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Manatū Ahu Matua

Intentions of forest owners following harvest of post-1989 forests

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1 Executive Summary

A survey was undertaken to determine the intentions of post-1989 forest owners following harvest. The New Zealand Farm Forestry Association (NZFFA) database was used as the basis for the survey. This database was linked with the LUCAS Land Use Map (LUM) to estimate whether forests were likely to be post-1989 or pre-1990. The sample frame was the subset of the owners in the NZFFA estimated to have post-1989 forests for whom addresses were available. The final sample consisted of 4,403 owners with an estimated total area of 493,877 ha.

A total of 912 completed responses were received representing 971 responses in terms of wood supply region/size class combinations. The overall response rate was 21% in terms of number of responses. Because response rate was higher for owners with larger forests, overall responses were received for 276,439 ha, some 56% of the area of owners who were sent surveys. Main findings are:

Current species composition
- 87.1% of the post-1989 forests are radiata pine followed by 6.8% Douglas fir.

Non-harvest forest
- 6.1% of post-1989 forest is not intended to be harvested. Most of this (4.8%) is intended for carbon forestry while a further 1% is considered uneconomic for harvest. Small areas are also being retained for native forest development, shelter and conservation. The overall percentage is strongly influenced by a few owners with over 1,000 ha who are maintaining permanent carbon forests.
- The primary reason for non-harvest in the size classes under 1,000 ha is that area is now considered to be uneconomic to harvest; i.e. the area was planted with the intention of harvesting but is no longer expected to be harvested.

Rotation age
- Average rotation age for forests intended to be harvested is 27.6 years for radiata pine and 46.6 years for Douglas fir.

Intentions after harvest
- Owners intend replanting 87.6% of area in production forest and intend planting 2.3% of area into mānuka. They intend leaving a further 0.9% of area to regenerate naturally after harvest.
- Conversion is intended for 2.6% of area, within this:
    - 2.2% to sheep and beef agriculture,
    - 0.2% to dairy or dairy support,
    - 0.1% to horticulture or viticulture, and
    - 0.1% for residential or lifestyle purposes.
- Intended conversion is higher for small forests, with 8.3% for owners with less than 40 ha. Compared to 0.3% for owners with over 1,000 ha. It is also higher for non-ETS participants – 3.9% overall compared to 1.4% for ETS participants.
- There is uncertainty over intentions for the balance of 6.6% of area because:
    - 1.6% of the land is to be returned to the land owner,
    - 0.4% is intended to be sold prior to harvest,
    - 3.1% is intended to be sold after harvest in cutover state,
    - 1.5% is area for which the owner is, at this stage, unsure what they will do after harvest.
    There is greater uncertainty about smaller forests compared to larger forests.
- Owners intend replanting with similar proportions of species to the current rotation.

NZ ETS
- ETS participants who harvest intend:
    - replanting 92.8% of area in production forest,
    - planting 2% of area into mānuka,
    - leaving 0.4% of area to regenerate,
    - and are uncertain about post-harvest intentions for a further 3.4% of area.
    Owners intend to continue to participate in the ETS, with 94.4% of the replanted area expected to be registered in the ETS for the second rotation. Owners with 4.1% of currently registered area are unsure about continuing in the ETS. Owners with the remaining 1.5% of replanted area do not intend to continue in the ETS despite their intention to replant.

- Non-ETS participants who harvest intend replanting 82.6% of area in production forest, planting a further 2.5% of area into mānuka, leaving 1.4% of area to regenerate and are uncertain about post-harvest intentions for a further 9.6% of area. Owners who are replanting area that is not currently in the ETS intend entering 42.1% of this area into the ETS for the second rotation and are unsure about entering a further 23%.
- Owners typically cite $20 to $25 as the carbon price that would determine whether they would join the ETS for the second rotation.

Pruning
- Owners with over 100 ha intend to prune in the second rotation only 60-75% of the area currently pruned. However owners with less than 100 ha intend to prune a similar percentage of their area to that pruned in the current rotation.

There is uncertainty about the results. They are driven by current perceptions about forestry and alternative land uses and are subject to change. Respondents indicated a range of factors that will influence whether or not they replant including:
- The financial returns that are achieved from the current rotation.
- Environmental legislation and the ability to harvest the next rotation.
- Preferences of their children and grandchildren at the time.
- Finding new investors/partners for forests in which current owners do not want to invest in another rotation, in many cases because of age.

A limitation of the study is the low number of responses for some combinations of wood supply region, size class and ETS status, particularly for smaller forests that are not in the ETS. Allowance has been made for different response rates for different combinations in the estimation of overall averages. However in the interpretation of results, it is assumed that owners who did not respond have the same intentions as those owners who did respond in the same region/size/ETS participation combination.

The survey results will support policy formation, improve Government understanding of land use trends and help in understanding how New Zealand can reach its climate change targets.

2 Introduction

The objective of this project is to determine the post-harvest intentions of owners of post-1989 forests that are nearing harvest maturity. There is uncertainty about the proportion of these forests that will be harvested and, for those forests that will be harvested, the extent to which these planted production forests will undergo land use change, or management change following harvest.

To assist in quantifying any potential impact on New Zealand's international climate emission reduction targets and land use change impacts, the government requires information from post-1989 forest owners on their harvest/deforestation intentions. This information is required to provide an understanding of:
- Unit flows in the NZ ETS and likely future revenue and cost to the crown from future post-1989 forest deforestation.
- Potential policy options and implications to encourage forest replanting.
- Future land use and land use change and implications to the environment and GDP.
- Forestry's contribution to New Zealand reaching future climate change reduction targets.

Consequently this project was commissioned to collect and analyse information on post-1989 forest owners' intentions to continue with forestry or to change land use following harvest.

3 Approach

3.1 ESTIMATING TOTAL AREA IN TARGET POPULATION AND BREAKDOWN BY STRATA

Post-1989 forest owners are the target population for the survey. The project also requires stratification by wood supply region and NEFD size classes. A requirement for such stratification is for the area in each stratum to be known. This is required in order to weight the results of each stratum and provide an estimate for the total population.

The NEFD does provide a breakdown of area by wood supply region and size class. However these areas are for all plantations and include both post-1989 forest and pre-1990 forest. The NEFD asks respondents to differentiate forest area by rotation: First rotation versus Second or subsequent rotation. Consequently it is possible, in principle, to estimate forest area by national size class and wood supply region with only first rotation area planted post-1989 (Table 1). However this approach overestimates the post-1989 estate. The total area in Table 2 is 830,000 ha whereas according to the NEFD there has been 728,000 ha of new planting since 1989. The 2016 MfE Greenhouse Gas Inventory[1] documents a net area of 655,323 ha of post-1989 forest.

Table 1: Area (hectares) in NEFD (1st rotation) by size class and species (Source: MPI)

	<40	40-99	100-499	500-999	1000-9999	10000+	Total
Northland	31,536	6,136	8,677	5,131	16,178	25,498	93,156
Central North Island	53,533	4,949	13,124	5,531	26,577	44,217	147,931
East Coast	16,018	2,272	9,892	4,850	30,395	52,296	115,723
Hawkes Bay	20,323	2,624	7,097	2,397	6,439	40,751	79,631
Southern North Island	37,645	9,779	25,088	6,865	17,850	18,836	116,063
Nelson and Marlborough	21,914	8,523	15,743	3,195	14,518	12,205	76,098
West Coast	2,532	368	502	397	1,973	10,265	16,037
Canterbury	30,361	4,050	11,580	1,302	8,638	10,086	66,017
Otago and Southland	40,016	7,073	13,509	4,408	23,055	31,327	119,388
Total	253,878	45,774	105,212	34,076	145,623	245,481	830,044

Consequently an alternative approach to stratification has been adopted. The New Zealand Farm Forestry Association (NZFFA) has developed a database of forest growers by intersecting the LUCAS (Land Use and Carbon Analysis System) LUM (Land Use Map) with the New Zealand Digital Cadastral Database. The NZFFA database provides titles containing forest area greater than 5 ha. This database was linked with the LUCAS LUM to estimate whether the forest was post-1989 or pre-1990. The resulting estimates of post-1989 area were used to provide an estimate of the area in each wood supply region/size class combination (Table 2).

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[1] http://www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory

Table 2: Post-1989 area (hectares) by wood supply region and size class derived from NZFFA database and LUCAS LUM. Size class[2] is the estimate of the total (i.e. all of New Zealand) post-1989 area for each owner (from NZFFA database).

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Northland	15,932	8,670	15,174	13,857	53,634
CNI	16,587	10,542	2,5070	38,283	90,483
East Coast	6,369	5,053	55,057	55,659	122,138
Hawkes Bay	6,724	4,309	29,746	24,564	65,342
SNI	25,548	16,590	52,023	33,451	127,613
Marlborough	5,549	5,128	10,210	16,203	37,090
Nelson	4,520	3,626	3,156	6,120	17,421
West Coast	1,409	607	1,650	5,562	9,227
Canterbury	9,262	5,329	15,498	11,961	42,049
Otago	9,755	5,578	12,436	24,134	51,904
Southland	4,427	3,385	6,905	28,881	43,598
Total	106,082	68,817	226,926	258,675	660,499

The estimates in Table 2 are used here in preference to the NEFD data because they are based on spatial information. However they are indicative only. The NZFFA area estimates do not have a high level of accuracy for any particular owner – this became evident when returns for owners were subsequently compared with the estimates. The assumption made here is that the overall estimates of area by region and size class are reasonable.

3.2 DETERMINING THE SAMPLE FRAME

The sample frame gives the list of all those within a population who can be sampled. This was based on the subset of owners in the NZFFA database for whom addresses were available. This was further refined by selecting only those owners expected to have post-1989 forest. Any owner with estimated post-1989 area over 10 ha (with an address) was included in the sample. Owners estimated to have less than 10 ha of post-1989 forest were included in the sample if their estimated post-1989 area exceeded their estimated pre-1990 area. This test was applied on the basis that the split of pre-1990 and post-1989 forest for these owners was more likely to be an artefact of the LUCAS mapping than reality. The test was designed to avoid including owners without post-1989 forest in the sample.

This total sample selected was 4,870 owners. However 467 surveys were returned unanswered for a range of reasons, primarily because the owner was no longer at the address in the database. Consequently the final sample consisted of 4,403 owners with an estimated total area of 493,877 ha.

Table 3 provides a breakdown of post-1989 forest owners who received the survey. Because some owners have forests in more than one region, the total number of owner/region combinations is 4,579.

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[2] The original intent was to use the same 6 size classes used in the NEFD. However the relatively small number of owners in the 500-999 ha and 10,000+ ha meant that these classes were merged with adjacent classes.

Table 3: Number of forest owners included in sample by wood supply region and size class. Size class is the estimate of the total (i.e. all of New Zealand) post-1989 area for each owner (from NZFFA database).

	<40 ha	40-99 ha	100-999 ha	>1000 ha	All
Northland	484	77	49	13	623
CNI	483	89	105	18	695
East Coast	263	48	129	17	457
Hawkes Bay	191	56	92	13	352
SNI	735	161	153	20	1,069
Marlborough	122	39	42	8	211
Nelson	131	20	13	4	168
West Coast	38	6	3	2	49
Canterbury	251	47	51	7	356
Otago	300	55	33	13	401
Southland	130	34	22	12	198
	3,128	632	692	127	4,579

3.3 RESPONSE RATE

A total of 912 completed responses were received representing 971 responses in terms of region/size class combinations (Table 4). The overall response rate was 21%. The response rate varied with size class with a response rate of 61% for the >1000 ha class compared to 16% for the <40 ha class (Table 5). Overall responses were received for 276,439 ha, some 56% of the post-1989 forest area for owners who were sent surveys.

Table 4: Number of responses received by wood supply region and size class. Size class is the estimate of the total (i.e. all of New Zealand) post-1989 area for each owner (from NZFFA database).

Wood supply region	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Northland	66	17	10	5	98
CNI	78	23	17	10	128
East Coast	40	5	62	10	117
Hawkes Bay	35	8	64	8	115
SNI	120	34	62	8	224
Marlborough	21	10	12	6	49
Nelson	18	16	4	3	41
West Coast	7	0	2	2	11
Canterbury	35	9	17	4	65
Otago	45	18	7	10	80
Southland	21	0	11	11	43
Total	486	140	268	77	971

Table 5: Response rate (expressed as a percentage) for the survey by wood supply region and size class.

Wood supply region	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Northland	14	22	20	38	**16**
CNI	16	26	16	56	**18**
East Coast	15	10	48	59	**26**
Hawkes Bay	18	14	70	62	**33**
SNI	16	21	41	40	**21**
Marlborough	17	26	29	75	**23**
Nelson	14	80	31	75	**24**
West Coast	18	0	67	100	**22**
Canterbury	14	19	33	57	**18**
Otago	15	33	21	77	**20**
Southland	16	0	50	92	**22**
Total	**16**	**22**	**39**	**61**	**21**

3.4 CALCULATION OF WEIGHTED AVERAGES

Initial analysis found that 67% of respondents' area was entered into the ETS. This is higher than the estimate of 50% of post-1989 forest that has been entered in the ETS - the total area of post-1989 forest registered in the ETS in March 2018 was 327,712 ha out of the total post-1989 area of 655,323 estimated by 2016 Greenhouse Gas Inventory. This indicates that the survey response rate for ETS participants was higher than that of non-participants. Consequently an additional level of stratification was introduced to the analysis. MPI provided the breakdown of post-1989 forest registered in the ETS by wood supply region and size class; i.e. in the same format as Table 2. Initial data analysis considered the response for each combination of wood supply region and size class separately for ETS-participants and non-participants. Overall estimates were made by weighting these responses.

3.5 LIMITATIONS

3.5.1 Calculation of weighted averages
The accuracy of averages calculated for regions, size classes or nationally is dependent on the relative areas of region/size class in Table 2 being representative of the post-1989 estate.

3.5.2 Low number of responses for some combinations
The low number of responses for some combinations is in many cases a reflection of the low number of forest owners in these combinations. However it does mean that results need to be viewed with caution. Consequently, in most cases only national averages by size class are presented.

3.5.3 Post-1989 forest land
The concept of post-1989 forest land is not well understood by all respondents. Some responses included forest planted before 1990. These were easily screened out. However some of the responses included in the survey will include some area that would not be eligible post-1989 forest under the ETS. This is particularly the case where owners have not attempted to register land for the ETS and undergone the scrutiny involved in that process.

3.5.4 Different response rate
The higher response rate (a) for larger forests and (b) ETS participants indicates that owners who have the greatest interest in forestry are more likely to respond. Allowance has been made for size and ETS participation in the estimation of overall averages. However in the interpretation of results, it is assumed that owners who did not respond have the same intentions as those owners who did respond in the same region/size/ETS participation combination.

4 Findings

4.1 SPECIES

The species composition of the post-1989 plantations (Table 6), as estimated from the survey, is similar to that for the total estate estimated by the 2017 NEFD (Table 7). The survey indicates that the post-1989 plantation estate has a lower percentage of radiata pine and more Douglas fir, cypress species and eucalypts compared to the NEFD which includes pre-1990 as well as post-1989 forest.

There is a clear trend with size class - large forests have a lower proportion of radiata pine and a higher proportion of Douglas fir and eucalypts than small forests. Small forests have a higher proportion of the other species (Table 6).

There were regional patterns:
- Douglas fir is more important in the South Island than the North Island.
- The highest percentage of cypress species is in the West Coast.
- The highest percentage of other softwoods is in Canterbury. This category includes redwoods.
- The highest percentage of eucalypts is in Southland.

Table 6: Percentage of post-1989 area in different species by size class

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Radiata pine	91.1	93.2	91.8	79.7	87.1
Douglas fir	1.8	3.6	3.3	12.8	6.8
Cypress species	2.6	1.5	0.4	1.1	1.1
Other exotic softwood	1.0	0.3	1.2	1.8	1.3
Eucalypts	2.0	1.1	2.6	4.6	3.1
Other exotic hardwood	1.0	0.2	0.2	0.0	0.3
Native	0.5	0.1	0.5	0.0	0.3
Total	100.0	100.0	100.0	100.0	100.0

Table 7: Comparison of national species percentages from with survey (post-1989 plantations) with that of the 2017 NEFD (all plantations).

	Survey	NEFD
Radiata pine	87.1	90.0
Douglas fir	6.8	6.1
Cypress species	1.1	0.6
Other exotic softwood	1.3	1.3
Eucalypts	3.1	1.3
Other exotic hardwood	0.3	0.7
Native	0.3	
Total	100.0	100.0

4.2 NON-HARVEST FOREST

Overall some 6.1% of post-1989 forest is not intended (or is not economic) to be harvested. There are large differences by size class (Table 8) with 11.9% of the area in the >1000 ha class not intended to be harvested compared to only 2.2% to 2.6% in smaller size classes. The majority of the non-harvest area is intended for carbon forestry.

Below is a selection of the comments from respondents:
- *"Carbon farming is the most attractive forestry option at more than $1000/ha per year. I will make much more from carbon than dairy."*
- *"Marginal land, better return from carbon."*
- *"Trees planted for ETS only. No intention of harvesting."*
- *"I have terrible land best left in trees to claim carbon credits."*

- *"Intend to revert to native and get continuous returns from ETS."*

However 1% of post-1989 forest is not expected to be harvested because it is now considered not economic to harvest:
- *"Environmentally and economically marginal."*
- *"Unharvestable areas. Planting was done in the mid-90s without foresight on how it would be physically and/or economically harvested."*
- *"Altitude means trees are poor quality."*
- *"Poor trees and site not suitable for forestry."*
- *"Doubtful economic return on steep part of our land."*
- *"Too costly to get trees out"*
- *"Steep site in Sounds and would require barging. Established forest has good recreation values."*
- *"Difficult block for harvesting. Was put in for erosion control."*
- *"Depends on regional council rules."*
- *"Manuka planted for honey. Eucalyptus not economic to harvest - retain for cover & ETS."*

Other reasons given for not harvesting:
- *"Nurse crop for native."*
- *"Allow stream protection, wind protection + corridors of native regeneration for bird movements."*
- *"No financial need to harvest, makes too much mess."*
- *"Shelter for stock."*
- *"Like the trees."*

Table 8: Percentage of post-1989 area that is not intended for harvest broken down by reason for not harvesting

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Carbon forest	0.3	0.6	1.0	11.2	4.8
Uneconomic	1.0	1.1	1.5	0.7	1.0
Native	0.2	0.1	0.1	0.0	0.1
Shelter/Conservation	0.7	0.4	0.0	0.0	0.2
Total non-harvest	2.2	2.2	2.6	11.9	6.1

Given the focus on carbon of owners not intending to harvest it is not surprising that ETS participants are more likely to have non-harvest forests than non-participants (Table 9).

Table 9: Percentage of post-1989 area that is not intended for harvest split by ETS participation

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
ETS participants	4.1	4.1	2.4	16.6	10.5
Non-ETS participants	1.6	0.3	2.8	1.3	1.9
Total	2.2	2.2	2.6	11.9	6.1

4.3 ROTATION AGE FOR FORESTS INTENDED TO BE HARVESTED

Average rotation age varies with species (Table 10). There are no marked differences with region or size class (Table 11) although there are indications of:
- Older rotation ages in Canterbury and Otago.
- Younger rotations for owners of smaller forests.

Table 10: Average age intended for each species

	Number of respondents	Average age
Radiata pine	657	27.6
Douglas fir	43	46.6
Cypress species	42	34.3
Other exotic softwood	11	43.6
Eucalypts	28	20.1
Other exotic hardwood	16	28.7
Native	1	50.0

Table 11: Average age intended for radiata pine by wood supply region and size class.

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Northland	26.8	25.9	28.2	28.0	27.4
CNI	26.7	26.6	27.5	28.1	27.5
East Coast	27.3	25.3	27.3	27.9	27.5
Hawkes Bay	26.3	25.5	27.2	28.5	27.5
SNI	27.4	27.1	27.3	27.9	27.4
Marlborough	28.4	27.8	28.8	28.1	28.3
Nelson	26.8	27.3	28.2	27.3	27.3
West Coast	27.6		25.9	27.0	26.9
Canterbury	28.6	29.9	27.4	29.0	28.4
Otago	27.7	28.9	29.4	28.0	28.4
Southland	26.9		28.5	27.7	27.7
Total	**27.3**	**27.0**	**27.6**	**28.0**	**27.6**

Although the average rotation ages for radiata pine reported in Table 11 are quite similar, there is a distribution of intended rotation ages (Figure 1). The distribution of rotation age is even wider for Douglas fir (Figure 2).
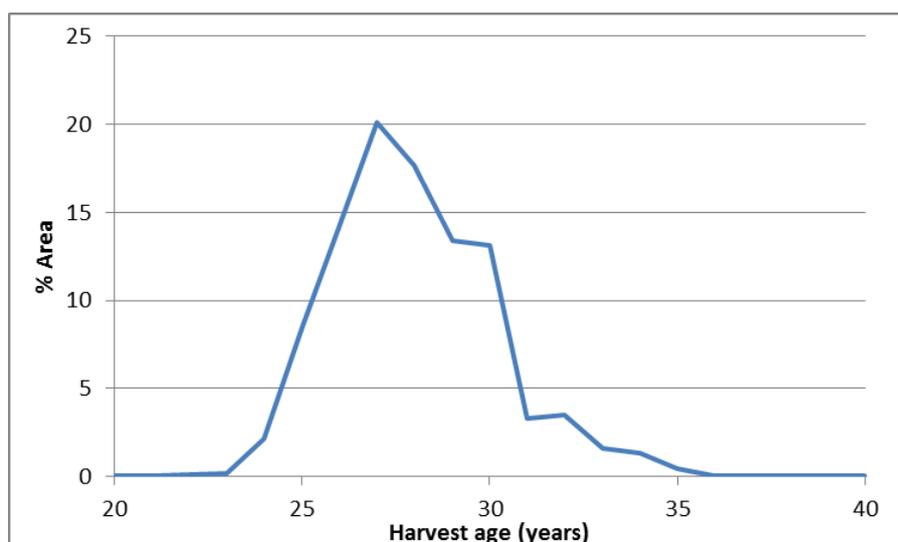

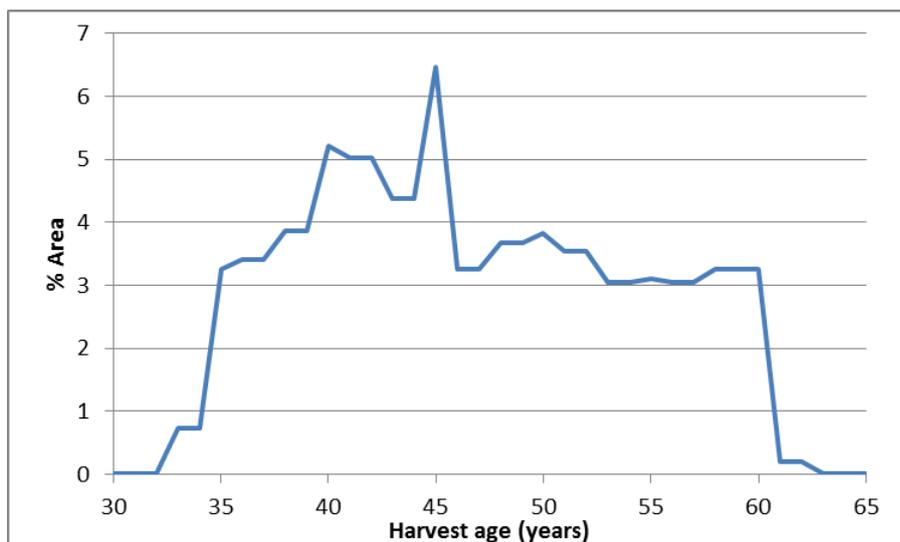Figure 1: Distribution of intended harvest age for radiata pine

Figure 2: Distribution of intended harvest age for Douglas fir

4.4 INTENTIONS AFTER HARVEST

The majority (85%) of forest owners who intend planting are certain that they will replant (Table 12). Others (11%) said that they will probably replant. Only a small percentage (4%) said that they will possibly replant; i.e. that there is a 50/50 chance they will replant. For subsequent analysis the 8,424 ha in this category was split with 50% of the area assumed to be replanted and the other 50% assumed to be not replanted but allocated to the alternative indicated by the owner.

Table 12: Certainty of replanting for post-1989 forest owners intending replanting

Certainty of replanting	Area (ha)	Percent (%)
Certain	203,382	85
Probably	26,946	11
Possibly	8,424	4
Total	238,751	100

The clear majority of forest owners intend replanting. However there are some clear trends with size (Table 13). Owners of smaller forests are less likely to replant the production forest and are more likely to:

- Plant mānuka,
- Leave the area to regenerate naturally,
- Convert to some other land use,
- Sell after harvest, or
- Be unsure.

Overall, 87.6% of area is intended to be replanted in production forest after harvest. ETS participants intend replanting 92.8% of area while non-ETS participants intend replanting 82.6% of area.

Table 13: Intentions after harvesting

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Replant	72.1	76.2	89.8	95.2	87.6
Plant mānuka	5.8	3.6	0.5	2.0	2.3
Leave to regenerate	3.4	1.4	0.6	0.0	0.9
Convert dairy	1.2	0.1	0.0	0.0	0.2
Convert sheep/beef	6.8	4.2	1.6	0.3	2.2
Convert hort/viticulture	0.1	0.3	0.2	0.0	0.1
Convert resident/lifestyle	0.2	0.4	0.2	0.0	0.1
Return land to owner	0.7	2.8	0.8	2.4	1.6
Sell after harvest	7.7	5.5	3.6	0.1	3.1
Sell before harvest	0.6	0.0	0.8	0.0	0.4
Unsure	1.4	5.5	1.9	0.0	1.5
Total	100.0	100.0	100.0	100.0	100.0

Respondents indicated a range of factors will influence whether or not they replant including:
- The financial returns that are achieved from the current rotation:
  - *"Cost vs money obtained from harvest."*
  - *'Depends on how the harvest of these trees goes and the price of logs."*
  - *'Need to end up with $ in the bank – not just a whole lot of bills to pay!'*
  - *"Cyclone Fehi snapped/windthrew our forest. Replanting intention depends on the outcome of salvage harvest."*

- Perceptions about environmental legislation and the ability to harvest the next rotation.
  - *"Due to all new regulations and trouble with Council I am debating whether to replant or not."*
  - *"Depends on environmental constraints. Council is very restrictive and unfriendly toward forestry."*
  - *"NES rules."*
  - *"Compliance restriction."*
  - *"Objection from people who do not like forestry."*

- The age of the owners:
  - *"I'm an old man and matters to do with the forestry block may well be a matter for my heirs!"*
  - *"I am in my 96th year and the rest of the owners are in their late 60s so there is no guarantee what will happen when grandchildren take over."*
  - *"Next generation of family may make different decisions."*
  - *"I'm 83 years old."*
  - *"At age 79 I would not see another rotation."*

- Finding new investors/partners for forests in which current owners do not want to invest in another rotation, in many cases because of age:
  - *"Depends on finding new forestry partners and possible offers for viticulture or pastoral use."*
  - *"I am aged 80 years. My family may sell as is?!"*

In other cases the decision is clear:
- *"We have to replant under conditions of the original scheme."*

4.4.1 Mānuka

Comments from respondents planning to replant in manuka:
- *"Depends on manuka honey price at time of replant."*
- *"Access for harvest/ too steep or exposed."*
- *"More sustainable and ecologically valuable use."*
- *"Manuka/bees/environmentally friendly."*

- *"Carbon credits on manuka. Income from honey from manuka."*
- *"Honey would be a more secure investment."*

4.4.2 Leave to regenerate

The motivation to leave cutover area to regenerate, rather than replant, came from both ecological and economic considerations:

- *"Return to native vegetation."*
- *"Inclination to leave some to covenants and to regenerate."*
- *"Aesthetics, environmental, land management."*
- *"Allow stream protection, wind protection + corridors of native regeneration for bird movements."*
- *"Looks better for going back to ecological production i.e. natives."*
- *"Inaccessible for harvesting."*
- *"Land is very steep - hard to harvest."*
- *"Block too small for commercial use -cost of harvesting."*
- *"All area was lost to windthrow in Cyclone Ita or Feti storms. Have no money to replant. Will leave fallow."*
- *"Trees too heavy for land, i.e. Slipping."*

4.4.3 Conversion

Overall, the intention is to convert 2.6% of post-1989 forests. The most common conversion is intended to be into sheep and beef agriculture (2.2%). Reasons for converting (selected from a list provided) were:

- Poor forestry returns – 18 respondents.
- Better agricultural returns – 26 respondents.
- Housing – 1 respondent.
- Other Higher and Better Use -11 respondents.
- Environmental – 8 respondents.

Comments from those intending to convert fell within a number of themes:

Forestry factors

- *"Difficult access."*
- *"The 4ha is split into 3 woodlots and is a nuisance."*
- *"Risk of further windthrow, too old to achieve financial return if we replanted."*
- *"Pine block site too windy so won't replant."*
- *"Costs of replanting."*
- *"Considerable concern with where RMA will be in 25 years."*
- *"Replanting reduces flexibility."*

Agricultural factors

- *"Family inheriting farm/different policies."*
- *"Partnership to be wound up."*
- *"Return land to family farm."*
- *"Proximity of block to woolsheds makes this area for valuable in pasture."*
- *"Easier movement of stock."*
- *"Conversion to access way."*

Environmental factors

- *"Aesthetic value."*
- *"View corridors."*
- *"I hate pine trees!"*
- *"Loss of sun on house."*

Practicalities

- *"My age. I will be 80 years when I harvest.""*
- *"Too old to consider."*
- *"Our age – I am 69 and my wife is 64."*

4.4.4 Unknown

In some cases the decision of whether or not to replant will ultimately be made not by the current owner but either by the land owner after return of the land following harvest or by the new owner after sale of the land. The overall intention is for;

- 1.6% of area to be returned to the land owner in cutover state (i.e., unplanted after harvest),
- 0.4% of area to be sold before harvest, and
- 3.1% of area to be sold after harvest in cutover state.

The response from one large forest company was that *"we only have a lease for the current rotation. However we expect that the majority of the land will be replanted, most is unsuitable for conversion."*

The last category was particularly pronounced for smaller forests. One owner stated: *"No replant. I want to on-sell a poor investment - land rates are too expensive."* However, a common response was that the owners feel that they are too old for another rotation and want to sell the land after realising the benefits of the current rotation:

- *"Too old so cease the investment"*
- *"Selling the land as I have retired."*
- *"Property will be sold. New owners can decide."*

Owners with 1.5% of area are unsure and could not give any indication about future intentions:

- *"No idea at present sorry. Will depend on incentives at the time."*
- *"Decision not made."*
- *"Unknown. Farm is for sale."*
- *"It won't be making that decision for the Douglas fir."*
- *"Too far out to speculate."*

4.4.5 Summary of intentions

Intentions are summarised into three major categories in Table 14. This makes overall patterns clear. Over 90% of area is intended to be replanted in production forest or planted in mānuka or left to regenerate.

There are clear differences between ETS-participants (Table 15) and non-ETS participants (Table 16) with the former less likely to convert and more certain about planting.

Table 14: Summary of intentions after harvesting for all owners

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Replant/ mānuka /regenerate	81.2	81.1	90.9	97.2	90.8
Convert	8.3	5.1	2.0	0.3	2.6
Return/Sell/Unknown	10.5	13.8	7.1	2.5	6.6
Total	100.0	100.0	100.0	100.0	100.0

Table 15: Summary of intentions after harvesting for ETS participants

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Plant/ mānuka /regenerate	88.4	89.4	89.7	100.0	95.2
Convert	1.8	4.0	2.9	0.0	1.4
Return/Sell/Unknown	9.8	6.6	7.4	0.0	3.4
Total	100.0	100.0	100.0	100.0	100.0

Table 16: Summary of intentions after harvesting for non-ETS participants

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Plant/ mānuka /regenerate	79.1	73.3	91.8	90.9	86.5
Convert	10.2	6.0	1.3	0.9	3.9
Return/Sell/Unknown	10.7	20.7	6.9	8.2	9.6
Total	100.0	100.0	100.0	100.0	100.0

4.4.6 Replanting species

Radiata pine is the dominant species for intended replanting (Table 17). There is continued interest in Douglas-fir particularly by owners of larger forests. The proportions of species intended for replanting are similar to those for the current rotation (Table 18).

Table 17: Species intended for replanting

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Radiata pine	89.1	89.7	94.5	80.9	87.8
Douglas fir	1.4	3.9	3.5	13.7	7.2
Cypress species	2.0	0.8	0.2	0.0	0.5
Other exotic softwood	0.4	0.2	0.8	1.4	0.9
Eucalypts	1.1	0.5	1.0	4.0	2.1
Other exotic hardwood	0.6	0.1	0.0	0.0	0.1
Native	2.4	0.4	0.0	0.0	0.4
Unsure species	3.0	4.4	0.0	0.0	1.0
Total	100.0	100.0	100.0	100.0	100.0

Table 18: Comparison of current species with species intended for replanting

	Current (%)	Replant (%)
Radiata pine	87.1	87.8
Douglas fir	6.8	7.2
Cypress species	1.1	0.5
Other exotic softwood	1.3	0.9
Eucalypts	3.1	2.1
Other exotic hardwood	0.3	0.1
Native	0.3	0.4
Unsure species		1.0
Total	**100.0**	**100.0**

4.5 CARBON AND EROSION SCHEMES

The ETS is the dominant carbon or erosion scheme that respondents have entered (Table 19).

Table 19: Respondents area that is entered into different schemes

Scheme	Area (ha)
ETS	184,175
AGS	2,588
PFSI	70
ECFP	9,674
HCEP	75

4.5.1 Stay in ETS

There were responses to the question about staying in the ETS for 96% of the area currently entered in the ETS by owners who intend harvesting and replanting. They almost all intend staying in the ETS for the second rotation (Table 20). Some of the responses were conditional:

- *"But only if the scheme will be improved, e.g. averaging."*
- *"As long as price is right & financially worth it."*
- *"If the Government in its ETS review doesn't recognise HWP as part of the carbon accounting methodology we will review the investment."*

Table 20: Intention to stay in ETS after replanting (% of area by size class).

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Stay in ETS	85.1	90.0	99.0	95.3	94.4
Leave ETS	4.0	5.7	0.9	0.0	1.5
Unsure	10.9	4.3	0.2	4.7	4.1
Total	100.0	100.0	100.0	100.0	100.0

4.5.2 Join ETS

There were responses to the question about joining the ETS for 82% of the area currently not entered in the ETS by owners who intend harvesting and replanting. These owners are divided about whether to join the ETS after replanting (Table 21). Comments received reflect this:

Owners who intend joining:
- *"To counteract any carbon payment required on farm."*
- *"I have a 50 ha block but only 30 ha will be classed at post-1989 because of scrub."*

Owners who don't intend joining:
- *"Can't afford penalties if windthrown again."*
- *"If I register with ETS today and backdate 2 years I may get $18/tonne, the risk at harvest is that I may have to pay back at $80/tonne - not a great investment."*
- *"Currently the administration fees outweigh the benefits of joining for the small area I own."*
- *"Don't understand or trust ETS."*
- *"Too many fish hooks in ETS at present."*
- *"Politics & commercial forestry are a bad mix commercially & environmentally."*
- *"Too complicated."*

Owners who are unsure:
- *"Only if criteria change and entry into carbon market simplified."*
- *"Don't know enough about ETS to answer."*
- *"Not up to speed with ETS."*

Table 21: Intention to join ETS after replanting with area not currently in the ETS (% of area by size class).

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
Join ETS	25.5	23.0	60.3	38.0	42.1
Don't join ETS	49.0	46.7	18.4	40.4	34.9
Unsure	25.5	30.3	21.3	21.6	23.0
Total	100	100	100	100	100

4.5.3 Carbon Price

Respondents were asked "What is the carbon price that would determine whether you decided to join the ETS for the second rotation?" A total of 156 respondents answered this question with the most common response being $25/NZU followed by $20/NZU (Figure 3). Again there were divergent views expressed in the comments received:
- *"Even if price drops significantly we will bring in remaining 17% of our post-89 forest. We have faith (at present) that price will be good ($15+) in the long term."*
- *"Price not deciding factor. Don't approve of ETS - it should be a carbon tax."*
- *"Rules more important than price."*
- *"Rules need revising, not just a pricing issue."*
- *"Stupid question as it can too easily be manipulated after setting."*
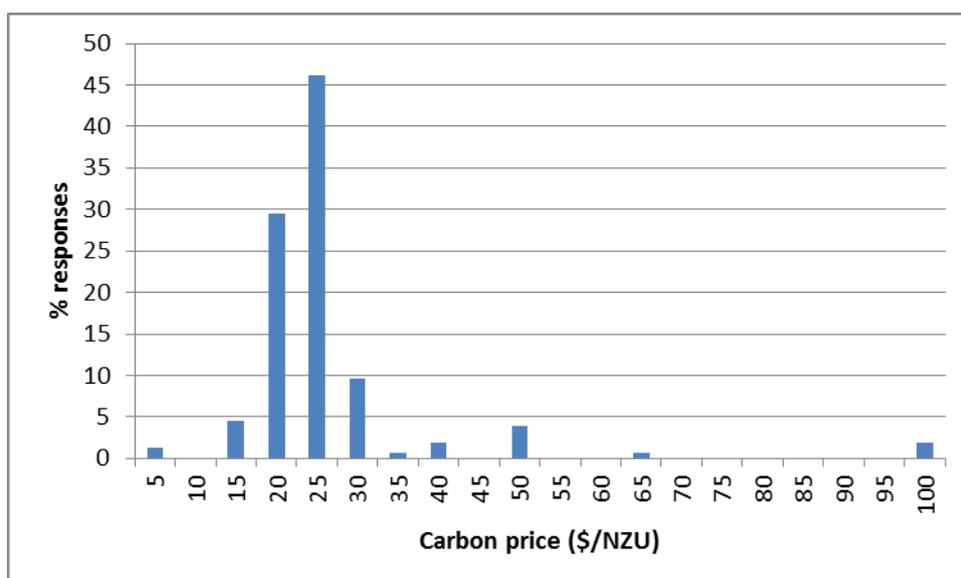- *"Totally irrelevant question. Nobody understands carbon price."*

Figure 3: Carbon price that would determine whether respondents would join the ETS for the second rotation. X-axis values are the minimum value for $5 range – most values were at the minimum value for each range.

4.6 PRUNING

The survey asked "What percentage of your forest has been pruned (to at least 4 metres)?" This question was answered for 95% of the current radiata pine area (intended for harvest). The majority of post-1989 plantation area has been pruned (Table 22). Owners of smaller forests are more likely to have pruned.

The survey also asked "What percentage of the area that you intend to replant will get pruned?" A comparison was made of the responses of owners who answered both questions. The ratio of the percentage of area intended to be pruned in the next rotation to the percentage of area currently pruned was calculated. Results indicate that owners in size classes over 100 ha intend to prune only 60-75% of the area currently pruned.

However, owners in size classes of less than 100 ha intend to prune a similar area (Table 23). This result needs to be treated with caution. Many owners of smaller forests are uncertain about their pruning intentions – responses to this question were provided for only 71% of area in the <40 ha class and 68% of area in the 40-99 ha class. In contrast responses were received for 90% of area in the 100-999 ha class and 94% of the area in the >1000 ha class.

Table 22: Percentage of current rotation of radiata pine that has been pruned

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
NZ	80.6	73.7	83.3	54.8	70.7

Table 23: Ratio of percentage of replanting area that is intended to be pruned to percentage of current area that has been pruned

	<40 ha	40-99 ha	100-999 ha	>1000 ha	Total
NZ	1.01	1.01	0.75	0.60	0.76

5 Concluding remarks

Results of the survey show that forest owners intend replanting the clear majority (87.6%) of post-1989 plantations. There is some interest in planting mānuka (2.3%) or allowing area to naturally regenerate after harvest (0.9%), particularly by owners of small forests.

The percentage of area intended for conversion varies from 8.3% for owners with less than 40 ha to 0.3% for owners with over 1000 ha. Overall the percentage of post-1989 forest that is intended to be converted to non-forest is small (2.6%). There is a higher percentage of area (6.6%) in the uncertain category. There is greater uncertainty for small forest holdings with intentions after harvest being uncertain for 10.5% of area in the <40 ha size class and 13.8% of area in the 40-99 ha size class.

Owners of post-1989 forests generally intend replanting with the same species as planted for the current rotation. Intentions about pruning in the second rotation vary depending on size. Whereas owners with over 100 ha intend pruning less area (60 to 75%) than pruned in the current rotation, owners with less than 100 ha intend, overall, to prune a similar percentage of area.

The percentage of forest not intended for harvest also varies with size. The overall percentage (6.1%) is strongly influenced by a few owners with over 1000 ha who are maintaining permanent carbon forests. This leads to 11.9% of the area in the >1000 ha size class not being intended for harvest, compared to 2.2% to 2.6% of area for other size classes. The primary reason for non-harvest in the size classes under 1,000 ha is that area is now considered to be uneconomic to harvest; i.e. the area was planted with the intention of harvesting but is no longer expected to be harvested.

ETS participants intend replanting 92.8% of area in production forest, with a further 2% of area planted into mānuka and 0.4% of area left to regenerate. Intentions are for the vast majority of replanted area (at least 94.4%) that is in the ETS for the current rotation to stay in the ETS for the second rotation. Non-ETS participants intend replanting 82.6% of area in production forest. Intentions are for a significant percentage of area (at least 42.1%) that is not in the ETS for the current rotation to be entered into the ETS for the second rotation.

Clearly there is uncertainty about the results. They are driven by current perceptions about forestry and alternative land uses and are subject to change. Respondents indicated a range of factors will influence whether or not they replant including:
- The financial returns that are achieved from the current rotation.
- Environmental legislation and the ability to harvest the next rotation.
- Preferences of their children and grandchildren at the time.
- Finding new investors/partners for forests in which current owners do not want to invest in another rotation, in many cases because of age.

A limitation of the study is the low number of responses for some combinations of wood supply region, size class and ETS status, particularly for smaller forests that are not in the ETS. Allowance has been made for different response rates for different combinations in the estimation of overall averages. However in the interpretation of results, it is assumed that owners who did not respond have the same intentions as those owners who did respond in the same region/size/ETS participation combination.

The accuracy of estimates is dependent on the relative areas for each wood supply region and size combination (determined using the NZFFA database and the LUCAS LUM) being representative of the post-1989 estate.

6 Future research

Further work is warranted by the relatively high percentage (6.6%) of area for which intentions following harvest are uncertain. The unknown category includes:
- area to be returned to the land owner in cutover state (i.e., unplanted after harvest),
- area to be sold before harvest,
- area to be sold after harvest in cutover state; and
- area about which the owner is unsure of their intentions.

One approach for MPI to consider would be to characterise the area in this category by:
- Land Use Capability Class
- Slope
- Erosion Susceptibility Classification (March 2018) form National Environmental Standard for Plantation Forestry

This would allow an assessment of the alternative land uses for area in the unknown category and the likelihood of conversion.

7 Acknowledgements

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