Independent Forestry Panel

Public submission

MIA CASSIDY

Submission ID: 205147

Organisation:	*N/A*
Location:	*New South Wales*
Supporting materials uploaded:	*Attached overleaf*

Submission date: 10/13/2024 8:20:43 PM

Topic 1. Sustainability of current and future forestry operations in NSW

Timber production is highly regulated through state government legislation delivered and monitored by government departments. The legislation is specifically designed to ensure the sustainability of the forests for both timber production and environmental protection.
The continuation of responsible timber production from state owned forests should be encouraged.
The history of forestry in the north east region of NSW extends back 150 years with the first State forests created in the early 1900s. In recent decades large areas of state-owned native forests have been transferred from State Forest that permit wood production to National Parks & Reserves which have a conservation focus. This has been largely motivated, directly or indirectly, by the development of Regional Forest Agreements (RFAs) that were brokered between state and Commonwealth governments in the late 1990s. Developed as a way of resolving the ongoing conflict over the use of Australia's forests, the RFAs saw a great change in the way forests are used and managed.
Unfortunately, the RFA have not entirely lived up to their promise with harvesting of native State forests still vigorously contested. The contest has raised interest in the development of private forestry. This includes establishing new hardwood plantations as well as providing better support for native farm forestry.
Examining the potential of plantations to replace public native forestry is not new. In the late 1990s the Commonwealth government developed a Plantation 2020 Vision for Australia that aimed to establish 3 million ha of hard and soft wood timber plantations by the year 2020, a trebling of the estate at that time.
Unfortunately, in many regions, including the far north of New South Wales, the poor management of many of these plantations has led to scepticism from the rural agricultural community towards plantation forestry.
In 2018 the Department of Agriculture and Water Resources released a national forest industry plan entitled Growing a better Australia , A billion trees for jobs and growth. The plan introduced the government's intentions to encourage the establishment of 400 000 ha of plantation, focusing on farmland. A subsequent policy, Support Plantation Establishment Program, offering a grant pool of $73.76 million to subsidise plantation establishment over 4 years was released in 2023.
Both policies aim to increase Australia's long rotation plantation timber estate. However, limited uptake to date suggests the incentives are insufficient. To achieve its goal, it will be necessary for the government to work with the farming community to better understand the motivations and barriers to planting forests on farms.

Topic 2. Environmental and cultural values of forests, including threatened species and Aboriginal cultural heritage values

The North-East region of NSW has a long forest history. Some of the first European settlers in the region were timber getters harvesting the Big Scrub and Australia's first direct-action blockading took place at Terania Creek near Lismore in 1979. Native forestry continue in the area however changed over the decades with policy and demographic transformations.

North-Eastern NSW is characterised by its natural beauty. The natural environment is a drawcard for tourists and residents alike. As the rest of the country, competition for land access between forestry, agriculture and more recently conservation and residential land uses are prevalent in North-East NSW.

The role of the forests for providing cultural and environmental values is well established and well managed. The continuation of harvesting under the current forestry regulations will not threaten the values of the forest. Forests in reserve system offer the environmental and amenity values, but not the timber and economic values that are provided by State Forests.

Topic 3. Demand for timber products, particularly as relates to NSW housing, construction, mining, transport and retail

Demand for timber products has not reduced in line with the reduced access to harvestable forest in recent decades. Should the productive native forest be moved to the reserve system the demand for timber will not be met from Australian resources. Privately owned native forest and plantation timbers will not produce enough timber, or timber with the right properties to replace native forest timbers from the State Forests.

Topic 4. The future of softwood and hardwood plantations and the continuation of Private Native Forestry in helping meet timber supply needs

The timbers from the plantation estate are not the same as the timbers from State Forests. The resources are not interchangeable, beyond that the current size of the estate, and the reluctance of landholders to establish new plantations suggests NSW will struggle to fill timber needs now and in the future.

I recently conducted a survey of 301 rural land holders who live in the North East of NSW about their views on plantation establishment and management of their native forest for timber production. The full report is attached.

This study provides insights into landholder motivations for planting trees on their properties, sources of land management information, barriers to timber production and desired incentives to enable plantation establishment for timber production on private land. When asked if they would consider growing tree for timber production 58.8% of landholders said they would consider growing timber and 41.2% said they would not. The separation of the sample into unwilling and willing landholders showed motivations to grow trees and where landholders source land management information was consistent across the groups. The main barrier for the unwilling landholders was land use conflict; whereas willing landholders have a wider range of barriers, namely cost, time and land use conflict.

The survey also asked about private native forest production. Landholders were asked if they had native forest on their properties, if they manage the native forest for timber production and the reasons why. Close to 20% of landholders reported having no native forest on their properties; 19% stated that their forest was not suitable for harvesting and 32% do not want to manage their forest for timber production. Lack of knowledge was a barrier to managing their forests for timber for 12% of landholders and a further 5% cited legislative barriers (too prohibitive 1.8%; too complicated 3.2%). Only 12% of landholders with native forest engage in native forest timber production. Of those who are engaged in native forest timber production 49% felt the legislation was too prohibitive, 51% found the legislation workable.

For plantations timber production to become part of the local rural economy in the north east region of NSW the establishment of a plantation estate will need to be economically viable. The relatively recent establishment of the hardwood plantation estate in north east NSW means that

data availability is relatively scarce in terms of regional coverage of species, geographical location, management practices and biometrics. As the plantations established in the mid 1990s and early 2000s are close to mid rotation it is timely to assess the current state of the plantations and consider the mix of products that will be available in the future and their potential value. I conducted a study (attached) aimed to assess the financial viability of existing hardwood plantations in the north east of NSW based on timber value estimated using log size and form at the current age. The study also sought to identify biophysical and management factors influencing species performance (product volume and quality).
The interactions of site, species and management on the factors that affect log value: species, size and form are intricate. The need to understand such interactions for successful plantation management supports the need for further research with a focus on high value species and the application of optimum silviculture. Intricacies of growing and management costs and returns and the effect of the current log value system requires further consideration. However, this study highlights the importance of management for log size and quality outcomes. The price returned for logs needs to account for growing costs. To provide a full account of plantation worth the exploration of the environmental values offered by plantations need to be highlighted regardless of their monetisation. Plantation growth is correlated with rain fall, and site occupation should be managed for optimum productivity. To expand the plantation estate current and potential resource owners will require clear technical advice during establishment and management and access to secure markets in the future.
This research shows that the transition to plantation grown hardwood timbers is not viable in the near future. Transition to plantations is not a new or novel idea. Announcing a transition away from native forest timbers to the plantation estate when it is not yet established and landholders are reluctant to be involved would result in a timber shortage or the supplementation from international timber supplies or alternative products.

Topic 5. The role of State Forests in maximising the delivery of a range of environmental, economic and social outcomes and options for diverse management, including Aboriginal forest management models

The continuation of timber supply from the state forests is the most responsible decision when considering both the need for timber within the community and the lack of local resource supply options. It is also the most responsible decision if considering the potential environmental cost of the alternative products.
Timber supplies from international forests, especially hardwoods to take the place of native forest hardwoods are likely to come from the indo-pacific. Species already in the market such as merbau is harvested from native forests. The environmental cost of sourcing our timbers from countries with poor environmental protection credentials instead of continuing our own proven sustainably managed resources is beyond irresponsible as a developed highly regulated nation.
The cost of mining and manufacturing finite resources into alternative products instead of continuing of the native forest timber as a renewable resource is also irresponsible.

Topic 6. Opportunities to realise carbon and biodiversity benefits and support carbon and biodiversity markets, and mitigate and adapt to climate change risks, including the greenhouse gas emission impacts of different uses of forests and assessment of climate change risks to forests

The carbon markets that exist for plantation forests account for harvesting and management. Entering State Forests into the same system using the same or similar rules within the equations is achievable. The biodiversity offering of the state forests are similar, if not the same as offered by the reserve estate.

Public submission

The forgone cost of the environmental disaster that could be prompted by NSW sourcing its timber needs from international forest when out plantation estate is not yet viable and we have our own viable resource is most likely the best environmental opportunity. Additionally, forgoing the carbon cost of the mining and manufacture of alternate products will provide the best carbon outcome for the state.

Evaluation of the financial performance of existing hardwood plantations in north east New South Wales

Mia Cassidy and Graeme Palmer

Southern Cross University

Prepared for the North East NSW Forestry Hub

July 2024

Contents

Document Control

Project name	Flip barriers into opportunities to stimulate timber supply.
Report name	Evaluation of the financial performance of existing hardwood plantations in north east New South Wales
Date	31/07/2024
Status	FINAL Prepared by Mia Cassidy for and on behalf of Southern Cross University
Review	Reviewed by NE NSW Forestry Hub. Approved by Graeme Plamer for and on behalf of Southern Cross University

Acknowledgments

Professor Jerry Vanclay for guidance with data collection design and analysis.
Forest Corporation NSW for supplying data and access to forests for further data collection.
The private planation holders who allowed access to their plantations.
Southern Cross University technical officer Ron Cox for assistance with field work

This report was commissioned by the North East NSW Regional Forestry Hub with funding from the Australian Department of Agriculture, Fisheries and Forestry.

Disclaimer

All findings, conclusions or recommendations in the report are based on the information provided and collected for this project, and on the personal expertise of the lead author. The report is for the use of the Hub only and SCU accepts no liability or responsibility for its use by other parties.

Executive summary

Background

In recent decades, large areas of state owned native forests have been transferred from wood production to conservation uses. This has been largely motivated, directly, or indirectly, by the development of Regional Forest Agreements (RFA's) This decreased access to public native forests for harvesting prompted the establishment of large areas of hardwood plantations (Clark, 2004).

Unfortunately, in many regions, including the north east of New South Wales, plantations were established prior to the formation of silvicultural guidelines (Smith and Brennan, 2006), without the robust stakeholder engagement (Leys and Vanclay, 2011; Loxton, 2012) and lacking an established or proven market. This has led to poor plantation management, poor relationships with rural communities (Leys and Vanclay, 2011) in turn leading to poor uptake of the investment and weak justification for the investment.

For timber production to become part of the local rural economy in the north east region of NSW the establishment of a plantation estate will need to be economically viable.

The relatively recent establishment of the hardwood plantation estate in north east NSW means that data availability is relatively scarce in terms of regional coverage of species, geographical location, management practices and biometrics. As the plantations established in the mid 1990s and early 2000s are close to mid rotation it is timely to assess the current state of the plantations and consider the mix of products that will be available in the future and their potential value.

This study aimed to assess the financial viability of existing hardwood plantations in the north east of NSW based on timber value estimated using log size and form at the current age. The study also sought to identify biophysical and management factors influencing species performance (product volume and quality).

Data

The data from 26 plantations was used to represent the spread of species, management and climatic conditions within the study area. Of particular importance was to match similar plantations that had received differing levels of silvicultural treatment. The data was sourced from private and publicly owned plantations greater than 15 years of age. The data combines field data collected specifically for the study and inventory data provided by private plantation owners and Forestry Corporation of NSW.

Modelling

Height and diameter of the measured trees were extrapolated to age 40 using Vanclay's (2010) single parameter height and diameter models. Individual models were created for each location, species and management (thinned/unthinned) combination. The model for each location, species, management combination was used to create an 'average' tree at age 40.

Log taper equations (Bi, 2000) were used to determine underbark diameter along the log for merchandising. Stand volumes were calculated by multiplying the log volume for the average tree by stand stocking to determine the volume in each log class ha^{-1}.

Current Forestry Corporation of NSW stumpage price schedules that account for both species and the geographic origin of forest products were used to calculate log prices. The individual log volumes and values by size class for each plot were summed and the figures were extrapolated based on plot size to calculate values ha^{-1}.

Average annual rainfall and Australian Soil Classification type were used to assess the effect of site on productivity for the select and key species in the data set (blackbutt, Gympie messmate and spotted gum).

Results and discussion

The results of the study reiterate information about the resource that is widely available: subtropical eucalypt plantations need to be managed to promote the growth of quality timber.

The most limiting impact on plantation value in this study was log quality, represented as the form score. Lower stem counts, either because of thinning or natural self-sorting and mortality, was positively related to both diameter at breast height and stem form. Low stem counts also affected MAI, this is thought to be due to the plantations not reaching full site capacity. The cost of silvicultural management has been seen as a hurdle to management (Stephens and Grist, 2004; Cassidy et al, 2012), however the cost of not managing is far greater. This analysis shows that the average cost of providing two thinning events and two pruning events is 0.38% of IRR. Comparatively the average cost of poor form was 4%.

The availability of two site and species combinations to assess the impacts of thinning in this study points to the lack of silviculture being practiced in the region. Comparing the returns of the thinned versus unthinned plantations of the same species in the same, or comparable region, found the impact on return to be 4.13% (Gympie messmate) and 11.25% (spotted gum). The cost of silviculture being exceeded by the returns.

Species selection is crucial to plantation value. Species nominated as ‘select’ and ‘key’ species by Forestry Corporation of NSW are the highly sort after native forest species in the region, offering the greatest return to the grower. Species selection for plantations should consider log values and marketability at the end of the rotation (Venn, 2005; Nolan et al, 2005, Smith and Brenna, 2006, Cassidy et al, 2012). Shining gum grown in the Central Tablelands region exemplifies this; the log volume and form were both high for this species, but the low market value of the timber negates further perusal of the species for plantation establishment.

Reviewing the value of hardwood logs may be necessary to support the expansion of the privately owned plantation estate in the north east of NSW. Across NSW most hardwood logs come from public land so the price is largely set by the government who is represented by the Forestry Corporation of NSW (FCNSW). FCNSW’s hardwood log pricing system was originally based on a residual stumpage model that supported industry and employment however it now seeks to represent a market based price by estimating customers’ ‘willingness-to-pay’. One of the challenge for plantations logs is that the prices determined through the ‘willingness-to-pay’ model are based on native forest logs that are older and larger.

With the continued pressure on native forest harvesting in the rest of the country (Kanowski, 2017), the Australian timber market's dependence on native hardwood is becoming less reliable. This may support increased pricing of plantation grown hardwood and enable consideration of the cost of their production as proposed by Cassidy et al, 2012; Whittle et al, 2019; and Cacho et al, 2001.

Prices used in this study from Forestry Corporation NSW are less than the prices paid for logs grown on private property (J. Rankin, 2024, personal communication, 31 May). Even so, when considering the best performing species, management and region combination: thinned Gympie messmate grown in the Coastal North region (1.66% IRR), increasing the value of the logs by 200% provides a return of 5.03%, unsurprisingly three times the modelled value. Alternately, if better genetics (Henson and Smith, 2007) or silvicultural management (Smith and Brennan, 2006), was available and the time to grow the same product was reduced to 30, rather than 40 years the return to the producer would be 2.67%, 1.6 times the modelled value. The governments Support Plantation Establishment Program (DAFF, 2023) offers \$2000 ha^{-1} towards establishment cost. Factoring this potential funding to reduce upfront cost could change the rates of return above to 2.13% over 40 years or 3.38% over 30 years (1.28 and 2.04 times the modelled value respectively).

The available data did not contain enough replicates to make detailed site species matching inferences, however, some useful insights were gained. Regression analysis confirmed a significant relationship between MAI and stocking and MAI and rainfall ($p = 0.01$ and $p = 0.05$ respectively). No soil type provided an obvious disadvantage to growth for any of the three select or key species. The significant relationship between MAI and stocking suggests growth on these sites was not attributed to site productivity, rather stocking and site occupation.

Conclusion

The interactions of site, species and management on the factors that affect log value: species, size and form are intricate. The need to understand such interactions for successful plantation management supports the need for further research with a focus on high value species and the application of optimum silviculture. Intricacies of growing and management costs and returns and the effect of the current log value system requires further consideration. However, this study highlights the importance of management for log size and quality outcomes. The price returned for logs needs to account for growing costs. To provide a full account of plantation worth the exploration of the environmental values offered by plantations need to be highlighted regardless of their monetisation. Plantation growth is correlated with rain fall, and site occupation should be managed for optimum productivity. To expand the plantation estate current and potential resource owners will require clear technical advice during establishment and management and access to secure markets in the future.

1. Introduction

In recent decades, large areas of state owned native forests have been transferred from wood production to conservation uses. This has been largely motivated, directly, or indirectly, by the development of Regional Forest Agreements (RFA's) brokered between state and federal governments. These agreements aimed to secure long term forest management, providing industry access whilst protecting environmental and cultural values (Commonwealth of Australia, 1995). This decreased access to public native forests for harvesting prompted the establishment of large areas of hardwood plantations (Clark, 2004).

Unfortunately, in many regions, including the north east of New South Wales, plantations were established prior to the formation of silvicultural guidelines (Smith and Brennon, 2006), without the robust stakeholder engagement (Leys and Vanclay, 2011; Loxton, 2012) and lacking an established or proven market. This has led to poor plantation management, poor relationships with rural communities (Leys and Vanclay, 2011) in turn leading to poor uptake of the investment and weak justification for the investment.

For timber production to become part of the local rural economy in the north east region of NSW the social and environmental landscape must be successfully navigated. Regardless of environmental and social licence, the establishment of a plantation estate will still hinge on the economic viability of the venture.

Is the economics of planting trees on private property a barrier to landholders taking part in growing trees for timber production?

Plantation value is determined by the sum total of the timber and environmental services available minus the cost of establishment and management and the discount rate on capital invested (Venn, 2005; Nolan et al., 2005; Smith and Brennan 2006; Cassidy et al., 2012). Product yield, growth rate and timber quality will be determined by species choice, management and site quality (Gerrand et al., 2003; Venn 2005; Smith and Brennan, 2006). The log price depends on product quality access to the market based on haulage distance, market demand and purchaser pricing (Leskinen and Kangas, 1998).

Hardwood mills buy logs based on diameter and length; the relationship between log size and price is not always linear (Cassidy et al, 2012). Mills use specifications to determine the grade of the log, which is correlated with both size and monetary value of the log to the seller. Log value is determined by size (girth), length, form, internal defect, and species (James, 2001; Montagu et al, 2003; Palmer, 2010). The hierarchy of product values, determined by the end use, from most to least valuable is poles and girders, veneer, sawlogs, and pulp logs (James, 2001).

Environmental services provided by timber plantation include biodiversity, soil and watershed protection (O'Grady and Mitchel, 2018; Marais et al, 2019); agricultural co-benefit values (Barker at al, 2018; Fleming et al., 2019); and carbon sequestration (Monckton and Mendham, 2022; Wall, 2022).

Most costs for forestry plantations are incurred at the beginning of the venture with no return on investment until a commercial thinning event, if there is a market for the thinned product, or the end of the rotation. It is important to consider the cost of capital for the investment, the interest paid on money borrowed to set up the plantation, or interest forgone on money spent. Therefore, when considering the cost of the venture compared to the estimated benefit, the cost of interest must be included (Cassidy et al., 2012). The optimum rotation length is the age when discounted returns are maximised (Maraseni and Cockfield, 2011). It is generally accepted that a 6% return on capital is required for long term investment (Ibbotson and Chen, 2003). Previous studies (Venn, 2005; Maraseni and Cockfield, 2011; Cassidy et al., 2012) have shown that plantation return is sensitive to not only establishment and management costs but site quality and environmental factors.

The relative recent establishment of the hardwood plantation estate in north east NSW means that data availability is relatively scarce in terms of regional coverage of species, geographical location, management practices and biometrics. As the plantations established in the mid 1990s and early 2000s are close to mid rotation it is timely to assess the current state of the plantations and consider the mix of products that will be available in the future and their potential value.

This study aims to assess the viability of timber plantation establishment in the north east of NSW based on timber value estimated using log size and form. The study also seeks to identify appropriate species for different sites and optimum management in terms of product volume and quality.

2. Methods

2.1 Study area

The study location mimics the North East NSW RFA Region. The area covered by the North East NSW RFA stretches from the Queensland boarder in the north to the edge of the Sydney basin in the south. It covers close to 10 million Ha, of which about two thirds (6 314 922 ha) is privately owned land and one third (3 005 738 ha) forested public land (Dept of Agriculture Water and the Environment, ND).

2.1.1Climate

The climate of the area varies from Subtropical (warm humid summer, mild winter) in the north east to Warm Temperate from Port Macquarie south along the coast. The Climate inland along the range is mild temperate, except for Armidale Shire which has a cool temperate climate (Figure 1) (Australian Building Codes Board, 2019).

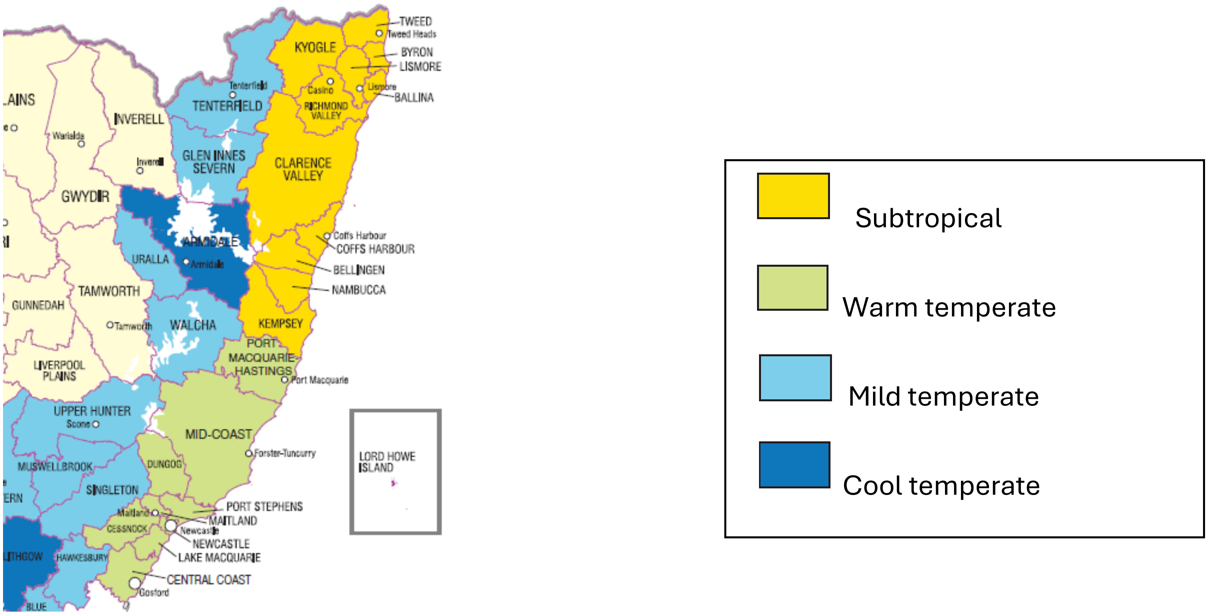


Figure 1. Climate range of the study area (Adapted from, Australian Building Codes Board, 2019).

2.2 Data

The data for the study aims to represent the spread of species, management and climatic conditions within the study area. Of particular importance was to match similar plantations that had received differing levels of silvicultural treatment. The data was sourced from private and publicly owned plantations greater than 15 years of age. The data combines field data collected specifically for the study and inventory data provided by private plantation owners and Forestry Corporation of NSW. Maps of the Forestry Corporation NSW forest regions may be seen in Appendix 1.

2.2.1 Field Measurements

Plots

Circular plots were established at each location to a density of 0.1% of the plantation area. Plot size was established to capture a minimum of 10 trees and increased in diameter until the standard deviation of the diameters at breast height (DBH) of the trees within the plot was less than 10%. Plot locations were chosen to cover the aspect, elevation and species at individual plantation sites. All plots were positioned at least 2 rows away from gaps and edges. The radius of the plot was measured using a Nikon forestry 550 laser rangefinder to an accuracy of 0.1 m.

Tree measurements

The top height and the clear bole length; defined as the height to the lowest large persistent branch that would limit the length of the merchantable log, were measured for each tree within the plot to an accuracy of 0.1m using a Nikon forestry 550 laser rangefinder. The DBH (1.3 m) was measured using a diameter tape to the nearest millimetre (Figure 2).

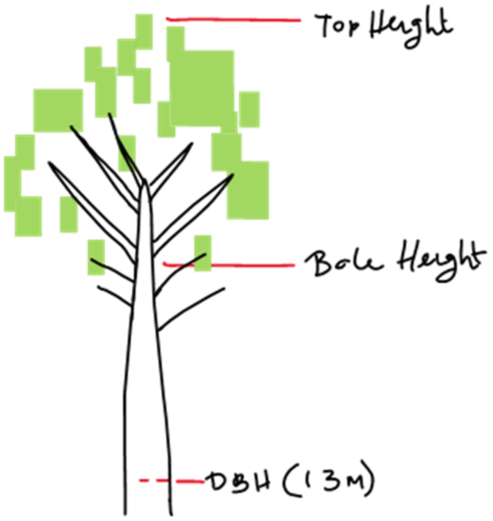


Figure 2. Representation of height and diameter measurement locations.

Each measured tree was allocated a form score, this score translates to the quality of the potential log products available at harvest (Table 1). Additional information about the tree vigour, disease, presence of double or snapped leaders and fire damage were also recorded.

2.2.2 Inventory Data

Inventory data was collected from both private and public. All plantations had data collected from an area equal to at least 0.01% of the plantation area and representative of the plantation e.g. up and down slope, differing aspects. For FC data this was achieved by matching inventory data with mapping information.

The inventory data provided by Forestry Corporation of NSW includes plot location, size, species, planting date, measure age and silvicultural history. DBH and stem merchandising with quality ratings were provided for all trees within the plots, and plot specific predominant height. The merchandising and quality ratings were used to estimate bole height and a form score between 1 and 5.

Table 1. Tree form ratings

Score	Description	Potential grade
1	Straight and clean bole. Minimum length 6 m	Pole
2	Minor bend, but clean bole	High quality large
3	Minor bend/s or branch defects that will imply cross cutting with no significant waste	High quality small
4	Multiple bends or other defect implying multiple crosscuts with some waste	Low quality
5	Malformations or defects implying no merchantable saw logs/sections	Waste

2.2.3 Report data

This report presents the data for 26 plantations and eight species commercial eucalypts. The plantations are both privately and publicly owned. The data for nine plantations was collected specifically for the project, four from privately owned plantation forest inventory and the remainder of the data was derived from the inventory data provided by Forestry Corporation of NSW

Only three plantation datasets contained known thinned and unthinned plot data, two sets of spotted gum and one set of Gympie messmate. This data is utilised for assessing the benefits of thinning. The stocking density and related size and form information for all location, species and treatment combinations are refenced in the results and discussion. Plantation locations can be seen in Appendix 2, see Table 5 for related information.

2.3 Modelling

2.3.1 Height and diameter

Height and diameter of the measured trees were extrapolated to age 40 using Vanclay's (2010) single parameter height and diameter models. Individual models were created for each location, species and management (thinned/unthinned) combination. The model for each location, species, management combination was used to create an 'average' tree at age 40.

Height

$$H = \beta_1 (t - 0.5)^{0.5}$$

H= Height
β_1= parameter to be found
t= age in years

Diameter

$$D = \beta_2 (H - 1.3)/\ln N$$

D= Diameter
β_2= parameter to be found
H= Height
t= age in years
N = Stocking

2.3.2 Merchantable log length

The measured tree height and height of the clear bole; or predominant height and merchandising assessment from the supplied inventory data, were used to determine the merchantable portion of each stem. The average merchantable portion from each set of model data, calculated as bole height/total height x 100 or, merchantable product length/predominant height x 100, was used with the modelled average height to determine the merchantable log length at age 40.

2.3.3 Log taper

Log taper equations (Bi, 2000) were used to determine under bark diameter along the log for merchandising. A generic Eucalypt species equation was used for all species except for E.pilularis and C. maculata; equations specifically derived for those species were used.

2.3.4 Log and Stand Volume

The modelled plantation average merchantable log length, diameter at breast height over bark (DBHOB) and modelled under bark taper were used to estimate stand volume. Using modelled under bark diameters the logs were merchandised for optimum financial return using current Forestry Corporation of NSW log mid diameter specifications and standard log lengths of 3, 3.6, 4.2, 4.8, 5.4 and 6m. Smalian's sectional volume equation (West, 2004) was used to determine log volume (m^3) in each log category for each location, species, management combination.

Stand volumes were calculated by multiplying the log volume for the average tree by stand stocking to determine the volume in each log class ha^{-1}. The stocking rate recorded at the time the measurements were taken were used for volume and value calculations, no thinning or mortality modelling have been used.

2.3.5 Stand value

Current Forestry Corporation of NSW stumpage price schedules that account for both species and the geographic origin of forest products were used to calculate log prices (see Appendix 3 for full schedule). The individual log volumes and values by size class for each plot were summed and the figures were extrapolated based on plot size to calculate values ha^{-1}.

The Forestry Corporation of NSW price data was used as it is accessible, consistent and set by the government. Logs sourced from private resources are often purchased at a higher price however, using this set and accessible list of figures that allows for species, size and location figures was used in an effort to limit discrepancies in the analysis.

Table 2 lists the species in this report and their respective species group. Figure 3 (below) represents the relationship between log size diameter and species group baseline pricing (Forestry Corporation of NSW, 2017).

Table 2. Species value group, common name, botanical name and code (Forestry Corporation of NSW, 2017).

Species group	Common name	Botanical name	Code
Select hardwoods	Gympie Messmate	*Eucalyptus cloeziana*	GMM
Key hardwoods	Blackbutt	*Eucalyptus pilularis*	BBT
	Spotted gum	*Corymbia maculata* *Corymbia citriodora*	SPG
High value hardwoods	Flooded gum	*Eucalyptus grandis*	FLG
	Silvertop stringybark	*Eucalyptus laevopinea*	STS
	Sydney blue gum	*Eucalyptus saligna*	SBG
Mixed hardwoods	Blue-leaved stringybark	*Eucalyptus agglomerata*	BLS
High country hardwoods	Shining gum	*Eucalyptus nitens*	SHG

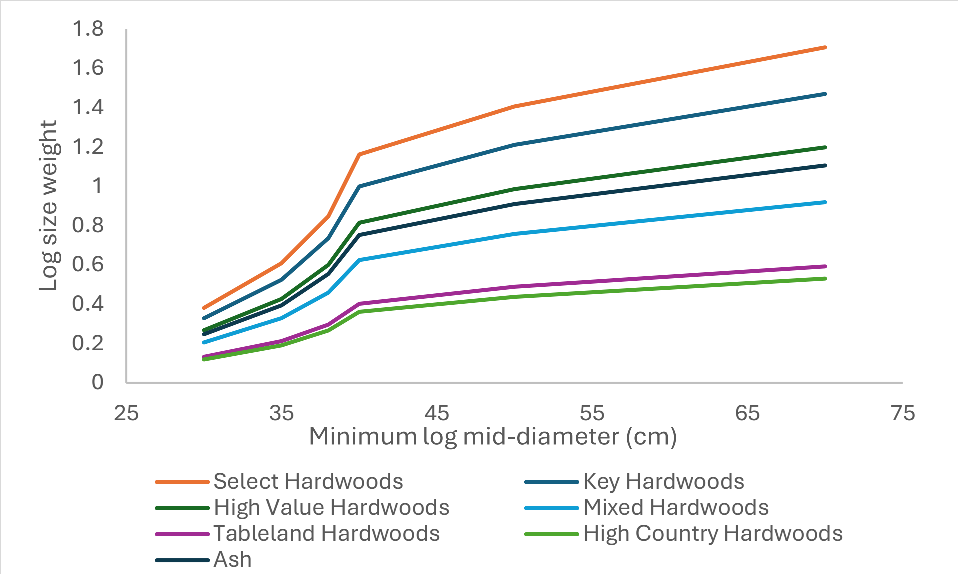


Figure 3. The relationship between minimum log mid diameter, log size weighting applied to log value and species group (Forestry Corporation of NSW, 2024).

2.3.6 Form weighting

A form weight was calculated using the values representative of native forest products classed by both size and form. The $/m^3 values used to inform the form weights were sourced from Palmer (2022). The data was collected across multiple native forest operations in the study region and averaged to provide a regional average value.

To convert the information from Palmer (2022) to a weight index, each form class was matched with the relevant product grade. To convert the dollar value to an index the dollar value for each product was divided by the dollar value for poles, returning a representation of each category as a proportion of the highest value product (Table 3).

Table 3. Product class, form score, cubic meter price and derived form weight (adapted from Palmer 2022).

Product	Form Score	Average $/m^3	Form weight
Pole	1	135.45	1.00
HQ Large[a]	2	128.01	0.95
HQ Small[b]	3	76.19	0.56
Low qual	4	24.80	0.18
Waste	5	0	0

[a] centre log diameter under bark >40cm

[b] centre log diameter under bark <40cm

The derived weight and the related form scores (1-5) were graphed and a non-linear equation, 3rd order polynomial, was fit to the data (Figure 4). The equation was used to create a form weight based on the average form score for each location, species, management combination. The values of merchandised logs ha^{-1} for each location, species, management combination was multiplied by the form weight to account for differences in plantation form quality. Accounting tree and log form in the plantation valuation aims to provide a representation of value based on log conversion and expected waste, as well as glean the value of silvicultural inputs on product availability and value.

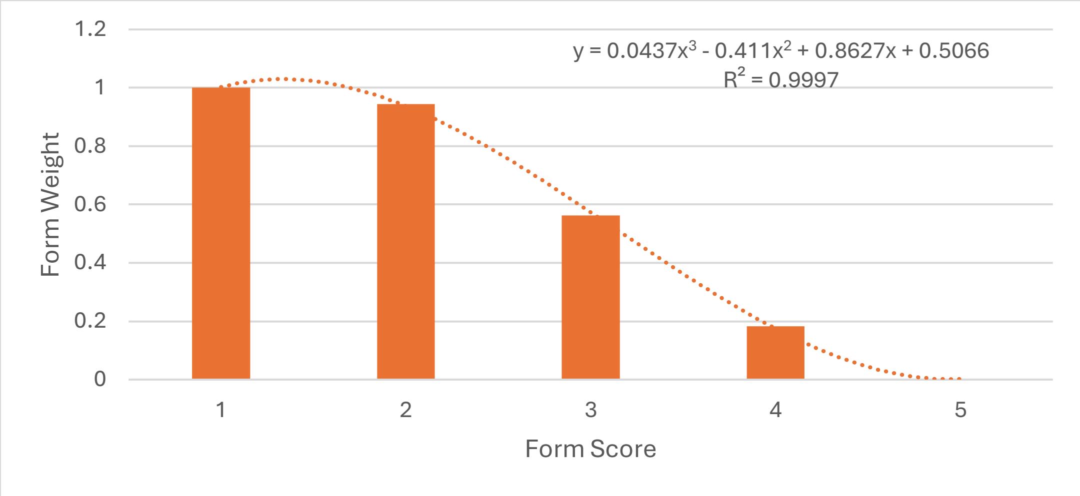


Figure 4. Non linear relationship between form weight and form score (adapted from Palmer 2022).

2.4 Financial analysis

The data available for this analysis covers a range of species, locations and management regimes sampled within the study area. Timber volumes and values were interrogated using the management variables thinning and pruning

Log values ha^{-1}, establishment and management costs were used to calculate internal rate of return (IRR) to assess the value and viability of timber production across species, locations and management combinations across the study region.

2.4.1 Establishment and management costs

Estimates of establishment and management costs were acquired from discussions with private plantation growers in the region. Costs for thinning and pruning assume generic per hectare thinning or pruning cost. Two thinning events, and two pruning events have been factored into management costs. Thinning at age 3 was costed at $1000 ha^{-1}, a second commercial thin was assumed to be cost neutral i.e. the returns for the timber produced was equal to the cost of thinning. Pruning events were costed at $1000 ha^{-1}. The profitability of the plantations was assessed with and without the pruning at ages 3 and 7. The list of costs and the year each cost has been applied may be seen in Table 4.

2.5 Interrogating site quality and management

Plot locations were partitioned as per Forestry Corporation of NSW's grouped price zones. Forestry Corporation of NSW price zones are aligned with site quality factors such as rainfall and climatic variations for growing different species. Plots were further analysed based on management to include presence or absence of thinning and pruning.

Plot data for each location, species, management combination were analysed to examine the trends in DBH, Clear bole length, individual log volume and volume ha^{-1}. Financial returns ha^{-1}

were analysed across species, silvicultural treatments and plot locations, to explore differences in plantation returns across the plantation estate in north east NSW. Forestry Corporation NSW grouped price zone maps are attached as Appendix 1.

Table 4. Modelled establishment and maintenance costs for private eucalypt plantations in the north east of New South Wales and year they incur.

Year	Event	Cost ha^{-1}
0	Establishment	$6100
1	Post plant weed spray	$100
2	Post plant weed spray	$100
3	Precommercial thin	$1000
3	Form prune	$1000
7	Form prune	$1000
Annual	Maintenance	$200

2.5.1 Site Species Matching

Average annual rainfall and Australian Soil Classification type were used to assess the effect of site on productivity for the select and key species in the data set (blackbutt, Gympie messmate and spotted gum).

Average annual rainfall figures were obtained using the ANUCLIM Annual Mean Rainfall raster layer (State Government of NSW and NSW Department of Climate Change, Energy, the Environment and Water, 2020).

The Australian Soil Classification (ASC) Soil Type map of NSW (Department of Planning, Industry and Environment, 2021) was used to find Australian soil classification types for each location.

Productivity was assessed using the modelled mean annual increment at age 40 (m^3) for each site. Regression analysis was preformed to assess if there was relationships between productivity rainfall.

3. Results

The results represent eight commercial eucalypts species collected from 26 plantations across 7 grouped price zones. The plantations are both privately and publicly owned. The data used in the analysis was collected specifically for the project or sourced from inventory data from private plantations and Forestry Corporation of NSW.

3.1 Height and diameter

Models for height and diameter were produced using Vanclay (2010) single parameter models for each individual species, location and treatment combination. The modelled heights and diameters at age 40 are presented in Table 5.

The average proportion of merchantable stem (bole height) measured in the field, or calculated from merchandising data for each species, location and treatment combination was applied to the corresponding modelled average tree at 40 years old (Table 5). Stocking, DBH, total height and bole height for each species and region is presented as Figure 5. The relationship between DBH, total tree height and merchantable height can be seen in Figure 6. The data shows a positive relationship between DBH and total height and DBH and bole height.

Table 5. Modelled diameter at breast height (cm), total tree height (m) and merchantable log length (m).

Region	Region code	Forest code	Species code	Stocking ha^{-1}	DBH[a] (cm)	Height (m)	Bole height (m)
Coastal North	1	1-1	GMM_T[b]	280	51.3	46.9	26.1
Coastal North	1	1-2	BBT[c]	700	37.2	36.2	13
Coastal North	1	1-7	BBT	610	35.4	37	15
Coastal North	1	1-9	BBT	530	39.5	40.9	15.9
Coastal North	1	1-8	BBT	530	45.9	45.5	12.7
Coastal North	1	1-4	SPG[d]	320	34.2	34.4	15.5
Coastal North	1	1-6	SPG	320	32.1	37.7	14.2
Coastal North	1	1-3	SPG	400	32.8	31.5	17.2
Coastal North	1	1-1	SPG_T[e]	270	42.5	36.3	12.3
Coastal North	1	1-6	SPG_T	290	37	35.7	16.1
Coastal North	1	1-5	SBG[f]	680	33.4	26.3	12.2
Coastal North	1	1-9	SBG	400	35.5	33.6	12.9
Coastal North	1	1-8	SBG	700	41.6	42	5.8
North east up river	2	2-4	GMM[g]	680	37.8	37.2	21.1
North east up river	2	2-5	GMM	500	37	37.4	13.5
North east up river	2	2-1	BBT	360	52.9	49.7	19
North east up river	2	2-3	BBT	630	42.1	43.9	18.9
North east up river	2	2-2	BBT	480	43	41	12.8
North east up river	2	2-6	SPG	340	39.8	28.8	9
North east up river	2	2-1	SBG	520	48.4	40.4	16.5
Northen Foothills	3	3-1	BBT	460	41.1	43.9	15.7
Central Foothills	4	4-4	GMM	440	48.3	33.9	14
Central Foothills	4	4-4	BBT	550	46.7	37.4	16.2
Central Foothills	4	4-4	BLS[h]	520	42.8	32.1	14.1
Central Foothills	4	4-1	STS[i]	455	39.6	34.9	19.2
Central Foothills	4	4-3	STS	160	45.7	32.8	14.7
Central Foothills	4	4-2	STS	570	33.9	29.1	14.3
Central Foothills	4	4-1	SBG	460	37.9	40.2	17.3
Central Foothills	4	4-3	SBG	290	34.6	30.6	13.3
Central Foothills	4	4-2	SBG	520	32.1	33.4	16.1
Central Tablelands	5	5-1	SHG[j]	440	55.8	41.4	26.5
Central Up River	6	6-1	BBT	570	54.7	42.7	19.8
Central Up River	6	6-2	BBT	220	59.2	42.5	23
Central Up River	6	6-3	BBT	530	37.4	37.9	9.6
Central Up River	6	6-1	FLG[k]	580	38.6	35.6	17.5
Central Up River	6	6-2	FLG	470	47	46	27.9

Region	Region code	Forest code	Species code	Stocking ha^{-1}	DBH[a] (cm)	Height (m)	Bole height (m)
Central Up River	6	6-1	BLS	730	46.5	33.3	15.9
Coastal South	7	7-1	GMM	160	46	31.6	15.5
Coastal South	7	7-2	GMM	740	35.4	37.6	13.2
Coastal South	7	7-1	BBT	280	51.4	38	19.5
Coastal South	7	7-2	BBT	630	37.9	40.2	15.6
Coastal South	7	7-1	FLG	110	54.5	45.5	23.5

[a] Diameter at breast height [b] Gympie messmate, thinned [c] Blackbutt [d] Spotted gum
[e] Spotted gum, thinned [f] Sydney blue gum [g] Gympie messmate
[h] Blue-leaved stringybark [i] Silvertop stringybark [j] Shining gum [k] Flooded gum

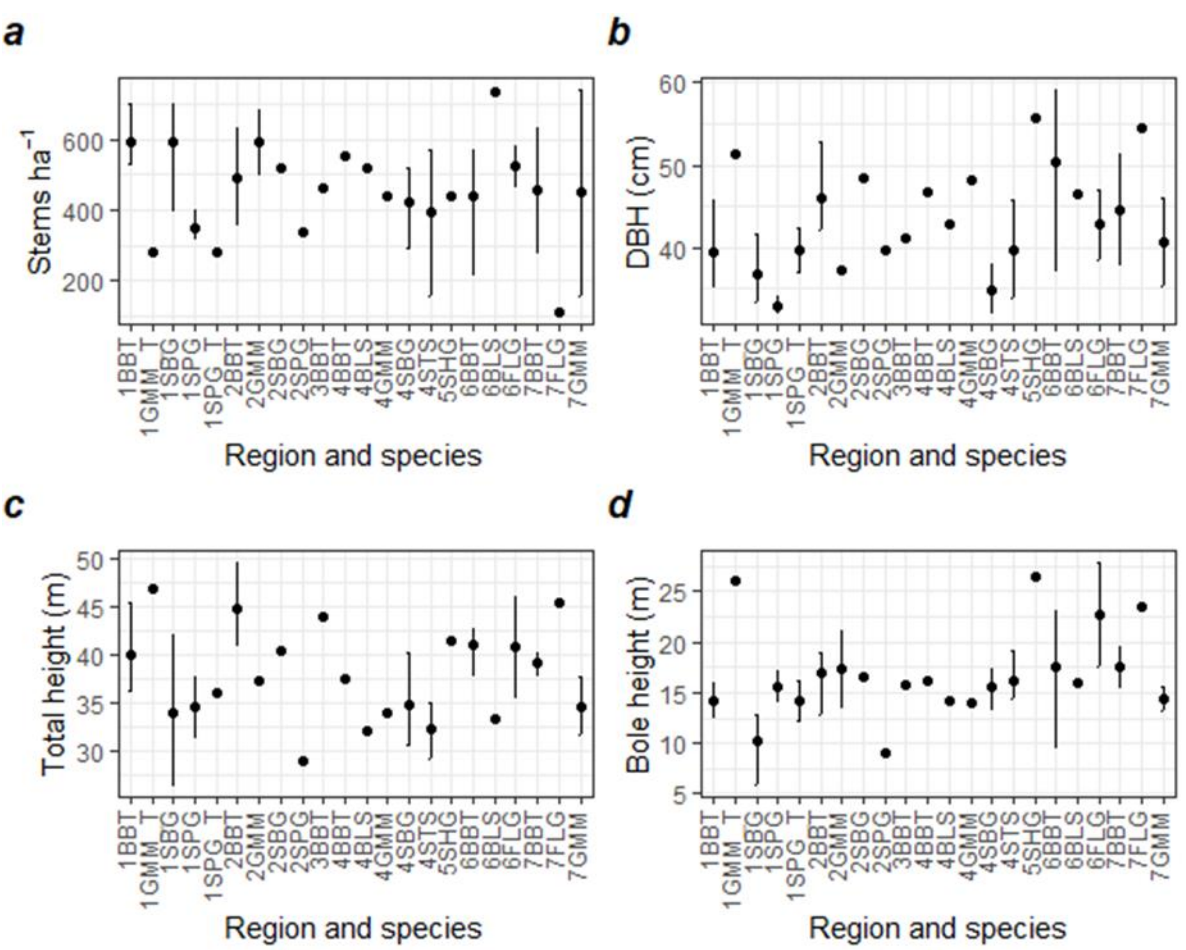


Figure 5. a) Plantation stocking by region and species, b) Modelled diameter at breast height (cm) at age 40 by region and species, c) Modelled total height (m) at age 40 by region and species, d) Modelled clear bole height (m) at age 40 by region and species. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

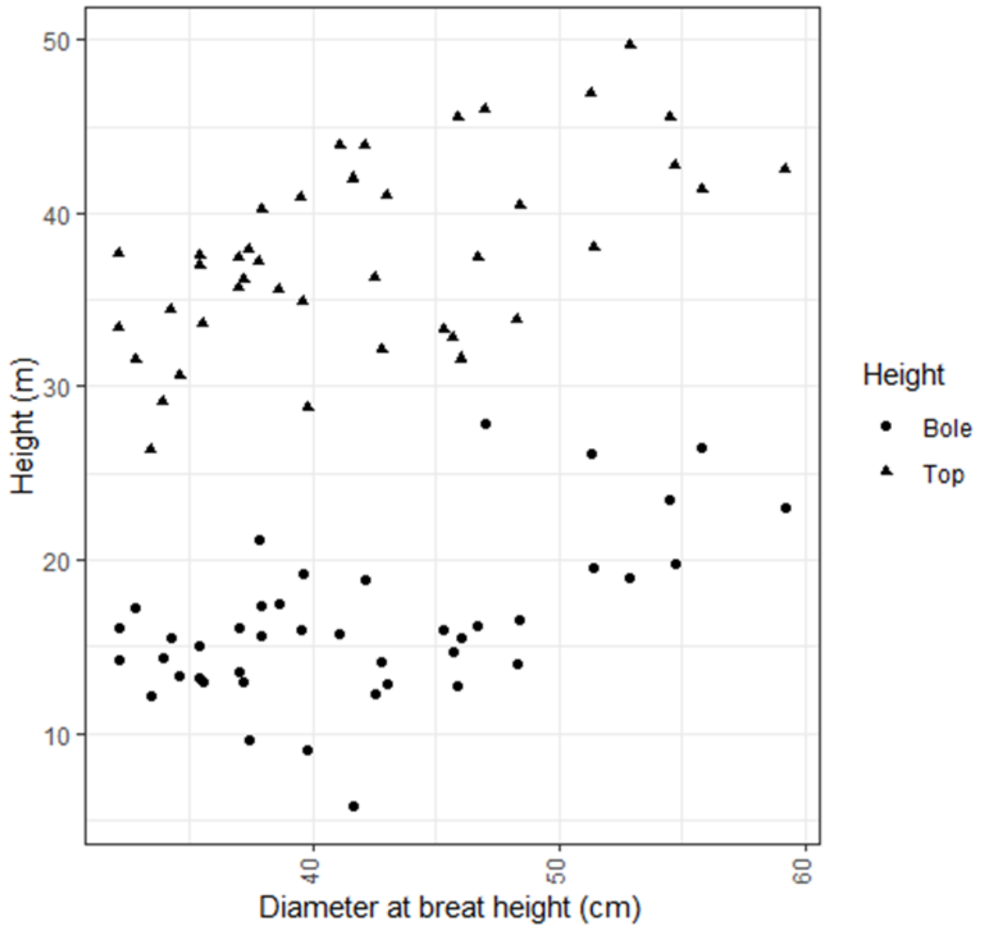


Figure 6. The relationship between diameter at breast height (cm), total height (m) and merchantable log length (m) at age 40. The figure shows the modelled average trees for each plantation, not average region and species groups.

3.2 Mean Annual Increment

Mean annual increment (Figure 7) varied from 2.24 m^3 ha^{-1} for spotted gum grown in the North Coast region to 13.9 m^3 ha^{-1} for shining gum grown in the Central Up River region. The average MAI for all species and regions is 7.3 m^3 ha^{-1}. The greatest variation for a single species and region was Sydney blue gum in the North Coast region, 8.2 m^3 ha^{-1}.

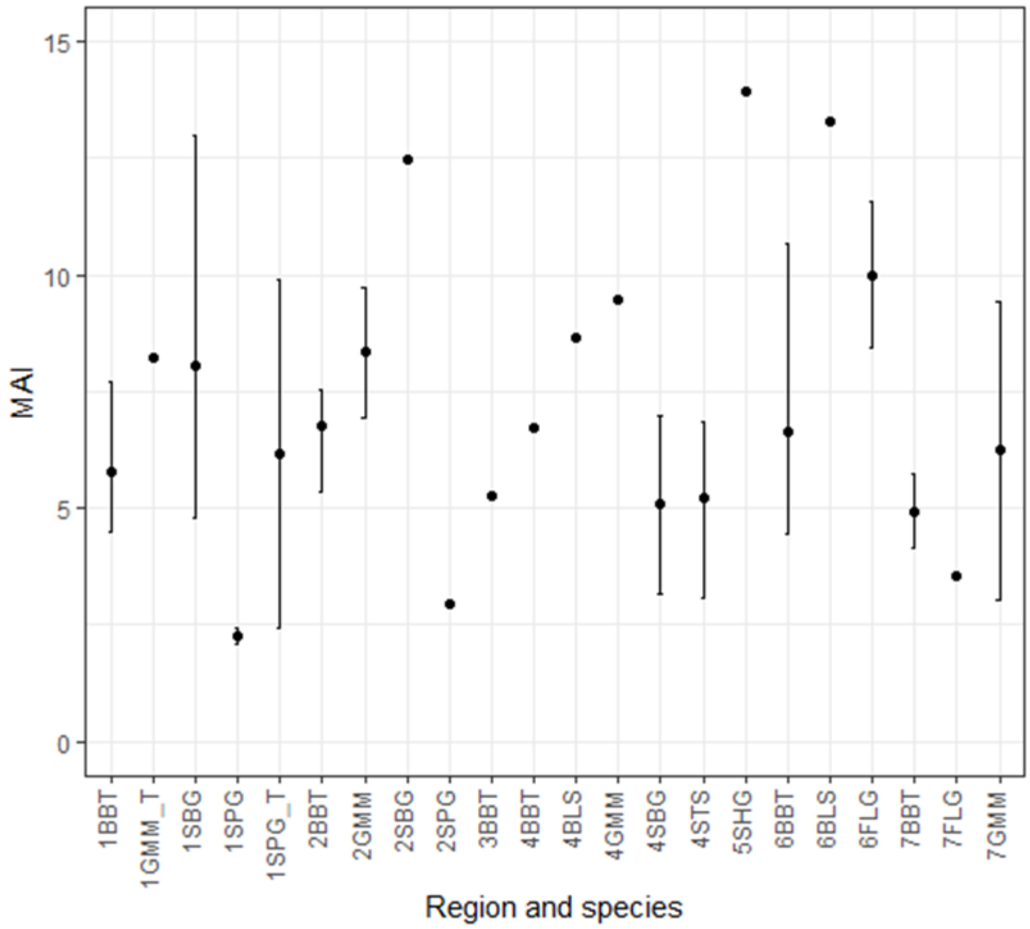


Figure 7. Modelled mean annual increment (MAI) m^3 ha^{-1} by region and species at age 40. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

3.3 Log and Stand Volume

Merchantable log volumes by size class modelled at 40 years show a positive relationship between DBH, log size and merchantable volume ha^{-1} (Figure 8). The stands with the largest modelled volume m^3 ha^{-1} are blue-leaved stringybark grown in the Central Up River region and shining gum grown in the Central Table Lands region. Both of these plantations had logs modelled in the higher size classes and higher stocking rates (730 and 440 stems ha^{-1} respectively). The two lowest yielding plantations were both spotted gum grown in the Coastal North region, stocked at 400 and 320 stems ha^{-1}.

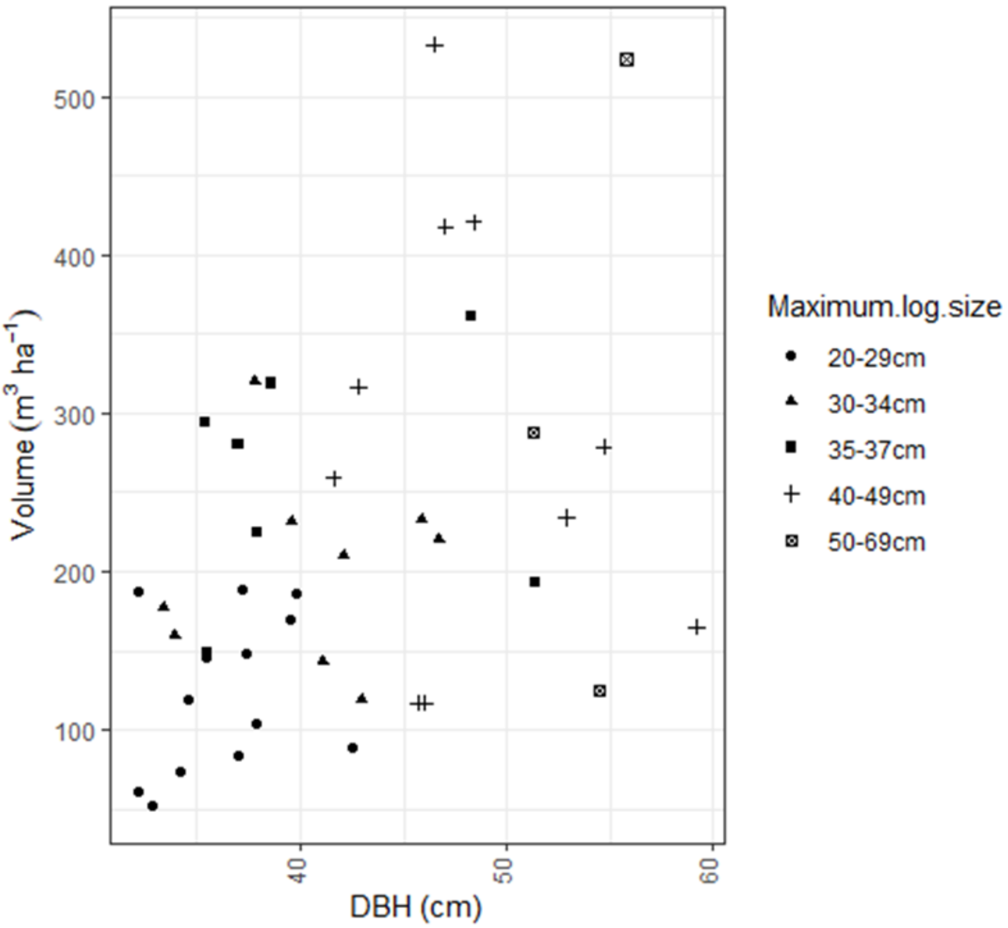


Figure 8. The relationship between diameter at breast height (DBH), merchantable log volume ha^{-1} and maximum log size for modelled 40 year old average trees. The figure shows the modelled average trees for each plantation, not average region and species groups.

The average merchantable log volume is 215 m^3 ha^{-1}, the range in merchantable log volume is 471m^3 ha^{-1} (Figure 9). The largest merchantable volume was modelled for blue-leaved stringybark grown in the Central Up River region (533 m^3 ha^{-1}), the least was spotted gum grown in the North Coast region (62 m^3 ha^{-1}). No logs were produced from any species or region with a mid-diameter of 70+ cm.

Figure 10 shows the modelled individual tree log volumes by log size class. The figure illustrates the range of individual log volumes within the single size classes. Differences in log volumes are due to the variable lengths of the logs; each tree was mechanised to produce the highest financial gain.

Log volume availably ha^{-1} by size class is presented in Figure 11. Species and region combinations with lager modelled DBH's generally produced larger logs, however volume ha^{-1} is also affected by stand stocking (Figure 8); this relationship is variable. Looking at the most and least densely stocked forests, blue-leaved stringybark grown in the Central Up River region at 730 stems ha^{-1} returned the highest merchantable volume (533 m^3 ha^{-1}), whereas the second most densely stocked sample Sydney blue gum grown in the North Coast region at 593 stems ha^{-1} returned 195 m^3 ha^{-1}, the 11th highest volume of merchantable logs. The least stocked plantation flooded gum grown at 110 stems ha^{-1} in the Coastal South region produced 125 m^3 ha^{-1}, the third lowest volume overall. Plantations with logs in the 50-69 cm mid DBH range were thinned Gympie messmate grown in the coastal North region, Shining gum grown in the Central Tablelands region and flooded gum grown in the Coastal South region. These plantations were grown at 280, 440 and 110 stems ha^{-1} respectively and returned the 8^{th}, 2^{nd} and 19^{th} highest volumes overall.

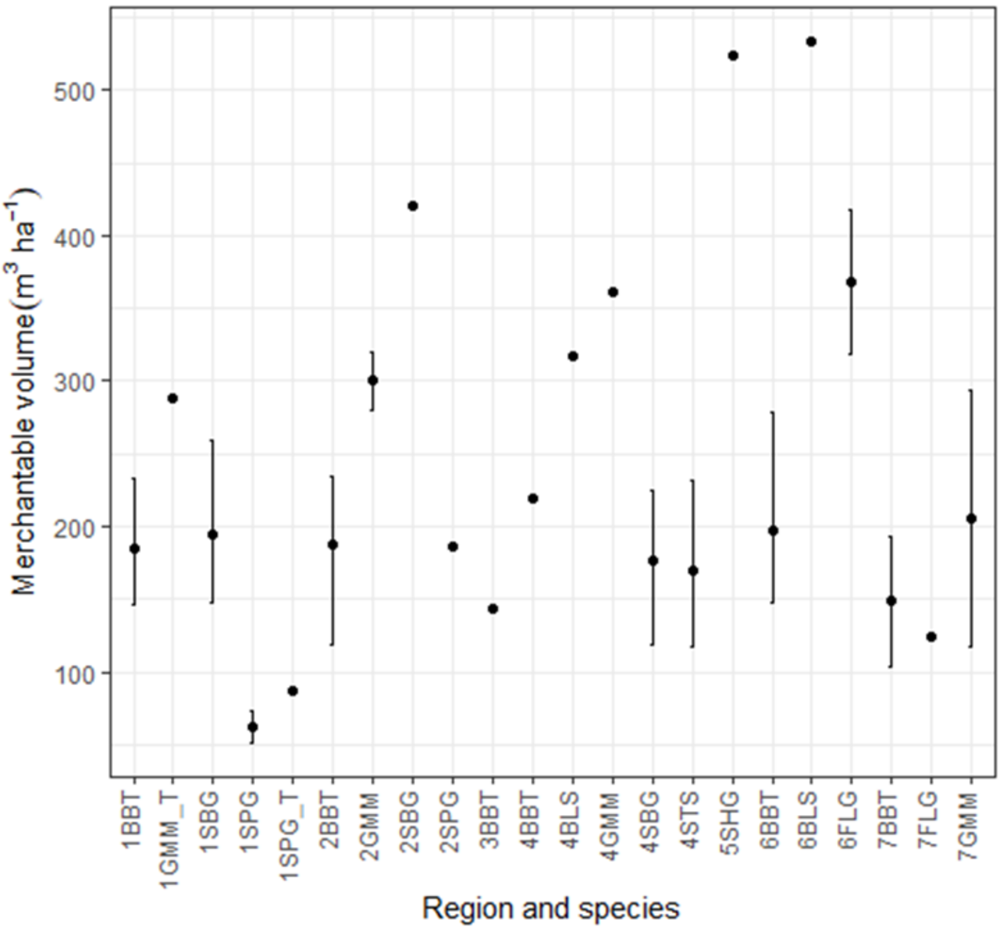


Figure 9. Modelled merchantable log volume by size class (m^3 ha^{-1}) grouped by region and species at age 40. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

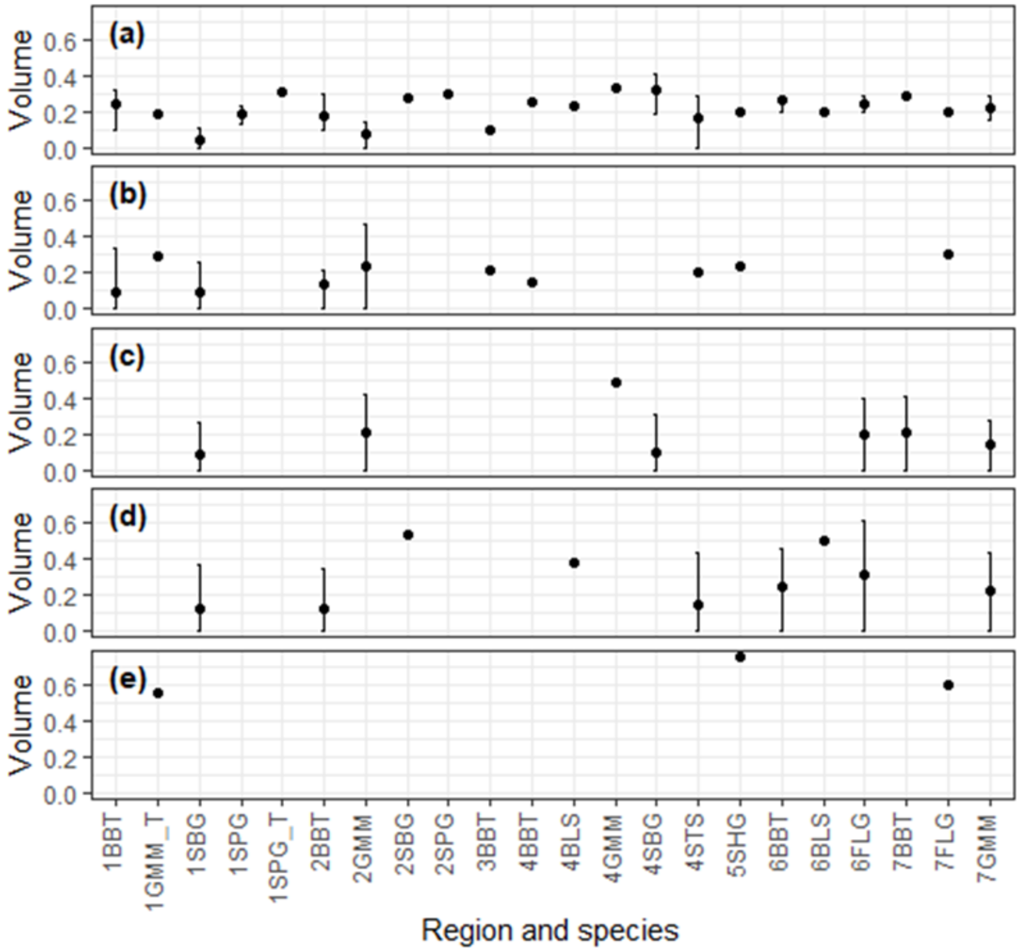


Figure 10. Modelled merchantable log volume per tree by size class (m^3) grouped by region and species at age 40. a) log mid diameter 20-29 cm, b) log mid diameter 30-34 cm, c) log mid diameter 35-37 cm, d) log mid diameter 40-49 cm, e) log mid diameter 50-69 cm. N.B. no logs were merchandised in the size classes 38-39 cm or 70+ cm. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

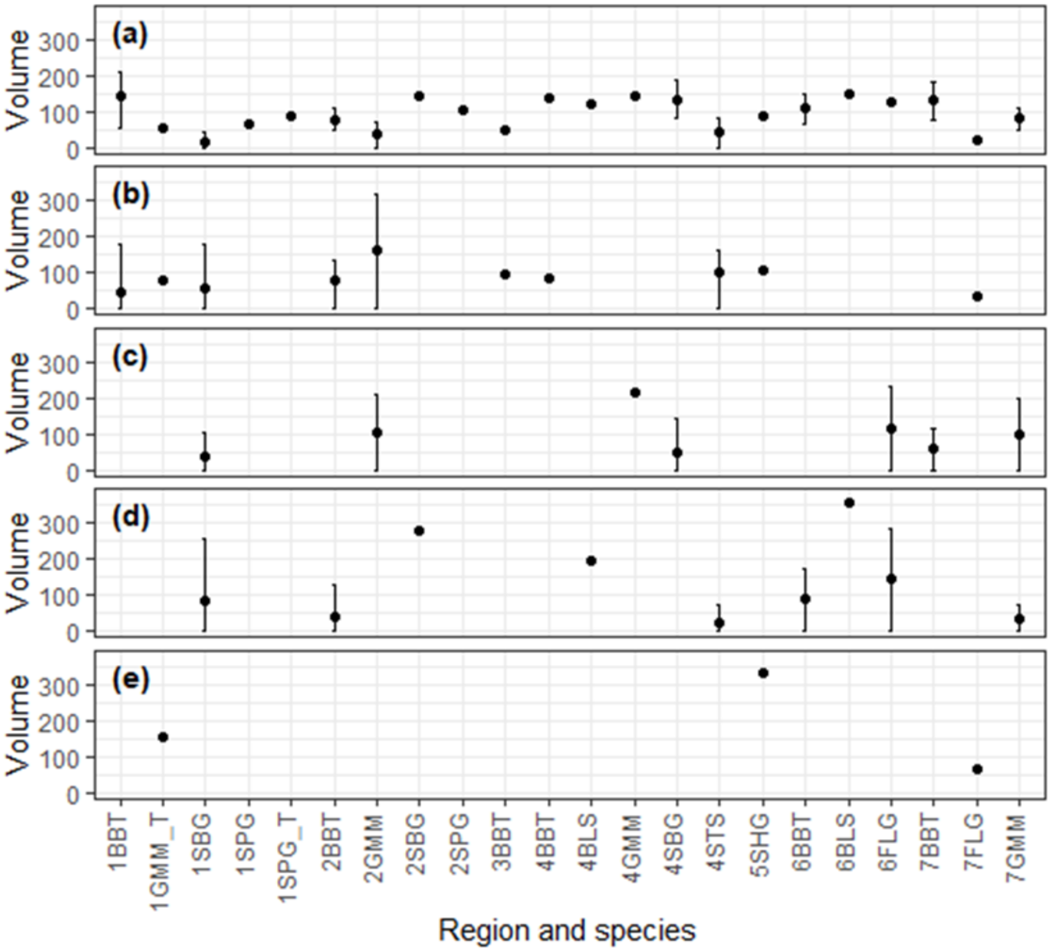


Figure 11. Merchantable log volume(m^3 ha^{-1}) by size class modelled at age 40. a) log mid diameter 20-29 cm, b) log mid diameter 30-34 cm, c) log mid diameter 35-37 cm, d) log mid diameter 40-49 cm, e) log mid diameter 50-69 cm. N.B. no logs were merchandised in the size classes 38-39 cm or 70+ cm. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

3.4 Log and stand value

The non linear relationships between log size and value (see Figure 3), and form and value (See Figure 4), as well as the differences in value attributed to different species groups (Figure 3), contribute the financial outcomes for plantations. Thus, plantation species, location and management all attribute to long term financial results.

3.4.1 Form weighting

Incorporating a form measurement in the data set provides the opportunity to value the plantations beyond standard species or volume assumptions. The form weight provides an indication of expected product recovery or waste. Viewing the data in this way provides a further step to understanding resource value and management opportunities.

Figure 12, below, shows the form scores for each species and region combination. Close to 70% of form scores fall between 2.5 and 3.5, the overall average is 2.9. Thinned Gympie messmate in the North Coast region has the lowest average form score (2.1); Sydney blue gum in the same region has the highest (3.9). Blackbutt grown in the Central Up River region had the greatest range in form score (1.8 – 3.8).

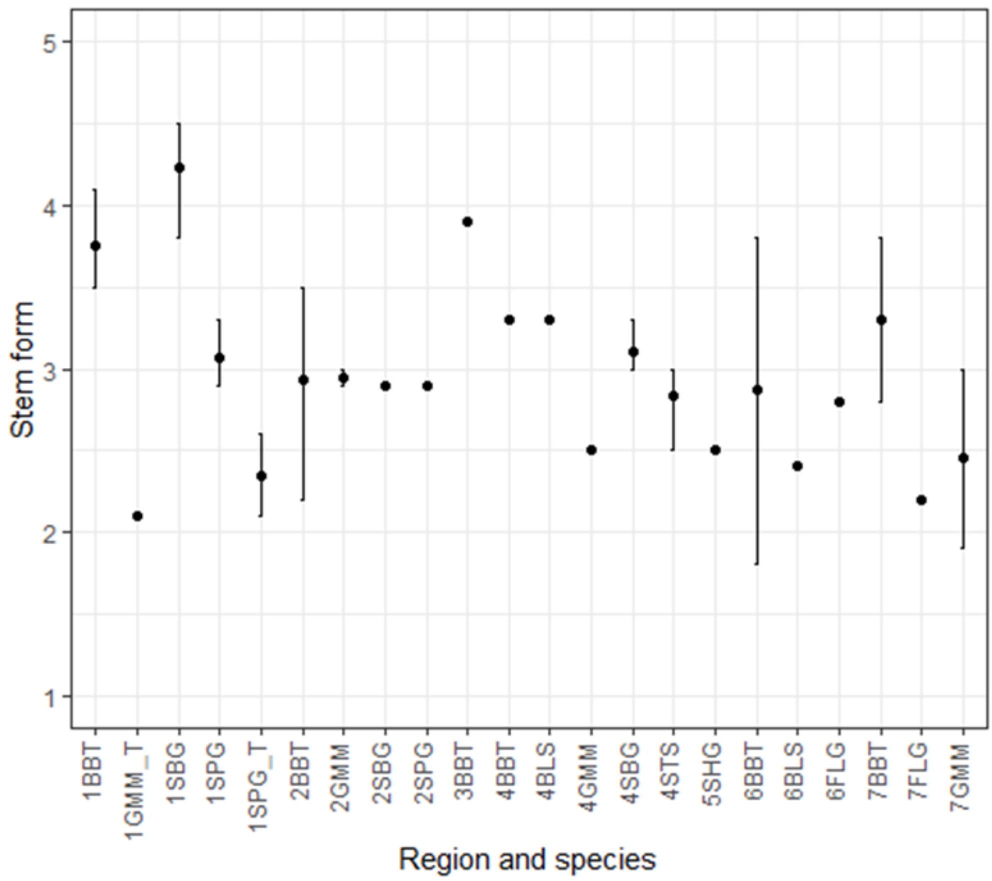


Figure 12. Tree form rating by region and species. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

Figure 13, below, shows the relationship between stems ha^{-1} and form score. Generally, stands with lower stocking have lower form score, indicating a lower overall portion of trees containing defect or trees with consistently low occurrence of defect. This pattern is reflected in Figure 14, showing stands with lower DBH have a higher form score i.e. higher occurrence of defect or non-commercial stems.

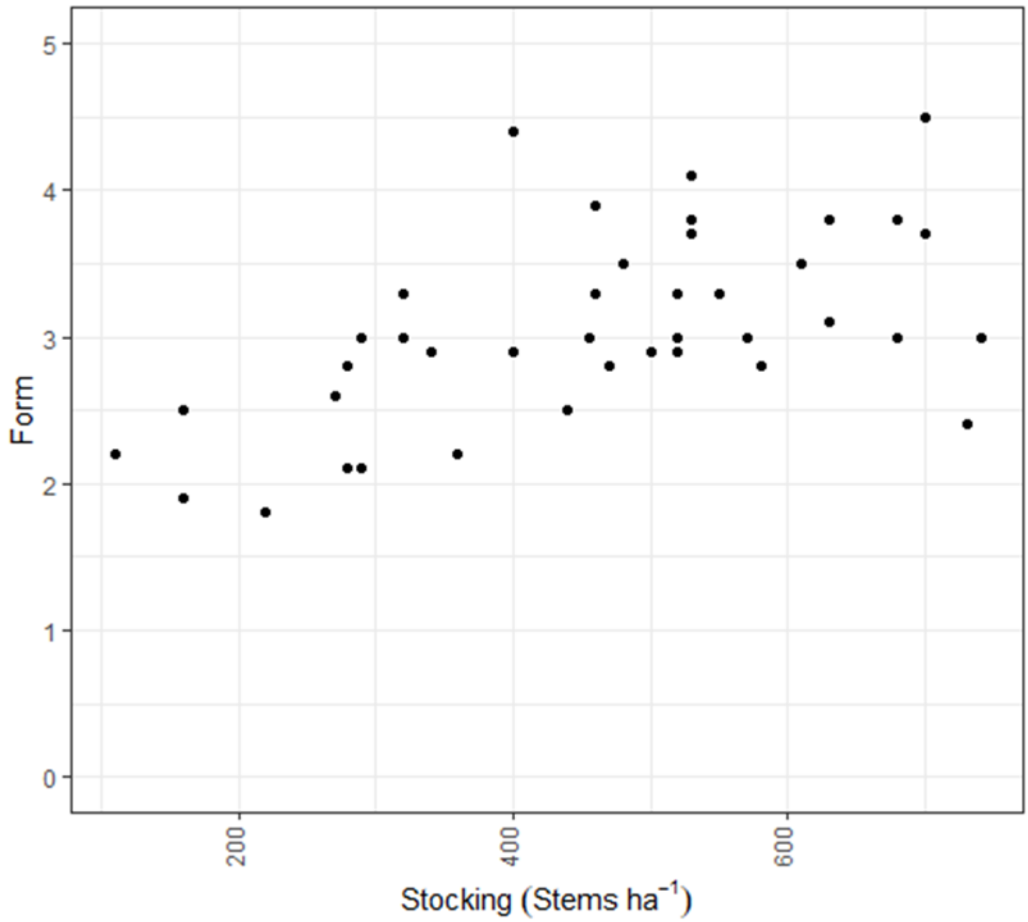


Figure 13. The relationship between stocking (stems ha^{-1}) and form score. The figure shows the modelled average trees for each plantation, not average region and species groups.

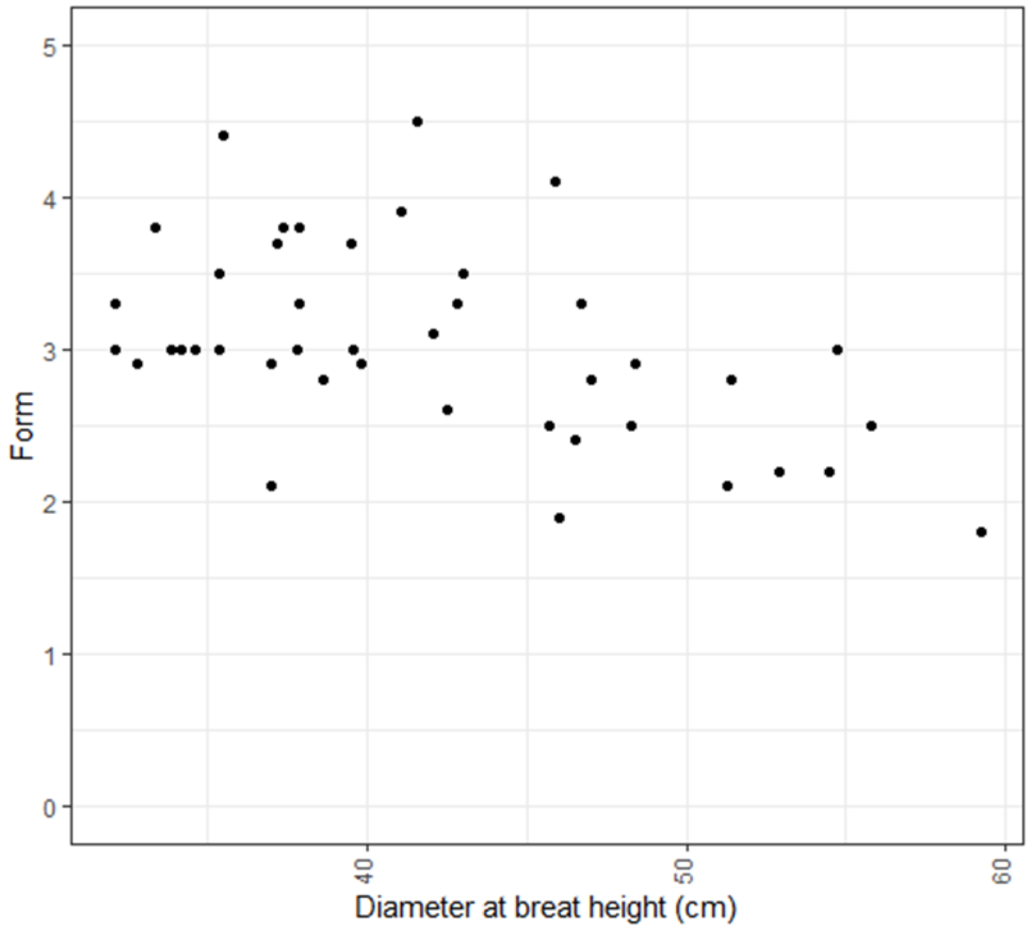


Figure 14. The relationship between diameter at breast height (cm) at age 40 and form score. The figure shows the modelled average trees for each plantation, not average region and species groups.

Applying the form weight to the modelled stand values provides an expected value for the stand incorporating defect and down grade. The effect of the form score on stand value is shown in figure 15. Differences between weighted and unweighted values are smallest when the form score and value are low, becoming more impactful where the initial value and form score are high.

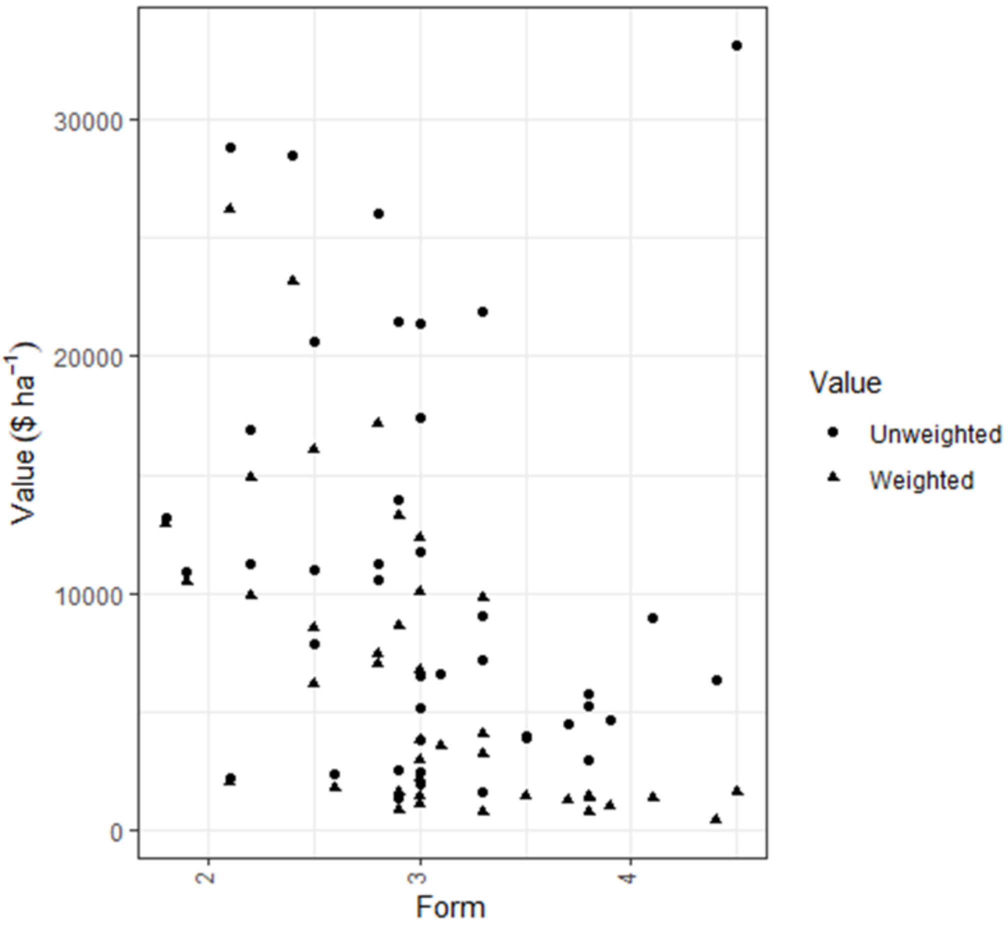


Figure 15. The relationship between form score and weighted and unweighted log value ($ ha-1) at age 40. The figure shows the modelled average trees for each plantation, not average region and species groups.

The relationship between weighted and unweighted value ha^{-1} is linear (R^2=0.69) (Figure 16). This indicates the more extreme weights placed on poorer formed trees are in stands of already low value (see Figure 8); applying more extreme form weights on already low value stands has less affect than if placed on larger and therefore higher value logs. The exception is Sydney Blue Gum grown in the North Coast region, the unweighted value of $33154 ha^{-1} and weighed values of $1597 ha^{-1}.

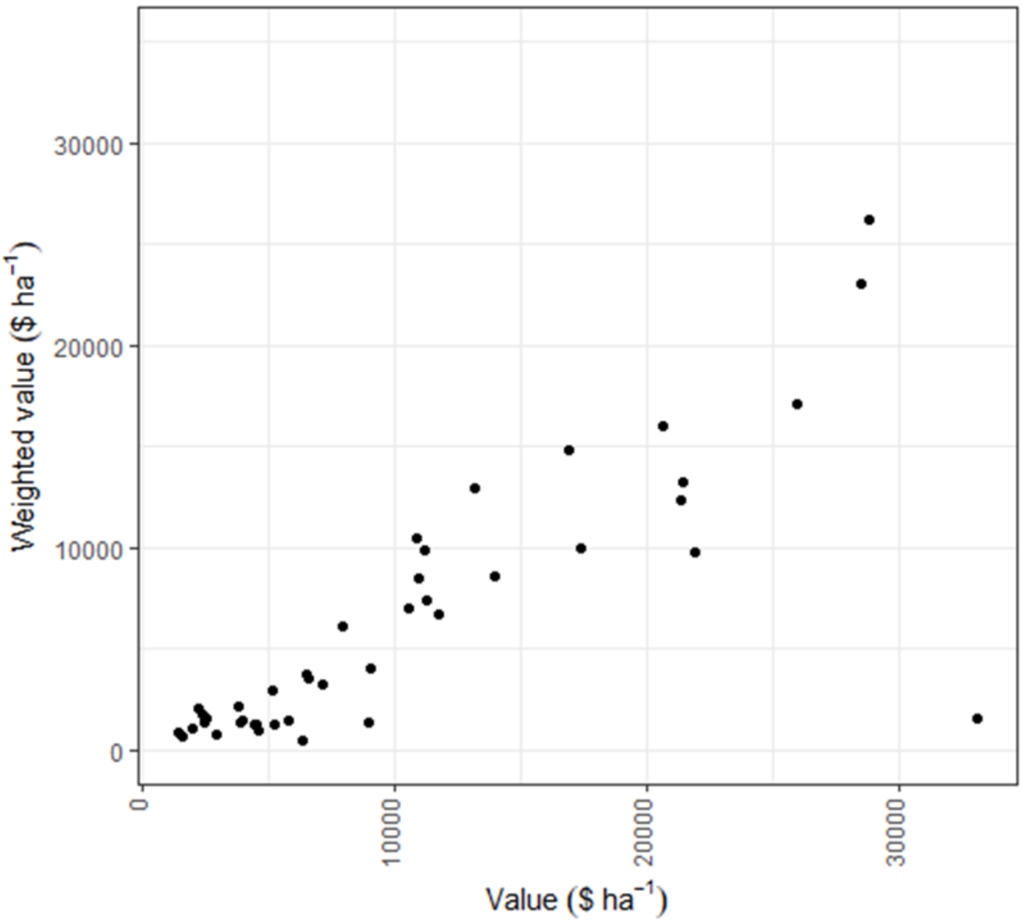


Figure 16. The relationship between weighted and unweighted value ($ ha^{-1}) at age 40. The figure shows the modelled average trees for each plantation, not average region and species groups.

3.4 2 Weighted and unweighted stand values

Weighted and unweighted stand values for the modelled stands show the impact of stand quality on overall financial value (Figure 17). The greatest downgrade in value is for Sydney blue gum grown in the North Coast region (96%). The downgrade on the thinned stands was 8.5% for Gympie messmate and 17.7% for spotted gum. The management to reduce stems favoured keeping trees with good form and low defect for the final crop.

Thinned Gympie messmate grown in the North Coast region and blue-leaved stringybark grown in the Central Up River region returned the greatest values both before and after the form weight has been applied. The Thinned Gympie messmate was grown at 280 stem ha^{-1} whereas the blue-leaved stringybark was grown at 730 stem ha^{-1}. Gympie messmate is a select species, priced at the highest rate; blue-leaved stringybark is classed as the mixed hardwood, has the 5th highest value rating.

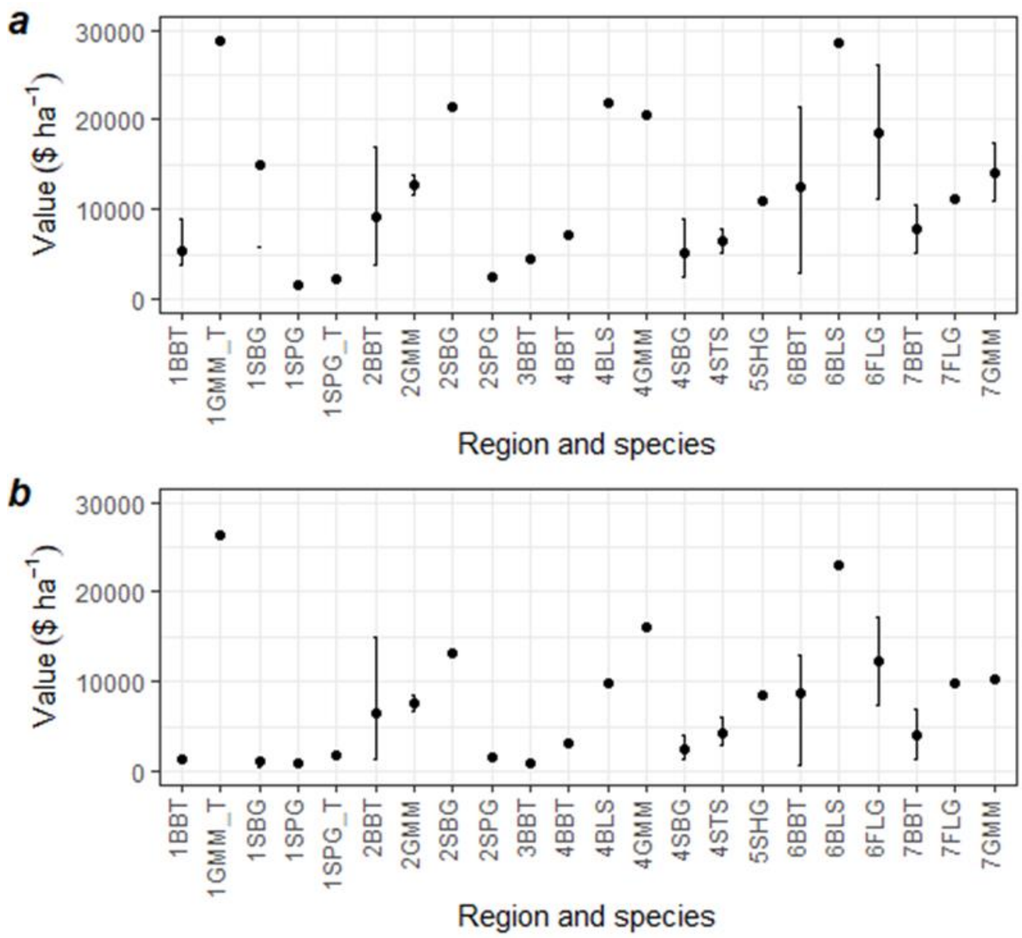


Figure 17. Value ($ ha^{-1}) by region and species modelled at age 40. a) Unweighted value b) Weighted value. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

3.4.3 Species and value implications

Figure 18 shows merchantable volume (m^3 ha^{-1}) (a), unweighted value ($ ha^{-1}) (b) and weighted value ($ ha^{-1}) (c) ordered by Forestry Corporation species value groups (see Table 2 and Figure 3). The figure highlights the importance of species choice. Shining gum grown in the Central Tablelands region was one of only two species and region combinations that achieved a merchantable volume greater than 500 m^3 ha^{-1}, the other being blue-leaved stringybark grown in the Central Up River region (524 and 533 m^3 ha^{-1} respectively). Shining gum is in the High Country Hardwoods value group, the least profitable group overall. The unweighted value returned for shining gum was $10 975 ha^{-1}; blue-leaved stringybark returned $28 587 ha^{-1}. Comparatively, Gympie messmate is classed in the Select Hardwoods value group, the most profitable species group. Gympie messmate grown in the Coastal North, North East Up River, Central Foothills and Coastal South regions produced 288, 300, 361 and 206 m^3 ha^{-1} respectively; retuning $28 811, $12 834, $20 651 and $14 154 ha^{-1}.

Gympie messmate from the Coast North region produced the least volume (288 m^3 ha^{-1}), but the greatest return for the species ($28 811 ha^{-1}). This stand had been thinned; the volume available attributed to a lesser number of larger trees. The effect of thinning on the quality of the available trees is illustrated further when comparing the effect of form weighting on values (b and c panels). The effect of thinning on volume and value can been seen for thinned and unthinned spotted gum. The thinned spotted gum grown in the Coastal North region produced slightly more volume than the unthinned spotted gum in the same region but less than the unthinned spotted gum grown in the North East Up River region (87, 62 and 186 m^3 ha^{-1} respectively). However, when viewing the values the thinned spotted gum is worth close to the same as the unthinned spotted gum grown in the North East Up River region when unweighted ($2282 and $2553 ha^{-1} respectively) and more when the form weight is applied ($1877 and $1577 ha^{-1}), despite the unthinned plantation producing more than double the merchantable volume.

Blackbutt, the species grown across the most sites in the study ranged in volume production from 143 m^3 ha^{-1} in the Northern Foothill regions to 220 m^3 ha^{-1} in the Central Foothills region, returning values of $12488 ha^{-1} and $4610 ha^{-1} unweighted and $8657 ha^{-1} and $978 ha^{-1} weighted.

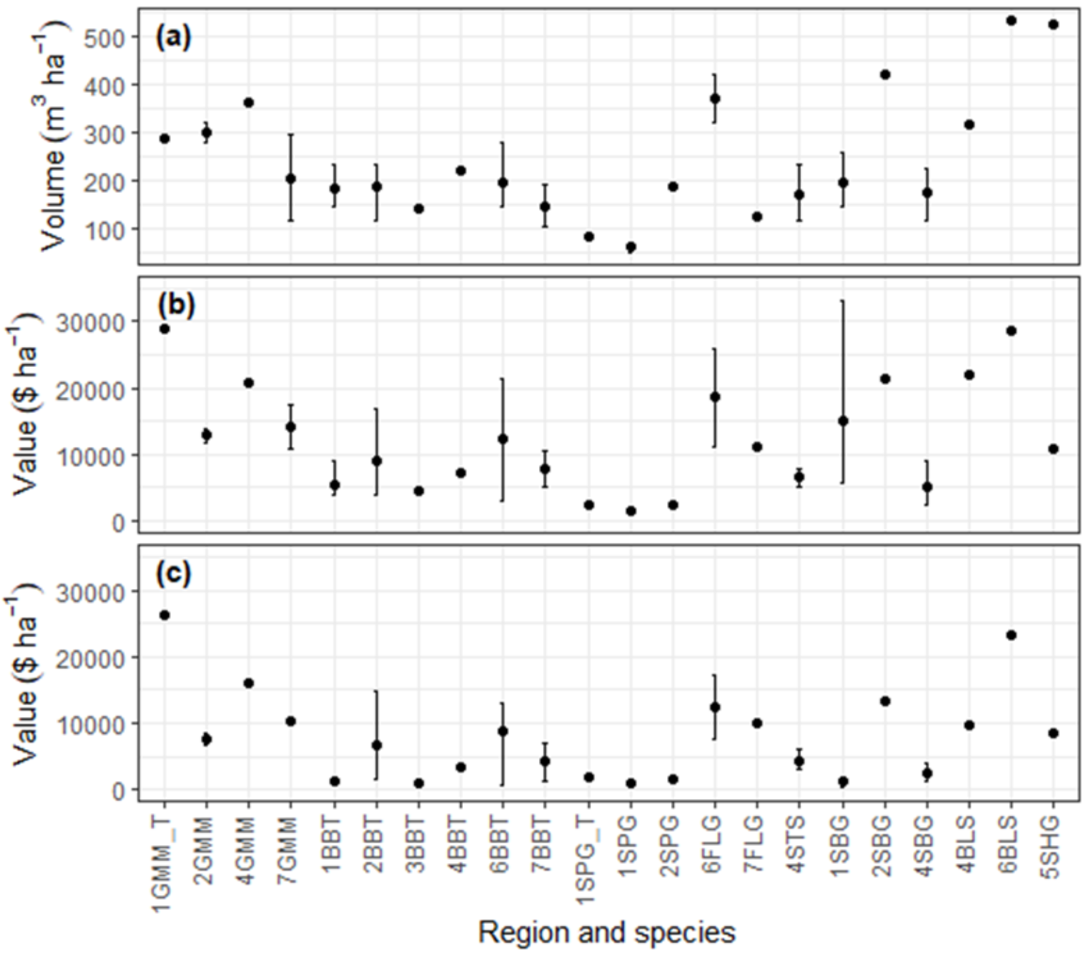


Figure 18. a) Merchantable volume (m^3 ha^{-1}) modelled at age 40; b) unweighted value ($ ha^{-1}) modelled at age 40, and c) weighted value ($ ha^{-1}) modelled at age 40. Figures are ordered by Forestry Corporation species value groups from the highest to lowest value group. Black dots represent the average for the region and species combination, the bar represents the range of

the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

3.5 Financial analysis

Internal rate of return (IRR) for timber was calculated for each location, species and treatment combination. The analysis was completed utilising two management approaches: without pruning events at ages 3 and 7 (Figure 19), and with pruning events at ages 3 and 7 (Figure 20). The 'a' graphs show the unweighted values and 'b' the weighted values.

The modelled returns calculated without pruning costs (Figure 19) show the highest average IRR, Gympie messmate grown in the North Coast region, was 2.08 % unweighted and 1.78 % weighted. Spotted gum grown in the Coastal North region returned the lowest average IRR, -12.46 %, and -22.40% once the form weighting was applied. Thinned spotted gum grown in the North Coast region returned one of the lowest IRRs (-9.23 %), however, as the combination also had a low form rating, the weighted value out preformed 4 combinations with higher unweighted IRR's.

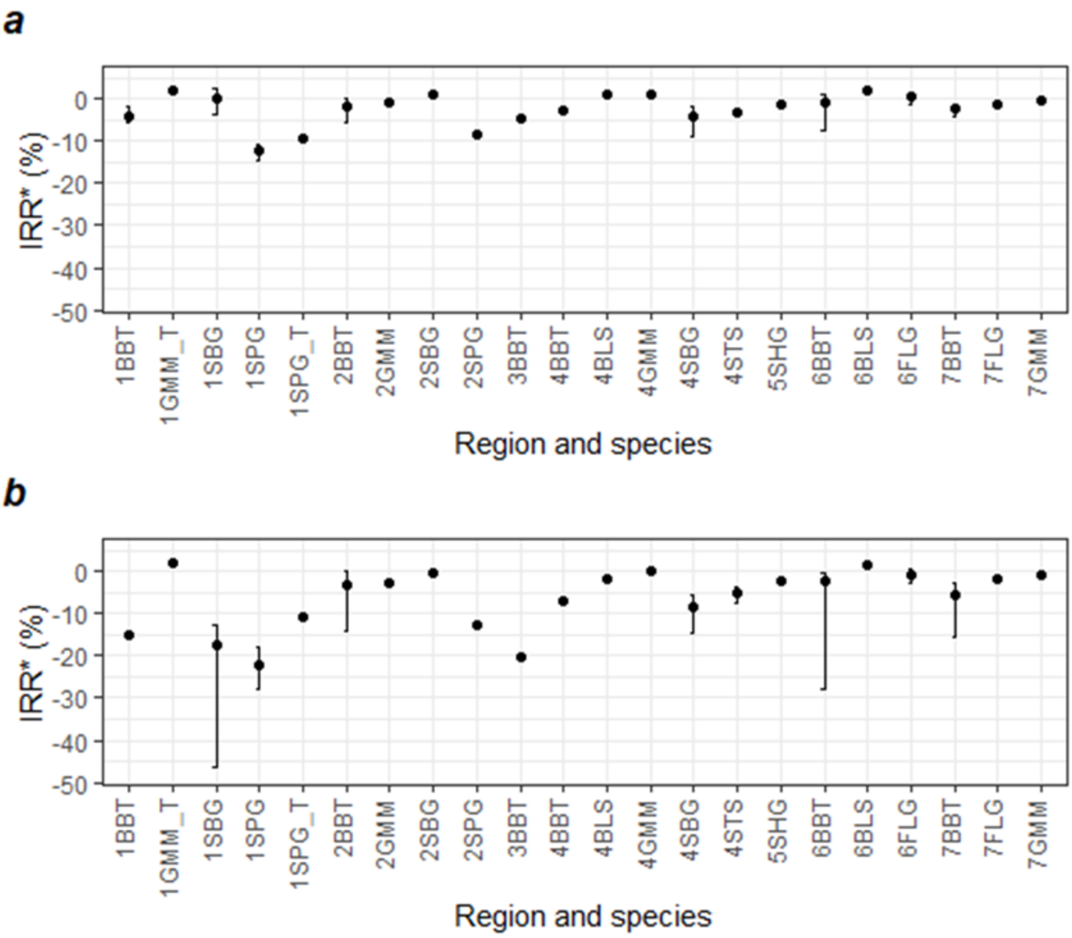


Figure 19. Internal rate of return (IRR) (%) without including the cost of pruning, by region and species modelled at age 40. a) Unweighted value b) Weighted value. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

Figure 20 shows the weighted and unweighted returns for the plantations with the cost of two pruning events. The unweighted and weighted returns for the best preforming combination, Gympie messmate grown in the North Coast region, were 1.66% and 1.36% respectively. Spotted gum grown in the Coastal North region returned the lowest average IRR, -12.59 %, and -22.41% once the form weighting was applied (Figure 20).

Including the two pruning events had an average impact on mean IRR figures for each species and region combination of – 0.38%. Comparatively the average effect of poor form, expressed through the form rating, had an impact of close to 4% (4.08% unpruned and 3.90% pruned).

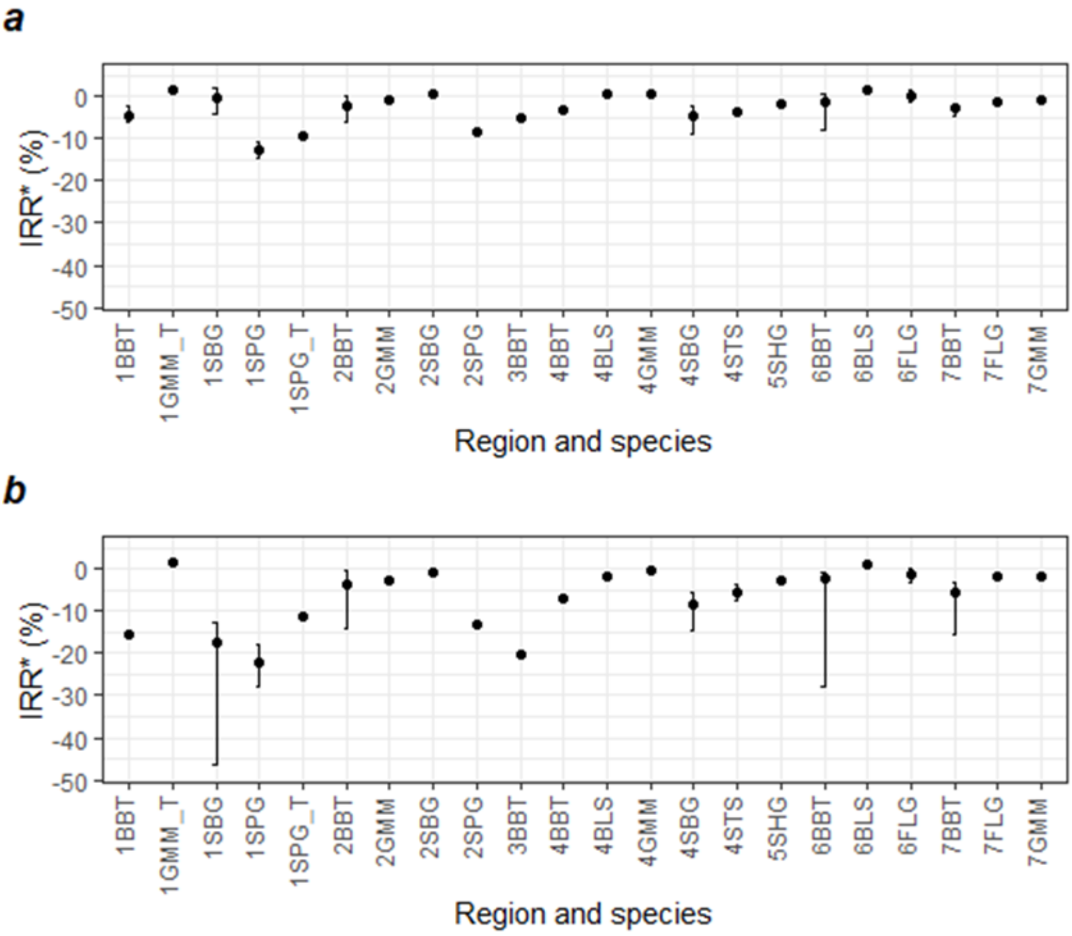


Figure 20. Internal rate of return (IRR) (%) including the cost of pruning, by region and species modelled at age 40. a) Unweighted value b) Weighted value. Black dots represent the average for the region and species combination, the bar represents the range of the data above and below the average. Where there is only a dot, only a single plantation was measured for that region and species combination.

3.6 Site Species Matching

The data for the three select and key species in the dataset was available across 26 sites. The available data did not contain enough replicates to make detailed site species matching inferences, however, some useful insights were gained.

Rainfall ranged from 1000 to 1600 mm yr^{-1} with a mean of 1245 mm yr^{-1}. Blackbutt sites received the highest average rainfall (1329 mm yr^{-1}), followed by Gympie messmate (1291 mm yr^{-1}), then spotted gum (1158 mm yr^{-1}). A rainfall map of the study region is attached as Appendix 4.

Figure 21 shows the relationship between modelled MAI at age 40, stocking and rainfall level. The figure shows a positive trend between MAI and stocking, and higher productivity with higher rainfall. This relationship was confirmed with regression analysis finding a significant relationship between MAI and stocking and MAI and rainfall ($p = 0.01$ and $p = 0.05$ respectively).

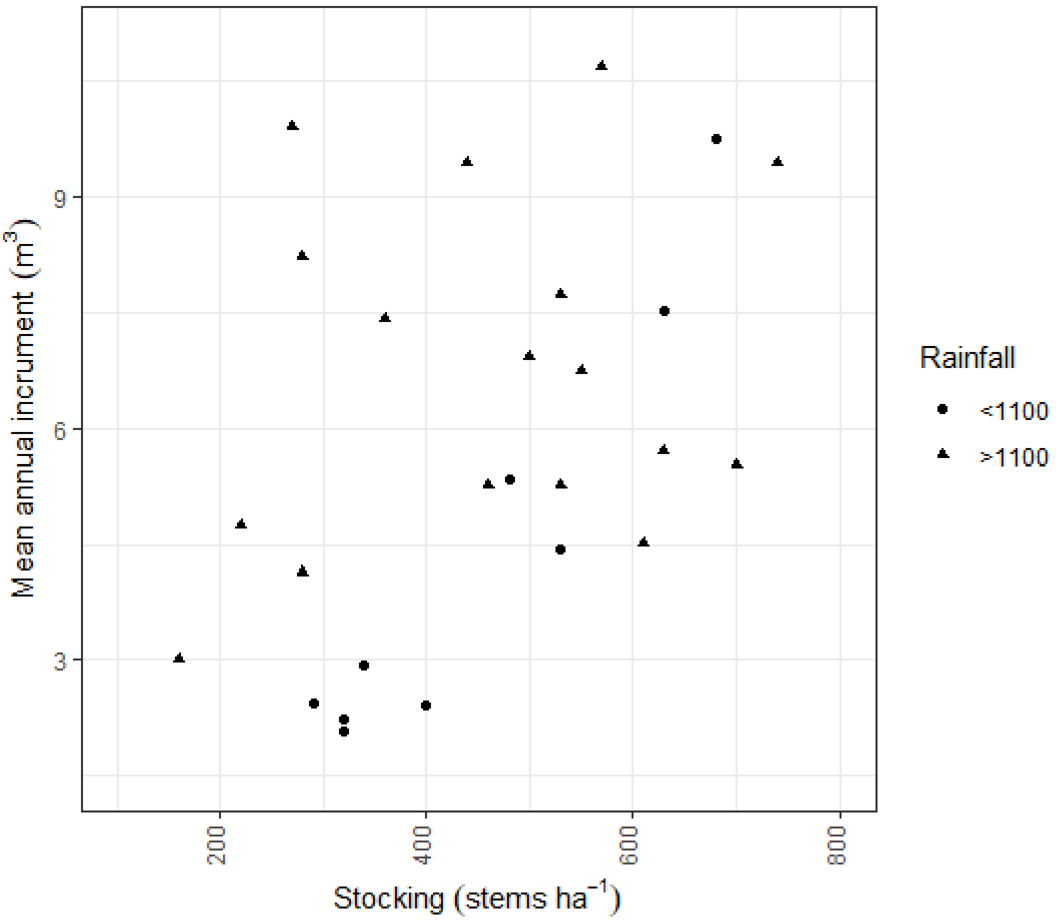


Figure 21. The relationship between stocking (stems ha^{-1}), mean annual increment (m^3) and average annual rainfall (mm yr^{-1}) at age 40. The rainfall has been separated into two groups low rainfall (<1100 mm yr^{-1}) and high rainfall (>1100 mm yr^{-1}). The figure shows the modelled averages for each blackbutt, Gympie messmate and spotted gum plantation, not average region and species groups.

The dermosols and kurosols dominated the soil types present across the study area. The list of soils present and a description may be found in Table 6.

Table 6. Australian Soil Classification, code, and description of soils present in the data set (Adapted from Isbel, R., 2016)

Soil classification	Code	Description
Dermosols	DE	soils with B2 horizons that have grade of pedality greater than weak throughout the major part of the horizon.
Kurosols	KU	Clear but abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is strongly acid.
Sodsols	SO	Clear but abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is sodic and is not strongly subplastic.
Kandosols	KA	Have B2 horizons in which the major part has a grade of pedality that is massive or weak, **and** Have a maximum clay content in some part of the B2 horizon which exceeds 15% (ie. heavy sandy loam [SL+] or heavier).
Rudosol	RU	negligible (rudimentary), if any, pedologic organisation apart from the minimal development of an A1 horizon or the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils have a grade of pedality of single grain, massive or weak in the A1 horizon and show no pedological colour change apart from darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present. Cemented pans may be present as a substrate material.

Figure 22 shows the relationship between modelled MAI at age 40, stocking and soil type. The figure shows a positive trend between MAI and stocking, but no relationship between soil type and productivity.

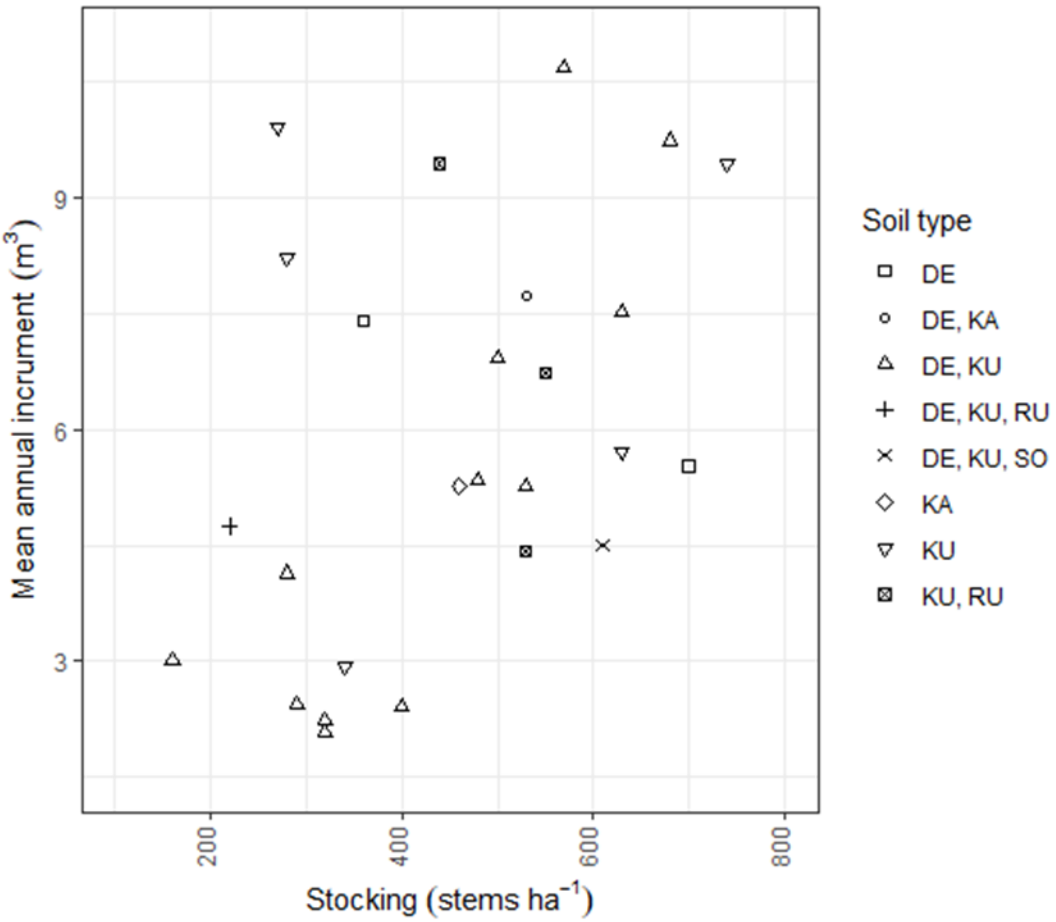


Figure 22. The relationship between stocking (stems ha^{-1}), mean annual increment (m^3) and soil type (Australian Soil Classification) at age 40. The figure shows the modelled averages for each blackbutt, Gympie messmate and spotted gum plantation, not average region and species groups.

DE: Dermosol, KU: Kurosols, SO: Sodsols, KA: Kandosols, RU: Rudosol

4. Discussion

This study provides the opportunity to assess the timber value of the hardwood plantation estate in the north east region of NSW. The estate is close to 20 years in age, 50% of the assumed 40 year rotation. The study drew data from a range of sources and species within the region to model growth and financial outcomes. The modelled outcomes aim to provide the basis for discussion about the current estate and future plantation establishment and management in the region for quality log production.

The results of the study reiterates information about the resource that is widely available: subtropical eucalypt plantations need to be managed to promote the growth of quality timber (Monague et al, 2003; Smith and Brennan, 2006; Cassidy et al, 2012; West and Smith, 2020; Carias and Page, 2023); site and species selection is crucial to positive timber and value outcomes (Garrand et al. 2003; Evans and Turnbull, 2004; Venn, 2005; Nichols et al, 2010; Paul et al, 2013; Carias and Page, 2023); and, the price of logs requires augmenting to incorporate the cost of growing trees (Cassidy et al., 2012).

Silviculture to promote the growth of less, but better quality trees through thinning or longer clear boles through pruning is largely absent from the data set. The resource in the north east of NSW planted in the late 1990's or early 2000's has been largely left unmanaged (Clark, 2004). Plantations established on private property have mostly been removed or left unmanaged. Some, mostly established by now defunct managed investment schemes such as Forest Enterprises Australia have been managed as brown field plantations and have been retrospectively thinned and pruned by new owners (A. Hurford, 2024, personal communication, 03 March)

The most limiting impact on plantation value in this study was log quality, represented as the form score. Lower stem counts, either because of thinning or natural self sorting and mortality, was positively related to both diameter at breast height and stem form. The cost of silvicultural management has been seen as a hurdle to management (Stephens and Grist, 2004; Cassidy et al, 2012), however the cost of not managing is far greater. This analysis shows that the average cost of providing two thinning events and two pruning events is 0.38% of IRR. Comparatively the average cost of poor form was 4%. It is notable that most subtropical eucalypt plantations are planted from unimproved genetic sources; improvements to tree genetics would likely see gains in form and therefore value.

The availability of two site and species combinations to assess the impacts of thinning in this study points to the lack of silviculture being practiced in the region. Comparing the returns of the thinned versus unthinned plantations of the same species in the same, or comparable region, found the impact on return to be 4.13% (Gympie messmate) and 11.25% (spotted gum). The cost of silviculture being outshone by the returns.

Species selection is crucial to plantation value. Species nominated as 'select' and 'key' species by Forestry Corporation of NSW are the highly sort after native forest species in the region, offering the greatest return to the grower. Species selection for plantations should consider log values and marketability at the end of the rotation (Venn, 2005; Nolan et al, 2005, Smith and Brenna, 2006, Cassidy et al, 2012). Shining gum grown in the Central Tablelands region exemplifies this; the log volume and form were both high for this species, but the low market value of the timber negates further consideration of the species for plantation establishment.

Reassessing the value of plantation grown logs will be necessary to support the expansion of the privately owned plantation estate in the north east of NSW. Historically prices set buy government have been such to support industry and employment, not reflective of the cost to grow trees (Cassidy et al, 2012). Potentially, the logs produced in long rotation managed plantations will be of higher and more consistent quality, the cost of harvest lower and haulage distances less due to planting on preciously cleared land.

With the continued pressure on native forest harvesting in the rest of the country (Kanowski, 2017), the Australian timber market is to become more reliant on plantation grown logs or imported products. The market will need to consider the cost of timber production (Cassidy et al, 2012; Whittle et al, 2019; Cacho et al, 2001).

Prices used in this study from Forestry Corporation NSW are less than the prices paid for logs grown on private property (J. Rankin, 2024, personal communication, 31 May). Even so, when considering the best preforming species, management and region combination: thinned Gympie messmate grown in the Coastal North region (1.66% IRR), increasing the value of the logs by 200% provides a return of 5.03%, unsurprisingly three times the modelled value.

Alternately, if better genetics or silvicultural management was available and the time to grow the same product was reduced to 30, rather than 40 years the return to the producer would be 2.67%, 1.6 times the modelled value. The government's Support Plantation Establishment Program (DAFF, 2023) offers \$2000 ha^{-1} towards establishment cost. Factoring this potential funding to reduce upfront cost could change the rates of return above to 2.13% over 40 years or 3.38% over 30 years (1.28 and 2.04 times the modelled value respectively). The high cost of plantation establishment, compared to other plantation timber such as pine. Cost are higher due to challenges such as terrain and weed control, some cost could be mitigated in the future due to the economies of scale should there be higher demand. Improvements in genetics (Henson and Smith, 2007) and silviculture (Smith and Brennan, 2006) may also yield higher gross product recovery during processing and contribute to reduced establishment and maintenance costs by reducing the number of trees planted and thinned non commercially at an early age (Cassidy et al, 2012). The improved economics of these contributions can't be estimated however, without data to support this suggestion. Despite that, there is the potential to underwrite the necessary log price adjustments to support the investment.

As the estate is reaching 20 years of age thinnings logs are being harvested for commercial products. Chip based products are not viable in the region due to lack of local market and distance to the nearest port for export (Cassidy et al., 2012). Thinnings products are predominantly small poles and firewood. These value adding activities will increase profitability beyond the figures modelled in this study for producers with the capability to access such processes. Indeed, value adding processes for both thinning and final harvest products will change the financial viability for plantation grown eucalypts in the region. However, the capacity to value add is beyond many current or would be plantation owners, and out of scope for the largest plantation owner, Forest Corporation of NSW. Investment into thinnings market creation or cooperative processing facilities for small private producers may prove helpful for encouraging the expansion of the hardwood estate in the region. Market certainty and transparency for logs harvested at the end of the rotation is also needed (Keenan et al, 2019).

Additional plantation values are beyond the scope of this report but are not insignificant. They include environmental and biodiversity values (O'Grady and Mitchel, 2018; Marais et al, 2019); agricultural co-benefit values (Barker at al, 2018; Fleming et al., 2019); and, carbon. Carbon sequestration benefits may be monetised as Australian Carbon Credit Units (ACCU's) (Monckton and Mendham, 2022; Wall, 2022) and the income has the potential to offset some of the establishment and management costs for the plantation and increase the overall financial performance of the investment. Wall (2022) suggests growing plantation eucalypts in the north east of NSW could return \$4100 - \$6800 ha^{-1} in carbon credit revenue (assuming \$18/unit).

The effect of site and species match was evaluated for the most financially viable species in the data set only; the select (Gympie messmate) and key (blackbutt and spotted gum) species. The data consisted of 26 sites for the 3 target species. Whilst there wasn't enough data to reach conclusions on site and species matching, the data did provide some useful insights.

The rainfall variation in the data set is representative of the spread of rainfall in the east of the study area. The lowest rainfall in the dataset (1000mm yr^{-1}) is quite substantial. Given the significant relationship between rainfall and productivity lesser performance would be expected with lesser rainfall. Planting on sites with rainfall lower than 1000mm yr^{-1} should be done with caution, adding further replicates to the data set with lower rainfall averages would provide further certainty on productivity.

The target species were tolerant of the range of soils in the data set. Several of the soil combinations only occurred once or twice in the set, adding further sites to the data set would enable further discussion on the effect of soils on productivity. No soil type provided an obvious disadvantage. The significant relationship between MAI and stocking suggests growth on these sites was not attributed to site productivity, rather stocking and site occupation.

5. Conclusion

The interactions of site, species and management on the factors that affect log value: species, size and form are intricate. The need to understand such interactions for successful plantation management supports the need for further research with a focus on high value species and the application of optimum silviculture. Intricacies of growing and management costs and returns and the effect of the current log value system requires further consideration. However, this study highlights the importance of management for log size and quality outcomes. The price returned for logs needs to account for growing costs. To provide a full account of plantation worth the exploration of the environmental values offered by plantations need to be highlighted regardless of their monitorisation. Plantation growth is correlated with rain fall, and site occupation should be managed for optimum productivity. To expand the plantation estate current and potential resource owners will require clear technical advice during establishment and management and access to secure markets in the future.

6. References

Australian Building Codes Board, 2019. Climate zone map. www.abcb.gov.au

Baker T, Moroni M, Mendham D, Smith R, Hunt M. 2018. Impacts of windbreak shelter on crop and livestock production. Crop & Pasture Science. 69:785–796. doi:https://doi.org/10.1071/CP17242.

Bi, H., 2000. Trigonometric variable-form taper equations for Australian eucalypts. Forest science, 46(3), pp.397-409.

Cacho, O., Greiner, R., Fulloon, L., 2001. An economic analysis of farm forestry as a means of controlling dryland salinity. Australian Journal of Agricultural and Resource Economics, 45(2), pp.233-256.

Carias Vega, D., Page, T., 2023. Conditions that Enable Successful Participation of Smallholder Tree Growers in Timber Value Chains. Small-scale Forestry, 22(3), pp.457-479.

Cassidy, M., Palmer, G., Glencross, K., Nichols, J.D., Smith, R.G.B., 2012. Stocking and intensity of thinning affect log size and value in *Eucalyptus pilularis*. For. Ecol. Manage. 264, 220–227. https://doi.org/10.1016/j.foreco.2011.10.007

Cassidy, M., Palmer, G., Smith, R.G.B., 2013. The effect of wide initial spacing on wood properties in plantation grown *Eucalyptus pilularis*. New For. 44, 919–936. https://doi.org/10.1007/s11056-013-9385-5

Clark, J., 2004. Forest policy for sustainable commodity wood production: An examination drawing on the Australian experience. Ecol. Econ. 50, 219–232. https://doi.org/10.1016/j.ecolecon.2004.03.032

Commonwealth of Australia, 1995. Regional Forest Agreements: the Commonwealth Position. Commonwealth of Australia, Canberra.

Department of Agriculture fisheries and forestry (DAFF) 2023. Support Plantation Establishment Program.

Department of agriculture water and environment, ND. Regional Forest Agreements Environment and heritage factsheet.

Department of Planning, Industry and Environment, 2021. *Australian Soil Classification (ASC) Soil Type map of NSW*, Version 4.5, Department of Planning, Industry and Environment, Parramatta.

Evans, J., Turnbull, J., W., 2004. Plantation forestry in the tropics: the role, silviculture and use of planted forests for industrial, social, environmental and agroforestry. Oxford University Press, Oxford.

Fleming, A., O'grady, A.P., Mendham, D., England, J., Mitchell, P., Moroni, M., Lyons, A., 2019. Understanding the values behind farmer perceptions of trees on farms to increase adoption of agroforestry in Australia. Agronomy for sustainable development, 39(1), p.9.

Forestry Corporation of NSW, 2017. The price system. NSW native forest and hardwood plantation pricing system.

Forestry Corporation of NSW, 2024.High Quality Sawlog – 1 April 2024 Stumpage prices (North)

Gerrand, A., Keenan, R.J., Kanowski, P., Stanton, R., 2003. Australian forest plantations: An overview of industry, environmental and community issues and benefits. Aust. For. 66, 1–8. https://doi.org/10.1080/00049158.2003.10674881

Henson, M. and Smith, H.J., 2007. Achievements in forest tree genetic improvement in Australia and New Zealand 1: Eucalyptus pilularis Smith tree improvement in Australia. Australian Forestry, 70(1), pp.4-10.

Ibbotson RG, Chen P (2003) Long-run stock returns: participating in the real economy. Financ J. 59, 88–98.

Isbell R., 2021. The Australian soil classification. CSIRO publishing

James, R.N., 2001. Defining the Product Log Grades Used in Australia: A Report for the RIRDC/Land & Water Australia/FWPRDC Joint Venture Agroforestry Program. RIRDC.

Kanowski, P.J., 2017. Australia's forests: Contested past, tenure-driven present, uncertain future. *Forest* Policy and Economics, *77*, pp.56-68.

Keenan, R.J., Anderson, N., Bull, L., Dembek, K., Kostanski, L., Patterson, S., 2019. Designing business models for commercial tree-growing partnerships on rural land. University of Melbourne.

Leskinen, P. and Kangas, J., 1998. Modelling and simulation of timber prices for forest planning calculations. Scandinavian Journal of Forest Research, *13*(1-4), pp.469-476.

Leys, A.J., Vanclay, J.K., 2011. Stakeholder engagement in social learning to resolve controversies over land-use change to plantation forestry. Reg. Environ. Chang. 11, 175–190. https://doi.org/10.1007/s10113-010-0132-6

Loxton EA, Schirmer J, Kanowski P. 2012. Social impacts of the Regional Forest Agreement on members of the forest industry in north-eastern New South Wales. Aust For. 75:251–263.

Marais ZE, Baker TP, O'Grady AP, England JR, Tinch D, Hunt MA. 2019. A natural capital approach to agroforestry decision-making at the farm scale. Forests. 10(11):980.

Maraseni, T.N., Cockfield, G., 2011. Crops, cows or timber? Including carbon values in land use choices. Agric. Ecosyst. Environ. 140, 280–288. https://doi.org/10.1016/j.agee.2010.12.015

Monckton, D., & Mendham, D. S., 2022. Maximising the benefits of trees on farms in Tasmania–a desktop review of investment opportunities to improve farm enterprise productivity, profitability and sustainability. Australian Forestry, *85*(1), 6-12.

Montagu, K.D., Kearney, D.E., Smith, R.G.B., 2003. The biology and silviculture of pruning planted eucalypts for clear wood production - A review. For. Ecol. Manage. 179, 1–13. https://doi.org/10.1016/S0378-1127(02)00579-0

Nichols, J.D., Smith, R.G.B., Grant, J., Glencross, K., 2010. Subtropical eucalypt plantations in eastern Australia. Aust. For. 73, 53–62. https://doi.org/10.1080/00049158.2010.10676310

Nolan G, Washusen R, Jennings S, Greaves B, Parsons M (2005) Eucalypt plantations for solid wood products in Australia—a review. Forest and Wood Products Research and Development Corporation

O'Grady A, Mitchell P. 2018. Agroforestry: realising the triple bottom benefits of trees in the landscape. Hobart (Australia): CSIRO. [accessed 2021 Dec 22]. doi:https://doi.org/10.25919/5b5625b5c08df.

Palmer, G. (2022). A report on return on investment in wood production from public and privately-owned native forest. Southern Cross University. Lismore, Australia.

Palmer, G., 2010. Conversion modelling: simulating tree stems. PhD thesis, Southern Cross University, Lismore, NSW.

Paul, K.I., Reeson, A., Polglase, P.J., Ritson, P., 2013. Economic and employment implications of a carbon market for industrial plantation forestry. Land use policy 30, 528–540. https://doi.org/10.1016/j.landusepol.2012.04.015

Smith, R.G.B., Brennan, P., 2006. First thinning in sub-tropical eucalypt plantations grown for high-value solid-wood products: a review. Aust. For. 69, 305-312.

State Government of NSW and NSW Department of Climate Change, Energy, the Environment and Water., 2020. ANUCLIM Annual Mean Rainfall raster layer.

Stephens, M. L., Grist, P., 2014. Market failure for plantations: past experiences and emerging trends for delivering wood production and ecosystem services in Australia. International Forestry Review 16, 205-215.

Vanclay, J.K., 2010. Robust relationships for simple plantation growth models based on sparse data. *Forest* Ecology and Management, *259*(5), pp.1050-1054.

Venn, T.J., 2005. Financial and economic performance of long-rotation hardwood plantation investments in Queensland, Australia. Forest Policy and Economics, *7*(3), pp.437-454.

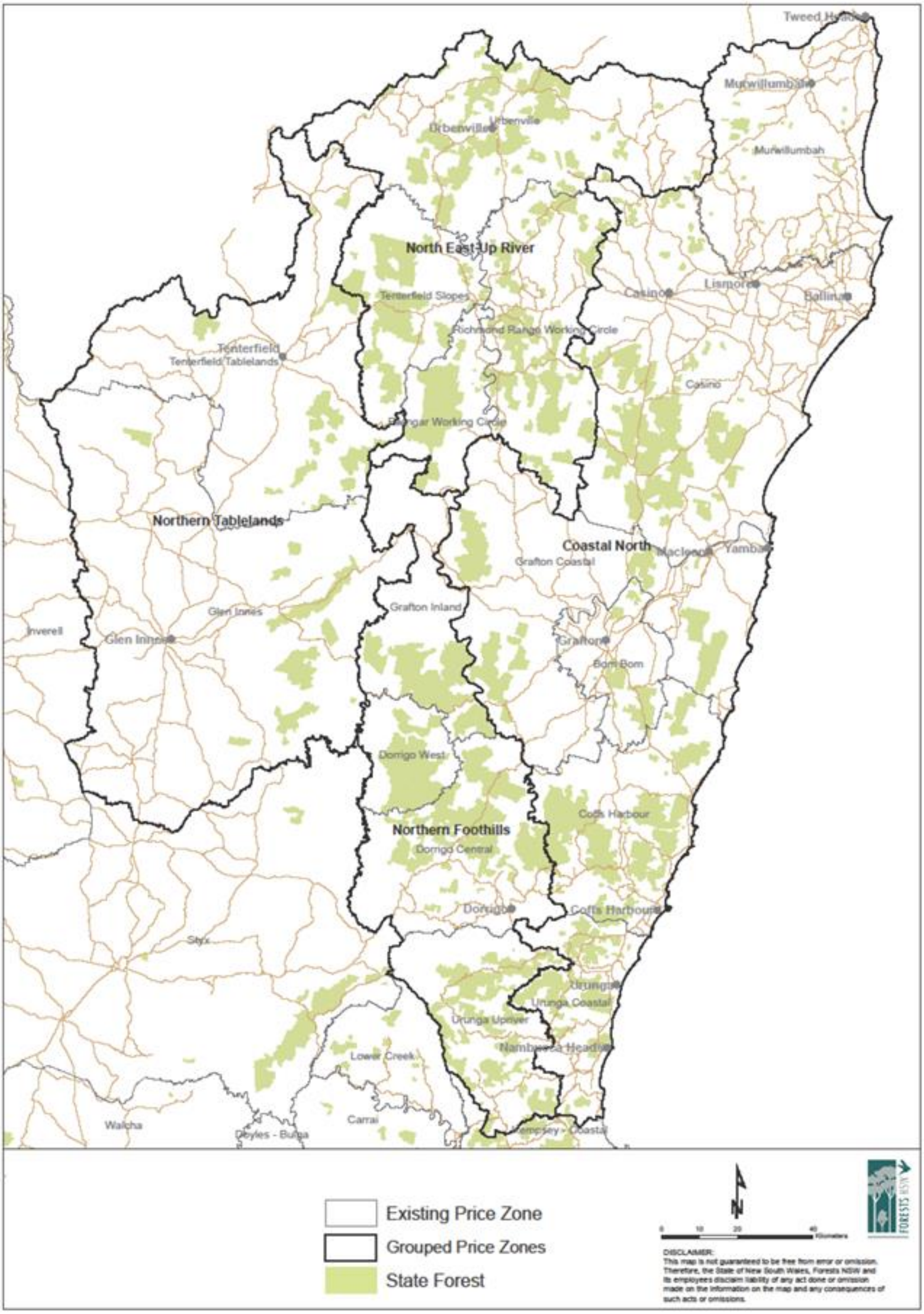
Wall, J. A Grower's Guide for North East NSW - Realising the Carbon Sequestration Benefits of Planted Forests. 2rog Consulting.

West, P.W. and Smith, R.G.B., 2020. Effects of tree spacing on branch-size development during early growth of an experimental plantation of *Eucalyptus pilularis* in subtropical *Australia*. *Australian Forestry*, *83*(1), pp.39-45.

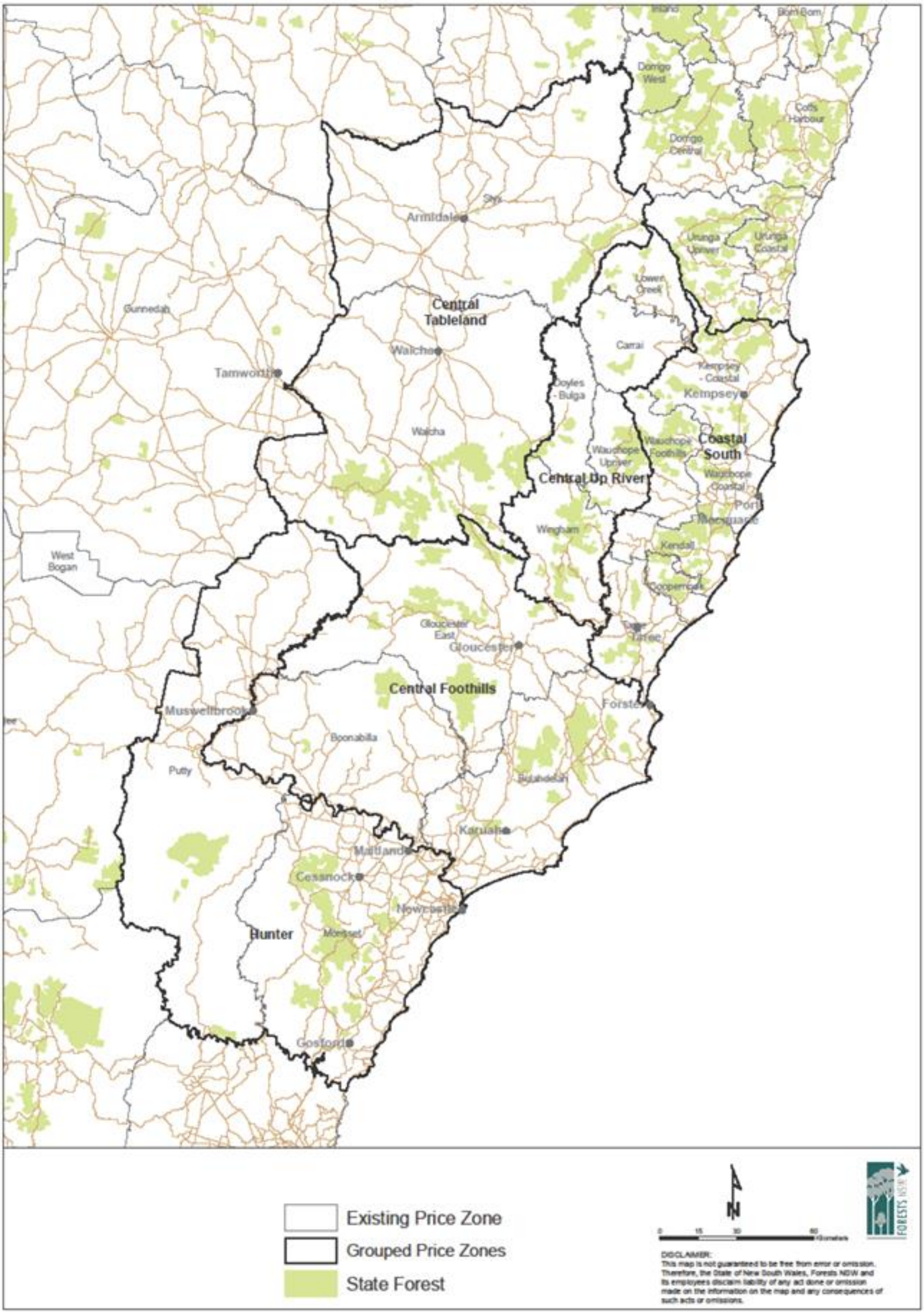
West PW (2006) Growing plantation forests. Springer, Berlin

Whittle, L., Lock, P., Hug, B., 2019. Economic potential for new plantation establishment in Australia: outlook to 2050. ABARES research report, Canberra.

Appendix 1. Forestry Corporation NSW price zone maps

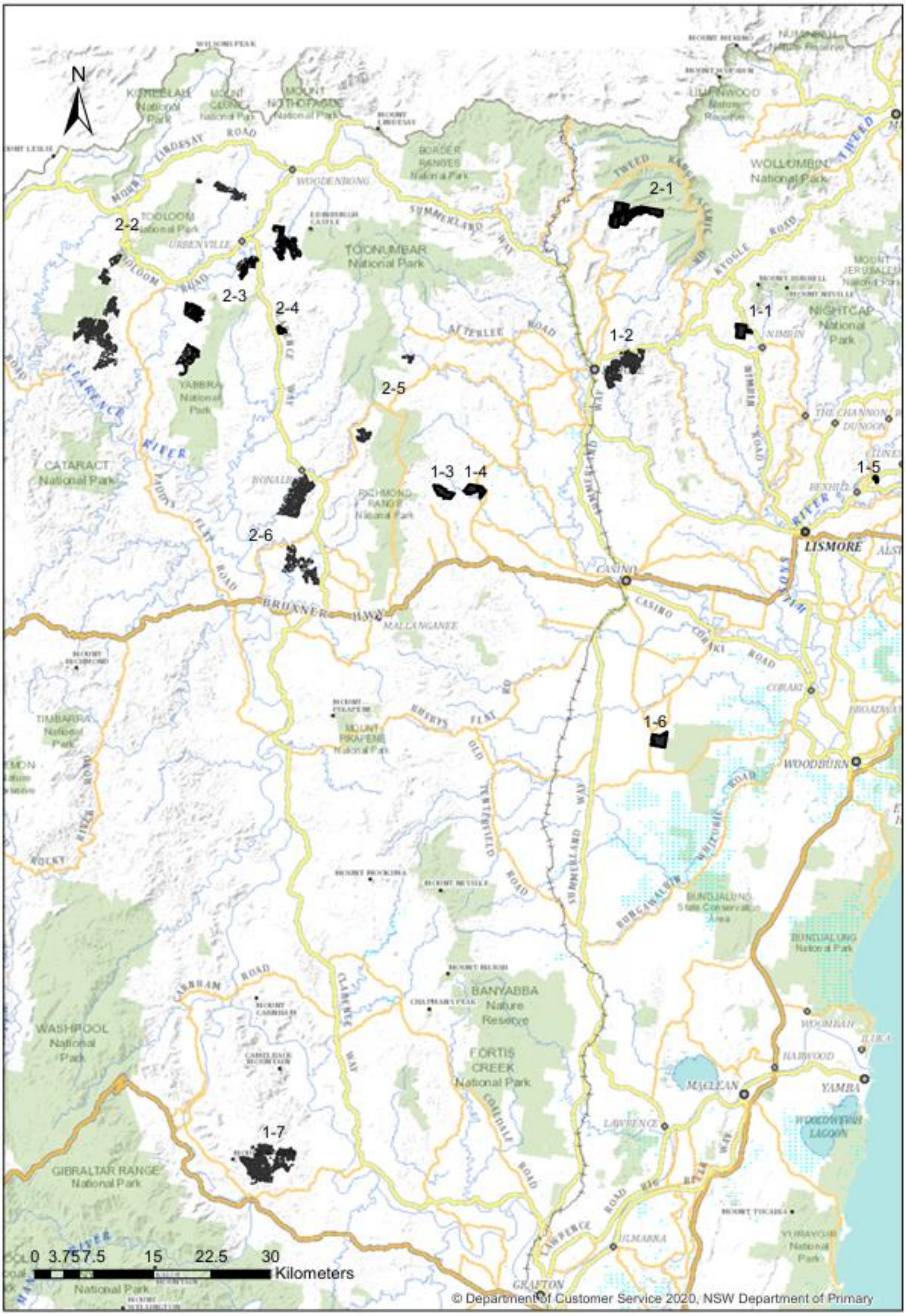


Map 1.1. North East Region (Forestry Corporation NSW, 2017)

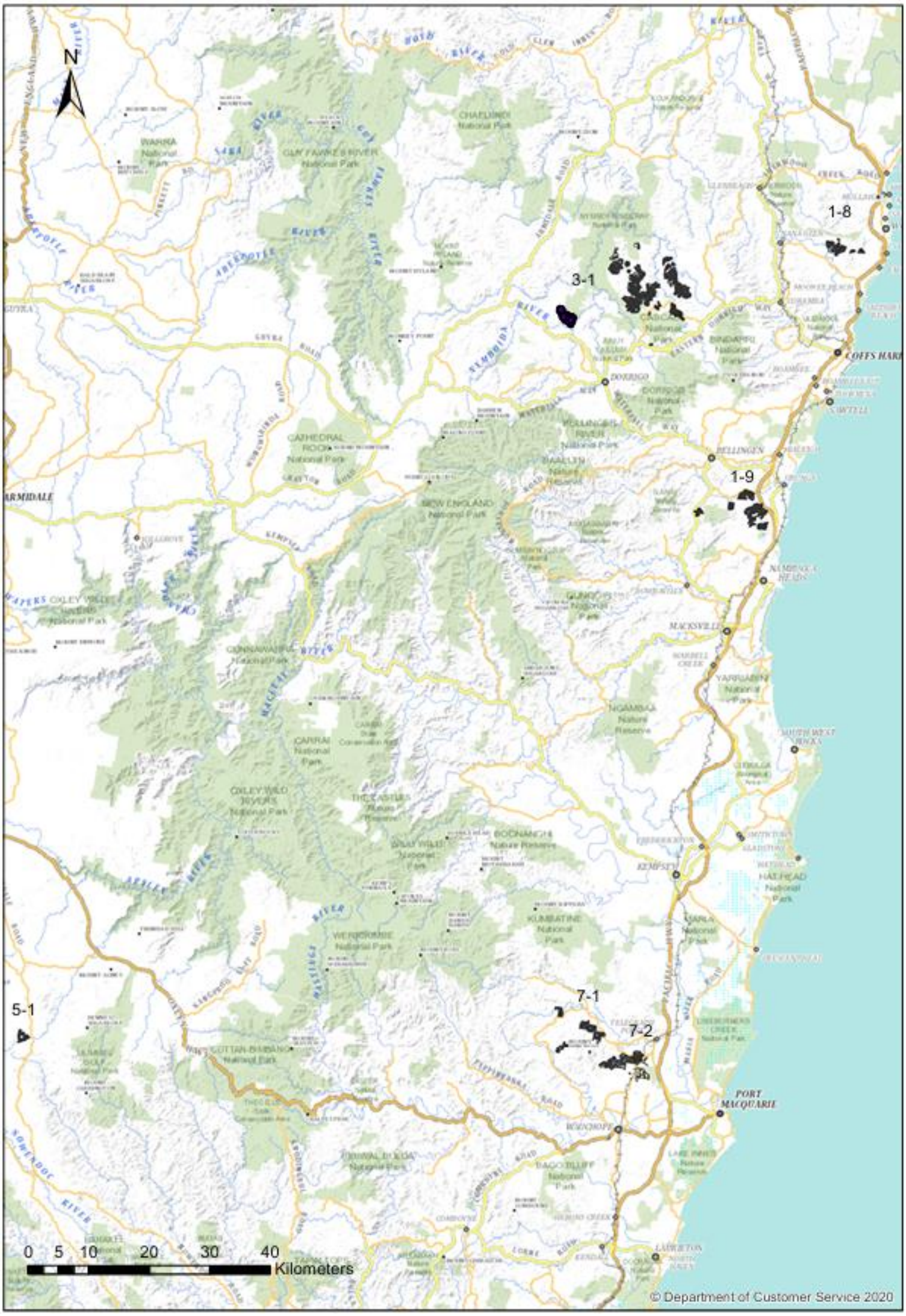


Map 1.2. Central Region (Forestry Corporation NSW, 2017)

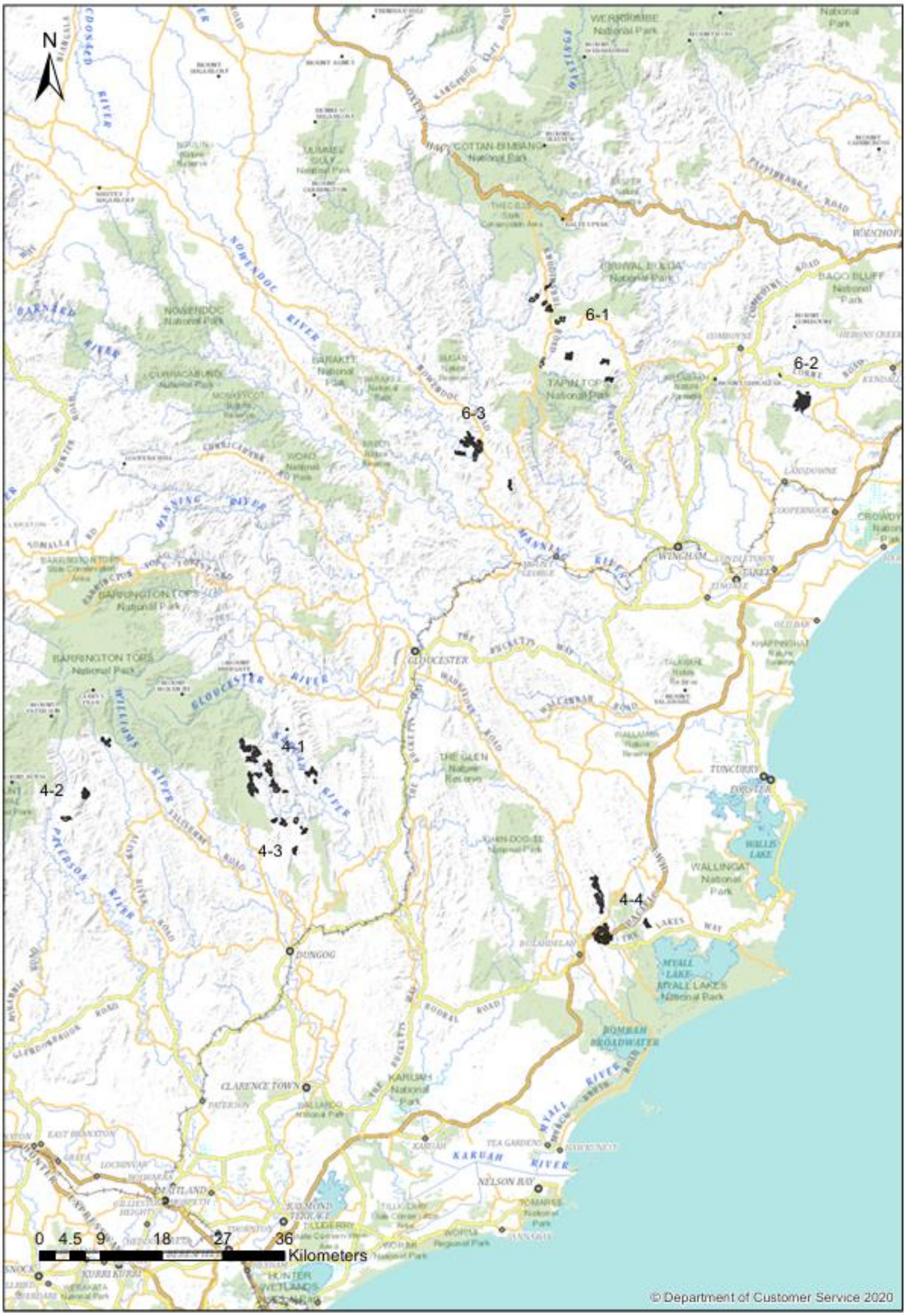
Appendix 2: Plantation locations



Map 2.1. Plantation locations in regions 1 and 2



Map 2.2. Plantation locations in regions 1, 3, 5 and 7.



Map 2.3. Plantation locations in regions 6 and 4.

Appendix 3: Stumpage price schedule

Log prices by species, size and region (Forestry Corporation of NSW, 2024.

Price Zone	Species Group	Size Classes						
		20-29	30-34	35-37	38-39	40-49	50-69	70+
Coastal North	Select Hardwoods	$26.49	$42.20	$67.42	$93.92	$128.66	$155.68	$189.13
	Key Hardwoods	$26.35	$41.99	$67.08	$94.08	$128.01	$154.89	$188.17
	High Value Hardwoods	$20.46	$32.60	$52.09	$73.06	$99.40	$120.28	$146.12
	Mixed Hardwoods	$18.19	$28.98	$46.30	$64.94	$88.35	$106.91	$129.88
	Tableland Hardwoods	$11.19	$15.76	$25.17	$36.46	$50.78	$64.25	$79.11
	High Country Hardwoods	$12.19	$19.42	$31.02	$43.52	$59.21	$71.64	$87.03
North East Up River	Select Hardwoods	$23.05	$36.72	$58.66	$81.72	$111.95	$135.46	$164.57
	Key Hardwoods	$23.47	$37.39	$59.73	$83.78	$113.99	$137.93	$167.56
	High Value Hardwoods	$14.26	$22.72	$36.29	$50.90	$69.25	$83.80	$101.80
	Mixed Hardwoods	$7.73	$12.31	$19.67	$27.59	$37.54	$45.42	$55.18
	Tableland Hardwoods	$9.31	$14.82	$23.68	$33.21	$45.18	$54.67	$66.42
	High Country Hardwoods	$9.98	$15.89	$25.38	$35.60	$48.43	$58.60	$71.19
Northern Foothills	Select Hardwoods	$24.31	$38.74	$61.89	$86.22	$118.11	$142.92	$173.63
	Key Hardwoods	$23.06	$36.74	$58.70	$82.33	$112.02	$135.54	$164.67
	High Value Hardwoods	$16.81	$26.78	$42.79	$60.02	$81.66	$98.81	$120.04
	Mixed Hardwoods	$15.84	$25.24	$40.33	$56.57	$76.96	$93.12	$113.13
	Tableland Hardwoods	$10.55	$16.80	$26.85	$37.66	$51.23	$61.99	$75.31
	High Country Hardwoods	$9.62	$15.32	$24.48	$34.34	$46.72	$56.53	$68.68
Northern Tablelands	Select Hardwoods	$20.51	$36.76	$57.68	$79.40	$109.41	$135.51	$164.22
	Key Hardwoods	$21.06	$37.07	$59.35	$82.58	$113.32	$141.47	$174.34
	High Value Hardwoods	$16.78	$26.74	$42.71	$59.91	$81.51	$98.63	$119.82
	Mixed Hardwoods	$12.98	$24.77	$39.14	$52.92	$72.03	$86.75	$111.67
	Tableland Hardwoods	$11.78	$18.76	$29.96	$42.03	$57.18	$69.19	$84.05
	High Country Hardwoods	$8.32	$13.25	$21.17	$29.69	$40.39	$48.88	$59.38
Central Foothills	Select Hardwoods	$29.76	$47.41	$75.74	$105.52	$144.55	$174.91	$212.49
	Key Hardwoods	$26.64	$42.44	$67.80	$95.10	$129.39	$156.56	$190.21
	High Value Hardwoods	$20.31	$32.36	$51.70	$72.51	$98.65	$119.37	$145.02
	Mixed Hardwoods	$20.78	$33.11	$52.89	$74.19	$100.94	$122.14	$148.38
	Tableland Hardwoods	$11.24	$17.90	$28.60	$40.12	$54.58	$66.05	$80.24
	High Country Hardwoods	$8.93	$14.22	$22.72	$31.86	$43.35	$52.46	$63.73
Central Tablelands	Select Hardwoods	$18.33	$32.86	$51.57	$70.98	$97.81	$121.14	$146.81
	Key Hardwoods	$18.82	$33.14	$53.06	$73.82	$101.30	$126.47	$155.86
	High Value Hardwoods	$15.00	$23.90	$38.18	$53.56	$72.87	$88.17	$107.12
	Mixed Hardwoods	$11.60	$22.15	$34.99	$47.31	$64.39	$77.55	$99.83
	Tableland Hardwoods	$8.28	$13.19	$21.07	$29.56	$40.22	$48.66	$59.12
	High Country Hardwoods	$4.99	$7.94	$12.69	$17.80	$24.22	$29.30	$35.60
Central Up River	Select Hardwoods	$24.67	$39.31	$62.80	$87.49	$119.85	$145.02	$176.18
	Key Hardwoods	$23.70	$37.76	$60.32	$84.60	$115.11	$139.28	$169.21
	High Value Hardwoods	$17.07	$27.19	$43.44	$60.93	$82.90	$100.31	$121.87
	Mixed Hardwoods	$13.20	$25.20	$39.81	$53.82	$73.26	$88.23	$113.58
	Tableland Hardwoods	$10.27	$16.36	$26.13	$36.65	$49.87	$60.34	$73.31
	High Country Hardwoods	$7.89	$12.56	$20.07	$28.16	$38.31	$46.35	$56.31
Coastal South	Select Hardwoods	$28.08	$44.75	$71.49	$99.59	$136.43	$165.08	$200.55
	Key Hardwoods	$28.55	$45.49	$72.67	$101.93	$138.68	$167.80	$203.86
	High Value Hardwoods	$23.29	$37.12	$59.30	$83.17	$113.16	$136.92	$166.35
	Mixed Hardwoods	$17.54	$27.95	$44.65	$62.63	$85.21	$103.10	$125.26
	Tableland Hardwoods	$16.23	$25.84	$41.28	$57.90	$78.78	$95.32	$115.81
	High Country Hardwoods	$12.42	$19.79	$32.65	$47.00	$65.71	$75.02	$78.43

Appendix 4: Rainfall map

Map 4.1. Rainfall distribution across study area

Landholder barriers and incentives to timber production in north east New South Wales

Mia Cassidy and Graeme Palmer

Southern Cross University

Prepared for the North East NSW Forestry Hub

May 2024

Contents

Document Control

Project name	Flip barriers into opportunities to stimulate timber supply.
Report name	Landholder barriers and incentives to timber production in north east New South Wales.
Date	9/05/2024
Status	FINAL Prepared by Mia Cassidy for and on behalf of Southern Cross University
Review	Reviewed by NE NSW Forestry Hub. Approved by Graeme Plamer for and on behalf of Southern Cross University

Acknowledgments

Professor Jerry Vanclay and Dr Stephanie Hernandez for their guidance with survey design and analysis.

This report was commissioned by the North East NSW Regional Forestry Hub with funding from the Australian Department of Agriculture, Fisheries and Forestry.

Disclaimer

Executive summary

Background

The history of forestry in the north east region of NSW extends back 150 years with the first State forests created in the early 1900s. In recent decades large areas of state-owned native forests have been transferred from State Forest that permit wood production to National Parks & Reserves which have a conservation focus. This has been largely motivated, directly or indirectly, by the development of Regional Forest Agreements (RFAs) that were brokered between state and Commonwealth governments in the late 1990s. Developed as a way of resolving the ongoing conflict over the use of Australia's forests, the RFAs saw a great change in the way forests are used and managed (Mercer and Underwood, 2002; Clark, 2004; Jay et al., 2007).

Unfortunately, the RFA have not entirely lived up to their promise with harvesting of native State forests still vigorously contested (Kanowski, 2017). The contest has raised interest in the development of private forestry. This includes establishing new hardwood plantations as well as providing better support for native farm forestry.

Examining the potential of plantations to replace public native forestry is not new. In the late 1990s the Commonwealth government developed a Plantation 2020 Vision for Australia that aimed to establish 3 million ha of hard and soft wood timber plantations by the year 2020, a trebling of the estate at that time (Plantation 2020 Vision Implementation Committee, 1997).

Unfortunately, in many regions, including the far north of New South Wales, the poor management of many of these plantations has led to scepticism from the rural agricultural community towards plantation forestry (Montoya, 2010; Medows et al., 2014: Rhodes and Stephens, 2014; Fleming et al., 2019).

In 2018 the Department of Agriculture and Water Resources released a national forest industry plan entitled *Growing a better Australia – A billion trees for jobs and growth* (DWAR, 2018). The plan introduced the government's intentions to encourage the establishment of 400 000 ha of plantation, focusing on farmland. (DWAR, 2018). A subsequent policy, Support Plantation Establishment Program, offering a grant pool of $73.76 million to subsidise plantation establishment over 4 years was released in 2023 (DAFF, 2023). Both policies aim to increase Australia's long rotation plantation timber estate. However, limited uptake to date suggests the incentives are insufficient. To achieve its goal, it will be necessary for the government to work with the farming community to better understand the motivations and barriers to planting forests on farms.

The objectives of small scale private land holders is changing both in Australia (Herbohn et al., 2005; Meadows et al., 2014; Baker et al., 2017) and overseas (Kendra and Hull, 2005; Bjarstig and Kvastegard, 2016; Matilainen et al., 2018). By identifying motivations and constraints regarding growing trees and timber production, effective policy and support for timber production can be delivered. This study surveyed land holders in north east NSW to better understand their objectives, attitudes, and motivations for growing and managing trees on their property.

Study location and methods

The study location mimics the North East Regional Forest Agreement zone in north east NSW which stretches from the Queensland border in the north to the Hawkesbury River, just to the north of Sydney, in the south.

A total of 301 land holders were surveyed across the region, 284 of the surveys were assessed as viable for use in analysis. Landholders were surveyed to capture a snapshot of the landholder's demographics and land management practices and attitudes toward timber production as a land use. Landholders were asked to identify barriers to timber production on their property and associated incentives, if any, that would help them to overcome the barriers.

Landholders were separated into two groups based on their willingness to consider timber production on their property. 'Willing' landholders who would consider producing timber on their property, and "Unwilling' landholders: those who wouldn't.

Results and discussion

Unwilling Landholders

Unwilling landholders were more likely to be family or multi-generational households residing on their property, older, working on the property and residing towards the south of the survey region. They have smaller properties, are not engaged in private native forestry and do not manage their property for timber production.

Willing Landholders

Willing landholders were more likely to be child free single generation households or businesses, not residing on the property; younger, working off the property and residing towards the north of the survey region. They had larger properties, were more likely to be involved in private native forestry and managing their properties for timber production.

Motivation to grow trees.

Motivations to grow trees for both willing and unwilling landholders were dominated by environmental and amenity reasons and if the trees will be complimentary to their agriculture. Willing landholders were also motivated to grow trees for commercial production and carbon reduction.

Information sources

The distribution of sources for land management information was consistent for both willing and unwilling landholders. Peer to peer communication was the most common source of land management information followed by Government extension.

Barriers to timber production

Land Use Conflict (the landholder is using their property for other endeavours and doesn't have space for trees), was the main barrier for unwilling landholders; seen as a barrier by 70% of the group. The barriers Cost, Land Use Conflict, Knowledge, and Time rank as the most popular choices for willing landholders.

Incentive choices

The incentives favoured by landholders for overcoming the barriers to timber production were a mix of information, financial and production support options. Financial and market creation incentives were favoured to overcome the cost barrier. Provision of information and extension was favoured to overcome the knowledge barrier. The more complex barriers of time and land use conflict identified a mix of financial, information and production support needs.

Conclusion

Recasting timber plantations as complementary to farm activities and income will be paramount to the success of timber production on private land. To access land of sufficient quality to ensure plantation growth and health, future policy needs to provide a suite of incentives including economic and educational supports.

To pique the interest of both unwilling and willing landholders in the north east of NSW, future incentives should be designed to capture the environmental and amenity motivations of land holders. Combining new incentives with quality extension, highlighting successful examples of timber production in the landscape, and fostering positive peer to peer information sharing will increase the profile of timber plantations as a rural land use.

Landholder barriers and incentives to timber production north east New South Wales

1. Introduction

The history of forestry in the north east region of NSW extends back 150 years. Some of the first European settlers in the region were timber getters harvesting the Big Scrub (Pressey et al., 1996); the areas cleared of timber were used for agricultural production (Pressey et al., 1996). Both the forest and agricultural industries have changed in the region over time with demographic and policy changes (Jay et al., 2007; Leys and Vanclay, 2011; Loxton et al., 2012). Traditionally, forestry and agriculture have competed for tenure in the landscape (Ajani, 2007) and this was the catalyst for creating State forests that were dedicated for sustainable wood production from the early 1900s onward. However, in recent decades the pressure on native timber production has come more from forest conservationists.

Australia's first direct-action blockading took place at Terania Creek near Lismore in 1979 (Turvey, 2006). In 1982 the NSW state government passed *New South Wales Government Rainforest Policy 1982* (New South Wales Government, 1982), known as the Rainforest Decision, ceasing all rainforest logging in NSW (Gibbs, 1992; Lugg, 1998; Loxton et al., 2012). Across the state 119 953 ha of forest were rezoned as national parks or nature reserves, 62 866 ha were included in the Border Ranges, Nightcap and Washpool National Parks on the far north coast (Gibbs, 1992; Lugg, 1998).

In recent decades large areas of state owned native forests have been transferred from State forest to National Parks and reserves. This has been largely motivated, directly or indirectly, by the development of Regional Forest Agreements (RFA's) brokered between state and federal governments. These agreements aimed to secure long term forest management, providing both industry access whilst protecting environmental and cultural values (Commonwealth of Australia, 1995).

The RFAs were developed as a way of resolving the ongoing conflict over the use of Australia's forests. The introduction of the agreements also aimed to minimise the political and electoral importance of disputes over forest use (Lane, 1999; Lane, 2003). The RFAs saw a great change in the way forests are used and managed (Mercer and Underwood, 2002; Clark, 2004; Jay et al., 2007).

Unfortunately, the RFA have not entirely lived up to their promise with harvesting of native State forests still vigorously contested (Kanowski, 2017). The contest has raised interest in the development of private forestry. This includes establishing new hardwood plantations as well as providing better support for native farm forestry.

Examining the potential of plantations to replace public native forestry is not new. In the late 1990s the Commonwealth government developed a Plantation 2020 Vision for Australia that aimed to establish 3 million ha of hard and soft wood timber plantations by the year 2020, a trebling of the estate at that time (Plantation 2020 Vision Implementation Committee, 1997). As part of the government's commitment to the vision it allocated tens of millions of dollars in tax concessions and grants for plantation establishment (Mercer and Underwood, 2002; Schirmer et al; 2014, Whittle et al., 2019; Lewis et al., 2022)

Unfortunately, in many regions, including the far north of New South Wales and south east Queensland, plantations were established prior to the formation of silvicultural guidelines (Smith and Brennon, 2006, Dargusch, 2008), without robust stakeholder engagement (Leys and Vanclay, 2011; Loxton et al., 2012) and lacking an established or proven market. The poor management and failure of many of these plantations has led to scepticism from the rural agricultural community towards plantation forestry (Montoya, 2010; Medows et al., 2014: Rhodes and Stephens, 2014; Fleming et al., 2019).

In more recent years the government has acknowledged that Australia is facing a timber shortage, with timber consumption anticipated to quadruple by 2050 (DWAR, 2018). Department of Agriculture and Water Resources released a national forest industry plan entitled *Growing a better Australia – A billion trees for jobs and growth* in September 2018 (DWAR, 2018). The key measures outlined were: Growing our forest industries; creating regional forestry hubs; reducing barriers to forestry expansion; using our forest resources smarter; growing community understanding of forestry and benefits of trees in production forests.

The plan recognised the need to develop new technologies, products, and supporting infrastructure in key locations. It also highlighted the importance of establishing 'the right trees at the right scale in the right place'. The government plan included expenditure of $20 million over 4 years, to encourage the establishment of 400 000 ha of plantation, focusing on farmland. Risks to plantation success were recognised as land price, long term investment, pests and climate (DWAR, 2018). The fiscal stimulus proved insufficient to deliver on the plan.

A subsequent policy, Support Plantation Establishment Program, offering a larger grant pool of $73.76 million to subsidise plantation establishment over 4 years was released in 2023 (DAFF, 2023). This program is still in its infancy, however, limited uptake to date suggests the incentives may still be insufficient.

For the government to achieve its private forestry objectives it will be necessary to work with the farming community more closely to better understand its motivations and the barriers to change. In this study we sought to identify and quantify the relative importance of the issues in relation to both farm forestry and the establishment of new plantations.

The objectives of small scale private land holders is changing both in Australia (Herbohn et al., 2005; Meadows et al., 2014; Baker et al., 2017) and overseas (Kendra and Hull, 2005; Bjarstig and Kvastegard, 2016; Matilainen et al., 2018) Properties are becoming smaller and landscapes more urbanised (Emtage, 2001; Kendra and Hull, 2005; Ives and Kendal, 2013; Meadows et al., 2014; Ruseva et al., 2015; Baker et al., 2017; Matilainen et al., 2018). Landholders with traditional farming ideologies, where the value of the land lies in its productive capabilities, are being replaced with landowners who are interested in the environmental and social services the land can offer rather than economic gains through production (Gamberg and Larson, 2003; Barr 2005; Kendra and Hull, 2005; Herbohn et al., 2005; Gosnell et al., 2011; Mendham et al., 2012; Schirmer et al., 2012; Meadows et al., 2014; Matilainen et al., 2018).

These trends are reflected in the land uses and demographics observed in north east NSW. Native and plantation forestry persist in the region. However, practices have changed over the decades with policy and demographic transformations (Jay et al., 2007). Land uses such as tourism, cultural industries, and hobby farming have all gained popularity (Gibson et al., 2005; Pritchard 2024). Younger generations are increasingly reluctant to stay on the land and growing property values has led to an increase in farms being sold for rural residential blocks where the land is valued for its amenity rather than productive values (Burnley and Murphy, 2002; Barr 2005; Holms, 2005 in Gibson et al., 2005). The immigration of 'amenity migrants' to the region has resulted in an increased number of landholders lacking skills and experience in land management (Taylor et al. 2015).

By identifying motivations and constraints regarding growing trees and timber production, effective policy and support for timber production can be delivered. This study surveyed land holders in north east NSW to better understand their objectives, attitudes, and motivations for growing and managing trees on their property.

2. Methods

2.1 Survey area

The study location is north east New South Wales, Australia. Mimicking the North East Regional Forest Agreement zone (Figure 1) the area stretches from the Queensland boarder in the north to the Hawkesbury River in the south. Covering close to 10 million ha, about two thirds (6 314 922 ha) is privately owned land, and the other third (3 005 738 ha) is forested public land (Dept of Agriculture Water and the Environment, ND.). Close to half of the privately owned land in the study area (48.4%) is native forest (New South Wales Department of Primary Industries, 2024)

Figure 1. Map of the study region.

(https://nswforestryhub.maps.arcgis.com/apps/MapSeries/index.html?appid=9580f1a1287b460bbdd0be212c76ab96)

2.2 Survey tool and sampling methods

Landholders were surveyed to capture a snapshot of the landholder's demographics and land management practices. Also, attitudes toward timber production as a land use, level of satisfaction with current forestry activities and barriers to pursuing timber production. Additionally, landholders were asked to identify incentives, if any, that would help them to overcome the barriers to investment in timber production on their properties.

Developed and deployed using Qualtrics the survey tool consists of 57 questions across three sections: 1) About the landholder, 2) About the property and, 3) landholder attitudes to private timber production. (Appendix 1). The survey was designed to identify links between landholder attributes, willingness to consider timber production as a land use, barriers to timber production and favourable incentives to overcome barriers.

2.2.1 Survey Distribution

The survey was initially distributed by electronic means. Contact was initiated with 83 stakeholder groups including shire councils, Landcare groups, interest groups, and industry groups and associations in the study region. This method of distribution proved unsuccessful, yielding few survey responses.

The survey was subsequently delivered via anonymous in person interviews. The interviews were conducted at agricultural events 'Tocal Field Days' held in the Hunter Valley, to the south of study region and 'PRIMEX' held in the Northern Rivers, to the north of the study region in 2021. Due to the Covid19 pandemic and catastrophic flooding in the region in early 2022, further face to face interviews were not undertaken until the second half of 2022 and early 2023. The interviews were conducted at agricultural shows. Show locations (Table 1) were chosen the provide access to landholders across the study region.

The survey interviews were conducted from stall within the trade area of the shows. The stall included two signs, 'Trees on farms' and 'Landholder survey, post graduate research'. Show attendees either approached the stall on their own to enquire about the survey or were approached by researchers as they passed the stall. After initial greetings attendees were asked if they were landholders with greater than 5 ha; 5 ha being the minimum property size to be eligible to participate in the survey. Landholders with greater than 5 ha were asked if they would like to complete the survey. Only a small portion of eligible landholders declined to take part in the survey, however this was not quantified. Wrapped sweets were offered to participants during the survey interview. The same two interviewers were used for the duration of the study.

The anonymous survey was conducted via the Qualtrics platform regardless of if it was completed online or in person. Due to the change in the mode of data collection from electronic distribution to in person survey Question 13 'What is your approximate household gross (before tax) income' was dropped from the survey.

Table 1. Survey locations

Survey Location	Event name
Maitland	Tocal Field Days
Casino	Primex
Taree	Taree Agricultural Show
Lismore	North Coast national Show
Gloucester	Gloucester Agricultural Show
Murwillumbah	Tweed River Agricultural Show
Dorrigo	Dorrigo Agricultural Show
Tenterfield	Tenterfield Agricultural Show

2.3 Data

Surveys were deemed viable for analysis of the landholder completed questions beyond Section 1: About you. None on the surveys deemed viable for analysis, contained missing information.

A total of 61 variables were available from the survey data. Several variables were combined to create new succinct variables to be used during analysis. These were as follows:

- Question 1: 'Do you, or members of your family live on the property?' and the follow-on question if the landholder did not liver on the property, Question 2: Where do you live? Were combined to form 1 variable consisting of the options: 'On property', 'Off property, same region', 'Off property, other rural' and 'Off property, metropolitan'.

- Question 9: Do you or a household member work off the property? and the follow-on question if the landholder answered 'yes', Question 10: Which best describes the level of work? Were combined to create one variable consisting of the options: 'No', 'Yes: Casual', 'Yes, Part time' and 'Yes, Full-time'.

- Question 25: Do you have native forest on your property? and the follow-on question if the landholder answered 'yes', Question 26: Do you manage the native forest for commercial timber production? Were combined to create one variable consisting of the options: 'No forest', 'Yes, I find the legislation workable', 'Yes, I find the legislation prohibitive', 'No, I don't want to', 'No, it's not suitable for harvesting', 'No, the legislation is too prohibitive', 'No, the legislation is too complicated' and 'No, I don't how to manage my native forest for commercial production'.

- The responses from question 17: What is the land managed for? Given as a percentage of property landholders allocated the differing management uses of lifestyle, conservation, timber production and agriculture were combined to create a land use index. The index was created using the formula:

  X= ((1*Lifestyle) +(2*conservation)+(3*timber production)+(4*Agriculture))/100

  The results were then partitioned to four discrete index levels (Table 2).

  The index aimed to create a scale to represent land use intensity (lifestyle being the least and agriculture being the most). Intensity in this case relates to how intensive or structured the land use is and the potential for the land use to generate income.

  Table 2. Land use index levels and related raw data intervals

Land use index levels	Partitioned raw data interval
1	0 – 1.49
2	1.5 – 2.49
3	2.5 – 3.49
4	3.5 – 4

2.4 Data analysis

The data was analysed using R Statistical Software (R Core Team, 2023) to identify trends within the dataset. Correlation analysis was used to uncover relationships between demographic, land use, and property management with timber production barriers and incentives.

The willingness of the landholder to consider timber production on their property was used to assess the barriers and related incentives to encourage private timber production. Question 22 'Would you consider producing timber on your property?' was used to partition the sample into two groups, landholders who would consider producing timber on their property, and those who wouldn't. Analysis of the landholder's willingness to adopt a land management practice provides a way to compare initial interest, which is a prerequisite to adoption (Schirmer and Bull, 2014).

Further analysis of relationships between demographics, land management, barriers to timber production and possible incentives to overcome the barriers were conducted with t-tests and chi square analysis with paired T-Tests using Bonferroni correction (Myint et al 2010; Lee and Lee 2018).

3. Results

3.1 Data

A total of 301 land holders across the region were surveyed, 284 of the surveys were assessed as viable for use in analysis. The field day events Tocal and Primex yielded the most data. These events were both 3 days in duration, unlike the agricultural shows, which were regularly 1.5 days.

3.2 Section 1. About you

The majority of the landholders (90.5%) lived on their property. The remainder of the landholders lived off their property in the same region, 3.2%; another rural area, 3.2% or in a metropolitan area, 3.2%. The highest proportion of landholders not living on their property was recorded at Lismore (15%), similar results were found at Dorrigo and Taree (both 14.3%) (Table 3).

The household occupant structure of the landholders was dominated by childless older singles or couples, making up 63.7% of the data. The remainder of the landholders was made up of 18.7% household with young children, 10.2% multigenerational households with adult children at home and 7.4% businesses. The only region where the landholders were dominated by households with children was Taree (71.4%). The highest portion of landholders identifying as business was at Lismore (15%)

The sample was dominated by older landholders. More than 50% of landholders above the age of 60 and a further 26.1% of the sample are aged between 50 and 59. Landholders between 18 and 29 make up less than 3 % of the data.

The majority of the landholders identified as having an occupation other than a farmer (40.1%), 36.6% of landholders identified as farmers and 23.2% were retirees. The majority of landholders at or nearing retirement age (60-69 and 70+) did not identify as retired (67.8% and 56.2% respectively).

Landholders who had an occupation other than farming were likely to be professionals 39%, work in the heath sector (16.8%) or be a trades person (15%); 4.4% were in the forestry industry (Table 4).

Close to half of landholders who identified as farmers (45.2%) are from families that have been farming for greater than 3 generations; 11.5% are 3rd generation farmers, 11.5% are 2nd generation farmers and 37.1% of farmers are first generation. There is a negative relationship between age and generations farming, with younger farmers more likely to be 3rd generation farmers than older farmers; 50% or more of each of the age group between 18 and 59; 42% aged between 60-69 and 37% aged 70+.

Prior to retirement landholders were most likely to have been professionals (43.8%) or farmers (20.3%); 3.1% were involved in the forest industry (Table 4).

Table 3. Demographic variables, proportion by survey location and pooled data set.

Location	Tweed	Lismore	Primex	Tenterfield	Dorrigo	Walcha	Taree	Gloucester	Tocal	Sum
Sample size	5.3	7.0	31.3	5.6	7.4	3.5	4.9	9.5	25.4	100.0
Where landholder resides										
On property	100.0	85.0	89.9	87.5	85.7	100.0	85.7	92.6	91.7	90.5
Same rural	0.0	10.0	2.2	6.3	4.8	0.0	0.0	0.0	4.2	3.2
Other rural	0.0	0.0	2.2	6.3	9.5	0.0	14.3	3.7	1.4	3.2
Metropolitan	0.0	5.0	5.6	0.0	0.0	0.0	0.0	3.7	2.8	3.2
Household structure										
Young Child(ren)	20.0	20.0	19.1	6.3	19.0	10.0	71.4	7.4	15.3	18.7
Adult child(ren)	20.0	0.0	7.9	6.3	19.0	0.0	0.0	11.1	15.3	10.2
Just me/us	60.0	65.0	61.8	87.5	61.9	90.0	28.6	81.5	58.3	63.7
Business	0.0	15.0	11.2	0.0	0.0	0.0	0.0	0.0	11.1	7.4
Landholder age										
18-29	0.0	0.0	3.4	6.3	14.3	0.0	0.0	3.7	0.0	2.8
30-39	20.0	0.0	6.7	0.0	9.5	0.0	21.4	7.4	2.8	6.3
40-49	6.7	15.0	12.4	6.3	14.3	10.0	28.6	3.7	11.1	11.6
50-59	6.7	25.0	27.0	37.5	23.8	50.0	28.6	11.1	29.2	26.1
60-69	33.3	40.0	29.2	25.0	28.6	30.0	14.3	37.0	31.9	30.6
70+	33.3	20.0	21.3	25.0	9.5	10.0	7.1	37.0	25.0	22.5
Landholder occupation										
Other	53.3	45.0	33.7	37.5	42.9	20.0	78.6	37.0	40.3	40.1
Farmer	33.3	40.0	42.7	31.3	38.1	80.0	7.1	29.6	31.9	36.6
Retired	13.3	15.0	23.6	31.3	19.0	0.0	14.3	33.3	27.8	23.2

Table 4. Employment industries of non-farming landholders.

Industry	Other	Retired
Agriculture	8.9	6.3
Education	5.3	9.4
Farmer		20.3
Forestry	4.4	3.1
Health	16.8	4.7
Hospitality/retail	10.6	3.1
Professional	39	43.8
Trade	15	9.4

The majority of landholders had a household member that worked off the property (56.7%). The majority of workers were in full time employment, 35.2%; 15.5% worked part time and 6% were employed on a casual basis.

The majority of landholders in the two highest age brackets (56.3% and 75% respectively) are not engaged in work off the property, this is not consistent with the number of landholders who identified as retired; indicating landholders in these age brackets are themselves or have household members who engaged in farming for household income (Figure 2).

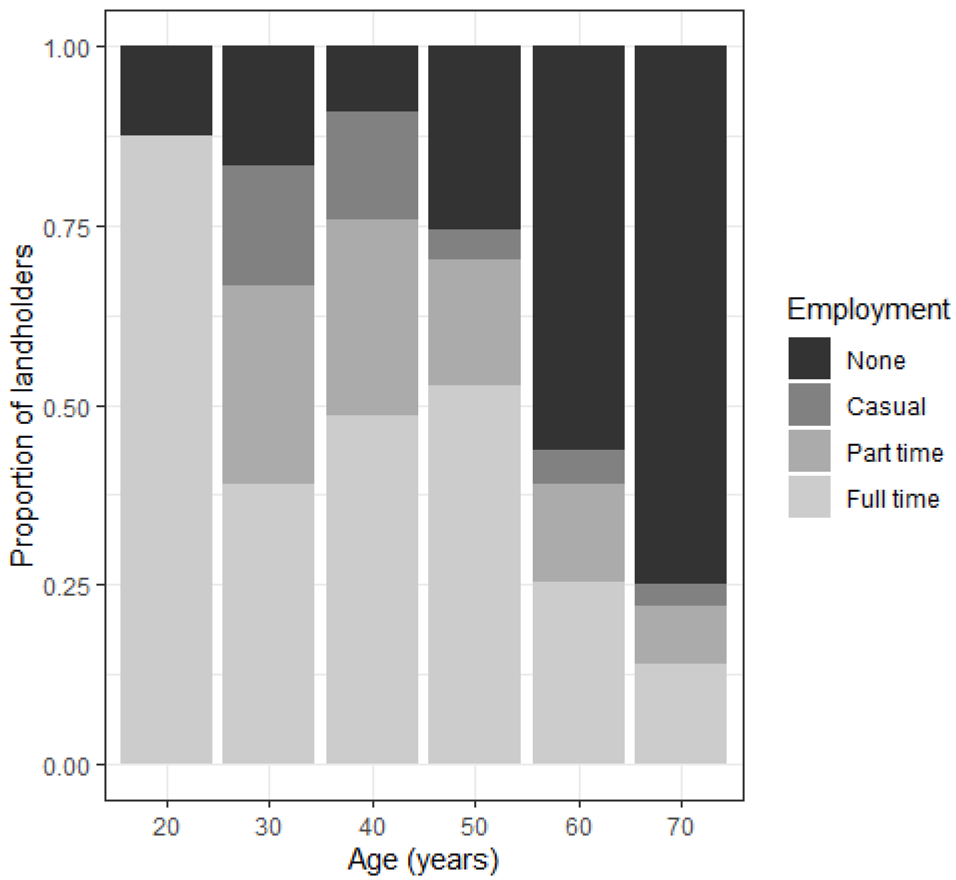


Figure 2. Landholder employment off property by age.

Figure 3 A shows the relationship between occupation and employment off the property. Landholders who identify their occupation as 'other' are most likely to be engaged in employment off the property at any level; 57.9% are engaged in full time employment off the property and only 8.8% are not engaged in any employment off the property. Almost half of farming households are engaged in work off the property (45.2); more than a quarter a household member engaged in full time work (26.9%). Only 15.2% of households where the landholder identified as a retiree have a household member engaged in employment off the property, of these, greater than half (9.1%) were engaged in fulltime employment.

Only 13.4% of landholders reported that their household earned no income off the property, that is all income is generated from activities on the property; 34.9% of landholders reported all income was generated off the property. However, if considering if landholders generated 50% or more income on the property, or 50% or more off the property the data shows close to a 50/50 split (47.2/52.8%).

If considering this data by occupation, farmers generate a greater percent of their household income on the property, 49% generate greater than 75% of their income on their properties, compared to 28.9% and 24.2% of other and retired respectively (Figure 3 B).

Figure 4 shows the trend for increasing proportion of household income generation off the property with decreasing property size.

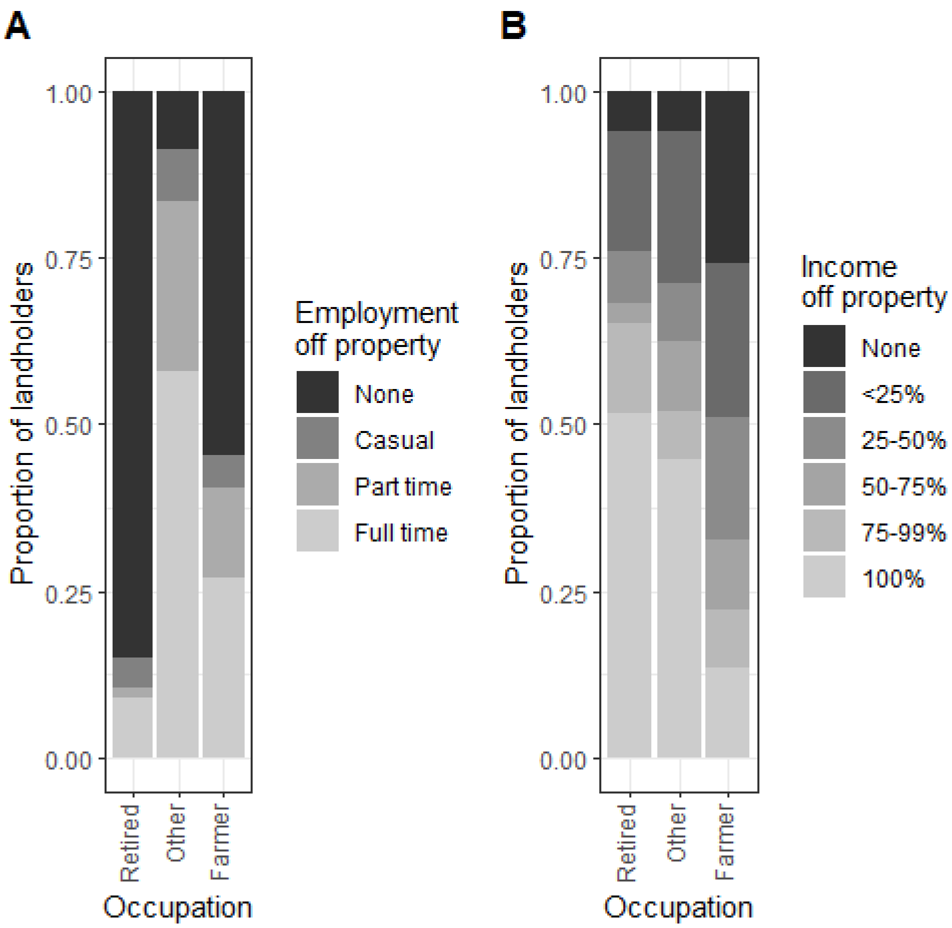


Figure 3. A landholder employment off property and occupation. B percent of household income generated off the property and occupation.

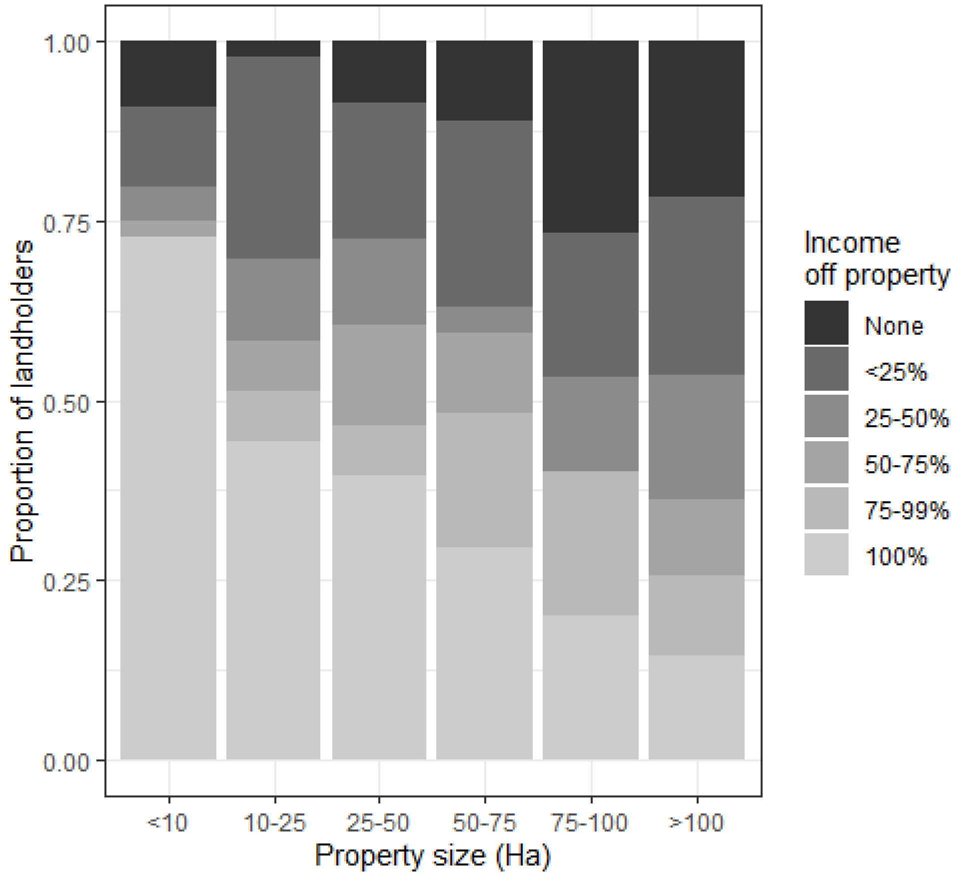


Figure 4. Percentage of household income generated off the property by property size.

Over half of the survey landholders held bachelor, or post-graduate degrees (33.8% and 27.1% respectively); 21 % of landholders had TAFE level education and 17.6 had high school level education.

Younger landholders had the highest occurrence of TAFE education (62.5%) and the lowest rates of tertiary education, this could be attributed to age and the time it takes to earn a degree. The oldest landholders we most likely to have high school level education (29.7%). The most highly educated age barracked was 40-49 (42.4% undergraduate degree, 39.4% postgraduate degree) (Figure 5A).

If considering education by occupation, landholders with an occupation other than farming had the highest occurrence of tertiary education 66.7% (38.6% undergraduate degree, 28.1% postgraduate degree). Followed by retirees 57%.6% (34.8% undergraduate degree, 22.7% postgraduate degree) and farmers 56.7%. Farmers had the highest percent of postgraduate education, 28.8% and lowest level of undergraduate education, 27.9% (Figure 5B).

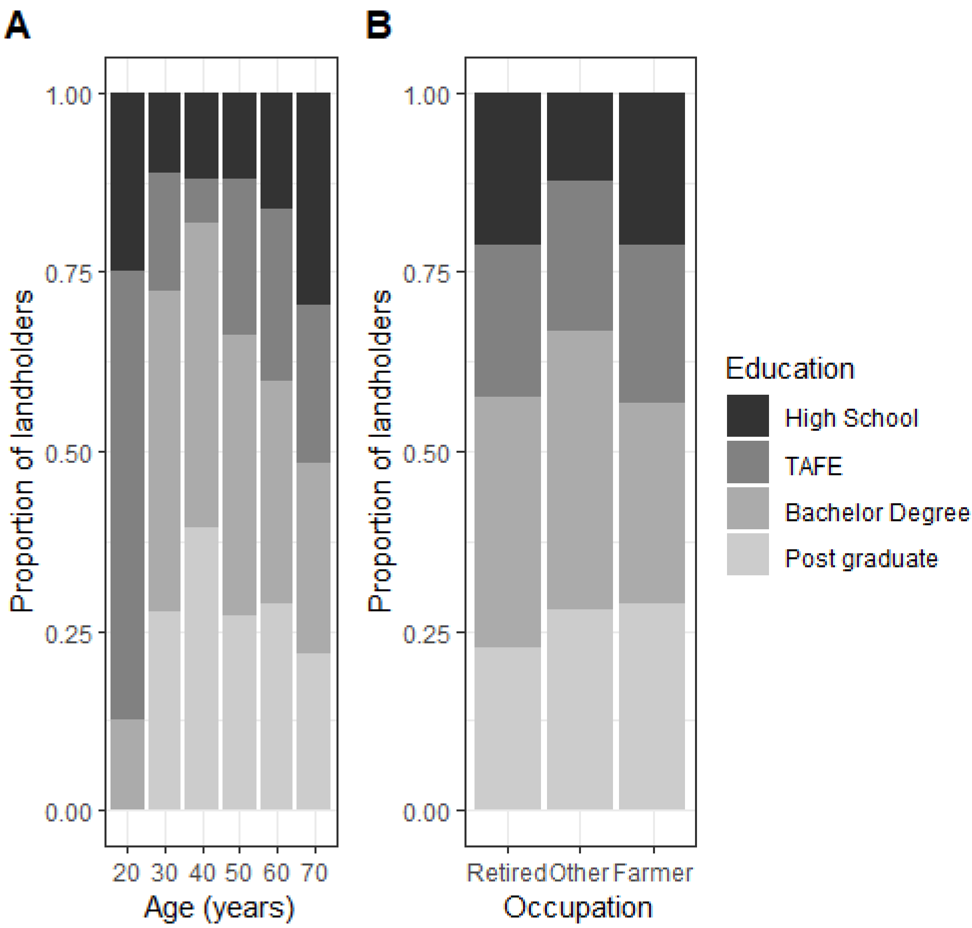


Figure 5. A Landholder age and education. B Landholder occupation and education

3.3 Section 2: About your property

3.3.1 Length of ownership and property size

Over half of landholders (55.6%) had owned their property for greater than 15 years. The next largest group was those who had owned their property for less than 5 years (20.1%). Landholders that had owned their properties for 5-10 years made up 16.2% of the data and the remaining 8.1% had owned their properties for 10-15 years.

The data shows close to half of the landholders own property smaller than 50 ha (51.5%) and half greater than 50 ha (48.9%). Over a third of landholders own a property greater than 100 ha in size (34.2%) (Figure 6A).

When considering property size and years of ownership, landholders with less than 10 ha have the highest portion of landholders who have owned their properties for less than 5 years (45.5). Conversely, the majority of the landholders who own properties that are 75 ha or larger have owned their properties for more than 15 years (73.2%) (Figure 6B).

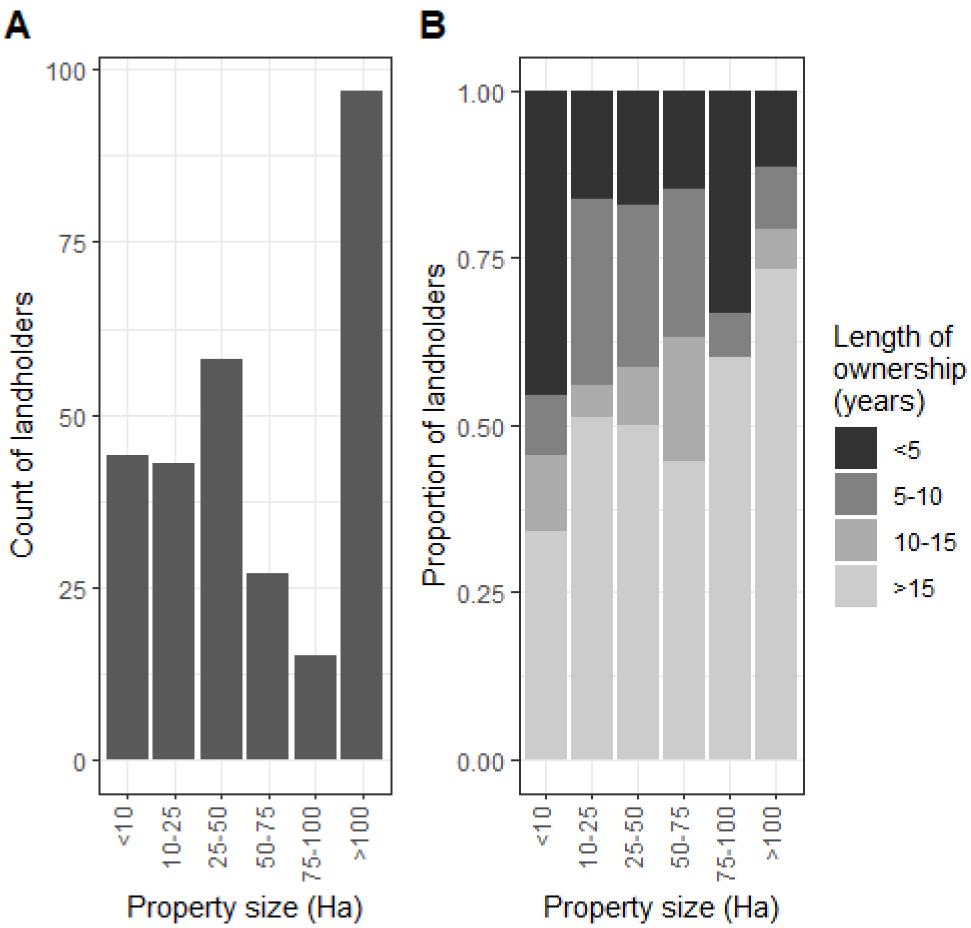


Figure 6. A Distribution of landholder property size. B The length of time landholders have owned their property grouped by size.

3.3.2 Presence and management of native forests

Landholders were asked if they had native forest on their properties, if they manage the native forest for timber production and the reasons why. Close to 20% of landholders reported having no native forest on their properties; 19% stated that their forest was not suitable for harvesting and 32% do not want to manage their forest for timber production. Lack of knowledge was a barrier to managing their forests for timber for 12% of landholders and a further 5% cited legislative barriers (too prohibitive 1.8%; too complicated 3.2%). Only 12% of landholders with native forest engage in native forest timber production. Of those who are engaged in native forest timber production 49% felt the legislation was too prohibitive, 51% found the legislation workable.

Figure 7 below shows the presence and current management of native forests by property size. The figure shows engagement in private native forestry increases with property size.

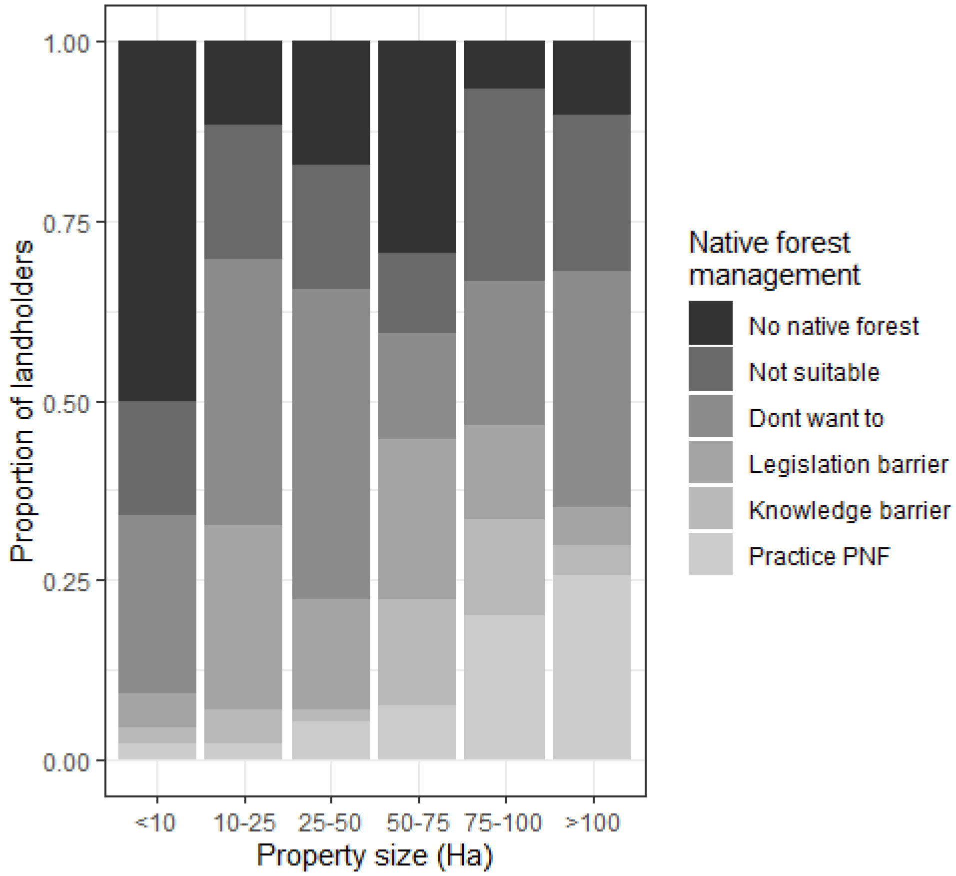


Figure 7. Landholder native forest management grouped by property size.

3.3.3 Future intentions to keep or sell the property

The majority of landholders intend to keep their properties, either for future generations (47.5%) or for the foreseeable future (43%); 4.2% of landholders intend to sell their properties, whist 5.3% are undecided. This trend of landholders looking to keep their properties is consistent regardless of property size. Landholders with properties greater than 100 ha were most likely to keep their properties for future generations (60.8%) (Figure 8).

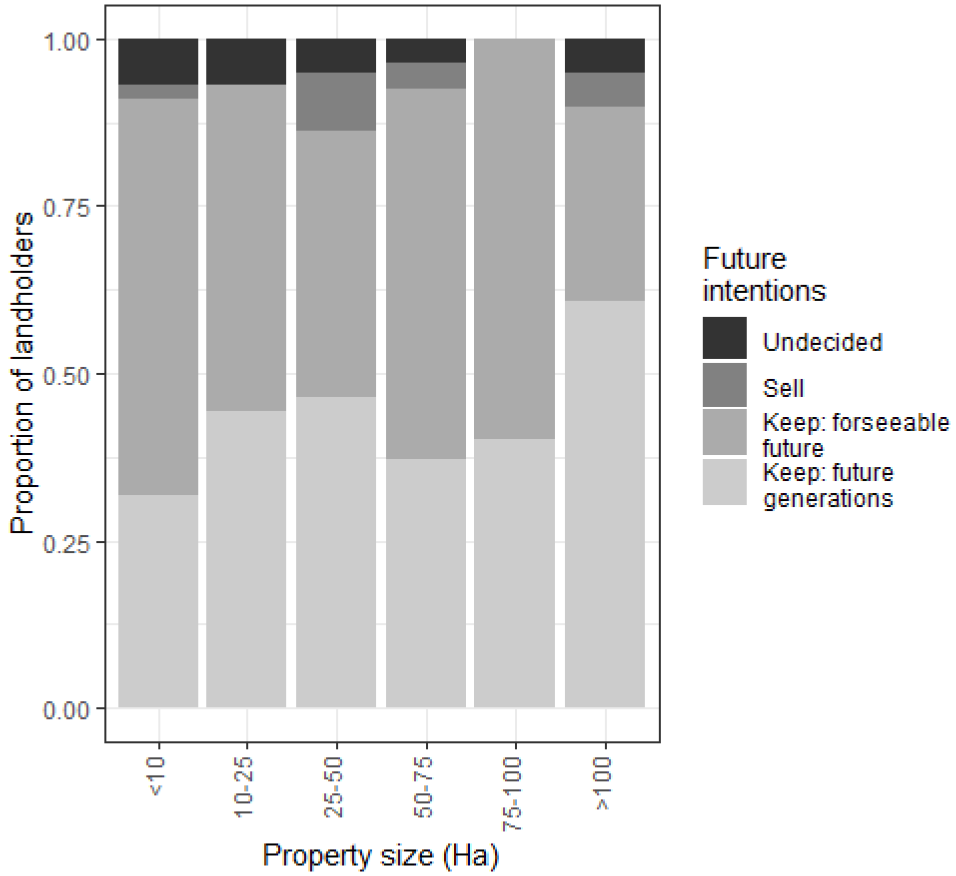


Figure 8. Landholders' future intention to keep or sell their property grouped by property size.

3.3.4 If the landholder would consider timber growing timber on their property

When asked if they would consider growing tree for timber production 58.8% of landholders said they would consider growing timber and 41.2% said they would not.

When considering property size and willingness to consider timber production Figure9 shows willingness to consider timber production increases with property size; from less than 10 ha (47.7%) to 50-75 ha (70.4%); 60% of land holders with 75-100 ha and 66% of landholders with greater than 100 ha would consider growing timber on their properties.

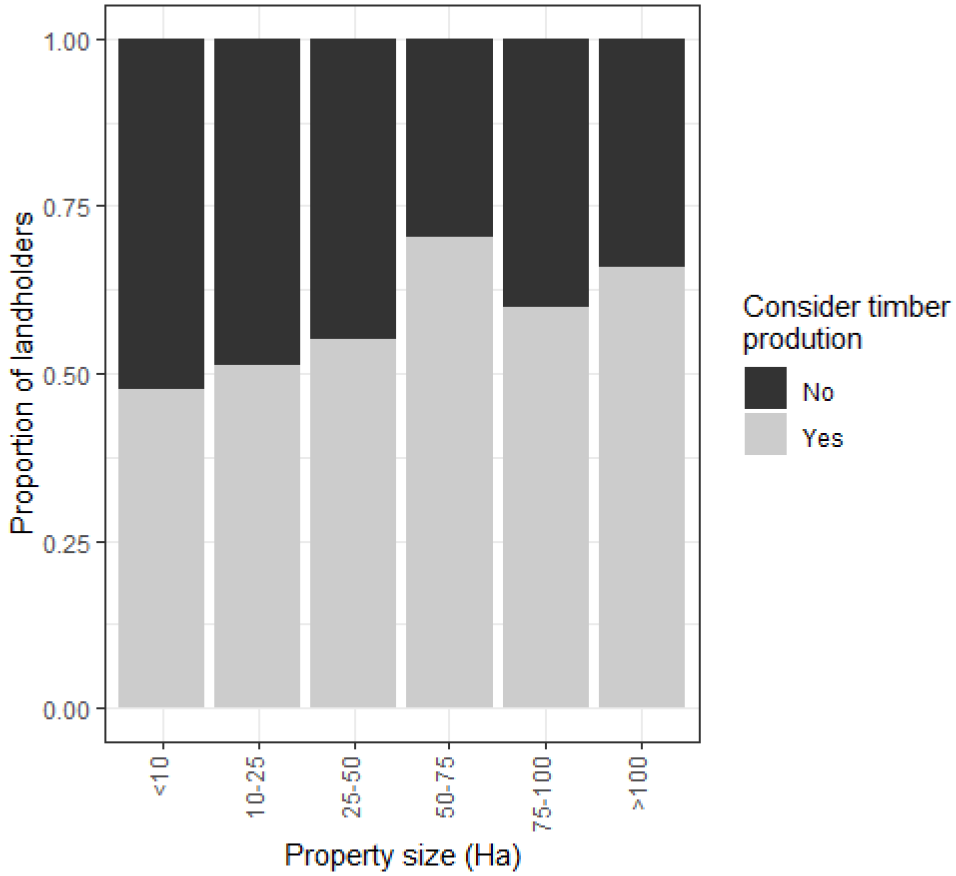


Figure 9. If a landholder would consider growing trees for timber production on their property grouped by property size

3.3.5 Landholders likeliness to change management practices

More than half of landholders were happy to be the first to try something new when it comes to changing management practices on their property (56%). A further 33.5% of landholders are comfortable to change their management practices after they have observed a new practice; 6.7% of landholders would only consider changing their current practices if they have had personal interaction with the new management method and 3.9% of landholders are unlikely to change their management practices.

3.3.6 Land use

Table 5 shows the proportions of property landholders manage for the land uses lifestyle, conservation, timber production and agriculture. The table shows that 43.3% of landholders manage a portion or all their property for lifestyle; 43.3% of landholders manage a portion or all of their property for conservation; 15.8% of landholders manage a portion or all of their property for timber production; and 69% of landholders manage a portion or all of their property for agriculture. The table shows that only 3.5% of landholders manage greater than 50% of their property for timber production, whereas 48.3% of landholders manage greater than 50% of their property for agriculture.

Table 5. The proportions of property landholders manage for the land uses lifestyle, conservation, timber production and agriculture

	None	1- 25%	26-50%	51-75%	76-100%
Lifestyle	56.7	14.1	11.3	1.4	16.5
Conservation	56.7	18.0	16.5	2.1	6.7
Timber production	84.2	8.1	4.2	0.7	2.8
Agriculture	31.0	4.2	16.5	6.0	42.3

Landholders who manage their properties for agricultural production were most likely to farm cattle (72.3%); 34.5% produce more than one product on their properties and 17.6% of landholders who engage in agriculture produce timber and cattle. Table 6 lists agricultural products produced by landholders who cited agriculture as a land use on their property.

Table 6. The products produced by landholders who cited agriculture as a land use on their property and the proportion of landholders who produce each product; 34% of landholders produce 2 or more products.

Product	Landholder (%)
Agistment	3.4
Cattle	72.3
Cropping	2.5
Flowers	1.7
Honey	6.7
Macadamia	7.6
Produce	12.6
Timber	18.5
Sheep	3.4
Wine	1.7
Other livestock	5.8

Table 7 below shows the partitioning of the data by Land Use Index. The table shows that the majority of the landholders manage all or a large portion of their properties for agriculture (45%). The index enables the properties that are managed for multiple uses to be categorised based on intensity of the land use and the portion of the property it occupies.

Table 7. Partitioning of data by land use index

Land use index	1	2	3	4
% of sample	18	15	21	46

Figure 10 shows the relationship between (A) land use index and property size and (B) land use index and occupation. There is a trend in the data for larger properties to have higher land use indexes i.e. be more likely to be utilised for agriculture or timber production and smaller properties to be managed for lifestyle or conservation. Landholders who identify as farmers are more likely to manage their properties for higher intensity uses and retirees and those with occupations other than farming are likely to manage for lower intensity uses.

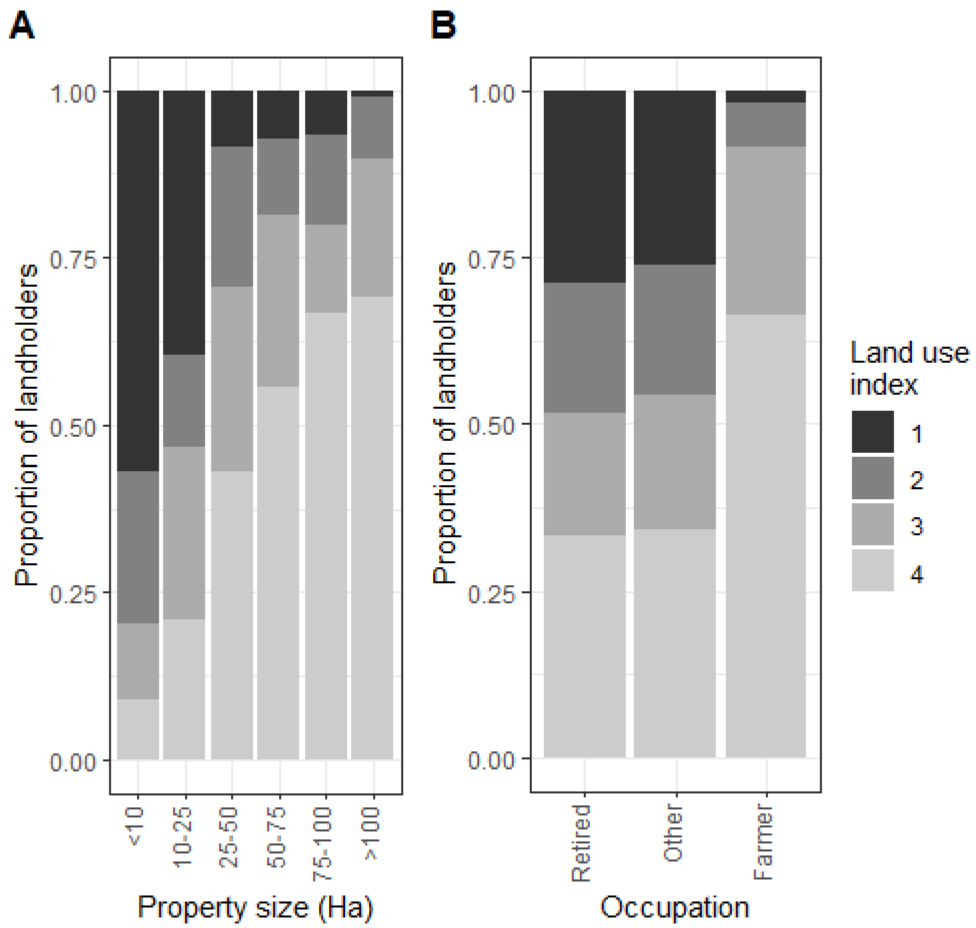


Figure 10. A. Land use index and property size (Ha) B. Land use index and occupation

3.3.7 Where landholders source land management information

Landholders were most likely to source property management information from peers (82%) and government extension services (60.6%). Seeking information from social media or not seeking information ranked the lowest (9.2% and 12%). Paid advice also ranked poorly (15.1%) (Figure 11).

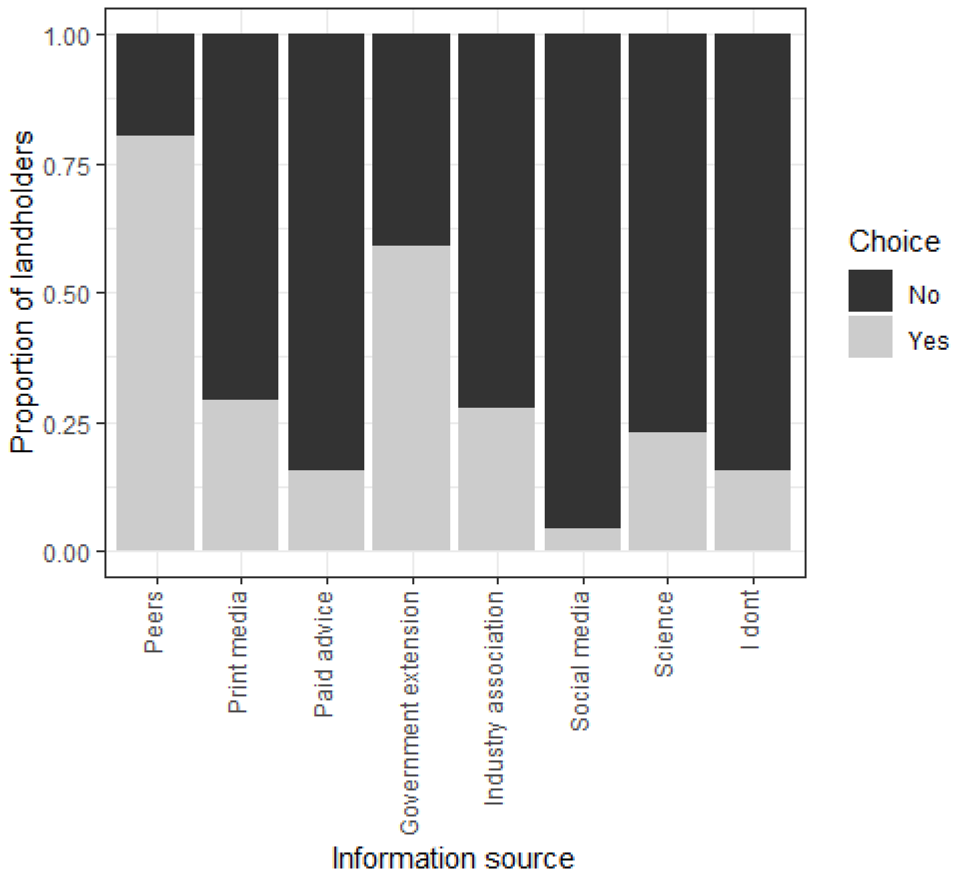


Figure 11. Where landholders source their land management information. Landholders could choose multiple answers. Each column in the figure represents the entire survey population.

3.4 Section 3. Attitudes to timber production

3.4.1 Timber production

Only 15.8% of landholders managed all or a portion of their properties for timber production. The majority of timber production is private native forestry (55%); 25% are engaged in eucalypt plantations and the remaining landholders are engaged in Exotic species (4%), cabinet timbers (6%) or environmental plantations (11%).

3.4.2 Motivations to grow trees

Environmental reasons such as biodiversity and climate change (76.1%) and land restoration (69.4%) were favourable as reasons to grow trees, as was amenity (69.4%) and if the trees would be complimentary to the landholder's agriculture (67.9%). Over a third of landholders (39.1%) would consider growing trees for commercial harvest. Only 1.4% of landholders were not interested in growing trees on their property and 6.3% would grow trees for reasons other than those listed. Other reasons to grow trees included apiary, flowers and foliage for floristry, and visitor experience for eco-tourism (Figure 12).

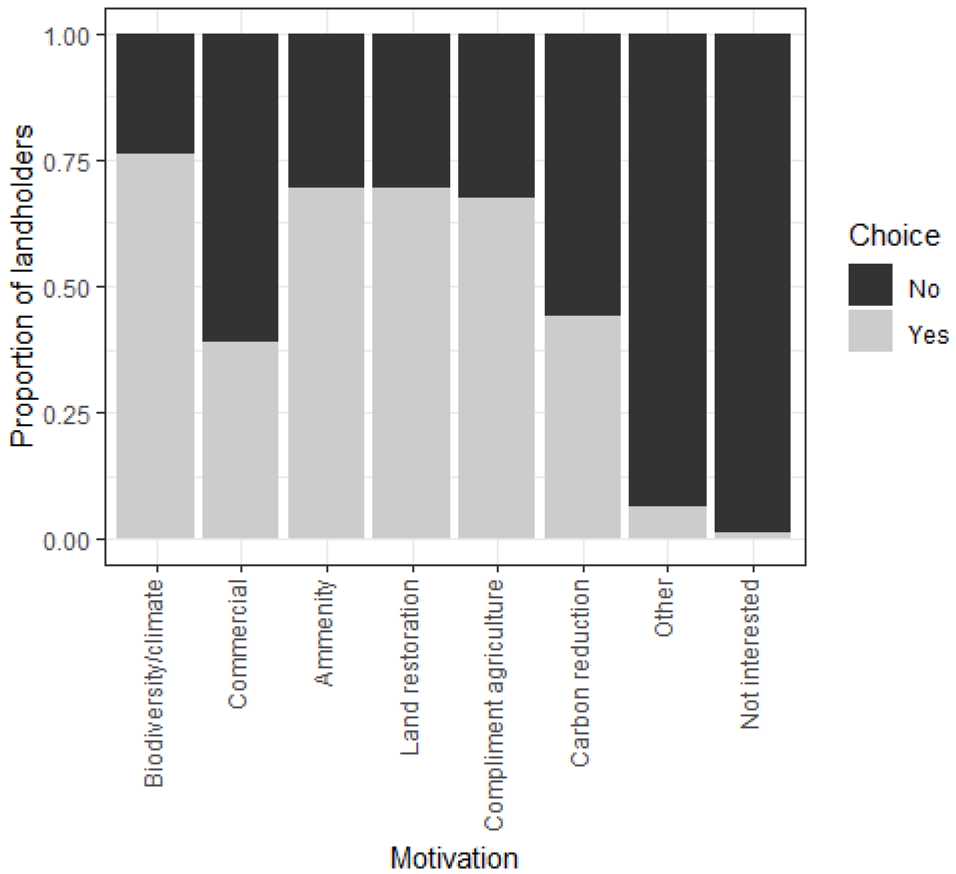


Figure 12. Motivations for landholders to grow trees on their property. Landholders could choose multiple answers. Each column in the figure represents the entire survey population.

3.4.3 Barriers to timber production

The most common barriers to timber production were land use conflict, selected by 45% of landholders, cost (26%), knowledge (21%) and time (19%). The policy barriers for both native forest and plantation policy were not highly rated. At the time of the surveys many landholders commented that they were not well placed to comment on the policy as they were not familiar with the legislation (Figure 13).

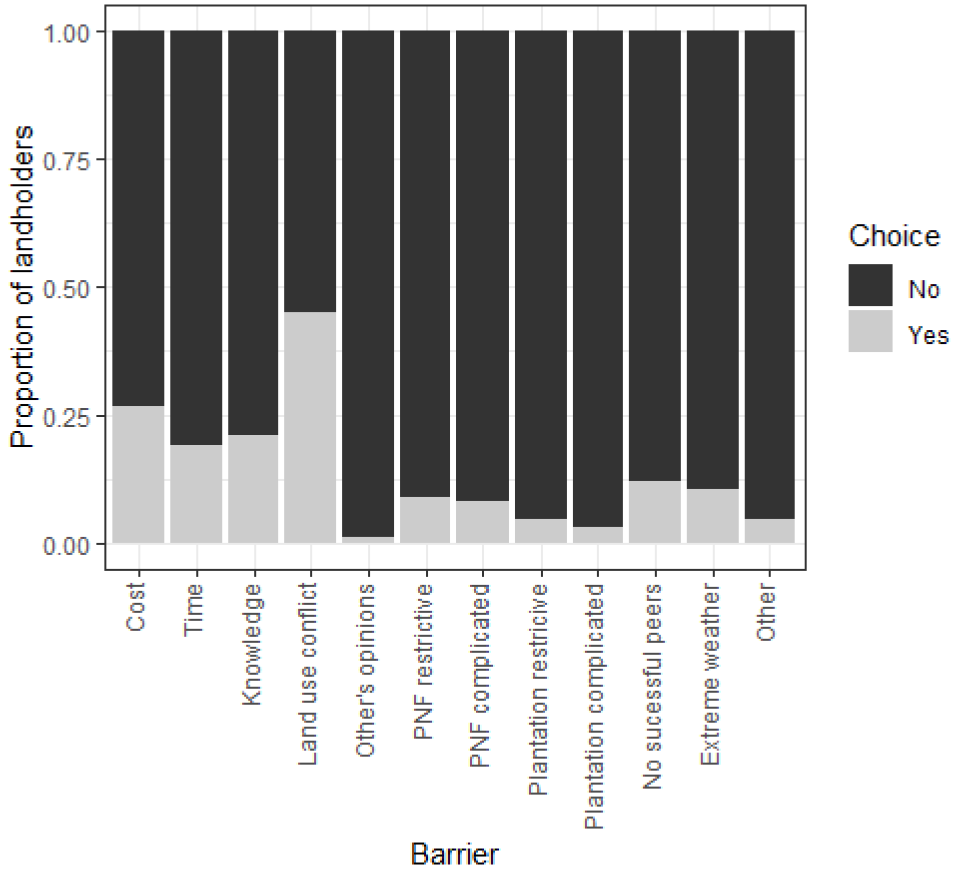


Figure 13. Barriers to land holders engaging in timber production. Landholders could choose multiple answers. Each column in the figure represents the entire survey population.

3.5 Correlation analysis

3.5.1 Correlations between demographic, tenure, size and future management variables

The data was assessed for correlations between demographics variables (Table 8). The data shows older land holders and multigenerational farmers are most more likely to live on their properties (p<0.05). Older landholders are more likely to be to live in a household of a single or couple without children still at home (p=<0.01); and identify as retirees (p=<0.01); less likely to work (p=-<0.01) or gain income from off the property (p<-0.01). Non-retirees were likely to work off the property (p=0.05) however having a household member work off the property was not correlated with high portion of the household income being generated off the property (p<-0.01). Multigenerational farmers were less likely to work or generate income away from their properties (p<0.01, p<0.01). Education (p=<0.01) was significantly correlated with working off the property. Where the landholder's property was in the study region was not related to any other demographic variable.

Table 8. Correlations between demographic variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
Reside	3.81	0.64								
Occupant structure	2.6	0.87	0.1							
Age	54.3	12.85	**.15***	**.39****						
Occupation	2.13	0.76	0.11	-0.03	**-.16****					
Generations farming	0.99	1.53	**.14***	-0.01	0.03	**.74****				
Work off property	1.43	1.35	-0.09	**-.18****	**-.42****	**.14***	**-.17****			
Income off property	2.83	1.92	-0.06	-0.05	-0.04	**-.34****	**-.37****	0.09		
Education	2.7	1.05	-0.04	-0.03	-0.09	0.01	-0.08	**.16****	0.09	
Region	5.33	2.8	0.02	-0.01	-0.06	-0.1	-0.09	0.03	0.01	-0.03

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education

3.5.2 Correlations between demographic, tenure, size and future management variables

The correlation analysis results between demographic, tenure, size and future management variables can be seen in Table 9.

Older landholders and multigenerational farmers are more likely to have larger properties that they have owned for longer than younger land holders and non-multigenerational farmers (p=<0.01). Landholders who have owned their properties for lesser amounts of time are more likely to work and gain the majority of household income way from the property (p=-<0.01 and p=-0.05 respectively).

Households of coupled or single adults without children at home seek to keep their properties for future generations or the foreseeable future (p=-<0.01), although landholders with larger properties were more likely to sell or were undecided as to their intentions for property in the future (p=0.05).

Younger (p=- .01) non-farming (p=.05) landholders with larger properties (p=.05) in the north of the study region (p=-.05) who work (p= .01) and reside off their property (p-.05) are more likely to consider growing trees on their properties for timber production. However, the longer a landholder had owned their property, the less likely they were to change their property management (p=<-0.05).

Landholders who had larger properties (p=0.01) in the north of the study region (p=-0.01) were more likely to manage their native forest for timber production, these landholders are likely to consider growing trees on their properties for timber production (p=0.01)

Table 9. Correlations between demographic, tenure, size and future management variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Years owned	2.99	1.24	0.05	0.1	**.34****	0.03	**.19****	**-.16****	**-.13***	-0.05	-0.08					
Size	3.76	1.89	-0.1	0.05	0.06	**.34****	**.37****	-0.06	**-.34****	-0.09	-0.01	**.27****				
Future intentions	3.33	0.79	-0.06	**-.20****	-0.1	0	0.01	0.03	0.1	0	0.02	0.09	**.13***			
Consider timber	0.59	0.49	**-.13***	-0.11	**-.15****	**.12***	0	**.17****	-0.01	0.06	**-.14***	0.01	**.14***	0.08		
Change management	3.42	0.78	-0.05	-0.05	-0.1	0.05	0.01	0.06	0.01	0.05	0.02	**-.13***	-0.05	0	0.06	
Manage NF	3.43	2.15	**-.25****	0.11	0.08	-0.03	-0.1	0.04	-0.07	-0.04	-0.04	0.03	**.25****	0.07	**.35****	-0.02

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education, 9. Region, 10. Years landholder has owned the property, 11. Size (Ha), 12. Future intentions, sell or keep the property, 13. Would landholder consider producing timber, 14. Is landholder likely to change property management

3.5.3 Correlations between demographics and land use

The correlation analysis results between demographic and land use variables can be seen in Table 10.

Landholders who were farmers (p=0.01), and multigeneration farmers (p=0.01) who are more likely to generate their income from the property (p=-0.01), are likely to have higher land use index (more intensive land use practices). These landholders are likely to have less tertiary education (p=-0.05) but have larger properties (p=0.01) they have owned for longer (p=0.01).

The opposite is true for landholders who utilise their properties for lifestyle purposes, the lowest intensity land use. Typically, these properties owned by retirees or those working in other industries than farming (p=-0.01), with more tertiary education (p=0.05) who earn their income off the property (p=0.01). The properties are smaller (p=-0.01) and have been owned for less years (p=-0.01).

Landholders who manage their properties for conservation are unlikely to be multigenerational farmers (p=-0.01) or generate their income on the property (p=0.01); they are likely to have higher levels of tertiary education (p=0.05), own smaller properties (p=0.05) in the south of the study region (p=0.05).

Landholders who produce timber on their property are less likely to reside on their property (p=-0.01) and have larger properties (p=0.01). This is the only land use correlating with willingness to grow trees for timber production, either positively or negatively (p=0.01).

As land use index, landholders who manage their property for agriculture for were farmers (p=0.01), and multigeneration farmers (p=0.01) who are more likely to generate their income from the property (p=-0.01). They have larger properties (p=0.01) they have owned for longer (p=0.01). Unlike land use index, there is no correlation between agriculture as a land use a education.

Table 10. Correlations between demographics and land use

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Land Use Index	2.95	1.15	0.02	0.03	0.06	**.36****	**.39****	-0.05	**-.38****	**-.12***	-0.06	**.28****	**.55****	0.05	0.05	-0.08
Lifestyle	24.06	36.91	0.06	-0.07	-0.09	**-.32****	**-.32****	0.05	**.28****	0.07	0.02	**-.23****	**-.53****	-0.08	-0.09	0.08
Conservation	17.33	27.37	0	0.09	0.08	-0.09	**-.16****	-0.01	**.24****	**.15***	**.12***	-0.06	**-.15***	0.09	0.04	0.05
Timber production	6.04	18.41	**-.36****	0.1	0.03	-0.02	-0.01	0.09	-0.06	-0.1	-0.09	-0.03	**.21****	0.04	**.27****	-0.03
Agriculture	52.86	41.97	0.11	-0.03	0.02	**.36****	**.39****	-0.07	**-.39****	-0.1	-0.05	**.26****	**.48****	0	-0.06	-0.09

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education, 9. Region, 10. Years landholder has owned the property, 11. Size (Ha), 12. Future intentions, sell or keep the property, 13. Would landholder consider producing timber, 14. Is landholder likely to change property management

3.5.4 Correlations between demographics and information source

The correlation analysis results between demographics and information source variables can be seen in Table 11.

The use of government extension and science as information sources for property management are correlated with education (p=0.05). Where as utilising an industry association for land management information was realated to being younger (p=-0.05) farmers (p=0.01) and multigeneration farmers (p=0.01) who may not reside on the propertty (p=-0.05) but earn income from the property (p=-0.01).

Multigenerational (p=0.05), educated (p=0.05) farmers with larger properties (p=0.05) were likely to utilise paid sources for land managemnt information.

Younger landholders (p=-0.05) in the north of the region (p=-0.05) who were likely to consdier timber production (p=0.05) were likely to utilise social media for information about land management. Whereas utilisong print media was likely for non-retirees (p=0.05) in the north on the study region(p=-0.05).

Peer tp peer communication of land management information was utilised by farmers (P=0.01)and multigenerational farmers (P=0.05) in the north of the study region (P=-0.01) who intend to keep their properties (p=0.05).

Non farmers (p=-0.05) with low education (p=-0.01) who reside towards the south of the study region (p=0.05) and unlikly to change their land mangamnt (p=-0.05) do not seek information about land managemnet.

Table 11. Correlations between demographics and land management information sources.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Gov. extension	0.61	0.49	0.01	-0.06	-0.09	0.09	0.07	0.02	0.01	**.14***	-0.06	0.04	0.11	0.02	0.03	0.12
Industry assoc	0.31	0.46	**-.13***	0.01	**-.12***	**.16****	**.16****	0.07	**-.13***	0.04	-0.1	0.05	0.11	-0.04	0.07	-0.04
Science	0.28	0.45	0.02	0.07	-0.05	0.11	0.04	0.06	-0.05	**.23****	-0.03	0.01	0.04	0.05	0.09	0.03
Paid advice	0.15	0.36	-0.04	0.06	0.02	0.08	**.15***	0	0.01	**.12***	0.05	-0.04	**.14***	-0.06	-0.01	0.05
Social media	0.09	0.29	-0.02	-0.01	**-.13***	-0.01	-0.05	0.05	0.02	0.08	**-.18****	-0.03	-0.07	0.05	**.14***	-0.01
Print media	0.33	0.47	-0.06	-0.05	-0.05	**.12***	0.11	-0.04	0.02	0.1	**-.12***	0.02	0.06	0.01	0.07	-0.05
Peers	0.82	0.38	0.08	0.02	-0.02	**.18****	**.12***	-0.03	-0.05	-0.01	**-.21****	0.1	**.12***	0.1	0.04	0.1
I dont	0.12	0.33	0.08	0.05	0.1	**-.14***	0	-0.04	0.03	**-.19****	**.12***	0.05	-0.02	-0.02	-0.09	**-.13***

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education, 9. Region, 10. Years landholder has owned the property, 11. Size (Ha), 12. Future intentions, sell or keep the property, 13. Would landholder consider producing timber, 14. Is landholder likely to change property management

3.5.5 Correlations between demographics and motivation to grow trees

The correlation analysis results between demographics and motivation to grow tree variables can be seen in Table 12.

Landholders who had greater education (p=0.01), earned their income away from the property (p=0.01) and were newer owners (p=-0.05) of smaller properties (p=-0.01) and likely to try new management practices (p=0.01) were likely to plant trees for biodiversity and climate mitigation reasons.

Planting trees for amenity was correlated with landholders being younger (p=-0.05), earning income away from the property (p=0.05) and having a smaller property (p=-0.05).

Younger landholders (p=-0.01) who work off the property (p=0.01) and would try new land management practices are likely to grow trees for land restoration. Whereas farmers (p=0.05) and multigenerational farmers (p=0.01) who generate income (p=0.01) on their large properties (p=0.01) are likely to plant trees if it is complimentary to their agriculture.

Landholders who live (p=-0.01) and work (p=0.05) off their large (p=0.01) properties and would consider growing trees for timber production (p=0.01) are likely to plant trees for commercial timber production. Likewise, landholders who would consider a carbon reduction planting would consider growing trees for timber production (p=0.01). These younger landholders (p=-0.05) have greater education (p=0.01), work (p=0.05) and earned their income away from the property (p=0.01) and were newer owners (p=-0.05).

Being uninterested in growing trees was negatively correlated with being a multigenerational farmer (p=-0.05) and being interested in growing trees for timber production (p=-0.05). Planting trees on your property for other reasons was negatively correlated with the length of time a landholder had owned their property (p=-0.05). Other reasons included apiary, flowers and foliage for floristry and eco-tourism.

Table 12. Correlations between demographics and motivations to grow trees.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Biodiversity/climate	0.76	0.43	0.05	-0.06	-0.1	0.02	-0.08	0.01	**.17****	**.21****	0	**-.12***	**-.19****	0.1	-0.02	**.21****
Ammenity	0.69	0.46	0.04	-0.03	**-.13***	-0.01	-0.05	0.04	**.15***	0.1	0.03	-0.1	**-.14***	0.01	0.02	0.11
Land restoration	0.69	0.46	0.02	-0.08	**-.19****	0.05	-0.09	**.15****	0.07	0.08	-0.02	-0.12	-0.05	-0.05	-0.03	**.15***
Compliment agriculture	0.67	0.47	0.06	-0.11	-0.09	**.15***	**.17****	-0.04	**-.20****	0.02	-0.05	0.11	**.23****	-0.08	0.03	0.09
Commercial	0.39	0.49	**-.17****	0.02	-0.05	0.1	0.01	**.13***	-0.04	-0.01	-0.08	0.04	**.18****	0.05	**.61****	0.07
Carbon reduction	1.84	1.11	-0.01	-0.05	**-.17****	0.03	-0.07	**.12***	**.16****	**.19****	-0.05	**-.19****	-0.11	0.04	**.30****	0.1
Not interested	0.01	0.12	0.04	-0.01	0.03	0.06	**.14***	-0.06	-0.04	-0.08	0.07	0.02	0.03	0.03	**-.14***	-0.03
Other	0.06	0.24	-0.08	-0.01	-0.01	-0.01	-0.04	-0.09	-0.04	0.05	-0.01	**-.13***	-0.03	0.04	-0.02	0.01

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education, 9. Region, 10. Years landholder has owned the property, 11. Size (Ha), 12. Future intentions, sell or keep the property, 13. Would landholder consider producing timber, 14. Is landholder likely to change property management

3.5.6 Correlations between demographics and barriers to timber production

The demographic variable with the most correlations with barriers to timber production is if the landholder would consider growing trees for timber production; correlated with 10 of 12 barriers (Table 13).

The barrier land use conflict was negatively correlated with if the land holder would consider growing trees for timber production on their property (p=-0.01). Indicating landholders with the barrier land use conflict would not consider growing trees for timber production.

The other barriers were positively correlated with growing trees for timber production, indicating that although there are barriers, the landholder would consider growing trees for timber production.

The barriers time, native forest policy is too complicated and plantation forest policy is too complicated are correlated only with if the landholder would consider growing trees for timber production (p=0.01, p=0.01 and p=0.05 respectively).

The barriers cost, no successful peers and plantation forest policy is too restrictive are correlated with if the landholder would consider growing trees for timber production (all p=0.01) and education (all p=0.05).

The barrier extreme weather is correlated with the landholder being younger (p=-0.05), living (p=-0.05) and working off (p=0.05) and with if the landholder would consider growing trees for timber production (p=0.05)

The barrier knowledge is correlated with the landholder being younger (p=-0.05), working off (p=0.05) sourcing their income off the property (p=0.01), and with if the landholder would consider growing trees for timber production (p=0.01).

The barrier native forest policy is too restrictive is correlated with older landholders (p=0.05) who source their income from the property (p=0.01) have larger properties (p=0.05) and are less likely to change land management (p=-0.05) but would consider growing trees for timber production (p=0.01).

The barrier other's opinions is correlated with the reluctance to change management practices (p=-0.05). The barrier other is not correlated with any of the demographic variables.

Table 13. Correlations between demographic variables and barriers to timber production.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Land use conflict	0.45	0.5	0.08	-0.05	0.01	0.01	0.04	-0.09	-0.05	-0.08	0	0	-0.06	-0.01	**-.42****	0.01
Cost	0.26	0.44	0	-0.05	-0.09	0.09	0.01	0.05	0.03	**.13***	-0.12	0	0.02	-0.04	**.32****	0.03
Time	0.19	0.4	0.09	-0.1	0	0.09	0.07	-0.08	-0.06	0.03	-0.06	0.08	0.08	0.03	**.23****	-0.04
Extreme weather	0.11	0.31	**-.13***	0.01	**-.12***	0.06	0.02	**.12***	0.1	0.1	0.05	-0.04	0.01	-0.01	**.12***	0.04
No sucessful peers	0.12	0.33	-0.04	-0.05	-0.06	0.02	-0.08	0.07	0.11	**.13***	-0.08	-0.1	0.02	0.01	**.18****	-0.09
Need knowledge	0.21	0.41	0.01	-0.08	**-.12***	0.01	-0.07	**.12***	**.16****	0.06	-0.02	-0.09	-0.05	0.06	**.24****	0.01
Other's opinions	0.01	0.1	0.03	0.01	0.02	0.03	0.11	-0.03	-0.04	-0.07	0.05	0.06	0.07	0.09	0.02	**-.14***
NF policy restrictive	0.09	0.29	-0.12	0.09	**.15***	0.01	0.02	-0.01	**-.12***	-0.02	-0.02	0.07	**.14***	-0.05	**.22****	**-.12***
NF policy complicated	0.08	0.28	0.03	0.02	0.09	0.01	0.01	-0.06	-0.06	-0.06	-0.03	0.08	0.08	-0.06	**.23****	-0.11
Plantation policy restricive	0.05	0.22	-0.01	-0.03	0.09	0.09	0.08	-0.01	-0.02	**.13***	0	0.07	0	-0.07	**.16****	-0.1
Plantation policy complicated	0.03	0.18	-0.04	0.04	0.11	-0.01	0.01	0.03	-0.05	0.11	-0.03	0.03	0.01	-0.08	**.15***	0.03
Other barrier	0.05	0.22	0.07	0.03	0.03	0.02	0.01	0.07	0	0.06	0.06	-0.1	-0.09	-0.01	-0.01	-0.08

M: Mean, SD: Standard deviation, 1. Reside on property, 2. Occupant structure, 3. Age, 4. Occupation, 5. Generations farming, 6. Level of work off property, 7. Income generated off property, 8. Education, 9. Region, 10. Years landholder has owned the property, 11. Size (Ha), 12. Future intentions, sell or keep the property, 13. Would landholder consider producing timber, 14. Is landholder likely to change property management

4. Landholder preferences based on if they would consider growing trees for timber production on their property.

4.1 Grouping

The willingness of the landholder to consider timber production on their property was used to assess the barriers and related incentives to encourage private timber production. The sample into two groups, 'Willing' landholders who would consider producing timber on their property, and "Unwilling' landholders: those who wouldn't. Table 14 shows significant T test results between survey variable and the unwilling and willing landholder groups.

Unwilling Landholders

Unwilling landholders were more likely to be family or multi-generational households residing on their property, older, working on the property and residing towards the south of the survey region. They have smaller properties and are not engaged in private native forest production and do not manage their properties for timber production.

Willing Landholders

Willing landholders were more likely to be child free single generation households or business, not residing on the property; younger, working off the property and residing towards the north of the survey region. They had larger properties, were more likely to be involved in native forest production and managing their properties for timber production.

Table 14. Significant T-test results between unwilling and willing landholders

Variable	Unwilling		Willing		t	df	p-value
	Mean	SD	Mean	SD			
Reside	3.91	0.47	3.74	0.72	2.13	282	0.034
Occupant structure	2.72	0.71	2.51	0.97	1.94	282	0.054
Age	56.67	11.82	52.63	13.31	2.63	282	0.009
Work off property	1.15	1.37	1.62	1.31	-2.97	282	0.003
Region	5.81	2.62	4.99	2.88	2.46	282	0.014
Size	3.44	1.9	3.99	1.86	-2.4	282	0.017
Native forest mgmt.	2.52	1.28	4.06	2.39	-6.35	282	<0.001
Timber Production	0.04	0.46	10.24	23.11	-4.77	282	<0.001

4.2 Motivations to grow trees

Only 1.4% of landholders indicated that they were not interested in growing trees on their properties. Conversely 76.1% of landholders would plant trees for biodiversity and climate change. Close to the same portion would be motivated to grow trees for amenity (69.4%), land restoration (69.4%) and if the trees will be complimentary to their agriculture (67.3%). Chi square analysis found significant differences between the popularity of motivations to grow trees (p=<0.001) (Tabe 15). Paired t-tests show the four most chosen motivations are not different to one another, but significantly different to all other choices (p=0.000).

Partitioning the data into the groups shows both Unwilling and Willing landholders have the same choice patterns as the pooled data (Figure 14). Willing landholders also include commercial timber production as not different to the four most popular motivation choices, but different to all other choices except carbon reduction planting. T-tests found significant differences between the groups for the motivations commercial production, carbon reduction planting and not interested (Table 16).

Table 15. Chi squared results

Variable	All landholders				Unwilling				Willing			
	N	X-squared	df	p value	N	X-squared	df	p value	N	X-squared	df	p value
Motivation	284	691.29	7	<0.001	167	368.31	7	<0.001	117	424.52	7	<0.001
Information source	284	572.68	7	<0.001	167	242.77	7	<0.001	117	336.16	7	<0.001
Barrier	284	408.98	11	<0.001	167	540.71	11	<0.001	117	175.80	11	<0.001

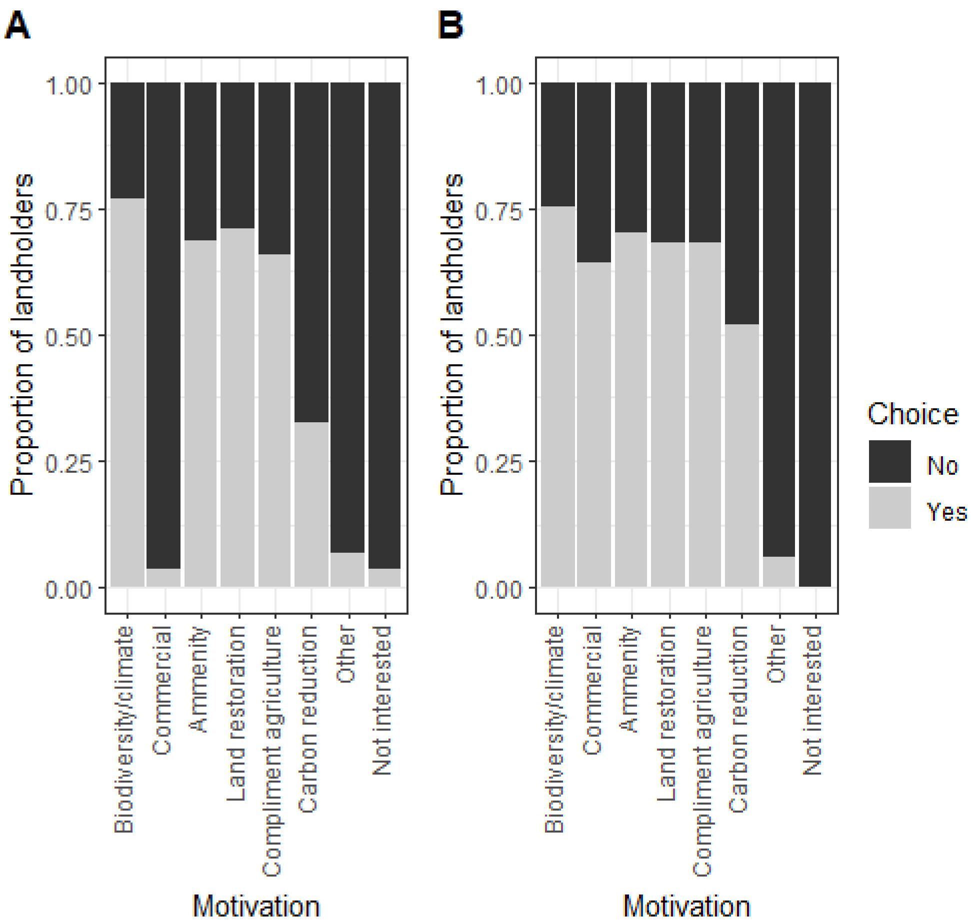


Figure 14. The portion of landholders who chose motivations to grow trees. **A** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **B** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

Table 16. Significant T-test results for willing and unwilling landholders and motivation to grow timber variables

Variable	Unwilling		Willing		t	df	p-value
	Mean	SD	Mean	SD			
Commercial	0.03	0.18	0.64	0.48	-12.99	282	<0.001
Carbon reduction	1.44	0.76	2.12	1.23	-5.27	282	<0.001
Not interested	0.03	0.18	0	0	2.42	282	0.016

4.3 Information source

The distribution of sources for land management information was consistent when considering the data set as a whole or grouped. Peers was the most common source of information and significantly different to all other sources (p=0.000). followed by Government extension, also different to all other sources (p=0.000). The only significant difference between unwilling and willing landholders was that willing landholders (M = 0.13, SD = 0.33) were more likely to source information from social media than unwilling landholders (M = 0.4 , SD = 0.04), t(282) = -2.4, p = 0.017). However, this option only represents 12.6% of willing landholders (Figure 15).

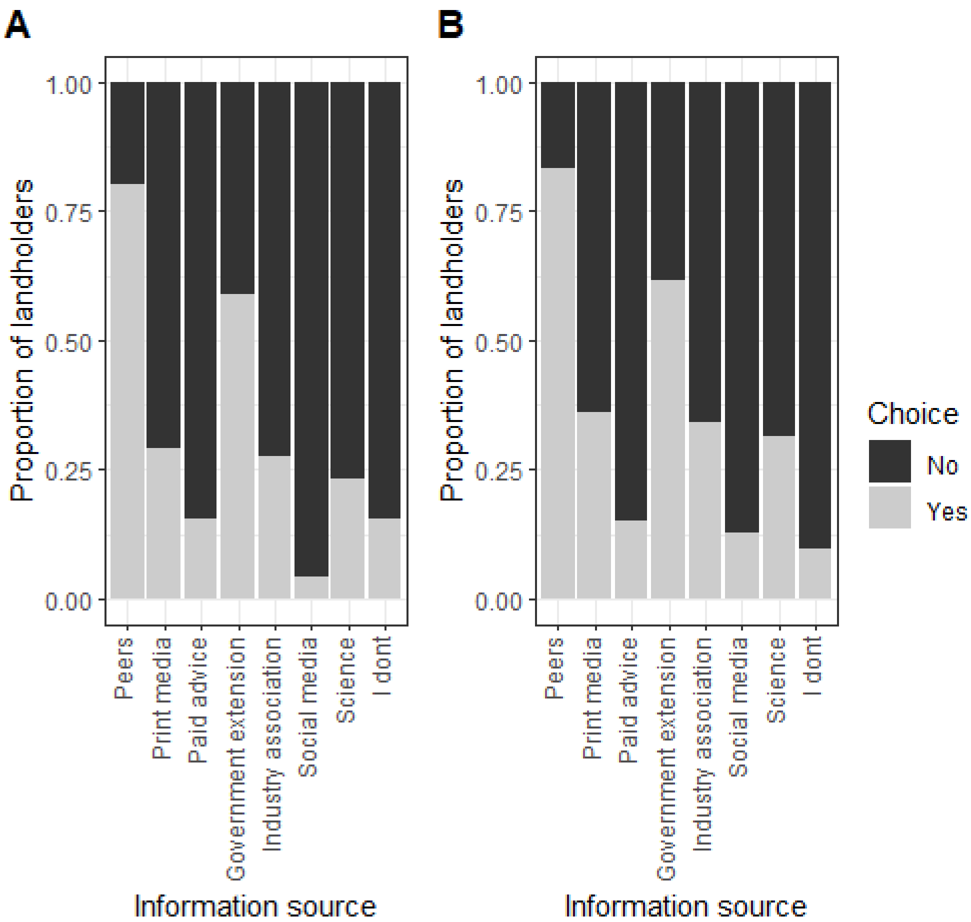


Figure 15. The portion of landholders who chose information sources. **A** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **B** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.4 Barrier choice

Considered as full data set, significant differences exist between the barrier choices ($p=<0.001$). The most frequently chosen barrier, Land use conflict was chosen by 45.1% of land holders. Analysis using pairwise T tests shows land use conflict is significantly different to all other barriers ($p=0.00$). The next most frequently chosen barriers were Cost (26.4%) and Knowledge (21.1%). Pairwise T test show Cost is different the reaming barriers ($p=0.00$) other than time and knowledge. Knowledge is different to the remaining barriers other than 'time' and No successful peers.

Assessment of the data by group found that Land Use Conflict was the main barrier for unwilling landholders, seen as a barrier by 70.1%. Land use conflict was statistically different to all other barriers ($p=0.000$) which are not significantly different to one another (Figure 16).

The distribution of barrier choices for willing landholders shows Cost, Land Use Conflict, knowledge and time rank as the most popular choices (38.3%, 27.5%, 29.3% and 27% respectively). The barrier Cost was significantly different ($p= 0.000$) to all barriers other than Land Use Conflict, knowledge and time. Land use conflict, Knowledge and Time were all significantly different to the least chosen barriers Plantation restrictive, Plantation prohibitive, other people's opinions and other ($p=0.000$). T-Test between the 2 groups show the number of times each barrier was chosen for each group are significantly different except other people's opinions and other (Table17).

Four barriers were chosen by less than 5% of land holders: Plantation policy too is complicated (3.2%), Plantation policy is too restrictive (4.9%), Other people's opinions (1.1%) and other barrier (4.9%). Due to the low representation in the population these barriers will not be analysed further.

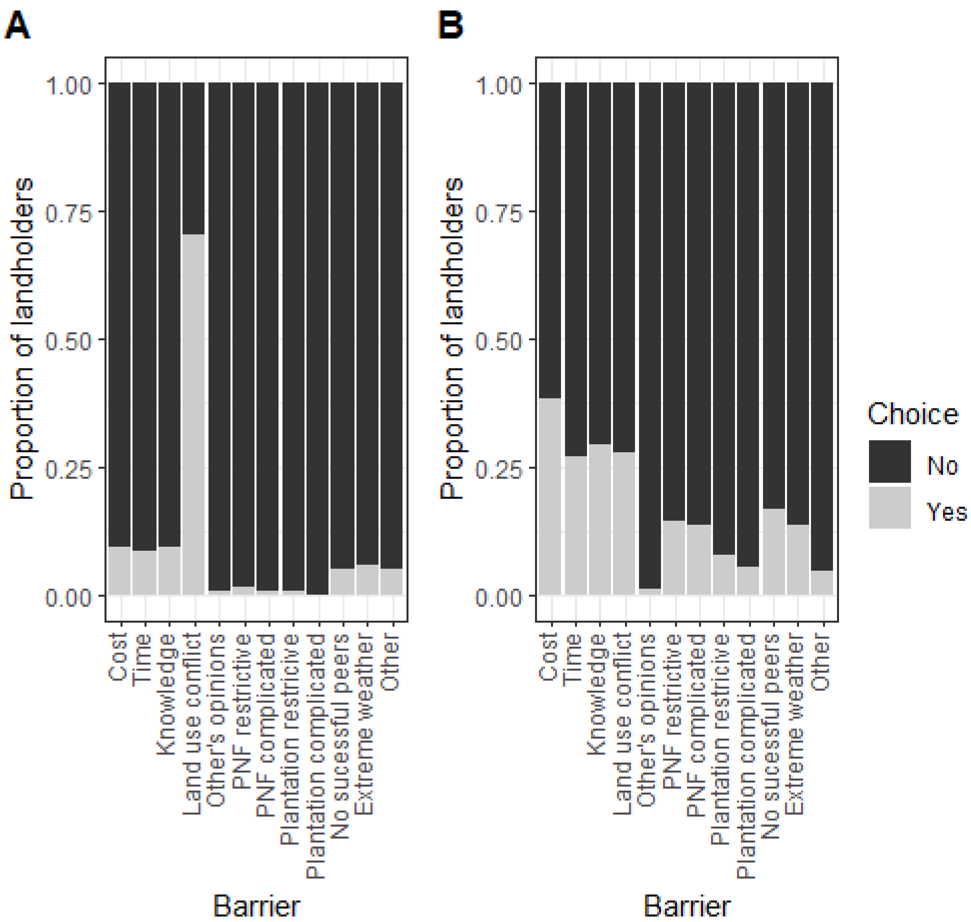


Figure 16. The portion of landholders who chose barriers to timber production. **A** Willing landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **B** Unwilling landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all the landholders for the relevant group.

Table 17. T-test results comparing unwilling and willing landholders for the barrier variables that were significantly correlated with consider timber.

Variable	Unwilling		Willing		t	df	p-value
	Mean	SD	Mean	SD			
Land use conflict	0.7	0.46	0.28	0.45	7.79	282	<0.001
Cost	0.09	0.29	0.38	0.49	-5.73	282	<0.001
Time	0.09	0.28	0.27	0.45	-3.95	282	<0.001
Extreme weather	0.06	0.24	0.14	0.35	-2.11	282	0.036
No successful peers	0.05	0.22	0.17	0.37	-3.01	282	0.003
Knowledge	0.09	0.29	0.29	0.46	-4.16	282	<0.001
PNF restrictive	0.02	0.13	0.14	0.35	-3.72	282	<0.001
PNF complicated	0.01	0.09	0.14	0.35	-3.94	282	<0.001
Plantation restrictive	0.01	0.09	0.08	0.27	-2.68	282	0.008
Plantation complicated	0	0	0.05	0.23	-2.57	282	0.011

4.5 Barrier: The cost of planting and managing trees and harvest related costs

The cost barrier was chosen by 26% landholders, the distribution of landholders by group is 15% unwilling landholders and 85% willing landholders.

Chi square analysis found that the frequency each incentive was chosen was significantly different (p=<0.001) (Table 18). Paired t tests with Bonferroni adjustment were used to find significant differences between the number of times incentives were chosen. The most chosen incentives were government grant (73%), subsidised establishment (71%) and environmental payments (59%). These incentives were not different to each other but mostly different to all other incentives (p<0.01); environmental payment was not different to residue income (p=0.66) or joint venture (p=0.07) (Figure 17A).

Table 18. Chi-square results assessing for differences between the frequency incentives were chosen for each barrier. Results are shown for the pooled data, unwilling landholders and willing landholders.

	All landholders				Unwilling				Willing			
Variable	N	X-squared	df	p value	N	X-squared	df	p value	N	X-squared	df	p value
Cost	75	143.08	7	<0.001	11	16.48	7	0.02	64	133.66	7	<0.001
Time	55	61.66	5	<0.001	10	1.86	5	0.87	45	75.68	5	<0.001
Knowledge	60	128.96	6	<0.001	11	9.17	6	0.16	49	137.32	6	<0.001
Land use conflict	128	66.27	6	<0.001	82	88.93	6	<0.001	46	22.59	6	<0.001
PNF Restrictive	26	32.26	6	<0.001	2	5.09	6	0.53	24	31.38	6	<0.001
PNF Complicated	24	38.99	6	<0.001	1	7.00	6	0.32	23	36.10	6	<0.001
No sucessful peers	34	78.31	6	<0.001	6	12.00	6	0.62	28	81.46	6	<0.001
Extreme weather	30	8.78	7	0.27	7	1.70	7	0.97	23	11.52	7	0.12

Unwilling landholders

Chi square analysis found that the frequency each incentive was chosen was significantly different (p=0.02), however further testing using paired t tests with Bonferroni adjustment did not find statistical difference between any of the pairs, most likely due to the small sample size. Figure 17B shows government grant (64%) followed by subsidised establishment and environmental payments (both 45%) were the most frequently chosen.

Willing landholders

Making up the majority of the land holders who chose cost as a barrier (85%), the preferences for Group B mimic the pooled sample, there were significant differences in the frequency incentive were chosen was (p=<0.001) (Figure 17C). The most popular incentives being government grant (75%), subsidised establishment (75%) and environmental payments (61%). As the pooled sample, these incentives were not different to each other but mostly different to all other incentives (p<0.01); environmental payment was not different to residue income (p=1) or joint venture (p=0.11).

Comparing the unwilling and willing landholders it can be seen that beyond the 3 most popular choices, willing landholders were more likely to choose interest free loan and Environmental payment than unwilling landholders.

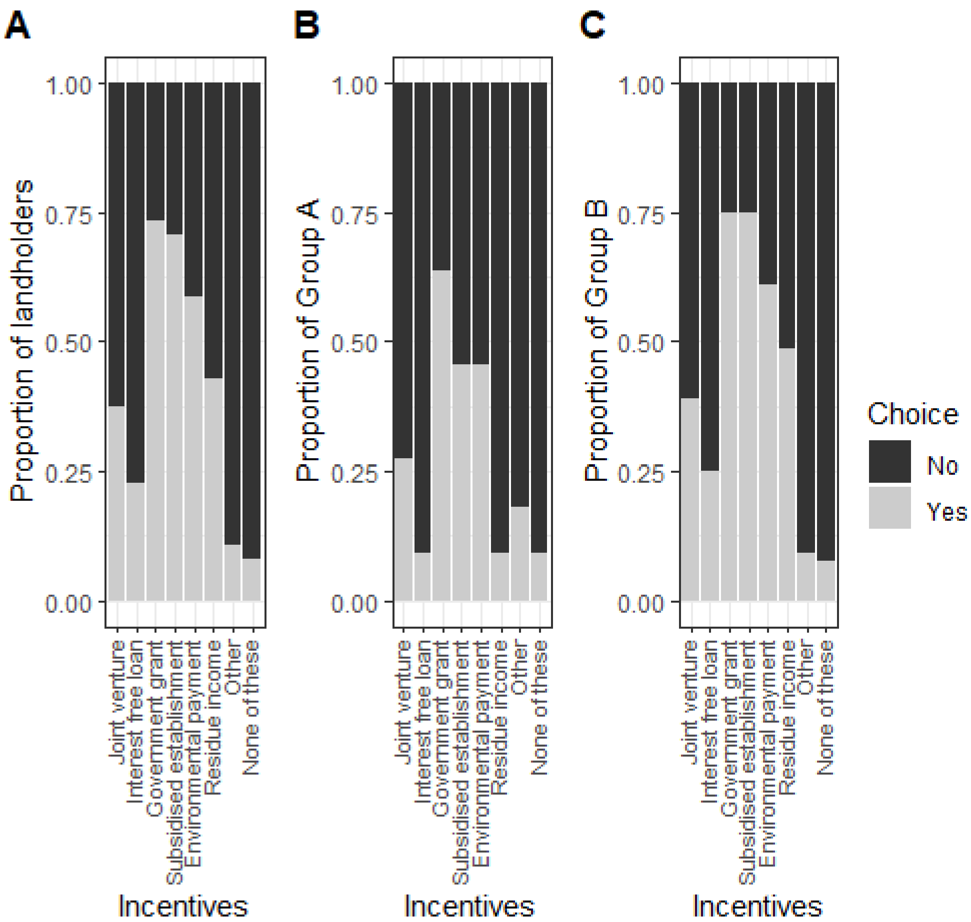


Figure 17. Frequency of incentive choices for the barrier Cost. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.6 Barrier: The time between investment and return is too long

The time barrier was chosen by 19% landholders, the distribution of landholders by group is 18% unwilling landholders and 82% willing landholders.

Chi square analysis found significant differences in the frequency incentives were chosen ($p=<0.001$). The most chosen incentives were environmental payment (66%), intermittent return (49%), secure market (49%) and agricultural co-benefits (47%) (Figure 18A). The number of times these incentives were chosen is significantly different to the options other and none of these ($p<0.001$)

Unwilling landholders

Chi square analysis found there were not significant differences in the frequency incentives were chosen ($p=0.87$). The most frequently chosen options were agricultural co-benefits, secure market and none of these (all 30%) (Figure 18B).

Willing landholders

The preferences for willing landholders were similar to the pooled sample, there were significant differences in the frequency incentives were chosen was (p=<0.001). The four most popular choices environmental payment (76%), intermittent return (58%), secure market (51%) and agricultural co-benefits (53%) were chosen significantly more than the two least chosen options other and none of these (p<0.001) (Figure 18C).

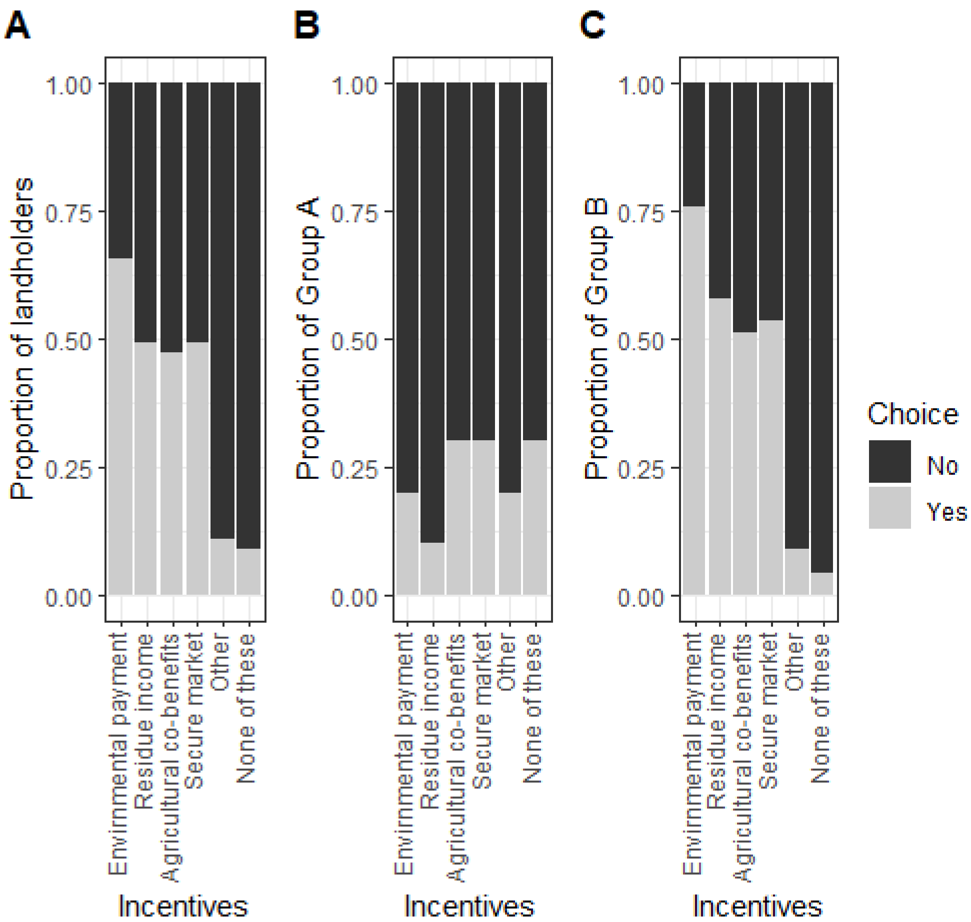


Figure 18. Frequency of incentive choices for the barrier Time. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.7 Barrier: I don't know how to manage trees for timber production

The knowledge barrier was chosen by 21% of landholders, the distribution of landholders by group is 18% willing landholders and 82% unwilling landholders.

Chi square analysis found significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentives were peer networking, guided information (both 72%) and field days (70%). Government extension and paid advice also ranked highly, being chosen by 67% and 50% of the landholders respectively. The frequency these incentives were chosen is significantly different to the options other and none of these (p<0.001) (Figure 19A).

Unwilling landholders

Chi square analysis found there were not significant differences in the frequency incentives were chosen ($p=0.16$). The most chosen incentive for unwilling was peer networking (54%) followed by paid advice (37%) (Figure 19B).

Willing landholders

Chi square analysis found significant differences in the frequency incentives were chosen ($p=<0.001$). Simar to the partitioning of the pooled sample the most popular incentives were guided information (87%), field days (85%), peer networking and government extension (both 80%). The frequency these incentives were chosen was significantly different the other incentive choices ($p=<0.05$), except paid advice which was not different to peer networking ($p=0.1$) and government extension ($p=0.1$) (Figure 19C).

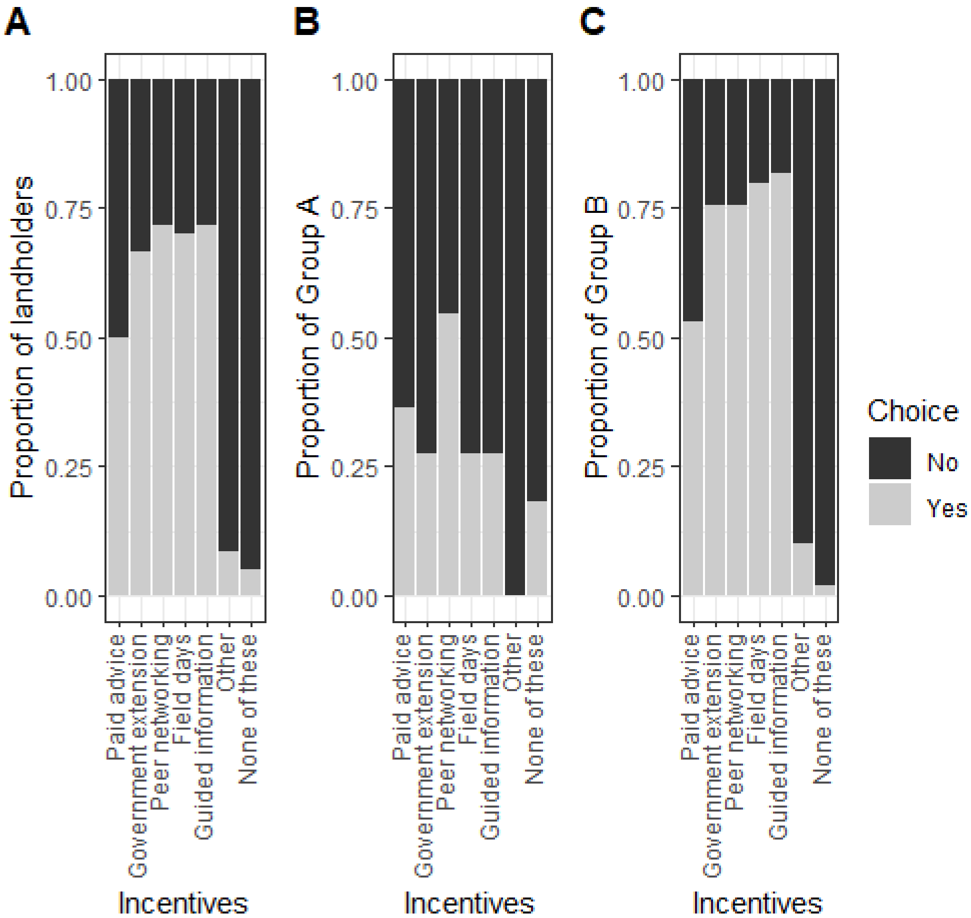


Figure 19. Frequency of incentive choices for the barrier Knowledge. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.8 Barrier: My land is used for other endeavours; I don't have space for trees

Land use conflict was the most selected barrier, chosen by 82% of land holders, the distribution of land holders by group was 64% unwilling landholders and 35% willing landholders. This the only barrier where the majority of the sample is unwilling landholders.

Chi square analysis found significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentives were none of these (37%) and agricultural co-benefits (34%) (Figure 20A). The frequency none of these was chosen was not different to agricultural co-benefits (p=1) or environmental payment (p=0.14), but different to all other incentives (p<0.01). The frequency agricultural co-benefits was chosen was not significantly different to environmental payment (p=0.80), guided information (p=0.09) or none of these (p=1)

Unwilling landholders

Chi square analysis found significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentive for unwilling landholders was none of these (43%) followed by agricultural co-benefits (29%). The frequency none of these and agricultural co-benefits was chosen was significantly different to all other choices (p=0.000 and p=<0.05) (Figure 20B).

Willing landholders

Chi square analysis found significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentive for willing landholders were agricultural co-benefits and environmental payment (both 41%). The frequency the least popular option 'other' was chosen (4%) was significantly different to the most chosen options agricultural co-benefits, environmental payment, government extension (37%) and guided information (37%) (p<0.05, p<0.01, p<0.01, p<0.05 respectively). There were no other differences between choice frequency for Group B (Figure 20C).

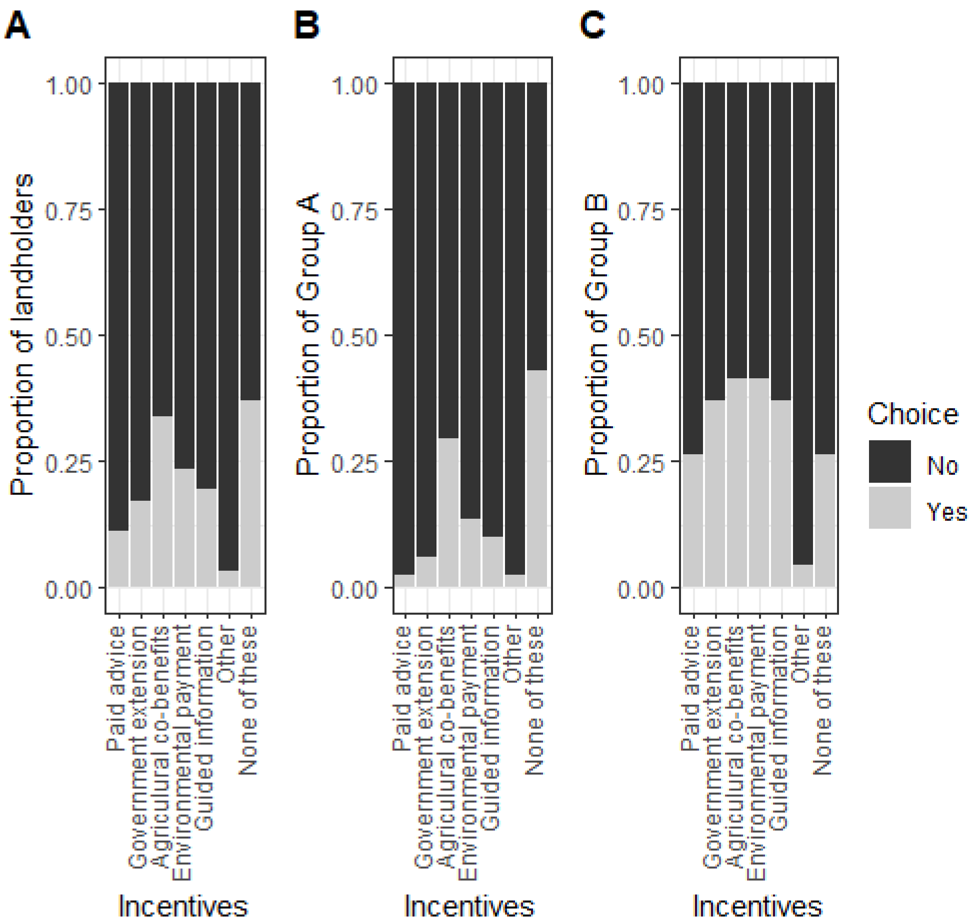


Figure 20. Frequency of incentive choices for the barrier Land use conflict. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.9 Barrier: The regulations for native forest timber production are too restrictive

The barrier native forest policy is too restrictive was chosen by 9% of land holders, the distribution of land holders by group was 8% Unwilling landholders and 92% willing landholders.

Chi square analysis found there were significant differences in the frequency incentives were chosen ($p=<0.001$). The most chosen incentive was changes to regulations (65%), followed by government extension (35%) and paid advice (31%). The frequency change to regulations was chosen is different to the frequency the 4 least chosen options peer networking ($p<0.001$), guided information ($p<0.01$), other ($p<0.00$) and none of these ($p<0.001$) were chosen. There are no other differences between choice frequencies for incentive options (Figure 21A).

Unwilling landholders

Chi square analysis found there was not significant differences in the frequency incentives were chosen ($p=0.53$). The incentives government extension, changes to regulations and none of these were equally chosen by half of the unwilling landholders who selected the restrictiveness of native forest policy as a barrier (Figure 21B).

Willing landholders

Chi square analysis found there were significant differences in the frequency incentives were chosen (p=<0.001). The most frequently chosen incentive for willing landholders was changes to regulations (67%), followed by government extension (33%) and paid advice (33%). The number of land holders who selected the incentive change to regulations was different to the four least chosen options peer networking (p<0.001), guided information (p<0.05), other (p<0.001) and none of these (p<0.001). There are no other differences between choice frequencies for incentive options (Figure 21C).

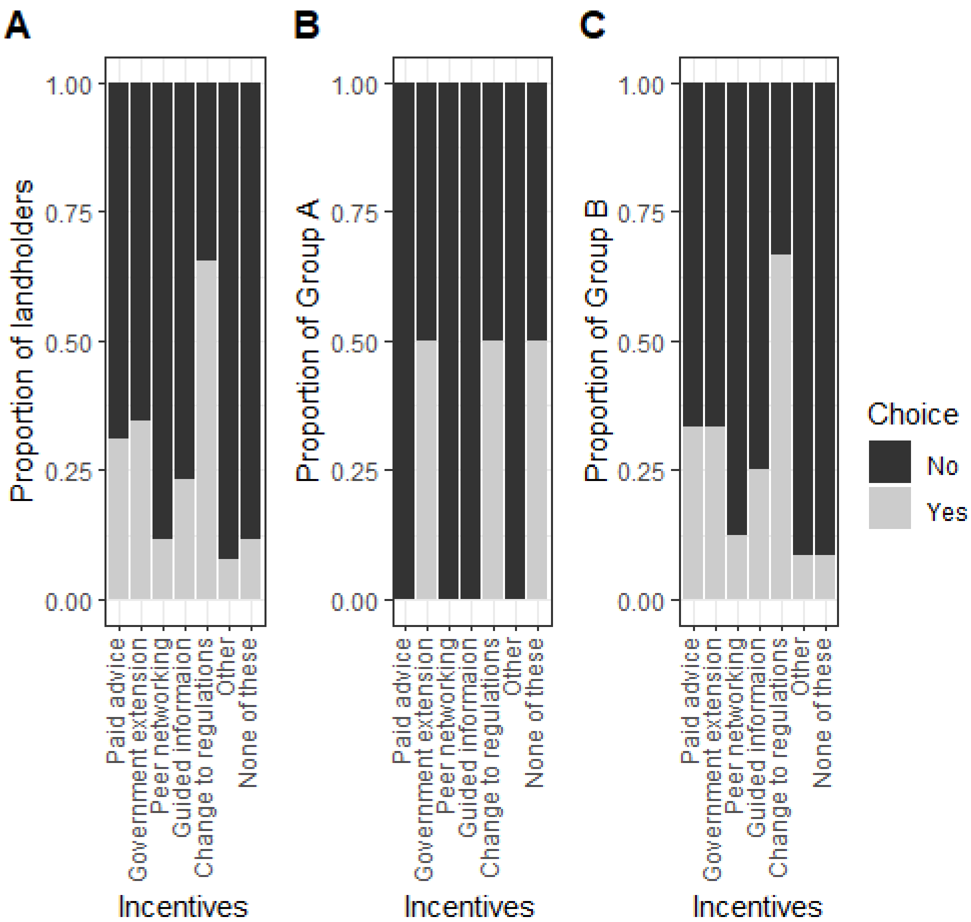


Figure 21. Frequency of incentive choices for the barrier Native Forest policy is too restrictive. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.10 Barrier: The regulations for native forest timber production are too complicated

The barrier native forest policy is too complicated was chosen by 9% of land holders, the distribution of land holders by group was 4% unwilling landholders and 96% willing landholders.

Chi square analysis found there were significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentives were paid advice and government extension (both 63%). The two least chosen options: other and none of these were significantly different to all other options, but not each other (p=<0.05). There were no other differences between the choice frequencies (Figure 22A).

Unwilling landholders

Chi square analysis found there were not significant differences in the frequency incentives were chosen (p=0.32). The incentives paid advice, government extension, peer networking and guided information were all chosen by each unwilling landholder who cited native forest policy too complicated as a barrier (Figure 22B).

Willing landholders

Chi square analysis found there were significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentives for willing landholders were paid advice and government extension (both 61%). The least chosen options other and none of these were chosen significantly less than the alternative incentives (p<0.05) other than peer networking (p=0.06 for both) (Figure 22C).

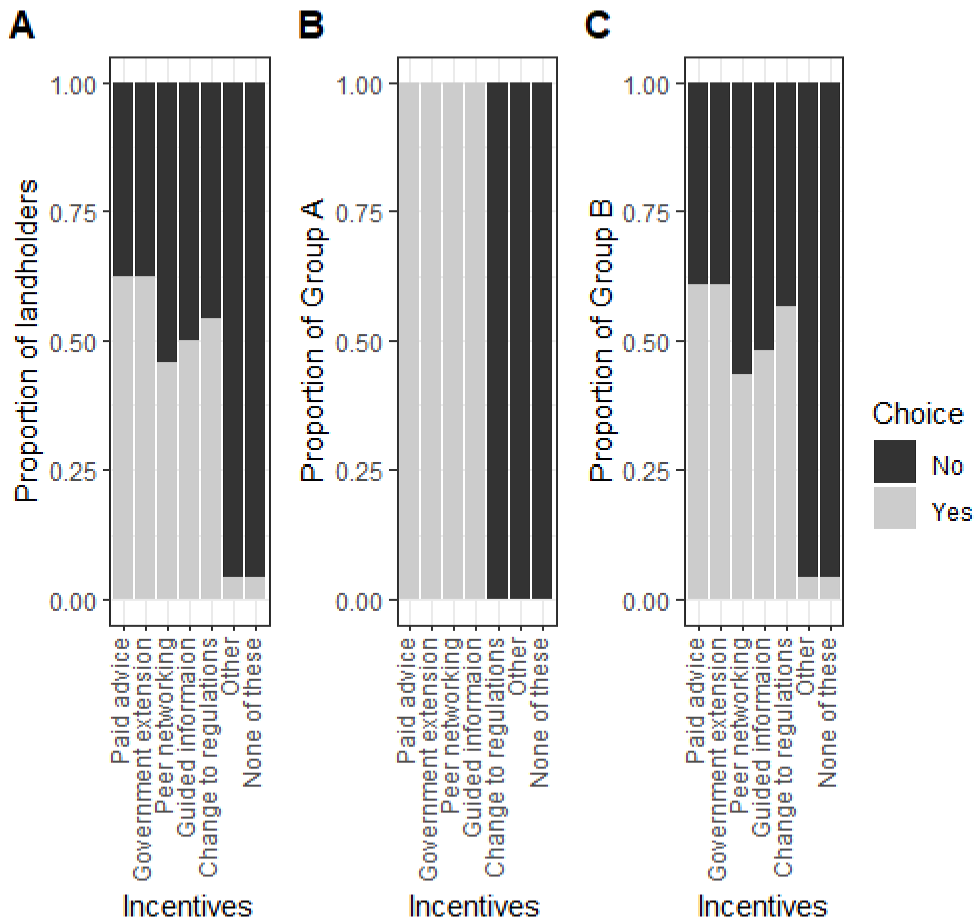


Figure 22. Frequency of incentive choices for the barrier Native Forest policy is too complicated **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.11 Barrier: I don't know anyone who has successfully managed their property for timber production

The lack successful peers barrier was chosen by 12% of the land holders, the distribution of landholders by group was 18% unwilling landholders and 82% willing landholders.

Chi square analysis found significant differences in the frequency incentives were chosen ($p=<0.001$). The most chosen incentives were field days (74%), followed by government extension and peer networking (both 71%). The frequency other (9%) and none of these (3%) were chosen was different to all other incentives ($p<0.001$), but not each other; no other differences were significant (Figure 23A).

Unwilling landholders

Chi square analysis found no significant differences in the frequency incentives were chosen ($p=0.62$). The most chosen incentive for unwilling landholders was guided information (67%) (Figure 23B).

Willing landholders

Chi square analysis found significant differences in the frequency incentives were chosen (p=<0.001). The most chosen incentive for willing landholders was guided information (89%). The incentives paid advice (64%), government extension (75%), peer networking (75%) and field days (68%) were all chosen as viable options for most land holders. There are not significant differences in the number of times the five most popular incentives were chosen. The options none of these and other were chosen significantly less than the favoured incentive options but were not different to each other (p<0.001) (Figure 23C).

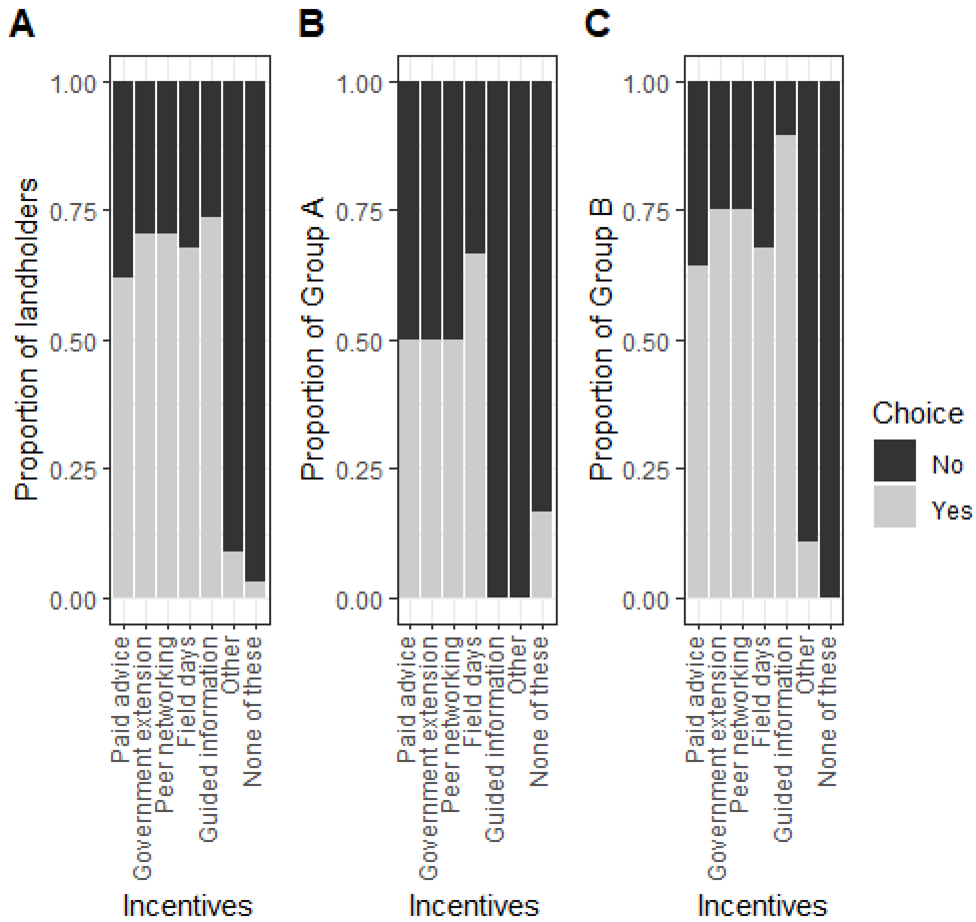


Figure 23. Frequency of incentive choices for the barrier No successful peers. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

4.12 Barrier: I am worried about the risk of extreme weather events

The extreme weather barrier was chosen by 11% of the land holders, the distribution of landholders by group was 23% Unwilling landholders and 77% willing landholders.

Chi square analysis found there was not significant differences in the frequency incentives were chosen (p=0.27). The most chosen incentives were guided information (34%) and government extension (33%) (Figure 24A).

Unwilling landholders

Chi square analysis found there was not significant differences in the frequency incentives were chosen (p=0.97). The most selected incentives for unwilling landholders were insurance, guided information and none of these (29% each) (Figure 24B).

Willing landholders

Chi square analysis found there was not significant differences in the frequency incentives were chosen (p=0.12). The most selected incentives for willing landholders were government extension and guided information (39% each) (Figure 24C).

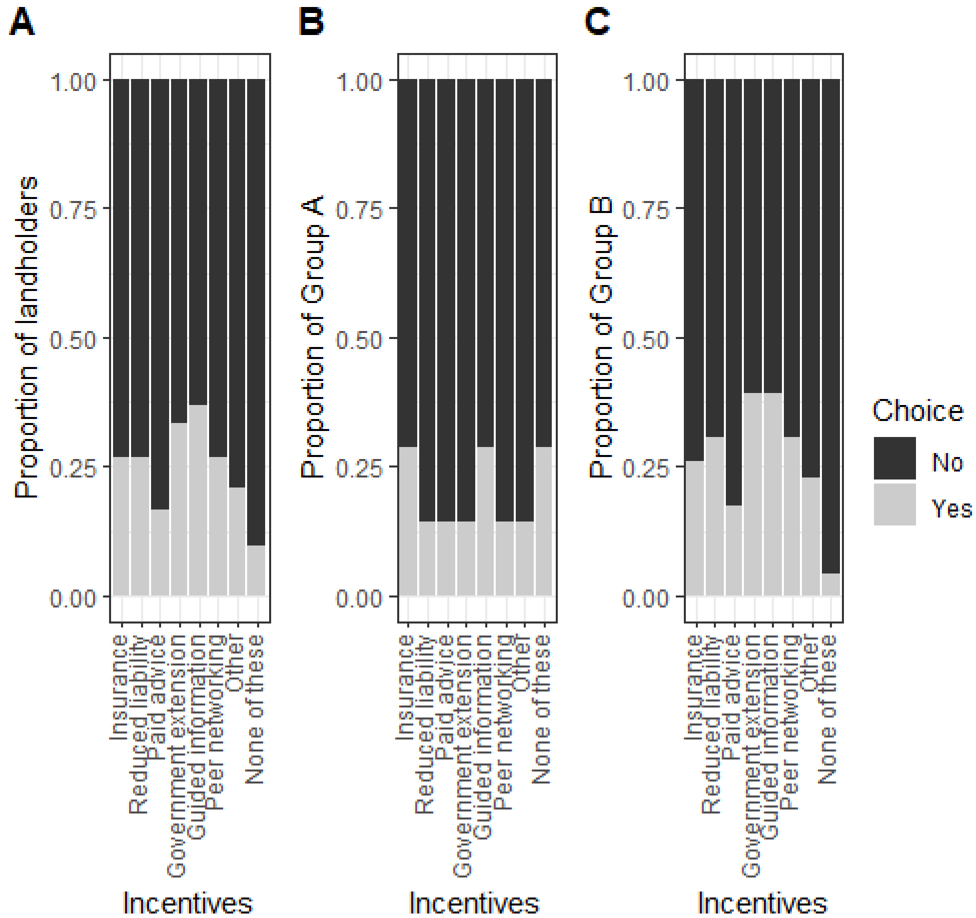


Figure 24. Frequency of incentive choices for the barrier Extreme weather. **A** Pooled data for all landholders. **B** Unwilling landholders, landholders who selected 'No' to the questions 'Would you Would you consider producing timber on your property?'; **C** Willing landholders, landholders who selected 'Yes' to the questions 'Would you Would you consider producing timber on your property?'. Landholders could select multiple incentives; each column represents all of the landholders for the relevant group.

5 Discussion

The characteristics of the survey sample terms of age distribution, property size, length of tenure, and primary land use the results were similar to those reported by Wright and Parker (2023) who surveyed 2400 landholders and land managers across rural and peri rural NSW. The participants in this survey had a higher level of education than that of the general population for the same region (ABS, 2023), this is thought to be indicative of the type of people who are drawn to participate in a survey for research. The low level of participation of families with children living at home, 18.7% of the sample compared to 35.7% of households in regional NSW (ABS, 2021), may also be a result of the survey delivery method, those with young children less likely to stop for an interview.

The results from the survey, in terms of both demographics and incentives, are not novel. Research into landholder perceptions of barriers to timber production conducted in Australia and internationally have found similar results: influx of non-farming landholders (Gibson et al., 2005; Bowden, 2007; Ferguson, 2014a), changing land use and value characteristics (Gamberg and Larson, 2003; Barr 2005; Gosnell et al., 2011; Mendham et al., 2012; Schirmer et al., 2012), and smaller lot sizes (Emtage, 2001; Ives and Kendal, 2013; Ruseva et al., 2015; Baker et al., 2017; Matilainen et al., 2018). Landholders, new and established, require a mix of information (Pannel et al., 2006; Gordon et al., 2013; Medows et al. 2014; Schirmer et al., 2014; Ofoegbu and Babalola, 2015; Evans, 2018; Oduro et al., 2018; Fleming et al., 2019; Lewis et al., 2022) and financial support (Cacho et al., 2001; Pannel et al., 2006; Herbohn and Harrison, 2004; Herbohn et al., 2005; Barua, et al. 2014; Ofoegbu and Babalola, 2015; Faruqi, et al. 2018; Oduro et al., 2018;Fleming et al., 2019; Lewis et al., 2022) to overcome their barriers to timber production. So, if we already have this information, why aren't we seeing gains in plantation areas?

Incentives to increase plantation area on private land have been available for decades (Schirmer et al; 2014, Whittle et al., 2019; Lewis et al., 2022). The low uptake of these schemes is often lamented; but, poor uptake is not restricted to planting trees for timber production but also carbon (Schirmer et al., 2014; Evans, 2018), conservation (Pannel et al., 2006) and biodiversity (Torabi, 2016).

A brief review of recent plantation incentives: the 2020 vision (Plantation 2020 Vision Implementation Committee, 1997), Emissions Reduction Fund (ERF) Plantation Forestry Method (DAFF, 2017) and The Support Plantation Establishment Program (DAFF, 2023) finds policies that offer financial incentives but lacking in information support.

The 2020 policy was effective in terms of getting trees in the ground, but the survival or utility of the trees planted was marred by poor management (Dargusch, 2008), common for projects that focus on planting numbers or area (Duguma et al., 2020; Fleischman et al., 2020). The ERF Plantation Forestry Method provides options for productive and non-productive plantations to be involved in the carbon market (DAFF, 2017), but the complexity of the program requires specialist skills to understand, implement and audit carbon projects. The Support Plantation Establishment Program administered by DAFF requires a minimum land commitment of 20 ha and offers nothing in terms of future management requirements or support (DAFF, 2023).

These three programs illustrate policy and incentives are not utilizing knowledge about landholder needs to maximize program uptake. Lack of support in terms of information, large land commitments and complex administration provide for failed long term success and restricts access for landholders with limited production skills (Pannel et al., 2006, Evans 2018), land use flexibility (Coomes et al., 2008; Schirmer and Bull, 2014; Schirmer et al., 2014), or resources available for administration (Cocklin et al., 2007; Torabi et al., 2016).

This study provides insights into landholder motivations for planting trees on their properties, sources of land management information, barriers to timber production and desired incentives to enable plantation establishment for timber production on private land.

The separation of the sample into unwilling and willing landholders showed motivations to grow trees and where landholders source land management information was consistent across the groups. The main barrier for the unwilling landholders was land use conflict; whereas willing landholders have a wider range of barriers, namely cost, time and land use conflict.

Novel to this study is the reporting of landholder preferences for potential incentives to overcome barriers to timber production on their property. Providing insight for policy makers for how to best cater to landholders and encourage timber production as a viable land use.

The incentives favoured by landholders for overcoming the barriers to timber production were a mix of information, financial and production support options. Similar to other studies, financial and market creation incentives were favoured to overcome the cost barrier (Herbohn and Harrison, 2004; Pannel et al., 2006; Barua, et al. 2014; Schirmer et al 2014; Midgley et al., 2017; Faruqi, et al. 2018; Oduro et al., 2018) and the provision of information and extension was favoured to overcome the knowledge barrier (Black, 2000; Pannel et al., 2006; Meadows et al. 2013; Medows et al. 2014; Schirmer et al 2014; Ruseva et al 2015; Bjarstig and Kvastegard, 2016; Torbabi et al., 2006; Midgley et al., 2017; Oduro et al., 2018). The more complex barriers of time and land use conflict returned a mix of financial, information and production supports.

Incentives such as an environmental payment scheme, favoured to overcome both the cost and time barriers, requires a system that is easy to navigate, backed by information and not marred by administrative burden (Sothern Cross Group, 2006; Cocklin et al., 2007; Schirmer and Bull, 2014). A scheme such as the approach outlined by the Southern Cross Group (Vanclay et al., 2006) for native forest payments could be adapted for plantations. The scheme offers relatively low data input that could be mostly facilitated by the landholder, self-adjusts for productivity and encourages stem size. Such a scheme could potentially provide access to payments to offset the opportunity cost of land use change (Cacho et al., 2003; Pannel et al., 2006; Coomes et al., 2008) or plantation management (Cassidy et al., 2012) without onerous reporting or audit costs (Cocklin, 2007; Torabi et al., 2016). Similarly, any considered grants or establishment subsidies will need to be flexible in terms of land size (Schirmer and Bull, 2014) and length of commitment (Schirmer et al., 2012; Schirmer and Bull, 2014), and have milestones beyond planting (Dargusch, 2008; Duguma et al., 2020; Fleischman et al., 2020).

Landholders will require a suite of information sources to understand and achieve agricultural co-benefits or overcome land use conflict and time barriers. Linking guided information (Black 2000; Schirmer et al., 2014), local examples for peer interaction (Torabi et al., 2016; Schirmer et al., 2014), and extension for on property design and implementation (Black,2000) to provide a coherent message will help land holders move through their decision-making process (Schirmer et al., 2014).

A similar suite of accessible information could potentially double participation in native forest harvesting (the percent of landholders actively participating was 12%, landholders not participating due to not knowing how was 12%). Providing information specifically aimed at demystifying private native forest policy could provide additional 25 % of landholder participation.

Assurances of a secure market for plantation grown timber will hinge on species and plantation management (Vega and Page, 2023). The provision of intermittent returns for timber products is recognised as an industry wide issue for plantation grown eucalypts in north east NSW where traditional residue markets, such as chip, are not viable due to transport distance and cost (Cassidy et al., 2012). Support will be necessary for landholders to market locally utilised products such as firewood, fence posts and strainers, small poles and landscaping timbers to provide income. Greater information availability, training and price transparency may be required to facilitate landholder confidence (Keenan, 2019; Monckton and Mendham 2022).

Landholder motivations to grow trees and land management information sources were consistent across the sample. Allowing for environmental, amenity and land management aspirations within future plantation policy may pique the interest of the landholder not currently interested in managing trees for timber production. Offsetting the legacy of failed MIS plantations (Montoya, 2010; Medows et al., 2014: Rhodes and Stephens, 2014; Fleming et al., 2019) with quality examples of timber production through fostering positive peer to peer information exchange (Torabi et al., 2016; Monkton and Mendham, 2022) and quality extension (Fulton and Race 2001; Herbohn et al., 2005; Emtage et al., 2006; Meadows et al., 2014: Ruseva et al., 2015) will reach both unwilling and willing landholders, potentially changing management goals. However, it should be noted that quality forestry related education and extension is often lacking (Pannel et al., 2006; Vanclay, 2007; Gordon et al., 2013; Torabi et al 2016) and the newness of the industry lends itself to gaps in knowledge (Smith and Brennan, 2006), therefore information should be well considered before providing landholders with advice (Tisdell, 1985)

6 Conclusion

Recasting timber plantations as complementary to farm activities and income will be paramount to the success of timber production on private land. To access land of sufficient quality to ensure plantation growth and health, future policy needs to provide a suite of incentives including economic and educational supports.

To pique the interest of both unwilling and willing landholders in the north east of NSW, future incentives should be designed to capture the environmental and amenity motivations of land holders. Combining new incentives with quality extension, highlighting successful examples of timber production in the landscape, and fostering positive peer to peer information sharing will increase the profile of timber plantations as a rural land use.

7 References

Ajani, J., 2007. *The forest wars*. Melbourne University Press (an imprint of Melbourne University Publishing).

Australian Bureau of Statistics (ABS), 2021. Census of Population and Housing. Retrieved May 6, 2024

Australian Bureau of Statistics (ABS), 2023. Education and Work. Retrieved May 6, 2024Baker, D., Dizyee, K., Parker, W., Scrimgeour, F., Griffith, G., 2017. Primary Industry Chains and Networks: Analysis for Public and Private Interests. Syst. Res. Behav. Sci. 34, 699–709. https://doi.org/10.1002/sres.2400

Barr, N., 2005. *The changing social landscape of rural Victoria*. Department of Primary Industries (VIC).

Barua SK, Lehtonen P, Pahkasalo T. 2014. Plantation vision: potentials, challenges and policy options for global industrial forest plantation development. Int For Rev. 16:117–127.

Bjärstig, T., Kvastegård, E., 2016. Forest social values in a Swedish rural context: The private forest owners' perspective. For. Policy Econ. 65, 17–24. https://doi.org/10.1016/J.FORPOL.2016.01.007

Black, A.W., 2000. Extension theory and practice: a review. *Australian journal of experimental agriculture*, *40*(4), pp.493-502.

Bowden, B., 2007. Sea-changers and shifting political loyalties in the Northern Rivers of NSW 1966-2007. J. R. Aust. Hist. Soc. 93, 199.

Burnley, I.H., Murphy, P.A., 2002. Change, continuity or cycles: the population turnaround in New South Wales. *Journal of Population Research*, *19*(2), pp.137-154.

Cacho, O., Greiner, R., Fulloon, L., 2001. An economic analysis of farm forestry as a means of controlling dryland salinity. *Australian Journal of Agricultural and Resource Economics*, *45*(2), pp.233-256.

Carias Vega, D., Page, T., 2023. Conditions that Enable Successful Participation of Smallholder Tree Growers in Timber Value Chains. *Small-scale Forestry*, *22*(3), pp.457-479.Cassidy, M., Palmer, G., Glencross, K., Nichols, J.D., Smith, R.G.B., 2012. Stocking and intensity of thinning affect log size and value in *Eucalyptus pilularis*. For. Ecol. Manage. 264, 220–227. https://doi.org/10.1016/j.foreco.2011.10.007

Clark, J., 2004. Forest policy for sustainable commodity wood production: An examination drawing on the Australian experience. Ecol. Econ. 50, 219–232. https://doi.org/10.1016/j.ecolecon.2004.03.032

Cocklin, C., Mautner, N., Dibden, J., 2007. Public policy, private landholders: Perspectives on policy mechanisms for sustainable land management. J. Environ. Manage. 85, 986–998. https://doi.org/10.1016/j.jenvman.2006.11.009

Commonwealth of Australia, 1995. Regional Forest Agreements: the Commonwealth Position. Commonwealth of Australia, Canberra.

Dargusch, P., 2008. Understandings of sustainable corporate governance by Australian Managed Investment Schemes and some implications for small-scale forestry in Australia. Small-Scale For. 7, 67–75

Department of Agriculture fisheries and forestry (DAFF) 2017. Emissions Reduction Fund Plantation Forestry Notification Guidelines: Guidance for Proponents. Canberra

Department of Agriculture fisheries and forestry (DAFF) 2023. Support Plantation Establishment Program.

Department of Agriculture and Water Resources, 2018. Growing a better Australia – A billion trees for jobs and growth, Canberra. CC BY 4.0. ISBN 978-1-76003-174-9 (printed)

Department of agriculture water and environment, ND. Regional Forest Agreements Environment and heritage factsheet.

Emtage, N., Herbohn, J., Harrison, S., 2006. Landholder typologies used in the development of natural resource management programs in Australia-a review. Australas. J. Environ. Manag. 13, 79–94. https://doi.org/10.1080/14486563.2006.9725119

Emtage, N.F., Harrison, S.R. and Herbohn, J.L., 2001. Landholder attitudes to and participation in farm forestry activities in sub-tropical and tropical eastern Australia. *Sustainable farm forestry in the tropics*. *Edward Elgar, Cheltenham, UK*, pp.195-210.

Evans MC. 2018. Effective incentives for reforestation: lessons from Australia's carbon farming policies. Curr Opin Environ Sustain. 32:38–45.

Faruqi, S., Wu, A., Brolis, E., Ortega, A.A. and Batista, A., 2018. The business of planting trees: a growing investment opportunity. World Resources Institute, Washington.

Ferguson, I., 2014a. Australian plantations: mixed signals ahead. Int. For. Rev. 16, 160–171. https://doi.org/10.1505/146554814811724739

Fleischman, F., Basant, S., Chhatre, A., Coleman, E.A., Fischer, H.W., Gupta, D., Güneralp, B., Kashwan, P., Khatri, D., Muscarella, R., Powers, J.S., 2020. Pitfalls of tree planting show why we need people-centered natural climate solutions. *BioScience*, *70*(11), pp.947-950.

Fleming, A., O'grady, A.P., Mendham, D., England, J., Mitchell, P., Moroni, M., Lyons, A., 2019. Understanding the values behind farmer perceptions of trees on farms to increase adoption of agroforestry in Australia. *Agronomy for sustainable development*, *39*(1), p.9.

Fulton, A. and Race, D. 2001. Farm forestry in Australia: Why do landholders get involved? In: Herbohn, J.L., Harrison, S., Herbohn, K. and Smorfitt, D. (eds) Developing Policies to Encourage Small-Scale Forestry, Proceedings of the Kuranda IUFRO group 3.08 Small-scale Forestry conference. School of Natural and Rural Systems Management, The University of Queensland, Brisbane.

Gibbs, D. M., 1992. Economic impacts of the New South Wales Rainforest Policy Decision of 1982 on the timber industry of the Far North Coast. Aust. For. 55, 80-89.

Gibson, C., Dufty, R., Drozdzewski, D., 2005. Resident attitudes to farmland protection measures in the Northern Rivers Region, New South Wales. Aust. Geogr. 36, 369–383. https://doi.org/10.1080/00049180500325744

Gamborg, C., Larsen, J.B., 2003. 'Back to nature'—a sustainable future for forestry?. *Forest Ecology and Management*, *179*(1-3), pp.559-571.

Gordon, M., Schirmer, J., Lockwood, M., Vanclay, F., Hanson, D., 2013. Being good neighbours: Current practices, barriers, and opportunities for community engagement in Australian plantation forestry. *Land Use Policy*, *34*, pp.62-71.

Gosnell, H., Kline, J., Chrostek, G., Duncan, J., 2011. "Is Oregon's Land Use Planning Program Conserving Forest and Farm Land? A Review of the Evidence." Land Use Policy 28 (1): 185–192. doi:10.1016/j.landusepol.2010.05.012.

Herbohn, J.L., Emtage, N.F., Harrison, S.R., Smorfitt, D.B., 2005. Attitudes of landholders to farm forestry in tropical eastern Australia. Aust. For. 68, 50–58. https://doi.org/10.1080/00049158.2005.10676226

Herbohn, J.L. and Harrison, S.R., 2004. The Evolving Nature of Small-Scale Forestry in Australia. J. For. *102*(1), pp.42-47.

Ives, C.D., Kendal, D., 2013. Values and attitudes of the urban public towards peri-urban agricultural land. Land use policy 34, 80–90. https://doi.org/10.1016/j.landusepol.2013.02.003

Jay, V.A., Nichols, J.D., Vanclay, J.K., 2007. Social and ecological issues for private native forestry in north-eastern New South Wales, Australia. Small-scale For. 6, 115–126. https://doi.org/10.1007/s11842-007-9008-0

Kanowski, P.J., 2017. Australia's forests: Contested past, tenure-driven present, uncertain future. *Forest Policy and Economics*, *77*, pp.56-68.

Keenan, R.J., Anderson, N., Bull, L., Dembek, K., Kostanski, L., Patterson, S., 2019. Designing business models for commercial tree-growing partnerships on rural land. University of Melbourne.

Kendra, A., Hull, R.B., 2005. Motivations and Behaviours of New Forest Owners in Virginia. For. Sci. 51, 142–154. https://doi.org/10.1093/forestscience/51.2.142

Lane, M.B., 1999. Regional forest agreements: Resolving resource conflicts or managing resource politics? Aust. Geogr. Stud. 37, 142–153. https://doi.org/10.1111/1467-8470.00075

Lane, M.B., 2003. Decentralization or privatization of environmental governance? Forest conflict and bioregional assessment in Australia. J. Rural Stud. 19, 283–294. https://doi.org/10.1016/S0743-0167(02)00084-0

Lee, S., Lee, D.K., 2018. What is the proper way to apply the multiple comparison test?. *Korean journal of anesthesiology*, *71*(5), p.353.

Lewis, T., Pachas, N., Venn, T.J., 2022. How can we grow the plantation estate and improve private native forest management in Australia? Silvopastoral systems provide a solution. *Australian Forestry*, *85*(2), pp.55-59.

Leys, A.J., Vanclay, J.K., 2011. Stakeholder engagement in social learning to resolve controversies over land-use change to plantation forestry. Reg. Environ. Chang. 11, 175–190. https://doi.org/10.1007/s10113-010-0132-6

Loxton EA, Schirmer J, Kanowski P. 2012. Social impacts of the Regional Forest Agreement on members of the forest industry in north-eastern New South Wales. Aust For. 75:251–263.

Lugg, A., 1998. Social impacts of a forest policy on a dependent rural community: Bombshell or blessing? Aust. For. 61, 173–184. https://doi.org/10.1080/00049158.1998.10674737

Matilainen, A., Koch, M., Zivojinovic, I., Lähdesmäki, M., Lidestav, G., Karppinen, H., Didolot, F., Jarsky, V., Põllumäe, P., Colson, V., Hricova, Z., Glavonjic, P., Scriban, R.E., 2018. Perceptions of ownership among new forest owners – A qualitative study in European context. For. Policy Econ. https://doi.org/10.1016/J.FORPOL.2018.06.002

Meadows, J., Emtage, N., Herbohn, J., 2014. Engaging Australian small-scale lifestyle landowners in natural resource management programmes – Perceptions, past experiences and policy implications. Land use policy 36, 618–627. https://doi.org/10.1016/j.landusepol.2013.10.016

Meadows, J., Herbohn, J., Emtage, N., 2013. Supporting Cooperative Forest Management among Small-Acreage Lifestyle Landowners in Southeast Queensland. Aust. Soc. Nat. Resour. 26, 745–761. https://doi.org/10.1080/08941920.2012.719586

Mendham, E., Curtis, A., Millar, J., 2012. The Natural Resource Management Implications of Rural Property Turnover. Ecol. Soc. 17, art5. https://doi.org/10.5751/ES-05071-170405

Mercer, D., Underwood, A., 2002. Australian timber plantations: National vision, local response. Land use policy 19, 107–122. https://doi.org/10.1016/S0264-8377(02)00005-4

Midgley, S.J., Stevens, P.R., Arnold, R.J., 2017. Hidden assets: Asia's smallholder wood resources and their contribution to supply chains of commercial wood Hidden assets: Asia's smallholder wood resources and their contribution to supply chains of commercial wood. Aust. For. 80:1, 10-25. https://doi.org/10.1080/00049158.2017.1280750

Monckton, D., Mendham, D.S., 2022. Maximising the benefits of trees on farms in Tasmania–a desktop review of investment opportunities to improve farm enterprise productivity, profitability and sustainability. *Australian Forestry*, *85*(1), pp.6-12.

Montoya, D., 2010. *Plantation forestry in NSW: Regulatory regimes and future prospects*. NSW Parliamentary Library Research Service.

Myint, J., Edgar, D.F., Kotecha, A., Murdoch, I.E., Lawrenson, J.G., 2010. Barriers perceived by UK-based community optometrists to the detection of primary open angle glaucoma. *Ophthalmic and Physiological Optics*, *30*(6), pp.847-853.

New South Wales Government, 1982. *New South Wales Government Rainforest Policy 1982*. Published by Department of Environment and Planning, Sydney.

Oduro, K.A., Arts, B., Kyereh, B., Mohren, G., 2018. Farmers' Motivations to Plant and Manage On-Farm Trees in Ghana. Small-scale For. 17, 393–410. https://doi.org/10.1007/s11842-018-9394-5

Ofuegbu, C., Babalola, F., 2015. Private Investment in Plantation Forestry: A Review of Lessons from Uganda Sawlog Production Grant Scheme. For. Res. Open Access. https://doi.org/10.4172/2168-9776.S1-001

Pannell, D.J., Marshall, G.R., Barr, N., Curtis, A., Vanclay, F., Wilkinson, R., 2006. Understanding and promoting adoption of conservation practices by rural landholders. *Australian journal of experimental agriculture*, *46*(11), pp.1407-1424.

Plantation 2020 Vision Implementation Committee, 1997. Plantations for Australia: the 2020 Vision. Department of Primary Industries and Energy, Canberra. 24 pp.

Pressey, R. L., Ferrier. S, Hager, T. C., Woods, C. A., Tully, S.L., Weinman, K.M. 1996. How well protected are the forests of north-eastern New South Wales? - Analyses of forest environments in relation to formal protection measures, land tenure, and vulnerability to clearing. For. Ecol. Manage. 85, 311-333.

Pritchard, B., Welch, E., Restrepo, G.U., 2024. How land-use planning in multifunctional regions shapes spaces for farming. *Geographical Research*.

Qualtrics, Provo, UT, USA. https://www.qualtrics.com

R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical computing, Vienna, Austria. URL https://www.R-project.org/.

Rhodes, D., Stephens, M., 2014. Planted forest development in Australia and New Zealand: comparative trends and future opportunities. New Zeal. J. For. Sci. 44. https://doi.org/10.1186/1179-5395-44-S1-S10

Ruseva, T.B., Evans, T.P., Fischer, B.C., 2015. Can incentives make a difference? Assessing the effects of policy tools for encouraging tree-planting on private lands. J. Environ. Manage. 155, 162–170. https://doi.org/10.1016/j.jenvman.2015.03.026

Schirmer, J., Dovers, S., Clayton, H., 2012. Informing conservation policy design through an examination of landholder preferences: a case study of scattered tree conservation in Australia. *Biological Conservation*, *153*, pp.51-63.

Schirmer, J., Bull, L., 2014. Assessing the likelihood of widespread landholder adoption of afforestation and reforestation projects. Glob. Environ. Chang. 24, 306–320. https://doi.org/10.1016/j.gloenvcha.2013.11.009

Smith, R.G.B., Brennan, P., 2006. First thinning in sub-tropical eucalypt plantations grown for high-value solid-wood products: a review. Aust. For. 69, 305-312.

Taylor, E., Butt, A., Amati, M., 2015. Making the Blood Broil: Conflicts Over Imagined Rurality in Peri-Urban Australia. Plan. Pract. Res. 00, 85–102. https://doi.org/10.1080/02697459.2015.1028252

Tisdell, C.A., 1985. Conserving and planting trees on farms: lessons from Australian cases. *Review of Marketing and Agricultural Economics*, *53*(3), pp.185-194.

Torabi, N., Mata, L., Gordon, A., Garrard, G., Wescott, W., Dettmann, P., Bekessy, S.A., 2016. The money or the trees: What drives landholders' participation in biodiverse carbon plantings? Glob. Ecol. Conserv. 7, 1–11. https://doi.org/10.1016/j.gecco.2016.03.008

Turvey N. 2006. Terania Creek: rainforest wars. Brisbane: Glass House Books.

Vanclay, J.K., Thompson, D., Sayer, J.A., McNeely, J., Kaimowitz, D., Gibbs, A., Crompton, H., Cameron, D., Bevege, I., 2006. A proposal for stewardship support to private native forests in NSW.

Vanclay, J.K., 2007. Community attitudes towards private native forestry in New South Wales. *Small-Scale Forestry*, 6(2), pp.177-188.

Whittle, L., Lock, P., Hug, B., 2019. Economic potential for new plantation establishment in Australia: outlook to 2050.ABARES research report, Canberra. Wright, V., Parker, J., 2023. NSW Landholders Survey. NSW Government, Local Land Services

Appendix 1. Survey questionnaire

Barriers to private timber production

SECTION 1: ABOUT YOU

Q1 Do you, or members of your family live on the property?

- ◯ Yes
- ◯ No

Display This Question:

If Do you, or members of your family live on the property? = No

Q2 Where do you live?

- ◯ Same region
- ◯ Out of region: rural
- ◯ Out of region: metropolitan

Q3 How would you describe the occupants or family structure associated with the property:

- ◯ Just me/us
- ◯ Child(ren) still at home
- ◯ Adult child(ren)
- ◯ Business/corporation

Q4 How old are you?

- ◯ 18-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60-69
- ◯ 70+

Q5 What is your occupation?

- ◯ Farmer
- ◯ Other
- ◯ Retired

Display This Question:

If What is your occupation? = Farmer

Q6 How many generations has your family been farming?

- ◯ I'm the first generation
- ◯ 2 generations
- ◯ 3 generations
- ◯ More than 3 generations

Display This Question:

If What is your occupation? = Other

Q7 What is your occupation?

____

Display This Question:

If What is your occupation? = Retired

Q8 What was your occupation before you retired?

____

Q9 Do you or a household member work off the property?

- ○ Yes
- ○ No

Display This Question:

If Do you or a household member work off the property? = Yes

Q10 Which best describes the level of work?

- ○ Casual
- ○ Part-time
- ○ Full-time

Q11 What percent of your weekly household income is sourced off the property?

- None, all household income is generated on the property
- Less than 25%
- 25 - 50%
- 50 - 75 %
- 75 - 99%
- 100%, all household income is generated outside the property

---

Q12 Considering every member of the household, what is the highest level of education anyone has achieved?

- High school
- TAFE
- Bachelor degree
- Post-graduate degree

Q13 What is your approximate household gross (before tax) income (This question is optional)

- SKIP
- $0 - $18 200
- $18 201 - $45 000
- $45 001 - $120 000
- $120 001 - $180 000
- $180 000 +

SECTION 2: ABOUT YOUR PROPERTY

Q14 What is the post code of the property?

____

Q15 How long have you owned the property?

- ◯ Less than 5 years
- ◯ 5 -10 years
- ◯ 10-15 years
- ◯ More than 15 years

Q16 What size is the property?

- ◯ Less than 10 ha (<24.7 acres)
- ◯ 10 - 25 ha (24.7 - 61.8 acres)
- ◯ 25 - 50 ha (61.8 - 123.6 acres)
- ◯ 50 - 75 ha (123.6 - 185.3 acres)
- ◯ 75 - 100 ha (185.3 - 247 acres)
- ◯ > 100 ha (>274 acres)

Q17 What is the land managed for?
Choose as many as are relevant.
Please enter in terms of % land use e.g. 50% agriculture, 20% lifestyle, 30% timber production

______ Agriculture
______ Lifestyle
______ Conservation
______ Timber production
______ Other

Display This Question:

If What is the land managed for? Choose as many as are relevant. Please enter in terms of % land us... [Agriculture] Is Not Empty

Q18 What do you produce?

____

Display This Question:

If What is the land managed for? Choose as many as are relevant. Please enter in terms of % land us... [Timber production] Is Not Empty

Q19 Which best describes your timber production?
Please choose all relevant

- ☐ Native forest harvesting
- ☐ Plantation forest, eucalypt
- ☐ Plantation forest, cabinet timbers
- ☐ Plantation forest, exotic e.g. pine
- ☐ Carbon emission reduction planting- Permanent (environmental planting)
- ☐ Carbon emission reduction planting- Harvest

Display This Question:

If What is the land managed for? Choose as many as are relevant. Please enter in terms of % land us... [Other] Is Not Empty

Q20 What id the 'other' land use on your property?

____

Q21 What are your intentions for the property in the future?

- Sell
- Keep for the foreseeable future
- Keep for future generations
- Undecided

Q22 Would you consider producing timber on your property?

- Yes
- No

Q23 Where do you get your information about property management?
Please select all that are applicable

- ☐ Talking with peers
- ☐ Print media
- ☐ Paid profession advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Industry association
- ☐ Social media
- ☐ Scientific research
- ☐ I don't

Q24 When it comes to initiating management change on your property, which best describes you?

- ○ I am happy to be the first to try something new
- ○ I like to observe a practice before undertaking change
- ○ I will only initiate change if I’ve had personal interaction with the new management/ technology
- ○ I am unlikely to change

SECTION 3. ATTITUDES TO TIMBER PRODUCTION

Q25 Do you have native forest on your property?

◯ Yes

◯ No

Display This Question:

If Do you have native forest on your property? = Yes

Q26 Do you manage the native forest for commercial timber production?

◯ Yes, I find the legislation workable

◯ Yes, I find the legislation prohibitive

◯ No, I don't want to

◯ No, its not suitable for harvesting

◯ No, the legislation is too prohibitive

◯ No, the legislation is too complicated

◯ No, I don't how to manage my native forest for commercial production

---

Q27 Which of the following reasons you might grow trees on your property:
Select all that apply

- ☐ Biodiversity and climate change
- ☐ Commercial timber harvest
- ☐ It looks good or makes me feel good
- ☐ Land restoration e.g. Salinity mitigation
- ☐ Complementary to agriculture e.g. shade for live stock or wind protection for crops
- ☐ Other
- ☐ I'm not interested in growing trees on my property

Q28 Would you consider a carbon emissions reduction planting?

- ☐ Yes, a permanent planting (no commercial harvesting)
- ☐ Yes, a harvest planting (commercial harvest permissible)
- ☐ No

Display This Question:

If Which of the following reasons you might grow trees on your property: Select all that apply = Other

Q29 Please describe 'Other' as a reason you would grow trees on your property

____

Q30 Are the following barriers to timber production on your property?
Tick all that are applicable

☐ The cost of planting and managing trees/harvest related costs

☐ The time between investment and return is too long

☐ I don't know how to manage trees/forest for timber production

☐ My land is used for other endeavours, I don't have space for trees

☐ I'm worried about what others will think of me if I use my property for timber production

☐ The regulations for NATIVE FOREST timber production are too restrictive

☐ The regulations for NATIVE FOREST timber production are too complicated

☐ Regulations around PLANTATION timber production are too restrictive

☐ Regulations around PLANTATION timber production are too complicated

☐ I don't know anyone who has successfully managed their property for timber production

☐ I am worried about the risk of extreme weather events

☐ Other

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = The cost of planting and managing trees/harvest related costs

Q31
Considering, the cost of planting and managing trees/harvest related costs,
Please select the solutions that would help you, choose as many as are relevant.

- ☐ Entering into a joint venture agreement
- ☐ An interest free loan
- ☐ Government grant
- ☐ Government subsidized establishment, reducing establishment costs
- ☐ Payment for environmental services
- ☐ Wood residue income stream
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, the cost of planting and managing trees/harvest related costs, Please select the sol... = Other

Q32 Please describe the 'Other' incentive that would help you overcome the barrier of:
The cost of planting and managing trees/harvest related costs.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = The time between investment and return is too long

Q33
Considering, the time between investment and return is too long,
Please select the solutions that would help you, choose as many as are relevant.

- ☐ Provision of an environmental services payment i.e. carbon
- ☐ Taking an intermittent return from the forest e.g. through thinning
- ☐ Agricultural co-benefits provide sufficient cost offset
- ☐ Secure market for the timber produced with a proven product and price
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, the time between investment and return is too long, Please select the solutions that... = Other

Q34 Please describe the 'Other' incentive that would help you overcome the barrier of:
The time between investment and return is too long.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = I don't know how to manage trees/forest for timber production

Q35 Considering, I don't know how to manage trees/forest for timber production,
Please select the solutions that would help you, choose as many as are relevant.

- [ ] Access to paid professional advice
- [ ] Government funded extension (e.g. DPI)
- [ ] Community/peer networking
- [ ] Field days
- [ ] Access to guided information sources e.g. factsheets or handbook
- [ ] Other
- [ ] No, none of these incentives

Display This Question:

If Considering, I don't know how to manage trees/forest for timber production, Please select the sol... = Other

Q36 Please describe the 'Other' incentive that would help you overcome the barrier of:
I don't know how to manage trees/forest for timber production.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = My land is used for other endeavors, I don't have space for trees

Q37 Considering, my land is used for other endeavours, I don't have space for trees, Please select the solutions that would help you, choose as many as are relevant.

- ☐ Access to paid professional advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Agricultural co-benefits
- ☐ Provision of an environmental services payment i.e. carbon
- ☐ Access to guided information sources e.g. factsheets or handbook
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, my land is used for other endeavors, I don't have space for trees, Please select the... = Other

Q38 Please describe the 'Other' incentive that would help you overcome the barrier of:
My land is used for other endeavours, I don't have space for trees.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = I'm worried about what others will think of me if I use my property for timber production

Q39 Considering, I'm worried about what others will think of me if I use my property for timber production, Please select the solutions that would help you, choose as many as are relevant.

- ☐ Access to paid professional advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Community/peer networking
- ☐ Field days
- ☐ Access to guided information sources e.g. factsheets or handbook
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, I'm worried about what others will think of me if I use my property for timber produ... = Other

Q40 Please describe the 'Other' incentive that would help you overcome the barrier of:
I'm worried about what others will think of me if I use my property for timber production.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = The regulations for NATIVE FOREST timber production are too restrictive

Q41 Considering, the regulations for NATIVE FOREST timber production are too restrictive, Please select the solutions that would help you, choose as many as are relevant.

- ☐ Access to paid professional advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Community/peer networking
- ☐ Access to guided information sources e.g. factsheets or handbook
- ☐ Changes to current regulations
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, the regulations for NATIVE FOREST timber production are too restrictive, Please sele... [Changes to current regulations] Is Not Empty

Q42 Please describe the 'Changes to current regulations' that would help you overcome, the regulations for NATIVE FOREST timber production are too restrictive.

____

Display This Question:

If Considering, the regulations for NATIVE FOREST timber production are too restrictive, Please sele... [Other] Is Not Empty

Q43 Please describe the 'Other' incentive that would help you overcome the barrier of: the regulations for NATIVE FOREST timber production are too restrictive?

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = The regulations for NATIVE FOREST timber production are too complicated

Q44 Considering, the regulations for NATIVE FOREST timber production are too complicated, Please select the solutions that would help you, choose as many as are relevant.

- ☐ Access to paid professional advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Community/peer networking
- ☐ Access to guided information sources e.g. factsheets or handbook
- ☐ Changes to current regulations
- ☐ Other
- ☐ No, none of these incentives

Display This Question:

If Considering, the regulations for NATIVE FOREST timber production are too complicated, Please sel... [Changes to current regulations] Is Not Empty

Q45 Please describe the 'Changes to current regulations' that would help you overcome, the regulations for NATIVE FOREST timber production are too complicated.

____

Display This Question:

If Considering, the regulations for NATIVE FOREST timber production are too complicated, Please sel... [Other] Is Not Empty

Q46 Please describe the 'Other' incentive that would help you overcome the barrier of: The regulations for NATIVE FOREST timber production are too complicated?

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = Regulations around PLANTATION timber production are too restrictive

Q47 Considering, regulations around PLANTATION timber production are too restrictive, Please select the solutions that would help you, choose as many as are relevant.

- ☐ Access to paid professional advice
- ☐ Government funded extension (e.g. DPI)
- ☐ Community/peer networking
- ☐ Access to guided information sources e.g. factsheets or handbook
- ☐ Changes to current regulations
- ☐ Other
- ☐ No, none of these

Display This Question:

If Considering, regulations around PLANTATION timber production are too restrictive, Please select t... [Changes to current regulations] Is Not Empty

Q48 Please describe the 'Changes to current regulations' that would help you overcome, the regulations for PLANTATION timber production are too restrictive.

____

Display This Question:

If Considering, regulations around PLANTATION timber production are too restrictive, Please select t... [Other] Is Not Empty

Q49 Please describe the 'Other' incentive that would help you overcome the barrier of: The regulations around PLANTATION timber production are too restrictive?

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = Regulations around PLANTATION timber production are too complicated

Q50 Considering, regulations around PLANTATION timber production are too complicated, Please select the solutions that would help you, choose as many as are relevant.

- ▢ Access to paid professional advice
- ▢ Government funded extension (e.g. DPI)
- ▢ Community/peer networking
- ▢ Access to guided information sources e.g. factsheets or handbook
- ▢ Changes to current regulations
- ▢ Other
- ▢ No, none of these

Display This Question:

If Considering, regulations around PLANTATION timber production are too complicated, Please select t... [Changes to current regulations] Is Not Empty

Q51 Please describe the 'Changes to current regulations' that would help you overcome, the regulations for PLANTATION timber production are too complicated.

____

Display This Question:

If Considering, regulations around PLANTATION timber production are too complicated, Please select t... [Other] Is Not Empty

Q52 Please describe the 'Other' incentive that would help you overcome, the regulations for PLANTATION timber production are too complicated.

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = I don't know anyone who has successfully managed their property for timber production

Q53 Considering, I don't know anyone who has successfully managed their property for timber production, Please select the solutions that would help you, choose as many as are relevant.

- ▢ Access to paid professional advice
- ▢ Government funded extension (e.g. DPI)
- ▢ Community/peer networking
- ▢ Access to guided information sources e.g. factsheets or handbook
- ▢ Field days
- ▢ Other
- ▢ No, none of these incentives

Display This Question:

If Considering, I don't know anyone who has successfully managed their property for timber productio... = Other

Q54 Please describe the 'Other' incentive that would help you overcome the barrier of:
I don't know anyone who has successfully managed their property for timber production?

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = I am worried about the risk of extreme weather events

Q55 Considering 'I am worried about the risk of extreme weather events', Please select the solutions that would help you, choose as many as are relevant.

- ▢ Clear, affordable insurance
- ▢ Reduced lability for fuel reduction burning
- ▢ Access to paid professional advice
- ▢ Government funded extension (e.g. DPI)
- ▢ Access to guided information sources e.g. factsheets or handbook
- ▢ Community/peer networking
- ▢ Other
- ▢ No, none of these

Display This Question:

If Considering 'I am worried about the risk of fire', Please number 1-3 solutions that would help you, 1 [Other] Is Not Empty

Q56 Please describe the 'Other' incentive that would help you overcome the barrier of:
I am worried about the risk of extreme weather events

____

Display This Question:

If Are the following barriers to timber production on your property? Tick all that are applicable = Other

Q57 Please describe the 'other' barrier to timber production on your property.

____

End of survey