

# Quantifying the area of the small-scale owners' forest estate in the East Coast, Hawke's Bay and Southern North Island

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## Abstract

The National Exotic Forest Description (NEFD) estimated that, as at 1 April 2016, the small-scale forest estate area in the East Coast, Hawke's Bay and Southern North Island (SNI-West and SNI-East) wood supply regions was 268,233 ha. As part of the Management Case Study in 2017 and 2018, Bachelor of Forestry Science (BForSc) students mapped the small-scale estate in these regions. Forest boundaries were mapped in a geographic information system (GIS), based on visual interpretation of aerial photography and satellite imagery. It was found that the mapped area of small-scale estate in these regions totalled 248,331 ha, with the NEFD area being 8% larger. On a wood supply region basis, the NEFD over-estimates the small-scale forest area by 20% for the East Coast and 15% for Hawke's Bay, but under-estimates by 2% for SNI-East and 0.5% for SNI-West. The results also vary at the level of territorial authority (TA). Only eight of the 22 TAs have the NEFD area within 10% of the mapped area, while another eight are within 10–20% of the mapped area.

While the NEFD over-estimates net forest area in the overall study region by 8%, the Land Cover Database (LCDB) over-estimates it by 17%, and the Land Use and Carbon Analysis System (LUCAS) over-estimates it by 27%. These differences arise because LCDB and LUCAS are based on gross rather than net area and because of some misclassification of land uses in those spatial databases. In the case of the LCDB, the gross/net difference is 8% of the mapped area, while net misclassification causes over-estimation by another 8%. For LUCAS, the gross/net difference is equal to 11% of the mapped area, with net misclassification also equal to 11% of the mapped area. Additional differences arise because of new planting not captured by the mapping.

The study confirms the urgent need for an accurate and up-to-date spatial database of New Zealand's plantation forests. Not only would this provide accurate estimates of plantation area, it would also enable detailed transportation and logistics planning, as well as quantification of the potential wood supply within specified distances from current and potential wood processing sites. It could also improve New Zealand's international carbon accounting and reporting.

## Introduction

Small-scale forest owners (less than 1,000 ha) are estimated to own 520,000 ha out of the total New Zealand plantation estate of 1,705,000 ha (MPI, 2016a). This portion (~30%) of the estate is becoming increasingly important for wood production as the large areas of land afforested in the 1990s matures. Wood availability forecasts (WAFs) indicate that, 'From 2020, the potential wood available from the small-scale owners' forests increases to around 15 million m<sup>3</sup> per annum through to 2035' (MPI, 2016b).

However, there is uncertainty about the actual area of the small-scale estate. The 2016 National Exotic Forest Description (NEFD) survey was sent out to all known forest owners with at least 40 ha of plantation forest (NEFD, 2016a). This survey accounts for 1,436,000 ha. An additional 67,000 ha was derived from a survey of small-scale forest growers carried out in 2004. The final 203,000 ha of area in the NEFD is imputation of new planting in 1992 to 2006. For these years additional areas, not directly captured in the NEFD surveys, were estimated based on annual nursery surveys that measured the sales of planting stock. Imputation was stopped after 2006 because of the low new land planting rate.

For 1992 to 2006, the total number of seedlings sold was used to estimate the total area of planting each year and, by subtracting the area of replanting, the area of new planting was estimated. The national new planting adjustment was calculated by subtracting the new planting area captured in the NEFD survey from this estimate of the total area of new planting. The national new planting adjustment for each year was distributed into territorial authorities (TAs) using the proportions indicated from the new planting collected in the NEFD survey (MPI, 2016a). Consequently, there are questions about the estimated total area of the small-scale estate in New Zealand and its distribution by TAs. There are also questions about how much of the area in the small-scale estate has been harvested and not replanted.

Concerns about the quality of the NEFD data were confirmed by the Management Case Study in 2015 and 2016, where Bachelor of Forestry Science (BForSc) students mapped the small-scale estate in

Canterbury, Otago and Southland (Manley et al., 2017). It was found that the mapped area of small-scale estate was only 56% of the NEFD estimate in Canterbury, 96% in Otago and 75% in Southland.

The study reported here is an extension of this earlier study. The purpose is to better characterise the small-scale estate in the East Coast, Hawke's Bay and Southern North Island (SNI) and specifically to answer:

- What is the area of the small-scale estate in each TA within these regions?
- What are key attributes of the small-scale estate?
- Where is the small-scale estate located relative to the location of ports and transport hubs?
- How do estimates of area compare to those of the NEFD, Land Cover Database (LCDB) and Land Use and Carbon Analysis System (LUCAS)?

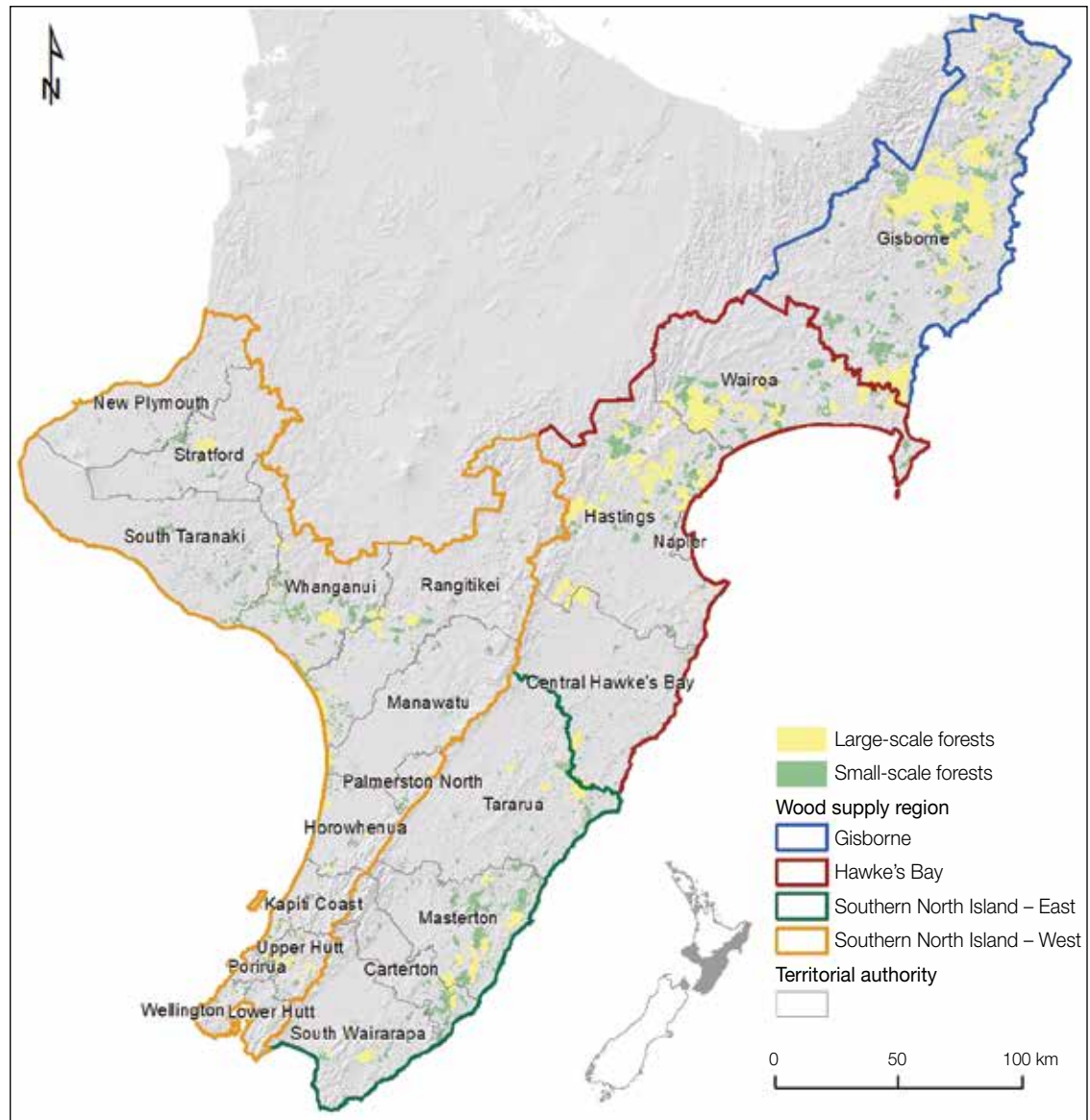


Figure 1: Wood supply regions and constituent TAs used in the study. Also shown are the mapped small-scale forests and the legal boundaries provided by large-scale owners

## Methods

The research was undertaken by final year BForSc students as part of the Management Case Study in 2017 and 2018. Initially, the area of the small-scale estate was estimated and compared with NEFD estimates. Subsequently, it has been compared with the v006 map from LUCAS (2019) and the v4.1 map of LCDB (2015). The small-scale estate was characterised by slope, Euclidean distance to public road and network distance to nearest port. Finally, the distribution of area by distance to key locations (transport hubs as well as ports) was analysed.

## Study area

The study area included the East Coast, Hawke's Bay and SNI (West and East) wood supply regions. These regions together with constituent TAs are shown in Figure 1.

## Small-scale forest area mapping

Orthorectified aerial photography was used for forest boundary mapping. For SNI, aerial photos were sourced from Land Information New Zealand (LINZ). The orthophotos dated from 2010 to 2014 and had a spatial resolution between 0.3–0.4 m. To check the current status of stands, cross-referencing was done using Google Earth. For the East Coast and Hawke's Bay, orthophotos with a spatial resolution between 0.3–0.4 m, dating from 2012 to 2015, were accessed from LINZ. Sentinel-2 satellite imagery collected in 2016 to 2017 was used to check the current status of stands digitised from older imagery.

The 2019 LUCAS map provided by the Ministry for the Environment, and the 2015 LCDB developed by Landcare Research, were used to indicate the area and location of plantation forests. A mask was applied to the study areas to exclude large-scale plantation forests (with boundaries provided by forest owners – the same

set of large-scale owners was used as for the MPI Wood Availability Forecasts). Small-scale forests on all land outside this mask, including harvested area awaiting restocking, were systematically mapped in ArcGIS 10.4 (ESRI, 2017) using the following rules:

- The area had to be over 1 ha and greater than 30 m wide, but the 1 ha rule was relaxed when there were contiguous small blocks that added to over 1 ha
- Gaps over 0.1 ha were excluded from the forest area polygons
- All mapping was done at a scale of 1:4,000 or greater.

Prior to mapping, students received training on how to identify plantation forests in aerial imagery. They were also taught best practices for forest boundary mapping. Quality control of mapping was undertaken. Line-work for all polygons mapped by students was verified, and checks were made to ensure that all small-scale plantations had been included and no other land covers had been inadvertently included as small-scale plantations. These steps ensured forest boundary mapping was accurate and minimised omission and commission errors. As every polygon mapped by the students (as well as its classification) was independently checked by experienced postgraduate students, the mapped area reported here is considered to be the 'true' net stocked plantation area as at the end of 2016. However, it is recognised that mapping will have missed areas of new planting since the time of aerial photo capture.

## Attributes

For each mapped small-scale forest, the average slope was derived using the 'Zonal Statistics' tool in ArcGIS, with input of a 25 m Digital Elevation Model developed by Landcare Research. The Euclidean distance between the forest polygon centroid and the nearest public road was calculated using the 'Near' function in ArcGIS. On-road network distance to port and transport hub was estimated for each mapped forest using the 'Network Analyst' in ArcGIS. The distance between each forest and port/hub was calculated as the sum of the distance to nearest public road and on-road distance.

The port/hub locations used were:

- Gisborne Port
- Wairoa Town
- Napier Port
- Woodville Rail
- Masterton Rail (Waingawa)
- Wellington Port
- Whanganui Rail
- New Plymouth Port.

## Forest area comparisons

Mapped forest areas (as at the end of 2016), including both stocked area and area awaiting restocking, were compared against estimates for NEFD (2016), LCDB (2015) and LUCAS (2019). For the comparison, the total of the NEFD stocked area and

area awaiting restocking classes was used. The LCDB included both 'Exotic forest' and 'Forest-harvested classes'. The LUCAS 'Regenerating natural species' and 'Wilding trees' categories were excluded.

As part of the reconciliation process, a spatial comparison was made of the LCDB and LUCAS small-scale forest area with the mapped area. An initial automated comparison was manually verified for all blocks over 10 ha:

- Where the LCDB or LUCAS plantation area included the mapped area for a forest block, any difference in area was deemed to be 'gross/net difference (i.e. the difference caused by LCDB or LUCAS mapping the gross area of the block rather than the net area)
- Where the LCDB or LUCAS plantation area did not include the mapped area, the error was deemed to be 'misclassification-over' (i.e. non-plantation area classified as plantation)
- Where mapped blocks were totally missed by LCDB or LUCAS, the error was deemed to be 'misclassification-under' (i.e. plantation area classified as non-plantation).

In the reconciliation between the LUCAS (2019) areas and mapped (2016) areas, allowance was made for the area of new planting that has occurred, most of it subsequent to the mapping, and which has been included in LUCAS and, to a lesser extent, the LCDB.

## Results

### Small-scale forest area

The mapped area of the small-scale estate is shown in Figure 1, together with the legal boundaries provided by large-scale owners. NEFD, LCDB and LUCAS areas are compared with the mapped area of the small-scale estate in Tables 1 to 4. For the total study area the NEFD over-estimates the small-scale area by 8%. On a wood supply region basis, the NEFD over-estimates the small-scale area by 20% for the East Coast and 15% for Hawke's Bay, but under-estimates by 2% for SNI-East and 0.5% for SNI-West. The results also vary at the level of TA. The forest area in some TAs is over-estimated by the NEFD, including the Gisborne, Hastings, Central Hawke's Bay and Whanganui districts. However, other TAs have area under-estimated, including South Taranaki and Masterton districts. Only eight of the 22 TAs have an NEFD area within 10% of the mapped area, while another eight are within 10–20% of the mapped area.

LCDB over-estimates forest area in the total study area by 17%, while LUCAS exceeds it by 27%. LCDB over-estimates the area of the small-scale estate in all four regions, by 12% for the East Coast, 20% for Hawke's Bay, 13% for SNI-East and 21% for SNI-West. LUCAS area exceeds the mapped area of the small-scale estate by a greater percentage in all four regions, by 31% for the East Coast, 31% for Hawke's Bay, 23% for SNI-East and 22% for SNI-West. All TAs are over-estimated by both LCDB and LUCAS.

Table 1: Area of small-scale estate in East Coast wood supply region. Mapped (2016) areas are compared with NEFD (2016), LCDB (2015) and LUCAS (2019) areas. Areas are total of net stocked area and area awaiting replanting

Territorial authority	Mapped (ha)	NEFD (ha)	LCDB (ha)	LUCAS (ha)
Gisborne district	62,441	75,056	69,743	81,999

Table 2: Area of small-scale estate in each TA in Hawke's Bay wood supply region. Mapped (2016) areas are compared with NEFD (2016), LCDB (2015) and LUCAS (2019) areas. Areas are total of net stocked area and area awaiting replanting. Individual entries may not add to totals due to rounding

Territorial authority	Mapped (ha)	NEFD (ha)	LCDB (ha)	LUCAS (ha)
Wairoa district	24,109	24,814	25,682	27,963
Napier city	69	78	289	186
Hastings district	27,028	31,081	33,420	36,184
Central Hawke's Bay district	6,912	10,805	10,288	11,749
<b>Hawke's Bay total</b>	<b>58,118</b>	<b>66,778</b>	<b>69,679</b>	<b>76,082</b>

Table 3: Area of small-scale estate in each TA in SNI-East wood supply region. Mapped (2016) areas are compared with NEFD (2016), LCDB (2015) and LUCAS (2019) areas. Areas are total of net stocked area and area awaiting replanting. Individual entries may not add to totals due to rounding

Territorial authority	Mapped (ha)	NEFD (ha)	LCDB (ha)	LUCAS (ha)
Tararua district	11,702	12,672	14,682	16,802
Masterton district	26,365	23,979	29,014	30,805
Carterton district	8,924	7,880	10,093	10,303
South Wairarapa district	5,730	7,192	5,878	7,073
<b>Total</b>	<b>52,721</b>	<b>51,723</b>	<b>59,666</b>	<b>64,983</b>

Table 4: Area of small-scale estate in each TA in SNI-West wood supply region. Mapped (2016) areas are compared with NEFD (2016), LCDB (2015) and LUCAS (2019) areas. Areas are total of net stocked area and area awaiting replanting. Individual entries may not add to totals due to rounding

Territorial authority	Mapped (ha)	NEFD (ha)	LCDB (ha)	LUCAS (ha)
Wellington city	1,089	574	1,587	1,524
Lower Hutt city	384	354	591	710
Upper Hutt city	2,603	2,346	3,303	3,326
Porirua city	1,961	4,368	2,407	2,283
Kapiti Coast district	3,755	2,829	4,798	4,742
Horowhenua district	4,799	4,312	6,027	5,304
Manawatu district	6,392	5,983	8,367	8,075
Palmerston North city	2,095	1,764	2,504	2,317
Rangitikei district	12,371	12,605	14,089	14,205
Wanganui district	18,659	22,013	21,208	22,274
South Taranaki district	12,246	9,200	15,526	15,744
Stratford district	4,115	4,424	4,783	5,086
New Plymouth district	4,583	3,904	5,539	5,704
<b>Total</b>	<b>75,051</b>	<b>74,676</b>	<b>90,728</b>	<b>91,295</b>



Table 5: Average values for key attributes of the small-scale estate in each East Coast/Hawke’s Bay and SNI TA. The distance to closest port is the closest of Gisborne, Napier, New Plymouth or Wellington

Territorial authority	Slope (%)	Distance to nearest road (m)	Distance to closest port (km)
Gisborne district	48	650	78
Wairoa district	44	238	96
Napier city	49	26	13
Hastings district	38	360	45
Central Hawke’s Bay district	29	473	89
Tararua district	34	444	146
Masterton district	39	696	139
Carterton district	45	591	110
South Wairarapa district	36	734	100
Wellington city	50	144	14
Lower Hutt city	54	201	27
Upper Hutt city	49	298	38
Porirua city	43	189	30
Kapiti Coast district	44	332	65
Horowhenua district	16	503	107
Manawatu district	24	399	165
Palmerston North city	28	244	140
Rangitikei district	25	568	164
Whanganui district	48	359	171
South Taranaki district	37	398	106
Stratford district	37	419	65
New Plymouth district	33	267	35

## Key attributes of the small-scale estate

Key attributes that affect delivered wood cost and hence harvest viability are:

- Slope, which influences harvesting costs
- Distance to nearest public road, which influences roading costs
- Distance to nearest port, which influences transport costs.

Average values of these attributes vary between TAs (Table 5). Key features are:

- The overall average slope is 36%. Some 17 of the 22 TAs have average slope over 30%, including 10 TAs which have average slope over 40%
- The overall average distance to public road is 467 m. South Wairarapa, Masterton, Gisborne, Carterton, Rangitikei and Horowhenua districts all have average distance to public road exceeding 500 m. As these are Euclidean distances, the roading distance will be greater, particularly for steep areas

- The overall average distance to port is 112 km. Whanganui, Manawatu and Rangitikei districts all have an average distance to port in excess of 150 km. Given the current limited domestic processing capacity in these regions, the viability of harvesting is particularly sensitive to the level of export log prices being high enough to cover the additional transport costs.

## Location of forests relative to ports or transport hubs

Different patterns are evident in the distribution of small-scale forest area by road distance from ports or transport hubs (Figure 2). Some locations have substantial forest area located within 50 km by road (e.g. Gisborne, Masterton), while others have limited forest area within 50 km or even 100 km (e.g. Wellington, New Plymouth). Woodville is an example of a central location that has limited area within 50 km, but substantial area within 100 km.

The proximity of small-scale area to different locations is compared in Figure 3. Trends for Gisborne, Wairoa, Napier, Whanganui and Masterton are similar. Woodville starts at a lower level compared to these regions, but is at a higher level at distances above about 90 km. Wellington and New Plymouth are at lower levels.

## Discussion

### What is the area of small-scale estate in each TA within these regions?

It is evident that the NEFD does not provide an accurate estimate of the small-scale estate in each TA. Although the NEFD area was only 2% under the mapped area for SNI-East and 0.5% for SNI-West, for the four TAs in SNI-East it was 12% under, 9% under, 8% over and

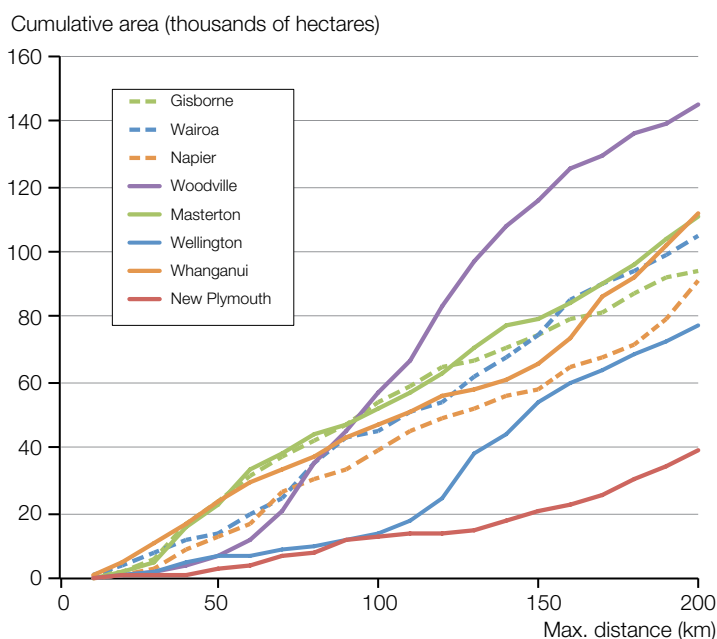


Figure 3: Distribution of cumulative small-scale forest area by distance (on road network) from ports or transport hubs. Only area within East Coast, Hawke’s Bay, SNI-East and SNI-West wood supply regions is included. The same forest area may be included in graphs for multiple locations

26% over, while the TAs in SNI-West varied from 47% under to 120% over. For the East Coast and Hawke's Bay regions, the NEFD area was not so close to the mapped area and there were large differences at the level of TA.

One reason that both the LCDB and LUCAS plantation area is greater than the mapped area is that satellite imagery with semi-automated classification is used to estimate gross rather than net area. However, the differences are larger than can be explained simply by the ratio of gross area to net area. Although LUCAS does include the 'Regenerating

natural species' and Wilding trees' categories as forest, they were excluded in this study. However, during the mapping process, the students noted misclassification in both LCDB and LUCAS with, for example, areas of native forest (including shrubland) or grassland being incorrectly classified as plantation (see Figures 4 and 5).

The reconciliation of LUCAS, and to a lesser extent, the LCDB area with the mapped area requires allowance to be made for new planting that has occurred since the time of the aerial photography used for mapping.

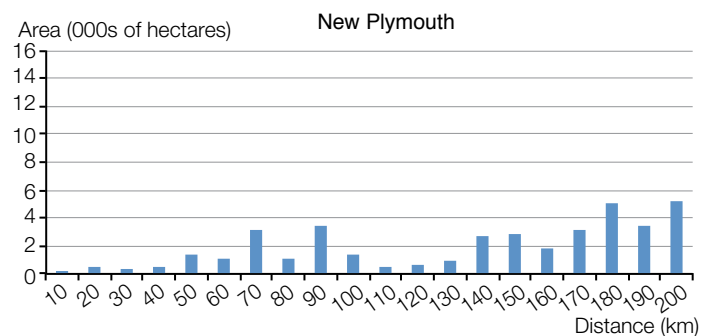
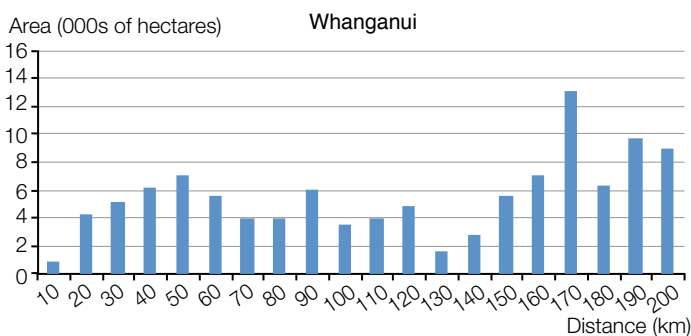
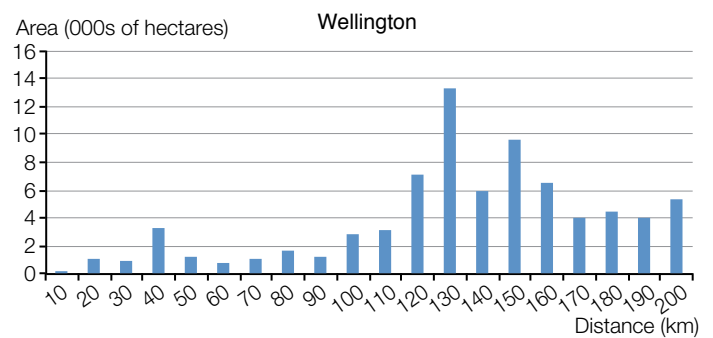
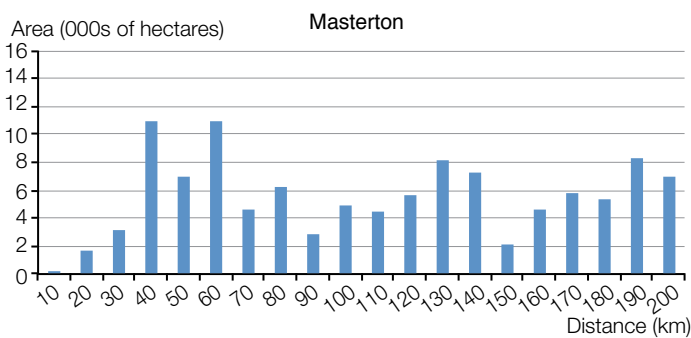
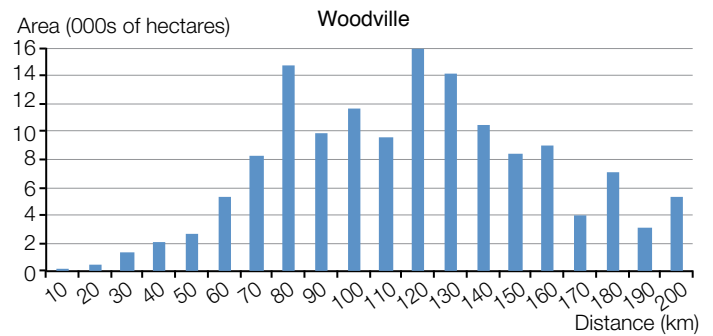
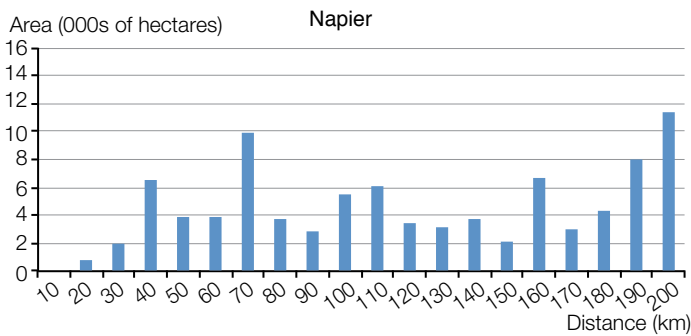
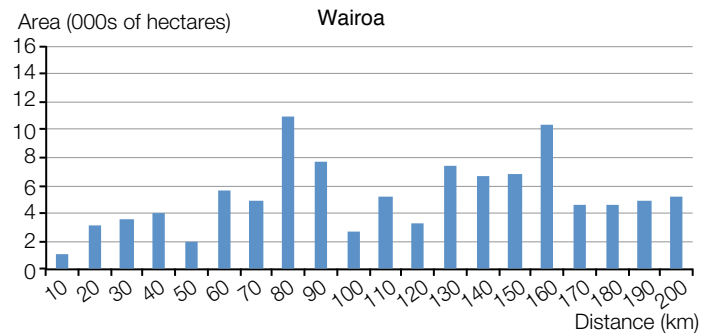
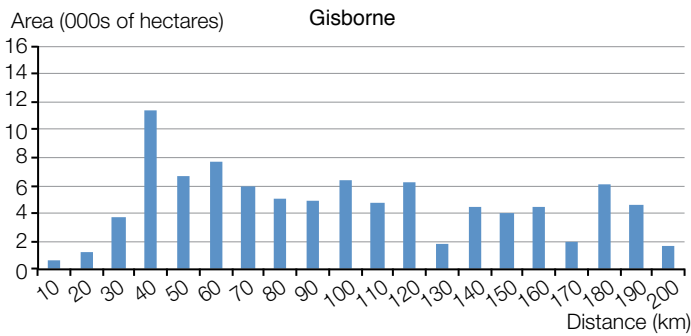


Figure 2: Distribution of small-scale forest area by distance (on road network) from ports or transport hubs. Only area within East Coast, Hawke's Bay, SNI-East and SNI-West wood supply regions is included. The same forest area may be included in graphs for multiple locations. Area is graphed by 10 km classes with the distance shown being the upper limit of the class

Table 6: Reconciliation of LCDB area with mapped area. LCDB area equals mapped area plus the values in the other four columns. New planting is area planted subsequent to mapping. Gross/net is the difference caused by LCDB mapping different boundaries for mapped blocks. Misclassification-over error is non-plantation area classified by LCDB as plantation. Misclassification-under error is plantation area classified as non-plantation by LCDB

Region	Mapped (ha)	New planting (ha)	Gross/net difference (ha)	Misclassification –over error (ha)	Misclassification –under error (ha)	LCDB (ha)
East Coast	62,441	491	6,021	2,878	-2,087	69,743
Hawke’s Bay	58,118	398	4,318	9,506	-2,661	69,679
SNI-East	52,721	91	3,872	4,174	-1,191	59,666
SNI-West	75,051	111	5,980	9,860	-274	90,728
<b>Total</b>	<b>248,331</b>	<b>1,091</b>	<b>20,190</b>	<b>26,417</b>	<b>-6,213</b>	<b>289,816</b>

Table 7: LCDB differences/errors as a percentage of mapped area

Region	Gross/net difference (%)	Misclassification –over error (%)	Misclassification –under error (%)
East Coast	9.6	4.6	-3.3
Hawke’s Bay	7.4	16.4	-4.6
SNI-East	7.3	7.9	-2.3
SNI-West	8.0	13.1	-0.4
<b>Total</b>	<b>8.1</b>	<b>10.6</b>	<b>-2.5</b>

LUCAS includes new planting registered in the Emissions Trading Scheme (ETS) or Afforestation Grant Scheme.

Reconciliation of LCDB area with the mapped area shows that, overall, net misclassification error is the same as the gross/net difference of 8.1%. Across the four wood supply regions, misclassification-over error is 10.6% of the mapped area while misclassification-under error is -2.5%. The gross/net difference is 8.1% (Table 7).

Overall, LUCAS has a higher gross/net difference at 11.1% of mapped area. Again, this is very similar to overall misclassification. Across the four wood supply

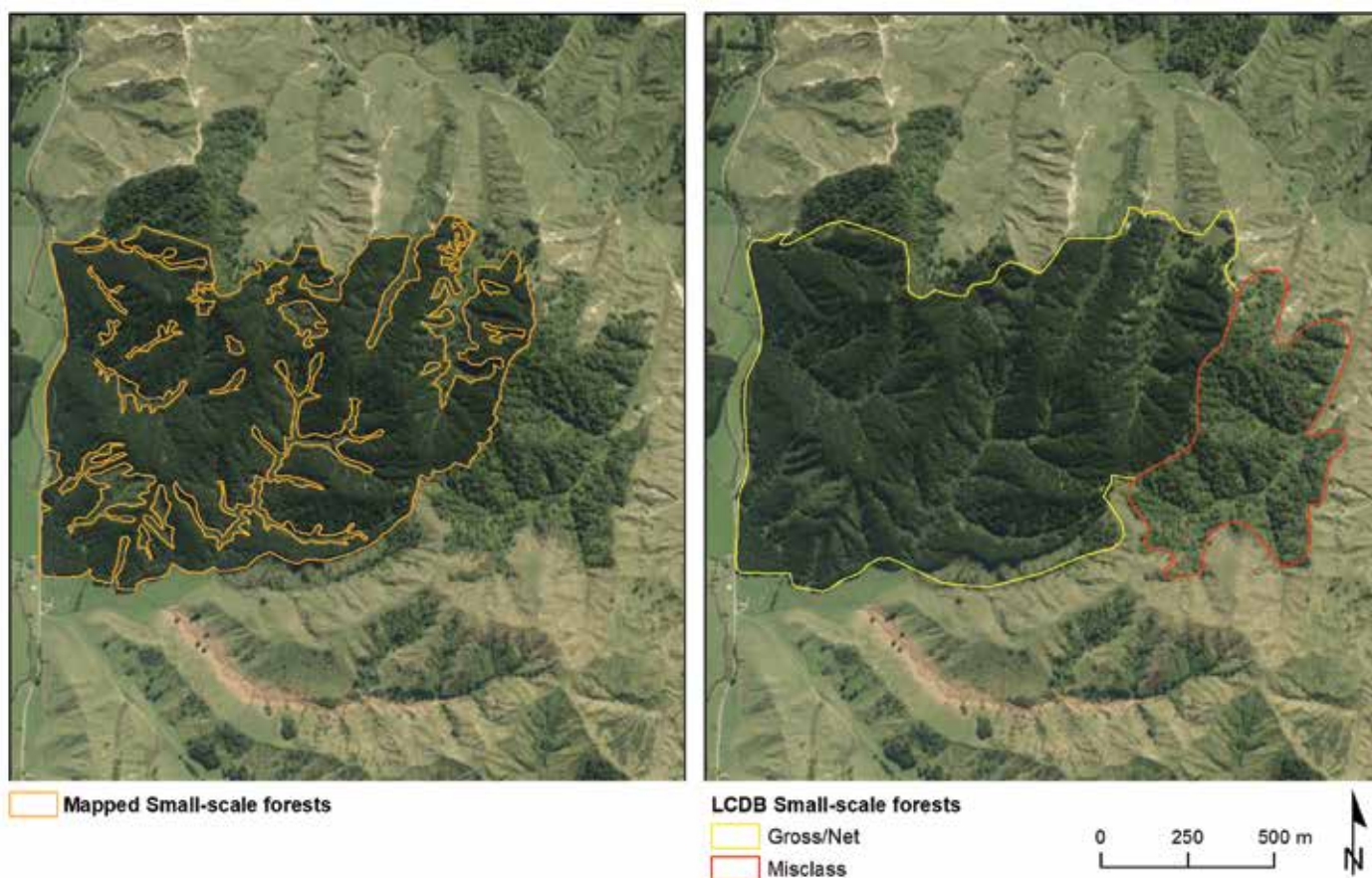


Figure 4: Example of a 95.4 ha plantation (mapped area in left photo) that has been mapped by LCDB as 120.5 ha (gross area shown with yellow boundary). The adjacent 30 ha area (with red boundary) has been misclassified as plantation



regions, misclassification-over error is 11.3% of the mapped area compared to  $-0.3\%$  for misclassification-under error (Table 9).

LUCAS has a higher gross/net difference than LCDB in each of the four regions. However, trends for misclassification error are not as consistent. LUCAS has higher misclassification error than LCDB in the East Coast and Hawke's Bay, but is lower in SNI-East and SNI-West.

It is apparent from Tables 6 and 8 that both LCDB and LUCAS have missed very few of the mapped blocks. The total area of mapped plantation area that was classified as non-plantation area is 6,213 ha for LCDB and only 702 ha for LUCAS. However, both LCDB and LUCAS are classifying large areas of non-plantation vegetation as plantation.

### Implications for wood processing

The findings on the total small-scale area in a wood supply region have implications for potential wood processing opportunities. Of importance is the location of the small-scale estate. With the spatial map developed it has been possible to analyse the distribution of area by distance from different ports and transport hubs. This information is relevant for transport planners looking at flows of logs to the four ports in the regions studied and also for the potential use of rail from transport hubs to ports. There are existing processing plants

at, or near, some of these locations. There is also the opportunity to expand these existing plants, or build new plants, at these locations. This study has provided some critical information for both transport planning and wood processing feasibility studies. With additional information on age-class distribution and yield, it would be possible to forecast the volumes available by year.

### Conclusions

The results presented here confirm those of Manley et al. (2017). The small-scale estate is an increasingly important component of the New Zealand estate, yet New Zealand's Tier 1 database (the NEFD) does not accurately estimate the total area of the small-scale estate, and by extension, the total New Zealand plantation area.

The results also show that the LCDB and LUCAS estimated areas are substantially larger than the mapped areas. Although some of this difference can be explained by the LCDB and LUCAS estimating gross rather than net area, both systems have misclassified substantial areas of non-plantation land as plantations. There is internal consistency in the LUCAS system in that, in the estimates of national carbon stocks, a gross to net adjustment is made based on the proportion of grid points in the plantation land use classes that have planted forest. Nevertheless, the area of plantation reported by New Zealand in its annual Greenhouse Gas Inventory is not accurate.

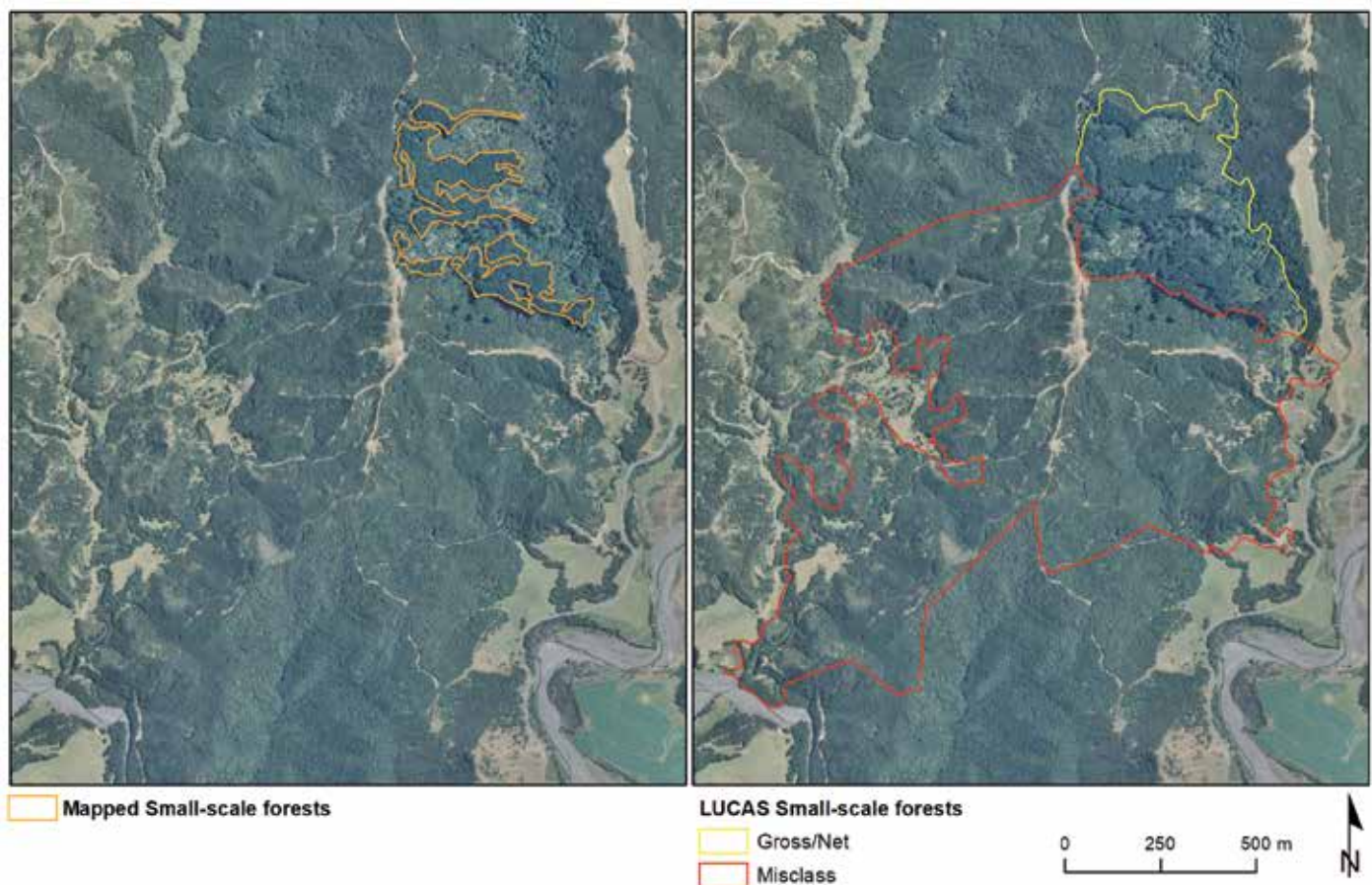


Figure 5: Example of an 8.8 ha plantation (mapped area in left photo) that has been mapped by LUCAS as 23.8 ha (gross area shown with yellow boundary). The adjacent 100.8 ha area (with red boundary) has been misclassified as plantation



Table 8: Reconciliation of LUCAS area with mapped area. LUCAS area equals mapped area plus the values in the other four columns. New planting is area planted subsequent to mapping. Gross/net is the difference caused by LUCAS mapping different boundaries for mapped blocks. Misclassification-over error is non-plantation area classified by LUCAS as plantation. Misclassification-under error is plantation area classified as non-plantation by LUCAS

Region	Mapped (ha)	New planting (ha)	Gross/net difference (ha)	Misclassification -over error (ha)	Misclassification -under error (ha)	LUCAS (ha)
East Coast	62,441	4,708	9,378	5,559	-87	81,999
Hawke's Bay	58,118	720	6,395	11,267	-418	76,082
SNI-East	52,721	3,713	4,832	3,769	-51	64,983
SNI-West	75,051	1,993	7,028	7,371	-147	91,295
<b>Total</b>	<b>248,331</b>	<b>11,133</b>	<b>27,632</b>	<b>27,966</b>	<b>-702</b>	<b>314,360</b>

Table 9: LUCAS differences/errors as a percentage of mapped area

Region	Gross/net difference (%)	Misclassification -over error (%)	Misclassification -under error (%)
East Coast	15.0	8.9	-0.1
Hawke's Bay	11.0	19.4	-0.7
SNI-East	9.2	7.1	-0.1
SNI-West	9.4	9.8	-0.2
<b>Total</b>	<b>11.1</b>	<b>11.3</b>	<b>-0.3</b>

Manley et al. (2017) noted that results of the Management Case Studies in 2015 and 2016 had raised concern about NEFD accuracy. These concerns are starting to lead to concrete plans (and resources) to improve the NEFD by the development of a spatial database of the total New Zealand plantation estate.

The results presented here confirm the need for an accurate spatial database of New Zealand plantations. The case studies have shown that it is possible to develop an accurate base map of small-scale plantations. Once this is achieved it will be possible to use satellite imagery to update the status of the area (i.e. when it is harvested). With the recently announced funding for national LiDAR coverage comes the opportunity to estimate stand height for the area and from this standing volume and age (Xu et al., 2018), thus making it possible to forecast the annual wood volumes available from small-scale forests.

At present, there are three estimates of New Zealand's plantation forest estate but none of them is accurate. This leads to two questions:

- Given the importance of the New Zealand plantation estate, shouldn't we know the area and where it is located?
- Given the available technology, why don't we know?

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