for multiple ecosystem services could increase the likelihood of environmentally beneficial outcomes (e.g. wetland restoration instead of riparian revegetation) (Cooley & Olander 2011). The dynamic between different ecosystem services (e.g., biodiversity and biomass (Kirchner et al. 2015)) requires careful consideration for designing the incentives to manage those services without jeopardising one while achieving the others (Horan et al. 2008; Fargione et al. 2008; Kolinjivadi et al. 2015). However, Kirchner et al. (2015) argued that despite the trade-offs, opportunities exist to promote synergies between ecosystem services.

Electric Power Research Institute (EPRI) conducted a survey in the USA to capture opinions about bundling and stacking credits. Credit buyers and sellers (wetlands, water, species and carbon credits), academics and policymakers in the field (wetland and species credits) active in the markets for ecosystem services participated in the survey (EPRI 2011). More than 40 per cent of survey respondents believed that stacking will deliver positive ecological outcomes and 42 per cent stated that the positive ecological outcomes depend on the details of the stacking scenario (EPRI 2011). However, in North Carolina, stacking credits for
water quality improvement and wetland biodiversity have been criticised by academics and policymakers for ‘double-dipping’ and not achieving the net gain in restoration (Kenny 2010 in Robertson 2012). In this study we qualitatively explore the perspectives of experts on stacking/ bundling of ecosystem services credits and discuss practical issues (e.g. market and policy) in design and implementation of such policies.

Corporate social responsibility (CSR) (Di Giuli and Kostovetsky 2014) and mandatory requirements (Freedman et al. 2009; Tvinnereim 2014) act as drivers for businesses to invest in bundled credits for ecosystem services (Bekessy and Wintle 2008). Bundled credits have the potential to be seen as a ‘public good’. Bundling and stacking should also appeal to private landholders seeking additional revenue sources to cover the establishment and transaction costs of biodiverse plantings for carbon sequestration. However, market and political uncertainty could reduce the attractiveness of such investments (Kragt et al. 2014). Political certainty attracts buyers and sellers, creates a better functioning market, and drives research and practical innovation towards bundling and stacking ecosystem services (Watson et al. 2014); the ultimate consequences could be novelty in the market for ecosystem services and diversity of credits generated from those services provided by natural resources.

This paper explores the opportunities and risks of bundling and stacking carbon and biodiversity credits from the perspectives of policy experts and academics in Australia. We provide the first empirical analysis in this context, interviewing stakeholders who are involved in guiding or implementing these schemes on the ground. Our research builds on the survey results of EPRI (2011) and other theoretical analyses (Robertson et al. 2014) to gain a deeper understanding of the opportunities and risks of bundled and stacked ecosystem service markets. We conclude with some recommendations for the development of stacked/bundled markets. Australia presents a valuable case study because it has an established history of voluntary biodiverse plantings for carbon sequestration and has recently introduced a range of regulated markets under the Emission Reduction Fund (Commonwealth of Australia 2014). Lessons learnt in the Australian context will have international relevance as similar market and policy issues are of global concern.
Materials and Methods

Current carbon and biodiversity policy settings

There are two key policy instruments relevant to the management of carbon and biodiversity on private land in Australia: The Carbon Farming Initiative (CFI) and biodiversity offsetting.

Carbon Farming Initiative (CFI)

The CFI was legislated in the Australian Federal Parliament in August 2011 with the aim of reducing emissions and establishing tradeable carbon credits (Australian Carbon Credit Units (ACCUs) through enhanced land management practices (Australian Government 2011a). Since the repeal of the Carbon Tax in July 2014, the scheme has been supported through the Emission Reduction Fund (ERF) as part of the Direct Action policy to tackle climate change and achieve Australia’s carbon abatement target (Commonwealth of Australia 2013c). Since the start of the scheme, 4,226,090 ACCUs have been issued (Australian Government 2013). Reforestation is one of the approved methodologies under the CFI (Commonwealth of Australia 2013c). To be eligible, projects must deliver extra reductions to business as usual level in greenhouse gas emissions. This is known as ‘additionality’ and is a requirement of all offset schemes (Bradshaw et al. 2013; Commonwealth of Australia 2013c). Furthermore, as part of the legal requirements of the Kyoto Protocol, ‘permanence’ refers to the condition of carbon offsets that requires trees to stay on landholders’ properties for 100 years (Commonwealth of Australia 2013c).

Biodiversity offsets

Biodiversity loss has become a pressing global issue, not only for its own sake but for the related negative effect on the economy and human well-being (SCBD 2010). Achim Steiner, executive director of the United Nations Environment Programme (2010) outlined that:
Annual losses as a result of deforestation and forest degradation alone may equate to losses of US$2 trillion to over US$4.5 trillion alone. These could be secured by an annual investment of just US$45 billion: a 100 to 1 return (Secretariat of the Convention on Biological Diversity 2010, p. 6).

To tackle biodiversity loss, different mitigation methods have been undertaken around the globe, from biodiversity banking to one-off offsets (Madsen et al. 2011). Biodiversity offsetting is a mitigation method designed to conserve native vegetation on private land (Gordon, Langford, White, et al. 2011). In the Australian states of New South Wales and Victoria respectively, private landowners can generate ‘biodiversity credits’ and ‘native vegetation credits’ by enhancing biodiversity outcomes on their properties through ‘Biobanking’ and ‘BushBroker’ agreements (Office of Environment and Heritage 2011; Department of Sustainability and Environment 2011b). Developers are responsible for the ongoing monitoring of the offset sites to maintain the no net loss or net gain achievements in the biodiversity condition of the developed sites (Burgin 2008). Importantly, management actions at the offset site must be additional to the ‘business as usual’ scenario to improve the condition of it and achieve net gain (Gordon, Langford, Todd, et al. 2011), otherwise the offset would not meet additionality requirements.

The opportunity to stack biodiversity credits with other ecosystem services (like carbon sequestration) was recently introduced in the draft policy paper Draft NSW Biodiversity Offsets Policy for Major Projects (State of NSW and Office of Environment and Heritage 2014). The proposal states that:

Land management requirements for the purpose of creating carbon credits are not considered to be legal requirements for biodiversity management under this policy. This means that the same site can potentially generate both biodiversity credits and carbon credits through the same management action (State of NSW and Office of Environment and Heritage 2014, p.9).
This proposal is the first formal Australian recognition of the stacking credits concept; however, the final document has yet to be released.

**Interviews**

We interviewed 14 policymakers and academics active in the field of carbon and biodiversity in Australia. The interviews were undertaken either face-to-face or over the phone during the period October 2012 to September 2013. Interviewees were chosen through snowball sampling (chain referral) whereby experts within relevant professional networks were contacted to participate in the interviews and then asked to recommend other suitable stakeholders to interview, hence growing the sample size of the study (Bryman 2004). The recommended stakeholders were invited for an interview based on their publication record in the related field or the number of years they were involved in design or implementation of biodiverse plantings for carbon sequestration.

Interviewees included actors in various public and private agencies ranging from State and Federal government organisations to not-for-profit organisations as shown in Figure 6. Our rationale for conducting in-depth semi-structured interviews was to obtain comprehensive individual data about their experiences, perceptions and opinions. This provided experiential data from different points of view. We chose interviews over fixed response surveys in an effort to capture rich, nuanced details that are difficult to elicit in more structured methods. The sample size is justified by a ‘sampling to saturation’ philosophy, whereby interviews continued until no new themes were emerging. We were careful to select different actors in the various public and private agencies to capture as much diversity as possible and not to reach saturation prematurely (Glaser & Strauss 1967). Unlike sampling strategies for quantitative research, the recruitment methods (snowballing) and sample size (14 participants) here do not guarantee generalizability to the population of practitioners. This trade off—reliability versus validity—is well known dilemma in the decision to use qualitative, rather than quantitative, methods. Here we have favoured ensuring the latter rather than the former.
The interviews were semi-structured (Bryman 2004); their aim was to discover stakeholders’ opinions about methods of increasing private landholders’ participation in biodiverse plantings for carbon sequestration, specifically exploring the opportunity of stacking or bundling biodiversity and carbon credits. An interview guide was designed to assess interviewees interest in participation (Drever 1995). Questions targeted stakeholders’ opinions about methods of increasing landholders’ participation in biodiverse plantings for carbon sequestration (monetary and non-monetary incentives), the feasibility of such incentives given the existing policy setting, and opportunities for policy alteration in favour of both greenhouse gas emissions reduction and biodiversity conservation.

Interviews were digitally recorded, transcribed verbatim and coded in the NVivo 10 software (QSR International 2012) for content and thematic analysis (Boyatzis 1998). We were particularly looking for themes about the opportunities and challenges involved in bundling and stacking credits from both market and policy perspectives. We started coding the interviews after the first was conducted. Interviews were continued until we reached the data saturation point (Glaser and Strauss 1967) at which no new themes were emerging. To maintain confidentiality we referred to our interviewees as P (policy actors) and S (scientists) in the results section.
Results

Corporate social responsibility as a driving force

CSR motivates businesses to voluntarily undertake activities for the social and environmental benefits of the broader community (Clapp & Rowlands 2015). As one of the interviewees noted, reducing carbon emissions could help businesses maintain their ‘green image’ in the community. ... there's always the branding opportunities. If a large high-emitting organisation purchases carbon credits from a particular organisation it can improve its image, its corporate social responsibility from where it purchases its credit (p8). This interviewee believed that businesses would be willing to pay for the extra costs involved in bundling/stacking ecosystem services credits to improve their national and international image. The cost involved in designing a flexible scheme that offers multiple incentives could increase the price for those credits.

Another participant mentioned the links between CSR and voluntary offsets and existing standards to measure co-benefits. Recognition of biodiversity and social benefits of biodiverse plantings for carbon sequestration as a part of corporate sustainability objectives for businesses could encourage them to get involved in the voluntary offset markets.

Perhaps if there was some incentive for companies to offset locally it might be more of a benefit, and on top of their existing carbon payments maybe they need to top it up with money for social licence to operate or something. But you'd end up reverting back to how it used to be as with voluntary offsets..., yeah, sort of CSR and companies wanting to show to the community what they’re doing, which is where all those biodiversity standards came from. (S5)

This quote also reflects the lack of adequate incentives for businesses to act locally and buy offset credits from national markets instead of sourcing international credits (Michaelowa 2014).
Barriers and challenges for bundling or stacking credits

Barriers in carbon and biodiversity markets make it less favourable for both landholders and businesses to participate. In addition, uncertainties in the political setting are considered an important barrier (Kapambwe & Keenan 2009; Maraseni & Dargusch 2008). Several interviewees reflected that for landholders to undertake carbon plantings on a sufficient scale, certainty in the carbon market and relevant policies were essential. One said:

Obviously you can have models where an intermediary, a specialist company takes that risk [fire] for them, but the farmer still has a risk there. If the carbon market disappears, that company will probably disappear too and so there’s nobody left to write the cheques. So you know, I think it’s potentially a slightly dangerous space for landholders to be in. If I were a landholder, before I did any serious commercial carbon plantings, I’d be waiting ... right now I’d be waiting to see what happens to the price, what happens to the scheme rules. I wouldn’t be getting into any long-term investments right now. (S2)

Another participant reflected slightly differently on the carbon market and Australian policies. “Carbon can come and go – it’s a political football, there’s an international market that makes it uncertain”. As the previous participant mentioned, introduction of any new standard or initiative to better incentivise landholders requires more stability in the market and related policies. This could possibly reduce the demand from buyers to invest in the bundled carbon and biodiversity markets (Meijaard et al. 2014).

Interviewees also mentioned uncertainties in the global political atmosphere regarding tackling climate change and taking meaningful actions in the carbon market.

Let’s face it, I haven’t seen either Obama or Romney mention climate change in regard to this biggest ever storm going through the US, right! So when you have the biggest country in the world and the opposition leader in Australia essentially you know not even wanting to go do anything serious, then there is clearly a political risk. (S1)
When the carbon or biodiversity markets are not adequately certain to attract buyers or seller this could impact the success and innovation of schemes that offer additional incentives for other ecosystem services.

Moving towards a successful bundling/stacking scenario

Apart from understanding drivers and barriers in developing stacked or bundled credits for carbon and biodiversity markets, improvement of conditions in favour of bundling or stacking needs consideration from both science and policy perspectives. Prioritising conservation objectives and improving carbon accounting models to accurately reflect the amount of carbon captured by biodiverse plantations are essential parts of moving towards more successful bundled/stacked markets.

Conservation prioritisation

Spatial planning at a regional scale could assist the incentivising process. This is because degraded landscapes need immediate action and landholders in those areas could be strategically incentivised to achieve conservation goals in addition to those related to carbon abatement. As one interviewee reflected, one plan may not fit all of the purposes related to carbon sequestration and biodiversity conservation.

In order to make carbon work for biodiversity, we need to identify where our linkages are, where our critical parts of the landscape are and then allow farmers in those areas to forward sell their credits that they’re going to have from these future bio-links. ...And I think that would be a really good solution. (P2)

This perspective implies the need for a landscape-scale planning focus to the introduction of bundling or stacking credits, which would require collaboration among different public and private stakeholders.
**Improving carbon modelling techniques**

Currently, the models (e.g. the Full carbon accounting model (FullCAM)) that are applied to calculate the carbon sequestered in biodiverse plantings for carbon sequestration are those developed for monocultures (Paul et al. 2013; Waterworth and Richards 2008). This means that the models are unlikely to accurately reflect the amount of carbon captured by biodiverse plantings for carbon sequestration. Developing models that can accurately calculate the carbon sequestered in biodiverse plantings (K. Paul et al. 2013) will increase the accuracy of carbon monitoring (Waterworth and Richards 2008) and provide more concrete evidence/assurance for buyers in the market. Paul et al. (2013) conducted a project designed to improve FullCAM yield curves for biodiverse plantings, but suggest that their model reflects the carbon capture for young stand mixed-species only. Further research is needed to develop accurate carbon sequestration models for biodiverse plantings for carbon sequestration as the dynamic of mixed-species carbon sequestration will change with age.

Some of the interviewees stated that the first step would be to develop an exclusive carbon modelling method for biodiverse plantings for carbon sequestration. This can assist in demonstrating the co-benefits of carbon planting more accurately.

> So one of the issues that we have around uptake of the CFI potentially is the fact that ... the default methodology for the CFI, [the] Reforestation Modelling Tool, [is] based on FullCAM, a type of carbon model. That carbon model was primarily designed around monoculture forestry and does not deal with the complexities of a biodiverse ecosystem planning, environmental planning well and generally underestimates. ... you can see that essentially there's a great discrepancy in the amount of carbon actually sequestered and the amount of carbon you get a credit for, for that model, both in the above ground and below ground. *(P5)*

This quote emphasises the fact that before introducing a biodiversity standard for carbon plantings we need to be able to predict the precise amount of carbon abatement using well-developed carbon models.
Market mechanisms to incentivise landholders’ participation in biodiverse plantings for carbon sequestration

We asked interviewees to comment on two scenarios for incentivising landholders’ participation in biodiverse plantings for carbon sequestration schemes – bundling (premium carbon) and stacking biodiversity and carbon credits – in addition to the status quo (business as usual). The potential of each option and their market and policy-related constraints are discussed here.

Status quo: Payments for carbon or assistance from the Biodiversity Fund

Currently, landholders are only paid for carbon credits, although a minority are able to receive financial assistance from the Biodiversity Fund (Australian Government 2013). Only one of the policy experts stated that the status quo will work well to incentivise both carbon abatement and biodiversity conservation. He reflected on the point that incentives like the Biodiversity Fund could facilitate landholders’ participation in the CFI. The Biodiversity Fund was introduced as a part of the Australian Government’s Land Sector Package of the Clean Energy Future plan to provide incentives for landholders to undertake revegetation activities to restore landscape and conserve biodiversity (Australian Government 2013). The first round of funding (AUD$270 million) was offered in 2011-2012 for 312 projects across Australia, followed by the second round for 2013-14, funding 18 successful projects (Australian Government 2013).

So yes, there certainly is enough incentive for landholders. At this moment in time, through the Biodiversity Fund and through the Native Vegetation so, there’s a CFI methodology for native vegetation, and that covers both maintaining and improving existing things as well as planting new native vegetation. (P3)

If the Biodiversity Fund continues operation after 2014, it could assist landholders to cover the additional establishment costs for biodiverse plantings for carbon sequestration.
However, P3 believes that innovative methods for incentivising landholders are not essential.

**Premium carbon: bundling carbon and biodiversity credits**

Standards for premium carbon have been part of the international voluntary carbon market for less than a decade (the first Climate, Community and Biodiversity Standards (CCBS) were released in 2005 (CCBA 2013)); however, these standards are not yet in place in Australia. Several interviewees championed the feasibility of bundled carbon and biodiversity credits from both market and policy perspectives. One research participant mentioned the value of extra incentives for landholders to undertake revegetation activities, covering the establishment costs in particular.

...situations where you’ve got potential for both carbon and biodiversity and the carbon price alone isn’t enough ... you could certainly imagine a conservation agency paying farmers an additional premium... you know we’ll pay you, we’ll give you an incentive to plant trees here. You can keep the carbon credits and sell them so that will give you some money, but we think that’s not enough so we’ll give you some extra, but we want ... you know, particular mixed species and mixed understorey, whatever type of planting they wanted for biodiversity so yeah, you know it’s certainly straightforward to do that. **(S2)**

As S2 mentioned, providing extra financial support for landholders through payments for biodiversity conservation could benefit the landscape. Some of the interviewees stated that financial incentives could be employed as a capacity building tool in a broader scale (e.g. catchment).

*There are many different instruments and they span the total spectrum of increasing knowledge and ability to act through building local or catchment base capability through providing financial incentives through bundling credits.** (S6)
Other respondents agreed that a conservation agency could govern the bundled carbon credits and pay landholders more for the landscape restoration and biodiversity benefits of those trees. One noted:

*It won’t pay for stuff that’s been established in the past, but if stuff’s been established now and they’re getting biodiversity credits, that’s fine. You can only sell the carbon once, but if you’re getting other stuff from it, then that’s fine. So yeah, so that certainly would work as a premium on top of carbon credits.* (S1)

Other interviewees were similarly positive about the possibility that other actors (e.g. financial institutions) in the market would support bundled credits to benefit landscape.

...the development of that market is occurring as we speak. You’ve already got banks and other investors who are looking at what’s occurring under the CFI and saying "Oh that’s all well and good but we want to ensure that what we do has multiple benefits for the landscape and the people in those regional areas." So we’re not prepared just to say go make sure you sequester 5,000 tonnes of carbon. We want you to go sequester 5,000 tonnes of carbon and demonstrate what the additional environmental benefits are. (P5)

Premium carbon could enable the stakeholders in carbon and biodiversity markets to introduce a set of standards that could prove the additional co-benefits that carbon sequestration activities offer.

**Stacking credits**

When designed carefully, stacking could provide positive ecological benefits (EPRI 2011). Some of the interviewees asserted that stacking carbon and biodiversity credits could work as a mechanism to allow both credits to be earned from one piece of private land.

*Landholders should be able to just register where their permanent plantings are, for example, and receive benefits from [them]. There should be the allowance to use carbon offsets and biodiversity offsets on the same project.* (P7)
As P7 expressed, the fact that these trees are permanent guarantees the biodiversity co-benefits for the landscape. Others mentioned that reforestation provides multiple services and landholders could have the opportunity of benefits from multiple markets for ecosystem services.

But when you’ve got a biodiversity outcome and you’ve got a carbon outcome I think it’s a reasonable expectation that you could ... market that to both of those two values. ... the same individual trees provide the same service across both of those but you are very much providing two services by the provision of that reforestation activity. So I think it’s a reasonable expectation that you should be able to engage with multiple markets for the same trees if the ecosystem services they’re providing are quite different. \( \text{(P2)} \)

The feasibility of stacking carbon and biodiversity credits and the way market and legislation deals with the issue was discussed with both policy experts and academics in this study. One noted:

Obviously the legislation finds that a very complex issue to deal with. The CFI looks at the tree and says "Well you’re planting the tree for biodiversity, you’re getting paid for biodiversity, you can’t get paid for the carbon", which is nonsensical from my perspective. You’re providing multiple benefits so you should potentially be able to engage in multiple markets. \( \text{(S4)} \)

Furthermore, some respondents reflected that policy could be changed easily in favour of both markets.

Quite simply, just allow it. A stroke of a pen – it’s a policy construct; it’s not like it’s market-driven. It’s a policy. At the moment... you can’t do both on the same project although you’re getting the benefits. I mean, why are landfill gas abatement projects allowed to create electricity, generate carbon credits, not register it on the land and
also reduce their impact of the carbon tax? They get to dip three times. Carbon gets to dip once. (P7)

P7 stressed that policies should be more flexible in favour of carbon plantings. One of the interviewees argued that the permanence rule should not be considered a hurdle in the stacking process. He also reflected that one streamlined policy design across Australia would be useful.

They can get rid of the permanence rule quite easily by getting consistence across the states, the multi-jurisdictional boundaries, by saying that once you’ve done a carbon planting and it gets 10 years of age, it goes into the biodiversity offset market. Or what it does is … you’re covered by the native EPBC Act [The Environment Protection and Biodiversity Conservation Act 1999] that after 10 years it’s there permanently and if you cut it down you have to replace it. And if you replace it you don’t get carbon credits ’cause you’re just balancing out what you cut down. (P2)

Interviewees opposed to stacking carbon and biodiversity credits stated that additionality was the main barrier to introducing the stacked credits and stacking could jeopardise the integrity of the carbon market.

Well a market operates on the integrity of the product. Additionality – with permanence – is one of the defining characteristics of a carbon credit. If you remove that concept of additionality then you can’t be sure that the work you’re doing in that project is in fact reducing emissions and if it’s not reducing emissions it devalues the product across all carbon credits. (P8)

As reflected above, additionality as one of the main requirements of an offset project to demonstrate the real gain in emissions reduction could act as a barrier in the credit stacking process. However, from the perspective of landholders, additionality could act as a barrier in the carbon market as it influences their willingness to revegetate permanently on their
properties. Here, we interrogated other stakeholders’ perspective about additionality as a barrier.

Figure 7 presents a broad summary of the opinions of interviewees regarding the appeal of the three policy scenarios. It represents the incentives each of the options provides for landholders and also the possible market and policy constraints in implementing each of these options. We assigned different actors to groups based on the risks and opportunities they mentioned regarding each option. Grouping also reflects that some interviewees were opposed to a specific scenario or in favour of the other one.

**Figure 7:** The broad position of interviewees on various options of integrating carbon and biodiversity markets. ‘P’ identifies policy-related interviewees and ‘S’ scientific experts.

**Note:** Status quo includes both existing regulation and using the Biodiversity Fund to help establish biodiverse plantings for carbon sequestration. Bundling is defined as ‘premium carbon’ (a higher price for co-benefits), and stacking refers to selling both biodiversity and carbon on the one piece of land.
Discussion

*The power of this bundling of nature into tradeable bits of capital should not be underestimated, but nor should it be exaggerated.* (Smith 2007, p.24)

The idea of bundling or stacking ecosystem services has gained considerable international attention, recognising that both buyers and sellers in the market could gain from its benefits (Bryan 2013; Deal et al. 2012; Turner et al. 2014). In the case of carbon sequestration and biodiversity conservation, carefully designed bundling or stacking scenarios could benefit both objectives (Standish and Hulvey 2014; Venter et al. 2009). In this paper, we presented the expert opinions of policy makers and academics in Australia about the possibility of integrating the carbon and biodiversity ecosystem services markets. Previous research (EPRI 2011) presents evidence of a general preference against stacking. What the current research adds beyond this is a substantial unpacking of the reasons behind that preference. We present a discussion of the nature and extent of challenges and opportunities for stacking and bundling credits, based on our elicitation of practitioners’ experiences in the field. We also build upon the theoretical suggestions of Robertson et al (2014) and Cooley and Olander (2011) to develop practical, grounded recommendations.

As a preliminary step we discussed the need for a driving force in the market from the buyers’ side to create the demand for such integration. CSR is the driver behind businesses participation and motivates their willingness to pay extra money for bundled or stacked credits. Businesses allocate budget not only to have a green image but to save money through environmental efficiency measures (Clapp and Rowlands 2015; Schmidheiny 1992). However, political and carbon market uncertainties act as barriers for developing integrated credits. This echoes findings of previous research about the concerns of both buyers and sellers regarding uncertainties in the market and policy setting (Kragt et al. 2014; Maraseni and Dargusch 2008; Kapambwe and Keenan 2009).
Before designing and introducing new bundled or stacked credits we need to focus on prioritising conservation objectives at a landscape scale and developing accurate carbon modelling techniques for biodiverse plantations. These two enhancements would provide confidence to buyers in the carbon and biodiversity markets so that genuine improvements in both carbon and biodiversity outcomes could be delivered. Landscape-scale restoration has been the subject of many studies from various perspectives and levels (Menz et al. 2013; Sorice et al. 2013; Goldman et al. 2007; Shea 2003), and as our paper suggests it is one of the essential elements in delivering tangible biodiversity outcomes from carbon plantings. This is not only to find fragmented landscapes where immediate action is required (e.g. landholder’s engagement with higher incentives) but to locate synergistic ecosystem services (Onaindia et al. 2013) to achieve both conservation goals and higher return on investment. Some of the institutions involved in multiple ecosystem services credits also use prioritisation to allocate their funding for conservation more efficiently (Willamette Partnership 2013). Zonation (Watts et al. 2009) is an example of spatial prioritisation software that could easily incorporate ‘potential for carbon sequestration’. Identifying priority sites for restoration could potentially include carbon sequestration potential as additional criteria.

We argue that before introducing a bundling or stacking scenario for carbon and biodiversity credits we need to answer the question ‘what does this bundling or stacking want to achieve?’ and then incentivise landholders in relevant parts of the landscape. Some of the interviewees also reiterated previous calls for improved models of carbon sequestration of biodiverse plantings (K. Paul et al. 2013).

We classified interviewees’ responses into three scenarios regarding future biodiverse plantings for carbon sequestration scenarios: status quo (with assistance from Biodiversity Fund), bundling credits and stacking credits. Status quo refers to undertaking biodiverse plantings for carbon sequestration through the aid of the Biodiversity Fund as an additional incentive for landholders to participate in a scheme like CFI. This scenario does not require any changes in market or policy obligations but provides minimum assistance and incentives
for landholders to participate in the carbon farming schemes. Only one policy expert expressed confidence in this approach (see Figure 7).

In contrast, the scenario of bundling credits (selling premium carbon at a higher price to the carbon market) was supported by the majority of interviewees (Figure 7). This is because opportunities for policy change in the bundled credits scenario seem more feasible. Such an approach could streamline landholders’ participation in a carbon planting scheme to achieve both biodiversity and carbon abatement goals (Standish and Hulvey 2014). Bundling could also reduce the administrative costs of the schemes. However, the lack of standards in Australia to demonstrate that the desired biodiversity gains have been achieved is one of the obstacles in introducing and designing bundled credits. Developing Australian standards or implementing existing international standards will assist both buyers and sellers in the carbon market. Such standards need to clearly demonstrate the co-benefits of carbon plantings. Similar standards exist in the international voluntary market (e.g., CCBS (CCBA 2013)). Adopting related standards has several merits. One of the advantages of such standards is the fact that the process of biodiversity monitoring is incorporated in the carbon monitoring, saving time and resources. The Emissions Biodiversity Exchange Project for the 21st Century (EBEX 21), a program of Landcare Research New Zealand, demonstrated this approach to monitoring (Maraseni & Dargusch 2008; Landcare Research 2015). Transparency in the policy and market are a further prerequisite for success. Procedures should be in place to streamline offering higher prices for the co-benefits of biodiverse plantings for carbon sequestration without additional complexities in a program.

Stacking credits could face more political and market-related constraints. This is because of the additionality requirements of carbon and biodiversity offsets. Trading stacked credits on the international market is not currently permissible. The other challenge in stacking credits is the missed opportunity for restoring another piece of land that could otherwise have been managed for biodiversity purposes. Yet it is the opportunity to reduce management costs that is a key advantage of stacking carbon and biodiversity markets. In addition, the revegetated sites for carbon sequestration need regular monitoring and the permanence rule of carbon planting schemes requires those trees to stay on landholders’ properties for
100 years. This could guarantee the biodiversity and restoration benefits of those trees in the landscape (Maraseni & Dargusch 2008; Landcare Research 2015). Furthermore, in the ‘stacked credits’ scenario, Interviewees expressed their concerns about the integrity of the carbon market, specifically regarding the additionality requirement. However, the recent release of the Draft NSW Biodiversity Offsets Policy for Major Projects (yet to be finalised) presents an opportunity for policy change in favour of both carbon and biodiversity (State of NSW and Office of Environment and Heritage 2014).

Similar challenges and opportunities exist in bundling and stacking credits in countries other than Australia. For example, carbon and water nutrient credit stacking effectively incentivised landholders in the USA. However, Lankoski et al. (2015) highlight the risk that this approach may be creating an oversupply in the market, which could result in reduced prices and the future non-profitability of such credits for landholders. This reality has been realised in a scheme in North Carolina, involving the stacking of wetland and water quality credits. In this case, oversupply of credits and concerns regarding additionality led to the discontinuation of this program.

Howard et al. (2015) challenge the idea of ‘fair carbon’ in scenarios where social and environmental co-benefits (in standards like Plan Vivo and CCBs) are bundled with the carbon credits. Social justice challenges arise when land tenure and carbon rights are linked together, or the benefits are not distributed fairly in the community. They also argue that environmental challenges occurred when achievable co-benefits at the outset of a bundled ecosystem services project were not defined (Howard et al 2015; Shames et al 2010). These international examples stress the careful design of any bundled or stacked credits of ecosystem services to achieve desired socio-ecological outcomes.

Finally, existing challenges in the carbon and biodiversity markets could influence the success of introducing new methods to incentivise landholders. We unpacked some of these challenges (e.g. uncertainty in policy and market). These uncertainties could reduce the innovation in the market for ecosystem services (e.g. bundling). Additionality as one of the
Legal requirements of carbon and biodiversity offsets reduce the popularity of stacking credits. Opponents of stacking credits argue that stacking credits on one piece of property is a missed opportunity for conservation of another part of the landscape. However, bundling opponents express their concerns about the lack of standards to show robust biodiversity gains.

**Conclusions**

The findings presented in this research make a novel contribution to current debates in the literature and in policy design regarding bundling or stacking payments for ecosystem services. To achieve both public benefits and improvement in management of natural assets, the co-benefits of ecosystem services require greater attention. Recognition of these co-benefits could assist in achieving ecological restoration objectives, particularly in highly fragmented landscapes.

We argue that careful policy design is crucial when considering stacking and bundling scenarios given the complex trade-offs between different ecosystem services (e.g. compromising biodiversity by planting mono-cultures for more carbon credits).

Policymakers must consider what a bundling or stacking credit scenario aims to achieve in terms of both landscape restoration and carbon sequestration. Carbon market rules (in particular the additionality requirement) make stacking credits a more complicated option. In our study, designing bundled credits (premium pricing for biodiversity benefits of carbon plantings) that could provide landholders with financial assistance for transaction costs was deemed a more viable policy alternative than stacking or the status quo. However, the success of any of the incentivizing scenarios depends on higher certainty in both carbon markets and political settings. This is crucial to attract both buyers and sellers in the market to achieve the desired biodiversity conservation and carbon abatement outcomes. In addition, there is a clear need for standards that measure carbon planting co-benefits (e.g. biodiversity), and better techniques for modelling sequestered carbon from biodiverse plantings for carbon sequestration to improve the design of bundled/stacked credits.

Although these incentives lower the transaction costs for landholders and could increase
their participation rate, the initial cost for designing the standards, improving the modeling
techniques and designing a scheme that offers such flexibilities may be considered a barrier
for policy makers. Finally, biodiversity conservation and carbon sequestration interact; this
highlights the need for careful design of the best policy option to achieve both goals by
fostering synergies between ecosystem services.

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Chapter Seven: The money or the trees: what drives landholders’ participation in biodiverse carbon plantings?


Abstract:

Carbon farming programs typically aim to maximise landholder participation rates to achieve desired environmental outcomes. This is also critical for programs aiming to tackle both climate change and biodiversity loss simultaneously, as landholder participation in those schemes directly determines the level of carbon sequestered and the potential biodiversity gains. Biodiverse carbon planting is a key private land conservation practice that needs active stakeholders’ involvement to deliver successful policy design and implementation. In this study we developed a Bayesian Belief Network (BBN) of landholder participation in biodiverse carbon planting schemes to determine factors most likely to influence program participation. Based on a review of the literature, we developed a conceptual model. The model was refined through interviews with participating landholders, other key stakeholders and, finally, parameterised using expert-elicited knowledge. Our results indicate that participation rates are most influenced by program attractiveness and the identified values of co-benefits (such as biodiversity conservation) rather than financial incentives. Scenario evaluation revealed that providing a combination of biodiversity incentives with more flexible permanence options could increase the program adoption rate. Stacking/ bundling credits combined with contract agreements may also increase the participation rate. These findings can assist policy development by focusing on the aspects of policy design most likely to increase participation.
Keywords: Bayesian Belief Networks (BBNs), Biodiverse carbon planting, Private land conservation, Landholder participation, bio-sequestration, Policy design, Biodiversity conservation, Carbon

Highlights:

- We developed a BBN model for landholder participation in biodiverse carbon planting.
- The BBN was constructed based on a literature review, interviews and expert elicitation.
- Program attractiveness is more influential than financial incentives.
- Stacking/bundling credits plus contract agreements increase the participation rate.

Introduction

In Australia, biodiversity is in a parlous situation and biodiversity loss is among the most important ecological issues (Hatton et al. 2011; Vanclay & Lawrence 1995). The State of Environment Report 2011 (Hatton et al., 2011) concluded that human activities such as land clearance in addition to population growth are responsible for the situation. Currently, public conservation areas encompass one-third of Australia but are not considered adequate to conserve biodiversity given their size and the ecological systems they represent (Cowell & Williams 2006). Therefore, biodiversity conservation on private land (two-thirds of Australia) requires more attention and the participation of landholders is essential (Stephens 2001).

Biodiverse carbon planting is a key private land conservation practice that needs active stakeholders’ involvement to deliver successful policy design and implementation. In addition to storing carbon, tree planting has the potential to preserve vital ecological processes and provide suitable habitats for wildlife (Bauhus et al. 2010; Campos et al. 2005; Carswell and Burrows 2006). Biodiverse plantations will potentially increase the availability
of resources for native animals, function as seedlings banks and enhance the resilience of
the ecosystem against climate change and pest invasion (Crossman et al. 2011; Pearce,
2005). Such plantations can be incorporated into existing farming systems through wind
breaks, riparian zones and native woodland plantations (Sabto & Porteous 2011).

**Participation rates of landholders in biodiverse carbon programs**

Participation rates in agri-environmental schemes are of concern for policy-makers in
natural resource management (Mettepenningen et al. 2013) as in many cases the number of
participants has a direct impact on the expected environmental outcomes of the scheme. In
particular, the number of landholders participating in carbon and biodiversity related
programs directly influences the objectives of carbon abatement and improvements to
biodiversity. Thus, if favourable to landholders, biodiverse carbon planting schemes have
the potential to lead to large scale landscape restoration and carbon sequestration (Lin et al.
2013). Like many carbon planting schemes (and other market-based instruments),
biodiverse carbon planting schemes rely on financial incentives to increase program
attractiveness and achieve higher participation rates among landholders (Rode et al. 2015;
Hecken & Bastiaensen 2010). However, the conservation outcomes of these schemes may
also provide an incentive to landholders (Pascual and Perrings 2007).

The Carbon Farming Initiative (CFI) was introduced in Australia in 2011 to assist in the
achievement of a five per cent greenhouse gas abatement target by 2020 (Besley et al.
2014). The CFI offers landholders an opportunity to sell sequestrated carbon in the form of
ACCUs (Australian Carbon Credit Units) (Australian Government 2013). Bio-sequestration (e.g.
biodiverse carbon planting) is one of the approved methodologies (Australian Government
2014). The CFI is currently in a transitional period to the Emission Reduction Fund (ERF)
(Australian Government 2014). Hence, it is timely to review carbon farming programs with a
view to identifying approaches that could better achieve objectives for carbon abatement, biodiversity conservation and landholder engagement.

Landholder participation rates depend on many social and environmental drivers (Bacon et al. 2002), some of which are independent of scheme design. Examples include the compatibility of programs with the primary land management practices of landholders (Pannell et al. 2006) and the awareness and values of the environmental and productivity benefits of the scheme (Jellinek et al. 2013; Balderas Torres et al. 2015). Existing social networks and the presence of trusted peers within a scheme could also increase participation rates (Sharp et al. 2013; Bodin et al. 2006). This is because landholders can observe what is involved in the adoption phase and participation outcomes experienced by their peers (Kueper et al. 2013). Active engagement in local Landcare groups also provides social learning opportunities that appear to increase participation in agri-environmental schemes (Sobels et al. 2001). In addition, landholder participation in other conservation programs develops skills and knowledge (Pannell and Wilkinson 2009) and progresses emergent stewardship values (Gill 2013) that assist them to engage in biodiverse carbon planting schemes.

Specific characteristics of biodiverse carbon sequestration schemes can also affect participation rates and implementation success. Of these, transaction costs are particularly influential (Coggan et al. 2013); a complicated administration process typically reduces landholders’ willingness to become involved. Understanding those processes is resource-consuming for participants, in terms of both time and money (Cocklin et al. 2007). The management requirements of a scheme are another important factor, as extensive management requirements could negatively impact participation rates (Coggan et al. 2013). In addition, the legal obligation of carbon planting schemes that requires the trees to stay on properties for 100 years (Bradshaw et al. 2013) may reduce landholder willingness to join a scheme, especially when they are in traditional farming landscapes, where landholders might be concerned about the financial implications of revegetation, including impacts on property values (Lokocz et al. 2011).
Financial incentives could assist landholders with establishment and ongoing management costs. Such incentives can be introduced in a range of ways to compensate for the loss of income associated with land use change and thus increase the program uptake rate (Pannell et al. 2006; Pannell and Wilkinson 2009). Different methods to financially incentivise landholders’ participation in biodiverse carbon plantings exist. These include bundling carbon and biodiversity credits and paying a premium price for biodiverse carbon credits (Deal et al. 2012; Turner et al. 2014). Bundling provides an opportunity for selling the biodiversity co-benefits of carbon plantings as one credit in the carbon market; therefore, the bundled credits cannot be sold separately in the relative markets. This also provides buyers in the market with the opportunity to achieve other objectives such as environmental marketing (Bekessy and Wintle 2008). In addition, stacking credits and enabling landholders to sell their carbon and biodiversity credits from one piece of property in both markets is another option to stimulate participation in biodiverse carbon planting (Lee et al. 2013; Deal et al. 2012). Currently, markets for stacked and bundled ecosystem services credits mainly exist in the USA as wetland and endangered species credits or water quality and carbon sequestration credits. The water quality market values at $10.8 million per year (Gardner & Fox 2013). However, ‘additionality’ could be a barrier to introducing a market for stacked carbon and biodiversity credits because of the regulatory requirements (Torabi & Bekessy 2015). In addition to monetary incentives, existing financial resources available for landholders, such as off-farm income, could also affect participation (Raymond & Brown 2011; Frayer et al. 2014).

In this paper, we aim to develop a Bayesian Belief Network (BBN) model to predict the likely participation rate of different types of biodiverse carbon sequestration programs when applied to diverse cohorts of landholders.

**Bayesian Belief Networks**

Bayesian Belief Networks (BBNs) are powerful tools for decision-making under uncertainty in many fields, including natural resource management, and are particularly useful when combining qualitative and quantitative data (C. Smith et al. 2012). They are based on probability distribution modelling (Aalders 2008) and are able to represent causal
relationships among variables via an influence diagram (Haines-Young 2011). BBNs are also useful in supporting policy decision-making and incentive scheme design by identifying key nodes and links that drive program outcomes (McCloskey et al. 2011).

BBNs are often used as a tool in Environmental Decision Support Systems (EDSS) because of their ability to work with interlinked factors and the simplicity of communication with stakeholders (Henriksen et al. 2007; Burgman et al. 2010). In addition, the ability of BBNs to undertake both future forecasting and current situation analysis makes them applicable in dealing with phenomena in a variety of contexts and socio-ecological systems (Liedloff and Smith 2010; Haines-Young 2011). The flexibility of BBNs to be modified and validated as new data becomes available has also made them practical decision making tools (Smith et al. 2007).

Several studies have employed BBNs to integrate various combinations of social, ecological and economic factors to tackle ecological problems. For example, to manage ground water contamination in Denmark, Henriksen et al. (2007) considered the values and interests of different stakeholders (e.g. farmers and hydrologists) while integrating ecological (e.g. surface water quality) and economic (e.g. farm economy) factors. In this context, they applied BBNs as a decision support system for “Public participatory modelling” (Henriksen et al. 2007 p.1101). In another example, Johnson et al. (2010) used a BBN to integrate ecological (population size), social (neighbour support) and institutional (e.g. government support) factors to develop a relocation model for a vulnerable cheetah population in Africa. They argued that BBNs not only revealed the most influential factors but also were powerful communication tools that facilitated cooperation among different stakeholders.

Using expert-elicited knowledge to refine and parameterise BBNs is gaining momentum in conservation science (Martin et al. 2012; Kuhnert et al. 2010). This is mainly because of the urgency and uncertainty (lack of adequate empirical data) involved in making decisions in environmental management (Kuhnert et al. 2010) and the fact that obtaining adequate data to parameterise BBNs can be consuming in both time and resources. When warranted, BBNs
allow expert-elicited data to be combined with empirical data, exploiting the full potential of the modelling flexibility associated with BBNs (Chen & Pollino 2012).

We aimed to investigate how landholder participation in biodiverse carbon planting schemes could be increased by considering the socio-cultural drivers of landholders, program design, and the availability of financial resources. We developed a Bayesian Belief Network model based on a review of the literature and findings from interviews with and surveys of landholders, policy-makers and academics, which was further refined and parameterised through expert-elicited knowledge. Our study explored the factors that had the strongest influence on landholders’ participation rate, with important implications for the design and implementation of policies relating to biodiverse carbon plantings. Our study may further contribute to addressing the paucity of program design research in the broader field of environmental planning.

Materials and Method

We used Bayesian Belief Networks (BBNs) to explore the causal relationships between social and cultural variables that affect a landholder’s decision to participate in biodiverse carbon plantings. A BBN is structured by nodes, representing the model’s variables, and arcs or links, representing the cause-effect links between nodes; the nodes and arcs together form a directed acyclic graph or influence diagram (Jensen & Nielsen 2007). Each node is attached to a Conditional Probability Table (CPT) in which probabilities are used to describe the degree of belief that the node will be in a particular state given the states of the nodes it is linked to (Pollino et al. 2007; Chen & Pollino 2012).

In Section 2.1, we discuss the steps undertaken to develop our BBN model of landholder participation rates, which are represented visually in Figure 8 (each step is further unpacked in the below sections). The BBN was developed using the software Netica™ version 5.15 (Norsys 2007).
Figure 8: Steps undertaken to develop and run the BBN model to test policy implications

A BBN model of landholder participation rate

Steps One and Two: Review the literature and define the preliminary nodes and links

To develop our BBN we first constructed a conceptual model based on a review of the literature. Relevant peer review articles were retrieved by searching for ‘landholder participation in private land conservation’, ‘agri-environmental schemes’ and ‘biodiverse carbon planting’ in the Web of Knowledge, Scopus and Google Scholar online databases. We also reviewed the original papers cited by these articles. The major drivers of landholder participation that emerged from this review were stewardship (Gill 2013), social networks (Bodin & Crona 2009), social learning (Kueper et al. 2013), and Landcare participation (Compton & Beeton 2012). Based on these themes, the model’s preliminary nodes were defined and linked to generate an initial landholder participation conceptual model.
**Step Three: Refine the model**

The conceptual model described in section 2.1.1 was refined using data collected during surveys and interviews with landholders and other stakeholders (science and policy experts). An initial survey was sent to 47 landholders who had previously participated in a voluntary biodiverse carbon planting scheme in Victoria, Australia. This particular scheme was coordinated by Greenfleet, a not-for-profit environmental organisation that aims to offset greenhouse gas emissions by designing and executing biodiverse tree plantings across Australia. We then interviewed all the survey respondents (n=17) who were willing to participate in face-to-face conversations on their properties (see Appendix I for details of the semi-structured interviews). To understand the challenges and opportunities for various scenarios to incentivise landholders to participate in biodiverse carbon plantings, we also conducted interviews with academics and policy makers actively working in the field of carbon and biodiversity (n=14), details of this study is provided in (Torabi & Bekessy 2015).

Three categories that may potentially influence landholder participation in biodiverse carbon planting emerged from this data. The first category included landholders’ socio-cultural drivers and farm-related factors, namely: (a) intrinsic motivation for biodiversity conservation and farm-related benefits that are influenced by participation in other conservation programs; (b) presence of related skills and knowledge, and (c) the impact of social networks and Landcare membership. We have also incorporated the relative advantage of innovation into the BBN model. Here, the profitability of the new practice has been bundled into the node “value of co-benefits”. This node relates to the conservation and productivity related recognition of co-benefits of carbon planting by landholders. In the productivity related state of this node, I considered the influences of the factors related to the improvement of farm productivity. The second category related to elements within the policy and program design that impacted either a landholders’ decision to participate in a scheme or their experience of participating. These elements included the time commitment required for participation, credibility of the institution that delivers the program, and whether the program contained a permanence rule (requiring 100-year agreement to maintain the plantings). The third category related to the existing financial resources and
different incentivising scenarios that make participation affordable, including monetary factors such as financial incentives (e.g. stacking, bundling and status quo) and type of income (e.g. off-farm income). Status quo refers to the current carbon market policy setting in Australia, in which carbon-only payments are offered to landholders.

Survey and interview findings were combined with the findings of the literature review to develop an updated BBN, which was further developed and agreed upon in an expert workshop.

**Steps Four and Five: Peer-review of the BBN by domain experts and model parameterisation through expert-elicited knowledge**

A formal peer-review of the refined literature-based BNN was undertaken by two experts during a one-day workshop in October 2014. Both experts were practitioners with extensive experience in working with landholders and different biodiverse carbon planting programs. Our experts had extensive experience engaging landholders in private land conservation schemes in Australia.

First, we agreed upon the objective of the model: to understand the influences of different factors on landholder participation in biodiverse carbon planting (applicable to both voluntary and regulated schemes) on ecologically and biophysically viable land under current carbon market and political settings in Australia. Next, the experts were presented with the opportunity to discuss and suggest ways to improve the refined literature-based BBN. During the workshop, the facilitators incorporated changes to the model’s structure as the discussion proceeded until experts and facilitators agreed on a final BBN that they felt was a good representation of current knowledge about landholder participation rates in biodiverse carbon schemes. The description of the final model’s nodes is given in Table 1 and the model’s influence diagram is illustrated in Figure 9.

Once experts had reached consensus about the structure of the BBN model, we parameterised each conditional probability table (CPT) using expert-elicited knowledge,
following the guidelines provided by Kuhnert et al. (2010), Martin et al. (2012) and McBride & Burgman (2012). In order to familiarise experts with the elicitation process, we conducted a trial elicitation prior to running the formal parameterisation of the landholder participation rate model.

Following Burgman et al. (2011) and Martin et al. (2012), we designed our elicitation process such that it: (1) required minimum statistical and probability knowledge from participants; (2) applied direct questioning techniques, and (3) accounted for possible bias in the answers. We used a face-to-face Delphi technique to elicit the probabilities for each node’s CPT, providing experts with an opportunity to discuss their responses and change their estimates (Speirs-Bridge et al. 2010; Martin et al. 2012). We asked experts to give us one consensus probability for each cell in the CPT. In parameterising our model, we only used expert-elicited data and not empirical data. However, the model could easily accommodate landholder-related empirical data could be collated in each area (e.g. Australian Bureau of Statistics or Catchment Management Authority data).
Figure 9: Influence diagram depicting the causal web of key correlates affecting landholder participation rate.

The left side branch of the model indicates landholders’ social drivers, the middle branch indicates financial factors and the right-hand branch refers to the specific elements of the program. The dark grey node indicates the output node. Landholder participation rate refers to the proportion of landholders in a given region who are likely to agree to participate.
Table 7: Description of each node of the BBN, the states each node can be classified as and relevant data sources.

The Description column explains each node, the States column describes different modes that variables can have and the Source column outlines how each node is added to the model, whether through literature review, survey, and interview or expert workshops. State of the output node (Landholder participation rate) was also defined during the expert elicitation workshop; low (0-10%), medium (10-30%) high (30-70 %) and very high (over 70%).

<table>
<thead>
<tr>
<th>Node Description</th>
<th>Description</th>
<th>States</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program attractiveness</td>
<td>To what degree a program is attractive to landholders</td>
<td>High, medium, low</td>
<td>Survey and interview</td>
</tr>
<tr>
<td>Value of co-benefits</td>
<td>The conservation and non-conservation (productivity related) recognition of co-benefits of carbon planting by landholders</td>
<td>Conservation, non-conservation and none</td>
<td>Literature (Saunders &amp; Walker 1998; Jellinek et al. 2013), survey and interview</td>
</tr>
<tr>
<td>Landholders’ financial resources</td>
<td>The availability of adequate financial resources (incentives from the scheme and off-farm income) to enable the participation</td>
<td>Present, absent</td>
<td>Literature (Rode et al. 2015), survey and interview</td>
</tr>
<tr>
<td>Permanence</td>
<td>The required longevity (duration) of trees remaining on properties</td>
<td>long (100 years), short (25 years), contract (non-binding, no time frame)</td>
<td>Interviews, expert opinion</td>
</tr>
<tr>
<td>Credibility</td>
<td>Trustworthiness of the program provider to the landholders</td>
<td>High, medium or low</td>
<td>Expert opinion</td>
</tr>
<tr>
<td>Type of incentives</td>
<td>Stacking carbon and biodiversity credits, bundling carbon and biodiversity credits or carbon only payments</td>
<td>Stacking, bundling or carbon only</td>
<td>Literature (Deal et al. 2012), interviews</td>
</tr>
<tr>
<td>Knowledge and skill</td>
<td>The required skills to undertake biodiverse carbon plantings</td>
<td>Extensive, moderate or limited</td>
<td>Literature (Davidson-Hunt 2006b; Pannell et al. 2006), interviews</td>
</tr>
<tr>
<td>Primary income source</td>
<td>Off-farm, on-farm or both</td>
<td>Off-farm, on-farm or both</td>
<td>Literature (Raymond &amp; Brown 2011), survey and interview</td>
</tr>
<tr>
<td>Committed time for participation</td>
<td>The amount of time needed to go through the administration process and undertake management of carbon plantings</td>
<td>Extensive, moderate or limited</td>
<td>Literature (Pannell et al. 2006), survey and interview</td>
</tr>
<tr>
<td>Participation in other conservation programs</td>
<td>If landholders are participating in any other private land conservation (PLC) programs such as Trust for Nature and Land for Wildlife</td>
<td>High (more than 5), medium (2 to 4) or low (1 or less program)</td>
<td>Survey and interview</td>
</tr>
<tr>
<td>Administration procedure</td>
<td>The time required to obtain information, make sense of the scheme and go through the administrative process</td>
<td>Highly complicated (requires more than a week), moderate (requires a few days) or straightforward (requires less than a day)</td>
<td>Literature (Bodin &amp; Prell 2011; Bodin &amp; Crona 2009), survey and interview</td>
</tr>
<tr>
<td>Social network impact</td>
<td>The strength of social networks in their community, how well connected they are</td>
<td>Strong, medium or week</td>
<td>Literature (Bodin &amp; Prell 2011; Bodin &amp; Crona 2009), survey and interview</td>
</tr>
<tr>
<td>Attended related courses</td>
<td>Any CMA, TAFE or university program attended related to conservation or sustainable land management</td>
<td>Yes or no</td>
<td>Survey and interview</td>
</tr>
<tr>
<td>Management requirement</td>
<td>Fencing, weed and feral animal control, and monitoring required by the scheme</td>
<td>Extensive, moderate or low</td>
<td>Literature (Pannell et al. 2006; Blackmore &amp; Doole 2013), survey and interview</td>
</tr>
<tr>
<td>Landcare participation rate</td>
<td>The percentage of landholders in an area participating in the local Landcare group</td>
<td>High (more than 40%), medium (10-40%) or low (less than 10%)</td>
<td>Literature (Martin 1997; Sobels et al. 2001; Compton &amp; Beeton 2012), survey and interview</td>
</tr>
<tr>
<td>Trusted peers</td>
<td>Presence of champions in a community</td>
<td>Present or absent</td>
<td>Literature (Meadows et al. 2013), survey and interview</td>
</tr>
</tbody>
</table>
**Steps Six and Seven: Sensitivity analyses and evaluation of scenarios**

We used sensitivity to parameters analysis to evaluate the fully parameterised and compiled BBN final model. This analysis was undertaken to assess how the ‘Landholder participation rate’ output node varied as the state of each node in turn was altered between their minimum and maximum ranges while the other nodes were held constant (Pollino et al. 2007, Korb & Nicholson 2011, Fenton & Neil 2013). This allowed us to identify the nodes with the greatest influence on the ‘Landholder participation rate’ output node. We also used the ‘sensitivity to findings’ function in Netica™ to corroborate the results from the sensitivity to parameters analysis. The function uses entropy reduction to estimate the mutual information value for the each network’s node, and expresses this as a percentage of the total entropy of the output node (Pearl 1988; Korb & Nicholson 2004; Pollino et al. 2007; Norsys 2007).

Finally, we estimated the expected landholder participation rate under nine scenarios that represented various combinations of permanence and financial incentives (while the other nodes were held constant) to provide an opportunity to inform policy. We ran the model for different scenarios combining stacking, bundling and carbon only payments with 100-year, 25-year and on-contract permanence options to examine their influences on the landholder’s participation rate. Although we tested these scenarios in an Australian context, they have international implications. This is because permanence and financial incentives are ubiquitous factors (Torabi & Bekessy 2015).

We noted the change in the output node as the nodes constituting a given scenario were altered. While altering these two nodes, the other nodes were set to their no-evidence state. The BBN model’s posterior distributions for each discretised state of the output node were imported into R (R Core Team 2015) and used to generate continuous simulated probability density functions for each scenario. This allowed us to estimate the mean and 95% confidence interval for each scenario. These estimations were based on a sample size of 400, which is an estimate of the minimum number of biodiverse carbon planting sites in Australia that the experts might have been exposed to during their professional careers.
Results

As a result of the expert elicitation workshop, the final BBN model was structured to include 14 nodes (6 input nodes; 7 intermediate nodes; 1 output node) which were linked by 15 arcs (Figure 9). Given our modelling context, landholder participation rate was 28.8% (confidence interval: 25.9-31.7%). Given the discretisation of the output node, this places the mean response in the medium state (10-30%) and the uncertainty in the medium to high states (10-70%). The final parameterised network is presented in Appendix IV.

Sensitivity analyses

Results from the sensitivity to parameters analysis are shown in Figure 10. The ‘Landholders participation rate’ was highly sensitive to nodes directly linked to it. ‘Program attractiveness’ was the most sensitive node (absolute change in the output variable between its higher and lower states [delta]=35.6), followed by ‘Value of co-benefits’ (delta=15.1) and ‘Landholders financial resources’ (delta=11.8). Overall, the sensitivity to parameters analyses confirmed that the model was behaving as expected, with nodes directly linked to the output node having the greatest influence compared to the influence of nodes which were diluted by other nodes (Korb & Nicholson 2004; Jellinek et al. 2014). These results were in agreement with the sensitivity to findings analysis (See Table 9).
**Scenario evaluation: considering different options for contract permanence and financial incentives**

Results from the scenario evaluation are presented in Table 8 and Figure 11. Stacking carbon and biodiversity credits and on-contract agreements are the most effective options (mean 37.7 and CI 34.6-40.7%), followed by bundling credits and on-contract arrangements (mean 36 and CI 33-39%). It also reveals that the status quo, where a sole payment for carbon credits is offered to landholders with a long term agreement option, reduces the participation rate substantially and it is the least effective scenario (mean 22.1 and CI 19.6-24.6%). The most attractive scheme is likely to offer contract participation, rather than a set timeframe committing participants. However, the difference between shorter (25 year) and longer term (100 year) agreements was trivial.
We presented the combination of different states of permanence and financial incentives nodes that built up the nine scenarios in Table 8. This table also shows the mean and confidence intervals for these scenarios and the base model (no-evidence condition of the model).

Table 8: Description of each scenario, mean and confidence intervals (2.5% and 97.5%). Scenario 7 is the status quo.

<table>
<thead>
<tr>
<th>NO.</th>
<th>State of the permanence node</th>
<th>State of the type of incentives node</th>
<th>Mean</th>
<th>Low (2.5)</th>
<th>High (97.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base model</td>
<td></td>
<td></td>
<td>28.8</td>
<td>25.9</td>
<td>31.7</td>
</tr>
<tr>
<td>Scenarios</td>
<td></td>
<td></td>
<td>Mean</td>
<td>Low (2.5)</td>
<td>High (97.5)</td>
</tr>
<tr>
<td>1</td>
<td>100-year agreement</td>
<td>Stacking carbon and biodiversity credits</td>
<td>26.5</td>
<td>23.9</td>
<td>29.1</td>
</tr>
<tr>
<td>2</td>
<td>25-year agreement</td>
<td>Stacking carbon and biodiversity credits</td>
<td>28.1</td>
<td>25.5</td>
<td>30.1</td>
</tr>
<tr>
<td>3</td>
<td>On-contract agreement</td>
<td>Stacking carbon and biodiversity credits</td>
<td>37.7</td>
<td>34.6</td>
<td>40.7</td>
</tr>
<tr>
<td>4</td>
<td>100-year agreement</td>
<td>Bundling carbon and biodiversity credits</td>
<td>25.1</td>
<td>22.6</td>
<td>27.5</td>
</tr>
<tr>
<td>5</td>
<td>25-year agreement</td>
<td>Bundling carbon and biodiversity credits</td>
<td>27.3</td>
<td>24.6</td>
<td>30.0</td>
</tr>
<tr>
<td>6</td>
<td>On-contract agreement</td>
<td>Bundling carbon and biodiversity credits</td>
<td>36</td>
<td>33</td>
<td>39.0</td>
</tr>
<tr>
<td>7</td>
<td>100-year agreement</td>
<td>Carbon only payments</td>
<td>22.1</td>
<td>19.6</td>
<td>24.6</td>
</tr>
<tr>
<td>8</td>
<td>25-year agreement</td>
<td>Carbon only payments</td>
<td>24</td>
<td>21.4</td>
<td>26.5</td>
</tr>
<tr>
<td>9</td>
<td>On-contract agreement</td>
<td>Carbon only payments</td>
<td>32.6</td>
<td>29.5</td>
<td>35.6</td>
</tr>
</tbody>
</table>
Discussion

We developed a Bayesian Belief Network of landholder participation rates based on a review of the literature, interviews with landholders and other stakeholders, and expert elicitation. Our model focused on three main factors that impact the uptake of biodiverse carbon planting schemes by landholders: the value of co-benefits, program attractiveness and availability of financial incentives for landholders. Results from our BBN model indicate that the rate of landholder participation is most sensitive to changes to program attractiveness. Hence, focussing design of programs towards elements that make programs appealing has the potential to improve uptake by landholders. A key element to consider in this context is the flexibility of the schemes to assist landholders to choose a plan that fits their local conditions (e.g. tackling salinity) and introducing some flexibility to permanence rules. Furthermore, policies should be designed to fit a broader audience in rural communities, including different options for commercial farmers looking for productivity
benefits and life-style landholders seeking aesthetic amenities. In addition, a credible program provider that has a good reputation in the community or supporting the existing landholder co-operatives could increase the success of biodiverse carbon planting schemes.

Our findings suggest that important social factors are key to the success of biodiverse carbon planting programs. The value of conservation and non-conservation related co-benefits among landholders were shown to potentially influence program adoption. This awareness occurs as landholders learn through their social networks (including friends, family, and neighbours) and attend land management-related courses to develop their knowledge and skills. Participation rates in other private land conservation programs, for example, Land for Wildlife (providing habitat for native wildlife) (Department of Environment and Primary Industry 2015) could assist with knowledge development and emergent land stewardship values. These have an impact on both the productivity drivers such as pasture improvement and establishment of windbreaks, and conservation-oriented drivers, including improving wildlife corridors and conserving biodiversity. Targeting champions in communities and investing in community-based natural resource management programs (like Landcare) could help the success of program adoption. In these settings, landholders are given opportunities to hear about the program from experienced and trusted peers and receive information regarding existing voluntary and regulated carbon farming programs.

We explored scenarios that provide different financial incentives to landholders including stacking, bundling and payments for carbon credits. Although financial incentives have been shown to assist landholders with establishment, management and monitoring expenses (Cacho et al. 2013; Crossman et al. 2011a; Galik et al. 2012), our research supports previous findings that these incentives are not the main factor affecting program uptake (e.g. Kragt et al. (2014)). Stacking credits, for example, have the potential to increase participation rates in biodiverse carbon plantings. However, considering the additional hurdles of the carbon and biodiversity markets, it seems more practical to consider the option of bundling carbon and biodiversity credits. This could be introduced as a premium carbon standard, offering higher
pricing to recognise the biodiversity co-benefits of carbon plantings and assist landholders with the transaction costs.

We also explored how financial incentives interact with permanence to influence participation rates in biodiverse carbon schemes. Stacking or bundling together with a less rigid agreement is likely to make a policy more attractive, achieving higher adoption rates among landholders. A flexible carbon farming scheme not only provides different options but will be straightforward to monitor, review and improve based on the landholders’ demands and the global carbon market (Besley et al. 2014). While our BBN was based on data collected in the Australian context, the findings have a much broader application. Financial incentives and permanence are elements of all biodiverse carbon planting programs, hence our findings have applications in many different parts of the world.

In this study, we presented a novel methodology for building a BBN based on a literature review, interviews and surveys. We also demonstrated the ability of BBNs to integrate expert-elicited data to predict the likelihood of landholders’ participation in biodiverse carbon plantings. We argue that this ability of BBNs makes them a useful tool to develop environmental management policy. BBNs have the potential to integrate expert knowledge and field data, and have the advantage of graphically demonstrating the likelihood of achieving the desired outcome with changes to variables in the model.

We recognise that there are some limitations to the present study. First, data from a larger sample size could contribute to improved accuracy of the model. However, our sample size for interviews captured a wide diversity of participants (both landholders and other stakeholders). Second, many interpersonal characteristics of landholders that fell outside the scope of this study may also affect participation rates. Third, future studies may benefit from exploring the barriers imposed by non-participants. Finally, our model was developed exclusively for the current carbon market political setting, which is a moving feast in Australia.
Conclusions

Increasing landholder participation rates is, arguably, one of the most important factors leading to the achievement of the landscape scale biodiversity conservation and carbon abatement goals typically stated by biodiverse carbon planting schemes. Results from our study indicate that higher adoption rates depend on the design of programs and the landholders’ perceived values of co-benefits. Stacking and bundling credits with a more flexible permanence option have the potential to increase the likelihood of landholders participating in biodiverse carbon schemes. Hence, a more flexible program design that offers different options for landholders to choose from, based on their own knowledge and available resources (e.g. time) seems to provide the optimal scenarios for improving landholder participation rates. Furthermore, programs should ensure that the landscape-specific co-benefits of participation are effectively communicated to landholders.

Acknowledgement:

This research was conducted with the support of funding from the Australian Government’s National Environmental Science Program (Threatened Species Hub) and the Australian Research Council Centre of Excellence for Environmental Decisions. Sarah Bekessy is supported by an ARC Future Fellowship.
Supplementary materials:

Table 9: Sensitivity analysis showing expected reduction in entropy in changes to landholders' participation rates due to changes in other variables in the model.

The percentage value represents the reduction in the entropy of a network variable as a proportion of the total entropy ($Q = 1.9$) in the landholder participation rate.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Landholders participation rate presented by Entropy (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program attractiveness</td>
<td>0.158 (8.4%)</td>
</tr>
<tr>
<td>Value of co-benefits</td>
<td>0.083 (4.4%)</td>
</tr>
<tr>
<td>Landholders' financial resources</td>
<td>0.082 (4.3%)</td>
</tr>
<tr>
<td>Permanence</td>
<td>0.02 (1.09%)</td>
</tr>
<tr>
<td>Type of incentives</td>
<td>0.0107 (0.6%)</td>
</tr>
<tr>
<td>Credibility of program delivery</td>
<td>0.0107 (0.6%)</td>
</tr>
<tr>
<td>Knowledge and skills</td>
<td>0.0038 (0.2%)</td>
</tr>
<tr>
<td>Primary income source</td>
<td>0.0035 (0.2%)</td>
</tr>
<tr>
<td>Committed time for participation</td>
<td>0.0031 (0.17%)</td>
</tr>
<tr>
<td>Participation rate in other conservation programs</td>
<td>0.002 (0.1 %)</td>
</tr>
<tr>
<td>Administration procedure</td>
<td>0.0016 (0.09 %)</td>
</tr>
<tr>
<td>Social network impact</td>
<td>0.0006 (0.03%)</td>
</tr>
<tr>
<td>Attended related courses</td>
<td>0.0003 (0.017%)</td>
</tr>
<tr>
<td>Management requirements</td>
<td>0.0003 (0.015%)</td>
</tr>
<tr>
<td>Landcare participation rate</td>
<td>0.0001 (0.005%)</td>
</tr>
<tr>
<td>Trusted peers</td>
<td>0.00006 (0.003%)</td>
</tr>
</tbody>
</table>
Chapter Eight: Distilling the key factors that influence participation in biodiverse carbon schemes: Lessons for policy design

In exploring motivational drivers and key trigger points that influence adoption of biodiverse carbon plantings among landholders, many factors can be distilled. In this chapter I will elaborate the emergent findings from the interviews with landholders, policy experts and academics. I then focus on the social and cultural elements important to landholders that are investigated in the course of this study. I will present the similarities and differences in the opinions of landholders and other stakeholders about participation in biodiverse carbon plantings. I conclude the chapter with recommendations for future research and policy in the field.

Carbon sequestration or biodiversity conservation?

As expressed in chapter four many landholders consider co-benefits of biodiverse carbon planting as their primary motivation for participation. These co-benefits are related to biodiversity conservation and on-farm co-benefits. In terms of biodiversity conservation, the main drivers for participation included providing habitat for wildlife, connectivity in the landscape and landscape restoration. On-farm co-benefits included increases in productivity through wind breaks and shelter belts, reducing erosion and salinity control. Landholders not only consider these benefits within their property boundary but acknowledge them as benefits to a broader landscape; salinity and landscape connectivity in particular. Interestingly, carbon sequestration was not a driver for participation of landholders in this study.

Carbon farming practices (both voluntary and regulated) could fail to adequately recruit landholders if they are marketed to landholders solely on the basis of carbon sequestration. To achieve abatement targets in Australia, it will be important to maximise participation
rates in carbon sequestration projects. This research demonstrated that highlighting co-benefits may prove to be more appealing to landholders than framing policies around carbon sequestration and climate change. These are not limited to the farm boundaries; the experience of ‘doing something’ for the public good, and improving the condition of natural capital assets is also valued. In order to achieve this good illustrations of co-benefits in understandable terms for landholders are needed. I will now consider some of the socio-cultural drivers of participation in biodiverse carbon plantings.

Social capital:

Chapter five focussed on the essential role of social capital in program uptake and implementation; especially notions of social networks and trusted peers. I discussed elements beyond the adoption phase and studied their role post-adoption and the successful introduction of program among communities by early adopters. I found that people with ‘high betweenness’ (Bodin & Crona 2009) can be influential in increasing participation rates and can be key to a program’s success. Landholders who had the opportunity to observe trusted peers’ ability, benevolence and integrity (Mayer 1995), responded more favourably to program recommendations from those peers. A centralized social network was observed around those trusted peers that assisted other landholders to participate in the program. Early adopters started to become new trusted peers themselves over time and a de-centralised social network started to build up around them. This happened partly as a result of ‘open days’ and recommendation of the program to others. Their successes demonstrated expertise and ability, which have been identified as important elements of trust (Mayer et al. 1995).

Figure 12 summarises the role of social networks and trusted peers in the uptake and implementation of biodiverse carbon plantings. It shows that in all phases of the program adoption (awareness, adoption and post implementation) landholders relied on the knowledge and the presence of a trusted peer. Furthermore, it illustrates how this program could be encouraged by early adopters and how the same process could occur for
landholders through time (i.e. landholder 1, Landholder 2,...). This can help the longevity of schemes in communities.

![Diagram of landholder cycle]

Figure 12: The role of social networks and trust in program uptake and implementation through time.

Each iteration of the landholder cycle on the left consists of the three steps presented on the right (n refers to the total number of landholders in the scheme). Note that most previous research only covers the adoption (implementation) phase of such programs.

Unpacking culture:

Culture has been referred to very broadly in the literature when exploring landholders’ motivations to participate in programs. In the course of this research I unpacked cultural elements that influenced landholders motivation to participate in conservation activities, including social learning (Ison & Watson 2007), role model influence (Kilpatrick & Johns 2003), childhood experiences (growing up on a farm) and spending time in natural settings (Chawla 1999; Louv 2010). Deeper understanding and analysis of these factors could assist responsible government organisations to further strengthen and utilise them.
Culture can refer to various factors which become triggers for landholder participation. Landholders revealed that cultural factors assisted them in the first stages of program adoption; awareness and non-trial evaluation. They became aware of such schemes as they were actively seeking different approaches to restore the landscape. As they expressed, growing up appreciating nature has built up the willingness to rehabilitate the land and give back to it. In the non-trial evaluation stage when landholders consider their drivers for participation, cultural factors played an important role in appreciating conservation related benefits (e.g. biodiversity).

**Landholders as change agents in environmental policy design**

The role of landholders as change agents is not often considered in the design of environmental management policies. This is because such policies are generally designed and delivered to tackle ecological problems, and they are outcome-oriented. However, landholders can have a critical influence on the success of conservation programs. Therefore, insights into best ways to engage landholders in adopting biodiverse carbon planting schemes could assist policy makers to introduce and implement programs that are more favourable for the targeted landholders. Landholders are more likely to participate in programs that are designed in collaboration with them and to address their landscape related ecological issues (e.g. erosion control).

The following suggestions have emerged through interviews with landholders and may assist the engagement of landholders in the policy design and implementation:

- Clear communication of outcomes of the policy/program
- Landholder involvement in the process of decision making, not only businesses or organisations that are responsible for program delivery (e.g. not-for profits, local governments)
- Improving the science-policy-community stakeholder engagement
- Demonstrating the outcomes of a program related to the landholders’ context without the use of scientific jargon
Similarities and differences in stakeholders’ voices

Interviews with landholders, policy experts and academics about biodiverse carbon plantings reveal some consistent themes, but also some contrasting perspectives. In chapters four and six I examined the perspectives from each group of stakeholders; here I compare and contrast their voices.

Similarities:

Barriers for participation

Uncertainty was a barrier that all stakeholders agreed upon. Carbon market, policy and political ‘perceived’ uncertainties were common themes concerning all stakeholders in regards to the program uptake by landholders. Factors related to program design such as complexity of a program and administrative burden were also identified as key barriers by all stakeholders. These findings have implications for policy makers and responsible organisations that deliver programs. To achieve the desired socio-ecological outcomes of biodiverse carbon planting programs, government bodies should further develop inclusive engagement strategies as these play an important role in landholder willingness to participate.

Improvement in the public-policy-science landscape

All of the stakeholders that participated in this research agreed that the public-policy-science landscape requires some shifts in recognition of different and competing imperatives. From the perspective of landholders, more communication and consultation with the target audience of the introduced policy could assist in greater acceptance. Other stakeholders (policy makers and academics) also stated that existing approaches in the communication of scientific findings to policy makers need to be more efficient and locally meaningful. The often ineffective nature of such conversations is due to tight timeframes and different approaches of science and policy communities in dealing with programs like biodiverse carbon plantings. In addition, a top-down approach of delivering carbon farming schemes is not likely to be favoured by the community. Landholders in different socio-
ecological contexts will not respond to policies in similar ways. Recognition of these
differences is vital to local participation. Hence, landholder consultation groups should be
tailored to the target audiences.

**Contrasting views:**

**Food security**

Contrasting viewpoints were revealed among the different stakeholders when discussing
food security. Landholders generally consider marginal and non-productive land as potential
space to revegetate. There is a sub-set of landholders with a holistic approach to balancing
agriculture/land management and conservation activities. They expressed recognition that
by sacrificing some prime agricultural land for revegetation, they managed to increase their
productivity in the longer term. However, some landholders expressed concern about
negative comments they had received about altering good cropping paddocks to biodiverse
carbon plantings. Other stakeholders expressed a concern for balancing food security and
carbon farming. They argued that we need to consider the increasing demand for food
production when designing and implementing such conservation schemes.

**Climate change**

Policy and academic stakeholders agreed that biodiverse carbon planting is a means to
tackle climate change and achieving the carbon abatement target. This justifies the way that
related policies are designed and communicated, especially around carbon sequestration
benefits as the focus is on the desired outcomes. As discussed in chapter 4 and also earlier
in this chapter, the co-benefits of biodiverse carbon plantings are the most appealing factor
for landholders to participate in programs; tackling climate change was not a driver
expressed by landholders. As a result, the focus of the communications to increase
landholder participation requires refinements and recognition of varied objectives, rather
than imposing a priority of ‘tackling climate change’.
**Socio-cultural drivers of landholders:**

Science and policy stakeholders expressed the complexity of landholders’ socio-cultural drivers for program uptake and decision making for participation in biodiverse carbon plantings. However, these social drivers were not unpacked by academics and policy makers in the course of interviews. Science and policy stakeholders acknowledged the complexity and the existence of these motivations but could not verify them in particular, which highlights the urgency of this research. This is because the terms ‘social and cultural drivers’ are mainly used in literature in very broad terms. In this study, I unpacked some of those elements from the landholder point of view. This study could assist stakeholders in both research and policy realms to understand the drivers in each stage of program adoption and use them in favour of conservation and greenhouse gas emission reduction objectives. It may be argued there is an integrated capacity building benefit in the inclusive engagement of landholders through recognition of their identified concerns.

**Financial incentives:**

Alternative methods of delivering financial incentives to landholders were explored in Chapter six. These include status quo (carbon only payments and aid from the Biodiversity Fund), bundling carbon and biodiversity credits (offering a higher price for biodiverse carbon plantings) and stacking carbon and biodiversity credits on one piece of land (creating the opportunity for double dipping). While one of the participants was in favour of the status quo and believed that governments are already offering adequate incentives to engage landholders in biodiverse carbon planting adoption, all others stated that bundling and stacking credits are better ways of increasing landholders’ willingness to participate. Bundling was discussed as the preferred method of incentivising landholders. This is because market and policy related constraints (e.g. additionality) are minimised with bundled credits. This is because bundling scenario does not have the additionality barrier but stacking has to deal with this barrier. However, several improvements were identified for bundled credits to fully realise potential benefits. Robust standards are required to verify and report on the biodiversity benefits of carbon plantings. Furthermore, modelling
techniques need to be improved to capture precise amounts of abated carbon from biodiverse plantations. These elements are underpinned by the need to clarify the objective(s) of bundling and stacking policies.

Comparing landholders’ perspectives on these financial incentives to those of the other stakeholders reveals that financial incentives feature far less in the dialogue. While landholders indicated that financial incentives could cover some transaction costs, social, cultural and environmental drivers primarily influence their participation. Biodiversity and productivity related co-benefits of biodiverse carbon plantings are among the main factors. When discussing different aspects of a program, one that offers adequate information and flexibility for participation and fits with landholders’ existing land management priorities could be most appealing to landholders. This is partly because landholders may not consider themselves as economic agents and think about other benefits within and beyond their property boundaries (e.g. natural capital, public goods). In addition, the existing financial gain for small-sized property owners is not considerable (in comparison with the transaction costs). As a result, it does not act as the primary factor influencing participation.

I introduced a model in Chapter seven to understand and predict the participation rate among landholders based on program attractiveness, the value of co-benefits and the availability of financial resources. This model revealed that program attractiveness was the most influential factor impacting landholder participation rate, followed by values of co-benefits and the availability of financial resources. This finding has implications for the design of policies targeting biodiversity conservation and carbon sequestration and more broadly in the design of private land conservation schemes.

**Program design:**

Elements that could make a program attractive to landholders include flexibility around the ‘permanence’ rule, credible and trust-worthy organisations responsible for its delivery, and reduced complexity of the administration procedures and the level of management required
of landholders who participate. A flexible program is more likely to be compatible to landholders’ property management goals and beliefs. An attractive program could demonstrate tangible co-benefits that are either aligned with participants’ conservation values (objectives) or assist them to tackle the landscape (context) related ecological issues (e.g. salinity) to increase the on-farm productivity. An appealing and straightforward program combined with adequate financial incentives to cover transaction costs could improve participation rates. Such a program is flexible enough to address co-benefit values by landholders and utilise those values in favour of achieving both landholders’ and program objectives.

**Recommendations:**

An important finding from this research that is directly relevant to policy development relates to the need for more flexible program design that can offer different options depending on the needs of landholders. The BBN presented in Chapter Seven presents the combination of scenarios that could influence landholder participation based on different combination of permanence and financial incentives. Hence, the Commonwealth could design a more flexible carbon planting scheme with feedback options, localised to the ecology and social needs. This program has scope for change and alteration based on the feedback received from the local reference groups, reflects the ecological context and social requirements. Furthermore, it is less complex and offers more streamlined programs for fragmented landscapes where immediate action is required. Landholders in those areas need to be incentivised in a more appealing, easy to understand way and with less administrative burden mechanisms. In doing so, The Commonwealth and the States enshrine involvement of landholders in decision making for a more bottom-up approach to improve the policies. That includes working with communities to develop a program that best suits their needs and fits their existing land management priorities. This could increase their participation rate and the likelihood of larger scale landscape restoration.

Communications with landholders should be reframed, focusing more on conservation co-benefits. Currently, the message is framed around tackling climate change and achieving
carbon abatement goals. Government and non-governmental agencies involved in the biodiverse carbon planting could establish mechanisms to communicate co-benefits with landholders (both conservation and non-conservation ones). To achieve this objective, demonstrating both biodiversity and productivity related co-benefits are essential. Research and innovation could assist in developing indicators to show the value of other co-benefits as a result of the revegetation on the properties.

A further recommendation relates to the need to develop better standards to measure biodiversity co-benefits of carbon plantings and carbon benefits of biodiversity plantings. I recommend that the Commonwealth develop biodiversity standards to demonstrate the co-benefits of biodiverse carbon planting. This could accelerate the process of establishing markets for bundled ecosystem services credits (carbon and biodiversity credits in particular). In doing so, regular monitoring of biodiversity alongside the sequestered carbon is essential. In addition, it provides the opportunity to offer premium prices for biodiverse carbon planting in the market to attract more buyers and sellers.

My research findings suggest that working with champions in communities (trusted peers) could be an efficient way of improving participation. Australian state governments could set up biodiverse carbon planting reference groups at the community level. Members should include identified ‘champions’ in the community, the local Landcare representative and local government representatives. These groups could meet regularly to discuss the opportunities and challenges in landholder participation in such schemes in each stage of program adoption. The group could also be responsible for organising open days and engaging other landholders with the success of early adopters.

**Final Comments**

This research illustrates possible means to enhance the role of landholders as change agents in environmental management, with a focus on carbon farming. I sought to identify the socio-cultural triggers influencing the success of biodiverse carbon planting schemes and to
discover the importance of program design and attractiveness in its successful uptake. My research findings emphasise the role of social capital (social networks and trusted peers), landholder awareness and the value of co-benefits in increasing participation rates in biodiverse carbon planting schemes.

These findings have important ramifications for the design and implementation of policy. Environmental management policies could invest more in enhancing the multiple aspects of social capital to increase landholder participation in conservation practices. Building capacity in rural communities often involves strengthening existing social capital. This could be achieved by valuing champions in communities and building trust in the landholder-agency relationship.

Furthermore, the scale of conservation practices (e.g. biodiverse carbon planting) could have an impact on achieving their ecological outcomes and increasing resilience in the face of climate change in rural societies. In addition, ‘scale’ is an important factor to be considered if such programs and policies aim to increase landholders ‘sustainagility,’ “allowing landholders agility to continue” (Verchot et al., 2007 p.911). This means recognising the dynamic aspects of sustainability in agricultural landscapes and providing opportunities for landholders to increase their productivity and conservation capacity by revegetating the marginal land.

Environmental policy design could benefit through more attention to transdisciplinary perspectives, but this approach demands researchers, policy makers and end users (communities) work together in a more adaptive manner (Campbell et al. 2015). Moving from the traditional top-down method to an adaptive governance framework could assist all of the stakeholders to achieve their objectives in a more sustainable manner. In doing so, these objectives are more likely to shift from outcome-oriented ones to socio-ecologically sustainable ones. Environmental management policy also needs reform to consider socio-ecological outcomes instead of ecological benefits with the change agent’s role elaborated. For such policies to be successful, one needs to answer these questions:
What does the policy aim to achieve in a socio-ecological landscape?

Who are the change agents or audiences of these policies?

What programs could work for their socio-ecological setting?

Biodiverse carbon planting is predominantly considered a conservation activity by landholders. The activity is considered in the framework of emergent stewardship and participate is principally motivated by the conservation, amenity or productivity co-benefits. This perspective is contrary to that of policy makers and academics interviewed in this research, who tend to consider biodiverse carbon planting a policy mechanism to tackle climate change and achieve greenhouse gas emission abatement targets. This reveals a mismatch in the understanding of the aims and objectives of such policies from various stakeholders’ perspectives. Responsible government institutions tend to communicate the climate change related co-benefits more than other those related to conservation and productivity. However, communication of these different aspects of the policy could influence its uptake among landholders and could potentially have negative impact on the participation rate given the climate change scepticism in some rural communities (Raymond & Robinson 2013).

Markets for ecosystem services on private land are gaining attention in Australia (Figgis et al. 2015). This provides an opportunity for innovation in the market and finding new approaches to deal with barriers such as ‘additionality’ (Fitzsimons 2015). Such innovations could offer bundled or stacked ecosystem services credits for buyers and sellers. Furthermore, given the complex dynamic and trade-offs between different ecosystems services, the target audience (e.g. communities) perception of the multiple benefits (water quality, carbon sequestration or landscape restoration) requires careful consideration by policymakers. In doing so, it is necessary to move from the traditional decision making approaches to a more adaptive and collaborative method. Adaptive governance considers socio-political and ecological contexts and the link between them in decision making, in contrast with the traditional top-down approach (Folke, et al. 2005; Wyborn, 2015). It also requires collaborative approaches among stakeholders in science, policy and community at
multiple levels (Wyborn 2015). Adaptive governance could be incorporated into the assessment of trade-offs in ecosystem services. It enables the process of linking different social, ecological and organizational elements.
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Appendices
Appendix I – landholder interview prompts

Introduction

1. How long have you had/lived on this property?

2. Did you grow up on a farm? If yes, did you participate in any revegetation activities in your childhood?

3. Have you been involved in any conservation planning activities (land care, Bush broker)?
   a. Have you adopted any other environmental initiatives/ will you do more in the future considering time and money?

4. Where do you seek information regarding conservation programs in your farm?

5. Since you bought/moved in this property, have you found more species of fauna and flora (e.g. relative abundance)?
   a. Have you documented changes of your property? Could you have some photos to show me? Could you draw a map of your property showing the new plantation?

Joining Greenfleet

6. How did you come across Greenfleet? Did anyone suggest them to you?
   a. What’s the main reason for plantation?
      b. How long did it take you to join Greenfleet after you heard about them/was it a difficult decision to make?
   c. Have you recommended plantings to anyone else? If yes, what was the response?
   d. Are you satisfied with the type of vegetation planted on your property?
   e. Was it important for you to have that diversity?
      f. Were you aware of the diversity of the trees, (Were you provided with a list)?
      g. What do you think about the benefits of trees on your property? are there any benefits for the landscape?

7. How did you find managing/integrating new plantings with your usual business?
   a. How did involvement with Greenfleet change the management of your property?
   b. Are the tree plantings compatible with the family goals/ neighbours?
c. Are you satisfied with your current agreement with Greenfleet?

d. Have you found any risks with planting trees?

e. Would you like to plant more trees in the future?

f. How would you see the local landscape in 20 years and how the work you have done fits in that landscape?

g. How would you like your property to operate in 20 years?

h. Have you formed connections with/come to know with other land holders through tree planting?

i. Would you be happy to meet like-minded land owners in your area in an annual meeting?

8. How much value do you think these trees have for your property? What about economic value?

a. Have you ever thought of selling any other benefits of these trees on other markets (e.g. Bed and Breakfast)?

b. Do you think there should be more government regulations to pay you more for having these trees (biodiversity rights)?

__Carbon markets and biodiversity market__

9. How much do you know about the carbon market and biodiversity offsets?

a. Have you heard of the Carbon Farming Initiative? If yes, what do you think of it?

10. Would you be willing to participate if you had been consulted with at the community level by local authorities?

11. Have you ever adapted/thought of doing an initiative at community level?

a. possibility of revegetation collectively/cooperative in your area will you join?

__Concluding questions__

12. What sort of tree planting suits you?

13. What would you participate in?
Appendix II – plain language statement

PARTICIPANT INFORMATION AND CONSENT FORM (PICF)

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT (Questionnaire)

PARTICIPANT INFORMATION

Re: PhD research project entitled “Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration”

Investigators:

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifications</th>
<th>Email</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Nooshin Torabi</td>
<td>PhD Student</td>
<td><a href="mailto:nooshin.torabi@rmit.edu.au">nooshin.torabi@rmit.edu.au</a></td>
<td>+3 9925 0909</td>
</tr>
<tr>
<td>Dr. Sarah Bekessy</td>
<td>Senior supervisor</td>
<td><a href="mailto:sarah.bekessy@rmit.edu.au">sarah.bekessy@rmit.edu.au</a></td>
<td>+3 9925 1858</td>
</tr>
</tbody>
</table>

Dear Sir/Madam,

‘Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration’

Who is involved in this research project? Why is it being conducted?

My name is Nooshin Torabi, and I am undertaking a PhD at RMIT University in Melbourne. My Senior Supervisor is Dr Sarah Bekessy, Senior Lecturer, Planning and Environment. The title of my research is ‘Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration’. Greenfleet has given approval for the research.

You are invited to participate in a research project being conducted by RMIT University. Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators.

Why have you been approached?

This research will focus on Greenfleet’s Victorian plantings as a case study for examining what drives landholders to participate in biodiverse reforestation projects for carbon sinks. You have been approached as you are one of the private landholders in Victoria that have participated in biodiverse carbon plantings through Greenfleet. I invite you to share your story about your decision to participate in biodiverse forest sinks scheme. To protect your privacy, this communication has been undertaken by Greenfleet.
What is the project about? What are the questions being addressed?

The primary intention of this research is to integrate social, ecological and economic factors to inform policy development around biodiverse plantings for carbon sequestration. The first step in this investigation is to identify the social and cultural drivers of private landholders who contribute to carbon sequestration projects. To undertake this research, a questionnaire has been sent to all the private landholders in Victoria who have Greenfleet’s carbon plantings on their property. For the next step, after I received the questionnaire result I expect to interview approximately 15 landholders who will return the signed consent form.

If I agree to participate, what will I be required to do?

If you are interested in being involved in this project, it would involve the following:

- To complete the attached questionnaire

What are the possible risks or disadvantages?

This project does not seek to intrude in the day to day life of the participants and there are no perceived risks outside the participant’s normal day-to-day activities. There is no intention to jeopardise the relationship between Greenfleet and the landholders. If you are unduly concerned about your responses to any of the questionnaire items or if you find participation in the project distressing, you should contact my supervisor, Sarah Bekessy, as soon as convenient. Sarah will discuss your concerns with you confidentially and suggest appropriate follow-up, if necessary. If you have any complaints about your participation in this project, please see the complaints procedure on the Complaints with respect to participation in research at RMIT page.

What are the benefits associated with participation?

This research aims to find out about the socio-cultural drivers of landholders who participate in biodiverse carbon planting. This will help the policy designers to deliver the better design for related programs to the landholders.

What will happen to the information I provide?

Any information gathered from you through questionnaire or an interview will be treated confidentially. They only will be available to my supervisors and me. The research data will be kept securely at RMIT for 5 years after publication, before being destroyed.

The information you provide will be reported in my PhD thesis and any academic conference or publication. During the reporting process, your name and your property place will remain anonymous by using codes or pseudonyms. I will not include any of the people’s or places’ names in my reports and research outcomes.

If you would like to participate in the questionnaire please sign the consent form and send it back to me with the completed questionnaire.
What are my rights as a participant?

Would you wish to participate, please note that you can withdraw from participation at any time, and if you redrew you have the right to have any unprocessed data withdrawn and destroyed, provided it can be reliably identified. You can also request that any recording cease. You have the right to have any questions answered at any time.

Whom should I contact if I have any questions?

If you would be willing to participate, or have any questions or concerns, please feel free to contact me at any time to discuss any aspect of this research in greater detail.

Thanks very much for your time!

Yours sincerely,

Nooshin Torabi
PhD Student

Dr. Sarah Bekessy
Senior Supervisor

If you have any complaints about your participation in this project please see the complaints procedure on the Complaints with respect to participation in research at RMIT page

If you are using web-based surveys, you must also include the following advice as part of the information sheet:

- Security of the website
  
  Users should be aware that the World Wide Web is an insecure public network that gives rise to the potential risk that a user’s transactions are being viewed, intercepted or modified by third parties or that data which the user downloads may contain computer viruses or other defects.

- Security of the data

  This project will use an external site to create, collect and analyse data collected in a survey format. The site we are using is Qualtrics If you agree to participate in this survey; the responses you provide to the survey will be stored on a host server that is used by RMIT University. No personal information will be collected in the survey so none will be stored as
data. Once we have completed our data collection and analysis, we will import the data we collect to the RMIT server where it will be stored securely for five (5) years. The data on the RMIT University host server will then be deleted and expunged.
PARTICIPANT INFORMATION AND CONSENT FORM (PICF)

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT (Interview)

PARTICIPANT INFORMATION

Re: PhD research project entitled “Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration”

Investigators:

<table>
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Dear Sir/Madam,

‘Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration’

Who is involved in this research project? Why is it being conducted?

My name is Nooshin Torabi, and I am undertaking a PhD at RMIT University in Melbourne. My Senior Supervisor is Dr Sarah Bekessy, Senior Lecturer, Planning and Environment. The title of my research is ‘Integrated Ecological and Socio-Economic Modelling of Biodiverse Plantings for Carbon Sequestration’. Greenfleet has given approval for the research.

You are invited to participate in a research project being conducted by RMIT University. Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators.

Why have you been approached?

This research will focus on Greenfleet’s Victorian plantings as a case study for examining what drives landholders to participate in biodiverse reforestation projects for carbon sinks. You have been approached as you are one of the private landholders in Victoria that have participated in biodiverse carbon plantings through Greenfleet. I invite you to share your story about your decision to participate in biodiverse forest sinks scheme. To protect your privacy, this communication has been undertaken by Greenfleet.

What is the project about? What are the questions being addressed?
The primary intention of this research is to integrate social, ecological and economic factors to inform policy development around biodiverse plantings for carbon sequestration. The first step in this investigation is to identify the social and cultural drivers of private landholders who contribute to carbon sequestration projects. To undertake this research, a questionnaire has been sent to all the private landholders in Victoria who have Greenfleet’s carbon plantings on their property. For the next step, after I received the questionnaire result I expect to interview approximately 15 landholders who will return the signed consent form.

If I agree to participate, what will I be required to do?

If you are interested in being involved in this project, it would involve the following:

- An interview with myself taking approximately one hour at your place of residence, at a time and day of the week that is convenient for you. With permission from yourself, interviews will be tape recorded to aid in the data analysis process.

- A brief walk or drive through your property to show me the carbon plantings you have in your properties. This can be a short walk and talk as I would like minimum disruption to your business as usual.

- With your permission, some photos of the planted trees will be taken. I will try my best in photo framing that your property will remain anonymous in any future publication arisen from this research. You can review the photos at the same time and can ask for any photos to be deleted.

What are the possible risks or disadvantages?

This project does not seek to intrude in the day to day life of the participants and there are no perceived risks outside the participant’s normal day-to-day activities. There is no intention to jeopardise the relationship between Greenfleet and the landholders. If you are unduly concerned about your responses to any of the questionnaire items or if you find participation in the project distressing, you should contact my supervisor, Sarah Bekessy, as soon as convenient. Sarah will discuss your concerns with you confidentially and suggest appropriate follow-up, if necessary. If you have any complaints about your participation in this project, please see the complaints procedure on the [Complaints with respect to participation in research at RMIT](http://example.com) page.

What are the benefits associated with participation?

This research aims to find out about the socio-cultural drivers of landholders who participate in biodiverse carbon planting. This will help the policy designers to deliver the better design for related programs to the landholders.

What will happen to the information I provide?

Any information gathered from you through questionnaire or an interview will be treated confidentially. They only will be available to my supervisors and me. The research data will be kept securely at RMIT for 5 years after publication, before being destroyed.
The information you provide will be reported in my PhD thesis and any academic conference or publication. During the reporting process, your name and your property place will remain anonymous by using codes or pseudonyms. I will not include any of the people’s or places’ names in my reports and research outcomes. You have the right to read the interview transcripts that I will send them and ask for any part of the interviews to be omitted if it makes them identifiable to both Greenfleet and other potential people who read the thesis.

If you would like to participate in an interview please sign the consent form and send it back to me.

**What are my rights as a participant?**

Would you wish to participate, please note that you can withdraw from participation at any time, and if you redraw you have the right to have any unprocessed data withdrawn and destroyed, provided it can be reliably identified. You can also request that any recording cease. You have the right to have any questions answered at any time.

**Whom should I contact if I have any questions?**

If you would be willing to participate, or have any questions or concerns, please feel free to contact me at any time to discuss any aspect of this research in greater detail.

Thanks very much for your time!

Yours sincerely,

Nooshin Torabi                     Dr. Sarah Bekessy
PhD Student                                                                                               Senior Supervisor

All researchers must sign the information sheet, with his/her qualification/s listed below each name.

If you have any complaints about your participation in this project please see the complaints procedure on the [Complaints with respect to participation in research at RMIT page](#)
Dear Sir/Madam,

My name is Nooshin Torabi, and I am undertaking a PhD at RMIT University in Melbourne. My Senior Supervisor is Dr Sarah Bekessy, Senior Lecturer, Planning and Environment. My research is about discovering socio-cultural drivers of private landholders who participate in biodiverse carbon plantings. The study area is Greenfleet’s tree plantings in Victoria. Greenfleet has given approval for the research.

I encourage you to read the statements (for the questionnaire and the interview) enclosed with this letter, which outline the project in greater detail, including what would be required of anyone interested in participating.

If you are interested in being involved, you can tick the box at the bottom of this page, and provide your contact details and a time that would suit for me to contact you. Having provided these details, simply return this single sheet, signed consent form and the questionnaire (if you are answering the paper-based one) in the self-addressed envelope provided. Alternatively, if you would like to contact me directly to express your interest, my contact details can be found at the top of the plain language statement enclosed. If you have further questions or queries before you decide whether you would be interested in participating, you are also most welcome to contact me at any time.

For those not interested, thank you for considering my project, and best of luck with managing your property into the future.

Yours Sincerely,

Nooshin Torabi
PhD Candidate
RMIT University
Yes, I would like to express my interest in participating in this research project. 

Name:

Contact details (phone, email):

Best time to contact me (time of day, day of week, etc):

Consent Form

*Please complete the consent form if you would like to participate in an interview.*

I have had the project explained to me, and I have read the information sheet

1. I agree to participate in the research project as described

2. I agree to complete a questionnaire.

3. I agree to be interviewed, my voice will be audio recorded and my property images will be taken

4. I acknowledge that:

   (a) I understand that my participation is voluntary and that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.

   (b) The project is for the purpose of research. It may not be of direct benefit to me.

   (c) The privacy of the personal information I provide will be safeguarded and only disclosed where I have consented to the disclosure or as required by law.

   (d) The security of the research data will be protected during and after completion of the study. The data collected during the study may be published. Any information which will identify me will not be used.

Participant’s Consent

Participant: ___________________________ Date: ___________________________

(Signature)

Participants should be given a photocopy of this PICF after it has been signed.
Appendix III- Interview Guide: Policy makers and academics

1. What do you think of different carbon planting schemes, both voluntary and paid programs?

2. How do you think private landholders’ participation in carbon planting could be increased?

3. What additional incentives would help (monetary and non-monetary)?
   A. What’s the role of education?

4. Which of these incentives are politically feasible both in an Australian context and internationally?

5. How do you think the current policy should be altered in favour of both Greenhouse gas emissions reduction abatement and biodiversity conservation?

6. What do you think about the application of Social Enterprises in success of carbon planting schemes? (e.g. Hepburn Community Wind farm)

7. What could be changed in the science (policy)-public landscape in favour of carbon planting? (both design and implementation)
   A. How to frame the message?

8. How does the biodiverse carbon planting schemes help increase the resilience in rural areas?

9. What is the greatest challenge in the carbon/biodiversity market?
Appendix IV- BBN model in the neutral state
Appendix V- Landholder survey

Landholder Questionnaire

Thank you for your time and participation, please notice that answering to the questions are optional and feel free to email me if you have any questions.

Part 1: General Information about yourself and your property

What is your age range?
- 18-24
- 25 to 39
- 40 to 54
- 55 to 69 More than 70

Please indicate the highest level of formal education in your household?
- High School
- TAFE
- University

What is the area of your property?
- Acre
- Hectares

How long have you been living on/managing your current property?

What is your primary source of income (usually)?
- Off farm
- On farm
How would you categorise your land use?

- Commercial
- Semi-commercial
- Hobby farmer
- Lifestyle landholder

How readily have you taken up any new agricultural/conservation initiatives?

- Never
- Rarely
- Sometimes
- Most of the Time
- Always

Please mark how strongly you agree with the following statement, “I am active in my community”

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Are you involved with a Landcare group?

- Yes
- No

How do you describe your previous experience with the work of any extension officers (e.g. Natural resource manager, staff from Catchment Management Authority)?

- Very Ineffective
- Ineffective
- Neither Effective nor Ineffective
- Effective
- Very Effective
- No experience
Did you grow up on a farm?

- Yes
- No

Were you involved in land conservation activities as a child?

- Yes, please specify
- No

Which of the following statements best describes you and your property?

- Landowner
- Land steward
- Others, please specify

Have you been involved with any of the following programs? (you can choose more than one option)

- CMA programs
- Care for Country
- BushBroker
- Bush Tender
- Land for Wildlife
- Land stewardship scheme
- Others please specify

How do you rate the performance of the following organisations for conservation programs in your area?

<table>
<thead>
<tr>
<th></th>
<th>Very Bad</th>
<th>Bad</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Government</td>
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<td></td>
<td></td>
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<tr>
<td>State Government</td>
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<td>Local Government</td>
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<tr>
<td>Non-government</td>
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<td>organisations</td>
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<td>Non-for-profits</td>
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<tr>
<td>Community groups</td>
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</tbody>
</table>
Who do you seek advice from regarding conservation activities on your properties? (you can choose more than one option)

- [ ] Family or friends
- [ ] Neighbours
- [ ] Community Groups
- [ ] Non-government organisations
- [ ] Local Government
- [ ] State Government
- [ ] Federal Government
- [ ] Others, Please
How do you keep your knowledge about land conservation practices up to date? (you can choose more than one option)

- Reading on the Internet
- Attending Landcare programs
- Talking to local landholders
- My knowledge is already sufficient
- Others, please specify

Have you undertaken any of these activities in your property? (you can choose more than one option)

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>Some</th>
<th>Quite a Bit</th>
<th>An Extreme Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlling weeds</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Controlling pest animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fencing revegetated areas</td>
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<tr>
<td>Erosion control</td>
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<tr>
<td>Revegetation</td>
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<tr>
<td>Grazing strategies</td>
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<tr>
<td>Others, please specify</td>
<td></td>
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</table>

How would you think about the importance of the following factors in affecting your ability to conduct land management practices?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Not at all Important</th>
<th>Very Important</th>
<th>Somewhat Important or Unimportant</th>
<th>Somewhat Important</th>
<th>Very Important</th>
<th>Extremely Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
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<tr>
<td>Help and support from family, friends and neighbours</td>
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<tr>
<td>Stress level</td>
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</table>

Please mark how strongly you agree with the following statement,

“Sometimes it is necessary to limit private property rights in order to achieve societal goals”

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree
Please mark how strongly you agree with the following statement,

“I would participate more in land conservation practices on my property if my neighbours, friends and local community were more actively engaged in private land conservation.”

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

What type of plantings would you revegetate on your property in the future?

- Native trees, single species
- Native trees with diversity of species
- No specific preferences
- I would not do any

How would you describe your overall approach to living on and managing your land?

Part 2: Information about you joining Greenfleet

How did you first find out about Greenfleet?

- Internet
- Family/Friend
- Neighbours
- Local community
- Others, please specify

Have you suggested joining Greenfleet to anyone else?
Yes, and they have joined

☐ Yes, and they have not joined yet

☐ No

What was the most important reason for you to undertake revegetation on your property?
How would you describe the administrative process of joining Greenfleet?

- Very Difficult
- Difficult
- Neutral
- Easy
- Very Easy

How comfortable are you with the Greenfleet carbon monitoring team visiting your property on a regular basis?

- Very comfortable
- Comfortable
- Somewhat comfortable
- Somewhat Uncomfortable
- Uncomfortable
- Very Uncomfortable

Do you think the following statements about the trees planted by Greenfleet in your property are true?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase the productivity of your farm</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Reduces wind damage to your crop</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Increases the beauty of your farm and the surrounding area</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Increases native animals and birds on your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Helps to connect other patches of vegetation</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Increases fire risk to your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Increases weeds in your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Increases rabbits and other pest animals in your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Creates shelter for your livestock</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
When considering tree planting what was important for you?

| Benefits to your farm | ☐ | ☐ |
| Benefits to your neighbours | ☐ | ☐ |
| Benefits to the next generation | ☐ | ☐ |
| Benefits to your local community | ☐ | ☐ |
| Natural assets | ☐ | ☐ |
| Employment | ☐ | ☐ |
| Education | ☐ | ☐ |
| Others, please specify | ☐ | ☐ |

How important is for you that trees planted by Greenfleet are local species?

- ☐ Not at all important
- ☐ Very Unimportant
- ☐ Neither Important nor Unimportant
- ☐ Very Important
- ☐ Extremely Important

How far from your property should seeds be collected?

- ☐ Only on my property
- ☐ Within 5 km of my property
- ☐ 5 to 10 km from my property
- ☐ 10 to 20 km from my property
- ☐ The seed source distance does not matter to me

How important has been the diversity of these trees to you?

- ☐ Not at all Important
- ☐ Very Unimportant
- ☐ Neither Important nor Unimportant
- ☐ Very Important
- ☐ Extremely Important

The most important reason to plant diverse native species of trees is:

- ☐ They add financial value to your property
- ☐ They are beneficial for your livestock
- ☐ They provide habitat for wildlife on your property
They connect other patches of vegetation in your local area.
How much did you have to change your land management practices after planting trees?

- None
- Little
- Some
- A Lot

How have you changed the management of your property since you planted trees with Greenfleet?

Do you intend to plant more trees with Greenfleet in the future?

- Yes
- Maybe
- No, I have no more available land
- No, I have available land but choose not to plant with Greenfleet

Would you be happy to meet like-minded land owners in your area in an annual meeting organised by Greenfleet?

- Yes
- No

Part 3: Information about other carbon market schemes

Have you heard of the Carbon Farming initiative (CFI)?

- Yes, and attended an information session about it.
- Yes, but have not attended any information sessions about it.
- No

Would you like to plant trees with CFI?

- Yes
- Maybe
- No
How would you describe the administrative procedures of CFI?

- Very Easy
- Easy
- Somewhat Easy
- Somewhat Difficult
- Difficult
- Very Difficult
- Don’t know

Thinking about participating in CFI, how important is each of the following factors?

<table>
<thead>
<tr>
<th></th>
<th>Not at all Important</th>
<th>Very Unimportant</th>
<th>Neither Important nor Unimportant</th>
<th>Very Important</th>
<th>Extremely Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire risk</td>
<td></td>
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<td></td>
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<tr>
<td>100 year obligation on title</td>
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<tr>
<td>Monitoring of carbon and your property rights</td>
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<tr>
<td>Amount of time to invest</td>
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<td></td>
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<tr>
<td>Lack of trust in related government policies</td>
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<td></td>
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<tr>
<td>Financial issues</td>
<td></td>
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<tr>
<td>Administrative burden</td>
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<tr>
<td>Auditing and reporting</td>
<td></td>
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<tr>
<td>Political uncertainty</td>
<td></td>
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<tr>
<td>Carbon market stability</td>
<td></td>
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<tr>
<td>Outlays (e.g. fencing and site preparation)</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Additional Comments: If you would like to add additional comments or expand any of the above questions please do here.