TESTING THE AFFORESTATION RESERVATION PRICE OF SMALL FOREST LANDOWNERS IN NEW ZEALAND

A thesis submitted in partial fulfilment of the requirements

for the Degree of Doctor of Philosophy

by

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ABSTRACT

The estimation of afforestation reservation prices for small landowners in New Zealand has not been the subject of much research despite its importance in predicting future land use. Reservation prices for planting represent the minimum payment a landowner must receive before converting land from agriculture to forest. A survey of 728 landowners from every region of New Zealand who own between 20 and 200 hectares of forest as well as other unplanted land used for agriculture were surveyed about forestland, forest land owner demographics, ownership objectives, silviculture and reservation prices.

In this study, reservation price strategies were investigated by offering hypothetical annual and one-time payments for converting land from agriculture to forestry. From this survey, the average one-time payment a landowner would be willing to accept to convert a hectare of land from agriculture to forestry was $3,554 and the average annual payment to convert a hectare of land was $360. The key factors influencing the reservation price were; whether or not the landowner lived on the property, if one of the ownership objectives was income from carbon, the primary agricultural enterprise and total household income. An implied discount rate was calculated for each landowner and excluding those who would not accept any payment the average after-tax discount rate was 9.7%.

Small landowners indicated that their primary reason for owning plantation forest was income from timber with very few landowners using their forest land for recreation. The median farm size was 400 hectares and the median forest plantation was 37 hectares. Planting of radiata pine peaked in 1994 and 1995 with more radiata pine planted in 1994 than in all the years from 2000-2009. Most landowners are performing some type of silviculture in their forests. Ninety percent of landowners are pruning in the current rotation while only 61% plan to prune in the future. Only 26% of landowners have engaged in any commercial harvesting in the past ten

years but as their current rotation matures 71% plan to replant on the same site. A majority of respondents thought the situation for forest landowners was getting better.

Understanding the reservation price strategies of landowners is important for predicting future land use patterns and recognizing how close landowners are to converting land. The ownership objectives of landowners and the replanting decisions they make are critical for future timber supply. The results of this study can assist in the development of forest establishment incentive programmes. Better information about landowner characteristics will result in enhanced decision-making for the timber industry and the government in New Zealand.

LIST OF ABBREVIATIONS

AGS	Afforestation Grant Scheme
ANOVA	Analysis of Variance
CAPM	Capital Asset Pricing Model
CVM	Contingent Valuation Method
DCF	Discounted Cash Flow
ETS	Emissions Trading Scheme
HEC	Human Ethics Committee
LEV	Land Expectation Value
MAF	Ministry of Agriculture and Forestry
MPI	Ministry of Primary Industries
NEFD	National Exotic Forest Description
NIPF	Non Industrial Private Forest
NOAA	National Oceanic and Atmospheric Administration
PFSI	Permanent Forest Sink Initiative
WACC	Weighted Average Cost of Capital
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER ONE-INTRODUCTION

1.1 Introduction

Landowners with less than 1000 hectares of forest land own 30% of the plantation forests in New Zealand (MAF, 2010a). Little is known about how they manage their land, the reasons they own forest and what factors influence their decisions to plant new forests and harvest existing forests. The decisions of small forest landowners affect future timber supply yet little is understood about the socio-economic and land management characteristics of small forest landowners and their economic decisions regarding forest harvesting, land conversion, silvicultural preferences, and replanting. There has never been a comprehensive survey to identify the demographics and ownership objectives of forest landowners in New Zealand and how those characteristics may affect their decisions to harvest, replant, implement silvicultural treatments and plant new forests.

There are several definitions of a “small forest landowner” depending on the organisation or publication. The National Exotic Forest Description (NEFD) defines a small forest landowner as owning less than 1000 ha of forest (MAF, 2010a). New Zealand has one of the largest definitions for small forest landowners. In other parts of the world a small forest landowner is defined as owning less than 20 hectares to less than 500 hectares (Hodgden et al., 2011). Researchers in the United States use the term “nonindustrial private forest landowner” (NIPF) and often no size restriction although 90% own less than 40 hectares. (Birch, 1996). A study in Sweden considered small landowners those with between 5 and 225 hectares of forest (Gotmark et al., 2000).

The few studies that have been done on small forest landowners in New Zealand are primarily an overview of planted forests. There has been no focus on landowner characteristics or non-timber benefits. The annual NEFD surveys landowners with more than 1000 hectares of planted

production forest. In 2010 and in alternate years the NEFD survey also includes all known landowners with more than 40 hectares of plantation forest. A study from the Ministry of Agriculture and Forestry (MAF) (2009a) estimated that of the 15,123 forest owners in New Zealand, about 15,000 of them own less than 1000 hectares individually, but collectively own 30% of the plantation forestland in New Zealand.

New forest plantings spiked in the 1990s and have since declined. Planting rates averaged 69,000 hectares per year from 1992-1998 but in 2007 only 2000 hectares were planted, the lowest amount since 1950 (MAF, 2010a). Most new plantings from the 1992-1998 period were made by new entrants to forestry (MAF, 2010a). The collective harvest and management decisions of these landowners will have significant effects on future timber supply. While larger landowners may be interested primarily in timber production, smaller landowners may be interested in both monetary and amenity benefits (Egan, 1997). Therefore the decision by small forest landowners to convert agricultural land to forestry may be due to a combination of market and non-market factors. Government programmes like the Emissions Trading Scheme (ETS) and the Afforestation Grant Scheme (AGS) may impact the land management decisions of small forest landowners.

Deforestation and the subsequent change in land use contribute approximately 20% of the world's carbon dioxide emissions (Woodwell et al., 1983; World Bank, 2007). Conversely, planting and the continued management of forest will mitigate climate change by reducing greenhouse gas emissions. The ETS and AGS legislation have included provisions to encourage new plantings and careful management of New Zealand forest resources with the aim of helping New Zealand meet its Kyoto obligations. The AGS was first introduced in 2009 by MAF. Under the programme landowners received a government grant for converting previously unforested land to exotic or indigenous forests. Landowners own the forests and can sell timber

but the government retains the rights to carbon for the first ten years and is responsible for all the harvesting liabilities associated with this carbon unless the land owner becomes an ETS participant (MAF, 2009b).

Plantation forests are covered by articles 3.3 and 3.4 of the Kyoto Protocol. New Zealand chose to account for forests under article 3.3 which includes forests established after 31 December 1989 (MAF, 2008). The Climate Change (Emissions Trading and Renewable Preference) Act became law on 10 September 2008 and has implications for the forestry sector (Caddie et al., 2008). Under the current provisions of the ETS, landowners with unforested land converted to forestry after 1989 are eligible to claim credits for the carbon dioxide sequestered in their forests. Landowners who participate are also liable for the release of carbon dioxide as a result of harvesting. Emissions trading is based on New Zealand Units (NZUs). A NZU is equivalent to one metric tonne of carbon dioxide or the equivalent of any other greenhouse gas (MAF, 2008).

As the ETS and other forestry programmes continue and small landowners begin participating we can observe the distribution of carbon prices at which they might choose to convert land. A 2008 study (Maclaren et al., 2008) calculated the Land Expectation Value (LEV) for a range of carbon prices, discount rates and site qualities. The LEV is an estimate of how much landowners could afford to pay for a hectare of land under different discount rates, carbon prices and land quality scenarios. If the LEV is higher than the land market value (LMV) then we would expect industrial landowners to buy land. The study found that, in general, as the carbon price increased, the LEV increased. This means landowners can afford to pay more per hectare and still have the same return on investment. For example, using an 8% discount rate on an average site planted with radiata pine, the LEV without carbon is $1215 while the LEV for a carbon price of $15 per NZU is $3378 per hectare. At a carbon price of $30 NZU the LEV

increases to $6647 per hectare. The optimal rotation age increases as carbon prices increase and any sort of annual payment from the sale of carbon units increased the profitability of all species and silvicultural regimes. The trade-off is the risk involved in unpredicted carbon loss, carbon price risk or choosing a regime that may not be profitable if the carbon price collapses. The study is theoretical and does not take into account landowner preferences toward forest or agricultural land, non-timber benefits or perceived risk. Predicting what payments a landowner requires in order to participate in government programmes is difficult to estimate.

Early landowner models focused on the probabilities of harvesting or planting new forests with little understanding of the decision process by landowners (Alig, 1986; Binkley, 1981; Brazee et al., 1988; DeSteiguer, 1984; Doolittle et al., 1987; Fina et al., 2001; Koskela, 1989; Kronrad, 1983; Marler et al., 1974). Of particular significance is the forest landowner's decision of whether to accept a payment price for converting a hectare of land to forestry which is related to a landowner's preferences and expectations. One method to determine this is to identify the reservation price for a landowner. The reservation price is the lowest price a seller would accept in order to engage in a business transaction, in this case the lowest price a landowner would accept to convert a hectare of land to forestry. Estimating reservation prices is challenging as it is a function of landowner preferences and market parameters such as interest rates and property prices. The preferences of the landowners are likely to be important determinants of their reservation prices and their tendency to plant trees in the future. Reservation prices for planting trees may depend on the landowner interest in non-timber benefits, bequest interests, risk tolerance and other factors.

Previous studies show that landowners with a higher interest in forest amenities will have a lower reservation price for converting land from agriculture to forestry (Amacher et al., 2001; Gong et al., 2005; Pattanayak et al., 2002). Other characteristics, interests and preferences may

influence reservation prices and decisions to accept land conversion payments. Landowners with timberland bequest motives may be more likely to accept a payment than those who intend to sell their land. The landowner's financial position could change the reservation price as landowners with a higher income may be less likely to accept a payment for land conversion. The type of payment reveals different things. An annual payment a landowner is willing to accept indicate the value for converting a hectare of land and the carbon prices necessary to achieve those values. A single payment tells us the number and characteristics of landowners who may be willing to participate in a scheme such as the AGS at various payment levels.

1.2 Research Objective

The main aim of this research is to determine the reservation price for converting one hectare of agricultural land to forest and the landowner characteristics that affect the reservation price. This study also seeks to explain how government programmes like the AGS and ETS may influence landowner decisions to convert agricultural land to forest plantations. The hypothesis is that landowners with a higher interest in forest amenities will have a lower reservation price for converting land from agriculture to forestry. Factors such as ownership objectives, size of forest and landowner demographics may also affect the land management preferences and reservation price.

Research questions include:

- Why do small landowners own forest land? The hypothesis is that they own land for reasons other than timber production
- How much forest land do small landowners have on their property and what species are the planting? The hypothesis is that small forest landowners have a similar species mix to large landowners.

- Who owns forest land? Are forest owners near retirement? What do they plan to do with their land in the future? The hypothesis is that forest landowners are ageing and plan to leave the land to their heirs
- Did small forest landowners also experience a forest planting spike in the mid-90s and what does this mean for future harvesting? The hypothesis is that forest landowners did experience a planting spike in the mid-90s but have no plans to change their harvesting patterns in response to the high volume of wood ready to be harvested in 2025.
- What quality of wood can we expect from small landowners? What silviculture can we expect from landowners in future rotations? The hypothesis is that small landowners are practicing similar silviculture to large landowners in regards to pruning and thinning patterns.
- What is the reservation price for converting land from agriculture to forestry for small landowners? At what payment levels can we expect landowners to start planting more forests? The hypothesis is that the payment levels required are similar to programs such as the AGS.
- What is the implied discount rate for small landowners? The hypothesis is that it is similar to large landowners in New Zealand.
- What factors affect a landowner's decision to plant more forests? The hypothesis is that the reasons are similar to other countries and include having a bequest motive, living on the property, managing the land themselves, harvesting in the past ten years, pruning in the current rotation, owning the land as part of a trust or partnership, inheriting the land and owning the land for recreation or environmental reasons.

Specific research objectives include:

- Objective One: Examine characteristics of forest land and ownership objectives of small forest landowners.
- Objective Two: Identify the silvicultural preferences of small forest landowners

- Objective Three: Determine the annual and lump sum reservation price for landowners to convert land from agriculture to forest and how does it compare to payments possible under government programmes
- Objective Four: Calculate the implied discount rate for small forest landowners and compare to other landowners
- Objective Five: Determine the landowner demographics and preferences that affect afforestation

1.3 Importance of Research

This research is important to the forest industry and policy makers in New Zealand as well as other countries that are considering including forestry in carbon sequestration arrangements or landowner incentive programmes. Understanding the reservation price strategies of landowners will be useful in determining how the collective action of small forest landowners may affect New Zealand's national obligations to Kyoto Protocol and for predicting future timber supply. This research is important as governments around the world review the role of forestry in an emission trading scheme or other programmes where afforestation is encouraged as a means of mitigating climate change.

More research is needed on the characteristics of small forest landowners in New Zealand. The objectives of landowners and the decisions they make are critical for future timber supply. Identifying the landowner characteristics that affect the reservation price is important for predicting future land use patterns and recognizing how close landowners are to converting land.

The results of this study can assist in the development of forest establishment incentive programmes. Better information about landowner characteristics will result enhanced decision-making for the timber industry and the government both in New Zealand and around the world.

This thesis is divided into nine chapters. Chapter two provides an overview of previous relevant research. Chapter three describes the specific methods applied to this research. Chapter four provides more detail on the survey design and the statistical methods used to analyse the data. Chapter five explains the preparation of the survey. Chapter six summarises the results by each of the five research objectives. Chapters seven, eight and nine discuss and summarise the key findings and provide future recommendations.

CHAPTER TWO-PREVIOUS RESEARCH

2.1 Introduction

Early research in this area looked at the motivations of small forest landowners. Other studies looked at economic decisions made by small forest landowners and the non-market valuation methods used to capture those decisions. More recent studies looked at specific survey methods for landowners, including random payments and payment cards proposed here. Studies of New Zealand's Emissions Trading Scheme have focused on theoretical studies of landowner participation at various carbon prices. The previous research is examined for each of the research objectives.

2.2 Objective One-Forest Landowners

There are very few studies identifying and surveying private landowners in New Zealand. An earlier study found that smaller landowners in New Zealand have a variety of management objectives with revenue from timber a lower priority than sustainable land management practices and boosting overall farm income (Morey, 1986). A more recent study surveyed 344 landholders in four South Island districts and found that the key factors in afforestation were property size, years of ownership, ownership being part of a partnership, off farm income, expectations of increasing log prices and perceptions of tax policies being favourable to forestry (Dhakal et al., 2008).

The recent NEFD found that landowners with less than 1000 hectares of forest comprise 31% of the total plantation forests (MAF, 2010a). The annual NEFD is a report that surveys landowners with more than 1000 hectares of planted production forest. In 2010 the NEFD survey was mailed to 1900 landowners including all known landowners with more than 40 hectares of plantation forest (MAF, 2010a). In addition, the results of a 2004 Small Forest Grower Survey completed by AgriQuality (now AsureQuality) are used in the NEFD analysis.

The data is from the 2004 AgriQuality survey of small forest growers is considered less dependable as some owners may report the total land area converted from pasture to forest without noting the unstocked areas. It is estimated that the difference between the reported gross forest area and the actual net stocked area may be a difference of 10 to 20 percent (MAF, 2010a). A recent MAF (2009a) publication estimates that of the 15,123 forest owners in New Zealand, about 13,000 landowners own less than 40 hectares of plantation forest.

Numerous studies of non-industrial private forest (NIPF) owners have been done in the United States. A 2006 survey found that 36 percent of forests (by area) in the United States were owned by non-industrial private forest owners (Butler, 2007). The first NIPF studies were motivated by concerns that private lands could not meet demands for timber production. More recent studies tried to understand landowners' diverse motivations for owning forestland (Egan, 1997; Karppinen, 1998) and include econometric models developed to explain how forest landowners make decisions and to identify the preferences and variables important to their decisions. Small landowners are thought to place value on non-timber benefits such as recreation, scenic beauty, privacy, and hunting (Binkley, 1981; Boyd, 1984; Newman et al., 1993). The likelihood of a landowner commencing an activity is related to landowner characteristics and preferences (Binkley, 1981; Boyd et al., 1989). Income and land values are inversely related to a landowners intent to harvest, while tract size, knowledge of cost share, technical assistance and farming as an occupation had a positive correlation (Dennis, 1990).

There have also been several studies on landowners in northern Europe. A study of landowners in Denmark owning more than three hectares of forest found them divided into three groups: classic owners, hobby owners and indifferent farmers. Each group of landowners had different values but overall the study found recreation and aesthetic benefits of forestland ownership to be more important than economic benefits (Boon et al., 2004). These findings are similar to

results of studies in Finland, Sweden, Austria, Portugal and Germany (Hogl et al., 2005; Kvarda, 2004; Novais et al., 2010). A study of landowners in the Black Forest region of Germany found that they could be segmented into three groups based on their interest in forests: economically interested, conceptually interested and uninterested (Bieling, 2004).

The behaviour of private landowners is less predictable than industrial landowners due to the various objectives for land ownership (Newman, et al., 1993). An early study by Hartman (1976) found that the presence of recreational or other services has an important influence on when or whether to harvest. Small landowners may not respond to prices in the same way industrial landowners do and this can make predicting timber supply from small landowners quite difficult (Dennis, 1989). Newman and Wear concluded that while small landowners are interested in making a profit they also have preferences for amenities. Hultkarntz (1992) also found that landowners have a concern for the next generation and programmes to promote long-term silvicultural investments must take into account this bequest motive. Non-timber management goals are now considered to be a primary motivation for private ownership of forestland (Binkley, 1981; Boyd, 1984; Pattanayak, et al., 2002). Smaller landowners tend to give a lower priority to timber production. Landowners may be less interested in timber harvesting due to lack of knowledge, low profit potential, lack of ability or non-timber goals that are incompatible with timber production (Worrell et al., 1975).

2.3 Objective Two-Silviculture

In recent years, forest economists realised that small forest landowners often have different silviculture than larger landowners. They may plant different species or cost constraints may limit their ability to prune or thin trees mid-rotation (Karpinnen, 1998). Forest economics research looks at studies that explain how small forest landowners make land management

decisions and the types of variables and preferences related to those decisions. Early studies focussed on the most important determinants of landowner harvesting and reforestation. In the past several decades research has found that landowners maximizing utility instead of maximizing profits. (Hardie et al., 1994; Hyberg et al., 1989).

A survey of Finnish landowners found that small forest landowners with multiple ownership objectives were the most active in their forest management. Landowners that were only interested in economic benefits of forest land did not have the most active silviculture and harvesting behaviour. Landowners with non timber objectives did not lower wood production. (Karppinen, 1998). Another study of Norwegian landowners found that government assistance caused landowners to reforest, and landowners with more education and higher quality sites participated in more forest management (Loyland et al., 1995).

Small landowners were found to have longer rotation ages but were likely to reforest sooner than larger landowners in a study of Canadian landowners. Those landowners were harvesting less than the economic optimum but had more capital investment in forest management (Hyberg, et al., 1989).

Studies of small landowners in the United States found that government programmes have an effect on land management. One survey by Boyd (1984) found that government cost share programmes and technical assistance led to more forest management, timber harvesting and reforestation. A review of 30 forest landowner studies by Beach (2005) found that government cost sharing and technical assistance most consistently influence land management decisions. Other variables that were found to have a statistically significant effect on land management were pulpwood prices, short-term interest rates, land value, tax incentives, site quality and planting costs (Beach, 2005).

In the United States, the Government has relied heavily on financial incentives to influence landowner behaviour (Boyd, et al., 1989). Many of these programmes target reforestation and began in the 1930s (Goodwin et al., 2002). Incentives include funds for research, landowner education workshops, technical assistance, tax benefits and input subsidies such as cost sharing for tree planting. Hodges et al. (1990) discovered that landowners with a knowledge of government cost sharing programmes were more likely to reforest.

2.4 Objective Three-Reservation Prices

The reservation price is the lowest price a seller would accept in order to engage in a business transaction. Reservation prices for planting represent the minimum payment a landowner must receive before converting land from agriculture to forest. A reservation price should exist for all landowner market decisions, including harvesting, selling annual carbon credits, changing land use from agriculture to forest production or reforestation after harvest.

The estimation of reservation prices for afforestation for small landowners has not been the subject of much research despite its importance in helping predict future timber supply and afforestation rates as log and carbon prices fluctuate. Many landowners do not plant forests but they hold a reservation price which is useful to determine how close they are to entering the market. There have been studies that use empirical models to estimate the probability of harvesting or reforestation as well as several studies on the theoretical prices at which landowners decide to participate in the market (Brazee, et al., 1988; Fina, et al., 2001).

Reservation prices are difficult to measure because they are time dependent and unobserved. They are also functions of a landowner's preference for forest land compared with other land uses. One study looked at how much money small forest landowners in the United States were

willing to forego to preserve forests over a fixed time period. (Kline et al., 2000). Another study assessed reservation prices for harvesting timber through a payment table and allowed landowners to choose the degree of certainty about the reservation price (Welsh et al., 1998). The payment table approach has been used in recent studies to determine the reservation prices for other landowner decisions and to help determine limits for market participation (Conway et al., 2003).

2.5 Objective Four-Implied Discount Rate

The decisions small landowners make regarding afforestation are often different from other agricultural enterprises. The discount rate is the interest rate we use to discount future values to the present. Forestry investments are sensitive to the discount rate because of the long time fram for forestry investments. Discount rates, when applied appropriately, account for the risk for each project (Vicary, 2006). Forestry is a long-term process and Faustmann documented this with his now widely accepted capital theory model of timber production. He recognized the importance of the discount rate in timber investment analysis. Newman (2002) reviewed the importance of Faustmann to the field of forest economics. Since Faustmann, forest economics research on landowner decision making has developed by proposing new theoretical models to explain landowner behaviour under certainty and uncertainty and policy interventions that can change behaviour. Previous landowner behaviour models looked at theoretical research on landowners' decisions to participate in harvesting activities when facing uncertain stumpage prices. (Brazee, et al., 1988; Fina, et al., 2001). Other models looked at stochastic dynamic programming to examine the effects of uncertainty on forest landowner behaviour (Haight, 1990, 1991; Haight et al., 1991).

A report published by Sewall Company suggests four methods for calculating the discount rate for forestry: using the Capital Asset Pricing Model (CAPM), calculating the Weighted Average

Cost of Capital (WACC), surveying active investors or deriving discount rates from comparable timberland transactions. Discount rates will vary by country and investor as they "reflect the specific risk of the investment and its context"(Vicary, 2006). The report found discount rates in Central America were higher than in Brazil. Australia had real, pre-tax discount rates ranging from 5.4% to 9.1% while New Zealand had real, pre-tax discount rates ranging from 6.8% to 8.7% (Vicary, 2006). An ongoing study in New Zealand surveys large landowners every two years to determine the implied discount rate. The 2011 survey found the average discount rate applied to post-tax cashflows was 6.7% with a range of 4.4% to 8.4%. The average was 6.9% in 2009 and 6.7% in 2007. The discount rate applied to pre-tax cashflows for New Zealand forest landowners was an average of 9.3% in 2011, 8.6% in 2009 and 9.0% in 2007. Implied discount rates have generally declined in New Zealand since 2005 particularily for the sale of forests lareger than 10,000 ha (Manley, 2007, 2010, 2012).

Studies have looked at the factors that influence the discount rate of small forest landowners. One study found that small forest landowners with a low income had a lower discount rate than those with a higher income (Bullard, 2002). Bullard (2002) also found that cost sharing programmes and public policies favourable to forestry led to lower implied discount rates for landowners in the Southern United States. Small landowners have a higher discount rate for longer investments. A study of landowners in US State of North Carolina found that for a five year forestry investment the nominal discount rate was 13.2% and for a 25 year forestry investment the discount rate was 15.1%. (Kronrad, 1983). The higher discount rate may reflect the illiquidity of forestry investments or greater uncertainty about future market demand (Bullard, 2002). Other studies found that forest landowners with a high preference for non-timber benefits of the forest had a lower discount rate than landowners who own land primarily for timber production and government programmemes that encouraged forestry led to lower discount rates for small landowners (Beach, 2005; Kuuluvainen et al., 1996).

Calculating the implied discount rate for small landowners in this study will allow us to compare it to the implied discount rate for larger landowners in New Zealand. It will also allow us to determine if small landowners in New Zealand find forestry to be more or less risky than large landowners.

2.6 Objective Five-Econometric Models for Afforestation

Reservation prices capture landowner preferences for forestry as compared to other land uses. The reservation price for landowners is a combination of the option value of the existing land use, the profitability of the existing land use as compared to other uses, the perception of risk, landowner knowledge and non-market factors. As part of methods to estimate reservation price, landowners are asked to identify the prices they will accept to commence forestry on one hectare of land. The results can be used to make predictions of planting rates and reservation prices for small landowners across a region and understand how reservation prices are related to their current management activities and ownership goals. A review of valuation models, including the one used in this study are discussed in Chapter 3.

Programs such as the AGS have been adopted by landowners in New Zealand but the characteristics and demographics of those landowners has not been studied. Studies of forestry assistance programmes in other countries have found that a landowners age and participation in forestry organizations were correlated with their participation in cost share programmes (Bell et al., 1994; Crabtree et al., 1998; Esseks et al., 1992; Nagubadi et al., 1996). A study by Bell et al. (1994) found that landowners in the US State of Tennessee were more likely to participate in a forest stewardship programme if they had previous experience with forestry, were actively seeking information regarding land use programmes and had unmanaged forest, pasture, or cropland as primary uses on their property.

These studies are useful in observing the characteristics of landowners that are participating in the market or government programme. This study seeks to identify landowners on the margin of participating, those landowners that may participate at a higher financial incentive but are not currently participating. The landowners' reservation price is based on their preferences for agricultural and forest uses, as well expectations of returns from, and risks associated with, these uses in the future. More details on the econometric methods used in this study are provided in the following chapter.

2.7 Conclusion

Previous studies conclude that small forest landowners are different from large landowners in several key ways including owning forest land for reasons other than timber, having less access to economies of scale and not always having access to the same information on harvesting and silviculture as larger landowners. Silvicultural practises may be more expensive for small forest landowners and therefore they may be less likely to carry out these operations. The reservation price strategies of forest landowners are relatively untested but are a factor of a landowner's preference for forestry over other land uses. Preferences for forestry may be due to demographics, ownership objectives, current forest holdings and past experiences with forestry. Implied discount rates vary by landowner as they are based on the perceived risk and the circumstance for the forest investment.

CHAPTER THREE-METHODS

3.1 Introduction

The principal method to determine a landowner's reservation price for converting land under government programmes is to watch as landowners enter the programme at various payments such as observing the successful tenders accepted by the government under the Afforestation Grant Scheme (which was terminated in 2011). This method captures landowners that are participating in the market but does not identify landowners at the margins that may be close to participating. Indirect methods of determining reservation prices reveal characteristics such as reasons for owning forest land or non-timber benefits that may influence decisions to plant new forests.

3.2 Valuation Methods

Methods for valuing goods that are not easily observable on the market are classified as using revealed or stated preferences. Revealed preferences are found by indirect methods and use actual choices made by consumers in markets in which the non-market good is implicitly traded. Stated preference methods were developed to help value non-market goods that have no related markets or surrogate markets. In stated preference models a consumer's preferences are elicited directly based on hypothetical, rather than actual scenarios. Both preference models rely on a subject's ability to choose. With stated preference models, the subject's preference is shown through a survey while in revealed preference it is exposed through implicit choices. Revealed preference models are suitable for short-term forecasting of small departures from the current state, whereas stated preference models are more appropriate to predict structural changes that occur over longer time periods (Louviere et al., 2000).

3.2.1 Revealed Preferences

Revealed preference methods draw inferences based on actual choices people make in markets. Revealed preference methods can be divided into several categories including travel cost, hedonics, defensive behaviour and damage cost (Champ et al., 2003). Travel cost, hedonics, and defensive behaviour are all inferred from individual choices.

Travel cost methods are best used to determine recreation demand by calculating the decision to visit recreation sites based on opportunity cost of visiting those sites (Englin et al., 1991). Hedonics focuses on valuing site characteristics. The variation in product gives rise to variations in product prices within each market, and the hedonic method for non-market valuation compares market transactions for goods or services that differ primarily due to the influence of the non-market good that is of interest. One common use is to determine the value of an environmental attribute by observing variations in housing prices (Rosen, 1974). Defensive behaviour models are based on substitutions that households make to avoid exposure to an environmental drawback (Champ, et al., 2003). For example, when someone with contaminated ground water purchases bottled water for drinking (Abdalla, 1990). Damage cost is a sum of the direct and indirect costs of treating an environmental problem. For example if an environmental problem caused an illness, the direct cost is the doctor’s visits while the indirect cost is lost work (Bresnahan et al., 1997; Shelby et al., 1986).

The main limitation with revealed preference methods is that they cannot estimate non-use values such as option values, existence values and bequest values. They also can not estimate values for levels of quality that have not been experienced (Larson, 1992). In new conditions like those seen under the ETS, people may not have had the opportunity to exhibit choice behaviour for the new condition. In other words, the new situation may be outside the current set of experiences. Another problem is that in cases of environmental degradation, people may

not have an opportunity to choose an alternative. An example is in the case of mercury deposition in which anglers may not have another choice for fishing, as all the lakes in the area contain fish with elevated levels of mercury (Champ, et al., 2003). A final problem with revealed preference methods is that people may not have full information when they make purchase decisions. In some instances, this can be mitigated by using a combination of revealed and stated preference methods (Adamowicz et al., 1994). By combining both methods the amount of information increases and the results can be cross-validated (Haab et al., 2002).

3.2.2 Stated Preferences

The key difference between revealed and stated preference methods is that stated preference models rely on data from surveys and revealed preference methods rely on data that record people's actual choices. Stated preference models for outdoor recreation and environmental opportunities have been used since the 1960s (Davis, 1963). The advantage of stated preference is survey instruments can be used to describe new goods, describe hypothetical situations, limit the choice sets and offer opportunities not available with revealed preference methods(Brown et al., 1996). The limitation with stated preference models is determining if the responses are valid, i.e. does the estimated value measure the theoretical construct under investigation (Brown et al, 1996). One way to determine this is to compare with market The framework for determining validity was outlined by the American Psychological Association and summarised by Mitchell and Carson (1989) as criterion, construct and content validity. Criterion refers to comparison of the stated preference measure with some other measure that is similar to the criterion under investigation. Construct validity relates to weather the measure under investigation is similar to other methods and studies. Content validity is the most important and looks at the quality of the survey used to obtain the measure. The key questions to ask are if the right questions were asked and did respondents answer the question that was asked. A good pre-test and pilot survey can answer these questions and help determine the validity of the stated

preference methods. Stated preference methods can be divided into three categories; contingent valuation, attribute-based, and paired comparison.

The contingent valuation method (CVM) is a process in which surveys are used to estimate values for goods not traded in the market or unobservable in the market. With the aid of a survey, people are asked their willingness to pay for a good or service. CVM methods were developed so that benefit-cost analysis (BCA) could be applied to non-market preferences (Davis, 1963). The first methods were used for consumer studies and were highly criticised for not being reliable (Bishop and Heberlein, 1979). As CVM techniques were adapted to specific situations, the reliability of the results improved and CVM became a more widely accepted means of valuation. In 1989, CVM made its way to the courts after an oil tanker, the Exxon Valdez, ran aground and public interest groups demanded compensation for the loss of environmental amenities (Carson et al., 2003). After the trial, the National Oceanic and Atmospheric Administration (NOAA) put together a panel of experts to assess the reliability of the findings and determined that it was an acceptable means of measuring passive use values (Carson et al., 1998).

Contingent valuation was designed to measure monetary value whereas the other methods were originally developed to order preferences then adapted for monetary valuation (Champ, et al., 2003). Contingent valuation method (CVM) is used to estimate economic values for many types of ecosystem and environmental services. It involves asking people how much they would be willing to pay or willing to accept as payment for some environmental service (Bateman et al., 1995; Bishop et al., 1979). Payment cards and discrete choice surveys are types of CVM.

The objective of an attribute based method is to estimate economic values for a set of attributes (Mackenzie, 1993). The inclusion of price allows for monetary valuation of the other attributes,

but if the monetary cost or benefit is not included, the method utilizes a preference ordering of the attributes (Adamowicz et al., 1998; Gan et al., 1993; Louviere, et al., 2000; Roe et al., 1996). For example, estimating the value of the benefits from improving a specific beach recreation area. The relevant values would be associated with changes in various attributes of the beach recreation area (water clarity, showers, picnic areas, etc.). Participants might be asked to select or rank a beach based on various attributes. An attribute model considered for this study was a choice model. A choice model allows more options for considering specific attributes such as funding agency, length of contract or other payments for ecosystem services. The limitation is that it can be used for 6-8 attributes and this study wanted to look at a variety of factors such as demographics, silviculture and ownership objectives. To increase participation, this study aimed to be completed by respondents in 20 minutes but on average, choice experiments require more than an hour to complete (Thomas et al., 2002).

The paired comparison approach asks subjects to choose between alternatives by ranking them or by stating the strength of their preference (Chuenpagdee et al., 2001). Subjects are presented with a pair of items and asked to choose between them without stating indifference. Each pair can be compared to the full set of choices to create a preference score for each item (Peterson et al., 1998; Rutherford et al., 1998).

Stated preferences are often criticized because the behaviour they depict cannot be observed (Cummings et al., 1986; Mitchell et al., 1989) and they often do not take into account real market constraints (Louviere, et al., 2000). However, stated preference methods provide the only means for estimating the value of public goods that do not have related markets. While most economists prefer revealed preference methods, there is not always a strong relationship between a market and non-market good which is required for the use of revealed preference models. Stated preference models can also be used to cover a wider range of attribute levels in

cases where revealed data do not encompass the range of potential quality or quantity changes in the attributes of the public good (Joffre et al., 1994). But as Manski (2000) argues, the rejection of stated preferences is both naive and limiting; naive because well-designed surveys can avoid many of the potential problems and limiting because surveys are often the most effective way to understand people's preferences.

Research on the components important to forest landowner decisions was done using a survey of reservation prices. The reservation price in early forest landowner studies was used to determine the minimum stumpage price a forest landowner would accept to harvest. One way this was done was by using reservation prices to estimate the probability of harvesting where a single price arises as an independent draw from a normal distribution (Brazee, et al., 1988).

There are numerous ways to estimate the reservation prices of landowners. One is to use a stated preference approach where landowners are given various offers for undertaking a harvest or land use activity. The first form of this is to use referendum voting where a single price payment is offered. Landowners can choose to accept or reject the offer. This method was used to determine how much income landowners are willing to forego to preserve forests (Kline, et al., 2000). The NOAA (1993) recommended dichotomous choice methods for large sample populations. Selection of the bids is important and 6 to 10 different random payments is optimal and pre-testing bids is important (Alberini, 1995). Factors influencing the acceptance of a random payment can be evaluated with logistic regression. Pilot tests for this study indicated landowners liked the dichotomous choice questions and found it easy to quickly make a decision about accepting or rejecting the offer. Dichotomous choice allowed us to use logistic regression to analyse the factors relevant to the acceptance of a payment and create supply curves for the probability of land conversion with various payments. The survey size was large

enough that dichotomous choice was a reasonable alternative and dichotomous choice was followed up with a payment card question as recommended by Hanneman (1991).

Another approach to determine reservation prices is to offer a range of prices through a payment table (Welsh, et al., 1998). A payment card offers respondents a list of payments and asks them to select the payment they would accept.

3.3 Payment Cards

A well known stated preference survey method that meets the objectives of this study is a payment card, used in contingent valuation literature and recommended by the NOAA Panel on Contingent Valuation (Cameron, 1988). There are many questions concerning the validity of contingent valuation and stated preference techniques. The concerns are addressed before discussing the validity of the survey method proposed for this study.

With payment cards, willingness to accept (WTA) is estimated by asking respondents to vote yes or no regarding acceptance of several payment offers to undertake some activity. This CVM was first introduced by Bishop et al. (1979). A list of payments is preferred to an open ended format since it is easier for participants to answer and similar to the choices consumers make in the marketplace when purchasing an item at a given price. Previous studies suggest that a discrete choice method with a simple yes or no option will increase willingness to pay (WTP) and lower WTA (Welsh, et al., 1998) but these problems are mitigated with more payment choices. One problem with contingent valuation is that research has found different contingent valuation methods can elicit different results (Cummings, et al., 1986; Grether et al., 1979; Slovic et al., 1983). Comparisons of studies found that there are significant differences between values elicited using open-ended or payment card formats and discrete choice formats (Brown, et al., 1996; Cummings, et al., 1986). In general, values collected using dichotomous choice

formats are larger than values collected using open-ended methods and payment cards (Boyle et al., 1996). Problems with dichotomous choice questions are mitigated with more respondents and a well selected choice of payments. An optimal design for a payment card has a small number of payments (between five and eight) with the payments clustered near the median WTA and not placed at the tails of the distribution (Alberini, 1995a; Boyle, et al., 1996; Cooper, 1994; Kanninen, 1993, 1995). Optimal payment design relies on the available information about the central tendency and dispersion of the value to be estimated (Boyle, et al., 1996; Champ, et al., 2003). The best way to determine the appropriate payments is through a pilot survey. The best pilot surveys are small numbers of people in a focus group or personal interviews (Champ, et al., 2003).

3.4 Conclusions

A landowner's reservation price to convert land from agriculture to forestry may be influenced by the demographics of the landowner, site quality, ownership objectives and other factors. Observing market transactions to determine the reservation price does not reveal landowners that are close to participating in the market. Contingent valuation methods allow us to survey landowners that are close to participating in the market and identify the characteristics of landowners that are not likely to participate. Dichotomous choice methods for contingent valuation are popular but require large sample sizes. Payment cards are one approach to contingent valuation method that provides more information than dichotomous choice. This study will use a combination of random dichotomous choice and payment cards in order to determine the factors that influence reservation prices and calculate the implied discount rate.

CHAPTER FOUR-SURVEY DESIGN AND ANALYSIS

4.1 Introduction

The objective of the survey is to elicit landowner votes on acceptance of various payment levels and to obtain information on landowner demographics, land description, current silviculture, and preferences for forest amenities. The chapter examines how the survey was designed and analysed to meet the five key objectives of this study. A copy of the survey is found in Appendix 1.

4.2 Objectives One and Two-Forest Landowners and Silviculture

Surveys of forest landowners generally focus on a description of the land, background of the landowner and ownership objectives. Survey questions on the land ask landowners about the size of forest, farm type, tree species and planting year. Landowner background questions ask demographic information such as the age, income, gender and highest level of education. It also asks how the land was acquired, if it is their primary residence, if they farm the land themselves and what they plan to do with the land in the future. Reasons for owning forest land are surveyed by asking about ownership objectives.

Survey questions regarding silviculture ask landowners if they are pruning trees in the current rotation, if they plan to prune in future rotations and the pruning height. It also asks about land management decisions such as harvesting age, plans to replant trees on the same site, land conversion in the past ten years and the rotation age for their current forest. The full survey is available in Appendix 1 and the question types are summarised in Table 1.

Table 1. Summary of survey questions by category

Category	Description of Question	Question Type
Perceptions	Benefits of being a forest landowner getting better, worse or staying the same	List of choices
Land	Total size of property	Numeric
	Primary agricultural enterprise	Open-ended
	Total livestock for sheep, beef, dairy, pigs, deer and other species	Numeric
	Size of plantation forest, native forest, crops, open land, grazing, scrub, water and other	Numeric
	Tree species, age and previous land use	Table to complete
Land Management/ Silviculture	Land conversion in the past ten years (forestry to agriculture or agriculture to forestry) and hectares	Dichotomous choice (yes/no) and numeric
	Harvested forest in the past ten years and age at harvest	Dichotomous choice (yes/no) and numeric
	Rotation age for current forest	Numeric
	Will you replant forest on the same site	List of choices (yes/no/unsure)
	Have you pruned or plan to prune in current rotation and to what height	List of choices (yes/no/unsure) and numeric
	Will you prune in future rotations	List of choices (yes/no/unsure)
Background/ Demographics	Is land your primary residence and if not what is the distance	Dichotomous choice (yes/no) and numeric

	Region the property is located	Open-ended
	Do you farm the land yourself	Dichotomous choice (yes/no)
	Type of landownership (individual, trust, family partnership, business partnership, club, non-profit)	List of choices (may choose more than one answer)
	What do you plan to do with the land in the future (sell it, leave it to heirs/family trust or a combination of two)	List of choices
	Age	Numeric
	Gender	Dichotomous choice
	Education (select highest level completed)	List of choices
	Income (5 categories from less than $25,000 to more than $200,000)	List of choices
Ownership Objectives	Importance of various land ownership objectives (Environmental reasons, scenic beauty, recreation, keep for future generations, income from timber, land investment, income from carbon)	Rate (1 to 5)
	Importance of various recreational activities (hunting, fishing, walking, horseback riding, camping, cycling, photography, observing wildlife, flower/plant/berry picking, other)	Rate (not applicable or 1 to 5)

Good survey design suggests opening with an opinion question respondents can easily answer. An opinion question encourages respondents to continue with the survey as they feel as if their opinion matters (Dillman, 1978). Good survey design also suggests placing general and less

personal questions at the beginning of the survey so this survey begins with an opinion question and the first section asks general questions about the land. Questions that are easy to answer are appropriate for the early survey questions as respondents are more likely to start and eventually complete the survey (Dillman, 1978). Respondents were also provided space at the end of the survey for additional comments.

Analysis of the landowner data were done through descriptive statistics. Descriptive statistics examines relationships between the survey data. This is done through the use of two-way tables, chi-square and log linear models. Chi-square tests analyse the distribution using proportions and are used when comparing two survey groups. Log linear analysis allows us to examine relationships among the variables in a multi-way contingency table. Table 2 shows the chi-square tests on survey data.

Table 2. Independent and dependent variables for chi-square tests on survey data

Objective	Independent Variable	Dependent Variable	Notes
To compare the primary residence to the occurrence of pruning.	Location of primary residence (on/off property)	Pruning (yes/no)	This is done for other silviculture (harvest in past 10 years, replant in future, etc)
To compare the benefits of land ownership and farm type	Type of farm	Benefits of land ownership (getting better/getting worse)	
To compare harvesting and farm	Type of farm	Harvesting in past 10 years (yes/no)	

type			
To compare replanting and farm type	Type of farm	Replant in future (yes/no)	
To compare pruning and farm type	Type of farm	Prune in current rotation (yes/no)	
To compare future pruning and farm type	Type of farm	Prune in future (yes/no)	
To compare farm type and land conversion	Type of farm	Land converted in past 10 years (yes/no)	
To compare harvesting and replanting	Harvested in past 10 years (yes/no)	Replant in future (yes/no)	
To compare harvesting and pruning	Harvested in past 10 years (yes/no)	Pruning in current rotation (yes/no)	This is done for pruning in future rotations
To compare land conversion and replanting	Convert land in past 10 years (yes/no)	Replant in future (yes/no)	
To compare land conversion and pruning	Convert land in past 10 years (yes/no)	Pruning in current rotation (yes/no)	This is done for pruning in future rotations

Descriptive statistics can also be used to analyse regional differences. Regional comparisons include student's t-tests (t-tests), chi-square tests and log linear models. The chi-square test compares the tallies or counts of categorical responses between two or more independent

groups. For this part of the analysis the independent variable is the region and the dependent variable is one of the following:

- Pruning in current rotation (yes/no)
- Pruning in future rotation (yes/no)
- Harvesting in the past ten years (yes/no)
- Land conversion in the past ten years (yes/no)
- Replant on the same site in future rotations (yes/no)
- Future of land/bequest motive (sell land or leave it to heirs)
- Importance of carbon farming (important/not important)

Log linear analysis is an extension of the two-way contingency table where the conditional relationship between two or more categorical variables is analysed by taking the natural logarithm of the cell frequencies in the contingency table. Log linear models can be used to analyse the relationship between two categorical variables as in two-way contingency tables, but they are more commonly used to evaluate multi-way contingency tables that involve three or more variables. All variables considered by log linear models are treated as response variables and there is no distinction made between independent and dependent variables.

Some of the data are numerical and if they have a normal distribution they can be tested using a t-test. T-tests can involve independent and dependent groups. In this case, the independent groups will be North Island versus South Island and the dependent groups will be a particular region when compared with all of New Zealand (including the region we are testing). The independent variables are the regions and the dependent variables are:

- Rotation age
- Size of forest plantation
- Size of native forest

- Total size of farm
- Age of radiata pine plantation
- Land converted from agriculture to forest in the past ten years
- Land converted from forest to agriculture in the past ten years
- Age of landowners

4.3 Objective Three-Reservation Prices

Reservation prices will be elicited by offering hypothetical random payments in a dichotomous choice format and a payment card with eight different hypothetical payments. Each landowner answers four payment questions. For the first two payments questions, a landowner is offered a random, hypothetical one-time and annual payment. To prevent landowners from being offered payment combinations that might be impossible such as a $1000 one-time payment and a $500 annual payment (an implied discount rate of 49.97% over a 30 year period) the combinations of payments are limited. There are 36 annual and one-time payment combinations. Landowners in each region receive a random combination of payment options. The last two payment questions landowners are asked to circle the lowest annual and one-time payments they would accept from a table of eight payment levels. The payment table is useful for calculating median reservation prices, while the random bids are useful for building a model of the predictor variables using logistic regression. The reasons for using logistic regression are discussed in Section 4.5.

The survey includes a brief overview before soliciting annual and lump sum payment acceptance. The overview explains to respondents that the forests provide benefits and provides an overview of the establishment costs for a forest. Landowners were presented minimal information as pre-tests revealed landowners preferred a succinct overview and longer explanations were deemed more confusing. The overview did not contain any information

about the ETS or AGS and the programs were not mentioned in the additional survey questions. This was important in order to ensure that landowners did not think the question was about government programs and select answers based on their feelings about programs like the ETS and AGS.

The payment tables include a range of payment levels that were pre-tested in interviews with landowners and a pilot survey and discussed in Section 5.5. The one-time payment question is provided to respondents with the description that they are being offered a single payment in exchange for establishing a hectare of forest on their land. The payment is tax-free and they would not retain the rights to carbon in the first rotation but there are no restrictions on rotation age or species. The one-time payments offered were:

- $1000
- $2000
- $2500
- $3000
- $3500
- $4000
- $4500
- $5000

The one-time payment question is followed by an annual payment question and a similar description. Landowners are offered an annual payment that is offered for the first rotation. The payment is tax-free and the landowner does not retain the rights to carbon but can plant any species they choose. The annual payments offered were:

- $100
- $200
- $250
- $300
- $350
- $400
- $450
- $500

The range of payments presented in each payment table is ordered from lowest to highest. The landowner is asked to circle the lowest payment they would accept. Landowners are also given the option to not accept any of the payments offered and asked to provide a reason. The option to explain the decision not to accept any payments follows recommendations set forth by the NOAA panel report on contingent valuation (Arrow et al., 1993; Carson, et al., 1998).

The advantage of this method is to calculate the median payment a landowner is willing to accept directly from the payment table and determine the median willingness to accept values. Landowners that will not accept a payment at any price are not included in the calculation of median values. The average values represent the predicted payments needed for a landowner to covert a hectare of land to forestry.

This study uses market information from payments offered by the AGS (MAF, 2011d), landowner interviews, pre-testing of payments via phone interviews and a pilot survey to identify the appropriate range of payments offered to landowners for converting a hectare of agricultural land to forestry. Given that a range of payments is presented, it is more likely that reasonable market values fall within this range.

4.4 Objective Four-Implied Discount Rates

Implied discount rates are calculated using the payment table and the rotation age provided by landowners. Landowners are asked to circle the lowest annual and one-time payments they would accept from a table of eight payment levels.

The implied discount rate is calculated using the following formula for the present value equation for a terminating annual series of payments. The equation is:

$$V_0 = \frac{P}{i}\,[1 - \frac{1}{(1+i)^n}]$$

Where: V_0= single payment

P= annual payment

i= implied discount rate

n= rotation age (in years)

To calculate each landowner's individual discount rate, the equation is solved for *i* using the lowest one-time and annual payment they would accept and the expected rotation age for their forest. The rotation age was provided by landowners in the survey. If landowners provided a range of rotation ages then the average rotation age was used. For example, if a landowner provided a rotation age of 28-32 years, 30 would be used in the equation. An Analysis of Variance (ANOVA) test is used to compare landowners implied discount rate to the survey

variables that may impact those rates including region, silviculture, demographics, land management and ownership objectives.

4.5 Objective Five-Econometric Models for Afforestation

Econometric estimations include linear regression, ANOVA and logistic regression. Logistic regression is used when you have a binary explanatory variable; in this case it is the landowners' yes or no decision to accept the random payment.

Logistic regression was selected because it allows us to build a model of predictor values and the calculation of odds ratios from the slope coefficients. Other models can be used to look at reservation prices but in this study it was important to look at the factors that influence those reservation prices. Some studies have used nonparametric and semi-parametric approaches to analysing dichotomous choice data and found them to be inferior to traditional logit models based on the mean squared error(Creel et al., 1997). Only when there is appreciable heteroscedasticity do the simulation results offer strong support for the non-parametric methods (Klein et al., 1993; Li, 1996). A comprehensive survey of best methods in contingent valuation concluded that logit models were the best approach for analysing discrete response questions (Boyle, 2003).

The responses to the payment table were analysed with regression and ANOVA. Landowners were given a list of annual and one-time payments and asked to choose the lowest payment they would accept. The lowest annual and one-time payment they would accept in return for converting a hectare of forest (the dependent variable) is a numeric value so if the independent variable is numerical and there is a linear relationship between the payment and the numeric variable, linear regression may be used. If the independent variable is categorical ANOVA will be used. Numeric survey responses are analysed using linear regression when there is a linear

relationship. The dependent variable in these cases is the lowest payment a landowner would accept and the independent variable is one of the following:

- Demographic and landowner information
    - Age
- Land information
    - Farm size
    - Area in plantation forest
    - Area in native forest
- Silviculture
    - Pruning height
    - Harvest age

For categorical survey responses, ANOVA is used and the dependent variable is the lowest payment a landowner would accept and the independent variable is one of the following:

- Demographic and landowner information
    - Gender
    - Bequest motive
    - Live on or off farm
    - Farm land themselves or have a farm manager
    - Interest in income from carbon
- Land information
    - Farm type
    - Area in plantation forest
    - Area in native forest
- Silviculture
    - Pruning
    - Harvest in past 10 years

- Convert land in past 10 years
- Replant on same site

ANOVAs were also performed for the region and the lowest annual and one-time payment landowners accepted.

Using logistic regression a model can be built to determine which factors influence landowners to accept a payment from the random payment offered to landowners. The dependent variable is defined as the probability that a landowner will not accept the payment amount offered as compensation for converting one hectare of land. The dependent variable is then regressed on the payment amounts offered, and on a vector of independent variables from the survey data.

Logistic regression can be used to predict a dependent variable on the basis of continuous or categorical independent variables and to determine the percent of variance in the dependent variable explained by the independent variables. Logistic regression can also be used to rank the relative importance of the independent variables (Hanneman, 1996). The fundamental mathematical concept that underlies logistic regression is the logit, the natural logarithmic of an odds ratio. The simple logistic model (Hanemann, 1996) has the form

$$logit\ (Y) = natural \log(odds) = ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X$$

Where:

Π = the probability of the outcome

α = the Y intercept

β = the regression coefficient

The equation can be expanded to multiple predictors. The y intercept and regression coefficients are estimated using maximum likelihood. Logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit variable (the natural

log odds of the dependent occurring). Logistic regression estimates the odds of a certain event occurring by calculating changes in the log odds of the dependent variable and is a procedure available in major statistical software packages.

Consider a landowner that must decide whether to answer yes or no to a specific payment to convert a hectare of land from agriculture to forestry. If the landowner perceives lower amenities with forests or higher amenities with agriculture, they are less likely to accept a lower payment for land conversion. Let WTA* be the landowners actual willingness to accept, which is assumed to follow a distribution *F(θ)*, where *θ* is a vector of parameters, and form an indicator, *I*, that takes on a value of one for "yes" responses and zero for "no" responses. Bishop et al. (1979) and later Hanneman et al. (1996) expressed the probability of observing a "yes" (or *i*=1) when the respondent has been offered a payment equal to B_i as:

$$Pr(I_i = 1) = Pr(WTA^* < B_i) = 1 - F(B_i; \theta)$$

The likelihood function of the sample is the product of the probability of each observation, and can be written as:

$$\sum_{i=1}^{n} [I_i \cdot \ln\big(1 - F(B_i;\ \theta)\big) + (1 - I_i\ ) \cdot \ln F(B_i;\ \theta)\ \ ]$$

If WTA is normally distributed, $F(\ \cdot)$ is the standard normal cumulative distribution function (CDF) and $F(B_i, \theta)$= φ (B_i; σ- μ/σ), where the symbol φ represents the normal CDF, μ is mean WTA, and σ us the standard deviation of the distribution (Hanemann, 1996). If WTA follows the normal distribution, the coefficients and maximum likelihood can be estimated using the logit estimation routine available in major statistical software packages. Specifically, a logit

regression is run on the dependent variable and a vector of independent variables. The dependent variable is 0 if the landowner rejected the payment and 1 if they accepted.

The output from the logistic regression model can be used to build a log curve for each of the effects in the final model. As discussed previously, logits are the log odds of the event occurring. Logistic regression in major statistical packages generates a constant(Y) and a coefficient(β) for the effect(X). The equation looks like this:

$$Log\ Odds = Y + \beta_1 X_1$$

Using that equation you can generate odds for each bid:

$$Odds = \mathrm{e}^{\log \mathrm{odds}}$$

And from that you can generate the probability:

$$Probability = \frac{odds}{(1 + odds)}$$

The sequence can be simplified:

$$Probability = 1 - \frac{1}{1 + e^{\log odds}}$$

4.6 Conclusions

The survey has five types of questions to understand and gather information on the land the land, current silviculture, background of the landowner, ownership objectives and reservation prices. The survey begins with questions about the land respondents own and some basic silviculture before moving on to the questions regarding reservation prices. The reservation price questions include a brief discussion of the payment scenario and background information to help the participant understand the costs of converting land from agriculture to forestry.

Analysis of objectives one and two is done through descriptive statistics by measuring the relationships within the survey data. Analysis is conducted using two-way tables, chi-square, t-tests and log linear models.

Reservation prices are obtained by using random payments in a dichotomous choice format and a payment card with eight different payments. First, each landowner is shown a random one-time and annual payment and asked if they would accept the hypothetical payment. Second, landowners are provided with a payment table that includes eight levels of hypothetical payments and asked to circle the lowest annual and one-time payment they would accept. Reservation prices can be determined by looking at the average lowest payment a landowner would accept to convert a hectare of land from agriculture to forestry. The payment table is useful for calculating each landowner's implied discount rate while the random bids are useful for building a model of the predictor variables using logistic regression. The implied discount rate is calculated by solving the present value equation for a terminating annual series of payments.

CHAPTER FIVE-PREPARATION OF SURVEY

5.1 Introduction

This survey examines landowners with between 20 and 200 hectares of forest land who own a mix of forest and agricultural land. The primary objective is to determine a lump sum and annual price at which they are willing to convert one hectare of agricultural or scrub land to forestry. This study also aims to establish the demographics, ownership objectives and silvicultural preferences of small forest landowners in New Zealand. This chapter examines the approval by the Human Ethics Committee, identification of appropriate participants, regional grouping and the pilot survey.

The survey was constructed to follow previous literature on survey design and follows the principles in Dillman's total design method (Dillman, 1978) including a pre survey postcard, an easy to follow questionnaire, a mix of question types, space for comments, a return stamped envelope and a follow up phone call to non respondents.

5.2 Human Ethics Committee

The University of Canterbury requires any research involving human participants to gain approval from the University of Canterbury Human Ethics Committee (HEC). The HEC evaluates research proposals confirm that they abide by ethical principles, cultural values and are in accordance with the Treaty of Waitangi. The key principals and values are justice, safety, truthfulness, confidentiality and respect.

An application must be made and approved by the HEC before research commences. A copy of the application is found in Appendix 2. The application asks for information on the research project, how the project is funded and information on the participants such as how they are recruited and any inducement offered for participation. The application asks for details on the

information given to participants, how consent is obtained and any risk to the participants. The application also requires information on how data will be stored, who has access to data and what happens to data after the study is completed. The HEC application is submitted to the HEC secretary and reviewed by a committee comprised of faculty from various departments, a student representative and Maori representatives selected by the local iwi. This committee reviews the application and research may only being once it is approved by the HEC.

5.3 Identifying Participants

MAF (2011c)estimates that small forest landowners own 30% of the plantation forests in New Zealand but identifying them is a challenge as there is no central database. The most complete national landowner database is maintained by a company called AsureQuality. The database includes the landowner address, type of agricultural enterprise, if they own a forest and area of forest land. The database is used in the event of biosecurity emergencies and its use for this student research was permitted by a special request. The original criterion in the research was to survey landowners with less than 200 hectares of forest land and another agricultural enterprise. The requirement for survey participants to own some forest land was used to select only landowners who have some experience with forestry, and therefore know the benefits and challenges of forest land ownership. Similarly, the landowners must also have another agricultural enterprise as the survey seeks a reservation price for converting land. Landowners with experience in both forestry and agriculture are more likely to understand the payment levels they would require before converting land to forestry.

The AsureQuality query revealed 12,517 landowners met the criteria of having between one and 200 hectares of forest land and some other agricultural enterprise with most having less than ten hectares of forest. There were 4258 landowners with between ten and 200 hectares of forest, 3300 landowners with between 15 and 200 hectares of forest and 2546 landowners with

between 20 and 200 hectares of forest. The final group of landowners with between 20 and 200 hectares of forest land and another agricultural enterprise were selected to receive the survey as this as this allowed every landowner that met the criteria to receive a survey and fell within practical constraints.

5.4 Regional Determinations

One goal of this survey was to understand regional differences in silviculture, ownership objectives and reservation prices. There are 72 district and city councils in New Zealand and MAF groups them into ten wood supply regions (MAF, 2010a). These regions represent similar growth patterns for radiata pine and common processing areas. The ten wood supply regions used for this survey are: Northland, Auckland, Central North Island, East Coast, Hawkes Bay, Southern North Island, Nelson/Marlborough, Canterbury, Otago/Southland and West Coast. These regions are illustrated in Figure 1.

Figure 1. Regions used for survey

Source: MAF (2011a)

5.5 Pilot Survey

The survey included a pilot study. Phase one of the pilot study was an interview by phone or in person of 20 individuals. Information gathered and participant names were confidential and each landowner was read each question in order to gauge understanding of the phrasing. Participants are contacted with a follow up email that included the recorded responses to the interview to verify their answers. The purpose of the pilot study was to test comprehension of the questions and test the payment levels. Previous studies have shown that an optimal design has five to eight bids and the bid amounts should be clustered near the mean WTA and not at the tails of the distribution. (Alberini, 1995b; Kanninen, 1993, 1995). The pilot survey helped to identify the appropriate payments.

Phase two of the pilot study included a test survey and follow up phone calls with non-respondents. A postcard was mailed one week before the main survey so recipients knew they would be receiving a survey. Three test surveys were mailed to each region for a total of thirty surveys. Landowners that did not return the survey were contacted by phone and reminded to return the survey. The pilot survey was analysed and changes made to the final survey. The second, larger pilot study helped confirm the appropriate payments were selected. The key changes from the pilot study led to questions being revised, eliminated or reworded. The payment table originally allowed landowners to indicate their certainty in accepting a payment but during the interview landowners found the wording to be confusing and preferred to circle the lowest bid instead of indicating how certain they were about accepting the payment. Circling the lowest payment was well-received in the second pilot study. The pilot study included a question asking landowners if they had harvested any firewood from their property in the past ten years and during the interview no landowners had harvested firewood and did not think it was an important question. The income groupings for landowners were also changed to more accurately reflect their incomes. Landowners had not participated in much recreation on

their land so the three recreation questions from the pilot survey were combined into one table for the final survey. Two landowners mentioned that one of the reasons they were interested in owning forest land in the future was the income from carbon so that was added to the ownership objective table.

5.6 Conclusions

This research surveyed more than 2500 landowners who own between 20 and 200 hectares of forest and also have another agricultural enterprise. The names and address of landowners are available from AsureQuality. The survey analysed responses at a regional level: six regions on the North Island and four regions on the South Island. The first step was to obtain approval from the University of Canterbury HEC to ensure it followed ethical principles and was in agreement with the Treaty of Waitangi. The next step was a two phase pilot study to help clarify the survey questions and test the payment levels. Finally the survey was mailed to all landowners.

CHAPTER SIX-RESULTS

6.1 Introduction

This chapter examines the results of the landowner survey based on the five objectives. The first objective is the characteristics and ownership objectives of small forest landowners. This includes characteristics of the property, forest land statistics, landowner demographics and motivations for owning forest land.

The second objective aims to identify the silvicultural and land management preferences of small forest landowners. This includes information about land conversion, harvesting, rotation ages, replanting intentions and pruning.

The third objective is to determine the annual and lump sum reservation price for landowners to convert land from agriculture to forest. This is determined by looking at the payments a landowner would accept to convert land. It also examines landowners who would not accept any of the payments offered.

The fourth objective is to calculate the implied discount rate for small forest landowners. This is calculated using the lowest annual and one-time payment a landowner would accept to convert land from agriculture to forest.

The fifth objective is to determine the landowner demographics and preferences that affect afforestation. The econometric model applies logistic regression using the random payments offered to landowners and survey effects.

6.2 Survey Returns

The survey response rate was 32%. A total of 2511 surveys were mailed and 253 were returned as undeliverable for various reasons. Some surveys were unusable because the landowner did not meet the criteria of forest land ownership as the landowners had less than 20ha or more than 200ha of forest or did not have another agricultural enterprise on their land. A further 26 surveys were returned incomplete with a note that the respondent did not own any forest land. A total of 728 usable surveys were received. Every region had at least a 30% return rate. The response rate by region is shown in Table 3.

Table 3. Forest landowner survey response rate by region

Region	Survey Return Rate	Number of Responses
Northland	32%	86
Auckland	42%	47
Central North Island	30%	86
East Coast	38%	35
Hawkes Bay	31%	64
Southern North Island	30%	147
Nelson/Marlborough	34%	62
Canterbury	33%	86
Otago/Southland	31%	107
West Coast	47%	8
All of New Zealand	32%	728

The highest numbers of responses were from landowners in the Southern North Island and Otago/Southland. The percentages of surveys returned from each region are shown in Figure 2.

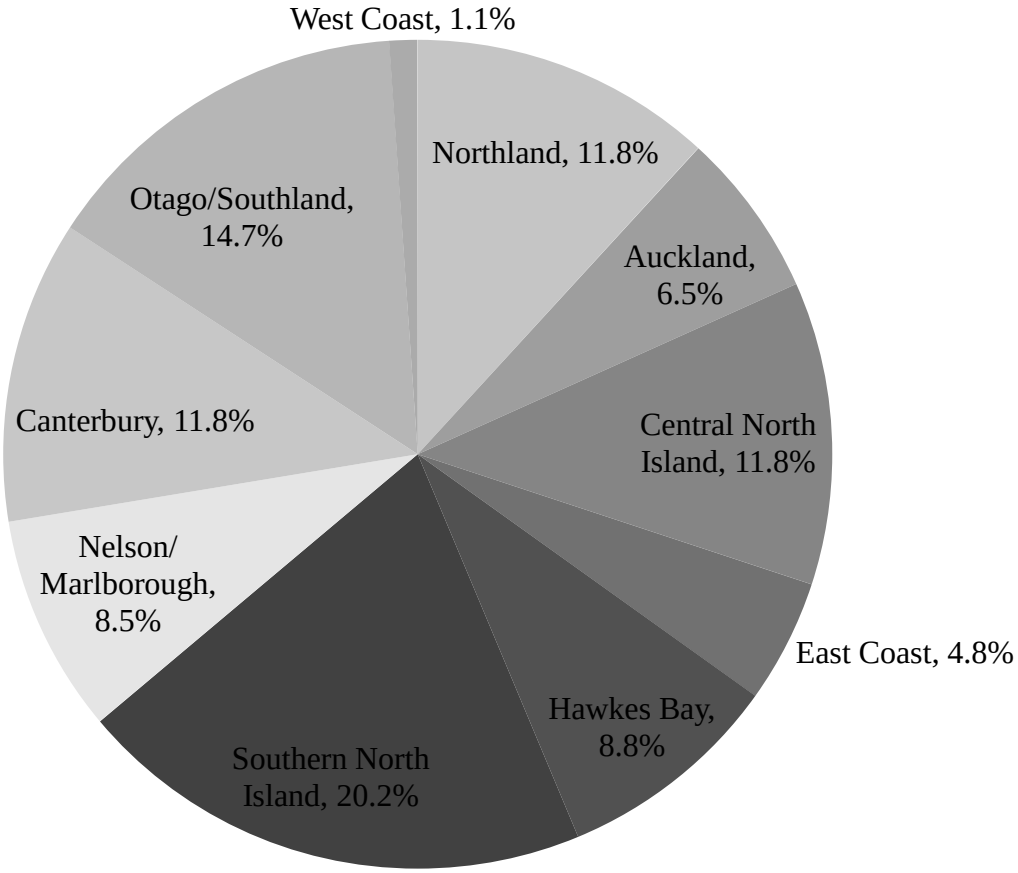

Figure 2. Forest survey returns by region as a percent of 728 total returns

Some 173 landowners included comments with their survey. Some attached letters and others phoned in with comments. Every comment was transcribed and entered into a database. All comments were confidential and any potentially identifying information was removed before the comment was submitted.

6.3 Objective One-Forest land Owners

This section examines objective one, the characteristics of forest land and ownership objectives of small forest landowners. This objective aims to answer several research questions including:

- How much forest land do small landowners have on their property?
- What species are the planting?
- Who owns forest land?
- Why do small forest landowners own forest land?
- Are forest owners near retirement?
- What do they plan to do with their land in the future?

The hypothesis is that they own land for reasons other than timber production. It is divided into three sections: forest land, forest land owners and ownership objectives. The data are summarised in terms of central tendency including measures that show centre of distribution or frequency of occurrence. The data are also described by the relationships with other survey data using two way tables, chi square and log linear analysis. Chi squared tests analyse the distribution using proportions and are used when comparing two survey groups. Log linear analysis allows us to look for relationships among the effects in a multi-way contingency table. Statistically significant differences were identified in the text and summarised at the end of section 6.3.

6.3.1 Forest Land

Survey questions two through six provided an overview of the respondents land. The questions asked about the total land area, type of agriculture on the property, livestock units and the various land uses on the property.

The landowners who returned surveys own a total of 426,668 hectares of land and 35,931 hectares of plantation forest land. The median farm size was 400 hectares with a median of 37 hectares of forest land. The average farm size was 586 hectares with an average of 50 hectares of forest. Respondents from Hawkes Bay and East Coast had the largest agricultural properties while landowners from Northland and Auckland regions had the smallest properties. Table 5 reveals the median size of the agricultural properties in the survey for each region.

Almost 52% of the respondents described their farm type as sheep and beef, other landowners described their primary land type as beef (12.6%), dairy (12.5%), sheep/beef/deer (6.9%), sheep/beef/dairy (6.2%), sheep (5.1 %), orchard (2.3%), deer (1.7%) and other (0.8%). The farm type by region is shown in Table 4. The key differences were that landowners on the North Island had more beef and dairy farms and landowners on the South Island had more sheep and sheep, beef, deer farms.

Table 4. Primary farm types of small forest landowners on the North and South Island

Farm Type	North Island	South Island	All of New Zealand
Sheep/Beef	51.8%	51.9%	51.9%
Beef	15.7%	6.5%	12.6%
Dairy	15.0%	9.9%	12.5%
Sheep/Beef/Deer	4.1%	11.5%	6.9%
Sheep/Beef/Dairy	6.2%	6.1%	6.2%
Sheep	2.2%	9.9%	5.1%
Orchard	2.4%	1.9%	2.3%
Deer	1.7%	1.5%	1.7%

Other	0.8%	0.8%	0.8%

The median size of the plantation forest was 37 hectares. Landowners with 20-200 hectares of forest land were the target for the survey and landowners outside of that range were not mailed a survey. Landowners from Nelson/Marlborough had the largest plantations with a median of 50 hectares and landowners from the West Coast had the smallest plantations with a median of 24 hectares. Table 5 examines the median property size reported by landowners in the survey and the median hectares of plantation forest.

Table 5. Median size of property and hectares of plantation forest by region

Region	Median Property Size (in hectares)	Median Size of Plantation Forest (in hectares)
Northland	260	32
Auckland	242	30
Central North Island	312	28
East Coast	580	40
Hawkes Bay	600	36
Southern North Island	398	47
Nelson/Marlborough	352	50
Canterbury	506	33
Otago/Southland	480	32
West Coast	358	24
All of New Zealand	400	37

Landowners reported a median of 322 hectares of pasture/open/shrub land, 17 hectares of native forest, 16 hectares of crops, 1.7 hectares of water and 3.9 hectares of other land (gardens, sand, rocks, wetlands, homes and buildings).

Landowners had the majority of their plantation forests planted in *Pinus radiata* (90.4%). The other key species as shown in Table 6 were *Pseudotsuga menziesii* (Douglas fir) (2.7%), *Eucalyptus spp* (1.7%), *Cupressus lusitanica* (1.4%) and *cupressus macrocarpa* (1.4%).

Table 6. Species planted by small forest landowners in New Zealand

Species	Total Hectares	Percent of Total
Radiata pine	32, 466	90.4%
Douglas fir	961	2.7%
Eucalyptus spp	615	1.7%
Cupressus lusitanica	518	1.4%
Cupressus macrocarpa	506	1.4%
Other pines	320	0.9%
Acacia spp	240	0.7%
Redwoods	135	0.4%
Mixed species	97	0.3%
Poplar	41	0.1%
Walnut	33	0.1%

Landowners were also asked the age of the plantation species on their property. The survey results show a spike in year 15 and 16 (1994 and 1995) for radiata pine that is similar to the results from the National Exotic Forest Description (NEFD). The 2010 NEFD shows a spike in planting in the mid 1990s with a steep decline in the following years (MAF, 2010a). The planting spike for radiata pine occurred in every region of New Zealand. Landowners from the Southern North Island reported a small planting spike in 2008 and 2009 while almost every other region had almost no new radiata pine plantings in the past five years. The hectares of land planted in radiata pine by landowners in the study are shown in Figure 3.

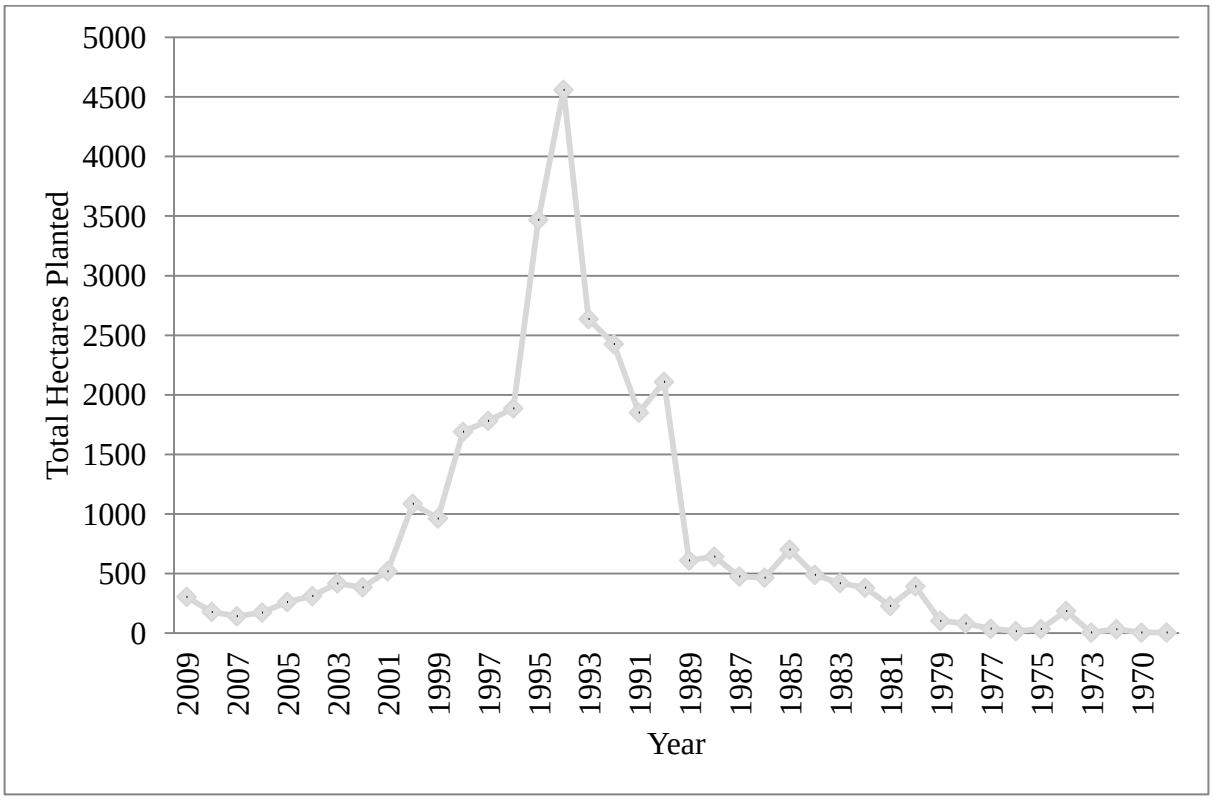

Figure 3. Radiata pine planted by forest landowners who returned a useable survey

There were more hectares of radiata pine planted in New Zealand in 1994 than the total planted in the last ten years. In 1994 forest landowners in the study planted 4559 hectares in radiata pine while from 2000-2009 they planted a total of 3781 hectares. Other species planted also peaked in the years from 1990-1999 with the exception of Douglas fir. From 2000-2009 survey

respondents planted 375 hectares of Douglas fir which is more than 1990-1999 when 303 hectares were planted.

Eucalyptus spp and *Cupressus lusitanica* show a similar spike in the mid 1990s but Douglas fir has several small spikes including one in 2004. Figure 4 shows the hectares planted for the major species, excluding radiata pine which is shown in Figure 3.

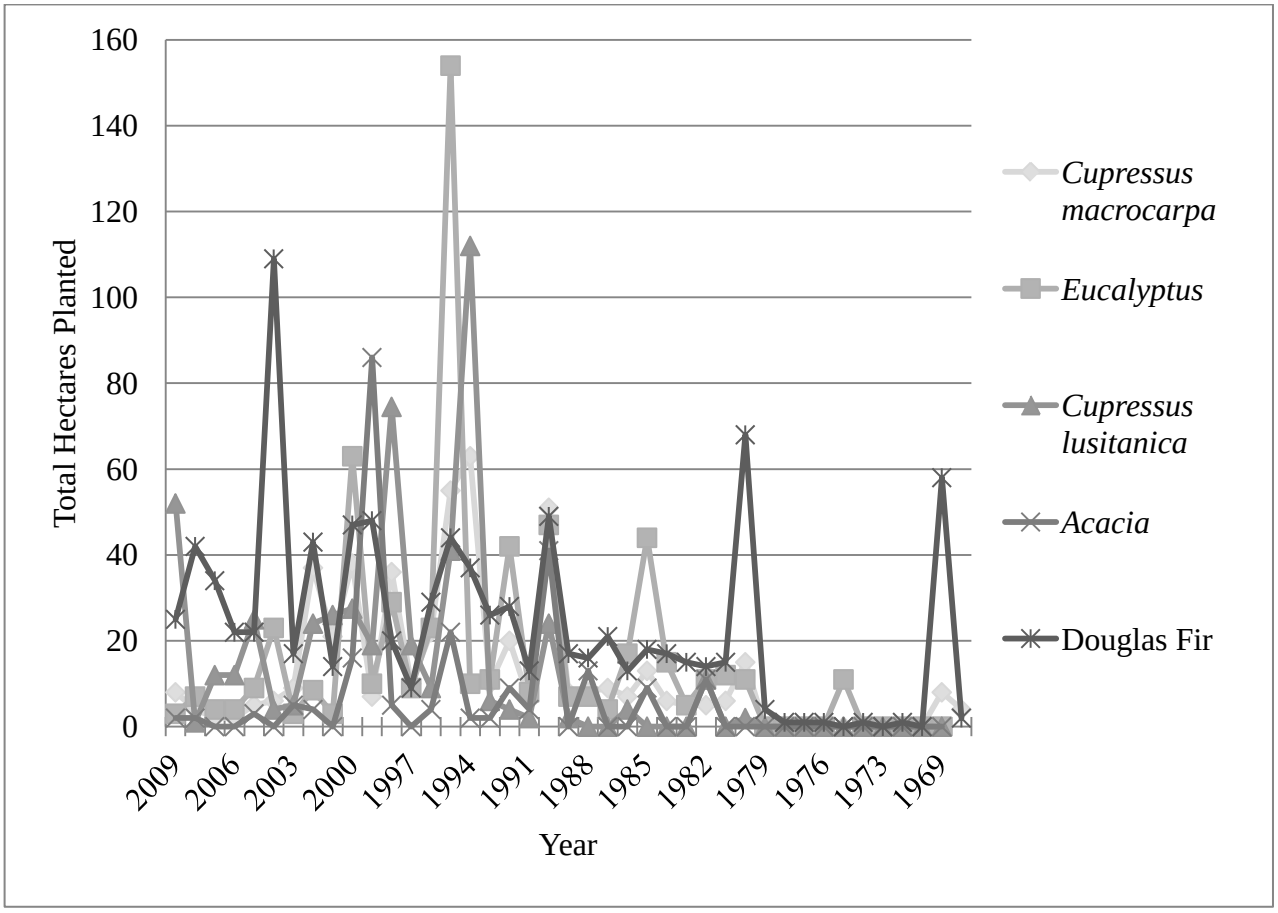

Figure 4. Most common species, excluding radiata pine, planted by small forest landowners in New Zealand

Species other than radiata pine have regional distributions. Douglas fir and *Cupressus macrocarpa* are planted primarily on the South Island. The majority of Douglas fir (95.2%) was planted on the South Island and only 4.8% on the North Island. *Cupressus macrocarpa*

plantings were also much higher on the South Island with 73.3% of the plantings. The category "other pine" on the survey was also entirely on the South Island. All other species had larger plantings on the North Island. Table 7 describes the regional distribution of species.

Table 7. Regional distribution of species planted by small forest landowners in New Zealand

Species	North Island	South Island
Radiata pine	66.5%	33.5%
Douglas fir	4.8%	95.2%
Cupressus macrocarpa	26.7%	73.3%
Eucalyptus spp	64.6%	35.4%
Cupressus lusitanica	84.6%	15.4%
Acacia	85.4%	14.6%
Other Pines	0.0%	100.0%
Redwoods	79.7%	20.3%
Mixed Species	77.8%	22.2%
Poplar	68.3%	31.7%
All Species	66.4%	33.6%

The question on species planted asked landowners to include the age of the plantations and the previous land use. Only 4% of landowners had their land in trees prior to the current rotation. The majority, 61.7%, had the land as improved pasture and 32.2% converted unimproved pasture. The previous land use is shown in Figure 5. The other category includes sand, flood plains and other land uses.

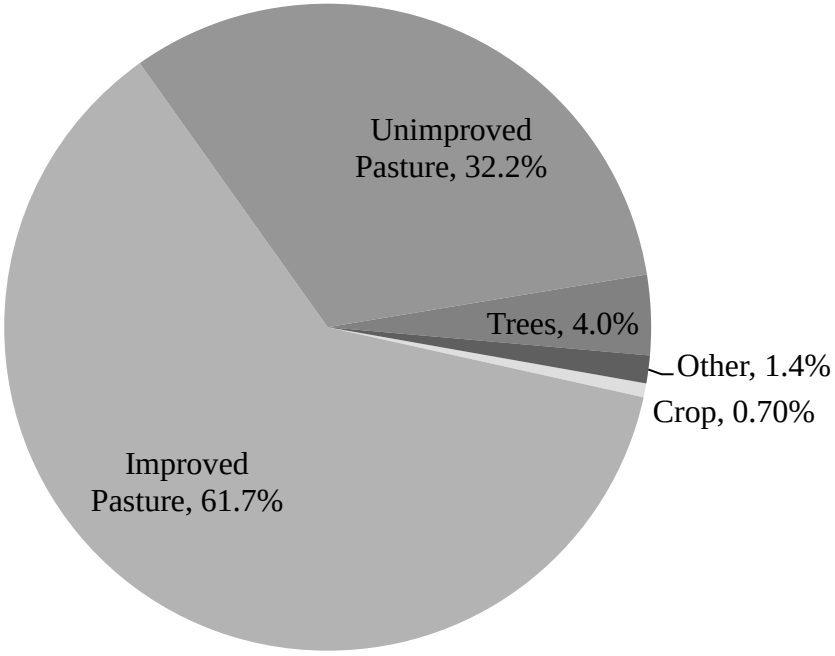

Figure 5. Previous land use of existing forest plantations by small forest landowners in New Zealand

6.3.2 Forest Land Owners

The land owner section of the survey asks questions about the property and the demographics of the landowner. The survey begins with a question asking landowners if the benefits of being a forest landowner are getting better, getting worse or staying about the same and 50.2% of landowners thought the benefits were getting better, 25% thought they were getting worse and 24.8% thought they were staying about the same. Attitudes about forestry varied by region with landowners in Otago/Southland and Nelson/Marlborough significantly more likely to think things were getting worse for forest landowners while landowners in East Coast were significantly more likely to think things are getting better than landowners in other regions. Some 57.1% of landowners in East Coast thought the benefits of being a forest landowner were getting better while 32.7% of landowners in Otago/Southland and 32.3% of landowners in Nelson/Marlborough thought things were getting worse for forest landowners. South Island

landowners were significantly more likely to think the benefits of being a forest landowner were getting worse with 22.8% of landowners on the North Island responding that things were getting worse compared with 28.6% of landowners on the South Island. The chi-squared value was 16.21 and the critical value for 99% confidence was 9.21. If chi-square is larger than 9.21 we can reject the null hypothesis. Table 8 shows landowner attitudes about forestry by region.

Table 8. Landowners on the benefits of owning forest land by region

Region	Things are Getting Better	Things are Staying the Same	Things are Getting Worse
Northland	41.2%	32.9%	25.9%
Auckland	53.2%	25.5%	21.3%
Central North Island	48.8%	30.2%	20.9%
East Coast	57.1%	28.6%	14.3%
Hawkes Bay	53.1%	29.7%	17.2%
Southern North Island	50.3%	22.4%	27.2%
Nelson/Marlborough	50.0%	17.7%	32.3%
Canterbury	53.5%	25.6%	20.9%
Otago/Southland	49.5%	17.8%	32.7%
All of New Zealand	50.2%	24.8%	25%

The largest landowners in the survey (landowners with more than 1000 hectares of land) were the most satisfied with forestry with 57% responding that things are getting better for forest landowners. Landowners 500 to 1000 hectares of land were the less satisfied than other landowners 48.1% of landowners with 47.7% responding that things were getting better. Table 9 shows the landowner attitudes about forestry by the size of the property.

Table 9. Survey respondents on the benefits of owning forest land by the size of property

Size of Property	Number of Respondents	Things are Getting Better	Things are Staying the Same	Things are Getting Worse
Less than 250 Hectares	232	48.1%	27.7%	24.2%
250 to 500 Hectares	215	51.2%	23.7%	25.1%
500 to 1000 Hectares	174	47.7%	25.3%	27.0%
More than 1000 Hectares	107	57.0%	20.6%	22.4%
All of New Zealand	728	50.2%	24.8%	25%

The landowners with the smallest amount of forest land were the least satisfied. Only 47.6% of landowners with 20 to 50 hectares of plantation forest thought things were getting better. Landowners with 50-100 hectares of plantation forest were the most satisfied. The results are displayed in Table 10.

Table 10. Survey respondents on the benefits of owning forest land by the size of forest plantation

Land in forest plantation	Number of Respondents	Things are Getting Better	Things are Staying the Same	Things are Getting Worse
20-50 hectares	511	47.6%	26.9%	25.5%
50-100 hectares	157	56.7%	20.4%	22.9%
100-200 hectares	60	55%	20%	25%
All of New Zealand	728	50.2%	24.8%	25%

There were differences between the type of agricultural enterprise and attitudes about forest ownership. Sheep and beef landowners were significantly more likely than other farm types to think things were getting better for forestry and dairy landowners were more likely to think things were getting worse. The chi-square value was 9.56, the critical value for 2 degrees of freedom and 99% confidence is 9.21. If the chi-squared value is greater than 9.21 we can reject the null hypothesis. Some 52.7% of sheep and beef landowners thought the situation was getting better, 21.9% thought it was getting worse and 25.4% thought it was staying the same. Dairy landowners were more negative about the future as only 42.6% thought things were getting better, 34% thought things were getting worse and 23.4% thought things were staying the same. Table 11 shows the type of agricultural enterprise and the attitudes about forestry.

Table 11. Survey respondents on the benefits of owning forest land by the type of agricultural enterprise

Agricultural Enterprise	Number of Respondents	Things are Getting Better	Things are Staying the Same	Things are Getting Worse
Sheep and Beef	504	52.7%	25.4%	21.9%
Dairy	141	42.6%	23.4%	34.0%
Other	83	48.2%	24.1%	27.7%
All of New Zealand	728	50.2%	24.8%	25%

Questions 24 and 25 asked about residence. In this study, 72.8% of landowners live on the property and 27.2% live off the property. The average distance for those living away from the property was 36 kilometres with a maximum of 400 kilometres and a median of 20 kilometres. The West Coast had the highest percentage of landowners living off the property while Otago/Southland and the Southern North Island had the fewest landowners living off the property. Table 12 shows the percentage of landowners in each region living off the property.

Table 12. Percent of landowners living off the property by region

Region	Number of Landowners Living Off the Property	Percent of Landowners Living Off the Property	Average Distance (in km)
Northland	27	31.4%	36
Auckland	12	25.5%	33
Central North Island	20	23.3%	39
East Coast	12	34.3%	47
Hawkes Bay	16	25.0%	56
Southern North Island	32	21.8%	34
Nelson/Marlborough	21	33.9%	24
Canterbury	29	33.7%	35
Otago/Southland	23	21.5%	35
West Coast	5	62.5%	15
All of New Zealand	197	27.2%	36

Sheep and beef landowners were more likely to live off the farm than dairy farmers and to live further away. Sheep and beef landowners lived an average of 36 kilometres from the property compared to dairy farmers that lived 17 kilometres from the property.

Question 27 asked how landowners acquired the land. This survey found that 64.1% of landowners had purchased the land on the market while 23.9% purchased land from the family trust and 11.9% had acquired the land through other methods. Of the landowners who had purchased the land from other methods, 60% had a combination of purchasing some land from the family trust and some land by market purchase, 27% inherited the land, 5.9% did not own the land but were managing the land on behalf of a family member and 2.4% received their land

in a Lands and Survey ballot. The Lands and Survey department allocated farm land by ballot at fixed values under three options-renewable lease, deferred payments or cash. Figure 6 shows how landowners acquired the property.

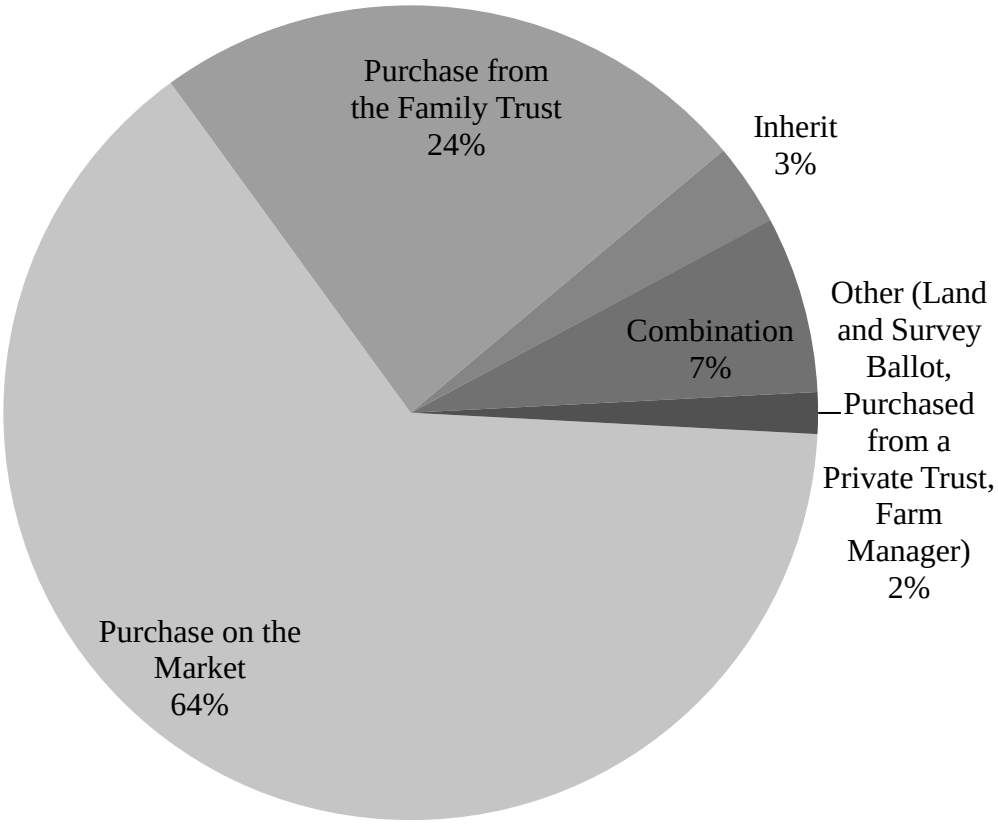

Figure 6. Acquisition of property by survey respondents

Dairy landowners were significantly more likely to purchase on the open market than sheep and beef landowners with 71.9% of dairy landowners purchasing their property on the open market compared with 62.1% of sheep and beef landowners. The chi-squared value was 11.38 and the critical value at .01 significance is 9.21. Sheep and beef landowners were significantly more likely to purchase from a family trust than dairy landowners with 26.1% of sheep and beef landowners purchasing their land from a family trust and 11.8% acquired it in another way

while only 18.8% of dairy farmers purchased their land from a family trust and 9.4% acquired the property from a combination for family trust and market purchased or from another method. Table 13 shows the primary agricultural enterprise and the acquisition of the property.

Table 13. Acquisition of property and primary agricultural enterprise

Type of Agricultural Enterprise	Purchased from the Market	Purchased from the Family Trust	Other
Sheep and Beef	62.1%	26.1%	11.8%
Dairy	71.9%	18.8%	9.4%
Other	68.7%	15.7%	15.7%
All of New Zealand	64.1%	23.9%	11.9%

Questions 28 and 29 asked if landowners manage the land themselves or have another arrangement. Some 91.7% of the landowners farm the land themselves while 8.3% of landowners do not farm the land themselves and the majority of those landowners rent the land to farm tenants. Of the landowners who do not farm the land themselves, 57% rent to farm tenants 20% have a family member manage the land, 5% have a farm manager and 18% have another arrangement. Dairy farmers were less likely to manage the land themselves (88.7%) compared with sheep and beef landowners (93.2%). Table 14 shows the land management by agricultural enterprise.

Table 14. Land management by agricultural enterprise

Agricultural Enterprise	Manage the Land	Employ a Farm Manager or Rent to Farm Tenants
Sheep and Beef	93.2%	6.8%
Dairy	88.7%	11.3%
Other	91.6%	8.4%
All of New Zealand	91.7%	8.3%

Question 30 asked about the land ownership. There are many different types of land ownership and landowners were asked to select all the types of land ownership that applied to their property. The most common types of land ownership were individual ownership and a trust or estate. Landowners responded that 44.7% of land was individual or joint ownership, 35% was a trust or estate, 16.1% was a family partnership or corporation, 2.9% was a business partnership and 1% was an association or a non profit organisation. Figure 7 shows land ownership.

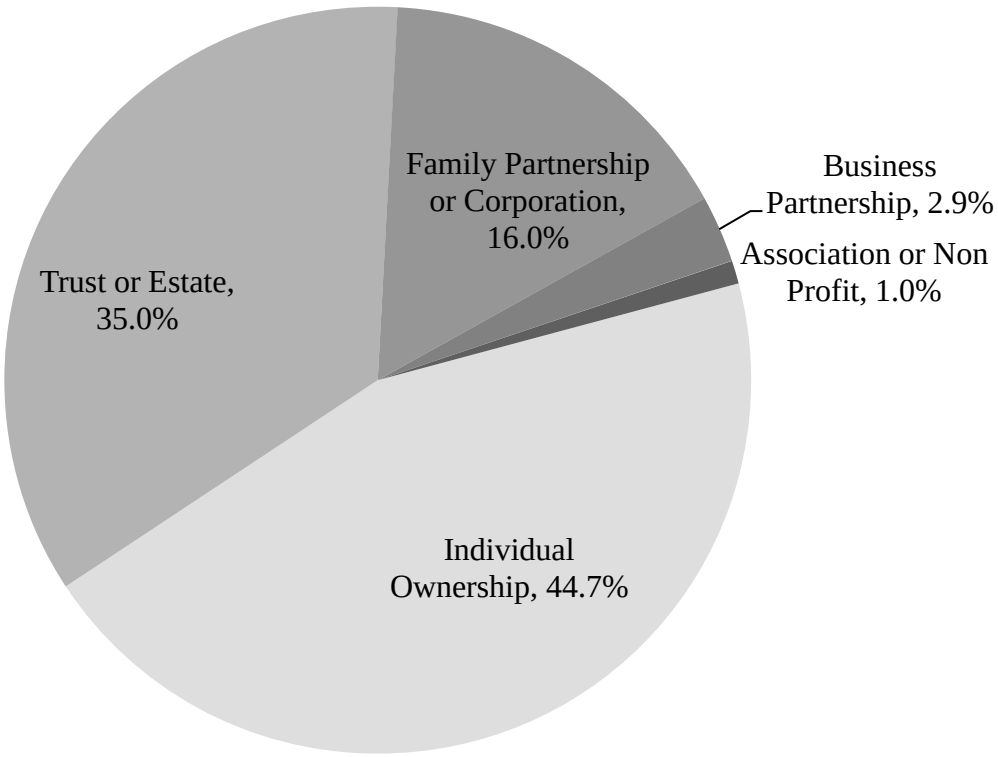

Figure 7. Land ownership of survey respondents

Question 31 enquired about the future of the land. The survey question asked landowners what they plan to do with their land in the future and provided three choices: leave it all to heirs or sell it to the family trust, leave some to heirs and sell some to the family trust, or sell it. More than half the landowners plan to leave the land to their heirs (51.2%) while 35.1% are planning to sell it and 4.4% plan a combination of selling it and leaving it to heirs. A notable feature of this question was that 9.3% of respondents wrote in that they were not sure what they would do with the land in the future. One landowner commented “Could not answer question about the future use of my land as I do not know what will happen in the future yet to think it out. Don't have any heirs yet. May take a few years yet.” Many landowners commented that they didn’t know if their children wanted to inherit the land. Some noted that the children lived overseas or were not interested in farming. One landowner commented “At this point I don't know.

Depends on what the next generation want to do" and another said "ask the kids. Will probably end up selling". Many landowners wanted to leave it to heirs but as one landowner commented "Not sure. Would like to keep farm in the family but my kids are not interested". Figure 8 shows the future of the property.

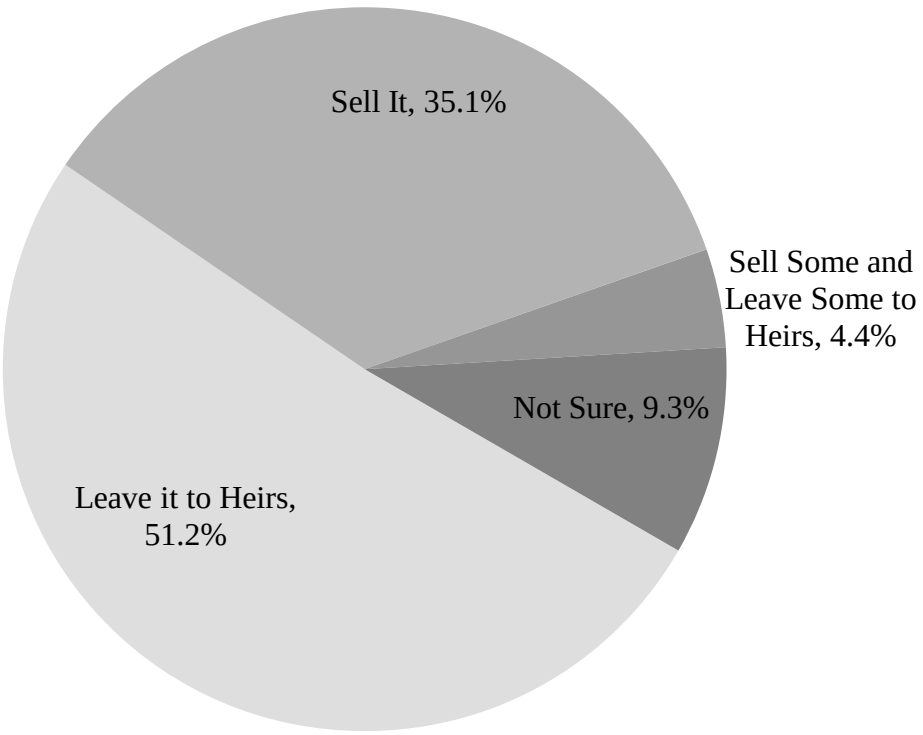

Figure 8. Survey respondents' plans for the future of the property

Dairy landowners were the most likely to indicate uncertainty about the future with 11.3% of dairy landowners indicating they did not know what they plan to do with the land in the future compared with 8.9% of sheep and beef landowners. Table 15 shows the future of the property based on primary agricultural enterprise.

Table 15. Primary agricultural enterprise and the future of the property

Primary Agricultural Enterprise	Leave Property to Heirs	Sell It	Combination	Unsure
Sheep and Beef	48.8%	37.7%	4.6%	8.9%
Dairy	54.6%	29.8%	4.3%	11.3%
Other	54.2%	33.7%	3.6%	8.4%
All of New Zealand	51.2%	35.1%	4.4%	9.3%

Landowners with medium tracts of forest land also expressed more uncertainty than landowners with large or small tracts. Landowners with 50 to 100 hectares expressed the most uncertainty with 15.9% unsure of what they would do with the land in the future compared with 10.0% of landowner with 100 to 200 hectares of forest land and 7.2% of landowners with 20 to 50 hectares of forest land. Table 16 shows the future of the property based on the size of the forest.

Table 16. Size of forest and the future of the property

Size of Forest Plantation	Leave Property to Heirs	Sell It	Combination	Unsure
20 to 50 Hectares	51.5%	37.2%	4.1%	7.2%
50 to 100 Hectares	49.0%	30.6%	4.5%	15.9%
100 to 200 Hectares	55.0%	28.3%	6.7%	10.0%
All of New Zealand	51.2%	35.1%	4.4%	9.3%

Questions 32-35 focused on the demographics of landowners. The average age of small forest landowners in New Zealand in this survey was 56 years. The oldest landowner was 91 and the youngest was 26 and 75% of the landowners were over the age of 50. Table 17 shows the distribution of landowners by age. There was no age difference for sheep and beef landowners and dairy landowners or between landowners with small and large blocks of forest land. The survey found 92% of the survey respondents were male and 8% were female. Female respondents were more likely to be dairy farmers. Sheep and beef landowners were 6.8% female compared to 10.6% of dairy farmers.

Table 17. Percent of landowners in each age category

Age Category	Number of Landowners	Percent of Landowners
20-29	2	0.3%
30-39	28	3.8%
40-49	121	16.6%
50-59	300	41.2%
60-69	214	29.4%
70-79	48	6.6%
80-89	14	1.9%
90+	1	0.1%

The survey found that landowners in New Zealand have a higher education than the average worker. According to the 2006 New Zealand census by Statistics New Zealand(SNZ, 2006), 25% of people over the age of 18 have less than a secondary education compared with less than 4% of survey respondents. The 2006 census revealed that 11% of people over the age of 18 had a university degree compared with 19.9% of survey respondents. The census found that 40% of

people over the age of 18 had some sort of post secondary training. The educational level of survey respondents is shown in Figure 9.

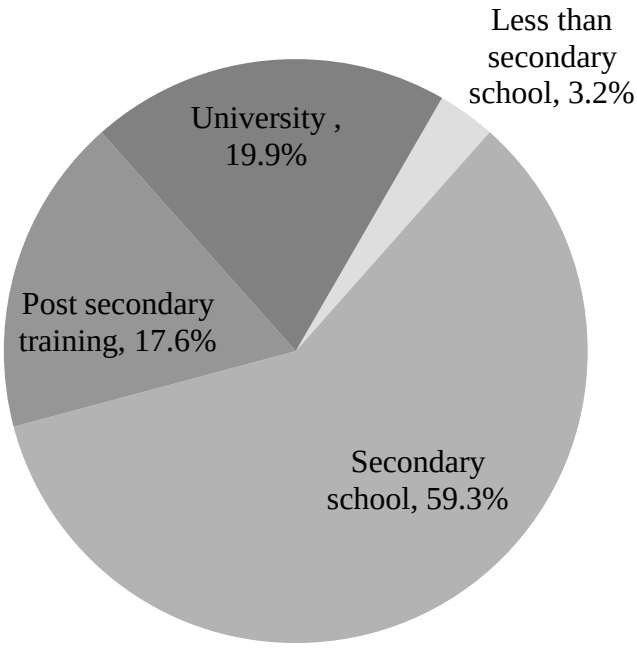

Figure 9. Education level of survey respondents

The final demographic question asked landowners about their approximate gross household income. In New Zealand, the 2006 census by Statistics New Zealand (SNZ, 2006) revealed that 23% of households earned more than $100,000 compared with 35.9% of the forest landowners in the survey. Previous studies found that people under reported their income when asked to provide a number so this survey provided income categories. The five categories in the survey were less than $25,000; $25,000 to $49,999; $50,000 to $99,999; $100,000 to $199,999 and more than $200,000. For the analysis, the income groups were combined into three household income categories: less than $50,000; $50,000 to $99,999 and greater than $100,000. This combination of incomes created three similar size groups. Dairy farmers had significantly higher incomes than sheep and beef farmers. The chi-squared value was 15.46 and the critical value for 99% confidence is 9.21. If the chi-squared value is greater than 9.21 we can reject the

null hypothesis. Some 32.9% of sheep and beef landowners earn more than $100,000 per year compared with 42.1% of dairy landowners. Only 26.4% of dairy landowners earn less than $50,000 per year compared with 30.4% of sheep and beef landowners. Table 18 shows the income of survey respondents by primary agricultural enterprise.

Table 18. Primary agricultural enterprise and income of survey respondents

Agricultural Enterprise	Income Less than $50,000	Income $50,000 to $99,999	Income greater than $100,000
Sheep and Beef	30.4%	36.7%	32.9%
Dairy	26.4%	31.4%	42.1%
Other	25.4%	32.5%	42.1%
All of New Zealand	29.0%	35.2%	35.8%

6.3.3 Ownership Objectives

Ownership objectives focus on the motives for owning forest land. The survey asked about the importance of various objectives in owning forest land and the types of recreation they participate in on their forest land. Landowners in the survey did not list recreation as an important reason for owning forest land. Landowners were asked to list on a scale of 1 to 5 how important various factors were in owning forest land, with one indicating it was not an important reason and five indicating it was very important. The factor with the highest ranking was income from timber with an average score of 3.94, followed by environmental reasons, to keep for future generations, land investment, scenic beauty, income from carbon and at the bottom of the list was recreation with an average score of 2.27. Table 19 examines the importance of seven ownership objectives for forest landowners in New Zealand.

Table 19. Importance of various ownership objectives of New Zealand small forest landowners

Ownership Objective	Score (out of 5)
Income from Timber	3.94
Environmental Reasons	3.84
To Keep for Future Generations	3.12
Land Investment/Real Estate/Capital Investment	3.01
Scenic Beauty	2.80
Income from Carbon	2.56
Recreation	2.27

The reasons for owning forest land generated comments from several landowners. One landowner commented that they owned land to leave “mother nature better dressed than when I found it” while others indicated they owned it for environmental reasons “Keeps gorse and broom out. Shelter from norwest, for stock, crops, wind erosion and makes climate easier to live with”. Other landowners indicated their forest was used as shelter for stock which was not a reason provided on the survey. One landowner wrote they “use forest land for lambing and wind storm shelter for stock and soil protection from erosion. We like trees-they beautify the landscape, bring birds, encourage rainfall and modify NW winds.” Some landowners expressed strong feelings about owning land for the income from carbon. One landowner wrote “what is it? Can't touch. Can't smell. Find somebody to deliver a ton of it.” Another landowner indicated that carbon was “too political at the moment”. Other landowners seemed quite confused about carbon and commented that there was “not enough information/absolutes to decide on ETS”. The majority of landowners commented that they owned their land for the income from timber or for the land investment.

Income from timber was the most important reason for owning land with 70.7% of landowners ranking it as being important or very important while only 20.3% of landowners ranked recreation as being important or very important. The percent of landowners who rated selected reasons for owning forest as being very important is shown in Table 20.

Table 20. Importance of various reasons for owning forest land

Reason for Owning Forest Land	Percent of Landowners Who Ranked it as:		
	Not Important or Low Importance (1 or 2 out of 5)	Medium Importance (3 out of 5)	Important or Very Important (4 or 5 out of 5)
Income from Timber	14.3%	15.0%	70.7%
Environmental Reasons	18.6%	16.9%	64.5%
To Keep for Future Generations	34.9%	20.3%	44.8%
Land Investment/Real Estate/Capital Investment	37.4%	22.0%	40.7%
Scenic Beauty	43.3%	22.8%	33.9%
Income from Carbon	49.0%	24.3%	26.7%
Recreation	61.4%	18.3%	20.3%

Dairy farmers were less interested in environmental reasons, income from carbon and land investment as reasons for owning forest land compared with sheep and beef landowners. Dairy farmers gave environmental reasons an average score of 3.61 compared with 3.93 for sheep and beef landowners. Dairy farmers ranked income from carbon as the least important reason for owning land with an average score of 2.06 compared with 2.67 for sheep and beef landowners.

The biggest difference in scores was for land investment with dairy farmers giving it an average importance of 2.52 compared with 3.11 for sheep and beef landowners.

Small landowners ranked scenic beauty higher than medium and large landowners while large landowners ranked environmental reasons higher than small and medium landowners. Medium sized landowners ranked income from timber, land investment and income from carbon higher than small and large landowners.

Question 37 focused on what specific recreational activities people participate in on their forest property. There were ten activities listed and landowners could select that the activity was not applicable to their property or if they did participate in the activity, they could indicate an importance between one and five with one indicating it was not important and five indicating it was very important. The highest ranking activity was observing wildlife with an average score of 2.3 and 60.7% of the landowners participating in this activity. Hunting had the highest percentage of participants with 61.3% of landowners indicating hunting occurs on their land but the importance was still only 2.1. Two landowners commented that hunting is primarily for possums. Table 21 displays the percent of landowners who indicated they do not participate in the activities on their land and the average importance of the activity for landowners who do participate.

Table 21. Importance of non-timber forest activities

Activity	Percent Answering 'Not Applicable'	Average of Remaining Respondents (Excludes N/A Responses)	Average Including N/A Responses
Observing Wildlife	39.3%	2.3	1.4
Walking/Tramping	41%	2.2	1.3
Hunting	38.7%	2.1	1.3
Bird Watching	41.9%	2.0	1.2
Horseback Riding	53.4%	1.8	0.8
Photography	50.9%	1.6	0.8
Camping	56.9%	1.7	0.7
Flower, Plant or Berry Picking	55.2%	1.5	0.7
Cycling	63.5%	1.5	0.5
Fishing	72.1%	1.6	0.4

Using the land for recreation was not the norm and landowners commented that they "preferred their grasslands to walk on and enjoy" and that it was hard to recreate on their land "as there is too much blackberry" or "no access available". Landowners prefer their forests for their timber and stated that "trees are grown for timber/erosion control only". A few people commented that they did use their forest land for recreation and "our family lives in a bach built at the forest edge. It is semi isolated on a major river. Various family/friends use it for free recreation, swimming, school holidays".

Landowners were allowed to write in other activities they participated in on their land and the answers in order of importance were: grazing under trees/shelter for stock, aesthetics/diversity,

satisfaction of owning land, all-terrain vehicles, firewood, research, privacy, beekeeping, tourism, picnics, filming documentaries, environmental education and army training.

The survey had a small space for additional comments but many landowners attached a note with additional comments. There were a total of 252 comments. Comments ranged from an extreme dislike of forestry and the government to optimism and enjoyment of being a small forest landowner. One landowner commented "Risk is very high for forestry. I hate pine trees" while another landowner commented "By planting trees the land will give a positive income greater than sheep and beef so the children can keep their good jobs and come to the homestead on the holidays."

Many landowners also expressed confusion about owning forest land with one landowner commenting "I do not understand carbon or ETS but do want some alternative timber for the future generation. I just want to plant trees" while other landowners commented "Not sure, seems very conflicting information on price of carbon and even if trees do store as much carbon as previously assumed" or "could use some advice on forestry and planting".

6.3.4 Summary of Significant Differences

The characteristics and ownership objectives of small forest landowners show they are a diverse group. This objective aimed to understand:

- How much forest land small landowners have on their property?
- What species they are planting?
- Who owns forest land?
- Why small forest landowners own forest land?
- Are forest owners near retirement?
- What they plan to do with their land in the future?

The results indicate that forest landowners own an average of 50 hectares and they are primarily planting radiata pine. The average age of forest landowners is 56 years, 19.9% have a tertiary qualification and 35.9% earn more than $100,000. The majority of forest landowners farm the land themselves (91.7%), 64% of landowners purchased their land on the open market and 51.2% plan to leave the land to heirs. Landowners own their land primarily for income from timber and environmental reasons and few own it for recreation.

Some of the data were summarised in terms of central tendency while other data were analysed using chi-square and log linear analysis. The statistically significant differences were in attitudes about forestry, acquisition of land and incomes. Landowners in Otago/Southland and Nelson/Marlborough were significantly more likely than landowners in other regions to think things were getting worse for forest landowners. Landowners in East Coast were significantly more likely to think things were getting better for forest landowners. Landowners from the South Island were significantly more likely than landowners from the North Island to think things were getting worse for forest landowners. Landowners whose primary agricultural enterprise was sheep and beef were significantly more likely than other farm types to think things were getting better for forestry while landowners whose primary agricultural enterprise was dairy cattle were significantly more likely to think things were getting worse. Landowners whose primary agricultural enterprise was dairy cattle were also significantly more likely than to have purchased their land on the open market than landowners whose primary agricultural enterprise was sheep and beef. Landowners whose primary agricultural enterprise was dairy cattle or other reported a significantly higher household income than landowners whose primary agricultural enterprise was sheep and beef.

6.4 Objective Two-Silviculture and Land Management

Questions seven through thirteen on the survey asked about land management and silviculture. This objective aims to answer several research questions including:

- Did small forest landowners experience a forest planting spike in the mid-90s?
- What does a planting spike mean for future harvesting?
- What quality of wood can we expect from small landowners?
- What silviculture can we expect from landowners in future rotations?

Landowners were asked if they converted any land in the past ten years and 30% of survey respondents had converted land from agriculture to forestry or forestry to agriculture in the past ten years. In the past ten years, 26.1% of the landowners converted land from agriculture to forestry and the average size of land conversion was 20.7 hectares. A smaller number of landowners, 4.8%, converted land from forestry to agriculture in the past ten years and the average size of the land conversion was 9.9 hectares. Landowners with the most forest land were significantly more likely to have converted land in the past ten years with 28.5% of landowners with 20-50 hectares of forest land had converted land in the past ten years, compared with 30.5% of landowners with 50-100 hectares and 41.6% of landowners with 100-200 hectares of forest land. The chi-squared for large landowners was 14.33 and the critical value for 99% confidence is 9.21. If the chi-square value is greater than 9.21 we can reject the null hypothesis. Table 22 summarizes the land conversion and forest size for small forest landowners.

Table 22. Size of plantation forest and land conversion in the past ten years

Size of Plantation Forest (hectares)	Percent of Landowners Who Converted Land in the Past 10 Years	Converted from Agriculture to Forestry		Converted from Forestry to Agriculture	
		Percent of Landowners	Average Hectares	Percent of Landowners	Average Hectares
20-50	28.5%	23.9%	13.0	4.6%	10.4
50-100	30.5%	26.7%	29.1	3.8%	10.4
100-200	41.6%	36.6%	47.2	5.0%	4
All of New Zealand	30.4%	25.6%	20.7	4.8%	9.9

Sheep and beef farmers were more likely to have converted land from agriculture to forestry or from forestry to agriculture than dairy farmers with 32% of sheep and beef farmers converting land in the past ten years compared with 27.7% of dairy farmers. Sheep and beef landowners who converted land converted an average of 23.4 hectares from agriculture to forestry and 9.9 hectares from forestry to agriculture. Dairy landowners who converted land converted an average of 12.5 hectares from agriculture to forestry and 11.8 hectares from forestry to agriculture. Table 23 summarises the land conversion in the past ten years by agricultural enterprise.

Table 23. Primary agricultural enterprise and land conversion in the past ten years

Agricultural Enterprise	Converted from Agriculture to Forestry		Converted from Forestry to Agriculture	
	Percent of Landowners	Average Hectares	Percent of Landowners	Average Hectares
Sheep and Beef	27.2%	23.4	4.8%	9.9
Dairy	22.0%	12.5	5.7%	11.8
Other	26.5%	18.3	3.6%	7.3
All of New Zealand	25.6%	20.7	4.8%	9.9

Questions 10 to 13 asked landowners questions about harvesting their forest. Most landowners had not recently harvested any trees from their property. Some commented that they had harvested trees for firewood or personal use but only 26.4 % had harvested any trees in the past ten years. The average age for harvesting those trees was 29 years. The distribution of harvesting ages amongst landowners who have harvested in the past ten years is shown in Figure 10.

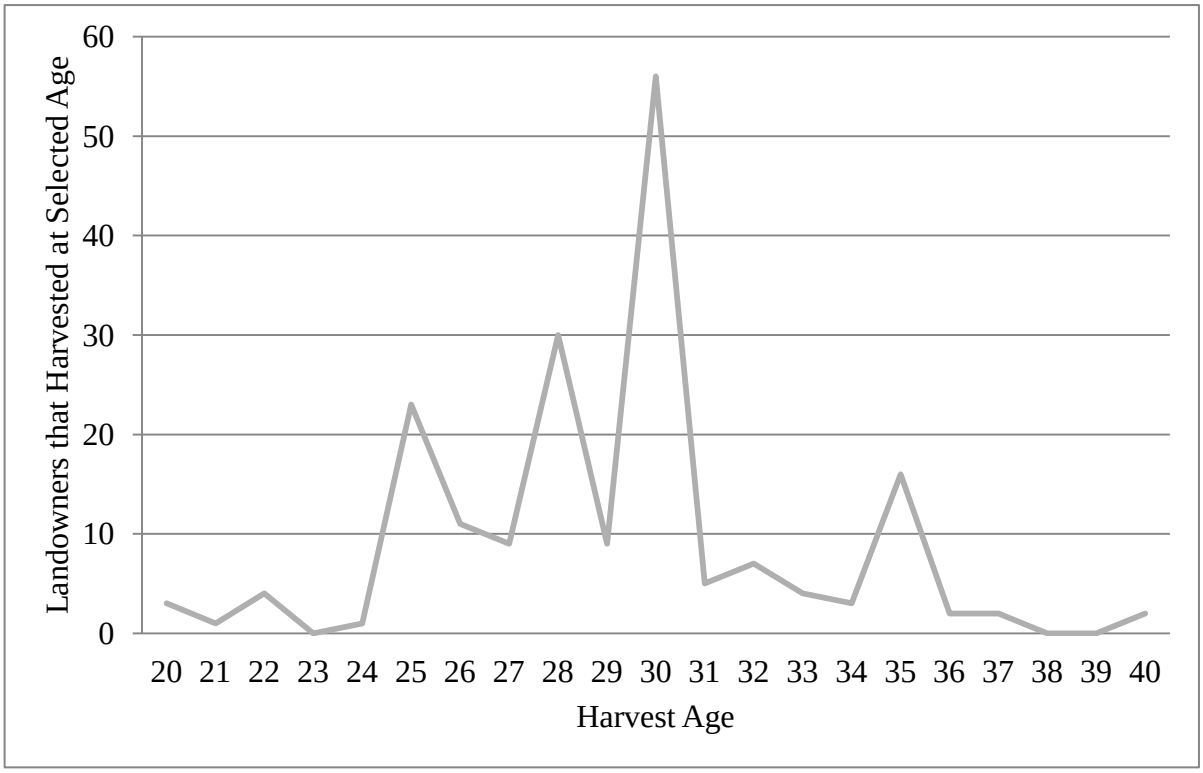

Figure 10. Distribution of harvest ages for landowners who harvested from 2000-2009

Similar to the questions on land conversion, the landowners with the most forest on their property were significantly more likely to have harvested in the past ten years. In the past ten years, 41.6% of landowners with 100-200 hectares of forest had harvested compared with 28% of landowners with 50-100 hectares and 24.1% of landowners with 20-50 hectares. The chi-squared for large landowners was 15.38 and the critical value for 99% confidence is 9.21. If the critical value is greater than 9.21 we can reject the null hypothesis. Table 24 shows the forest size and harvesting in the past ten years.

Table 24. Average forest size and harvesting in the past ten years

Forest Size in Hectares	Harvested Trees in the Past 10 Years	Average Rotation Age
20-50	24.1%	28.9 years
50-100	28.0%	29.3 years
100-200	41.6%	29.7 years
All of New Zealand	26.4%	29.1 years

Unlike land conversion sheep and beef landowners were significantly less likely to have harvested in the past ten years than dairy landowners. In the past ten years, 23.8% of sheep and beef landowners had harvested trees compared with 31.9% of dairy landowners. The chi-squared was 10.68 and the critical value for 99% confidence is 9.21. If the chi-squared value is greater than 9.21 we can reject the null hypothesis. Table 25 summarises harvesting in the past ten years and primary agricultural enterprise.

Table 25. Average forest size and harvesting in the past ten years by primary agricultural enterprise

Agricultural Enterprise	Harvested Trees in the Past 10 Years	Average Rotation Age
Sheep and Beef	23.8%	29.5 years
Dairy	31.9%	28.3 years
Other	32.5%	28.3 years
All of New Zealand	26.4%	29.1 years

The results show that there is a significant relationship between living on the property and land activity in the past ten years. People that live on the property were significantly more likely to

have harvested in the past ten years and converted land from agriculture to forestry or forestry to agriculture in the past ten years. The chi-squared value for harvesting was 10.04 and for land conversion was 20.97 with a critical value of 9.21 for 99% confidence. If the chi-squared value is greater than 9.21 we can reject the null hypothesis. The percent of landowners who converted land or harvested trees in the past ten years is shown in Table 26.

Table 26. Percent of landowners living on and off the farm that converted land and harvested trees in the past ten years

Residence	Percent of Landowners Who Converted Land from Agriculture to Forestry	Percent of Landowners Who Converted Land From Forestry to Agriculture	Percent of Landowners Who Harvested Trees in Past Ten Years
Live on the Property	30.7%	5.1%	29.2%
Live off the Property	13.7%	4.1%	18.8%
All of New Zealand	30.4%	4.8%	25.6%

This study also explored the intended rotation age of the current forest. Landowners were asked at what age they plan to harvest their trees in the future and most landowners provided a range of ages between 24 and 35 years for radiata pine with an average low of 28 years and the average high of 30 years. The size of the forest and the type of farm did not affect the harvesting age.

The final harvesting question asked landowners if they planned to replant on the same site, 71.2% of landowners planned to replant while 23.3% were not sure and 5.3% would not replant trees on the same site. One landowner commented that they “have cut down trees in the past and have not made any money out of them so they are a weed. Don’t know why I have them. Better to plant a shelter belt for stock shelter.” Several landowners in Otago mentioned that they would “only replant radiata and macrocarpa. Will not replant Douglas fir”. Most landowners planned to replant and one landowner commented that they would keep land in forestry as “we are still happy with the choices we’ve made and are unlikely to make any changes”. Sheep and beef landowners were more likely to replant than dairy farmers. Only 66.7% of dairy landowners planned to replant compared to 73.1% of sheep and beef landowners.

Landowners with smaller plantation forests were also less likely to replant. Landowners with more than 50 hectares of forest were significantly more likely to replant. The chi squared for replanting was 15.46 with a critical value of 9.21 Table 27 summarises the size of the plantation forest and the replanting decisions.

Table 27. Replanting by size of forest for small landowners in New Zealand

Forest Size in Hectares	Will Replant	Will Not Replant	Unsure
20-50	66.2%	6.2%	27.4%
50-100	84.0%	3.1%	12.7%
100-200	81.0%	3.3%	15.0%
All of New Zealand	71.2%	5.3%	23.3%

The smallest landowners (20-100 hectares of forest) harvested and converted less land in the past ten years but also expressed the most uncertainty about future replanting and were less likely to think things were getting better for forestry. The possible interaction between harvesting in the past ten years and plans to replant was further analysed. Table 28

demonstrates that landowners who have harvested in the past ten years are overall more likely to replant in the future.

Table 28. Size of forest, harvesting in past ten years and future replanting for small forest landowners in New Zealand

Forest Size in Hectares	Harvesting in Past Ten Years			No Harvesting in Past Ten Years		
	No Replant	Replant	Unsure	No Replant	Replant	Unsure
20-50	9.8%	70.7%	19.5%	5.2%	64.8%	30%
50-100	0	84.1%	15.9%	4.4%	84.0%	11.5%
100-200	4%	88.0%	8.0%	2.8%	77.1%	20.0%
All of New Zealand	6.8%	76.0%	17.2%	4.9%	69.6%	25.6%

Landowners who have harvested in the past ten years expressed less uncertainty over future replanting but were more likely to have a negative view of forestry. Table 29 examines landowners who harvested in the past ten years and if they think the benefits of being a forest landowner are getting better, getting worse or staying the same. Forest landowners with less than 100 hectares of forest were more likely to think things were getting worse for forest landowners if they had harvested in the past ten years.

Table 29. Size of forest, harvesting in past ten years and attitudes about forestry for small forest landowners in New Zealand

Forest Size in Hectares	Harvesting in Past Ten Years			No Harvesting in Past Ten Years		
	Getting Better	Staying the Same	Getting Worse	Getting Better	Staying the Same	Getting Worse
20-50	41.1%	25.2%	33.3%	49.6%	27.3%	22.9%
50-100	50.0%	13.6%	36.4%	59.3%	23.0%	17.7%
100-200	48.0%	28.0%	24.0%	60.0%	14.2%	25.7%
All of New Zealand	44.2%	22.9%	32.8%	52.3%	25.6%	22.0%

Questions 14 to 16 focused on pruning. The majority of small landowners in this survey were likely to prune in the current rotation with 90.1% of small landowners pruning or planning to prune in the current rotation. Some respondents were uncertain as to the benefits of pruning as only 61.2% of landowners plan to prune in the next rotation and 19.4% are unsure if they will prune in the next rotation. Table 30 details the percent of landowners who pruned to various heights. Small landowners prune their trees to an average of 6 metres. Some 97.1% of landowners pruned their trees to at least four metres while 82.2% pruned to at least six metres. Farm type and size of plantation did not affect the pruning height. Some landowners commented that “we pruned in the past but don’t know if it has paid off” or that they “selectively pruned about 10% of 15 year trees but have no plans to prune the rest of the trees or future plantations.” Others expressed uncertainty about pruning in the future due to

uncertainty in other aspects of the market and one landowner commented “who knows what is going to happen, i.e. carbon credits technology” or that they were “not sure, seems very conflicting information”. The average prune height was 5.9 metres with a range of 2 to 9 metres. The range of pruning heights is shown in Table 30.

Table 30. Pruning heights for radiata pine by small forest landowners in New Zealand

Pruning Height (Metres)	Percent
2	0.3%
3	2%
3.5	0.6%
4	4.1%
4.5	2.2%
5	6.7%
5.5	1.9%
6	62.5%
6.5	12.3%
7	3.8%
8	2.2%
9	1.4%

There was not a significant difference between the residence of the landowner and pruning in the current rotation or pruning in future rotations. Sheep and beef landowners were significantly less likely to prune in the current rotation with 10.3% of sheep and beef landowners not pruning in the current rotation compared with 5.6% of dairy landowners. The chi-squared value for pruning was 14.33 and the critical value for 99% confidence is 9.21. If the chi-squared value is

greater than 9.21 we can reject the null hypothesis. Table 31 shows the landowners who pruned in the current rotation and are planning to prune in future rotations.

Table 31. Percent of landowners who pruned in the current rotation and plan to prune in future rotations by primary agricultural enterprise

Primary Agricultural Enterprise	Percent of Landowners Who:			
	Pruned in the Current Rotation	Did not Prune in the Current Rotation	Will Prune in Future Rotations	Will Not Prune in Future Rotations
Sheep and Beef	88.1%	10.3%	60.7%	20.8%
Dairy	92.9%	5.7%	61.7%	18.4%
Other	93.2%	5.7%	63.4%	12.2%
All of New Zealand	90.1%	8.7%	61.2%	19.4%

*Does not include landowners who were uncertain about pruning in current or future rotations

6.4.1 Regional Differences in Silviculture and Land Management

This section looks in more detail at regional silvicultural differences. Landowners from Otago/Southland were significantly more likely to have converted land in the past ten years and landowners from the East Coast were the least likely. The chi-squared values are 12.71 for Otago/Southland is and 11.24 for the East Coast. The critical value for 99% confidence is 9.21. If the chi-squared value is greater than 9.21 we can reject the null hypothesis. Landowners from Auckland converted the highest average acres from forestry to agriculture while landowners from the Southern North Island converted the highest average acres from agriculture to forestry. Table 32 shows the percent of landowners who converted land in the past ten years in each region and the average hectares converted from agriculture to forestry and forestry to

agriculture. Landowners from the West Coast were omitted due to the small number of survey returns.

Table 32. Percent of landowners in each region that converted land and the average hectares converted

Region	Percent of Landowners who Converted Land in Past Ten Years	Agriculture to Forestry		Forestry to Agriculture	
		Percent of Landowners	Average Hectares	Percent of Landowners	Average Hectares
Northland	22.1%	19.7%	18	2.3%	5
Auckland	23.9%	19.8%	25	4.1%	24
Central North Island	32.6%	24.4%	13	8.2%	11
East Coast	17.1%	14.2%	14	2.9%	3
Hawkes Bay	34.4%	28.1%	18	6.3%	15
Southern North Island	34.1%	31.4%	31	2.7%	10
Nelson/Marlborough	25.8%	22.7%	20	3.1%	7
Canterbury	26.7%	18.7%	15	8.0%	7
Otago/Southland	39.3%	34.6%	16	4.7%	6
All of New Zealand	30.4%	25.6%	21	4.8%	10

The results were similar for harvesting in the past ten years with landowners in Otago/Southland and Hawkes Bay significantly more likely to have harvested forests in the past ten years while landowners in East Coast and Northland were significantly less likely to have harvested trees in the past ten years. The chi-squared values were 13.18 for Otago/Southland, 10.81 for Hawkes Bay, 9.36 for Northland and 11.21 for the East Coast. The critical value for

99% confidence is 9.21. Table 33 shows the percent of landowners in each region that have harvested trees in the past ten years.

Table 33. Percent of landowners in each region that harvested land in the past ten years and the average harvest age

Region	Percent of Landowners who Harvested Land in Past Ten Years	Average Rotation Age
Northland	16.2%	28.9
Auckland	21.3%	28.6
Central North Island	25.6%	27.6
East Coast	11.4%	30.5
Hawkes Bay	31.2%	29.7
Southern North Island	25.2%	28.7
Nelson/Marlborough	27.4%	29.1
Canterbury	27.9%	29.1
Otago/Southland	41.1%	29.9
All of New Zealand	26.4%	29.1

There were some regional variations in replanting with landowners in Auckland and Northland the least likely to replant on the same site. Some 10.9% of Auckland landowners and 9.3% of landowners in Northland did not plan to replant trees on the same site compared to a nationwide average of 5.4%. The percent of landowners in each region that plan to replant on the same site is shown in Table 34.

Table 34. Percent of landowners in each region that will replant forests on the same site

Region	Percent of Landowners Who:		
	Will Replant Trees	Will not Replant Trees	Are Unsure if They Will Replant Trees
Northland	60.5%	9.3%	30.2%
Auckland	76.1%	10.9%	13%
Central North Island	60.5%	5.8%	33.7%
East Coast	77.1%	5.7%	17.1%
Hawkes Bay	79.7%	1.6%	18.8%
Southern North Island	73.5%	2.7%	23.8%
Nelson/Marlborough	74.2%	3.2%	22.6%
Canterbury	73.3%	4.7%	22.1%
Otago/Southland	75.7%	4.7%	19.6%
All of New Zealand	71.4%	5.4%	23.2%

There were some regional variations in pruning. Landowners from Northland and East Coast were significantly more likely to prune in the current rotation than landowners in other regions. Landowners in Canterbury and Nelson/Marlborough were significantly less likely to have not pruned in the current rotation with 15.1% of landowners in Canterbury and 16.1% of landowners in Nelson/Marlborough not pruning in the current rotation. The chi-squared values were 10.59 for Northland, 9.47 for the East Coast, 11.63 for Canterbury and 12.78 for Nelson/Marlborough. The critical chi-square value for 99% confidence is 9.21. If the chi-squared value is greater than 9.21 we can reject the null hypothesis. Landowners from Auckland, Hawkes Bay and Southern North Island were more likely to prune in future rotations and landowners in Nelson/Marlborough, Canterbury and Northland were less likely to prune in

future rotations than landowners in other regions. Landowners in Northland expressed the biggest change with 95.4% pruning in the current rotation and only 49.4% planning to prune in future rotations. Table 35 shows the percent of landowners who pruned in the current rotation and plan to prune in future rotations. Landowners from the West Coast were omitted due to the small number of survey returns.

Table 35. Percent of landowners in each region that pruned in the current rotation and plan to prune in future rotations

Region	Percent of Landowners Who:			
	Pruned in the Current Rotation	Did not Prune in the Current Rotation	Will Prune in Future Rotations	Will Not Prune in Future Rotations
Northland	95.4%	4.6%	49.4%	28.2%
Auckland	89.4%	8.5%	72.3%	21.3%
Central North Island	93.0%	5.8%	64.0%	17.4%
East Coast	94.3%	5.7%	60.0%	8.6%
Hawkes Bay	89.1%	9.4%	68.8%	14.1%
Southern North Island	91.8%	6.8%	68.7%	10.9%
Nelson/Marlborough	80.7%	16.1%	53.2%	30.7%
Canterbury	83.7%	15.1%	50.0%	26.7%
Otago/Southland	92.5%	6.5%	63.6%	16.8%
All of New Zealand	90.1%	8.7%	61.2%	19.4%

*Table does not include landowners who were unsure about current or future pruning

6.4.2 Silviculture and Land Management on the North and South Island

Landowners in the North and South Island presented some differences in silviculture and land management. Landowners from the North Island were significantly more likely to have pruned in the current rotation and were significantly more likely to prune in future rotations. The chi-square value for pruning in the current rotation was 33.112 and 10.31 for pruning in future rotations. The critical chi-square value for 99% confidence is 9.21. If the critical value is greater than 9.21 we can reject the null hypothesis. The average pruning height reported by landowners on the North Island was 6.1 metres and the average pruning height reported by landowners on the South Island was 5.8 metres. Table 36 shows the percent of landowners who pruned in the current rotation and plan to prune future rotations.

Table 36. Percent of landowners on the North and South Island that pruned in the current rotation and plan to prune in future rotations

Region	Percent of Landowners Who:			
	Pruned in the Current Rotation	Did not Prune in the Current Rotation	Will Prune in Future Rotations	Will Not Prune in Future Rotations
North Island	92.3%	6.7%	64%	16.6%
South Island	85.9%	12.2%	56.3%	24.3%
All of New Zealand	90.1%	8.7%	61.2%	19.4%

South Island landowners were significantly more likely to have harvested trees in the past ten years. The chi-square value for harvesting trees was 12.23 with a critical chi-square value of 9.21. In the past ten years, 32.3% of landowners on the South Island harvested trees compared with 23% of landowners on the North Island. The average harvest age was 29.6 years for

landowners on the South Island and 28.7 for landowners on the North Island. There was no significant difference in land conversion between landowners on the North and South Island. In the past ten years, 29.3% of North Island landowners and 31.2% of South Island landowners converted land. Landowners who converted land converted an average of 22.8 hectares from agriculture to forestry and 12 hectares from forestry to agriculture on the North Island. South Island landowners who converted land in the past ten years converted an average of 17.1 hectares from agriculture to forestry and 6.8 hectares from forestry to agriculture. Table 37 shows the landowners who harvested trees and converted land in the past ten years.

Table 37. Land conversion and forest harvesting by small forest landowners on the North and South Island

Land Conversion and Harvesting in the Past Ten Years	North Island	South Island	All of New Zealand
Harvested in the Past Ten Years	23%	32.3%	26.4%
Average Age of Harvesting	28.7 years	29.6 years	29.1 years
Convert Land in the Past Ten Years	29.3%	31.2%	30.4%
Convert Land from Agriculture to Forestry	25.0%	26.2%	25.6%
Average Hectares Converted from Agriculture to Forestry	22.8 hectares	17.1 hectares	21 hectares
Convert Land from Forestry to Agriculture	4.3%	5.0%	4.8%
Average Hectares Converted from Forestry to Agriculture	12 hectares	6.8 hectares	10 hectares

There was no significant difference between North and South Island landowners on intentions to replant trees on the same site with 70% of landowners on the North Island and 73.8% of landowners on the South Island planning to replant forests on the same site. Table 38 shows the

percent of landowners who plan to replant trees on the same location in future rotations on the North and South Islands.

Table 38. Percent of landowners on the North and South Islands that will replant forests on the same site

Region	Percent of Landowners Who:		
	Will Replant Trees	Will not Replant Trees	Are Unsure if They Will Replant Trees
North Island	70.0%	5.4%	24.6%
South Island	73.8%	5.3%	20.9%
All of New Zealand	71.4%	5.4%	23.2%

6.4.3 Summary of Significant Differences

The silviculture and land management of small forest landowners shows they have a diversity of ideas on land management. This objective aimed to discover more about the current and future silviculture of forest landowners and specific research questions such as:

- Did small forest landowners experience a forest planting spike in the mid-90s?
- What does a planting spike mean for future harvesting?
- What quality of wood can we expect from small landowners?
- What silviculture can we expect from landowners in future rotations?

Forest landowners did experience a spike in planting in the mid-90s but are still planning to harvest the current forest at 29 years. Over a quarter of landowners converted land from agriculture to forestry in the past ten years and 26.4% of landowners have harvested trees in the past ten years. 90.1% of landowners pruned in the current rotation but only 61.2% are planning to prune in future rotations.

Some of the data were summarised in terms of central tendency while other data were analysed using chi-square and log linear analysis. The statistically significant differences were in land conversion, harvesting and pruning. Landowners with more than 100 hectares of forest were significantly more likely to have converted land from agriculture to forestry in the past ten years. These same landowners were also more significantly more likely to have harvested trees in the past ten years. Landowners that reside on the property were significantly more likely to have converted land in the past ten years and to have harvested trees. Landowners with more than 50 hectares of forest were significantly more likely to replant on the same site. Landowners whose primary agricultural enterprise was sheep and beef were significantly more likely to not prune in the current rotation and less likely to have harvested trees in the past ten years than landowners whose primary agricultural enterprise was dairy cattle or another agricultural enterprise.

Regionally, landowners from Otago/Southland were significantly more likely to have converted land from agriculture to forestry or forestry to agriculture in the past ten years while landowners from East Coast were significantly less likely to have converted land. Landowners from Otago/Southland and Hawkes Bay were significantly more likely to have harvested forests in the past ten years while landowners from the East Coast and Northland were significantly less likely to have harvested forests. Landowners from the North Island were significantly more likely to prune in current and future rotations while landowners from the South Island were significantly more likely to have harvested in the past ten years.

6.5 Objective Three-Reservation Prices

This part of the survey focussed on whether landowners would accept various payments for converting a hectare of land from agriculture to forestry. This objective aims to answer several research questions including:

- What is the reservation price for converting land from agriculture to forestry for small landowners?
- At what payment levels can we expect landowners to start planting more forests?

Reservation prices for converting land represent the minimum payment a landowner must receive before converting their land from agriculture to forestry. A reservation price should exist for all landowner market decisions such as harvesting, selling timber or selling land. To estimate the reservation price for converting land from agriculture to forestry we look at the minimum payment a landowner is willing to accept to convert a hectare of land from agriculture to forestry.

The questions were preceded by a brief neutral statement about forestry, “Forests can provide a number of goods and services. When forests are harvested they provide considerable income for a landowner. Standing timber also provides habitat for wildlife and recreational opportunities. A forest such as radiata pine can be harvested about once every 30 years and establishing a forest costs between $500-$1500/hectare.” The landowners were offered one-time and annual payments for converting a hectare of land.

Questions 17 and 18 offered the payments randomly. Each landowner received a random one-time payment and a random annual payment. The payment combinations provided landowners with an implied discount rate of 5-20% and each region got the same percentage of each possible combination of payments but the actual combination an individual landowner received

was otherwise completely random. The random payments allow us to look at the factors that affect the payments such as living on the farm, landowners pruning, region, farm type and other variables using logistic regression. The random one-time payment asked landowners “Suppose you could establish more forests on your property by converting one hectare of you open/agriculture land to forestry. Suppose you were offered a one-time dollar payment once in return for doing this. The payment would be tax free and in return you would have to keep the land in forestry or return the money. You would not retain the rights to the carbon in the first rotation. Apart from this there would be no restrictions (i.e. you could harvest anytime and could choose the species and silviculture). Please indicate whether you would accept the one-time payment below to convert one hectare of your open/agricultural land to forestry.” The acceptance rate for each payment is shown in Table 39. The random one-time payment at which more than 50% of the landowners accepted was $3000. Only 4% of landowners would not accept the highest random one-time payments of $5000.

Table 39. Landowner acceptance rates for random one-time payments

One-Time Payment (New Zealand Dollars)	Acceptance Rate
$1000	14%
$2000	41%
$2500	44%
$3000	53%
$3500	60%
$4000	65%
$4500	74%
$5000	96%

The random one-time payment was followed by the random annual payment. The question was similar and the payment levels ranged from $100 to $1000. The acceptance rate for the random annual payments is displayed in Table 40. The random annual payment at which more than 50% of the landowners accepted was $300. Only 10% of the landowners offered the highest random annual payment of $500 did not accept.

Table 40. Landowner acceptance rates for random annual payments

Annual Payment (New Zealand Dollars)	Acceptance Rate
$100	13%
$200	33%
$250	38%
$300	54%
$350	56%
$400	68%
$450	77%
$500	90%

Questions 19 and 20 asked landowners to consider the same scenario but instead of random payments they were offered a list of eight payments and asked to circle the lowest one-time payment they would accept. The annual and one-time payments allow us to calculate an implied discount rate for each individual landowner. The discount rate will be discussed in detail in Section 6.6. The most common one-time payment landowners accepted was $4000 and 6.1% of landowners would not accept any of the one-time payments. The acceptance rate for the one-time payments is shown in Table 41.

Table 41. Lowest one-time payment landowners would accept in exchange for converting a hectare of land to forestry

One-Time Payment	Percent of Landowners Who Accept as Lowest Payment	Cumulative
$1000	3.0%	3.0%
$2000	8.3%	11.3%
$2500	8.7%	20.0%
$3000	19.8%	39.8%
$3500	9.4%	49.2%
$4000	21.0%	70.2%
$4500	4.5%	74.7%
$5000	19.3%	93.9%
Would Not Accept Any of the Payments Provided	6.1%	6.1%

The most common payment landowners accepted was the $400 annual payment and 6.0% of landowners would not accept any of the annual payments. The acceptance rate for the annual payments is shown in Table 42.

Table 42. Lowest annual payment landowners would accept in exchange for converting a hectare of land to forestry

Annual Payment	Percent of Landowners Who Accept as Lowest Payment	Cumulative
$100	2.3%	2.3%
$200	6.9%	9.2%
$250	9.9%	19.1%
$300	19.2%	38.3%
$350	9.5%	47.8%
$400	21.7%	69.5%
$450	4.8%	74.3%
$500	19.6%	94.0%
Would Not Accept Any of the Payments Provided	6.0%	6.0%

Landowners who would not accept any payment were asked to provide a reason. The most common reasons were that they had converted all suitable land or that they did not like forestry with 32.5% of landowners responding that they had converted all suitable land. One landowner stated that “All available land is trees or dairy cows” and another said that “We only have a small dairy unit-it is our primary focus. All land not already in forest grows good grass and we see more long term profit in milk than wood.” Another common reason for not converting forest land is that landowners don’t like forestry. One landowner stated “pine trees decimate communities, farming creates a vibrant community. On the East Coast, north of Gisborne, vast areas (subsidised) have been converted to forestry. Now the unemployment rate is VERY HIGH-a once vibrant community has been decimated. ” Another landowner stated “forestry is a waste of time and money. My land is too valuable as is.” One South Island landowner stated

“We farm sheep, not trees. Trees under this scenario are a permanent land use change and not a good investment for the future”. Other reasons for not converting land included the age of the landowner. Many landowners were older and planned to sell the land or leave it to heirs and did not want to decide for their children on the best land use. One landowner stated “I am not interested-we are retired. It is for my kids to decide”. Some landowners were more direct stating “Because I wouldn't get any benefit from it (I will be pushing the daisies up)”. Other reasons included local restrictions on land, with a landowner stating “I am restricted by the local council. I am restricted by domestic buildings in the area.” Other landowners were planning to sell the property. Some landowners had a mix of other reasons including they didn’t want anyone telling them what to do with their land or they wanted to keep the carbon credits to themselves. Figure 11 shows the reasons landowners would not accept any annual or one-time payments.

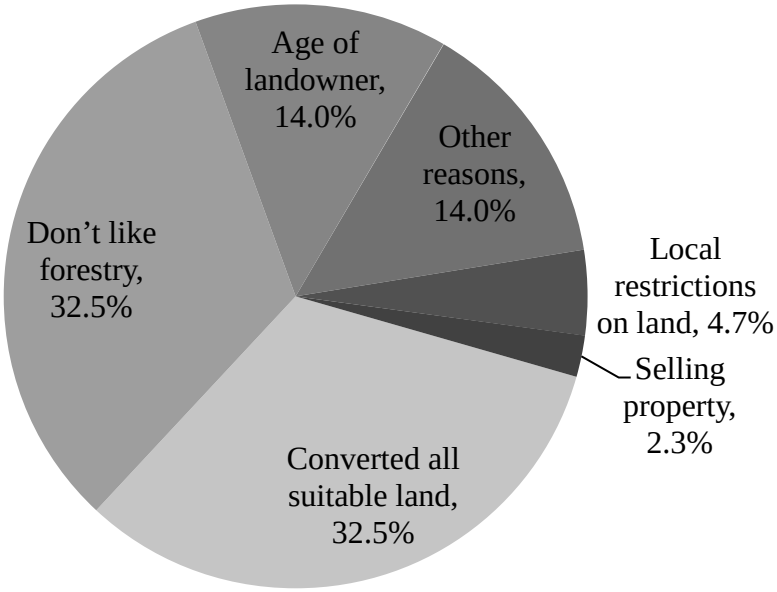

Figure 11. Reasons landowners would not accept any of the annual or one-time payments offered

The lowest payment a landowner accepted was compared against other survey results. Sheep and beef landowners accepted a lower payment for converting a hectare of land to forestry than dairy landowners. Sheep and beef landowners accepted average one-time payments of $3526 and an annual payment of $355. Dairy landowners accepted average one-time payments of $3814 and an average annual payment of $391. The average payments landowners would accept is shown in Table 43.

Table 43. The lowest average payment a landowner would accept to convert land by agricultural enterprise

Landowner	Average One-Time Payment	Average Annual Payment
Sheep and Beef	$3526	$355
Dairy	$3814	$391
Other	$3313	$337
All of New Zealand	$3554	$360

There was little regional variation among payments. North Island landowners accepted average one-time payments of $3580 compared with $3522 for South Island landowners. The North Island landowners accepted average annual payments of $363 compared with $355 for South Island landowners. The average annual one-time and annual payments accepted by region is shown in Table 44. The West Coast was excluded in the regional analysis due to the low number of survey returns but was included in the overall North/South comparison.

Table 44. Average one-time and annual payments accepted by small forest landowners in each region of New Zealand

Region	Average One-Time Payment	Average Annual Payment
Northland	$3939	$399
Auckland	$3523	$365
Central North Island	$3481	$363
East Coast	$3394	$342
Hawkes Bay	$3424	$343
Southern North Island	$3543	$354
Nelson/Marlborough	$3545	$370
Canterbury	$3350	$348
Otago/Southland	$3630	$351
North Island	$3580	$363
South Island	$3522	$355
All of New Zealand	$3554	$360

Landowners who had converted land in the past ten years accepted a higher payment than landowners who had not converted land. Landowners who had converted land from agriculture to forestry in the past ten years accepted an average one-time payment of $3586 and an annual payment of $3365. Landowners who had converted land from forestry to agriculture in the past ten years accepted an average one-time payment of $3545 and an average annual payment of $364. Landowners than had not converted land accepted an average one-time payment of $3531 and an annual payment of $357. The same was true of landowners who had harvested land in the past ten years; they accepted higher payments than landowners who had not harvested. Landowners who had not harvested in the past ten years accepted average one-time payments of $3503 compared to $3715 for landowners who had harvested. Landowners who had not

harvested in the past ten years accepted an average annual payment of $358 compared to $366 for landowners who had harvested. Landowners who had harvested trees or converted land from forestry to agriculture or agriculture to forestry in the past ten years and the lowest average one-time and annual payments landowners would accept is shown in Table 45.

Table 45. Lowest average annual and one-time payments a landowner would accept and land management in the past ten years.

Land Management	Average One-Time Payment	Average Annual Payment
Converted Land from Agriculture to Forestry	$3586	$365
Converted Land from Forestry to Agriculture	$3545	$364
Have Not Converted Land in the Past 10 Years	$3531	$357
Harvested Trees in the Past 10 Years	$3715	$366
Have Not Harvested Trees in the Past 10 Years	$3503	$358
All of New Zealand	$3554	$360

Landowners who pruned or did not prune accepted similar payments. Landowners who didn't prune accepted an average one-time payment of $3588 compared with landowners who did prune accepted an average one-time payment of $3557. Landowners who didn't prune accepted an average annual payment of $365 while landowners who did prune accepted an average annual payment of $360. Landowners who planned to prune in future rotations accepted significantly lower payments than landowners who did not plan to prune in future rotations. The F-value was 7.97 for the one-time payment and 8.036 for the annual payment. The F-critical value at 99% confidence is 4.64. If the F-value is greater than 4.64 we can reject the null hypothesis. Landowners who planned to prune in future rotations accepted an average one-time payment of $3451 while landowners who did not plan to prune in the future accepted an

average one-time payment of $3855. Landowners who were not sure about future pruning accepted an average one-time payment of $3637. Landowners who were planning to prune in future rotations accepted an average annual payment of $349 and landowners who were not planning to prune in future rotations accepted an average annual payment of $388. Landowners who were not sure about future pruning accepted an average annual payment of $369. The current and future pruning and the lowest average one-time and annual payment a landowner would accept is shown in Table 46.

Table 46. Lowest average annual and one-time payments a landowner would accept and pruning in current and future rotations

Pruning	Average One-Time Payment	Average Annual Payment
Prune in the Current Rotation	$3557	$360
Did Not Prune in the Current Rotation	$3588	$365
Will Prune in Future Rotations	$3451	$349
Will Not Prune in Future Rotations	$3855	$388
Unsure about Pruning in Future Rotations	$3638	$369
All of New Zealand	$3554	$360

The final forest management question was regarding landowners who planned to replant. Landowners who planned to replant accepted a significantly lower payment than landowners who did not plan to replant. The F-value was 8.74 for the one-time payment and 9.21 for the annual payment. The F-critical value was 4.64 so we can reject the null hypothesis. Landowners who planned to replant accepted an average one-time payment of $3469 and an average annual payment of $351. Landowners who did not plan to replant accepted an average one-time payment of $4114 and an average annual payment of $416. Landowners who were not sure if

they would replant accepted an average one-time payment of $3724 and an average annual payment of $376. Table 47 shows the lowest average annual and one-time payment a landowner would accept and the intention to replant on the same site in the future.

Table 47. Lowest average annual and one-time payments a landowner would accept and replanting forests on the same site in future rotations

Replanting	Average One-Time Payment	Average Annual Payment
Will Replant	$3469	$351
Will Not Replant	$4114	$416
Unsure about Replanting	$3724	$376
All of New Zealand	$3554	$360

The land ownership and management questions revealed that landowners living on the property accepted significantly higher payments than landowners living off the property. The F-value is 40.22 for the one-time payment and 33.20 for annual payment. The F-critical value for 99% confidence is 6.67. If the F-value is greater than the F-critical value we can reject thenull hypothesis. Landowners who lived on the farm accepted an average one-time payment of $3718 while landowners who lived off the farm accepted average one-time payment of $3165. Landowners who lived on the farm accepted average annual payments of $374 while landowners who lived off the farm accepted annual average payment of $325.

Landowners who farm the land themselves accept a similar payment to landowners who have a farm manager or a family member manage the land. Landowners who farm the land themselves accept an average one-time payment of $3556 while landowners who have a farm manager or family member manage the land accept an average one-time payment of $3591. Landowners

who farm the land themselves accept an average annual payment of $358 while landowners who have a farm manager or family member manage the land accept an average annual payment of $385. Table 48 shows the lowest average annual and one-time payment a landowner would accept and if they lived on the property and managed the farm themselves.

Table 48. Lowest average payments a landowner would accept and the farm management and residence of the landowner

Landowner Status	Average One-Time Payment	Average Annual Payment
Live on the Property	$3718	$374
Live off the Property	$3165	$325
Manage the Land Themselves	$3556	$358
Have a Farm Manager or Family Member Manage	$3591	$385
All of New Zealand	$3554	$360

Landowners who planned to leave the land to heirs accepted a significantly higher payment than landowners who planned to sell the land. The F-value is 5.46 for the one-time payment and 4.70 for the annual payment. The F-critical value is 3.81 for 99% confidence so we can reject the null hypothesis. Landowners who planned to leave the land to heirs accepted an average one-time payment of $3690 and an annual payment of $371. Landowners who planned to sell their land accepted an average one-time payment of $3346 and an average annual payment of $342. Landowners who were not sure what they would do with their land in the future accepted an average one-time payment of $3581 and an average annual payment of $352. The lowest average annual and one-time payment a landowner would accept and the bequest motive is described in Table 49.

Table 49. Bequest motive and the lowest average payments a landowner would accept

Future Land Use	Average One-Time Payment	Average Annual Payment
Plan To Sell	$3346	$342
Plan to Leave Land to Heirs	$3690	$371
Unsure	$3581	$352
All of New Zealand	$3554	$360

The demographic questions revealed that the landowners with higher incomes accepted significantly lower payments than landowners with less income. The F-value is 52.65 for the one-time payment and 49.95 for the annual payment. The F-critical value is 4.63 for 99% confidence so we can reject the null hypothesis. Landowners with incomes greater than $100,000 accepted an average one-time payment of $3179 while landowners with incomes from $50,000-$99,999 accepted an average one-time payment of $3508 and landowners with incomes of less than $50,000 accepted an average one-time payment of $4153. Landowners with the highest incomes of more than $100,000 accepted an average annual payment of $322 while landowners with a median income accepted an average annual payment of $358 and landowners with incomes of less than $50,000 accepted an average annual payment of $415.

Landowners who had completed some or all of the qualifications for a tertiary degree accepted an average one-time payment of $3179 and an average annual payment of $322 which was significantly less than landowners with less than a secondary education. Landowners with a secondary qualification accepted an average one-time payment of $3508 and an average annual payment of $358. Landowners with less than a secondary education accepted an average one-time payment of $4153 and an average annual payment of $415. The F-value was 29.76 for the one-time payment and 28.64 for the annual payment. The F-critical value was 3.35 for 99%

confidence. The gender also appeared to be important in payment selection. Female respondents accepted significantly higher average annual and one-time payments to convert a hectare of land to forestry. The F-value was 4.88 for the one-time payment and 3.89 for the annual payment. The F-critical value is 3.86 so we can reject the null hypothesis. Females accepted an average one-time payment of $3889 and an average annual payment of $389 in order to convert a hectare of land. Males accepted an average one-time payment of $3529 and an average annual payment of $358. The landowner demographics and the lowest average annual and one-time payment a landowner would accept are shown in Table 50.

Table 50. Landowner demographics and the average lowest payments a landowner would accept

Demographics	Average One-Time Payment	Average Annual Payment
Income Less than $50,000	$4153	$415
Income $50,000 to $99,999	$3508	$358
Income Over $100,000	$3179	$322
Less than a Secondary Education	$4153	$415
Secondary Education	$3508	$358
Completed Some or all of a Tertiary Education	$3179	$322
Male	$3529	$358
Female	$3889	$389
All of New Zealand	$3554	$360

The questions on ownership objectives revealed that landowners owning land for environmental reasons, income from timber, as a land investment or interest in carbon accepted lower payments than landowners who did not rank those reasons as important. Landowners were

asked to provide a number between one and five on how important they perceived various reasons for owning for forest land with one indicating it was not an important reason for owning forest land and five indicating it was an important reason for forest land ownership. The importance of owning forest land for various reasons and the average one-time payments a landowner would accept are shown in Table 51.

Table 51. Reasons for owning forest land and average one-time payments a landowner would accept

Reason for Owning Forest Land	Average One-Time Payment Accepted by Landowners who Ranked it as:		
	Not Important (Scored 1 or 2)	Medium Importance (Scored 3)	Very Important (Scored 4 or 5)
Environmental reasons (examples: protect habitat, water quality, protect against soil erosion)	$3875	$3662	$3424
Scenic beauty	$3691	$3472	$3605
Recreation (examples: hunting, fishing, walking, observing wildlife)	$3534	$3559	$3712
To keep for future generations	$3490	$3525	$3653
Income from timber	$4044	$3500	$3574
Land investment/ real estate/ capital investment	$3847	$3447	$3429
Income from carbon	$3751	$3387	$3356

Landowners who accepted the lowest one-time payments listed the most important reasons for owning land as income from timber, environmental reasons and land investment. Landowners who gave a medium importance to scenic beauty, income from timber and income from carbon also accepted lower payments than landowners who did not own land for carbon, income from timber or scenic beauty. Landowners who had a medium or high interest in the income from carbon accepted significantly less than landowners that were not interested in the income from carbon. The F-value was 7.94 for the one-time payment and 6.78 for the annual payment. The F-critical value is 3.35 so we can reject the null hypothesis. The annual payments revealed similar results with the exception of scenic beauty which was very important to landowners who accepted the highest payments. The importance of owning forest land for various reasons and the average annual payments a landowner would accept are shown in Table 52.

Table 52. Reasons for owning forest land and average annual payment a landowner would accept

Reason for Owning Forest Land	Average Annual Payment Accepted by Landowners who Ranked it as:		
	Not Important	Medium Importance	Very Important
Environmental reasons (examples: protect habitat, water quality, protect against soil erosion)	$390	$376	$349
Scenic beauty	$368	$356	$375
Recreation (examples: hunting, fishing, walking, observing wildlife)	$359	$358	$387
To keep for future generations	$353	$348	$376
Income from timber	$407	$357	$362
Land investment/real estate/ capital investment	$388	$346	$354
Income from carbon	$387	$343	$357

This objective intended to ascertain the payment levels at which landowners would convert more land to forestry. Specific research questions included:

- What is the reservation price for converting land from agriculture to forestry for small landowners?
- At what payment levels can we expect landowners to start planting more forests?

The average annual payment a landowner would accept to convert a hectare of land was $360 and the average one-time payment was $3554.

6.6 Objective Four-Implied Discount Rate

This objective aims to discover the implied discount rate for small forest landowners in New Zealand. The lowest price a landowner would accept to convert a hectare of land to forestry can be used to calculate the implied discount rate. The implied discount rate is calculated using the lowest one-time and annual payments the landowner selected. Landowners also provided the age at which they would harvest which is used as the rotation age. The payments offered in the survey were tax free. An implied discount rate was calculated for each landowner. Excluding landowners who would not accept any payment the average after-tax discount rate was 9.7%. The discount rate was compared to other survey effects using ANOVA tests. The only effects that were significant at 95% were harvesting in the past 10 years and if they manage the farm themselves. Landowners who mange the farm themselves had a lower discount rate (9.6%) than landowners who do not manage the farm themselves (10.8%). Landowners who had harvested in the past 10 years had a lower discount rate (9.2%) than landowners who had not harvested in the past 10 years (9.9%). The discount rates for various land management strategies are shown in Table 53.

Table 53. Land management and implied discount rate for small forest landowners

Land Management	Implied Discount Rate		
	Yes	No	Unsure
Prune in current rotation	9.7%	9.9%	9.8%
Prune in future rotation	9.8%	9.7%	9.8%
Harvest trees in the past ten years	9.2%	9.9%	N/A
Convert land in the past ten years	10%	9.6%	N/A
Replant on the same site	9.8%	9.9%	9.5%

The regional differences were not statistically different in the ANOVA but the landowners from Central North Island (10.6%) and Canterbury (10.1%) had the highest discount rates. Landowners from Otago (9.1%) and West Coast (9.3%) had the lowest discount rates. The discount rate for each region is shown in Table 54.

Table 54. Implied discount rate by region for small forest landowners

Region	Discount Rate
Northland	9.6%
Auckland	10.1%
Central North Island	10.6%
East Coast	9.5%
Hawkes Bay	9.5%
Southern North Island	9.5%
Nelson/Marlborough	10.0%
Canterbury	10.1%
Otago/Southland	9.1%
West Coast	9.3%
North Island	9.8%
South Island	9.6%
All of New Zealand	9.7%

6.7 Objective Five-Econometric Models for Afforestation

This objective aims to determine the landowner demographics and preferences that affect afforestation. The econometric estimations were completed in four steps. The first step was to select variables for the logistic regression model based on effects that were important in

previous studies. This step is referred to as the A Priori model. The second step was to run ANOVAs based on the lowest payment a landowner selected and the other survey effects. Any effects that were found to be significant in the ANOVA were used in the logistic regression model. This is referred to as the ANOVA model. The third step was to include all the survey effects as candidates in the logistic regression model. This is referred to as the All Effects model. All three models started by adding all the effects in as a block and then used forward selection. The fourth step was to build a final model including significant effects from the three models.

This study uses logistic regression to build a model that examines the factors that influence people to accept a certain payment using the random payments offered to landowners. The dependent variable is defined as the probability that a landowner will accept the payment amount offered as compensation for converting one hectare of land. The dependent variable is then regressed on the payment amounts offered and on a vector of independent variables from the survey.

6.7.1 A Priori Model

One objective of the study was the characteristics that determine a landowner's reservation price for converting land from agriculture to forestry. Knowing the characteristics will allow predictions of landowners who may be interested in the AGS or similar programs. The survey was designed to include effects that were found to be relevant to land conversion based on previous studies.

Based on previous studies eleven effects were included in the logistic regression model. The a priori effects included in the logistic regression model were:

- Bequest motive (Conway, et al., 2003; Hultkrantz, 1992; Royer, 1987)

- Residence on the property (Amacher et al., 2003; Conway, et al., 2003)
- Managing the land themselves or employing a farm manager(Greene et al., 1986; Royer, 1987)
- Harvest in the previous ten years (Binkley, 1981; Birch, 1996; Newman, et al., 1993)
- Converting land in the previous ten years (Conway, et al., 2003; Dennis, 1989; Greene, et al., 1986; Royer, 1987)
- Pruning in the current rotation (Greene, et al., 1986; Kline, et al., 2000)
- Type of land ownership (individual, trust, family partnership, etc) (Hyberg, et al., 1989; Kline, et al., 2000)
- Acquisition of land (purchase on the market, purchase from family trust, other) (Conway, et al., 2003; Hardie et al., 1996)
- Reasons for owning land: environmental (Butler, 2007; Butler et al., 2004; Kuuluvainen, et al., 1996; Novais, et al., 2010)
- Reasons for owning land: recreation (Boon, et al., 2004; Boyd, 1984; Butler, 2007; Butler, et al., 2004; Egan, 1997; Hogl, et al., 2005; Karppinen, 1998; Kvarda, 2004; Newman, et al., 1993; Novais, et al., 2010)
- Reasons for owning land: income from carbon (Goodwin, et al., 2002; Meng et al., 2003; Royer, 1987; Tavernier et al., 1996)

The significance of the effects for the one-time payment is shown in Table 55. The effects that were significant at the .05 level are payment, residence, recreation and income from carbon. The first test of significance looked at the effects to see if they significantly improved the overall prediction of model. This is the significance of the score test and is used to test whether adding an effect will result in a significant improvement in the model fit. The score test looks at how the model is improved if the effect added is constrained to zero. The Wald statistic also provides the significance of each effect in the model. The Wald statistic has a chi squared

distribution but is different from the score test because the Wald statistic can be used to assess the change in model fit when more than one level of a categorical variable is added. The two tests are similar; they both look at how adding an effect improves the overall model. The score test looks at the slope of the log likelihood and how the model is improved when each effect is included. The Wald compares the various levels of the effect to the value of the model without the effect. The Wald test examines a model with more parameters and assesses if removing the variable from the model significantly harms the fit of the model. In contrast, the score test examines whether adding the variable would significantly improve the fit of the model. As the sample size becomes infinitely large, the values of the Wald and Score test will become increasing close to the same. In finite samples such as this study, the tests will tend to generate somewhat different test statistics but will generally come to the same conclusion on the significance of the effect. The direction of change for the significant effects is positive or negative. For example, if the direction of change is positive it means that the probability of accepting the payment increases as the effect increases.

Table 55. Significance of a priori effects for one-time payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
One-Time Payment	Positive	.000	.000
Bequest		.401	.573
Residence	Negative	.000	.000
Manage Land		.150	.150
Harvest in Past Ten Years		.152	.153
Convert Land in Past Ten Years		.107	.297
Prune in Current Rotation		.457	.527
Type of Land Ownership		.550	.995
Acquisition of Land		.271	.122
Reasons for Owning Land: Environmental Reasons		.171	.184
Reasons for Owning Land: Recreation	Negative	.003	.004
Reasons for Owning Land: Income from Carbon	Positive	.000	.004

The method for entering effects can also be carried out as forward selection, testing for the significance of inclusion of the effect at each stage. The tests are based on the change in the likelihood ratio resulting from including the effect. Forward selection entered the effects in four steps:

Step 1: One-time payment

Step 2: Residence

Step 3: Reason for owning land: income from carbon

Step 4: Reason for owning land: recreation

It omitted the additional effects. At each step the number of cases the model can classify correctly will increase as effects are added to the model. Table 56 shows the number of cases correctly classify as each effect is added. Without adding any effects the model could correctly predict 57.5% of the one-time payments. The model predicts that every response will be a one (every payment will be accepted) and is correct 57.5% of the time.

Table 56. Correct classification of priori effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: One-Time Payment	69.1%
Step 2: Residence	69.5%
Step 3: Reasons for Owning Land: Income from Carbon	69.6%
Step 4: Reason for Owning Land: Recreation	71.4%

The significance of all the effects for the annual payment is shown in Table 57. The effects that were significant at the .05 level are payment, residence, converting land in the past ten years,

and income from carbon. The direction of change indicates that as the effect increases, the probability of accepting the payment increases (positive) or decreases (negative).

Table 57. Significance of a priori effects for annual payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
Annual Payment	Positive	.000	.000
Bequest		.219	.228
Residence	Negative	.000	.000
Manage Land		.211	.211
Harvest in Past Ten Years		.196	.197
Convert Land in Past Ten Years	Positive	.002	.002
Prune in Current Rotation		.387	.604
Type of Land Ownership		.824	.994
Acquisition of Land		.654	.684
Reasons for Owning Land: Environmental Reasons		.559	.148
Reasons for Owning Land: Recreation		.093	.095
Reasons for Owning Land: Income from Carbon	Positive	.000	.002

The table shows the significance for each effect entered as a block. The forward stepwise selection enters the effects in four steps:

Step 1: Annual payment

Step 2: Residence

Step 3: Reasons for owning land: income from carbon

Step 4: Convert land in past ten years

The classification table examines the proportion of cases it can classify correctly. At each step the number of cases it can classify correctly will increase as effects are added to the model. Table 58 shows the number of cases it could correctly classify as each effect is added. Without adding any effects the model could correctly predict 56.7% of the annual payments.

Table 58. Correct classification of a priori effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: Annual Payment	68.0%
Step 2: Reasons for Owning Land: Income from Carbon	71.4%
Step 3: Residence	71.9%
Step 4: Convert Land in Past Ten Years	72.6%

The effects that were significant for both the annual and one-time payments are residence on the property and income from carbon. The next step was to enter only those effects into the logistic regression model. The dependent variable is whether the landowner accepted the random payment and the effects are the payment level, residence on property and income from carbon. The Hosmer and Lemeshow test is commonly used for goodness-of-fit and allows for

any number of explanatory effects. The test is similar to the chi squared goodness-of-fit test. A significance of greater than .05 means the model fails to reject the null hypothesis that there is no difference between the observed and model predicted values. A well-fitting model shows non-significance on the Hosmer and Lemeshow goodness-of-fit test. A p-value of less than .05 indicates poor fit and a p-value closer to one indicates a good logistic regression model fit. The Hosmer and Lemeshow goodness-of-fit test statistic has a significance of .320 for the one-time payments and .255 for the annual payments. In addition to the goodness-of-fit, it is possible to look at the proportion of cases the model could classify correctly. Without adding any effects the model could only classify 57.5% of the one-time payments and 56.7% of the annual payments. With the effects the model could correctly classify 69.6% of the one-time payments and 71.9% of the annual payments.

6.7.2 ANOVA Model

The next step is to determine if any additional survey effects are significant. Landowners were given a list of annual and one-time payments and asked to choose the lowest payment they would accept. The lowest annual and one-time payment they would accept in return for converting a hectare of forest (the dependent variable) is a numeric value and if the independent variable is numerical and there is a linear relationship it was analysed using linear regression. If the independent variable is categorical it was analysed using ANOVA. Numeric survey answers were analysed using linear regression. The dependent variable is the lowest payment they would accept and the independent variable is:

- Demographic and landowner information
    - Income
    - Age
- Land information
    - Farm size

    - Area in plantation forest
    - Area in native forest
- Silviculture
    - Pruning height
    - Harvest age

ANOVA was used for categorical data where the dependent variable is the lowest payment they would accept and the independent variable is:

- Demographic and landowner information
    - Gender
    - Bequest motive
    - Live on or off farm
    - Farm land themselves or have a farm manager
    - Interest in various reasons for owning forest land (income from timber, recreation, income from carbon, environmental reasons, land investment, to keep for future generations and scenic beauty)
- Land information
    - Farm type
    - Area in plantation forest
    - Area in native forest
- Silviculture
    - Pruning
    - Harvest in past 10 years
    - Convert land in past 10 years
    - Replant on same site
- Region

After completing the ANOVA eight variables were found to be significant when tested with the minimum payment a landowner would accept. All the variables are categorical. The significant variables are summarised in Table 59.

Table 59. Summary of significant effects in the minimum annual and one-time payment a landowner would accept

Effect	Difference in Payment
Gender	Males accepted lower payments than females
Bequest Motive	Landowners who plan to sell their land accepted lower payments than landowners that plan to leave the property to heirs
Residence	Landowners who lived off the property accepted lower payments than landowners that lived on the property
Interest in Carbon	Landowners with a medium or high interest in owning land for the income from carbon accepted lower payments than landowners who were not interested in income from carbon
Replant	Landowners who planned to replant forests on the same site accepted lower payments than landowners who did not plan to replant
Prune in Future Rotations	Landowners who planned to prune in future rotations accepted lower payments than landowners who did not plan to prune
Education	Landowners who had a tertiary education accepted a lower payment than landowners with less than a secondary education.
Income	Landowners with an income over $100,000 accepted a lower payment than landowners with an income less than $50,000

There was no significant regional difference between payments and region (or North and South Island). There was also no significant difference between farm size, forest size, land conversion in the past ten years or farm type. A logistic regression model was built using the results of the significant effects from the ANOVA. The logistic regression model uses the random payments. The dependent variable is whether the landowner accepts the random payment they were offered.

The significance of the effects for the one-time payments are shown in the table. The effects that were significant at the .05 level are payment, gender, residence, interest in carbon and income. The first test of significance looked at effects as they were added to the model to see if they improved the model significantly. The Wald statistic provides the significance of each effect in the model. The direction of change indicates that as the effect increases, the probability of accepting the payment increases (positive) or decreases (negative).

Table 60. Significance of effects for one-time payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
One-Time Payment	Positive	.000	.000
Gender	Negative	.002	.002
Bequest Motive		.364	.375
Residence	Negative	.003	.003
Interest in Carbon	Positive	.001	.003
Replant		.830	.743
Future Pruning		.993	.995
Education		.064	.074
Income	Positive	.000	.000

The method for entering effects can be carried out in as a forward selection, testing for the significance of inclusion of the effect at each stage. The tests are based on the change in the likelihood resulting from including the effect. Forward selection entered the effects in five steps:

Step 1: One-time payment

Step 2: Income

Step 3: Residence

Step 4: Gender

Step 5: Reason for owning land: income from carbon

The classification table examines the proportion of cases it can classify correctly. At each step the number of cases it can classify correctly will increase as effects are added to the model.

Table 61 shows the number of cases it could correctly classify as each effect is added. Without adding any effects the model could correctly predict 57.5% of the one-time payments.

Table 61. Correct classification of effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: One-Time Payment	69.1%
Step 2: Income	76.6%
Step 3: Residence	76.9%
Step 4: Gender	77.3%
Step 5: Reasons for Owning Land: Income from Carbon	78.5%

The significance of the effects for the annual payments are shown in Table 62. The effects that were significant at the .05 level are payment, gender, residence, interest in carbon and income.

Table 62. Significance of effects for annual payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
Annual Payment	Positive	.000	.000
Gender	Negative	.003	.014
Bequest Motive		.058	.122
Residence	Negative	.005	.005
Interest in Carbon	Positive	.000	.000
Replant		.417	.442
Future Pruning		.701	.779
Education		.092	.128
Income	Positive	.000	.000

The table shows the significance for each effect entered as a block. The forward stepwise selection enters the effects in five steps:

Step 1: Annual payment

Step 2: Income

Step 3: Carbon

Step 4: Residence

Step 5: Gender

The classification table examines the proportion of cases it can classify correctly. At each step the number of cases it can classify correctly will increase as effects are added to the model. Table 63 shows the number of cases it could correctly classify as each effect is added. Without adding any effects the model could correctly predict 56.7% of the annual payments.

Table 63. Correct classification of effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: Annual payment	68.0%
Step 2: Income	76.8%
Step 3: Reasons for Owning Land: Income from Carbon	77.4%
Step 4: Residence	77.5%
Step 5: Gender	77.7%

The effects that were significant for both the annual and one-time payments are gender, residence, interest in carbon and income. The next step was to enter only those effects into the logistic regression model. The dependent variable is whether the landowner accepted the random payment and the effects are the payment level, gender, residence, interest in carbon and income. The effects were all significant in the model and the model was stronger than the a priori model. The Hosmer and Lemeshow goodness-of-fit test statistic has a significance of .230 for the one-time payments and .156 for the annual payments meaning the model is a good fit. In addition the model with the effects could correctly classify 78.5% of the one-time payments and 77.7% of the annual payments.

Gender is found to be a significant effect in the ANOVA tests and in the logistic regression model but in reality it may not be a great indicator of the actual payment price a landowner would accept. If we eliminate gender from the model the H-L goodness-of-fit test has a significance of .482 for the one-time payments and .492 for the annual payments. Without the

gender effect the overall model correctly classifies 76.9% of the one-time payments and 77.3% of the annual payments. The model is still significant without including the gender effect.

6.7.3 All Effects in the Survey

This analysis looked at all the effects including the ones that were not significant in the first round of ANOVA tests. It used logistic regression and the random payment offered to landowners. The dependent variable was whether they accepted or rejected the random payment and the factors were:

- Payment
- Gender
- Bequest
- Residence
- Reason for owning land: Carbon
- Replant
- Future pruning
- Education
- Income
- Manage land themselves or employ a farm manager
- Farm type (sheep and beef, dairy and other)
- Harvest in the past 10 years
- Pruning in current rotation
- Land conversion in the past 10 years
- Region
- Type of land ownership
- Reason for owning land: environmental reasons
- Reason for owning land: scenic beauty

- Reason for owning land: recreation
- Reason for owning land: to keep for future generations
- Reason for owning land: income from timber
- Reason for owning land: land investment
- Recreation: hunting
- Recreation: fishing
- Recreation: walking
- Recreation: horseback
- Recreation: camping
- Recreation: cycling
- Recreation: photography
- Recreation: observing wildlife
- Recreation: bird watching
- Recreation: flower, plant and berry picking

The first step was to create a correlation matrix to determine multicollinearity. Before building a logistic regression model all the variables were tested for correlation. There was no significant correlation between any of the effects (Appendix 3).

The next step was to include all the effects in the logistic regression model for the annual and one-time payments. The significance of all the effects for the one-time payment is shown in the table. The effects that were significant at the .05 level include the direction of change. The first test of significance looked at effects as they were added to the model to see if they improved the model significantly. The Wald statistic provides the significance of each effect in the model. The direction of change indicates that as the effect increases, the probability of accepting the payment increases (positive) or decreases (negative).

Table 64. Significance of effects for one-time payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
One-Time Payment	Positive	.000	.000
Gender	Negative	.006	.007
Bequest		.456	.317
Residence	Negative	.001	.001
Reason for Owning Land: Income from Carbon	Positive	.004	.014
Replant		.614	.503
Prune Future		.270	.309
Education		.448	.115
Income	Positive	.000	.000
Manage Land		.496	.106
Farm type	Negative	.013	.004
Harvest in the Past 10 Years		.401	.401
Pruning in Current Rotation		.573	.263
Land Conversion in the Past 10 Years		.663	.051
Region		.428	.473
Type of Land Ownership		.553	.678
Reasons for Owning Land: Environmental Reasons		.866	.866

Reasons for Owning Land: Scenic Beauty		.607	.607
Reasons for Owning Land: Recreation	Negative	.012	.011
Reasons for Owning Land: Keep for Future Generations		.229	.230
Reasons for Owning Land: Income from Timber		.381	.381
Reasons for Owning Land: Land Investment		.180	.180
Recreation: Hunting		.421	.322
Recreation: Fishing		.735	.610
Recreation: Walking		.576	.325
Recreation: Horseback Riding		.726	.504
Recreation: Camping		.205	.076
Recreation: Cycling		.668	.287
Recreation: Photography		.299	.409
Recreation: Observing Wildlife		.733	.160
Recreation: Bird Watching		.372	.359
Recreation: Flower, Plant and Berry Picking		.970	.481

The table shows the results for each effect entered as a block. This procedure for effect selection enters all effects as a block in a single step. The method for entering effects can also be carried out in a forward selection, testing for the significance of inclusion of the effect at

each stage. The tests are based on the change in the likelihood resulting from including the effect.

Forward selection entered the effects in seven steps:

Step 1: One-time payment

Step 2: Income

Step 3: Residence

Step 4: Farm type

Step 5: Gender

Step 6: Interest in carbon

Step 7: Reasons for owning land: recreation

The classification table examines the proportion of cases it can classify correctly. At each step the number of cases it can classify correctly will increase as effects are added to the model. Table 65 shows the number of cases it could correctly classify as each effect is added. Without adding any effects the model could correctly predict 57.5% of the one-time payments.

Table 65. Correct classification of effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: One-Time Payment	69.1%
Step 2: Income	76.6%
Step 3: Residence	76.9%
Step 4: Farm Type	77.0%
Step 5: Gender	77.6%
Step 6: Reasons for Owning Land: Income from Carbon	78.0%
Step 7: Reasons for Owning Land: Recreation	79.4%

The significance of all the effects for the annual payments is shown in Table 66. The effects that were significant at the .05 level are highlighted.

Table 66. Significance of effects for annual payments using logistic regression

Effect	Direction of Change for Significant Effects	Significance	Wald Statistic (Significance)
One-Time Payment	Positive	.000	.000
Gender	Negative	.013	.013
Bequest		.612	.984
Residence	Negative	.001	.001
Reason for Owning Land: Income from Carbon	Positive	.000	.003
Replant		.212	.500
Prune Future		.777	.696
Education		.188	.335
Income	Positive	.000	.000
Manage Land		.101	.102
Farm type	Negative	.000	.000
Harvest in the Past 10 Years		.559	.559
Pruning in Current Rotation		.825	.545
Land Conversion in the Past 10 Years	Positive	.021	.022
Region		.543	.394
Type of Land Ownership		.558	.506
Reasons for Owning Land: Environmental Reasons		.571	.865

Reasons for Owning Land: Scenic Beauty		.204	.396
Reasons for Owning Land: Recreation		.592	.592
Reasons for Owning Land: Keep for Future Generations		.095	.095
Reasons for Owning Land: Income from Timber		.425	.426
Reasons for Owning Land: Land Investment		.568	.521
Recreation: Hunting		.842	.387
Recreation: Fishing		.091	.223
Recreation: Walking		.770	.219
Recreation: Horseback Riding		.349	.433
Recreation: Camping		.758	.259
Recreation: Cycling		.337	.039
Recreation: Photography		.264	.203
Recreation: Observing Wildlife		.498	.019
Recreation: Bird Watching		.241	.029
Recreation: Flower, Plant and Berry Picking		.099	.019

The table shows the significance for each effect entered as a block. The forward stepwise selection enters the effects in seven steps:

Step 1: Annual payment

Step 2: Income

Step 3: Farm Type

Step 4: Carbon

Step 5: Residence

Step 6: Gender

Step 7: Land conversion in past 10 years

The classification table examines the proportion of cases it can classify correctly. At each step the number of cases it can classify correctly will increase as effects are added to the model. Table 67 shows the number of cases it could correctly classify as each effect is added. Without adding any effects the model could correctly predict 56.7% of the annual payments.

Table 67. Correct classification of effects added at each step of logistic regression using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: Annual payment	68.0%
Step 2: Income	76.8%
Step 3: Farm type	77.6%
Step 4: Reasons for Owning Land: Income from Carbon	77.7%
Step 5: Residence	78.3%
Step 6: Gender	79.3%
Step 7: Land Conversion in the Past 10 Years	79.8%

6.7.4 Final Model

Based on all the previous models there are five significant effects. The effects that were significant for both the annual and one-time payments are gender, residence, interest in carbon, income and farm type. The summary of the results of the a priori, ANOVA and all effects models are shown in Table 68.

Table 68. Summary of the direction of change for significant effects in the three models

Effect	One-Time Payment			Annual Payment		
	A Priori	ANOVA	All Variables	A Priori	ANOVA	All Variables
Residence	Negative	Negative	Negative	Negative	Negative	Negative
Reason for Owning Land (Income from Carbon)	Positive	Positive	Positive	Positive	Positive	Positive
Reason for Owning Land (Recreation)	Negative	Not Included	Negative	Not Significant	Not Included	Not Significant
Land Conversion in the Past Ten Years	Not Significant	Not Included	Not Significant	Positive	Not Included	Positive
Income	Not Included	Positive	Positive	Not Included	Positive	Positive
Gender	Not Included	Negative	Negative	Not Included	Negative	Negative
Farm Type	Not Included	Not Included	Negative	Not Included	Not Included	Negative

The next step was to enter only those effects that were significant for both the annual and one-time payments into the logistic regression model. The dependent variable is whether the

landowner accepted the random payment and the effects are the payment level, gender, residence, interest in carbon, income and farm type. The effects were all significant in the model.

Table 69. Significance of limited effects for one-time payments using logistic regression

Effect	Significance	Wald Statistic (Significance)
One-Time Payment	.000	.000
Gender	.002	.001
Residence	.000	.000
Carbon	.000	.014
Farm Type	.005	.006
Income	.000	.000

Table 70. Significance of limited effects for annual payments using logistic regression

Effect	Significance	Wald Statistic (Significance)
Annual Payment	.000	.000
Gender	.003	.006
Residence	.000	.002
Carbon	.000	.001
Farm Type	.000	.001
Income	.000	.000

The Hosmer and Lemeshow goodness-of-fit test statistic has a significance of .230 for the one-time payments and .398 for the annual payments meaning the model is a good fit. In addition, the model was able to correctly classify 79.4% of the one-time payments and 79.8% of the

annual payments. Without adding any effects the model could only classify 57.5% of the one-time payments and 56.7% of the annual payments.

Based on the survey data, gender is a significant effect for determining if a landowner will accept or reject a payment. In reality, it is unlikely a single member of the household would make decisions on future land use. If gender is removed from the model the result is that the H-L goodness-of-fit is .121 for the one-time payments and .292 for the annual payments. It could correctly classify 78.8% of the one-time payments and 78.3% of the annual payments. The model is still significant with gender omitted from the model. The significance of the effects in the final model for one-time payments are shown in Table 71.

Table 71. Significance of effects in final model for one-time payments using logistic regression

Effect	Significance	Wald Statistic (Significance)
One-Time Payment	.000	.000
Residence	.000	.000
Reason for Owning Land: Income from Carbon	.008	.011
Farm Type	.004	.001
Income	.000	.000

The forward stepwise selection enters the effects in five steps. Table 72 shows the order the effects were entered and how each step improved the number of cases the model could correctly classify.

Table 72. Correct classification of effects added at each step of the final logistic regression model using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: One-Time Payment	69.1%
Step 2: Income	76.6%
Step 3: Residence	76.9%
Step 4: Farm Type	77.0%
Step 5: Income from Carbon	78.8%

The significance of the effects in the final model for annual payments are shown in Table 73.

Table 73. Significance of effects in final model for annual payments using logistic regression

Effect	Significance	Wald Statistic (Significance)
One-Time Payment	.000	.000
Residence	.001	.001
Reason for Owning Land: Income from Carbon	.000	.011
Farm Type	.000	.000
Income	.000	.000

The forward stepwise selection enters the effects in five steps. Table 74 shows the order the effects were entered and how each step improved the number of cases the model could correctly classify.

Table 74. Correct classification of effects for annual payments added at each step of the final logistic regression model using forward selection

Effect	Percent of Cases Correctly Classified
Step 1: Annual Payment	68.0%
Step 2: Income	76.8%
Step 3: Income from Carbon	77.1%
Step 4: Farm Type	77.7%
Step 5: Residence	78.0%

Logistic regression generates a coefficient for the constant (the intercept) and logits for each effect. As discussed previously, logits are the log odds of the event occurring. Logistic regression in major statistical packages generates a constant(Y) and a coefficient(β) for the effect(X). The equation looks like this:

$$Log\ Odds = Y + \beta_1 X_1$$

And from that you can generate the probability:

$$Probability = 1 - \frac{1}{1 + e^{\log odds}}$$

The logits for each effect in the final model are shown in Table 75.

Table 75. Logits for all effects in the final model

Effect		Logit (One-Time Payment)	Logit (Annual Payment)
Constant		-2.426	-3.404
Payment		.001	.011
Residence	Live On the Property	.836	.779
Income from Carbon	Low Interest	-0.596	-0.319
	Medium Interest	.014	.422
Farm Type	Sheep and Beef	.866	1.050
	Other	.399	1.002
Income	Less than $50,000	-2.619	-2.458
	$50,000 to $99,999	-1.252	-.748

Using logistic regression we can build a log curve for each of the effects in the final model. The constant and the logits are different from the values in the table above as each effect was analysed independently. The first two graphs show the probability of accepting a one-time or annual payment based on residence. The survey revealed that landowners who live off the property are more likely to accept a payment than landowners who live on the farm. The constant was -2.748 the payment coefficient was .001 and the coefficient for living on property was 1.244.

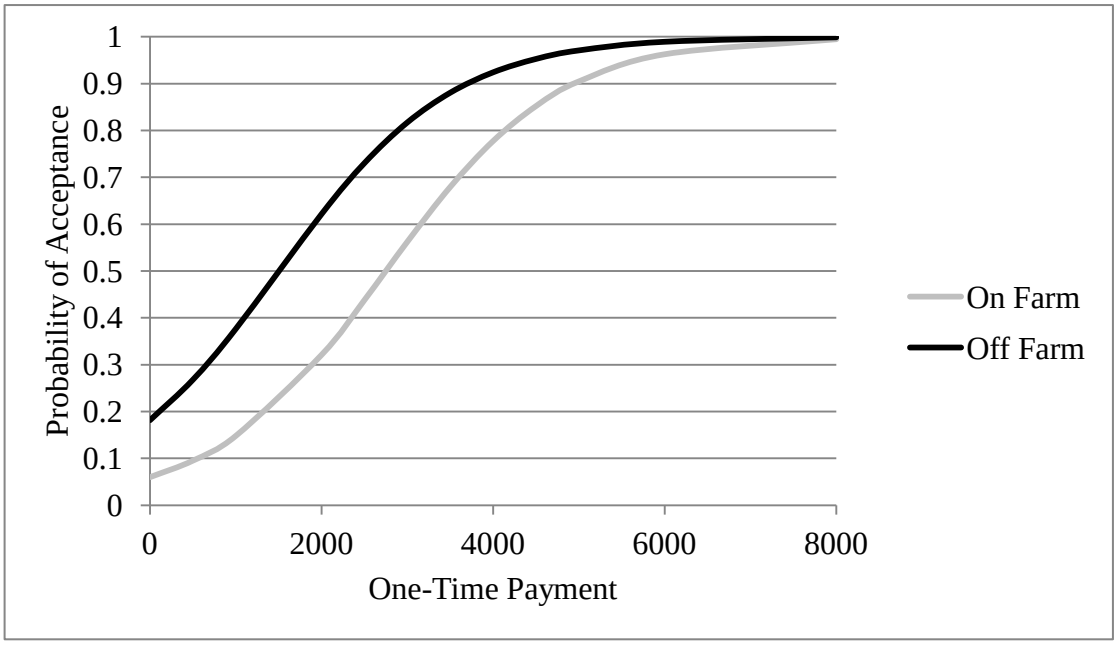

Figure 12. Probability of accepting a one-time payment for landowners living on and off the property

The probability of accepting the annual payments are similar to the probability of accepting the one-time payments. Landowners who live off the farm have a higher probability of accepting the annual payment than landowners who live off the farm. The constant is -3.029 the annual payment coefficient is .009 and the coefficient for living on the property is 1.103.

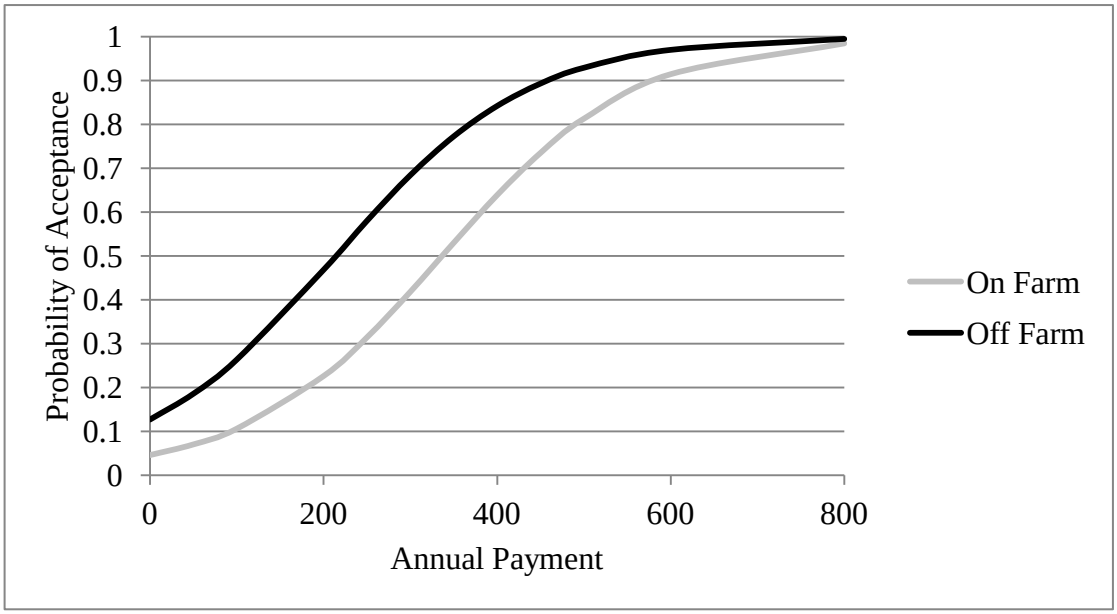

Figure 13. Probability of accepting an annual payment for landowners living on and off the property

The next effect in the model is carbon. This effect examines the importance of owning land for the income from carbon. Landowners who had a high interest in owning land for the income from carbon (scored it 4 or 5 out of 5) had the highest probability of accepting a one-time payment. Landowners who had a medium interested in owning land for the income from carbon (scored it 3 out of 5) had a higher probability than of accepting a payment than landowners who had a low interest in owning land for the income from carbon (scored it 1 or 2 out of 5). Figure 14 shows the probability of accepting a one-time payment based on the importance of owning land for the income from carbon. The constant is -1.853, the coefficients are -.963 for the landowners who are least interested in income from carbon and -.052 for landowners with a medium interest in income from carbon.

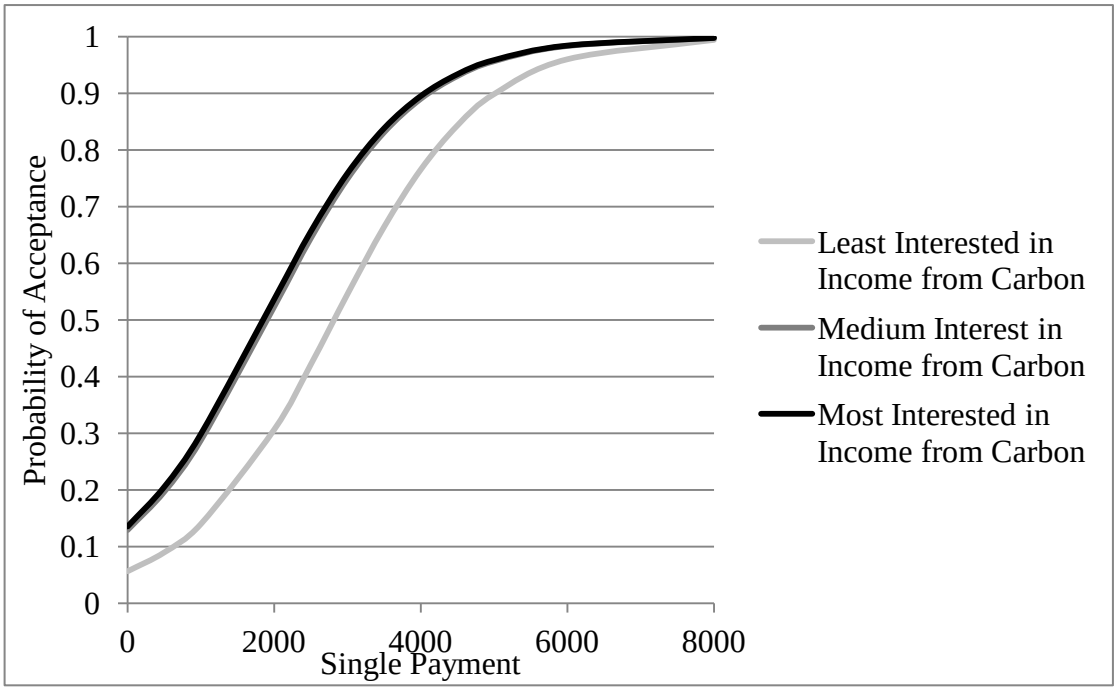

Figure 14. Probability of accepting a one-time payment for landowners interested in income from carbon

The annual payments were different and landowners that had a medium interest in owning the land for the income from carbon (scored it 3 out of 5) had the highest probability of acceptance. Landowners that had a high interest (scored it 4 or 5 out of 5) in owning the land for the income from carbon had a higher probability of accepting an annual payment than landowners that were not interested in the income from carbon (scored it 1 or 2 out of 5). Figure 15 shows the probability that landowners will accept an annual payment based on the interest in income from carbon. The constant is -2.718, the payment coefficient is .009 and the coefficients on landowners least interested in carbon -.67 and with a medium interest in carbon is .088.

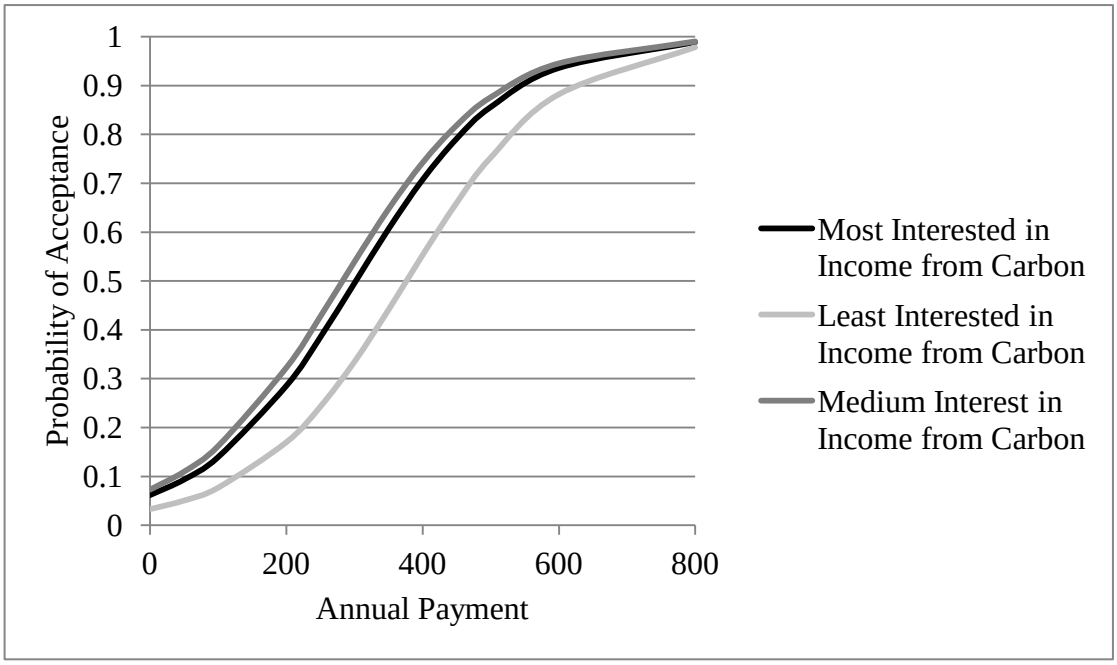

Figure 15. Probability of accepting an annual payment for landowners interested in income from carbon

The third effect in the model is farm type. The final model looked at limited farm types that included sheep and beef, dairy and other. Sheep and beef owners had a higher probability of accepting a payment than dairy landowners. Figure 16 shows the probability of sheep and beef or dairy landowners accepting a one-time payment. The constant is -2.838, the payment coefficient is .001 and the sheep and beef coefficient is .773 and the other coefficient is .655.

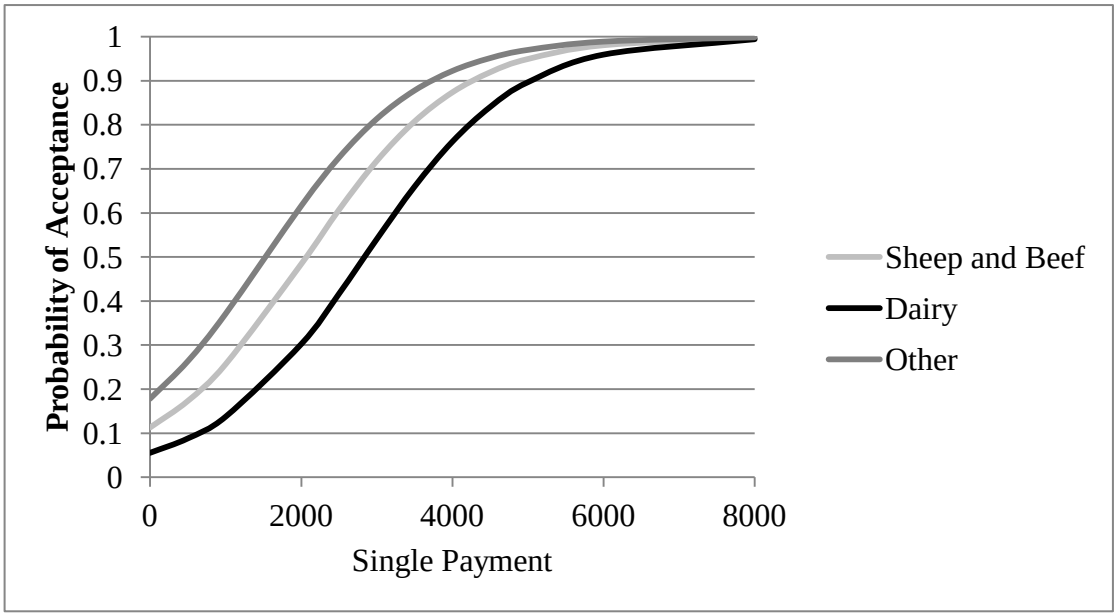

Figure 16. Probability of accepting a one-time payment by agricultural enterprise

Figure 17 shows the probability of a sheep and beef landowner accepting an annual payment is higher than the probability of a dairy landowner accepting the same annual payment. Landowners whose primary agricultural enterprise was not sheep and beef or dairy were identified as other. The constant is -3.329, the payment coefficient is .001 and the sheep and beef landowner coefficient is .1.127 and the other coefficient is .805.

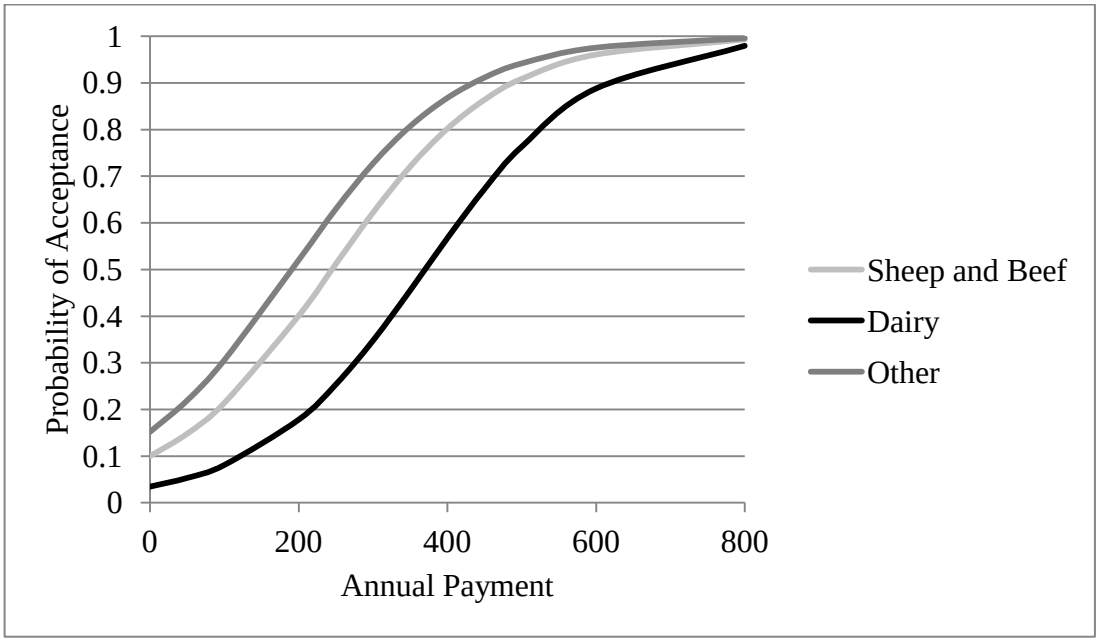

Figure 17. Probability of accepting an annual payment by agricultural enterprise

The final effect in the model is income. Landowners with the highest incomes have a higher probability of accepting a payment than landowners with medium or low incomes. In this study the highest income category was more than $100,000, the medium income category was $50,000 to $99,999 and the lowest income category was $49,999 or less. Figure 18 shows the probability of accepting a one-time payment based on income. The constant was -1.703, the payment coefficient was .001 and the coefficient on the middle incomes was -1.323 and on the lowest income was -2.675.

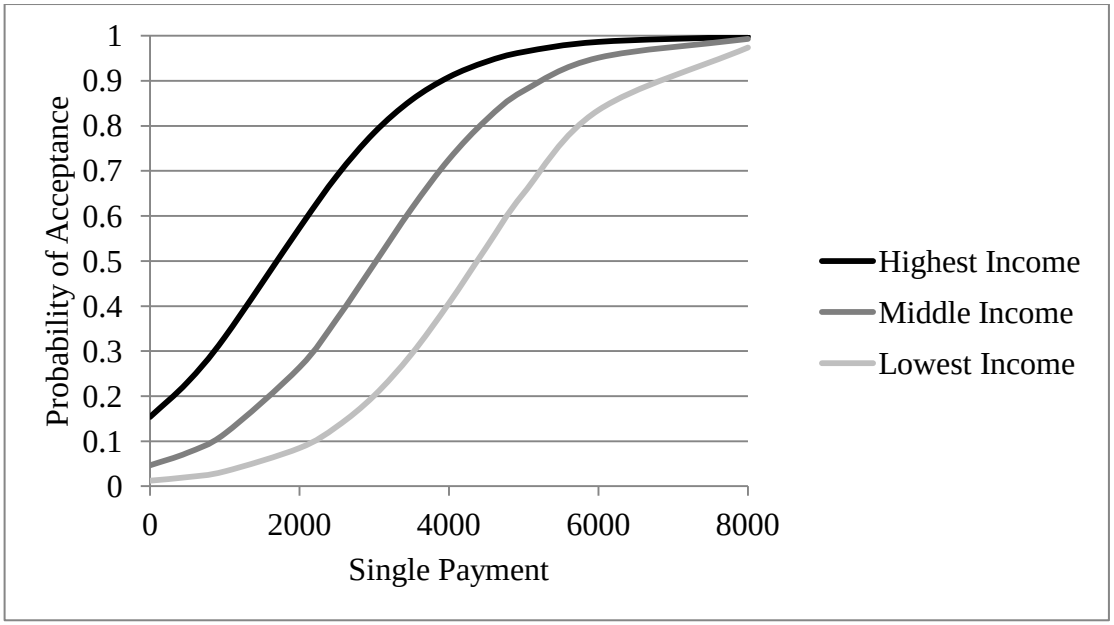

Figure 18. Probability of accepting a one-time payment for low, medium and high incomes

Figure 19 displays the probability of accepting an annual payment based on income. The constant is -2.244 the payment coefficient is .011 and the coefficient on the middle incomes is -.800 and on the lowest incomes is -2.480.

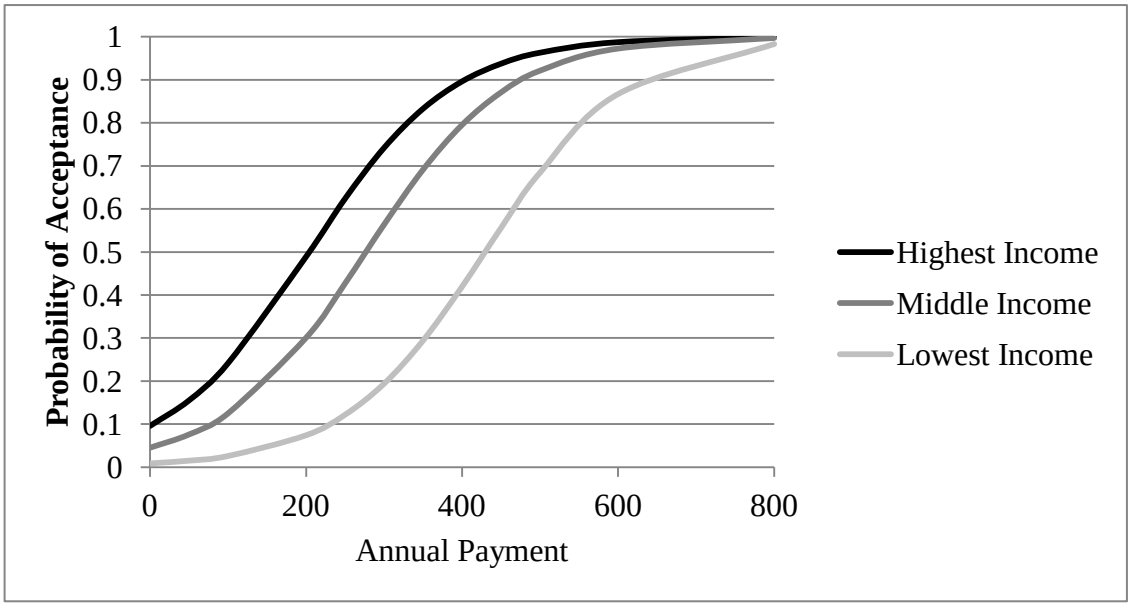

Figure 19. Probability of accepting an annual payment for low, medium and high incomes

This objective aimed to determine the landowner demographics and preferences that affect afforestation. The key factors are residence on the property, interest in the income from carbon, primary agricultural enterprise and income.

CHAPTER SEVEN-DISCUSSION

7.1 Introduction

Small forest landowners have not been the subject of much research in New Zealand. The hypothesis of this study was that landowners with a greater interest in forest amenities will have a lower reservation price for converting land from agriculture to forestry. Factors such as ownership objectives or size of forest may affect land management preferences and reservation prices. It is important to understand these preferences in order to predict land use changes and the effect institutional arrangements like the ETS and AGS may have on landowner behaviour. Surveying landowners for this information permits the inclusion of landowners who have not converted land under current government afforestation programs.

A survey was mailed to 2,546 small landowners in New Zealand that asked questions regarding forest land, silviculture, demographics, ownership objectives and if the landowner would accept a range of annual or one-time payments in exchange for converting a hectare of land from agriculture to forestry. This study offered both annual and one-time payments. Landowners were asked if they would or would not accept a randomly generated payment and also asked to circle the lowest payment they would accept from a list of eight payments.

7.2 Objective One-Forest Landowners

Objective one examined the characteristics of forest land and the ownership objectives of small forest landowners. This objective aims to answer a variety of research questions including: why do landowners own forest land, how much forest land do they own, what species they are planting, what are the demographics of these forest landowners, how did they acquire their land and what do they plan to do with their land in the future.

This survey found the majority of small forests are planted in radiata pine with smaller plantings of other species. Much of this radiata pine was planted in 1994 and 1995. A similar period of intense planting among landowners was detailed in the NEFD survey (MAF, 2010a). The planting increase is attributed to four key factors including a government focus on forestry as a tool for regional development, higher prices for forest products and favourable publicity, a change in taxation strategy and the removal of agricultural subsidies (Rhodes et al., 2002). New forest plantings have slowly increased in the past several years as evidenced in both this small landowner survey and the NEFD. The increase is in part due to policies and programmes, specifically the ETS, PFSI and AGS, established by the New Zealand government to enable New Zealand to meet its international obligations to climate change, reduce emissions and increase forest plantings.

The annual NEFD surveys landowners with more than 1000 hectares of planted production forest. In 2010 and in alternate years the NEFD survey also includes all known landowners with more than 40 hectares of plantation forest. The 2010 NEFD survey asked forest landowners about the previous use for currently forested land. It found that between 1993 and 2009, 44.9% of the forest area planted by landowners was land converted from improved pasture, 38.8% was unimproved pasture and 16.2% was other woody land (MAF, 2010a). A notable difference between landowners in the NEFD survey and small forest landowners in this survey appears to be that small forest landowners are converting more improved pasture (61.7%). This indicates that small landowners are planting better quality land than large landowners. In addition, only 4% of landowners in this survey had their land in forest prior to the current rotation. Small forest landowners with new forests may need more education and assistance regarding forest management and financial planning than those with established plantations.

This survey asked landowners if they reside on the property in question. Earlier studies of small landowners in the United States found that there was a relationship between landowners living on the property and the likelihood of harvesting timber. Absentee landowners were less likely to harvest, often as a result of having less information about the forest tract. This type of landowner regarded the property more as a place to visit and enjoy than as an opportunity for timber revenue (Conway, et al., 2003). This study found that 29.2% of landowners living on the property had harvested in the past ten years compared to 18.8% of landowners who live off the property. While absentee landowners in this study were found to be significantly less likely to harvest, their decision may be due to financial considerations and returns on their investment more than their use of the forest as a place to visit and enjoy unlike the findings in the Conway study. Absentee landowners in this survey were found to be more interested in the income from timber than other reasons for owning forest land.

The survey asked four questions regarding the demographics of small forest landowners. From a demographic perspective, New Zealand forest landowners in this survey are different from the average New Zealand resident. They have more in common with forest landowners in other countries than with the average New Zealand resident. In other countries, the trend is that the average age of forest landowners is increasing. In the United States, the average age of small forest landowners is 60 years (Butler, et al., 2004; Gan et al., 1999). A survey of New Zealand farmers found that the average age of small holders was 56 years in 2007, which is higher than the average of 44 years for farmers based on 1991 census data. (Fairweather et al., 2007). The average age of small forest landowners in this survey was 56 years with the oldest landowner being 91 years old and the youngest at age 26. This study found that 75% of landowners surveyed were over the age of 50. There was no significant age difference between landowners raising sheep and beef and those raising dairy cattle, or between landowners with small and

large blocks of forest land. The advancing age of forest landowners is important because it may lead to a transfer of forest land in the next decade.

Gender was surveyed so data may be compared to other studies. A study conducted in Australia found that 32% of respondents to a forestry survey were female (Deane et al., 2003). Studies show a wide range of gender distributions, but all surveys found that the majority of respondents were male. This survey found similar results with males making up 92% of respondents. Female respondents were significantly more likely to be landowners with dairy cattle. Landowners whose primary agricultural enterprise was sheep and beef were 6.8% female compared to 10.6% of those raising dairy cattle. In many countries, the proportion of landowners who are female is increasing. Between 1976 and 2008 the proportion of female landowners in Sweden rose from 20% to 38% (Lidestav, 1998). The study in Sweden found one reason for the increase in female landowners was due to an increase in urbanization, resulting in a greater proportion of forest landowners living far from their properties. This study of New Zealand landowners did not investigate which gender was making the land management decisions, but it is a useful question as it is easier and less costly to collect demographic data about landowners than information about specific land management preferences. Future studies of New Zealand landowners may seek to correlate demographic information, such as gender, to forest management decisions.

The question on education was included because a survey conducted in the US found the average forest landowner has a higher level of education than the average worker in the country (Butler, et al., 2004). This survey confirmed that the findings in the Butler study were also true in New Zealand. According to the 2006 New Zealand census by Statistics New Zealand (2006), 25% of the general population over the age of 18 have less than a secondary education compared with less than 4% of respondents to this survey. The 2006 census revealed that 11%

of the general population over the age of 18 had a university degree compared with 19.9% of survey respondents. In the United States, 31% of small forest landowners had a university degree compared with 24% of the general population (Butler, 2007). This study did not find significant differences between the education level and land management.

The final demographic question asked landowners about their approximate gross household income. Landowner surveys in other countries have found that small forest landowners had a higher average income than the general population (Hyde, 2012). In the United States, 18% of small forest landowners earned more than $100,000 USD while 12% of the general population earned at that level (Jacobson, 2002). The recent census by Statistics New Zealand (2006) revealed that 23% of households earned more than $100,000 and 35.9% of forest landowners who participated in this survey earned more than $100,000. In the Jacobson (2002) study, the reason for the high income and education levels was attributed to an influx of urbanites into rural areas. Higher income and education levels were also attributed to higher land turnover and increased forest fragmentation.

The survey included a number of questions regarding ownership objectives because in many parts of the world, small forest landowners indicate that their main reason for owning forest land is not for timber. Ownership objectives are one of the key areas where New Zealand forest landowners differ from forest landowners in other parts of the world. Small forest landowners have diverse reasons for owning land and derive a variety of values from their forest. In a study conducted in the United States, the top reason for owning forest land was recreation, followed by aesthetics, family legacy, land investment and timber (Butler, 2011). A study of forest landowners in Finland found similar results with the top reasons for owning forest land being non-market benefits such as recreation and aesthetics, followed by economic security and asset motives, and lastly income from the sale of timber (Karppinen, 1998). In both the United States

and Finland, income from timber ranked near the bottom of reasons small landowners own forest land. The results in this study conclude that in New Zealand, the primary reason small forest landowners own plantation forest land was income from timber while recreation ranked last. The New Zealand focus on income from timber in plantation forests was discussed in Sands textbook (2005). Worldwide, forest management ranges from completely protected areas to single species plantations. Countries like Germany operate in the middle ground, with group selection and natural regeneration of mixed stands. This is in contrast to New Zealand, which typically operates at the ends of the scale, with either plantations or forests in protected reserves. New Zealand has one of the highest percentages of protected areas in the world (Sands, 2005, p. 166). This dichotomy of management may be the reason that most forest landowners in New Zealand own their plantations primarily for the income from timber.

Few small forest landowners in New Zealand use their plantation forests for recreation. This is an important observation, because landowners who own land solely for income from timber may only plant more forest if the financial returns outperform those of other land uses. Landowners who derive high amenity benefits from forests may plant new forests even if the financial returns on timber are lower than the returns from other land uses. In this study, landowners were asked to register on a scale of one to five, where one is “not important” and five is “very important”, how they would rate various reasons for owning forest land. The factor with the highest rating was income from timber with an average score of 3.94, followed by environmental reasons, to keep for future generations, land investment, scenic beauty and income from carbon credits. The lowest ranking objective was recreation with an average rating of 2.27. By comparison, small forest landowners in Denmark found recreation and aesthetic benefits to be more important than economic benefits (Boon, et al., 2004). The findings from the Boon study are similar to results of studies in Finland, Sweden, Austria, Portugal and Germany (Hogl, et al., 2005; Kvarda, 2004; Novais, et al., 2010). A study of forest landowners

in the United States found that only 9% of forest landowners indicated that timber production was an important reason for holding forest land. The top reasons for owning forest land found by one study of forest landowners in the United States were to enjoy scenery, protect nature and to pass the land on to their heirs (Butler, et al., 2004). Income from timber may have received the highest rating in this study but many respondents added comments in this category stating that they owned land because it was “good for the soul” or they “just enjoy owning forest land”.

Landowners were asked about specific recreational activities. Studies in other countries have shown that recreation is an important part of owning forest land, with the most popular activities being hunting, observing wildlife and walking (Egan, 1997; Kvarda, 2004; Novais, et al., 2010). This survey revealed that recreation is not as important to New Zealand’s small forest landowners as this use was rated lowest among the reasons for owning forest land. Of the landowners in this survey that use their land for recreation the highest rated activities were observing wildlife and hunting, similar to findings in other countries. Two reasons for the lack of recreation on plantation forests may be due to accessibility of nearby public land and lack of access to their forests. New Zealand has a high percentage of land in parks and reserves (Sands, 2005, p. 166) and small forest landowners may prefer to recreate in nearby DOC land than in the plantation forests on their property. In addition, plantation forests are often planted on steep, less accessible land. One survey respondent commented that they did not use the land for recreation because there was “no access available. Trees grown for timber/erosion control only”. Another landowner commented that it “would be very hard to get through most of our forests as much blackberry [making for difficult walking]”. Landowners also seem to prefer the open land for operating all-terrain vehicles and walking. One such landowner commented “we much prefer our open grassland to walk on and enjoy”.

7.3 Objective Two-Silviculture

The second objective was to indentify the land management and silvicultural preferences of small forest landowners. This objective aims to answer several research questions including: did forest landowners experience the mid-90s planting spike and what quality of wood can we expect from small forest landowners in current and future rotations? The hypothesis was that forest landowners did experience a planting spike in the mid-90s but have no plans to change their harvesting patterns in response to the high volume of wood ready to be harvested in 2025.

The surge in planting that occurred in 1994 and 1995 means there will be many trees ready for harvest in 2022 and beyond. If most landowners choose to harvest at the same age, it could create an oversupply of wood on the market and reduce prices. In order for landowners to achieve more favourable prices, it may be in their interest to adjust the timing of their harvest. Landowners in the survey were asked at what age they plan to harvest their trees. Most landowners provided a range of ages, with the average low at 28 years and the average high at 30 years. The size of the forest and the primary agricultural enterprise were not factors influencing the harvesting age. MAF (2010b) analysed five different harvesting scenarios for the forests planted in the mid-nineties. The first scenario assumes all landowners harvest at 30 years. The second scenario assumes large-scale owners smooth out their harvests while small owners harvest at age 30. Scenario two is shown in Figure 20.

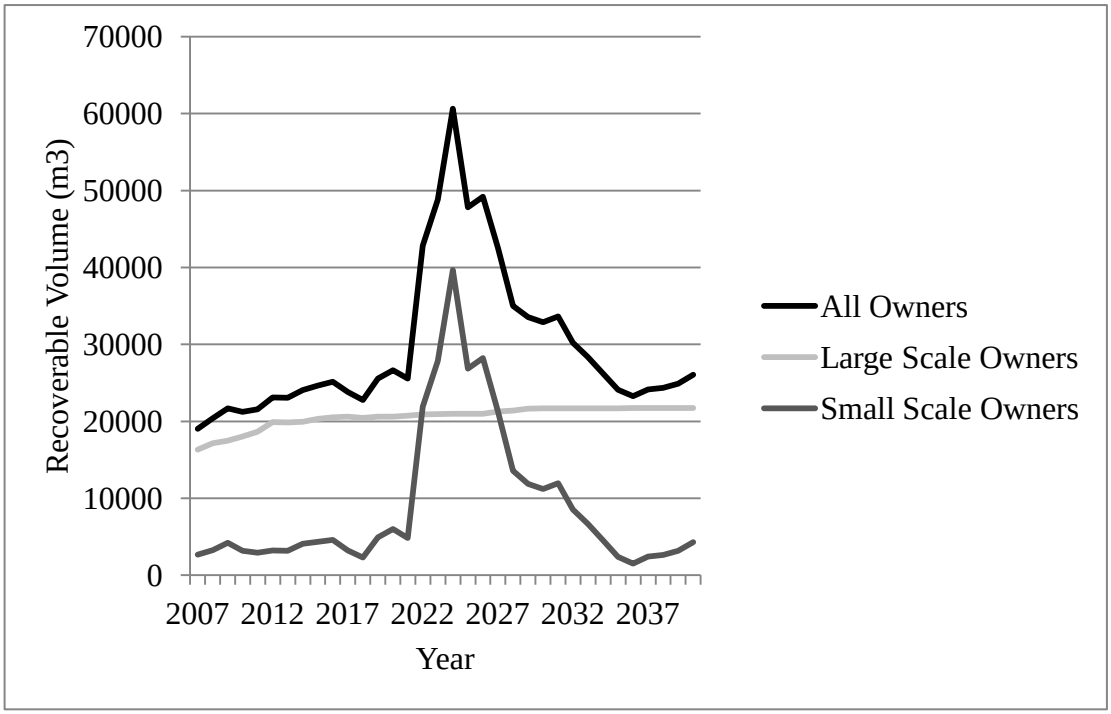

Figure 20. Results from the wood availability forecasts assuming small landowners harvest at age 30 and large landowners at stated harvest intentions

Source: MAF, 2011b

The other three scenarios assume that all landowners synchronise their harvests over several years to avoid all landowners trying to harvest at the same time. Market conditions, wood processing capabilities and availability of logging crews, road contractors, engineers and planners make the first two scenarios unlikely due to logistical constraints. Scenario three assumes that large and small landowners do not all harvest at age 30 and instead, time their harvests so there is a non-declining yield. The volume harvested in scenario three by large and small forest landowners is shown in Figure 21.

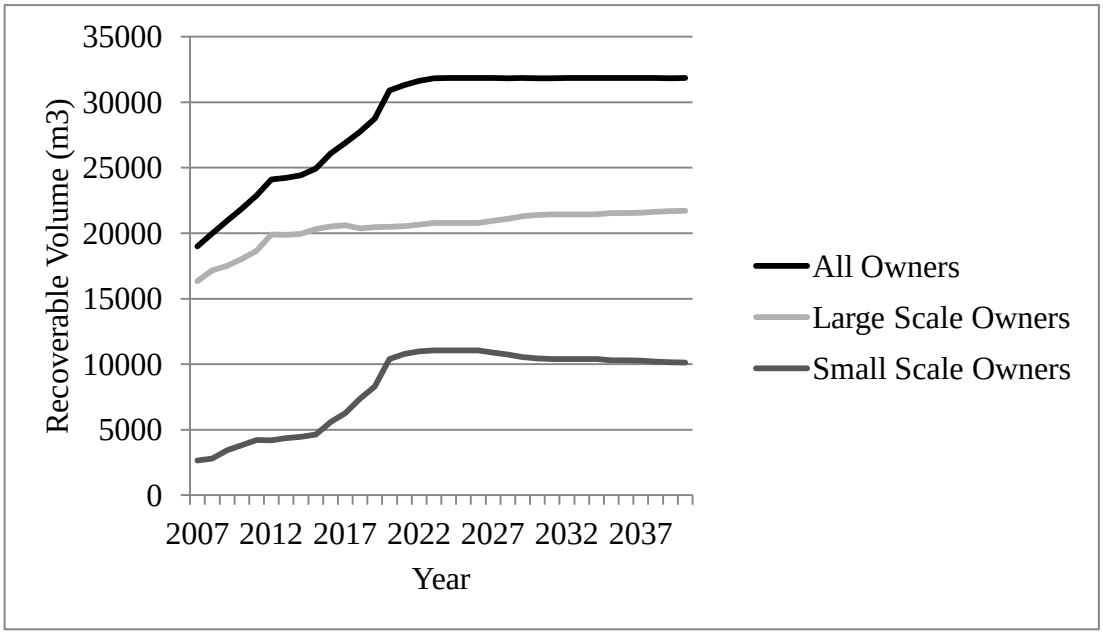

Figure 21. Scenario three from the wood availability forecasts assuming a non-declining yield

Source: MAF, 2010b

Under scenario three large forest landowners would have an average rotation age of 30 years but the rotation age for small landowners would vary, from a low of 27.8 to a high of 39.8 years. The average rotation ages for large and small landowners under scenario three is shown in Figure 22.

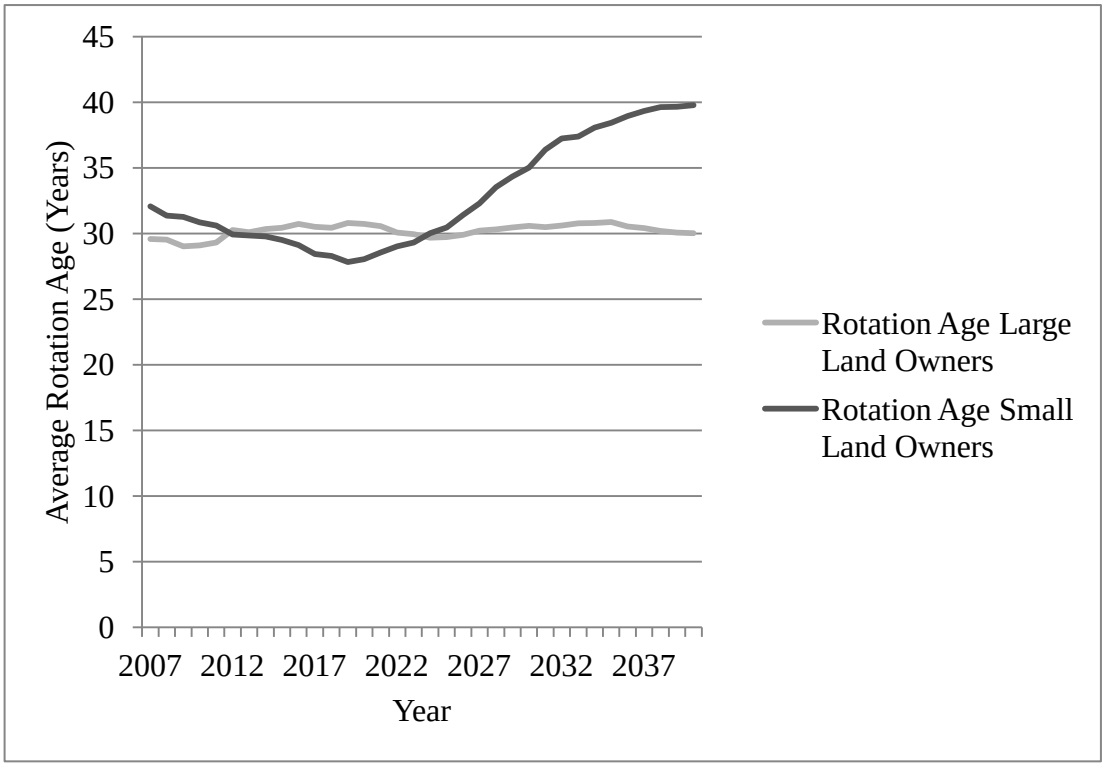

Figure 22. Average rotation age for scenario three from the wood availability forecasts

Source: MAF, 2010b

Landowners in this survey did not all plan to harvest at age 30, so some variability in rotation ages could be expected. However, none of the landowners intended to harvest at age 36 or later as suggested in scenario three. The highest rotation age provided by landowners in the survey was 35 years. The range of rotation ages provided by landowners is more similar to scenario four. Scenario four is a split non-declining yield with an average rotation age of 30 years. The key difference from scenario three is that smaller landowners harvest over a shorter period of time. The range of rotation ages for scenario four is shown in Figure 23.

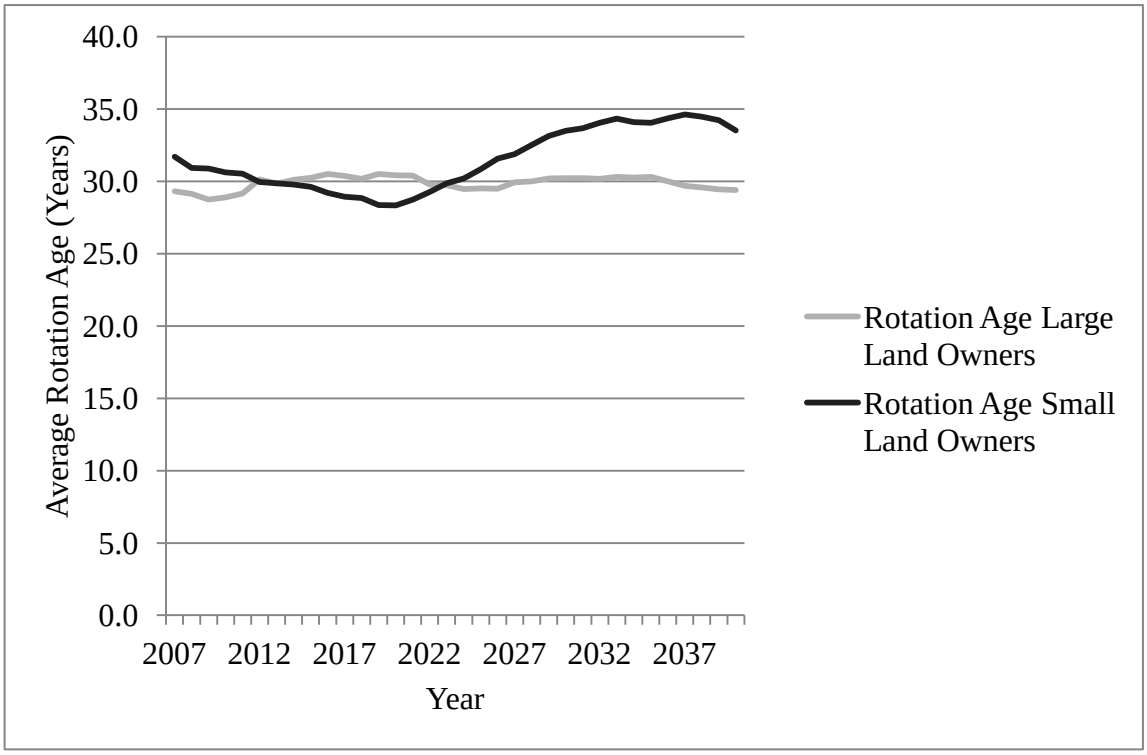

Figure 23. Average rotation age for scenario four from the wood availability forecasts

Source: MAF, 2010b

This survey shows that most small landowners are still planning to harvest at age 29. Without some outreach from government or the forest industry, landowners may be disappointed to find an inadequate supply of harvest crews or insufficient capacity at wood processing facilities will limit their ability to harvest at their intended rotation age. Landowners who are disappointed by harvesting may be less likely to replant. A study by Royer (1987) found that landowners who had a positive harvesting experience were more likely to keep the land in forestry. Scenario four appears to be the best option for small landowners, as the rotation ages fall within ranges provided by survey respondents.

Landowners were asked if they planned to replant on the same site after harvest. This is important for both the timber industry and for New Zealand's emissions profile. This study found that 71.4% of landowners planned to replant the same site, 23.2% were unsure and 5.4% do not intend to replant trees on the same site. One landowner commented that he planned to

replant trees because, “World supply of timber is changing. I imagine timber will increase in price over time. Then there is new technology in the use of pine” while another landowner expressed uncertainty, “We'd have liked to replant natives rather than pines but always the advice is for radiata. NZ has too much dependence on this species IMHO [in my humble opinion]. If we replant they'll be hardwood and preferably natives.” Another landowner wrote “we are planning to convert most forest land to dairy after the current rotation”.

The survey was also interested in pruning activity of small forest landowners. Opinions on pruning radiata pine in New Zealand are mixed and there has been a decline in popularity of pruning the species in recent years. The NEFD survey found that 60% of landowners pruned or will prune radiata pine to a height of at least four metres in the current rotation. Approximately 15% of pruned radiata pine is older than 25 years, while 17% is aged between 21 and 25 years and 69% of the pruned radiata pine is 20 years old or younger (MAF, 2010a). More than half of the forests planted during the planting increase from 1993 to 1998 were pruned, with 64.1% of landowners reporting that trees planted during that time have been pruned (MAF, 2010a). Small landowners in this survey were more likely to prune in the current rotation, with 90.1% of respondents having pruned or planning to prune in the current rotation. The primary agricultural enterprise and size of the forest plantation did not influence the pruning height. Small landowners seem as uncertain as large landowners regarding the benefits of pruning as only 61.2% of small landowners in this survey plan to prune in the next rotation and 19.4% are uncertain. One landowner commented “we pruned in the past but don’t know if it has paid off”. Another landowner commented that they pruned in the past on the advice of a professional forester but will not prune in the future, “We selectively pruned 15-year trees on advice but have no plans to prune future plantations”.

This survey generated numerous comments from landowners with many of them expressing a commitment to forest land management while others voiced frustration. There appears to be much uncertainty amongst landowners regarding the advantages of pruning, the cost of harvesting trees on their property and government initiatives available to forest landowners, specifically the ETS. One landowner commented that they were selling the property and added that they "do not really understand 'carbon credit' schemes. Have had a forest 'consultant' in to help try to put a value on the trees but he was not AT ALL helpful, still have no idea of the value. Real estate agents do not want to even give it a guess." Another landowner commented "As for carbon credits I read about it and it seems complicated and probably won't work."

7.4 Objective Three-Reservation Prices

The reservation price strategies of landowners were an important part of the survey. The third objective of this study was to determine the annual and lump sum reservation price for landowners to convert land from agriculture to forest, and to compare it to payments possible under government programmes like the AGS. The hypothesis was that the payment levels required were similar to programs such as the AGS. Reservation price strategies were investigated using hypothetical annual and one-time payments for converting land from agriculture to forestry.

The majority of landowners indicated that they would be interested in planting more trees if they were offered an annual or one-time payment to convert agricultural land to forest land. More than 50% of landowners accepted a random one-time payment offer of $3000 and annual payment offer of $300. Only 4% of landowners indicated that they would not accept the highest one-time payment offer of $5000, and 10% would not accept the highest annual payment offer of $500. The most common reasons given by landowners who would not accept any payments are that all suitable land had been converted or they simply did not like forestry.

In addition to the random payments, landowners were asked to select the lowest payment they would accept from a list of eight payments options. The average one-time payment a landowner would be willing to accept to convert a hectare of land from agriculture to forestry was $3554 and the average annual payment to convert a hectare of land was $360. These averages do not include landowners who indicated that they would not accept any of the payments offered. The acceptance rates of the random payment and the lowest payment a landowner selected from a list of eight options are shown in Figure 24 and Figure 25. The trends between the acceptance rates of the random payments and the payment a landowner selected from a list are similar. Acceptance rates were higher when landowners were offered a random payment than when landowners could choose from a list of eight payments. This may indicate that landowners are uncertain about the potential returns from forestry. For example, when offered a random payment without the context of other payments, a $2000 payment is acceptable to 42% of landowners. However, when asked to select from a list of payments, only 20% of landowners find the $2000 payment acceptable. Several landowners mentioned their uncertainty in choosing a payment, with one landowner commenting, “I could use some advice on this. Don't know” and another remarking, “At this point I don’t know. Very complicated answer. Forestry returns are extremely fickle.” The divergence in payments may be related to landowner uncertainty about the returns from plantation forestry on their property.

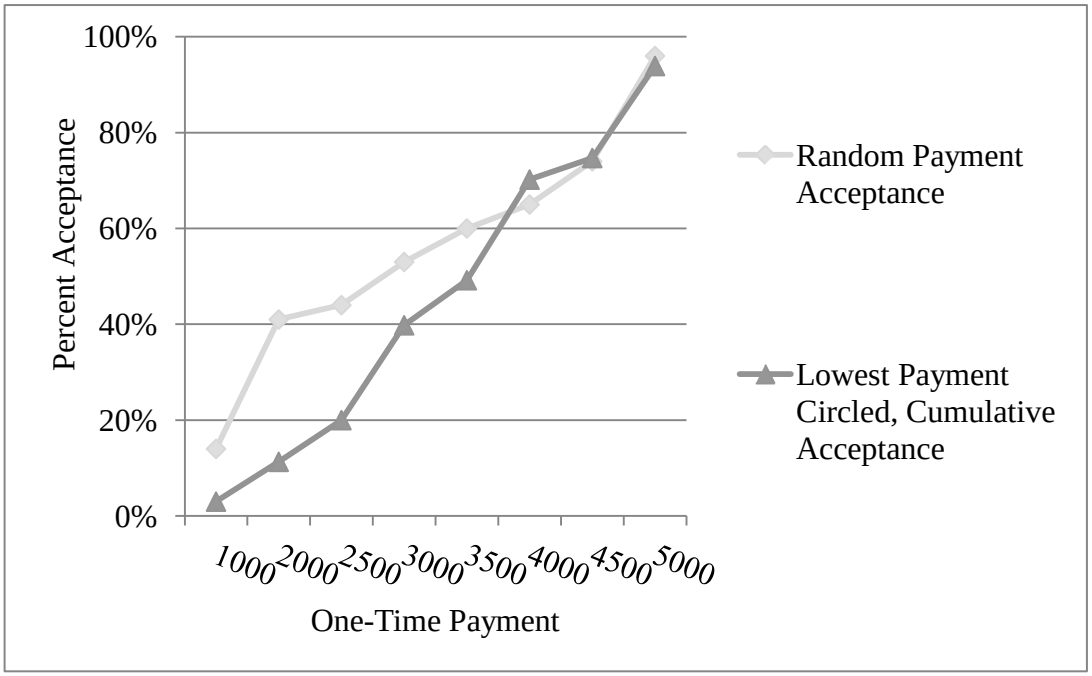

Figure 24. Cumulative acceptance rates of random one-time payments and lowest one-time payments selected from a list of payments

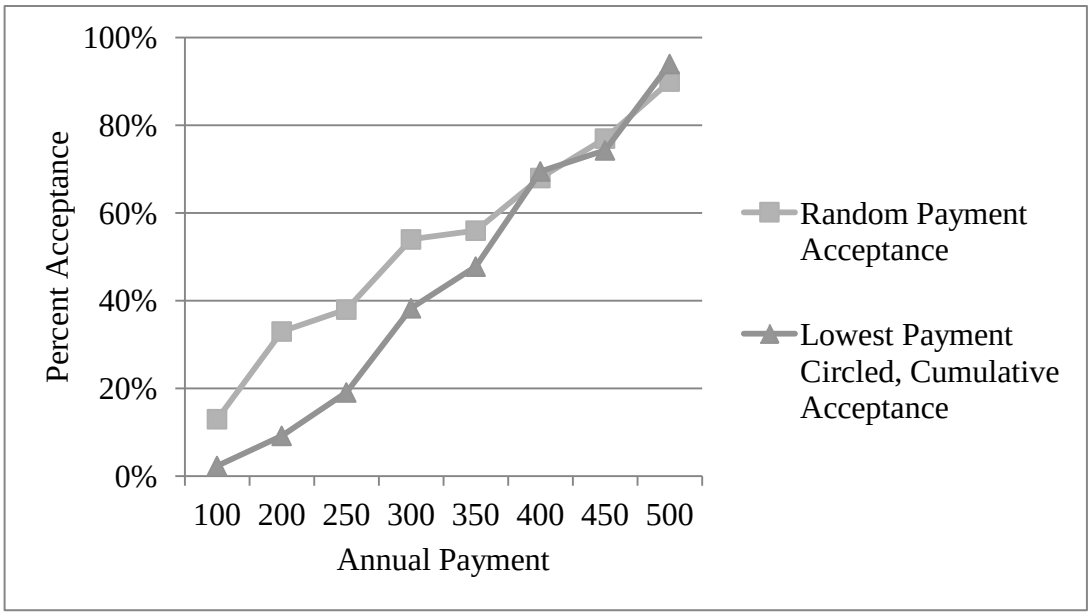

Figure 25. Cumulative acceptance rates of random annual payments and lowest annual payments selected from a list of payments

Questions in this survey regarding one-time payments to convert agricultural land to forest land were designed to be similar to actual payments offered by the AGS. The AGS is not currently

funded, but a MAF report indicates that the average grant per hectare for high sequestration trees was $2021 in 2010 and $1681 in 2011 (MAF, 2011d). This survey found that 3.2% of landowners would accept a $1000 payment and an additional 8.7% of landowners would accept a $2000 payment. The total AGS funding for the high sequestration rate category in the National Pool and average costs per hectare are shown in Table 76.

Table 76. Total AGS applications approved and average tender per hectare for the national pool

Year	Total Applications Approved	Area (Hectares)	Average Tender/Hectare
2008 (Actual)	5	93	$1542
2009 (Actual)	43	1232	$1942
2010 (Actual)	24	1431	$2021
2011 (Estimate)	28	1833	$1681
Totals	100	4589	$1797

Source: MAF, 2011a

For the years 2008 to 2011 of the AGS, there were a total of 4589 hectares of high sequestration trees planted through the public pool and 100 AGS applications approved for an average of 45.9 hectares per AGS application. If it is assumed that landowners who responded to this survey are representative of the 2546 landowners identified by AsureQuality and were asked to complete the survey, it is possible to speculate the additional land that could be planted at various tender levels. If 3.2% of landowners would accept a $1000 payment and the average size of AGS sponsored conversion for the high sequestration national pool is 45.9 hectares, then an additional 3739 hectares could be planted. With a $2000 payment and an 8.7% acceptance rate, an additional 10,190 hectares could be planted. AsureQuality identified an additional 9971

landowners with 1-20 hectares of land. Landowners with less than 20 hectares of land were not surveyed, but if it is assumed that this group would have similar acceptance levels at $2000 per hectare, an additional 867 landowners could potentially enrol in a programme similar to the AGS. Landowners with less than 20 hectares of forest land may not convert the average of 45.9 hectares but may be willing to convert some land. A study by Dhakal, et al. (2008) found that small forest landowners in four South Island districts planted less than half of their land that was potentially profitable in forestry. This indicates that landowners with less than 20 hectares may be willing to double their current plantation forests.

This survey also asked landowners the lowest annual payment they would accept. The average annual payment a landowner would accept was $360. Using the carbon sequestration tables provided by MAF, the average carbon sequestered per hectare per year for an average stand of radiata pine is about 25 tonnes of CO_2 for a 30-year rotation (MAF, 2011b). Landowners in this survey who accepted a payment were told they would not have to pay for any carbon liabilities at the end of the rotation for the hypothetical hectare of forestry. A study by SCION found that these so-called “risk-free credits” averaged between 240-370 tonnes of CO_2 per hectare for radiata pine over an average rotation (Turner et al., 2008). Risk-free credits are the credits a landowner does not have to pay back at harvest, and are similar to payments offered to landowners in the survey, as landowners were offered a hypothetical payment for one rotation that did not have carbon liabilities at the end of the rotation. Figure 26 illustrates the carbon sequestered per hectare using a 30-year rotation and the averages for radiata pine in the Bay of Plenty.

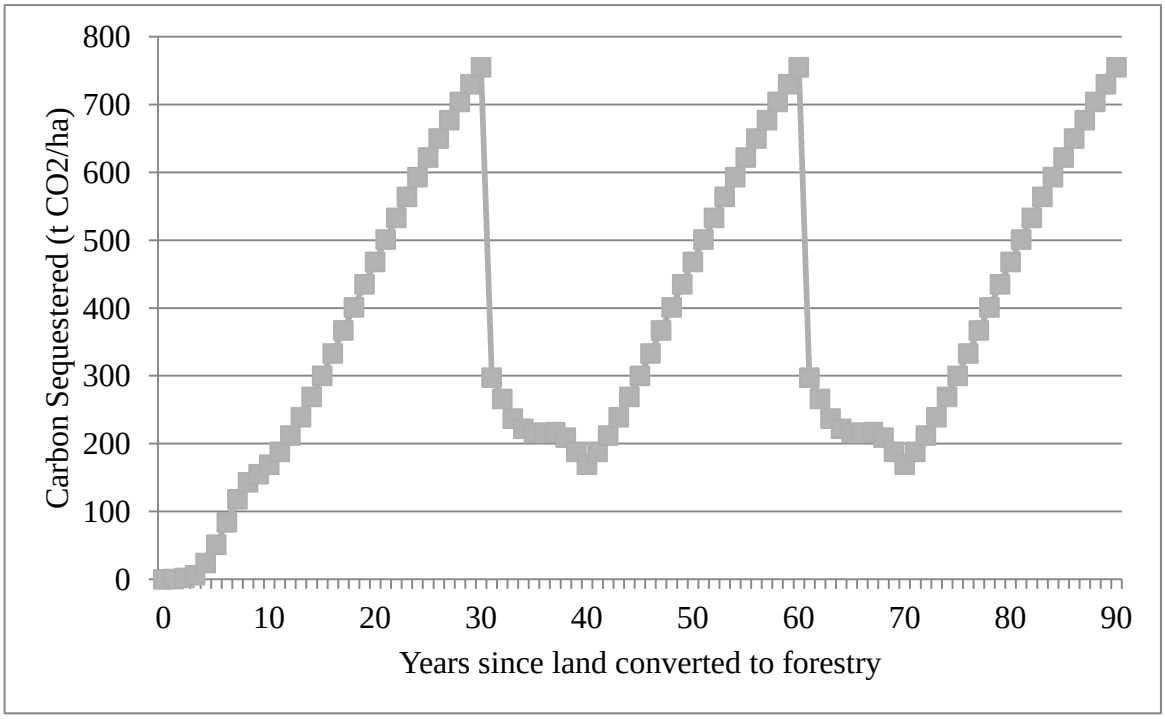

Figure 26. Carbon stocks for a single hectare stand of radiata pine in the Bay of Plenty on a 30-year rotation

Source: MAF, 2011b

Although the amount of carbon credits received varies each year, in order to compare it to the annual payments offered in the survey it is assumed that a hypothetical landowners sells their risk-free credits, which is between eight and ten NZUs in an average year. In reality, most landowners would sell all the credits received early in the rotation and save credits earned later in the rotation (Maclaren, et al., 2008). Landowners in this survey were offered an annual payment for 30 years. Assuming a carbon price of $20 per NZU for the year this survey was conducted and subsequent years, a landowner selling an average amount of risk-free credits would earn an annual payment of between $160 and $240 per year. In this survey, 9.2% of landowners indicated that they would accept an annual payment of $200.

New forest plantings increased in the mid-90s and declined until 2007. Since 2007, new forest plantings have been increasing and much of that is a result of New Zealand afforestation

schemes. MAF (2012) estimates that in 2010 there were 6000 hectares of new forest plantings and 12,000 hectares in 2011. Forest land planted under the AGS is not eligible to earn NZUs for the landowner but most other new forest plantings could be included in the ETS. Excluding those under the AGS, there were 8305 hectares of new plantings in 2011 and 3371 hectares in 2010. MAF attributes most of these additional new plantings to the ETS (MAF, 2011c). If 9.2% of landowners who responded to the survey would convert land at a carbon price of $20 per NZU, and assuming those landowners are representative of the population that were mailed a survey, we can conclude that 234 landowners could be interested in enrolling in the ETS. Landowners with less than 20 hectares of land were not surveyed but if the same proportion of those landowners would enrol in the ETS at $20 per NZU, an additional 906 landowners may plant new forests.

7.5 Objective Four-Implied Discount Rate

The fourth objective of this study was to calculate the implied discount rate for small forest landowners and compare it to that of other landowners. The hypothesis is that the implied discount rate for small landowners is similar to large landowners in New Zealand.

This study used an implied discount rate as many small landowners may not be able to specify a discount rate. Small landowners may decide to plant new forests by comparing the risk and returns from forestry compared to alternative land uses. The implied discount rate in this study was calculated using the lowest one-time and annual payments deemed acceptable by the landowner. Landowners also provided the age at which they intend to harvest, which was used as the rotation age. As part of the hypothetical scenario, landowners were informed that the payments offered in the survey would be tax-free. An implied discount rate was calculated for each landowner, excluding those who would not accept any payment. The average after-tax discount rate was found to be 9.7%. A 2011 survey found the average discount rate applied to

post-tax cashflows was 6.7% and ranged between 4.4% and 8.4%. The average was 6.9% in 2009 and 6.7% in 2007. Implied discount rates have generally declined in New Zealand since 2005 particularily for forest landowners with more than 10,000 ha of forest (Manley, 2007, 2010, 2012).

There is a possibility that the position of the questions on the survey affected how landowners responded, as the one-time payment question was followed by the annual payment question, so landowners may have chosen the annual payment option that was most similar to the one-time payment they had selected first. For example, if a survey respondent chose $3000 as an acceptable one-time payment and then selected $300 as an acceptable annual payment. The frequency of such paired selections is shown in Figure 27. There was a greater frequency of payment pairs selected where the annual payment was 10% of the one-time payment, though a variety of payment pairs were selected.

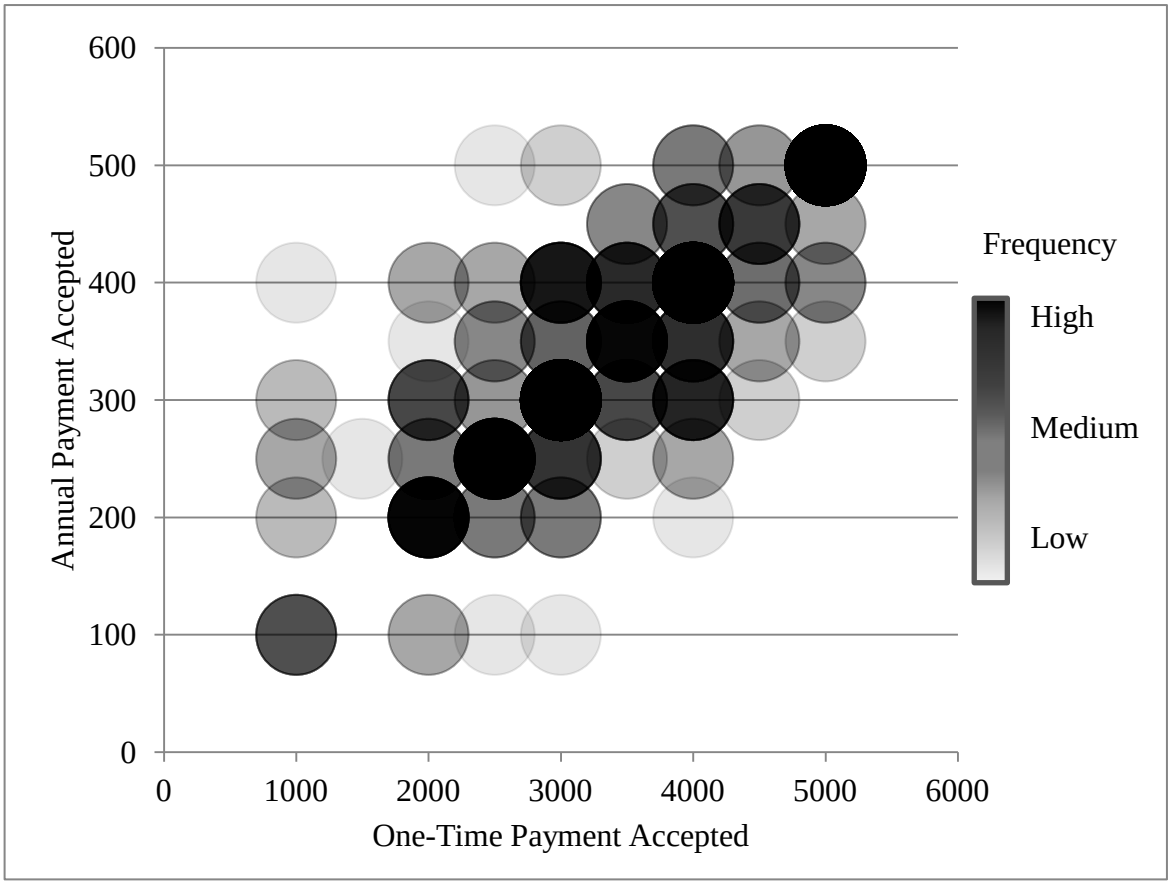

Figure 27. Frequency of payment pairs for landowners

The after-tax discount rate of landowners who participated in this survey is higher than discount rates found in studies of larger landowners in New Zealand. This difference may be due to the uncertainty expressed by small landowners throughout the survey. Economists assume that small landowners have the same information as professional foresters, large forestry companies and timber buyers with respect to planting rates, silviculture, harvest prices and actual costs of planting and maintaining forest plantations. However, the fact that such a large number of small forest landowners expressed uncertainty in their responses to this survey indicates they do not have perfect information and therefore regard forestry as being more risky than those with larger holdings and forestry companies. This represents an imperfection in the market. Landowners who had harvested forests in the past ten years reported a significantly lower discount rate than those who had not harvested, and landowners who manage the land themselves reported a significantly lower discount rate than those who employed a farm

manager. These factors support the speculation that landowners with less information and experience have a higher discount rate.

7.6 Objective Five-Econometric Models for Afforestation

The fifth objective of this study was to determine landowner demographics and preferences that are correlated to afforestation. The hypothesis was that the reasons are similar to other countries and include having a bequest motive, living on the property, managing the land themselves, harvesting in the past ten years, pruning in the current rotation, owning the land as part of a trust or partnership, inheriting the land and owning the land for recreation or environmental reasons.

This objective seeks to develop an econometric model of landowner demographics and preferences that influence reservation prices. Development of forest establishment incentive programmes should target individuals most likely to convert land. Offering hypothetical random payments to landowners allowed this study to use logistic regression to determine which factors are significant in a landowner accepting a payment. The final model included five variables: payment amount, whether the landowner lives on the property, primary agricultural enterprise, landowner’s interest in carbon credits and total household income.

Landowners who raise sheep and beef cattle as their primary agricultural enterprise accepted a lower payment to convert a hectare of land from agriculture to forestry than dairy farmers. This may be because sheep and beef cattle tend to be raised on lower value land and these landowners may be more willing to convert a hectare of land to forestry at a lower payment.

Landowners who live off the property accepted lower payments than those who live on the property. Absentee landowners may accept a lower payment because they are more likely to

make decisions from a financial perspective than from an emotional perspective. Landowners living off the property may have less non-monetary amenities attached to various land uses and simply choose the land use with the best financial return.

In this survey, landowners were asked the reasons they found it important to own forest land. Landowners were asked to rate various objectives from one to five, with one being “not important” and five being “very important”. In the analysis, income from carbon was combined into three groups. Landowners who rated income from carbon either one or two were combined to form a “low interest” group. Landowners who rated it three were labelled as a “medium interest” group and those who rated it four or five were combined to form a “high interest” group. Grouping them in this way allowed for a similar number of landowners in each group. Landowners who had a medium or high interest in owning land for the income from carbon accepted lower payments than those who had a low interest in income from carbon. This may indicate that landowners most interested in owning land for the income from carbon were familiar with existing carbon programmes and markets and were willing to receive a lower payment. They may have enough awareness of programmes to compare the payments offered in the survey to the payment they might receive if enrolled in the AGS or the annual payments they might receive from selling carbon credits.

Landowners from higher income groups accepted lower payments than other landowners to convert a hectare of land from agriculture to forestry. Landowners who were a member of households earning more than $100,000 per year accepted lower payment offers than those in households earning less than $50,000 per year. This may be because higher earners have more money and possibly more access to capital to finance the start-up costs for forestry and they have the financial security to wait up to 30 years for the returns from the investment. A study of forest landowners in four South Island districts investigated the factors important to decisions to

plant and the extent of plantations. It found that constraints to planting more forests were primarily financial, with key factors being landowner income and access to capital (Dhakal, et al., 2008). They concluded that with more access to capital and greater awareness of tax rules, landowners would expand forest plantations.

Two additional effects were excluded from the final model. Landowners were asked to rate the importance of recreation in owning forest land. Those who rated recreation as very important required higher one-time payments than landowners with little interest in recreation. This effect was not significant for the annual payments or the ANOVA tests of either the annual or one-time payments. Recreation was only found to be significant in the random one-time payments offered to landowners. The second effect was land conversion in the past ten years. Landowners who had converted land from agriculture to forestry or from forestry to agriculture in the past ten years required significantly higher annual payments than landowners who had not converted land. This effect was not significant in the one-time payments or the ANOVA tests. It was only significant in the random annual payments offered to landowners. Only effects that were significant in both the annual and one-time payments were included in the final econometric model.

CHAPTER EIGHT-CONCLUSIONS

8.1 Introduction

A survey of 728 small forest landowners from every region of New Zealand revealed they are a diverse group and in addition to forestry they manage sheep, beef and dairy cattle, deer, chickens, pigs, bees, orchards and other crops. They confront a variety of challenges that can complicate their equally varied land management goals.

In New Zealand, landowners own land primarily for the income from timber and environmental reasons. Recreation is not an important reason for owning forest land and New Zealand landowners participate in very little recreation on their land, in contrast to landowners in other countries. This suggests that reservation prices for converting land will be higher in New Zealand than in countries where land is owned for reasons other than to generate income from timber. Landowners who own forest land primarily for recreation and other non-timber benefits will usually accept a lower payment to convert land to forestry. In this study, the key factors influencing the reservation price were; whether or not the landowner lived on the property, if one of the ownership objectives was income from carbon, the primary agricultural enterprise and the total household income.

Most forest landowners in New Zealand are happy with forestry and plan to continue replanting and managing forest land in the future. Despite the challenges, 50% of landowners responded that they thought the situation for small forest landowners was improving, while 25% thought it was staying about the same and 25% thought it was getting worse. One landowner summed up his experience with forestry by commenting, “I very much enjoy my forest. Just being in the forest gives me a lift”.

8.2 Objective One-Forest Landowners

The first objective of this study was to determine the characteristics of small forest landowners, specifically the forest land they own and their ownership objectives. Landowners from every region of New Zealand who own between 20 and 200 hectares of forest land and have another agricultural enterprise were surveyed. The survey showed that the main reason for owning forest in New Zealand was income from timber with very few landowners using their forest land for recreation. The median size of the property included in the survey was 400 hectares and the median forest plantation was 37 hectares. Planting of radiata pine peaked in 1994 and

1995 with more radiata being planted in 1994 than in all the years from 2000 to 2009 combined. A majority of respondents thought the situation for forest landowners was generally improving.

The analysis found that landowners with sheep and beef cattle were more likely than those with other property types to think things were improving for forestry while landowners with dairy cattle were more likely to respond that things were getting worse. Landowners whose primary agricultural enterprise was dairy cattle were more likely to have purchased their property on the open market and reported higher incomes than landowners whose primary agricultural enterprise was sheep and beef. Some 42.1% of landowners with dairy cattle reported total household incomes of more than $100,000 compared to 32.9% of landowners with sheep and cattle for beef.

8.3 Objective Two-Silviculture

The second objective of this study was to determine the land management preferences of small forest landowners. Most landowners are performing some type of silviculture in their forests, with 90% of landowners currently pruning. However, only 61% plan to prune in the future and an additional 19% of landowners are unsure if they will prune in the future. Only 26.4% of landowners have engaged in any commercial harvesting in the past ten years, but as their current rotation matures, 71% plan to replant on the same site. Most landowners plan to harvest their forest at age 29.

Landowners whose primary agricultural pursuit was raising sheep and beef cattle were less likely to have harvested trees in the past ten years and also less likely to prune in the current rotation. Some 5.7% of landowners whose primary agricultural enterprise was dairy production did not prune in the current rotation compared to 10.3% of those landowners with sheep and beef cattle.

Landowners who had harvested in the past ten years reported a more negative view of forestry but expressed less uncertainty over future replanting. The landowners with the smallest amount of forest, those with 20 to 100 hectares of forest, had harvested and converted less land in the past ten years than those with 100 to 200 hectares of forest. The landowners with smaller forests expressed the most uncertainty about future replanting and were less likely to feel things were improving for forest landowners.

The results of this study show that there is a relationship between whether a landowner lives on the property and land activity in the past ten years. Those who live on the property were more likely to have harvested or converted land from agriculture to forestry in the past ten years than landowners who do not reside on the property.

This study investigated regional differences in forest management and found that landowners on the North Island were more likely to prune in current and future rotations, but were less likely to have harvested in the past ten years than their counterparts on the South Island. Less than a quarter (23.0%) of landowners on the North Island had harvested in the past ten years compared to 32.3% of landowners on the South Island. Landowners from Northland and East Coast regions were more likely to prune in the current rotation. Those in Canterbury and Nelson/Marlborough were the least likely to prune in the current rotation. Landowners in East Coast were the least likely to have converted land from agriculture to forestry in the past ten years while those in the Otago/Southland region were the most likely. Landowners from the East Coast and Northland regions were the least likely to have harvested land in the past ten years while landowners from Otago/Southland and Hawkes Bay regions were the most likely to have harvested. Landowners from both Otago/Southland and Nelson/Marlborough were both

more likely to think things were getting worse for forest landowners, while landowners from the East Coast region were the most likely to respond that things were improving.

8.4 Objective Three-Reservation Prices

The third objective of this study was to determine the annual and lump sum reservation price for landowners to convert land from agriculture to forest. Landowners were offered a randomly generated annual and one-time payment for converting a hectare of agricultural land to forests. More than 50% of the landowners indicated that they would accept a one-time payment of more than $3000 and annual payments of $300.

Landowners were also offered eight payments and asked to choose the lowest payment they would accept to convert a hectare of land from agriculture to forestry. Excluding those landowners who indicated they would not accept any of the payments offered, the average one-time payment landowners would accept was $3554 and the average annual payment accepted was $360.

This research also investigated landowner characteristics that influence the reservation price. When tested by ANOVA, eight characteristics were found to have a statistically significant effect on reservation price. These characteristics were a landowner's intention to replant, pruning plans for future rotations, interest in income from carbon credits, residence on the property, bequest motives, total household income, education level and gender.

Landowners who plan to replant forests on the same site accepted lower annual and one-time payment offers to convert a hectare of land from agriculture to forestry. On average, they accepted one-time payments of $3469 while those not intending to replant accepted one-time payments of $4114. Landowners who were unsure about replanting on the same site would

accept payments of $3724. When offered annual payments, landowners who plan to replant accepted annual payments of $351 and those not intending to replant accepted payments of $416. Landowners who were unsure about replanting on the same site accepted payments of $376.

Landowners planning to prune their trees in future rotations accepted lower payments than those who would not prune in future rotations. Those landowners who plan to prune in future rotations accepted a one-time payment of $3451 while those who do not plan to prune in the future would accept a one-time payment of $3855. Landowners who were unsure about pruning in future rotations accepted a one-time payment of $3638. The annual payments accepted were similar, with landowners who planned to prune in the future accepting a payment of $349 while those who did not plan to prune accepting a payment of $388. Landowners who were unsure about pruning in future rotations accepted a payment of $369.

Landowners who indicated that they were interested in owning land for the income from carbon credits accepted lower payment offers than those who were not interested in income from carbon. Landowners who expressed interest in owning land for the income from carbon accepted an average one-time payment of $3356 while those who were not interested in carbon income accepted an average payment of $3751. When asked about annual payments, landowners who were most interested in carbon income accepted an average annual payment of $357 while those who were least interested in the income from carbon accepted an annual payment of $387.

Landowners who did not reside on the property surveyed accepted lower payments than those who do. Landowners who live on the property indicated that they would accept an average one-time payment of $3718 while the average for those who reside off the property was $3165. As

for the annual payment option, landowners who reside on the property would accept an annual payment of $374 while landowners living elsewhere would accept a lower payment of $325.

Landowners planning to sell the property in the future accepted lower payments than landowners who planned to leave the property to heirs. Those who planned to leave the land to heirs accepted an average one-time payment of $3690 and an average annual payment $371. Those planning to sell their land accepted an average one-time payment of $3346 and an average annual payment of $342.

Landowners who were members of a household earning more than $100,000 per year accepted lower payments than those in households earning less than $50,000 per year. Landowners in the lowest income category (households earning less than $50,000) accepted an average one-time payment of $4153 while those in households earning more than $100,000 accepted an average one-time payment of $3179. For the annual payment offer, landowners in the lowest income category accepted an average offer of $415 while those in households earning over $100,000 accepted an average offer of $322.

Landowners with a tertiary education accepted lower payments than those who had not completed secondary school. Landowners who had some university education accepted an average one-time payment of $3179, while landowners with only a secondary education accepted an average one-time payment of $3508. Those landowners with less than a secondary education accepted an average one-time payment of $4153. In regards to the annual payment offers, landowners who had completed some university accepted an annual payment of $322 while landowners with a secondary education would accept $358. Those landowners with less than a secondary education accepted an annual payment of $415.

A final significant factor was that men accepted lower payments than women to convert a hectare of land from agriculture to forestry. Female respondents accepted higher average annual and one-time payments to convert a hectare of land to forestry. They accepted an average one-time payment of $3889 and an average annual payment of $389 to convert a hectare of land. Males accepted an average one-time payment of $3529 with an average annual payment of $358. The gender effect may not be important, as decisions to convert land would most likely be made by more than one member of the household.

8.5 Objective Four-Implied Discount Rate

The fourth objective was to calculate the implied discount rate for small forest landowners. This study has found the average after-tax discount rate for landowners was 9.7%. Landowners in the Central North Island had the highest implied discount rate of 10.6% while landowners from Otago/Southland had the lowest discount rate of 9.1%.

The two variables that were statistically significant in regards to the discount rate were whether the owner managed the property themselves and if harvesting had been done in the past ten years. Landowners who managed the property themselves and had not harvested in the past ten years had a lower discount rate than landowners who employed a farm manager or had harvested in the past ten years. Those who managed the property themselves indicated an average discount rate of 9.6%, while landowners not managing the property themselves indicated a discount rate of 10.8%. Landowners who had harvested in the past ten years had an average discount rate of 9.2% while landowners who had not harvested in the past ten years had an average discount rate of 9.9%.

8.6 Objective Five-Econometric Models for Afforestation

The fifth objective of this study was to determine which landowner demographics and preferences influence afforestation. An econometric model identifying the key predictors to landowner afforestation was completed using logistic regression and the random payments offered to landowners. This study used a survey that collected demographic information and a number of landowner preferences. Significant effects that were included in the final logistic regression model were; whether the landowner lives on or off the property, the landowner's interest in owning land for the income from carbon, total household income, gender and primary agricultural enterprise. Landowners who reside off the property accept lower payments than those who live on the property. Landowners who were interested in owning land for the income from carbon accepted lower payments than those who were not interested. Landowners with household incomes above $100,000 accepted lower payments than landowners whose household income is under $100,000. Landowners whose primary agricultural enterprise was raising sheep and beef cattle accepted lower payments than those who were dairy landowners. This model is useful for identifying landowners who may be the most likely to covert land to forestry which could aid in the design and implementation of afforestation incentive programmes.

CHAPTER NINE-RECOMMENDATIONS

This study makes some key findings, which provide policy recommendations and future research needs. One of the key findings is that notable market imperfections exist for small forest landowners. These landowners do not have the same information as professional foresters, large forestry companies and timber buyers regarding planting rates, silviculture, harvest costs and actual costs of planting and maintaining forest plantations. This market imperfection leads small forest landowners to feel very uncertain about the future.

Recommendation One: Provide small landowners with better information on silviculture and land management. Many small landowners are pruning now but are not sure if they will prune or replant in the future, which could be remedied by information and contact from professional foresters. While a decision to prune is individual to each landowner and depends on predictions of future price differentials, landowners may not know how to determine if the increased returns from pruned logs are worth the costs. Research in other countries has shown that after log prices, the most important factor in whether landowners choose to replant is contact with a professional forester prior to harvesting (Royer, 1987). This information could be provided via workshops, printed literature or direct contact with landowners. New Zealand does not currently have an agricultural extension program similar to the Cooperative Extension System in the United States but a similar outreach program through the university would be an appropriate way of delivering landowner education. Cooperative Extension is a non-credit educational program designed to help agricultural producers, small business owners, youth and others use research-based knowledge to improve their lives. The service is funded by the government and the educational services are provided by the university.

Recommendation Two: Educate small landowners on institutional arrangements such as the ETS and AGS. Afforestation efforts for small landowners should be different for various

groups. The results of this study indicate that household income, living off the property, type of agricultural enterprise and their interest in earning income from carbon programmes are the most important variables in a landowner's decision to convert land. Many landowners commented that they did not understand the ETS or did not trust the intentions of the government. Several landowners cited negative experiences with previous government programs. Landowners need to be educated on the details of the programmes and the advantages and disadvantages for their specific property. This survey was conducted before an outreach effort by MAF that included landowner seminars and workshops throughout the country. It is not possible to understand the effect of those workshops from the results of this survey. Future workshops could be targeted to landowners who are most likely to convert land to forestry.

Recommendation Three: Work with landowners to explain the planting surge of the mid 1990s to avoid all landowners trying to harvest in the same time period. Educating landowners about the increase in plantings may help avoid a harvesting surplus and help landowners achieve the best prices. MAF analysed five different harvesting scenarios based on the wood availability from 2010 to 2040 (MAF, 2010b). The first two scenarios assume small forest landowners harvest at 30 years with different harvesting for large forest landowners. The last three scenarios are based on yield regulation and harvesting is timed over several years. The last three scenarios are more likely to occur, due to the logistical constraints created by all small landowners trying to harvest in the same year (MAF, 2010b). However, results from this study indicate small forest landowners are planning to harvest at 30 years, meaning without better information landowners may not understand the coming harvesting surge. Surveys show that landowners who had a positive harvesting experience are more likely to replant and keep the land in forestry (Royer, 1987). Educating landowners about the planting spike and trying to smooth out the upcoming harvesting would be helpful to logging contractors, sawmills and

forest exporters. The benefit to these groups should entice them to play a major role in the education of small landowners.

Recommendation Four: Research the importance of adjacent landowners. Forests have been studied for their complex interactions across ecosystems and biologists have long recognised the importance of adjacent stands. The same interactions should be investigated for small forest landowners. The actions of one landowner may affect the welfare of adjacent or nearby landowners. There needs to be more research investigating how a landowner's silviculture and land use decisions are influenced by adjacent or nearby landowners. Forest landowners may already be making land use decisions by anticipating or reacting to the management decisions of nearby landowners. For example, indecision about pruning in future rotations may be related to not knowing what neighbouring landowners plan to do in the future. A majority of landowners in this survey pruned in the current rotation and it would be useful to investigate how adjacent landowners may have influenced this decision.

Recommendation Five: Investigate the potential for forest landowner cooperatives. Cooperatives can be formal or informal. It is important to investigate the effect of market imperfections on incentives for forest landowners to enter into cooperative forest management. The three main advantages to forest landowners in New Zealand would be to hedge risk, share information and increase profits. Landowners in this study cited uncertainty about replanting, pruning and government programmes. Landowners surveyed commented that they were uncertain what returns to expect from forestry. Forest cooperatives may eliminate some of the uncertainty for forest landowners. Landowners in the US cite the most important determinants in deciding whether to enter a forest cooperative are higher revenues, reduced cost of management and access to information about the benefits of coordination (Jacobson, 2002). Previous studies investigated whether landowners are willing to cooperate but it may be

advantageous to explain to landowners the problems a lack of cooperation produces in forest management. There is some work to develop forest cooperatives in New Zealand (Levack, 2012). Levack cites several reasons for the absence of forest cooperatives in New Zealand including a lack of understanding of the benefits, a culture of independence, reluctance to be first (landowners prefer to join after a critical mass of landowners have joined) and an unfair tax on forestry (Levack et al., 2010). Under the New Zealand tax system, landowners may not deduct the cost of trees in the year they were purchased and instead must hold the expense of the purchase until the trees are harvested and sold, an additional burden landowners refer to as "cost of bush" (Levack, 2010).

Recommendation Six: Further research on reservation prices of small landowners for other forest decisions. Reservation prices exist for other landowner decisions including harvesting trees, forest management and selling land. The reservation price strategies of landowners for other land use decisions could be investigated for all of New Zealand or focused on areas affected by urbanisation or a high possibility of land subdivision. It is assumed that small landowners have the same information as large land managers regarding prices for harvesting, but evidence from this survey suggests there may be some asymmetry in the market. Research should be conducted to understand the costs to those landowners without perfect information.

Recommendation Seven: Additional research on discount rates for landowners. This study calculated the implied discount rate based on the payment offered. Landowners may not be able to identify the discount rate they require for forestry but are likely to understand the relative risk or returns of a forestry investment compared to other investments. Research investigating discount rates for small forest landowners is useful to determine the discount rates they consider acceptable for specific forestry investments. Individual landowners differ in total wealth, current income, other opportunities for earning, age and aversion to risk; whereas forest

investments vary in scale, duration, risk and other important factors. Research should investigate how these and other factors affect the discount rate. It would be useful to compare forestry discount rates to those of investments elsewhere in the economy with a similar duration to forestry. Another study may look at how cooperative programmes that help hedge risk affect the discount rate. This study found small forest landowners to have a higher after-tax discount rate than large forest landowners. There are many opportunities for future research examining the implications of the differences in discount rates between these landowner groups. It would be useful to develop a better understanding of the social costs market asymmetries impose on landowners and the implications for future market conditions.

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APPENDIX ONE-LANDOWNER SURVEY

PRENOTICE

Dear NAME,
I am writing to ask for your help with an important study being conducted by the University of Canterbury to understand why landowners choose to plant forests. In the next few days you will receive a request to participate in this project by answering questions about your land. Your answers will remain completely confidential.

We are writing in advance because many people like to know ahead of time that they will be asked to fill out a questionnaire. This research can only be successful with the help of knowledgeable people like you. The survey should take about 20 minutes to complete and we hope you will take the time to help us with our research.

Kind Regards,
Julie Rodenberg

SURVEY

09 August 2010

123 Anystreet

Illam Christchurch 8041

Dear Forest Landowner,

You are invited to participate in this Small Scale Private Landowner Survey by completing the following questionnaire. It is estimated that 30% of the plantation forests in New Zealand are owned by small landowners and you have been selected to participate in this survey intended for landowners with less than 200 hectares in plantation forest. Researchers at the University of Canterbury are trying to determine what factors cause landowners to establish forests on open or agricultural land or to keep the land in farming. We are interested in what landowner characteristics and preferences influence decisions to plant forests and the nontimber benefits landowners receive from owning forest land. Your answers to these questions will be very important in future predictions about New Zealand's economy and natural resource base. In this survey, we will be asking you questions about how much money you would need to receive in order to switch your land from agricultural uses to forestry. Please answer each question truthfully. There is no "right" or "wrong" answer so please think about each one carefully and answer as if you faced the situations we are describing. Your participation is voluntary and you may skip any question that you do not wish to answer.

The project is being carried out as a PhD project by Julie Rodenberg (julie.rodenberg@pg.canterbury.ac.nz) under the supervision of Associate Professor Bruce Manley who can be contacted at 03 364 2122 or at bruce.manley@canterbury.ac.nz. He will be pleased to discuss any questions you may have about participation in the project.

The questionnaire is confidential and you will not be identified as a participant. Your information will be stored in our database only by a number and not by your name or address. By completing the questionnaire it will be understood that you have consented to participate in

the project, and that you consent to publication of the results of the project with the understanding that anonymity will be preserved.

This survey should take about 20 minutes to complete. Thank you very much for taking the time to help us with our research.

Many Thanks,
Julie Rodenberg

1. In your opinion, are the benefits of being a forest landowner:
   _____ Getting better
   _____ Getting worse
   _____ Staying about the same

2. How many hectares of land do you own? _____

3. What type of farm do you have (Example: Sheep, sheep and beef, arable, dairy, deer, etc.)?
   _____

4. What are your total livestock units?
   _____ Sheep
   _____ Beef
   _____ Dairy
   _____ Pigs
   _____ Deer
   _____ Other (please explain: _____)
5. Approximately how many hectares of land are:
   _____ Plantation forest
   _____ Native forest
   _____Crops
   _____Open/shrub land
   _____Water
   _____ Other (please explain: _____)

6. Could you tell us what forest species you have and the approximate area?

Tree Species	Number of Hectares	Age	Previous Land Use

7. In the past ten years have you converted any land from agriculture to forestry or forestry to agriculture? **Yes/No**
8. If your answer to question 7 was yes, approximately how many hectares did you convert from **agriculture to forestry**? _____
9. If your answer to question 7 was yes, approximately how many hectares did you convert from **forestry to agriculture**? _____
10. In the past ten years have you harvested any forest? **Yes/No**
11. If yes, at what ages? _____
12. At what rotation age are you planning to harvest your current forest(s)? _____
13. If you are planning to harvest, will you replant on the same site? **Yes/No/Don't Know**
14. Have you pruned or do you plan to prune your trees? **Yes/No/Don't Know**
15. If you have pruned or are planning to prune, to what height have you or will you prune? ____
16. Will you prune in the next rotation? **Yes/No**

Forests can provide a number of goods and services. When forests are harvested they provide considerable income for a landowner. Standing timber also provides habitat for wildlife and recreational opportunities. A forest such as radiata pine can be harvested about once every 30 years and establishing a forest costs between $500-$1500/hectare.

17. Suppose you could establish more forests on your property by converting one hectare of you open/agriculture land to forestry. Suppose you were offered a single dollar payment **once** in return for doing this. The payment would be tax free and in return you would have to keep the land in forestry or return the money. You would not retain the rights to the carbon in the first rotation. Apart from this there would be no restrictions. (i.e. you could harvest anytime and could choose the species and silviculture). Please indicate whether you would accept the **single payment** below to convert one hectare of your open/agricultural land to forestry.

    $1000 **Yes / No**

18. Question 17 asked whether you would accept a single payment once to establish forests. Now suppose you were given an **annual payment** to convert one hectare of open/agricultural land to a forest. The payment would be tax free and you would receive the annual payment for the first rotation but you would not receive any of the rights to carbon. If the land does not remain in forestry you would have to return the money. Apart from this there would be no restrictions (i.e. you could harvest when you wanted and could choose the species and silviculture). Please indicate whether you would accept the **annual payment** below to convert one hectare of your open/agricultural land to forestry.

    $100 **Yes / No**

19. Considering again a single payment to convert one hectare of land to forestry as described in question 17. Please circle the lowest **single payment** you would accept.

    $1000/ha
    $2000/ha
    $2500/ha
    $3000/ha
    $3500/ha
    $4000/ha
    $4500/ha
    $5000/ha

20. Consider again an annual payment to convert one hectare of land to forestry as described in question 18. Please circle the lowest **annual payment** you would accept.

    $100/ha
    $200/ha
    $250/ha
    $300/ha
    $350/ha
    $400/ha
    $450/ha
    $500/ha

21. If you would not convert a hectare of land to forest at any price, please explain why:

    _____

22. Assuming that you would convert a hectare of land, what is the current use of the hectare of land? If livestock, please include the current livestock units.

_____

23. What is the general description of the hectare of land that you would convert to forest? (If known, please include the slope, aspect, and annual rainfall).

_____

24. Is the land in the survey your primary residence? **Yes/No**
25. If no, how far is it from your primary residence? _____ kilometres
26. What region of New Zealand is your property located? _____ (Canterbury, Northland, etc)
27. How did you acquire your land?
    ___ Purchase on market
    ___ Purchase from family trust
    ___ Other (please explain: _____)
28. Do you farm the land yourself? **Yes/No**
29. If no, do you rent the land to farm tenants? **Yes/No/Other (please explain_____)**
30. There are many different types of landownership. Please check all that apply to your property.
    ___ Individual or joint ownership
    ___ Trust or estate
    ___ Family partnership or corporation
    ___ Business partnership
    ___Club or association
    ___ Nonprofit organization
31. What do you plan to do with your land in the future?
    ___ Leave it all to heirs or sell it to the family trust
    ___ Leave some to heirs or sell some to the family trust (If so, how many hectares? ____)
    ___ Sell it

The following four questions ask about the demographics of your household. These questions are to ensure that we have a cross section of people from New Zealand and your answers will remain completely anonymous.

32. What is your age? _____ years
33. Sex Male/Female
34. What is the highest level of education that you completed?
    ___ No formal education
    ___ Primary school
    ___ Intermediate school
    ___ Secondary school
    ___ Some University
    ___ University (Please specify highest degree and major): _____
35. What is your approximate gross household income?
    ___ Less than $25,000
    ___ $25,000 to $49,999
    ___ $50,000 to $99,999
    ___ $100,000 to $199,999
    ___ $200,000 or greater

36. How important are the following reasons for owning your forest land? (1 is not important, 5 is very important)

Reason	Rating				
	1(not important)	2	3	4	5(very important)
Environmental reasons (examples: protection of habitat, water quality, protection against soil erosion)					
Scenic beauty					
Recreation (examples: hunting, fishing, walking, observing wildlife)					
To keep for future generations					
Income from timber					
Land investment/real estate/capital investment					
Income from carbon					

37. Many people use their forest land for reasons besides timber production. Please indicate the importance of the following activities on your forest land (1 is not important, 5 is very important)

Activity	Rating					
	Not applicable	1(not important)	2	3	4	5(very important)
Hunting						
Fishing						
Walking/tramping						
Horseback riding						
Camping						
Cycling						
Photography						
Observing wildlife						
Bird watching						
Flower, plant, or berry picking						
Other (please explain):						

Thank you very much for taking the time to respond to this survey. If you have additional comments, please let us know. If you would like a copy of the results, include your email or postal address below. Your answers will still remain confidential. Please return the survey in the envelope provided.

APPENDIX TWO- HUMAN ETHICS COMMITTEE APPLICATION

This form should be completed in the light of the Principles and Guidelines issued by the Human Ethics Committee. Applicants must read those before filling out the application form. The latest versions of both the Guidelines and the Application Form can be found on the website of the Human Ethics Committee.
website:http://www.canterbury.ac.nz/humanethics

NOTE:- <u>This electronic copy may not have sufficient space for completion of all parts of the form if downloaded as a blank copy of the application form. It is intended as a template for use by those staff and students who have access to a word processor. When typing in please type where the paragraph marks start after each question, not in the actual boxes.</u>

Staff members are reminded that the guidelines and the application form are subject to occasional amendment.

PLEASE SEND **<u>twelve</u>** printed or typed copies of the completed form, duly signed by applicant and supervisor or Head of Department, and of the relevant documents referred to in questions 3, 7, 8, 9, 10, 11, 15 to the HEC Secretary, Level 6, The Registry

---

1. PROJECT NAME: Testing the Afforestation Reservation Price of Small Landowners in New Zealand

2. NAME OF APPLICANT:
Julie Rodenberg
Contact Telephone No:
02102546746
UNIVERSITY DEPARTMENT (or other contact address):
Forestry
email address (if available):
jmr181@student.canterbury.ac.nz
STATUS OF PROJECT (e.g., EDUC XYZ class project, M.A., M.Ed., M.Sc., Ph.D., Staff research study)
Ph.D.
SUPERVISOR:
Bruce Manley
OTHER INVESTIGATORS:

SIGNED BY: Applicant: ..... Date:

HOD/Supervisor: ..... Date:

A check page at the end of this application must also be signed by the applicant and, if the applicant is a student, by the applicant's supervisor

			Delete which ever is in-applicable
3	(a)	WILL THE PROJECT REQUIRE ETHICAL APPROVAL FROM OTHER BODIES? e.g. Health and Disability Ethics Committee If Yes please explain how this approval has been or will be obtained, enclosing copies of relevant correspondence.	**No**
	(b)	WILL THE PROJECT REQUIRE APPROVAL FOR ACCESS TO THE PARTICIPANTS FROM OTHER INDIVIDUALS OR BODIES? (e.g., parents, guardians, school principals, teachers, boards, responsible authorities, etc.) If Yes please explain how this approval has been or will be obtained, enclosing copies of relevant correspondence	**No**
4	(a)	IS THE PROJECT BEING EXTERNALLY FUNDED? If Yes, please identify the source of funds.	**No**
	(b)	IS THE PROJECT COMMISSIONED BY, OR CARRIED OUT ON BEHALF OF AN EXTERNAL BODY? If Yes, please identify the body.	**No**

A. DESCRIPTION OF THE PROJECT

Answer the following questions in language which is, as far as possible, comprehensible to lay people.

5 AIM

(a) What is the objective of the project?

The objective of this research is to determine the landowner characteristics that impact the reservation price for converting one hectare of agricultural land to forest and the landowner characteristics and preferences impact decisions to plant forests.

(b) Describe the type of information sought.

The survey will gather data about the prices at which a landowner will choose to give up agriculture and commence forestry on a hectare of land. The survey will include four types of questions including a description of the land, current silviculture, background of the landowner, and the reservation prices for converting land.

(c) Give the specific hypothesis, if any, to be tested.

The hypothesis is that an interest in non timber factors such as environmental preferences, bequest motives, and recreational activities will lower the bid acceptance decision for landowners.

6 PROCEDURE

Describe in practical terms how the participants will be treated, what tasks they will be asked to perform, etc. Indicate how much time is likely to be involved in carrying out the various tasks.

Participants will be mailed a questionnaire that should take about 20 minutes to complete.

7 DOES THE PROJECT INVOLVE A QUESTIONNAIRE? **Yes**

Yes-a copy of the questionnaire is attached

8 (a) DOES THE PROJECT INVOLVE A STRUCTURED INTERVIEW? **Yes**

Pilot study will include a phone interview of approximately 20 individuals.

It will be confidential. They will be read the questions from the survey in order to gauge understanding of the phrasing of the questions. The individuals will be contacted via a follow up email that includes the recorded answers to the questionnaire and they will be asked to ensure that they agree with their answers and give consent for them to be used in the pilot study.

(b) DOES THE PROJECT INVOLVE AN UNSTRUCTURED INTERVIEW? **No**

If Yes, please list the range of topics likely to be discussed.

(c) IF THE PROJECT INVOLVES AN INTERVIEW OF EITHER TYPE, WILL IT BE RECORDED BY: AUDIO-TAPE **No**

OR VIDEO-TAPE?

(d) WILL THE PARTICIPANTS BE OFFERED THE OPPORTUNITY TO CHECK THE TRANSCRIPT OF THE INTERVIEW? **Yes**

B. PARTICIPANTS

9 (a) WHO ARE THE PARTICIPANTS?

Landowners with less than 200 hectares of plantation forest and some land in agriculture and forestry

(b) HOW ARE THEY TO BE RECRUITED?

Recruitment is by letter. A copy of the letter is attached.

(c) WILL ANY FORM OF INDUCEMENT BE OFFERED? **No**

If Yes, please give details and a brief justification.

(d) IF A SELECTION FROM A GROUP IS NECESSARY, HOW WILL IT BE MADE?

Random selection

(e) HOW MANY PARTICIPANTS (OF EACH CATEGORY, WHERE RELEVANT) DO YOU INTEND RECRUITING?

1000 landowners with less than 200 hectares of plantation forest in New Zealand will be mailed letters.

C. INFORMATION AND CONSENT

10. WHAT INFORMATION IS BEING GIVEN TO PROSPECTIVE PARTICIPANTS?

Please attach a copy of the Information Sheet (or sheets if there are different categories of participant or if responsible persons, other than participants, need to be informed).

Information sheet is attached

If information is being supplied orally, please provide a full description of the information provided.

[NOTE:- Projects which involve only an anonymous questionnaire may not necessarily require a separate information sheet, provided that the rubric of the questionnaire includes your name and contact number as well as the other points contained in the model shown in the GUIDELINES. In general, however, the HEC recommends that participants be given an information sheet, which they may retain, unless there are good reasons against such a procedure.]

11 HOW IS INFORMED CONSENT TO BE OBTAINED?

	(a)	The research is strictly anonymous, an information sheet is supplied and informed consent is implied by voluntary participation in filling out a questionnaire (include a copy of the rubric for the questionnaire as in Appendix C of the Guidelines)	**No**
or	(b)	The research is not anonymous, but is confidential and informed consent will be obtained through a signed consent form (include a copy of the consent form and information sheet)	**Yes**
or	(c)	The research is neither anonymous nor confidential and informed consent will be obtained through a signed consent form (include a copy of the consent form and information sheet)	**No**
or	(d)	Informed consent will be obtained by some other method. (please specify and provide details)	**No**
	(e)	Where confidentiality is promised, what will be done to ensure that the identities of participants cannot be known by unauthorized persons? (e.g. use of pseudonyms and disguising of identifying material) Participants will only be identified by a number in the in the database and not by a name or number.	

[Note:- Separate information sheets and consent forms may be required if there are different categories of participant, or if consent is needed from responsible persons, other than participants.]

12 ARE THE PARTICIPANTS COMPETENT TO GIVE INFORMED CONSENT ON THEIR OWN BEHALF? **Yes**

If No, please explain:
(a) why they are not competent to give informed consent on their own behalf.
(b) how consent will be obtained.

D. RISK, DECEPTION, PRIVACY

13. WHERE WILL THE PROJECT BE CONDUCTED? In their own homes. They will answer the questionnaire at their own convenience

14. FORESEEABLE RISKS TO THE PARTICIPANTS
(a) Is there any risk to physical well-being? **No**
(b) Could participation involve mental stress or emotional distress? **No**
(c) Is there a possibility of giving moral or cultural offence? **No**

If the answer to any of those questions is "Yes", please indicate briefly the nature of the risk and what actions you could take, or support mechanisms you could rely on, if a participant should become injured, distressed or offended while taking part in this project.

15. IS DECEPTION INVOLVED AT ANY STAGE OF THE PROJECT? **No**

[NOTE: The use in the information sheet or consent form or questionnaire of a title which differs from the project title given in this application form, in order not to reveal the real aim of the project, is considered to be a form of deception - however mild.]

If Yes, please
(a) explain how and why it is to be used and how the participants will be 'debriefed' following their participation in the project.

(b) attach a copy of the debriefing sheet prepared for use by the researcher or for distribution to the participants after their participation in the project or after the completion of the project.

16. WILL INFORMATION ABOUT THE SUBJECTS BE OBTAINED FROM THIRD PARTIES? **Yes**

If Yes, please state:
(a) the identity of the third party or parties.
AgriBase

(b) why such information is needed.
Will provide the address of the landowners needed for the survey.

(c) whether appropriate consents for access to such information have been or will be obtained.
Do not need consent as we are only accessing the name and address of landowners. The information provided by AgriBase is public information.

(d) whether the use of such data in your research project needs the consent of the participants.
Do not need consent of participants because AgriBase is only providing names and addresses of landowners that meet the criteria for the research.

[NOTE: It may happen that by virtue of your job, you have right of access to information concerning the participants. Such information may have been given by the participants for a particular purpose or collated by yourself or colleagues in the normal course of your

job. The use of such information for a quite different purpose (i.e., a research project culminating in some form of report) may well require that potential participants at least be informed that their agreement to participate may involve such use. The Information Privacy Principles should be consulted for guidance in this area.]

F. DATA STORAGE AND FUTURE USE

17 HOW WILL THE DATA BE STORED?

(a) Where will the data with identifying information be securely stored?
There won't be any identifying information available

(b) Where will the data with no identifying information be securely stored?
The data will be stored on a laptop only accessible to the student and will be frequently backed up on an external drive which is password protected and only accessible by the student.

Note: All storage facilities should be locked and should be in rooms which can be locked.

(c) Who will have authorised access to the data? Julie Rodenberg and Bruce Manley

(d) What will be done to ensure that unauthorised persons do not have access to the data? Laptop and backup drive are password protected and stored in a locked cabinet when not in use.

(e) What will happen to the raw data at the end of the project? The raw data will be destroyed in 2012 at the conclusion of the project.

18 WHAT PLANS DO YOU HAVE FOR PUBLICATION OF THE DATA?

Results of thesis will be submitted to various forestry journals for publication and thesis will be available in the library

19 ARE THERE PLANS FOR FUTURE USE OF THE DATA BEYOND THOSE ALREADY DESCRIBED? **No**

[NOTE: It may be the case that such future use should properly involve the production at an appropriate later date of additional information sheets and/or consent forms prior to such use.
In that case, copies of those additional documents should be sent to the Human Ethics Committee, along with a covering letter referring to the present project, for HEC approval.]

Secretary, Human Ethics Committee

E CHECK LIST

Please check the following items before sending the completed form to the Committee. Circle N.A. i.e., Not Applicable, where appropriate.

All the necessary signatures on page 1 have been obtained. [ ]

All the necessary approvals under Q 3 have been obtained or are the subject of correspondence of which copies are attached. [ ] or N.A.
A copy of any questionnaire, with an appropriate rubric at the beginning or accompanied by an appropriate covering page, is attached. [ ] or N.A.
A list of interview topics and, for a structured interview, a reasonably detailed list of questions, is attached. [ ] or N.A.
A copy of any advertisement, or notice, or informative letter asking for volunteers is attached. [ ] or N.A.
A copy of each information sheet required is attached. [ ] or N.A.
A copy of each consent form required is attached. [ ] or N.A.
A copy of the required debriefing sheet is attached. [ ] or N.A.

Attention to the preceding check list is intended to ensure that the application and its documentation have been thoroughly reviewed by the applicant and (where applicable) by the supervisor and that the preparation of the project is up to the standard expected of and by the University of Canterbury.

The signature of the applicant will be understood to imply that the applicant has designed the project and prepared the application with due regard to the principles and guidelines of the HEC, that all the questions in the application form have been duly answered and that the necessary documentation has been properly formulated and checked.

APPLICANT'S NAME :-
and SIGNATURE:-

_____

The signature of the supervisor will be understood to imply in addition that, in the judgment of the supervisor, the design and documentation are of a standard appropriate for a research project carried out in the name of the University of Canterbury or for training in such research.

SUPERVISOR'S NAME:-
and SIGNATURE:-

_____

For HEC use.
Comments.

Recommended action
(1) Approve
(2) Approve subject to some action (**SPECIFY)**
(3) Defer approval until applicant and/or supervisor have responded to points raised.
(4) Withhold approval and return the application for redrafting and resubmission.
(5) Reject the application and return it to the applicant with reasons given.
(6) Refer the applicant to another authority, e.g., Health and Disability Ethics Cttee.

Secretary, Human Ethics Committee

APPENDIX THREE-CORRELATION MATRIX

		Constant	ONEBIDA(1)	ONEBIDA(2)	ONEBIDA(3)	ONEBIDA(4)	ONEBIDA(5)	ONEBIDA(6)
Step 1	Constant	1.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(1)	.000	1.000	.737	.748	.749	.737	.736
	ONEBIDA(2)	.000	.737	1.000	.836	.844	.832	.834
	ONEBIDA(3)	.000	.748	.836	1.000	.869	.855	.859
	ONEBIDA(4)	.000	.749	.844	.869	1.000	.877	.876
	ONEBIDA(5)	.000	.737	.832	.855	.877	1.000	.867
	ONEBIDA(6)	.000	.736	.834	.859	.876	.867	1.000
	ONEBIDA(7)	.000	.717	.809	.832	.854	.841	.842
	SEX(1)	.000	-.082	-.105	-.094	-.080	-.096	-.067
	LANDFUT(1)	.000	-.035	-.041	-.044	.020	-.016	-.021
	LANDFUT(2)	.000	-.008	-.045	-.022	-.012	-.047	-.017
	LANDFUT(3)	.000	-.063	-.046	-.060	-.005	-.036	-.036
	RESID(1)	.000	.003	-.003	.047	.008	-.010	.016
	RESID(2)	.000	.020	.022	.065	.019	-.001	.027
	CARBON(1)	.000	.013	-.002	.007	-.046	.014	.012
	CARBON(2)	.000	.076	.014	.050	.030	.017	.004
	CARBON(3)	.000	.029	-.018	-.004	-.003	.010	.006
	CARBON(4)	.000	.055	.007	.041	.042	.036	.025
	CARBON(5)	.000	.050	-.011	.037	.033	.017	.008
	REPLANT(1)	-1.000	.000	.000	.000	.000	.000	.000

REPLANT(2)	-1.000	.000	.000	.000	.000	.000	.000
REPLANT(3)	-1.000	.000	.000	.000	.000	.000	.000
PRUFUT(1)	1.000	.000	.000	.000	.000	.000	.000
PRUFUT(2)	1.000	.000	.000	.000	.000	.000	.000
PRUFUT(3)	1.000	.000	.000	.000	.000	.000	.000
EDUCA(1)	.000	.001	.016	-.002	-.002	.021	-.011
EDUCA(2)	.000	-.136	-.007	-.005	-.008	-.013	-.001
EDUCA(3)	.000	.019	.032	.020	-.001	-.007	.013
EDUCA(4)	.000	.022	.075	.055	.058	.053	.038
EDUCA(5)	.000	.075	.084	.056	.050	.068	.036
INCOME(1)	.000	.109	.085	.087	.068	.052	.025
INCOME(2)	.000	.155	.117	.128	.080	.085	.061
INCOME(3)	.000	.081	.037	.024	.037	.026	-.004
INCOME(4)	.000	-.055	-.041	-.002	.022	.031	.002
FARMSELF(1)	-1.000	.000	.000	.000	.000	.000	.000
FARMSELF(2)	-1.000	.000	.000	.000	.000	.000	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(2)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(3)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(4)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(5)	-.149	.000	.000	.000	.000	.000	.000

FARMTYP(6)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(7)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(10)	-.149	.000	.000	.000	.000	.000	.000
FARMTYP(11)	-.003	.000	.000	.000	.000	.000	.000
FARMTYP(12)	-.149	.000	.000	.000	.000	.000	.000
HARVEST(1)	.000	-.044	-.056	-.052	-.049	-.042	-.043
PRUNE(1)	.000	.009	.048	.037	.004	-.007	.050
PRUNE(2)	.000	.052	.075	.085	.034	.033	.086
CONVER(1)	1.000	.000	.000	.000	.000	.000	.000
CONVER(2)	1.000	.000	.000	.000	.000	.000	.000
REGION(1)	.000	-.037	-.011	-.010	.001	-.013	-.020
REGION(2)	.000	-.050	-.023	-.024	-.003	-.026	-.023
REGION(3)	.000	-.038	-.024	-.020	-.001	-.034	-.024
REGION(4)	.000	-.015	-.015	-.031	-.009	-.024	-.028
REGION(5)	.000	-.041	-.020	-.010	.007	-.021	-.015
REGION(6)	.000	-.035	-.014	-.014	-.001	-.028	-.019
REGION(7)	.000	-.025	-.013	.001	.009	-.011	-.012
REGION(8)	.000	-.039	-.026	-.020	-.007	-.027	-.022
REGION(9)	.000	-.029	-.011	-.011	.006	-.021	-.019

Correlation Matrix

		ONEBIDA(7)	SEX(1)	LANDFUT(1)	LANDFUT(2)	LANDFUT(3)	RESID(1)	RESID(2)	CARBON(1)
Step 1	Constant	.000	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(1)	.717	-.082	-.035	-.008	-.063	.003	.020	.013
	ONEBIDA(2)	.809	-.105	-.041	-.045	-.046	-.003	.022	-.002
	ONEBIDA(3)	.832	-.094	-.044	-.022	-.060	.047	.065	.007
	ONEBIDA(4)	.854	-.080	.020	-.012	-.005	.008	.019	-.046
	ONEBIDA(5)	.841	-.096	-.016	-.047	-.036	-.010	-.001	.014
	ONEBIDA(6)	.842	-.067	-.021	-.017	-.036	.016	.027	.012
	ONEBIDA(7)	1.000	-.057	-.023	-.022	-.023	-.005	.004	.010
	SEX(1)	-.057	1.000	-.148	-.097	-.149	.031	.030	-.023
	LANDFUT(1)	-.023	-.148	1.000	.488	.787	-.071	-.073	-.047
	LANDFUT(2)	-.022	-.097	.488	1.000	.447	.072	.079	.001
	LANDFUT(3)	-.023	-.149	.787	.447	1.000	-.059	-.053	-.023
	RESID(1)	-.005	.031	-.071	.072	-.059	1.000	.973	-.043
	RESID(2)	.004	.030	-.073	.079	-.053	.973	1.000	-.049
	CARBON(1)	.010	-.023	-.047	.001	-.023	-.043	-.049	1.000
	CARBON(2)	.014	-.009	-.035	.026	-.048	.042	.021	.180
	CARBON(3)	-.017	-.012	.006	-.020	-.012	.040	.010	.175
	CARBON(4)	.025	.001	-.005	.014	-.047	.034	.020	.172
	CARBON(5)	-.013	.028	.020	.072	.017	.043	.044	.143
	REPLANT(1)	.000	.000	.000	.000	.000	.000	.000	.000
	REPLANT(2)	.000	.000	.000	.000	.000	.000	.000	.000

REPLANT(3)	.000	.000	.000	.000	.000	.000	.000	.000
PRUFUT(1)	.000	.000	.000	.000	.000	.000	.000	.000
PRUFUT(2)	.000	.000	.000	.000	.000	.000	.000	.000
PRUFUT(3)	.000	.000	.000	.000	.000	.000	.000	.000
EDUCA(1)	-.012	-.053	.040	.007	.016	-.041	-.042	.019
EDUCA(2)	-.004	-.041	-.016	.015	.030	-.006	.005	.005
EDUCA(3)	.016	-.082	.044	.025	.046	-.079	-.067	.073
EDUCA(4)	.046	-.089	.057	.029	.003	-.014	-.007	.032
EDUCA(5)	.060	-.052	.000	-.040	-.020	-.030	-.044	.069
INCOME(1)	.042	-.046	-.081	-.010	-.090	.201	.191	-.122
INCOME(2)	.040	-.043	-.100	-.037	-.088	.063	.052	-.022
INCOME(3)	.011	-.036	-.026	-.026	-.052	.028	.010	-.006
INCOME(4)	.009	.070	.026	-.015	-.025	.001	-.008	-.014
FARMSELF(1)	.000	.000	.000	.000	.000	.000	.000	.000
FARMSELF(2)	.000	.000	.000	.000	.000	.000	.000	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(2)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(3)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(4)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(5)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(6)	.000	.000	.000	.000	.000	.000	.000	.000

FARMTYP(7)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(10)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(11)	.000	.000	.000	.000	.000	.000	.000	.000
FARMTYP(12)	.000	.000	.000	.000	.000	.000	.000	.000
HARVEST(1)	-.031	-.016	-.069	.009	-.104	.080	.078	-.045
PRUNE(1)	.006	.021	-.039	.013	-.027	.090	.094	-.075
PRUNE(2)	.043	-.016	-.046	.032	-.042	.037	.047	-.016
CONVER(1)	.000	.000	.000	.000	.000	.000	.000	.000
CONVER(2)	.000	.000	.000	.000	.000	.000	.000	.000
REGION(1)	-.023	-.041	.025	.080	.009	.051	.033	-.023
REGION(2)	-.034	-.055	.034	.100	.020	.054	.038	-.023
REGION(3)	-.025	-.027	.018	.077	-.005	.055	.038	-.027
REGION(4)	-.036	-.033	.007	.091	-.004	.047	.033	-.015
REGION(5)	-.017	-.051	.035	.105	.029	.051	.034	-.015
REGION(6)	-.029	-.055	.037	.114	.031	.070	.055	-.036
REGION(7)	-.011	-.081	.010	.101	.017	.074	.060	-.019
REGION(8)	-.035	-.060	.018	.095	.020	.041	.027	-.013
REGION(9)	-.018	-.072	.047	.093	.049	.072	.053	-.046

Correlation Matrix

	CARBON(2)	CARBON(3)	CARBON(4)	CARBON(5)	REPLANT(1)	REPLANT(2)	REPLANT(3)

Step 1	Constant	.000	.000	.000	.000	-1.000	-1.000	-1.000
	ONEBIDA(1)	.076	.029	.055	.050	.000	.000	.000
	ONEBIDA(2)	.014	-.018	.007	-.011	.000	.000	.000
	ONEBIDA(3)	.050	-.004	.041	.037	.000	.000	.000
	ONEBIDA(4)	.030	-.003	.042	.033	.000	.000	.000
	ONEBIDA(5)	.017	.010	.036	.017	.000	.000	.000
	ONEBIDA(6)	.004	.006	.025	.008	.000	.000	.000
	ONEBIDA(7)	.014	-.017	.025	-.013	.000	.000	.000
	SEX(1)	-.009	-.012	.001	.028	.000	.000	.000
	LANDFUT(1)	-.035	.006	-.005	.020	.000	.000	.000
	LANDFUT(2)	.026	-.020	.014	.072	.000	.000	.000
	LANDFUT(3)	-.048	-.012	-.047	.017	.000	.000	.000
	RESID(1)	.042	.040	.034	.043	.000	.000	.000
	RESID(2)	.021	.010	.020	.044	.000	.000	.000
	CARBON(1)	.180	.175	.172	.143	.000	.000	.000
	CARBON(2)	1.000	.688	.717	.619	.000	.000	.000
	CARBON(3)	.688	1.000	.655	.567	.000	.000	.000
	CARBON(4)	.717	.655	1.000	.595	.000	.000	.000
	CARBON(5)	.619	.567	.595	1.000	.000	.000	.000
	REPLANT(1)	.000	.000	.000	.000	1.000	1.000	1.000
	REPLANT(2)	.000	.000	.000	.000	1.000	1.000	1.000
	REPLANT(3)	.000	.000	.000	.000	1.000	1.000	1.000
	PRUFUT(1)	.000	.000	.000	.000	.336	.336	.336

PRUFUT(2)	.000	.000	.000	.000	.336	.336	.336
PRUFUT(3)	.000	.000	.000	.000	.336	.336	.336
EDUCA(1)	-.029	.020	-.016	-.011	.000	.000	.000
EDUCA(2)	-.012	-.071	-.029	-.004	.000	.000	.000
EDUCA(3)	.053	.067	.058	.002	.000	.000	.000
EDUCA(4)	.038	.036	-.001	.022	.000	.000	.000
EDUCA(5)	.124	.074	.060	.046	.000	.000	.000
INCOME(1)	.010	-.080	-.009	-.022	.000	.000	.000
INCOME(2)	.033	-.042	.010	-.013	.000	.000	.000
INCOME(3)	-.022	-.080	-.047	-.078	.000	.000	.000
INCOME(4)	-.046	-.081	-.029	-.085	.000	.000	.000
FARMSELF(1)	.000	.000	.000	.000	1.000	1.000	1.000
FARMSELF(2)	.000	.000	.000	.000	1.000	1.000	1.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(2)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(3)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(4)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(5)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(6)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(7)	.000	.000	.000	.000	.109	.109	.109
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000

	FARMTYP(9)	.000	.000	.000	.000	.109	.109	.109
	FARMTYP(10)	.000	.000	.000	.000	.109	.109	.109
	FARMTYP(11)	.000	.000	.000	.000	.002	.002	.002
	FARMTYP(12)	.000	.000	.000	.000	.109	.109	.109
	HARVEST(1)	.046	.028	.054	-.007	.000	.000	.000
	PRUNE(1)	-.059	-.024	-.066	-.039	.000	.000	.000
	PRUNE(2)	-.043	-.015	-.046	-.034	.000	.000	.000
	CONVER(1)	.000	.000	.000	.000	-.874	-.874	-.874
	CONVER(2)	.000	.000	.000	.000	-.874	-.874	-.874
	REGION(1)	-.037	-.048	-.019	-.061	.000	.000	.000
	REGION(2)	-.018	-.036	-.014	-.046	.000	.000	.000
	REGION(3)	-.025	-.043	-.043	-.043	.000	.000	.000
	REGION(4)	-.015	-.048	-.028	-.055	.000	.000	.000
	REGION(5)	-.044	-.032	-.017	-.028	.000	.000	.000
	REGION(6)	-.034	-.060	-.042	-.056	.000	.000	.000
	REGION(7)	-.045	-.049	-.042	-.042	.000	.000	.000
	REGION(8)	-.006	-.026	-.010	-.015	.000	.000	.000
	REGION(9)	-.025	-.032	-.025	-.046	.000	.000	.000

Correlation Matrix

		PRUFUT(1)	PRUFUT(2)	PRUFUT(3)	EDUCA(1)	EDUCA(2)	EDUCA(3)	EDUCA(4)
Step 1	Constant	1.000	1.000	1.000	.000	.000	.000	.000
	ONEBIDA(1)	.000	.000	.000	.001	-.136	.019	.022

ONEBIDA(2)	.000	.000	.000	.016	-.007	.032	.075
ONEBIDA(3)	.000	.000	.000	-.002	-.005	.020	.055
ONEBIDA(4)	.000	.000	.000	-.002	-.008	-.001	.058
ONEBIDA(5)	.000	.000	.000	.021	-.013	-.007	.053
ONEBIDA(6)	.000	.000	.000	-.011	-.001	.013	.038
ONEBIDA(7)	.000	.000	.000	-.012	-.004	.016	.046
SEX(1)	.000	.000	.000	-.053	-.041	-.082	-.089
LANDFUT(1)	.000	.000	.000	.040	-.016	.044	.057
LANDFUT(2)	.000	.000	.000	.007	.015	.025	.029
LANDFUT(3)	.000	.000	.000	.016	.030	.046	.003
RESID(1)	.000	.000	.000	-.041	-.006	-.079	-.014
RESID(2)	.000	.000	.000	-.042	.005	-.067	-.007
CARBON(1)	.000	.000	.000	.019	.005	.073	.032
CARBON(2)	.000	.000	.000	-.029	-.012	.053	.038
CARBON(3)	.000	.000	.000	.020	-.071	.067	.036
CARBON(4)	.000	.000	.000	-.016	-.029	.058	-.001
CARBON(5)	.000	.000	.000	-.011	-.004	.002	.022
REPLANT(1)	.336	.336	.336	.000	.000	.000	.000
REPLANT(2)	.336	.336	.336	.000	.000	.000	.000
REPLANT(3)	.336	.336	.336	.000	.000	.000	.000
PRUFUT(1)	1.000	1.000	1.000	.000	.000	.000	.000
PRUFUT(2)	1.000	1.000	1.000	.000	.000	.000	.000
PRUFUT(3)	1.000	1.000	1.000	.000	.000	.000	.000

EDUCA(1)	.000	.000	.000	1.000	.013	.082	.188
EDUCA(2)	.000	.000	.000	.013	1.000	.025	.120
EDUCA(3)	.000	.000	.000	.082	.025	1.000	.244
EDUCA(4)	.000	.000	.000	.188	.120	.244	1.000
EDUCA(5)	.000	.000	.000	.144	.081	.188	.586
INCOME(1)	.000	.000	.000	-.030	-.013	-.176	-.028
INCOME(2)	.000	.000	.000	.021	-.049	-.042	-.028
INCOME(3)	.000	.000	.000	.018	-.019	-.027	-.026
INCOME(4)	.000	.000	.000	.057	-.003	.008	.049
FARMSELF(1)	-.924	-.924	-.924	.000	.000	.000	.000
FARMSELF(2)	-.924	-.924	-.924	.000	.000	.000	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(2)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(3)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(4)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(5)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(6)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(7)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	-.412	-.412	-.412	.000	.000	.000	.000
FARMTYP(10)	-.412	-.412	-.412	.000	.000	.000	.000

	FARMTYP(11)	-.008	-.008	-.008	.000	.000	.000	.000
	FARMTYP(12)	-.412	-.412	-.412	.000	.000	.000	.000
	HARVEST(1)	.000	.000	.000	-.072	.017	-.063	-.058
	PRUNE(1)	.000	.000	.000	-.013	-.024	-.048	.058
	PRUNE(2)	.000	.000	.000	.004	-.024	-.024	.057
	CONVER(1)	-.627	-.627	-.627	.000	.000	.000	.000
	CONVER(2)	-.627	-.627	-.627	.000	.000	.000	.000
	REGION(1)	.000	.000	.000	-.003	-.006	.018	.004
	REGION(2)	.000	.000	.000	-.035	.019	-.015	.042
	REGION(3)	.000	.000	.000	-.032	.005	.011	.026
	REGION(4)	.000	.000	.000	-.051	.015	.006	.013
	REGION(5)	.000	.000	.000	-.008	.024	-.009	.024
	REGION(6)	.000	.000	.000	-.016	.022	-.002	.043
	REGION(7)	.000	.000	.000	-.005	.027	-.001	.032
	REGION(8)	.000	.000	.000	-.010	.008	.013	.004
	REGION(9)	.000	.000	.000	-.008	.017	.005	.033

Correlation Matrix

		EDUCA(5)	INCOME(1)	INCOME(2)	INCOME(3)	INCOME(4)	FARMSELF(1)	FARMSELF(2)
Step 1	Constant	.000	.000	.000	.000	.000	-1.000	-1.000
	ONEBIDA(1)	.075	.109	.155	.081	-.055	.000	.000
	ONEBIDA(2)	.084	.085	.117	.037	-.041	.000	.000
	ONEBIDA(3)	.056	.087	.128	.024	-.002	.000	.000
	ONEBIDA(4)	.050	.068	.080	.037	.022	.000	.000

ONEBIDA(5)	.068	.052	.085	.026	.031	.000	.000
ONEBIDA(6)	.036	.025	.061	-.004	.002	.000	.000
ONEBIDA(7)	.060	.042	.040	.011	.009	.000	.000
SEX(1)	-.052	-.046	-.043	-.036	.070	.000	.000
LANDFUT(1)	.000	-.081	-.100	-.026	.026	.000	.000
LANDFUT(2)	-.040	-.010	-.037	-.026	-.015	.000	.000
LANDFUT(3)	-.020	-.090	-.088	-.052	-.025	.000	.000
RESID(1)	-.030	.201	.063	.028	.001	.000	.000
RESID(2)	-.044	.191	.052	.010	-.008	.000	.000
CARBON(1)	.069	-.122	-.022	-.006	-.014	.000	.000
CARBON(2)	.124	.010	.033	-.022	-.046	.000	.000
CARBON(3)	.074	-.080	-.042	-.080	-.081	.000	.000
CARBON(4)	.060	-.009	.010	-.047	-.029	.000	.000
CARBON(5)	.046	-.022	-.013	-.078	-.085	.000	.000
REPLANT(1)	.000	.000	.000	.000	.000	1.000	1.000
REPLANT(2)	.000	.000	.000	.000	.000	1.000	1.000
REPLANT(3)	.000	.000	.000	.000	.000	1.000	1.000
PRUFUT(1)	.000	.000	.000	.000	.000	-.924	-.924
PRUFUT(2)	.000	.000	.000	.000	.000	-.924	-.924
PRUFUT(3)	.000	.000	.000	.000	.000	-.924	-.924
EDUCA(1)	.144	-.030	.021	.018	.057	.000	.000
EDUCA(2)	.081	-.013	-.049	-.019	-.003	.000	.000
EDUCA(3)	.188	-.176	-.042	-.027	.008	.000	.000

EDUCA(4)	.586	-.028	-.028	-.026	.049	.000	.000
EDUCA(5)	1.000	.019	.052	.019	.015	.000	.000
INCOME(1)	.019	1.000	.539	.543	.415	.000	.000
INCOME(2)	.052	.539	1.000	.742	.579	.000	.000
INCOME(3)	.019	.543	.742	1.000	.656	.000	.000
INCOME(4)	.015	.415	.579	.656	1.000	.000	.000
FARMSELF(1)	.000	.000	.000	.000	.000	1.000	1.000
FARMSELF(2)	.000	.000	.000	.000	.000	1.000	1.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(2)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(3)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(4)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(5)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(6)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(7)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(10)	.000	.000	.000	.000	.000	.422	.422
FARMTYP(11)	.000	.000	.000	.000	.000	.008	.008
FARMTYP(12)	.000	.000	.000	.000	.000	.422	.422
HARVEST(1)	-.010	.060	.053	.056	.029	.000	.000

	PRUNE(1)	-.045	.075	-.023	-.048	-.060	.000	.000
	PRUNE(2)	-.028	.077	-.007	-.051	-.081	.000	.000
	CONVER(1)	.000	.000	.000	.000	.000	-1.000	-1.000
	CONVER(2)	.000	.000	.000	.000	.000	-1.000	-1.000
	REGION(1)	.067	.083	.043	.032	.116	.000	.000
	REGION(2)	.059	.090	.028	.039	.100	.000	.000
	REGION(3)	.052	.093	.035	.036	.099	.000	.000
	REGION(4)	.072	.089	.051	.050	.062	.000	.000
	REGION(5)	.066	.072	.012	.014	.089	.000	.000
	REGION(6)	.078	.086	.033	.024	.089	.000	.000
	REGION(7)	.065	.099	.051	.050	.104	.000	.000
	REGION(8)	.039	.065	.039	.027	.093	.000	.000
	REGION(9)	.076	.096	.040	.026	.088	.000	.000

Correlation Matrix

		FARMSELF(3)	FARMTYP(1)	FARMTYP(2)	FARMTYP(3)	FARMTYP(4)	FARMTYP(5)	FARMTYP(6)
Step 1	Constant	.000	-.149	-.149	-.149	-.149	-.149	-.149
	ONEBIDA(1)	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(2)	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(3)	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(4)	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(5)	.000	.000	.000	.000	.000	.000	.000
	ONEBIDA(6)	.000	.000	.000	.000	.000	.000	.000

ONEBIDA(7)	.000	.000	.000	.000	.000	.000	.000
SEX(1)	.000	.000	.000	.000	.000	.000	.000
LANDFUT(1)	.000	.000	.000	.000	.000	.000	.000
LANDFUT(2)	.000	.000	.000	.000	.000	.000	.000
LANDFUT(3)	.000	.000	.000	.000	.000	.000	.000
RESID(1)	.000	.000	.000	.000	.000	.000	.000
RESID(2)	.000	.000	.000	.000	.000	.000	.000
CARBON(1)	.000	.000	.000	.000	.000	.000	.000
CARBON(2)	.000	.000	.000	.000	.000	.000	.000
CARBON(3)	.000	.000	.000	.000	.000	.000	.000
CARBON(4)	.000	.000	.000	.000	.000	.000	.000
CARBON(5)	.000	.000	.000	.000	.000	.000	.000
REPLANT(1)	.000	.109	.109	.109	.109	.109	.109
REPLANT(2)	.000	.109	.109	.109	.109	.109	.109
REPLANT(3)	.000	.109	.109	.109	.109	.109	.109
PRUFUT(1)	.000	-.412	-.412	-.412	-.412	-.412	-.412
PRUFUT(2)	.000	-.412	-.412	-.412	-.412	-.412	-.412
PRUFUT(3)	.000	-.412	-.412	-.412	-.412	-.412	-.412
EDUCA(1)	.000	.000	.000	.000	.000	.000	.000
EDUCA(2)	.000	.000	.000	.000	.000	.000	.000
EDUCA(3)	.000	.000	.000	.000	.000	.000	.000
EDUCA(4)	.000	.000	.000	.000	.000	.000	.000
EDUCA(5)	.000	.000	.000	.000	.000	.000	.000

INCOME(1)	.000	.000	.000	.000	.000	.000	.000
INCOME(2)	.000	.000	.000	.000	.000	.000	.000
INCOME(3)	.000	.000	.000	.000	.000	.000	.000
INCOME(4)	.000	.000	.000	.000	.000	.000	.000
FARMSELF(1)	.000	.422	.422	.422	.422	.422	.422
FARMSELF(2)	.000	.422	.422	.422	.422	.422	.422
FARMSELF(3)	1.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(2)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(3)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(4)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(5)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(6)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(7)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(10)	.000	1.000	1.000	1.000	1.000	1.000	1.000
FARMTYP(11)	.000	.020	.020	.020	.020	.020	.020
FARMTYP(12)	.000	1.000	1.000	1.000	1.000	1.000	1.000
HARVEST(1)	.000	.000	.000	.000	.000	.000	.000
PRUNE(1)	.000	.000	.000	.000	.000	.000	.000
PRUNE(2)	.000	.000	.000	.000	.000	.000	.000

	CONVER(1)	.000	-.469	-.469	-.469	-.469	-.469	-.469
	CONVER(2)	.000	-.469	-.469	-.469	-.469	-.469	-.469
	REGION(1)	.000	.000	.000	.000	.000	.000	.000
	REGION(2)	.000	.000	.000	.000	.000	.000	.000
	REGION(3)	.000	.000	.000	.000	.000	.000	.000
	REGION(4)	.000	.000	.000	.000	.000	.000	.000
	REGION(5)	.000	.000	.000	.000	.000	.000	.000
	REGION(6)	.000	.000	.000	.000	.000	.000	.000
	REGION(7)	.000	.000	.000	.000	.000	.000	.000
	REGION(8)	.000	.000	.000	.000	.000	.000	.000
	REGION(9)	.000	.000	.000	.000	.000	.000	.000

Correlation Matrix

		FARMTYP(7)	FARMTYP(8)	FARMTYP(9)	FARMTYP(10)	FARMTYP(11)	FARMTYP(12)	HARVEST(1)
Step 1	Constant	-.149	.000	-.149	-.149	-.003	-.149	.000
	ONEBIDA(1)	.000	.000	.000	.000	.000	.000	-.044
	ONEBIDA(2)	.000	.000	.000	.000	.000	.000	-.056
	ONEBIDA(3)	.000	.000	.000	.000	.000	.000	-.052
	ONEBIDA(4)	.000	.000	.000	.000	.000	.000	-.049
	ONEBIDA(5)	.000	.000	.000	.000	.000	.000	-.042
	ONEBIDA(6)	.000	.000	.000	.000	.000	.000	-.043
	ONEBIDA(7)	.000	.000	.000	.000	.000	.000	-.031
	SEX(1)	.000	.000	.000	.000	.000	.000	-.016

LANDFUT(1)	.000	.000	.000	.000	.000	.000	-.069
LANDFUT(2)	.000	.000	.000	.000	.000	.000	.009
LANDFUT(3)	.000	.000	.000	.000	.000	.000	-.104
RESID(1)	.000	.000	.000	.000	.000	.000	.080
RESID(2)	.000	.000	.000	.000	.000	.000	.078
CARBON(1)	.000	.000	.000	.000	.000	.000	-.045
CARBON(2)	.000	.000	.000	.000	.000	.000	.046
CARBON(3)	.000	.000	.000	.000	.000	.000	.028
CARBON(4)	.000	.000	.000	.000	.000	.000	.054
CARBON(5)	.000	.000	.000	.000	.000	.000	-.007
REPLANT(1)	.109	.000	.109	.109	.002	.109	.000
REPLANT(2)	.109	.000	.109	.109	.002	.109	.000
REPLANT(3)	.109	.000	.109	.109	.002	.109	.000
PRUFUT(1)	-.412	.000	-.412	-.412	-.008	-.412	.000
PRUFUT(2)	-.412	.000	-.412	-.412	-.008	-.412	.000
PRUFUT(3)	-.412	.000	-.412	-.412	-.008	-.412	.000
EDUCA(1)	.000	.000	.000	.000	.000	.000	-.072
EDUCA(2)	.000	.000	.000	.000	.000	.000	.017
EDUCA(3)	.000	.000	.000	.000	.000	.000	-.063
EDUCA(4)	.000	.000	.000	.000	.000	.000	-.058
EDUCA(5)	.000	.000	.000	.000	.000	.000	-.010
INCOME(1)	.000	.000	.000	.000	.000	.000	.060

INCOME (2)	.000	.000	.000	.000	.000	.000	.053
INCOME (3)	.000	.000	.000	.000	.000	.000	.056
INCOME (4)	.000	.000	.000	.000	.000	.000	.029
FARMSELF(1)	.422	.000	.422	.422	.008	.422	.000
FARMSELF(2)	.422	.000	.422	.422	.008	.422	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(2)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(3)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(4)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(5)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(6)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(7)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(8)	.000	1.000	.000	.000	.000	.000	.000
FARMTYP(9)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(10)	1.000	.000	1.000	1.000	.020	1.000	.000
FARMTYP(11)	.020	.000	.020	.020	1.000	.020	.000
FARMTYP(12)	1.000	.000	1.000	1.000	.020	1.000	.000
HARVEST(1)	.000	.000	.000	.000	.000	.000	1.000
PRUNE(1)	.000	.000	.000	.000	.000	.000	-.122
PRUNE(2)	.000	.000	.000	.000	.000	.000	-.126
CONVER(1)	-.469	.000	-.469	-.469	-.009	-.469	.000

	CONVER(2)	-.469	.000	-.469	-.469	-.009	-.469	.000
	REGION(1)	.000	.000	.000	.000	.000	.000	.070
	REGION(2)	.000	.000	.000	.000	.000	.000	.089
	REGION(3)	.000	.000	.000	.000	.000	.000	.093
	REGION(4)	.000	.000	.000	.000	.000	.000	.080
	REGION(5)	.000	.000	.000	.000	.000	.000	.103
	REGION(6)	.000	.000	.000	.000	.000	.000	.092
	REGION(7)	.000	.000	.000	.000	.000	.000	.098
	REGION(8)	.000	.000	.000	.000	.000	.000	.101
	REGION(9)	.000	.000	.000	.000	.000	.000	.133

Correlation Matrix

		PRUNE(1)	PRUNE(2)	CONVER(1)	CONVER(2)	REGION(1)	REGION(2)	REGION(3)
Step 1	Constant	.000	.000	1.000	1.000	.000	.000	.000
	ONEBIDA(1)	.009	.052	.000	.000	-.037	-.050	-.038
	ONEBIDA(2)	.048	.075	.000	.000	-.011	-.023	-.024
	ONEBIDA(3)	.037	.085	.000	.000	-.010	-.024	-.020
	ONEBIDA(4)	.004	.034	.000	.000	.001	-.003	-.001
	ONEBIDA(5)	-.007	.033	.000	.000	-.013	-.026	-.034
	ONEBIDA(6)	.050	.086	.000	.000	-.020	-.023	-.024
	ONEBIDA(7)	.006	.043	.000	.000	-.023	-.034	-.025
	SEX(1)	.021	-.016	.000	.000	-.041	-.055	-.027
	LANDFUT(1)	-.039	-.046	.000	.000	.025	.034	.018

LANDFUT(2)	.013	.032	.000	.000	.080	.100	.077
LANDFUT(3)	-.027	-.042	.000	.000	.009	.020	-.005
RESID(1)	.090	.037	.000	.000	.051	.054	.055
RESID(2)	.094	.047	.000	.000	.033	.038	.038
CARBON(1)	-.075	-.016	.000	.000	-.023	-.023	-.027
CARBON(2)	-.059	-.043	.000	.000	-.037	-.018	-.025
CARBON(3)	-.024	-.015	.000	.000	-.048	-.036	-.043
CARBON(4)	-.066	-.046	.000	.000	-.019	-.014	-.043
CARBON(5)	-.039	-.034	.000	.000	-.061	-.046	-.043
REPLANT(1)	.000	.000	-.874	-.874	.000	.000	.000
REPLANT(2)	.000	.000	-.874	-.874	.000	.000	.000
REPLANT(3)	.000	.000	-.874	-.874	.000	.000	.000
PRUFUT(1)	.000	.000	-.627	-.627	.000	.000	.000
PRUFUT(2)	.000	.000	-.627	-.627	.000	.000	.000
PRUFUT(3)	.000	.000	-.627	-.627	.000	.000	.000
EDUCA(1)	-.013	.004	.000	.000	-.003	-.035	-.032
EDUCA(2)	-.024	-.024	.000	.000	-.006	.019	.005
EDUCA(3)	-.048	-.024	.000	.000	.018	-.015	.011
EDUCA(4)	.058	.057	.000	.000	.004	.042	.026
EDUCA(5)	-.045	-.028	.000	.000	.067	.059	.052
INCOME(1)	.075	.077	.000	.000	.083	.090	.093
INCOME(2)	-.023	-.007	.000	.000	.043	.028	.035

INCOME(3)	-.048	-.051	.000	.000	.032	.039	.036
INCOME(4)	-.060	-.081	.000	.000	.116	.100	.099
FARMSELF(1)	.000	.000	-1.000	-1.000	.000	.000	.000
FARMSELF(2)	.000	.000	-1.000	-1.000	.000	.000	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(2)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(3)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(4)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(5)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(6)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(7)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000	.000
FARMTYP(9)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(10)	.000	.000	-.469	-.469	.000	.000	.000
FARMTYP(11)	.000	.000	-.009	-.009	.000	.000	.000
FARMTYP(12)	.000	.000	-.469	-.469	.000	.000	.000
HARVEST(1)	-.122	-.126	.000	.000	.070	.089	.093
PRUNE(1)	1.000	.906	.000	.000	-.174	-.165	-.164
PRUNE(2)	.906	1.000	.000	.000	-.217	-.196	-.196
CONVER(1)	.000	.000	1.000	1.000	.000	.000	.000
CONVER(2)	.000	.000	1.000	1.000	.000	.000	.000

REGION(1)	-.174	-.217	.000	.000	1.000	.899	.926
REGION(2)	-.165	-.196	.000	.000	.899	1.000	.900
REGION(3)	-.164	-.196	.000	.000	.926	.900	1.000
REGION(4)	-.176	-.205	.000	.000	.871	.845	.866
REGION(5)	-.166	-.186	.000	.000	.902	.877	.896
REGION(6)	-.174	-.204	.000	.000	.950	.926	.947
REGION(7)	-.156	-.170	.000	.000	.903	.875	.900
REGION(8)	-.192	-.217	.000	.000	.913	.885	.908
REGION(9)	-.182	-.216	.000	.000	.921	.896	.919

Correlation Matrix

		REGION(4)	REGION(5)	REGION(6)	REGION(7)	REGION(8)	REGION(9)
Step 1	Constant	.000	.000	.000	.000	.000	.000
	ONEBIDA(1)	-.015	-.041	-.035	-.025	-.039	-.029
	ONEBIDA(2)	-.015	-.020	-.014	-.013	-.026	-.011
	ONEBIDA(3)	-.031	-.010	-.014	.001	-.020	-.011
	ONEBIDA(4)	-.009	.007	-.001	.009	-.007	.006
	ONEBIDA(5)	-.024	-.021	-.028	-.011	-.027	-.021
	ONEBIDA(6)	-.028	-.015	-.019	-.012	-.022	-.019
	ONEBIDA(7)	-.036	-.017	-.029	-.011	-.035	-.018
	SEX(1)	-.033	-.051	-.055	-.081	-.060	-.072
	LANDFUT(1)	.007	.035	.037	.010	.018	.047
	LANDFUT(2)	.091	.105	.114	.101	.095	.093

LANDFUT(3)	-.004	.029	.031	.017	.020	.049
RESID(1)	.047	.051	.070	.074	.041	.072
RESID(2)	.033	.034	.055	.060	.027	.053
CARBON(1)	-.015	-.015	-.036	-.019	-.013	-.046
CARBON(2)	-.015	-.044	-.034	-.045	-.006	-.025
CARBON(3)	-.048	-.032	-.060	-.049	-.026	-.032
CARBON(4)	-.028	-.017	-.042	-.042	-.010	-.025
CARBON(5)	-.055	-.028	-.056	-.042	-.015	-.046
REPLANT(1)	.000	.000	.000	.000	.000	.000
REPLANT(2)	.000	.000	.000	.000	.000	.000
REPLANT(3)	.000	.000	.000	.000	.000	.000
PRUFUT(1)	.000	.000	.000	.000	.000	.000
PRUFUT(2)	.000	.000	.000	.000	.000	.000
PRUFUT(3)	.000	.000	.000	.000	.000	.000
EDUCA(1)	-.051	-.008	-.016	-.005	-.010	-.008
EDUCA(2)	.015	.024	.022	.027	.008	.017
EDUCA(3)	.006	-.009	-.002	-.001	.013	.005
EDUCA(4)	.013	.024	.043	.032	.004	.033
EDUCA(5)	.072	.066	.078	.065	.039	.076
INCOME(1)	.089	.072	.086	.099	.065	.096
INCOME(2)	.051	.012	.033	.051	.039	.040
INCOME(3)	.050	.014	.024	.050	.027	.026
INCOME(4)	.062	.089	.089	.104	.093	.088
FARMSELF(1)	.000	.000	.000	.000	.000	.000
FARMSELF(2)	.000	.000	.000	.000	.000	.000
FARMSELF(3)	.000	.000	.000	.000	.000	.000
FARMTYP(1)	.000	.000	.000	.000	.000	.000
FARMTYP(2)	.000	.000	.000	.000	.000	.000

FARMTYP(3)	.000	.000	.000	.000	.000	.000
FARMTYP(4)	.000	.000	.000	.000	.000	.000
FARMTYP(5)	.000	.000	.000	.000	.000	.000
FARMTYP(6)	.000	.000	.000	.000	.000	.000
FARMTYP(7)	.000	.000	.000	.000	.000	.000
FARMTYP(8)	.000	.000	.000	.000	.000	.000
FARMTYP(9)	.000	.000	.000	.000	.000	.000
FARMTYP(10)	.000	.000	.000	.000	.000	.000
FARMTYP(11)	.000	.000	.000	.000	.000	.000
FARMTYP(12)	.000	.000	.000	.000	.000	.000
HARVEST(1)	.080	.103	.092	.098	.101	.133
PRUNE(1)	-.176	-.166	-.174	-.156	-.192	-.182
PRUNE(2)	-.205	-.186	-.204	-.170	-.217	-.216
CONVER(1)	.000	.000	.000	.000	.000	.000
CONVER(2)	.000	.000	.000	.000	.000	.000
REGION(1)	.871	.902	.950	.903	.913	.921
REGION(2)	.845	.877	.926	.875	.885	.896
REGION(3)	.866	.896	.947	.900	.908	.919
REGION(4)	1.000	.846	.896	.844	.855	.868
REGION(5)	.846	1.000	.943	.897	.905	.919
REGION(6)	.896	.943	1.000	.909	.919	.933
REGION(7)	.844	.897	.909	1.000	.910	.921
REGION(8)	.855	.905	.919	.910	1.000	.943
REGION(9)	.868	.919	.933	.921	.943	1.000