



# Understanding the values behind farmer perceptions of trees on farms to increase adoption of agroforestry in Australia

Aysha Fleming<sup>1</sup> · Anthony P O'Grady<sup>1</sup> · Daniel Mendham<sup>1</sup> · Jacqueline England<sup>2</sup> · Patrick Mitchell<sup>1</sup> · Martin Moroni<sup>3</sup> · Arthur Lyons<sup>3</sup>

Accepted: 9 January 2019 / Published online: 22 January 2019  
© INRA and Springer-Verlag France SAS, part of Springer Nature 2019

## Abstract

Agriculture faces increasing sustainability pressures. Land intensification and degradation, energy use and inputs, complex environmental management, social issues facing farming communities and climate change are just some of the headline sustainability concerns threatening the viability of farming. Simultaneously, there is a need to increase food and fibre production and resource use efficiency. For many of these sustainability issues, increasing the number of trees planted in agricultural systems, or agroforestry, can improve the productivity and sustainability of future rural agricultural landscapes. In many parts of the world, the benefits of agroforestry remain under-realised. To understand the reasons behind this, interviews were conducted with 44 predominantly mixed enterprise farmers and farm advisors in Tasmania, Australia. Discourse analysis identified three groups of values driving perceptions and behaviours relating to agroforestry, trees as an economic proposition, trees as uneconomic and trees as essential regardless of economics. Previous work has identified many complex factors contributing to the lack of tree planting on farms including failures of past reforestation schemes, lack of awareness of the benefits of trees, perceptions of market volatility and risk, or simply a lack of time and money. This is one of the first times the underlying social norms and values creating perceptions of agroforestry have been identified. These new insights allow extension programs to tailor recommendations to identified groups based on perceptions of agroforestry. Evaluating these perceptions also allows new perspectives on opportunities for agroforestry adoption to be created, both in Tasmania and more broadly.

**Keywords** Farm forestry · Benefits of trees · Reforestation · Farmer motivations · Farmer values · Behaviour change · Discourse analysis

## 1 Introduction

Agroforestry is an agricultural practice that features deliberately growing woody perennials with agricultural crops or grazing animals. The intention, generally, is to deliver significant ecological or economic interactions (positive or negative) between the plant and/or animal production system (Baker et al. 2018; Jose 2009; Nair 1993). As environmental and economic sustainability challenges for agriculture increase, understanding the potential of agroforestry to address

these challenges is becoming more important. Despite the relative simplicity of the definition, agroforestry in practice is complex, and the motivations and drivers for incorporating agroforestry are as diverse as individual farmers and their enterprises (Vanclay 2004). Agroforestry can provide a range of economic, social and environmental benefits. Economic benefits such as using the timber for personal use on farm or selling the wood as firewood, solid wood, wood pulp or bio-fuel are often the most salient to farmers and require an interplay of individual (e.g. personal motivation) and structural (e.g. market) drivers (Deuffic et al. 2018). Non-economic social and environmental benefits can also be highly valued. Sustaining rural livelihoods through vibrant new industries and improving the amenity and resilience of local environments are major social and environmental benefits of agroforestry (Chavasse 1982; Duru et al. 2015; Jose 2009; Polyakov et al. 2014; Schirmer and Bull 2014; Wratten et al. 2012; Zhang et al. 2007). Globally, agroforestry is useful for

✉ Aysha Fleming  
Aysha.Fleming@csiro.au

<sup>1</sup> CSIRO Land and Water, Hobart, Tasmania 7000, Australia

<sup>2</sup> CSIRO Land and Water, Clayton, Victoria 3169, Australia

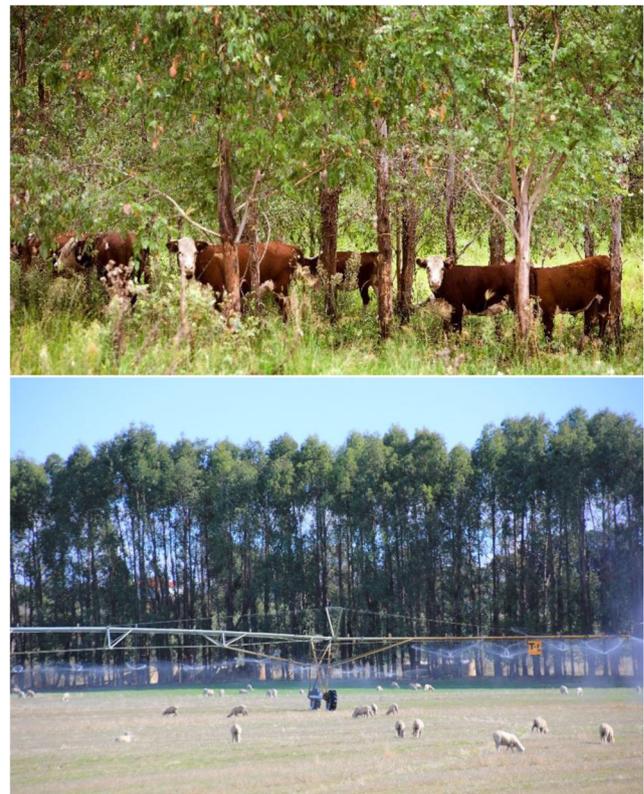
<sup>3</sup> Private Forests Tasmania, Hobart, Tasmania 7000, Australia

improving farmer livelihoods and environmental conditions and is receiving more recognition in regional and national policies (FAO 2013).

Some of the less considered aspects of agroforestry are amenity values that might increase property value (Polyakov et al. 2014), increased tourism potential, integrated pest management and improved pollination, restoring salt damaged land, mitigating flooding and managing spray drift (Cunningham et al. 2015; Jose 2009; Potts et al. 2016; Smith 2009; Wratten et al. 2012; Zhang et al. 2007). While the list of co-benefits is well documented (if rarely in one place), the quantitative evidence for these benefits remains limited. As a result, many of these interactions are not included in financial accounting of agroforestry and, if they are taken in to account, they are likely to be underestimated (Leimona et al. 2015). New approaches, such as natural capital accounting, may provide a potential mechanism for evaluating the benefits of agroforestry (Obst 2015; Ogilvy 2015). While the idea of natural capital accounting and the associated valuation of environmental services is not new, application of these principals at the scale of a farm enterprise is still emerging (see Fielke et al. 2018). Integrated reporting of the financial and natural capital within the farm balance sheet offers a way to demonstrate the benefits of agroforestry in a way that has not been previously considered.

In Australia, emergence of the ‘Landcare’ movement in the mid-1980s to encourage improved natural resource management saw the planting of trees on farms become increasingly common (Powell 2009). As Fig. 1 shows, trees on farms can provide shaded grazing for livestock as well as marking farm or paddock boundaries. At this time, agroforestry was seen as having the potential to become widespread, contributing to the sustainability and profitability of agriculture and reducing the pressure on public native forests for wood supply. Subsequent research assessed the potential economic, environmental and social outcomes from agroforestry (e.g. Pannell et al. 2006; Race and Curtis 2007; Schirmer and Bull 2014). Although much of this research was positive, in terms of the potential of the sector to become more economically successful (Powell 2009), to date, uptake of agroforestry has fallen well short of its potential (Baker et al. 2018).

One possible reason for the limited uptake is the complexity of designing agroforestry systems to achieve the broadest possible range of co-benefits to match farming systems (and farmers’) diverse objectives (Vanclay 2004). While there is excellent general information on how to design and manage tree plantings to achieve different objectives such as reduced wind and erosion or improved water quality (Bird et al. 1992), it can be difficult for farmers to match available advice to their own specific situations (Mann and Sherren 2018). Farm advisory services are well placed to support farmers to design agroforestry systems, but the number of publicly funded farm advisors is dwindling (Fleming et al. 2014). The developing



**Fig. 1** Example configurations of trees on farms, for shade and shelter, and marking boundaries. Photo credit: Rob Burnett, supplied by Arthur Lyons

gap may be filled by alternative sources of advice including nurseries, private consultants, neighbours and agronomists, all having varying levels of silvicultural knowledge and their own business agendas. Designing agroforestry systems for particular farms and farmers can mean the difference between successfully achieving co-benefits or failure.

Understanding of motivations (and barriers) for tree planting are well documented (Pannell et al. 2006; Schirmer and Bull 2014; Torabi et al. 2016). What is lacking, in the relevant sociological literature, is sufficient analysis of the social world views and discourses that create farmer perceptions and behaviour (Fleming et al. 2018; Fleming and Vanclay 2010). This paper aims to understand farmer perspectives around trees on farms and to identify mechanisms to support farmers to establish agroforestry systems that add value to farming enterprises. Understanding adoption of agroforestry from the farmer perspective helps make sense of the extensive research that has been conducted on trees on farms, both in Australia and around the world. Thus far, published papers have tended to focus on discrete, specific and readily quantifiable impacts of agroforestry, such as water quality or flow regulation, provision of shelter, carbon sequestration or enhancement of biodiversity (Chavasse 1982; FAO 2013; Jose 2009; Polyakov et al. 2014; Wratten et al. 2012; Zhang et al. 2007). It is rarely considered from the perspective of the landholder. This paper addresses this gap by

analysing farmer perceptions of agroforestry in relation to their social norms, knowledge, attitudes, skills and aspirations. Identifying and evaluating these key factors should inform strategies to better communicate and to better integrate trees on farms into farmers' rationales and reasons for farming. The focus, for this paper, is primarily on values, but key language, rules, norms, assumptions and information sources are also identified to examine how values might be leveraged into changing behaviour (Fleming et al. 2018).

## 2 Materials and methods

The analytic framework used was discourse analysis, which looks at ways language is used in particular situations and how it reflects and builds social structures and norms, thus shaping behaviour (Jorgensen and Phillips 2002). In this context, discourse is used in a way that is consistent with similar notions of frames or storylines (Dewulf 2013) and as world views that help to simplify and structure values for decision making (Cachelin and Ruddell 2013). These are captured in speaking form in interviews and relate directly to social practices (Fairclough 2001). The analysis of language comes after an initial 'grounded theory' (Charmaz 2006) analysis to fully understand the data and sort it into themes. The analysis is also informed by theories of adoption and change which are important in understanding farmer values and objectives (Kuehne et al. 2017; Pannell et al. 2006; Vanclay 2004). In 2017, interviews were conducted with 44 farmers and advisors associated with cropping, grazing and mixed enterprise farms in Tasmania, Australia. Tasmania has an overall cool temperate but highly variable climate, and farm incomes are mostly in the range \$AU 50–150,000 per year (ABARES 2018). Individuals came from a range of farm businesses ranging in size from small family farms through to managers of larger corporate farming businesses. The participants also included 13 independent agricultural advisors with experience in farm forestry but with no particular business affiliations in forestry or forest products.

All of the farms had some type of tree planting, ranging from established shelter belts, fenced off native vegetation (bush), established or new plantations for harvest (usually pine), native plantings under covenant, or riparian and amenity plantings. Given that a diversity of responses (to capture all aspects of social values of agroforestry) was the focus of the study, categorisations of interviewees provide context rather than reasons for the findings. The interviewees were sourced through formal and informal industry associations and groups, and the interviews were conducted on-farm, in office, or over the phone if a convenient time could not be arranged. On average, interviews were 60 min.

The interviews were conducted in a semi-structured manner, suitable for recording people's feelings and perceptions

with farmers asked to talk about perceived benefits, risks, barriers and opportunities related to trees. Indicative questions included the following: What does agroforestry mean to you? What do you think are the benefits? What do you think are the risks? Have you planted trees? Would you consider planting more? What is your opinion of funding incentives to plant trees? Where do you get information for your decision-making? And, how would you access information about trees? The questions were intentionally open-ended to allow responses to be freely given and to limit the input (and potential bias) of the interviewer.

The interviews were transcribed, entered in an NVIVO database (to facilitate analysis) and examined using a constructivist grounded theory approach (Charmaz 2006) and a discourse analysis methodology (Fleming et al. 2018). These qualitative methods fall under the umbrella of content analysis, based on the common technique of 'coding' (Bazeley and Jacon 2013). The analysis involved the researcher inductively assigning and grouping 'codes'—small, explicit ideas, e.g. biodiversity—and categories—groups of related codes, e.g. funding arrangements for tree planting, into themes—groups of related categories, e.g. benefits of trees. Coding focuses on qualitative interpretations of meaning and allows the analysis to be fully grounded in the data and to represent the collective (social) view. Values identified are linked to nuanced social, cultural and normative values, rather than individual views or situations. Table 1 lists themes and categories.

While the codes, categories and themes could be organised in different ways, the main focus of our analysis for this paper was farmers' values. The coding hierarchy is a preliminary step in this case to understanding, sorting and representing the data. The categories and themes were interrogated to see if they held up as discourses, looking for cross cutting ideas that were significant enough to have their own recognisable collective uses of key language, rules, norms, values and assumptions (Jorgensen and Phillips 2002).

Each theme is built up from codes that all interviewees contributed to, so the interviewees are not segmented solely into one group or another; however, it is likely that an individual will respond and relate more to one of the groups, according to their underlying values. The analysis of these interviews and a corresponding literature survey are the basis of this paper, and while they reflect the values specific to the Tasmanian cohort interviewed, they may not be the same in other contexts.

### 2.1 Data availability

The datasets generated during and/or analysed during the current study are not publicly available due to ethics and privacy considerations. They may be made available from the corresponding author on reasonable request.

**Table 1** The themes and categories showing the number of interviewees that expressed the ideas (no. of interviewees) and the frequency of the mentions (number of times mentioned). Numbers in italics are the total for each theme.

| Theme (no. of interviewees)  | Number of times mentioned |
|--|---------------------------|
| 1. Trees are an economic proposition                                 | <i>992</i>                |
| Benefits from trees (43)   | 422                       |
| Information networks (42)  | 197                       |
| Funding options (40)   | 182                       |
| Thoughts and opinions on trees (24)                                  | 70                        |
| Trees versus other priorities (28)                                   | 62                        |
| Future considerations (21)   | 59                        |
| 2. Trees are not an economic proposition                             | <i>849</i>                |
| Costs involved with trees (39)                                       | 388                       |
| Barriers to planting trees (44)                                      | 363                       |
| 3. Trees are essential and economic considerations are not important | <i>605</i>                |
| Rewards of trees (40)  | 201                       |
| Information sources (42)   | 141                       |
| Culture and trees (34)   | 102                       |
| Opportunities (32)   | 97                        |
| Perspectives on trees (22)   | 64                        |

### 3 Results and discussion

The majority of interviewees had a relatively narrow concept of agroforestry, regarding it either as monoculture plantations or trees planted for commercial harvest. They were unlikely to view mixed plantings for shelter, wildlife corridors, restoration, river health or aesthetics as agroforestry.

“There’s no ‘agroforestry’, that term is not one which, to date, has been well accepted or understood by landholders” (Int 17)

“I see agroforestry as more commercial, commercial forestry within a farming situation” (Int 39)

All of the interviewees were positive about trees, and the forestry industry, if unsure of their own part in that industry. All saw some value in trees, but there was considerable variation in the views on the number of trees, their placement in relation to other aspects of the farm and their economic value. The variation in views fits into three main themes. Table 1 provides an overview of the hierarchy of themes and categories, which are then discussed further below.

#### 3.1 Theme 1: trees are an economic proposition

The theme ‘trees are an economic proposition’ was the largest. It is about how trees are an important part of economic activity, boosting productivity on farm and are primarily a means to support profit from other areas. Trees are a pragmatic resource in this group, akin to any other crop to be managed and farmed. Even if the trees

are not to be harvested, they are a necessary part of the other production systems on the farm. The fact that this was the largest category is very promising for promoting agroforestry and represents a key group to target for support to increase tree planting. Interviewees who see trees as ‘an economic proposition’ see value in trees for the sale of wood products (logs or woodchips), or for use on the farm (fencing, building, firewood). Even where an economic figure is less tangible, such as for amenity, shelter for animals and/or crops, managing the health of water and soil (e.g. erosion, salinity, drainage), and integrated pest management and pollination, it is still valued.

Key language for this theme is around improving productivity, tree farming and indirect benefits from trees.

“it’s just farming of trees really, so as we grow a crop of wheat, or something, we grow trees, it’s just a longer timeframe until they get harvested.” (Int 34)

“What the agroforestry program is, and this is the way I think it should be sold, we’re on about improving crop productivity, that’s what it’s about, improving crop productivity.” (Int 17)

“From the point of view from livestock, the trees can provide shelter for livestock, reducing the wind effect and the cold and also heat. There’s grass growth improvements because you’re reducing the wind flow across the grass.” (Int 25)

Norms for the theme include trees as part of the building blocks of a functioning farm and important to reduce risk. Related to this is the view that what is good for the farm is

good for profit and that everything on the farm needs to be actively managed.

“In terms of pastures and trees and everything, it all comes under the same banner: infrastructure. Everything needs continual maintenance. Nothing gets away without it.” (Int 3)

“Diversity, which has given us another income stream. It’s a – what do you say – it’s an asset that you don’t have to realise every year, you know, we’ve had a hiatus of seven or eight years when there wasn’t money in it and, I guess, that could be an advantage or a disadvantage, what you need as far as cash flow goes, but it’s complementary to the other side of the business and in the good times, yes, you can harvest and in the poorer times you can usually postpone or work around things reasonably well.” (Int 14)

The ‘trees are an economic proposition’ theme demonstrated core values around the role farmers play adding significant value to the community through stewardship. Through stewardship of land, wildlife and waterways, farmers provide an enhanced ecosystem for their community, which could become a paid service in the future. While some farmers already felt rewarded through contributing to the ‘social good’, others felt that financial recognition would encourage more tree planting and help others in the community to think about the longer-term value of trees at the landscape scale.

“And I feel pretty strongly about this is that it’s a community issue, not just the farmer. Because those trees, you plant them, they’re there for a couple of 100 years, the farmer’s not going to be there.” (Int 36)

Public sector grant funding can be both a significant incentive for, and a barrier to, motivating tree planting. Even small amounts of funding that maintain the independence and flexibility of farmers in making land management decisions could be highly motivating. On the other hand, when available, the rules for funding can be too restrictive or application processes too complex. Sectoral policy limitations and a lack of collaboration are also barriers, and addressing these was seen as a key way to increase tree planting—by offering more types of incentives, with fewer restrictions, more simply.

“You don’t need a lot, you just need a bit of incentive, really. I know some people got a little bit through trees, got a bit for their trees. If there’s a little bit of incentive, it makes a lot of difference, funnily enough.” (Int 2)

“Farmers like their process to be relatively uncomplicated and, where there have been multiple pages of paperwork to fill in for funding; often the growers will say it is not worth the hassle.” (Int 30).

For farmers in this theme, it is common to already have trusted sources of information often derived from active participation in relevant community groups. Sources of information might include a Landcare network, private consultant, local nursery or attendance at regular attend field days. They would like to see a stronger collaboration between commercial forestry operations and agroforestry businesses so that issues of scale are dealt with and costs are reduced. This might include access to machinery and advice and information about regulations and markets.

This group is ideal to engage with to provide further agroforestry advice because they are hungry for information: particularly material, which supports the business case for trees, and is locally relevant.

“Well usually you’ve got to get, talk to people. A lot of information around which is still in people’s heads, that’s the way of it.” (Int 17)

“I do prefer one-on-one, but I do attend lots of field days and things because, not only from what’s presented but the people that are there, you can garner information from. Compare stories and experiences. So they’re always – it takes time and so on, but there’s usually something worthwhile to take home from those.” (Int 3)

This group is keen to make decisions about trees based on the benefits they can provide to different aspects of their farm. A tool to aid species selection and to compare species would be useful, especially if used in a collaborative way and related to examples of trees already on farms (e.g. field days or farm visits). The main constraints to farmers planting more trees in this group are largely structural and social, rather than individual. Farmers are already willing to plant more trees, and to manage them for different objectives including harvest but more social support, financial support, financial return and structural levers (policy, advisory, institutional) would enhance adoption.

### 3.2 Theme 2: trees are not an economic proposition

The second largest theme is ‘trees are not an economic proposition’. Their most valued benefit was economic return and comments largely related to direct or opportunity costs. In this view, trees are not seen as economic contributors in a farm production system. Trees are likely to be cleared or limited to land that is otherwise seen to be unusable. The return on harvestable trees is seen to be too low to justify the expenditure. This view is more likely amongst farmers on prime agricultural land, in locations where wind exposure is not damaging and issues of erosion, stock exclusion or safety of driving tractors on steep slopes are largely absent. It is also more likely in larger-scale operations where buying in services as required (e.g. pollination) is more cost-effective.

Key language for the theme is around maximising returns, revenue, cost, expense, risk and waste.

“In many cases, the monies they get back from the harvest would probably just about cover the cost of planting trees, let alone doing anything with stumps, so they’re not ahead, they’re not ahead. It’s a wasted investment.” (Int 17)

“When you’re looking at high value commercial land, when you’re looking at trying to stock three dairy cows to the hectare, putting in a shelter [on] a couple of hectares of country, when you start looking at the cost side you start to lose a considerable amount of money in lost revenue. So, from our side being established and already having the cow shed [for shelter], going in and taking land [to plant trees] is probably not economical.” (Int 8)

“So also, the opportunity cost of the land, and then just the risk of failures, so if something goes wrong with the weather, or the absolute right kind of plant wasn’t put in the right way in the right spot, it could be a waste of time and money.” (Int 22)

For this group, farming is all about profit and producing food. Trees add risk as they cannot be quickly reconfigured like crops can (e.g. moved, new species trialled, access points changed). It is fine for other operations to have trees, but trees are not seen to be necessary for all farms.

“because I know potato farmers around here, and your broad acre farmers [say you] can’t grow anything under trees, mate. Take them out.” (Int 6)

“And, I think, control is probably another one – as soon as you seem to put a tree in the ground, everybody seems to want to have a say in what – well once it gets up above head height, I think people seem to worship trees a bit and everybody wants to have a say in what lands in it and what happens to it.” (Int 14)

To make money from farming, this group sees it as being important to utilise all available land for its productive potential. For them, function is more important than aesthetics, although the efficiency of a clear and productive paddock (with no trees) can also be beautiful. Wood is never expected to be more valuable than food, and incentives for planting or maintaining trees are insufficient to compete.

“I actually prefer a clean field - I don’t prefer anything around them at all.” (Int 11)

“Firstly, it’s always function. It’s always got to be utilitarian to make it happen. Once you can make it happen then you can consider aesthetics.” (Int 10)

“the more expensive agriculture, every square metre seems to make a difference.” (Int 26)

Trees may be difficult to remove, limit access for machinery or irrigation, and increase pest pressure. Existing trees that are in locations not suitable for farming may be kept, either because it is too expensive to remove them, or to avoid government penalties for clearing native vegetation. Land clearing legislation, tree felling restrictions, retention of native vegetation and fire risk reduction are all examples of how trees complicate the business of farming, rather than supporting it. These views demonstrate a focus on short-term economic issues and the individual business, rather than a longer-term view of farm sustainability or the role of the farm in supporting wider landscape scale and community-level sustainability.

“[there are] some governance issues there with what you can and can’t cut down and when you can do those. I know that obviously tree clearing’s not allowed anymore and so is, burning is regulated.” (Int 10)

“We’re at an interesting time at the moment, because there’s been so much tree clearing for irrigation development. So, there’s a lot of guilty farmers around, worried that they’ve cleared a lot of trees and you know, wondering where best to put them back in the landscape.” (Int 1)

In this view, trees are outside business objectives; therefore, information about agroforestry is not required.

“I’m assuming if you went to one of the tree companies, like [names removed], I’m sure there’s information out there, it’s not something that I’m aware of because I’m not [interested].” (Int 44)

“it would take me a considerable amount of time to go, right, let’s research different varieties, let’s look at coverage, let’s look at this, to be honest I’m not going to do it.” (Int 8)

This group makes decisions based on the business case for their farm as they see it. Information that is economic and directly related to the benefits trees can provide, to crop production, may be of interest but may also be viewed as too insignificant to spark change. At present, this group is not a target for increasing agroforestry.

### 3.3 Theme 3: trees are essential and economic considerations are unimportant

The third theme is that ‘trees are essential’. This view is that, regardless of economic considerations, both the time and direct financial costs of tree planting are essential to the farm business. In this view, trees may be useful for shelter and as an investment, but their foremost justification is environmental and often aesthetic, as a farm is ‘not right’ without trees. Native species are likely to be preferred and planting trees

and shrubs for wildlife corridors and along rivers are seen to be particularly important. Plantings of exotic species for potential later harvest are also viewed positively, but whether they are ultimately harvested for money is not as important as the enjoyment and environmental services they provide. The value of trees is often seen as extending beyond the life of the farmer as a philosophical legacy to improving the farm and the environment. Trees are a symbol of a contribution to an ecosystem and landscape beyond the scale of the individual farm and the lifetime of the individual farmer.

Key language for the theme includes philosophy, legacy, environment, biodiversity, aesthetics, beauty and contribution.

“Philosophically I think that growing trees is the most sustainable thing that we can do. Trees are incredibly valuable.” (Int 7)

“I’d be happy to spend – the benefits of the beautification as such – are so great that it far exceeds the cost of it anyway.” (Int 42)

“The aesthetics is a huge one, whether we want to think about it or not, the farm looks prettier with trees on it than it does without.” (Int 20)

“I think, actually, it’s aesthetics to tell you the truth. I really value trees and aesthetically I find them very pleasing. It makes me feel happy and it’s where I want to live; I don’t want to live in a barren environment.” (Int 32)

It takes expertise to plant trees to survive long-term, so it is a norm for this group to access expertise to get the best result. Another norm is trusting in the future of the trees after you leave the property and you can no longer dictate how the land is used.

“Well, the provision of adequate advice and support for the projects is very important as it can make a significant difference in the outcome – the survival rates and growth of the trees.” (Int 22)

This group values the sense of well-being and satisfaction of seeing that you have made a contribution to the landscape that should outlive you. There is an assumption that this is an important moral consideration, to give back more than you take from the land. Those in this group are more likely to have a work history and some income stream outside of farming, and therefore are motivated to farm more for personal enjoyment and satisfaction. Even when they have retired or given up previous work and are wholly focused on the farm, income is not their primary motivation. In some cases, the farmers in this group are motivated to provide an environment and a future opportunity for their own children, but often, it is more about a general legacy and commitment to improving the landscape.

“I think there is a personal pride that comes in it too. I can’t help but look at those trees and think - you know we did that.” (Int 20)

“I’ve never really given back to the farm. And I know that sounds a little bit emotional but in a way, okay, we are here to feed our families and its hard work, and it’s a big sacrifice. But on the same token, this is probably one way that I can leave here and look behind me and say - I’ve given something back.” (Int 20)

“And the thing of putting back what use to be there originally is a nice idea too, what was, what did grow there, you know, 200 hundred years ago and return those things, [names removed] you know, did a lot of work, did a lot of work on, putting back what was there.” (Int 33)

“I like to even let areas regenerate. This big post office hill, this one opposite the front gate is called, and I just keep stock out of there and let the wattles and gums come back up, and I don’t know, it makes me feel good.” (Int 35)

Those in this group are effected by rules relating to inheritance and covenants, especially how land can be used after it changes hands, and one clear way to increase adoption for those in this group is to make information about the legal components more available.

“Under Tasmanian legislation, the Forestry Rights Act 1990 or whatever it was when they put it in place, the parents can leave an interest in trees to you and to me. The land goes to so and so, but our rights in the trees are registered on the title to us.” (Int 16)

Farmers in this group are more likely to refer to having completed education (formally or informally), and to highlight their enjoyment of researching and learning about trees and tree management. For this group, information is everywhere, if you look, and it is your responsibility to find the information you need.

“I’ve done a lot of courses. I’ve done biodynamic courses, I’ve done an organic course at {name removed}, I’ve done some soil courses and I’ve continued to do those while I’ve been in Tasmania, and I have been very impressed and very happy with the short courses that are funded. [names removed] send out a regular weekly update with a lot of good information in it, so I’m always out looking for new information.” (Int 32)

“Tasmania has got some absolutely amazing reference books here. Yeah. There’s absolutely no excuse for not being able to find that information, I don’t think.” (Int 21)

This group likes to find information about trees and facilitating access to information, including links to experts, and is a

clear way to support increased agroforestry. More unique or experimental tree plantings may appeal to the longer-term legacy that motivates this group. Opportunities for producing specialty or special purpose timbers and stories of interesting plantations successfully established elsewhere are likely to be positively received. Sharing stories about trees as opposed to the technical or economic information that appeals to the two previous groups is likely to be a more effective way to encourage tree planting for this group.

### 3.4 Supporting farmers to plan for tree plantings that match their objectives, individually or regionally

Table 2 summarises the views of the three themes to highlight recommendations tailored to each group. Identifying the value-based differences in these perceptions and behaviours aids in adequately facilitating change and tailoring information to their preferences and needs.

There is no one-size-fits-all solution for how trees should be incorporated into different farming systems to suit different farmers. As an important first step, individual needs and objectives should be taken into account in planning promotional and advisory packages. This can be achieved by helping farmers to acknowledge their values and then guiding them according to their preferences and values in a participatory way (Klerkx et al. 2012). To complement this, it is important to develop tools and information that is flexible and adaptable to different situations and values. Furthermore, farm advisors and tree planting groups (such as environmental or government

tree planting programs) should work from farmer objectives, or negotiate a middle ground, rather than enforcing their own expectations.

Farm advisors, extension workers, agronomists and tree planting groups are under-funded and under recognised for the wide range of advice they give and for the key role they play in supporting farmers (McDonald et al. 2018). Time to work with individuals, understand their needs, encourage consideration of trees and develop tailored programs is restricted. Better recognition and support of these critical advisor/extension relationships would go a long way towards reducing the burden on farmers to undertake significant research on species and site selection, matching plantings with their objectives, dealing with pests and disease and marketing options.

Better support can be achieved through information tailored to individual farmers, funding dedicated ‘trees on farm advisors’ or further training for currently active advisors. To achieve a more transformative vision of change, farmers need to work with communities and governments to reimagine their roles and responsibilities. They need to look at the broad suite of objectives and direct and indirect benefits of trees that are specific to their local region and how everyone might work together and support one another to achieve those goals. For example, the ‘Bees and Trees’ initiative in New Zealand, linking agroforestry, specialty timbers, honey production, indigenous farming, and medical research and marketing, achieved a transformative vision of agroforestry for their region ([www.treesforbeesnz.org](http://www.treesforbeesnz.org)). Another important component of this transformation is creating a sense of shared community

**Table 2** Summary of the issues and recommendations for each of the three themes. *N* number of references

| Issue                    | Trees are an economic proposition ( <i>N</i> = 902)  | Trees are not an economic proposition ( <i>N</i> = 849)   | Trees are essential and economic considerations are unimportant ( <i>N</i> = 605)   |
|--------------------------|--|---|---|
| Most valued benefit      | • Productivity benefits on farm  | • Lack of economic benefits   | • Environmental, personal, philosophical  |
| Attitude to risks        | • Trees reduce risk  | • Trees increase risk   | • Longer-term risks: succession plans, climate change, legacy (once property changes hands, will the trees be kept)   |
| Information sources      | • Local groups, talking, and examples of tree configurations on farms  | • Crop specific, written, rules and legislation   | • Experts, written, success stories   |
| Information needs        | • Species selection and quantification of specific benefits for comparison<br>• Examples of trees in different systems   | • None for trees  | • Specialty and novel options, identification of experts to work with   |
| Specific recommendations | • This group is ideal to engage with to provide further agroforestry advice, such as:<br>• Providing a tool to aid species selection<br>• Providing a tool to quantify and compare benefits of trees e.g. shelter benefit versus crop protection<br>• Promoting socialising with others, including wider community | • This group may not be good targets for promoting agroforestry, but strategies could include:<br>• Relating trees to specific crop benefits<br>• Providing economic evidence for benefits from tree planting | • A clear way to support increased agroforestry in this group is through improved sources of information, such as:<br>• Providing links to specialty timber options and other arrangements (e.g. unique native fauna/flora, honey production) and examples of these in other cases e.g. NZ<br>• Identifying a network of relevant expertise and other groups, including community |

to foster collaboration and create new norms and social identities (Pretty et al. 2006). In the past, Australia has done well in this regard, with the National Landcare Program, but since the mid to late 2000s, this has waned (Love n.d.). Despite increasing urgency, the potential for agroforestry to improve vital ecosystems and strengthen farming communities all around the world, whether in temperate or tropical regions, is still yet to be fully realised (Tremblay et al. 2014).

Key ways to promote more tree planting, at the local and individual level, include responding to individual values and describing how planting more trees can support those values. In the ‘trees are an economic proposition’ theme, farmers have a ‘hearts and minds’ approach, which values trees for both the emotional and economic benefits they provide on farm. The ‘trees are not economic’ group takes a more ‘minds’ approach, where a business case is not yet readily apparent for them to plant trees. Working with this group sometime in the future, when markets are more established and social norms or perhaps government policies have shifted, will make more sense. Finally, the ‘trees are essential’ group takes a mostly ‘hearts’ approach, where trees are important to plant, regardless of time, effort or cost, and appealing to, and working with, this emotional driver will be useful. The collective values demonstrated by these three distinct groups are likely to exist elsewhere, and working with similar values is a key way to instigate change and scale up tree planting. This supports previous work, which identifies the importance of positive attitudes to environmental conservation in intention to adopt agroforestry and the need to increase environmental education (McGinty et al. 2008). Encouraging value systems, which support the environment through education, is important and will contribute to changes in social norms needed to improve markets, incentives and community supports. Rather than waiting for the next generation, it is possible to start now to understand farmer values and work with them to see how trees align with their objectives.

At regional and community levels, it is important to match increasing recognition of the value of agroforestry services to the ecosystem (e.g. Cerdán et al. 2012) with work to improve market and community values for the stewardship of long-term tree provisioning and care. Stewardship, recognised both financially and socially (through community support and respect), is a key way to encourage tree planting. This requires change to government incentives, such as deferred tax obligations at harvest, allowing farmers to access credit to plant trees (Tremblay et al. 2014), reduced insurance, or access to a wider range of funding to support tree planting than currently exists (see Farm of the Future 2016: <http://www.takepart.com/feature/2016/11/28/agroforestry-us-farms>). It requires developing markets to pay for ecosystem services, directly (i.e. where the ecosystem service is paid for as the product) or indirectly (i.e. the ecosystem service adds a premium price to another product). For farmers to access markets, transport options need to be developed (Tremblay et al. 2014) along with training or access

to advice to assess risks and opportunities. These are all achievable, but not easy, and fundamentally rest on better recognition of, and response to, core values. If economic, social and cultural values are placed at the fore, then flexibility of tree planting and tree harvesting arrangements and co-innovation with farmers across sectors to develop new methods and new markets becomes possible (Sanial and Ruf 2018).

Over recent decades, various regional development initiatives in Australia have been successful in achieving at least a short-term increase in adoption of agroforestry. Most were designed to address specific issues, such as salinity remediation, but these were not focused on values and may not be readily applicable in other contexts. A re-imagining of these programs from a ‘values first’ perspective is needed. It is also important to recognise that agroforestry is not just an agricultural or forestry issue, it should involve all industries and sectors of community, including but not limited to, government. This would encourage a longer-term view of tree planting programs to grow the scale of agroforestry for potential market development. In the past, cross sector collaboration has been achieved through bi-partisan political support for on-going programs or international initiatives that operate outside of political funding. These include programs run through environmental non-governmental organisations or philanthropic associations, which are increasingly international and supportive of tree planting (e.g. Nature Conservancy).

New ways to collaborate, by integrating and forging new partnerships at organisational and policy levels, may emerge from openly responding and reflecting on past arrangements (successful and unsuccessful). This might include simplifying the rules around agroforestry arrangements, to allow farmers more flexibility to change their species and configuration arrangements—as long as they replace trees they remove (Reeson et al. 2015). To support cohesion and a collective culture across all of the primary industries, new government authorities could be established to facilitate and/or support collaborative working arrangements between agencies, tertiary institutions, industry, NGOs and farmers. Private Forests Tasmania is currently the only government-funded authority in Australia to specifically assist the private forestry sector. Reinvigorating government departments to undertake this work more broadly, or developing new ways to fund independent extension services, could be beneficial to take this work across industries.

Finally, recognising the values that drive behaviour is the first, most fundamental step, in tailoring any further approaches to increasing adoption of agroforestry. This reflective starting point is the critical contribution of this paper, but it is just the first step. Once the values underlying behaviour are made visible, it becomes possible to consciously assess them and alter them if desired (Fleming et al. 2018). This is an area we emphasise as needing prioritisation in establishing future programs.

## 4 Conclusion

“Why wouldn’t you grow trees?” (Int 6)

Agroforestry holds a great deal of promise for addressing the nexus of sustainability issues facing farmers—environmental, social and financial. But, its promise is yet to be realised and currently faces several barriers that are associated with farmer perceptions. To overcome these barriers, this paper outlined a novel contribution to understanding the underlying values that create different perceptions of agroforestry. Adoption is likely to remain slow if recognition of the social, value-based nature of perceptions and their link to behaviour is ignored. A concerted effort to align multiple parties towards the common goal of increasing the number of trees on farms is required to streamline and simplify pathways of accessing support and information. This will require better synergy of non-government organisations, research and development corporations, government, research, industry organisations, financiers, agricultural advisors and tree stockists (nurseries). Providing more incentives for people across these groups to work together and to prioritise trees on farms as a productive way to achieve multiple outcomes that fit with individual farmer objectives offers a clear way forward.

**Acknowledgements** Ethics approval was granted by the Commonwealth Scientific and Industrial Research Organisation’s human research ethics committee (103/16). This work was funded through the Commonwealth Government’s Rural Research and Development for Profit grant entitled ‘Lifting farm gate profit through high value modular agroforestry’. We acknowledge the support of our partner organisations, Forest and Wood Products Australia, Dairy Australia, Forico and Greening Australia. Special thanks to all of the farmers and growers interviewed and to Private Forests Tasmania and RMCG for help with data collection.

## Compliance with ethical standards

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

**Publisher’s note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

## References

- ABARES Department of Agriculture and Water Resources (2018) <http://www.agriculture.gov.au/abares/research-topics/aboutmyregion/tas>. Accessed 6 Nov 2018
- Baker TP, Moroni MT, Mendham DS, Smith R, Hunt MA (2018) Impacts of windbreak shelter on crop and livestock production. *Crop and Pasture Science* 69:785–796
- Bazeley P, Jacon K (2013) *Qualitative data analysis with NVIVO*. Sage, London
- Bird PR, Bicknell D, Bulman PA, Burke SJA, Leys JF, Parker JN, Van Der Sommen FJ, Voller P (1992) The role of shelter in Australia for protecting soils, plants and livestock. *Agrofor Syst* 20:59–86
- Cachelin A, Ruddell E (2013) Framing for sustainability: the impact of language choice on educational outcomes. *J Environ Stud Sci* 3: 306–315
- Cerdán C, Rebolledo M, Soto G, Rapidel B, Sinclair F (2012) Local knowledge of impacts of tree cover on ecosystem services in small-holder coffee production systems. *Agric Syst* 110:119–130. <https://doi.org/10.1016/j.agsy.2012.03.014>
- Charmaz C (2006) *Constructing grounded theory: a practical guide through qualitative analysis*. Sage, London
- Chavasse CGR (1982) Management of shelterbelts for wood products. *N Z J For* 27:189–206
- Cunningham SC, Cavagnaro TR, Mac Nally R, Paul KI, Baker PJ, Beringer J, Thomson JR, Thompson RM (2015) Reforestation with native mixed-species plantings in a temperate continental climate effectively sequesters and stabilizes carbon within decades. *Glob Chang Biol* 21(4):1552–1566. <https://doi.org/10.1111/gcb.12746>
- Deuffic P, Sotirov M, Arts B (2018) “Your policy, my rationale”. How individual and structural drivers influence European forest owners’ decisions. *Land Use Policy* 79:1024–1038
- Dewulf A (2013) Contrasting frames in policy debates on climate change adaptation. *Wiley Interdiscip Rev Clim Chang* 4:321–330
- Duru M, Therond O, Martin G, Martin-Clouaire R, Magne M-A, Justes E, Journet E-P, Aubertot J-N, Savary S, Bergez J-E, Sarthou JP (2015) How to implement biodiversity-based agriculture to enhance ecosystem services: a review. *Agron Sustain Dev* 35:1259–1281
- Fairclough N (2001) *Language and power*, 2nd edn. Routledge, London
- FAO (2013) *Advancing agroforestry on the policy agenda: a guide for decision-makers*. In: Buttoud G, Ajayi O, Detlefsen G, Place F et al (eds) *Agroforestry working paper, vol 1. Food and Agriculture Organization of the United Nations*. FAO, Rome, p 37
- Farm of the Future (2016) <http://www.takepart.com/feature/2016/11/28/agroforestry-us-farms>. Accessed 5 Nov 2018
- Fielke SJ, Kaye-Blake W, Mackay A, Smith W, Rendel J, Dominati E (2018) Learning from resilience research: findings from four projects in New Zealand. *Land Use Policy* 70:322–333
- Fleming A, Vanclay F (2010) Farmer responses to climate change and sustainable agriculture. *Agron Sustain Dev* 30:11–19
- Fleming A, Wilson S, Measham P (2014) Research to practice—a case study in relationship building for successful extension. *Rural Ex Innov Syst J* 10:1–10
- Fleming A, Jakku E, Lim-Camacho L, Taylor B, Thorburn P (2018) Is big data for big farming or for everyone? Perceptions in the Australian grains industry. *Agron Sustain Dev* 38(24):23–33
- Jorgensen M, Phillips L (2002) *Discourse analysis: as theory and method*. Sage, London
- Jose S (2009) Agroforestry for ecosystem services and environmental benefits: an overview. *Agrofor Syst* 76:1–10
- Klerkx L, van Mierlo B, Leeuwis C (2012) Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. In: Damhofer I, Gibbon D, Dedieu B (eds) *Farming systems research into the 21st century: the new dynamic*. Springer, Dordrecht, pp 359–385
- Kuehne G, Llewellyn R, Pannell D, Wilkinson R, Dolling P, Ouzman J, Ewing M (2017) Predicting farmer uptake of new agricultural practices: a tool for research, extension and policy. *Agric Syst* 156:115–125. <https://doi.org/10.1016/j.agsy.2017.06.007>
- Leimona B, van Noordwijk M, de Groot R, Leemans R (2015) Fairly efficient, efficiently fair: lessons from designing and testing payment schemes for ecosystem services in Asia. *Ecosystem Services* 12:16–28. <https://doi.org/10.1016/j.ecoser.2014.12.012>
- Love, C (n.d.) *Evolution of Landcare in Australia: In the context of Australian Government natural resource management policy and*

- programs. Australian Landcare Council <http://www.agriculture.gov.au/SiteCollectionDocuments/natural-resources/landcare/publications/evolution-of-landcare.pdf>. Accessed 10 July 2018
- Mann C, Sherren K (2018) Holistic management and adaptive grazing: a trainers' view. *Sustain For* 10(6):1848–1867
- McDonald R, Aljabar L, Aubuchon C, Birnbaum H, Chandler C, Toomey B, Daley J, Jimenez W, Trieschman E, Paque J, Zeiper M (2018) *Funding trees for health*. The nature conservancy, Virginia, USA <https://global.nature.org/content/funding-trees-for-health>. Accessed 30 Jul 2018
- McGinty M, Swisher M, Alavalapati J (2008) Agroforestry adoption and maintenance: self-efficacy, attitudes and socio-economic factors. *Agrofor Syst* 73:99–108. <https://doi.org/10.1007/s10457-008-9114-9>
- Nair PKR (1993) *An introduction to Agroforestry*. Kluwer Academic Publishers, Dordrecht
- Obst C (2015) Reflections on natural capital accounting at the national level. *Sustain Account Manag Policy J* 6(3):315–339. <https://doi.org/10.1108/SAMPJ-04-2014-0020>
- Ogilvy S (2015) Developing the ecological balance sheet for agricultural sustainability. *Sustain Account Manag Policy J* 6:110–137
- Pannell DJ, Marshall GR, Barr N, Curtis A, Vanclay F, Wilkinson R (2006) Understanding and promoting adoption of conservation practices by rural landholders. *Aust J Exp Agric* 46:1407–1424
- Polyakov M, Pannell DJ, Pandit R, Tapsuwan S, Park G (2014) Capitalized amenity value of native vegetation in a multifunctional rural landscape. *Am J Agric Econ* 97:299–314
- Potts S, Imperatriz-Fonseca V, Ngo H, Aizen M, Biesmeijer J, Breeze T, Dicks L, Garibaldi L, Hill R, Settele J, Vanbergen A (2016) Safeguarding pollinators and their values to human well-being. *Nature* 540:220–229. <https://doi.org/10.1038/nature20588>
- Powell J (2009) *Fifteen years of Joint Venture Agroforestry program - Foundation Research for Australia's tree crop revolution*. Canberra, Australia, Rural Industries Research and Development Corporation
- Pretty G, Bishop B, Fisher A, Sonn C (2006) *Psychological sense of community and its relevance to well-being and everyday life in Australia*. The Australian Psychological Society, Victoria <https://groups.psychology.org.au/Assets/Files/Community-Updated-Sept061.pdf>. Accessed 10 Jul 2018
- Race D, Curtis A (2007) Adoption of farm forestry in Victoria: linking policy with practice. *Aust J Environ Manag* 14(3):166–178
- Reeson A, Rudd L, Zhu Z (2015) Management flexibility, price uncertainty and the adoption of carbon forestry. *Land Use Policy* 46:267–272
- Sanial E, Ruf F (2018) Is kola tree the enemy of cocoa? A critical analysis of agroforestry recommendations made to Ivorian cocoa farmers. *Hum Ecol* 46(2):159–170
- Schirmer J, Bull L (2014) Assessing the likelihood of widespread landholder adoption of afforestation and reforestation projects. *Global Environ Change: Part A - Human and Policy Dimensions* 24(1):306–320
- Smith PF (2009) Assessing the habitat quality of oil mallees and other planted farmland vegetation with reference to natural woodland. *Ecol Manag Restor* 10:217–227. <https://doi.org/10.1111/j.1442-8903.2009.00491.x>
- Torabi N, Mata L, Gordon A, Garrard G, Wescott W, Dettmann P, Bekessy SA (2016) The money or the trees: what drives landholders' participation in biodiverse carbon plantings? *Global Ecol Conserv* 7:1–11
- Tremblay S, Lucotte M, Revéret J-P, Davidson R, Mertens F, Passos C, Romana C (2014) Agroforestry systems as a profitable alternative to slash and burn practices in small-scale agriculture of the Brazilian Amazon. *Agrofor Syst* 89(2):193–204
- Vanclay F (2004) Social principles for agricultural extension to assist in the promotion of natural resource management. *Aust J Exp Agric* 44:213–222. <https://doi.org/10.1071/EA02139>
- Wratten SD, Gillespie M, Decourtye A, Mader E, Desneux N (2012) Pollinator habitat enhancement: benefits to other ecosystem services. *Agric Ecosyst Environ* 159:112–122
- Zhang W, Ricketts TH, Kremen C, Carney K, Swinton SM (2007) Ecosystem services and dis-services to agriculture. *Ecol Econ* 64:253–260