An in-depth assessment of the suitability for horticulture of the land resources in the Maniapoto rohe

van den Dijssel C, Hall A and Clothier B

July 2014
Confidential report for:
Maniapoto Māori Trust Board

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Executive summary

An in-depth assessment of the suitability for horticulture of the land resources in the Maniapoto rohe

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July 2014

The Maniapoto Māori Trust Board (MMTB) is working with a multi Crown Research Institute (CRI) team led by NIWA, and comprising AgResearch, GNS, Landcare Research, Plant & Food Research and Scion to gain an in-depth understanding of the value of the natural assets of the lands within the Maniapoto rohe. This report details the work by The New Zealand Institute for Plant & Food Research Limited to assess the suitability of lands within the rohe for horticulture. Crops included in this study were market gardening (commercial vegetable production), nurseries, berryfruit, flowers, olives, viticulture, and pipfruit. The work could be extended in future to include other horticultural crops.

Climatic suitability was assessed using the dates of first and last frosts and the heat accumulation using the growing degree day sum during the growing season, and the suitability of land for horticulture was assessed using the Land Use Capability (LUC) classification of the New Zealand Land Resource Inventory. By overlaying maps of climate and land use suitability, and applying a decision tree developed within the multi-CRI Sustainable Land Use Research Initiative (SLURI), we were able to identify areas suitable for each crop. Economic, market, infrastructural and labour constraints are not considered here, but the work could be extended in future to include some of these factors.

By considering both the climate and soils resources of the Maniapoto rohe, we found that there is a substantial area of land within the rohe that is suitable for horticulture (144,000 ha), which is much greater than that currently being used for horticultural purposes (1,549 ha). Thus current horticultural land use is presently just over 1% of what would be possible.

The best region for horticulture is a contiguous region around Te Awamutu and Otorohanga with further potential area along the valley down to Mokau. Modern horticultural enterprises are aggregated agribusinesses with distributed orchards exploiting niche locations and pockets of suitable microclimates. So it would even be possible to consider horticultural expansion into the valley leading down to Mokau.

The climate within the Maniapoto rohe is well suited to horticulture, with 18% of the rohe in lands meeting climate constraints and exceeding the minimum Land Use Capability (LUC) class considered necessary.

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An in-depth assessment of the suitability for horticulture of the land resources in the Maniapoto rohe. July 2014. PFR SPTS No. 10349. This report is confidential to Maniapoto Māori Trust Board.
1 Introduction

The Maniapoto Māori Trust Board (MMTB) is working with a multi CRI team led by NIWA, and comprising AgResearch, GNS, Landcare Research, Plant & Food Research and Scion to gain an in-depth understanding of the value of the natural assets of the lands within the Maniapoto rohe. This report details the work by The New Zealand Institute for Plant & Food Research Limited to assess the suitability of lands within the rohe for horticulture.

In his report “Growing for Good”, the then Parliamentary Commissioner for the Environment, Morgan Williams (PCE 2004) noted that New Zealanders are highly dependent on our natural capital stocks of our waters, soils and biodiversity to sustain our wealth-generating capacities. This is especially so for New Zealand because of its reliance on primary production for its wealth.

This report assesses options for land use by considering the value of a rohe’s natural capital stocks and ecosystem goods and services (Mackay et al. 2005), and by using methods developed by the multi-CRI Sustainable Land Use Research Initiative (SLURI – www.sluri.org.nz). This approach was previously applied to assess the suitability of lands within the Otaki basin for horticulture (Clothier et al. 2008).

2 Methods

The land-use suitability methodology used here was first developed in 2005 in response to the concerns of the Kapiti Coast District Councils (KCDC) that their productive-sector environments were undergoing rapid land-use change especially in the northern region of the Kapiti Coast District in the Otaki Basin. The horticultural enterprises we consider here are:

• Market gardening (commercial vegetable production)
• Nurseries
• Berryfruit
• Flowers
• Olives
• Viticulture
• Pipfruit.

In the future this could, if required, be extended to other crops and products as has been carried out in the rohe of the Far North District Council (Griffiths et al. 2003), and for the Tararua District Council (Reid et al. 2006), and for global kiwifruit production by Zespri Group Limited (Hall et al. 2011).

To assess suitability of the selected horticultural crops, the suitable area for horticultural activities was first determined by interrogating the necessary conditions from the ecosystem services provided by the local climate, based on dates of first and last frosts and the growing degree sum for the growing season. In this assessment we did not consider whether or not irrigation might be needed. That detailed assessment can be carried out should it be required for given crops in specific locations.
Next, the Land-Use Capability (LUC) data from the New Zealand Land Resource Inventory served to provide the basis for establishing the natural-capital value of the soils in relation to horticultural land-use versatility – the soils with the higher natural-capital valued land (soils on Classes I and II) will have more options for horticultural activities. A decision tree developed within the multi-CRI Sustainable Land Use Research Initiative (SLURI) was then used to determine the potential land area for each horticultural activity in relation to the natural capital values of the soils grouped by the LUC.

This productive potential is based on the ecosystem services of the climate and the natural capital values of the land. Economic, market, infrastructural and labour constraints are not considered here, but as in the work for KCDC, the economic effects of an expansion in horticultural production in the Maniapoto rohe could be assessed as an extension of this work.

Presently within the Maniapoto rohe there is very little horticulture (Figure 1). There are some orchards, vineyards and other perennial crops, along with some short-rotation crop lands. In total there are just 1549 ha of horticulture in the Maniapoto rohe, which is less that 0.2% of the rohe’s area.

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Figure 1. A map of the locations of existing horticultural land uses in the Maniapoto rohe according to Land Cover Database v3. (Data reproduced with the permission of Landcare Research New Zealand Limited and the Maniapoto Māori Trust Board.)
3 The climate resources

Seven broad horticultural use classes (market gardening, nurseries, berries, flowers, olives, pipfruit and viticulture) were examined for their climatic suitability. Following Mackay et al. (2005), three climate layers were integrated to determine the climatic constraints for the seven horticultural activities. The overlay of all three layers was used to delimit a suitable area for the horticultural crops. The layers and their criteria are:

1. First ground-frost not before day-of-year (DOY) 80 (approximately the autumn equinox, 21 March) so that harvest is not compromised (Figure 2).
2. Last ground-frost not after DOY 331 (approximately 27 November) so that leaf development and flowering are not compromised (Figure 3).
3. Growing Degree Days (base 5°C) (GDD5) >2700 so that there is enough seasonal heat to enable fruit and harvest maturity (Figure 4). Growing Degree Days (GDD5) are a measure of the accumulated heat hours, above a predetermined base temperature (here 5°C). Levels of GDD5 in excess of 2700 are required to ensure horticultural crop development and maturity.

![Map of the area](image)

Figure 2. The green shaded area within the Maniapoto rohe meets the criterion that the first ground-frost does not occur before day-of-year (DOY) 80 so that fruit harvest is not compromised. (Data reproduced with the permission of Landcare Research New Zealand Limited.)
Figure 3. The brown shaded area within the Maniapoto rohe meets the criterion that the last ground-frost does not occur after day-of-year (DOY) 331 so that leaf emergence and flowering are not compromised. (Data reproduced with the permission of Landcare Research New Zealand Limited.)
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By overlaying these layers it is possible to map those areas within which there are no climatic constraints to production of the seven horticultural crops we are considering. A map of this area of no climatic constraints is presented in Figure 5. The areas for which the first autumn frost is sufficiently late, the last spring frost sufficiently early, and the GDD5 exceeds 2700, are all very similar (Figures 2–5).

Figure 4. The purple shaded area within the Maniapoto rohe meets the criterion that the Growing Degree Days (GDD5) exceeds 2700 in order that there is enough heat for the crops to reach maturity for harvest. (Data reproduced with the permission of Landcare Research New Zealand Limited.)
Figure 5. The green shaded area within the Maniapoto rohe meets all the criteria of first ground-frost after day-of-year (DOY) 80, last ground-frost before DOY 331, and the that the Growing Degree Days (GDD5) exceeds 2700. The green-shaded area has no constraints to horticultural production. (Data reproduced with the permission of Landcare Research New Zealand Limited.)

Figure 5 reveals that the climate within the Maniapoto rohe is well suited to horticulture, as the area without constraints to horticultural production is found to be 442,450 ha, which is 56% of the rohe’s area. Wind strength has not been considered in this analysis, and analysis of this could be sourced from NIWA. Nonetheless, even in windy regions, horticulture is successful through the use of shelterbelts and appropriate support structures. It is likely that wind shelter would need to be provided for some crops in some areas in the Maniapoto rohe.
4 The land resources

For horticultural production to be successful, not only must the climate be appropriate, but also the land and soil resources need to be suitable. We have used the Land Use Capability (LUC) classification of the New Zealand Land Resource Inventory to assess the suitability of land for horticulture.

At the class code level of the LUC there are eight classes; their descriptions are given in Table 1.

Table 1. The Land Use Classification (LUC) of the NZ Land Resource Inventory is a three-fold expression of the limitations of land to primary production. The code level descriptions are given first in the table below, followed by the subclass modifiers, and finally the unit identifiers. (Data reproduced with the permission of Landcare Research New Zealand Limited.)

<table>
<thead>
<tr>
<th>LUC Class code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land with virtually no limitations for arable use and suitable for cultivated crops, pasture or forestry</td>
</tr>
<tr>
<td>2</td>
<td>Land with slight limitations for arable use and suitable for cultivated crops, pasture or forestry</td>
</tr>
<tr>
<td>3</td>
<td>Land with moderate limitations for arable use, but suitable for cultivated crops, pasture or forestry</td>
</tr>
<tr>
<td>4</td>
<td>Land with moderate limitations for arable use, but suitable for occasional cropping, pasture or forestry</td>
</tr>
<tr>
<td>5</td>
<td>High producing land unsuitable for arable use, but only slight limitations for pastoral or forestry use</td>
</tr>
<tr>
<td>6</td>
<td>Non-arable land with moderate limitations for use under perennial vegetation such as pasture or forest</td>
</tr>
<tr>
<td>7</td>
<td>Non-arable land with severe limitations to use under perennial vegetation such as pasture or forest</td>
</tr>
<tr>
<td>8</td>
<td>Land with very severe to extreme limitations or hazards that make it unsuitable for cropping, pasture or forestry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LUC subclass modifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>erosion susceptibility, deposition or the effects of past erosion damage first limits production</td>
</tr>
<tr>
<td>W</td>
<td>soil wetness resulting from poor drainage or a high water table, or from frequent overflow from streams or coastal waters first limits production</td>
</tr>
<tr>
<td>S</td>
<td>soil physical or chemical properties in the rooting zone such as shallowness, stoniness, low moisture holding capacity, low fertility (which is difficult to correct), salinity, or toxicity first limits production</td>
</tr>
<tr>
<td>C</td>
<td>climatic limitations such as coldness, frost frequency, and salt-laden onshore winds first limits production</td>
</tr>
</tbody>
</table>
The lands that are potentially suitable for any of the seven horticultural land uses, where LUC is greater than or equal to LUC 4w, are shown in the map of Figure 6. This is purely an LUC determined consideration, and does not take into account the climatic criteria outlined in Section 3.

Figure 6. A Land Use Capability (LUC) class map of the rohe of the Maniapoto Māori Trust Board where the LUC class would enable at least one of the seven horticultural land uses being considered. No exclusion on the basis of climate criteria was made. (Data reproduced with the permission of Landcare Research New Zealand Limited.)

This map of the distribution of the LUC classes shows that there is a region of versatile high class land in the north east of the rohe from Te Awamutu, through Otorohanga to Te Kuiti, and then along the valley down to the coast at Mokau.

So whereas the climate of some 56% of the Maniapoto rohe would enable horticulture, land use versatility would limit horticultural production, as only 213,000 ha or 27% of the rohe is in lands with an LUC class better than 5.

The overall suitability of the seven various horticultural land-uses is presented in Figure 7.
Figure 7. The SLURI Decision Tree (Mackay et al. 2005) in which the decrease in soil versatility as measured by the Land Use Capability (LUC) class limits options for various of the seven horticultural land uses being considered here. (Recreated from the original report.)
5 Suitable areas for horticultural land uses

It would only be possible for horticulture to take place in locations that meet the climatic criteria (Figure 5) and for the various mixes of land-use types to satisfy the constraints posed by the soils' versatility (Figure 6). The areas where both sets of criteria are met are presented in Figure 8, where the LUC classes are themselves shown.

![Figure 8. The Land Use Capability (LUC) class map of the Maniapoto rohe where the LUC class would enable at least one of the seven horticultural land uses being considered (Figure 6) and where the climate constraints are also met (Figure 5). (Data reproduced with the permission of Landcare Research New Zealand Limited.)](image)

There is a substantial area of land within the Maniapoto rohe that is suitable for horticulture (144,000 ha), which is much greater than that currently being used for horticultural purposes (1549 ha). Thus current horticultural land-use is presently just 1% of that which is possible.

From Figure 9, we can assess the areas, and relative areal percentage of the rohe that would be suitable for mixes of the seven horticultural enterprises. These data are presented in Table 2.
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Table 2. A breakdown of the areas suitable for the various mixes of horticultural land-uses within the Maniapoto rohe. The Land Use Capability (LUC) class suitabilities for the various mixes come from Figure 7.

<table>
<thead>
<tr>
<th>The mix of horticultural landuses possible</th>
<th>Area (ha)</th>
<th>Percent of the rohe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market gardening, nurseries, berryfruit, flowers, olives, viticulture, pipfruit</td>
<td>11,265</td>
<td>1.4</td>
</tr>
<tr>
<td>Market gardening, nurseries, berryfruit, flowers,</td>
<td>28,650</td>
<td>3.6</td>
</tr>
<tr>
<td>Olives, viticulture, pipfruit</td>
<td>31,571</td>
<td>4.0</td>
</tr>
<tr>
<td>Market gardening, nurseries, berryfruit,</td>
<td>18,694</td>
<td>2.4</td>
</tr>
<tr>
<td>Olives, viticulture</td>
<td>52,140</td>
<td>6.6</td>
</tr>
<tr>
<td>Berryfruit</td>
<td>1,677</td>
<td>0.2</td>
</tr>
</tbody>
</table>

There is a contiguous region around Te Awamutu and Otorohanga that has potential for horticulture. Furthermore there is potential area for horticulture along the valley down to Mokau. Modern horticultural enterprises are aggregated agribusinesses with distributed orchards exploiting niches locations, or terroir. These aggregated agribusinesses process and pack produce from distributed orchards, and as well this enables sharing of capital equipment and the centralisation of processing and packing. So it would be possible to consider horticultural expansion into the valley leading down to Mokau.
6 Conclusions

We have found that there is currently little horticulture in the Maniapoto rohe. There are just 1549 ha of horticulture currently. However, by considering the climate and soils resources of the rohe, we have found that the area of land suitable for the horticultural land uses of market gardening, nurseries, berryfruit, flowers, olives, viticulture, and pipfruit is 144,000 ha. Thus current horticultural land use is presently just only about 1% of that which is possible. The natural resources of the rohe provide huge potential for horticulture.

We have not considered here whether there are markets for these products, nor have we considered economic, infrastructural, and labour constraints. These will be something for future consideration by establishing links with the rural economists located in the partner CRIs. Furthermore, there are future opportunities to consider other horticultural land uses.

7 References


