Mānuka – a viable alternative land use for New Zealand's hill country?

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Plantation mānuka for honey and oil production has emerged as an alternative land use for New Zealand's hill country. This paper examines the background to mānuka's emergence, what is driving this increase in demand and its impact on the honey and pollination services sectors. It then looks at mānuka harvesting, apiculture and management, and the factors influencing honey yield, before outlining the business case for mānuka (both natural forest and plantation) and making conclusions about its viability.

Introduction

Plantation forestry has long been promoted as a viable land use for New Zealand's degraded hill country, with various estimates of up to 3–5 million ha of marginal land potentially available for afforestation. Extensive areas of hill country were planted with plantation species during the 1990s while we enjoyed high log prices (e.g. on the East Coast, in Northland, the King Country and Manawatu/Wanganui). As these forests approach maturity, with increased compliance and operational costs and with less certainty around log prices, the viability of harvesting is being questioned in some cases.

This then raises questions around whether these plantations should be harvested or not, and the legacy issues that go with this. In particular, where plantation forests have been established for land stabilisation there is a risk that unharvested forests may exacerbate erosion as they become senescent. If the plantations are harvested, what is their net return and what are the replanting options? In addition, for remaining marginal land still in pasture or scrub, what are viable land use options?

Plantation forestry has often struggled to compete with pastoral farming on hill country, as the land prices attainable for farming are often well above what forestry can afford to pay under commonly promoted discount rates. This has remained the case until recently, even with sheep and beef returns under pressure. The recovery of carbon prices has started to encourage investors to look at land for production/carbon forestry under the emissions trading scheme (ETS), and for offset planting for pre-1990 forest land deforestation. However unless harvesting returns are viable, planting of marginal hill country in plantation forestry still carries significant risks.

Mānuka has emerged as an alternative land use, driven by strong demand for mānuka honey and oil with record prices, as well as a secondary consideration of carbon credits and no associated forest harvesting issues. Some are linking the marginal land now available to the potential for mānuka production. We've heard this before in relation to plantation forestry, so how does mānuka stack up?

What's driving mānuka?

One of the key ingredients in mānuka honey is the organic molecule methylglyoxal (MGO), which has long-lasting non-peroxide activity (NPA) clinically proven for wound dressings, and mānuka wound dressings are now sold worldwide (van Eaton, 2014). This NPA in mānuka honey has been expressed using many different measures in the industry including MGO, Molan Gold Standard,

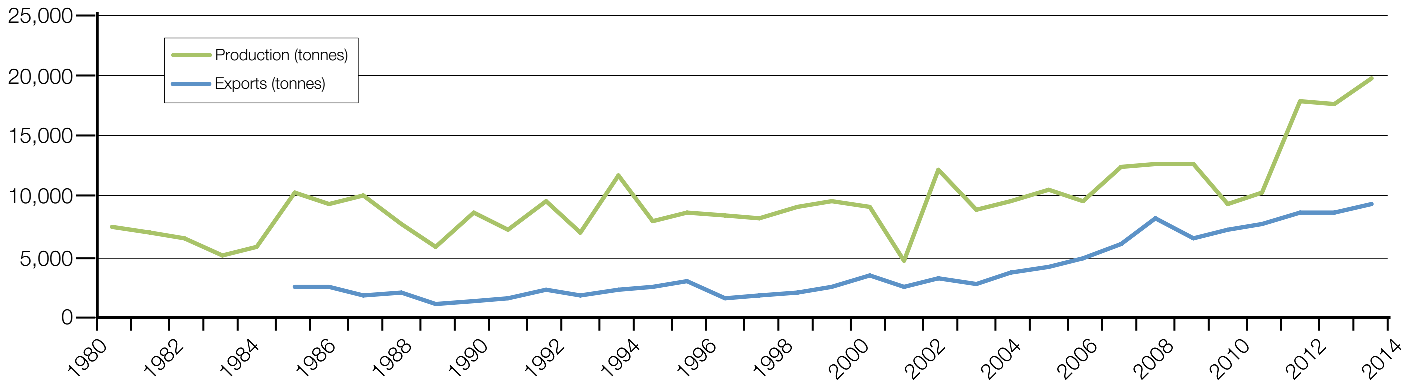

Figure 1: NZ honey production 1980–2014. Source: www.airborne.co.nz/statistics/new-zealand.shtml

and a trademark developed in New Zealand as 'Unique Manuka Factor' or UMF. UMF ratings of 15+ have strong antibacterial activity and can be used to treat wounds.

Mānuka and the resultant interest in mānuka apiculture are therefore being driven by high demand in the medical market and the associated demand in the health food industry. This demand has led to the record prices for high activity and medical grade mānuka honey. Broader health applications include the use of mānuka in cough syrups and lozenges, lip balm and moisturiser. There are also perceived health benefits of ingesting mānuka honey, but clinical evidence is so far lacking. Nevertheless high UMF mānuka honey now achieves a premium price on supermarket and health food store shelves. This has had a flow-on effect to less active mānuka honey, as well as other New Zealand monofloral and clover-based honeys now achieving record prices.

Figure 1 shows the steady growth of honey production in New Zealand since the early 2000s following the initial drop after the infestations of the varroa mite and then a marked lift in the last five years. This growth in production has been underpinned by steady growth in honey exports.

Understanding these markets and their opportunities and risks, as well as the difference between the wound care and health food markets, is important for assessing future prospects. The wound care market has been developed over a number of years and is based on well-researched clinical evidence. Nevertheless this does not mean it is immune to competition from other products and methods for wound care. Clinical evidence for the benefits of ingested honey, apart from topical use as lozenges, has not been published as yet. There is a risk that the demand for mānuka honey as a health food will not be sustained in the long run since health food fads are relatively short term in general. In part, much of the health food demand is being driven by the Chinese market where food as medicine has a long history.

Perhaps the biggest market risk is with product standards and reputational risk. For example, UK reports of mānuka honey sales are higher than total New Zealand production, and so there is significant blending occurring globally. While blending itself is not an issue, how the resultant product is labelled is critical. The Ministry for Primary Industries (MPI) is conducting research to address this issue and is developing monofloral mānuka honey labelling standards.

The other main risks for the mānuka industry are on the resource side, both in terms of supply and the financial viability of an industry entering what could be seen as a bubble. The government has set a target for mānuka honey to reach a level of $1.2 billion in annual exports by year 2025, up from $75 million in 2010 (see www.mpi.govt.nz/funding-and-programmes/primary-growth-partnership/primary-growth-partnership-programmes/high-performance-manuka-plantations/). This mānuka honey is harvested from an estimated area of 900,000 ha of natural mānuka forest throughout New Zealand (Wearmouth, 2016).

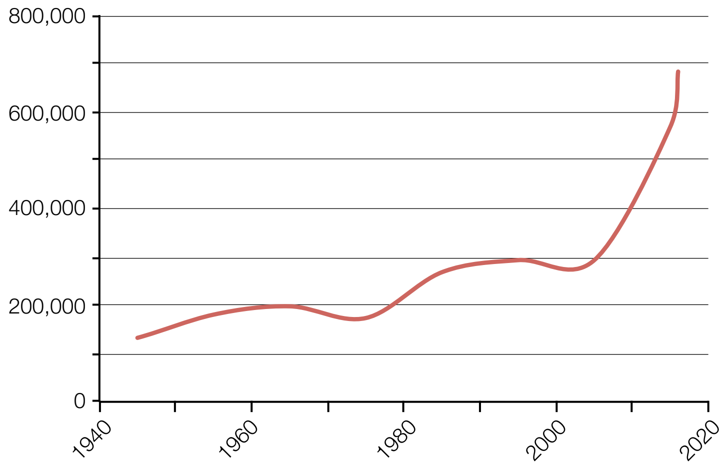

Figure 2: Total hives in NZ 1940–2020. Source: Murray Reid, AsureQuality

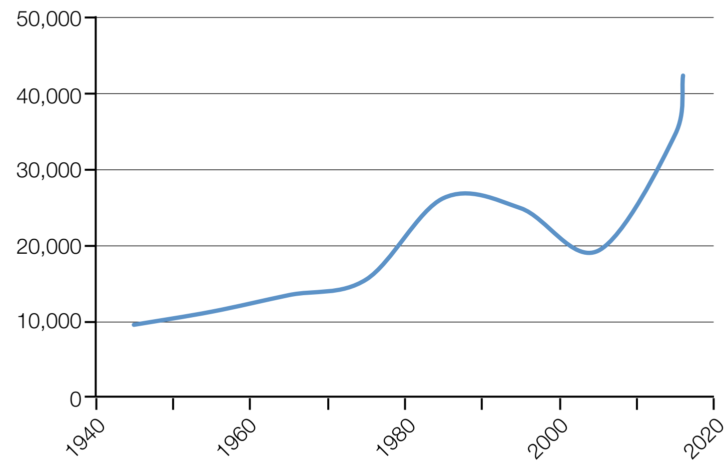

Figure 3: Total apiaries in NZ 1940–2020

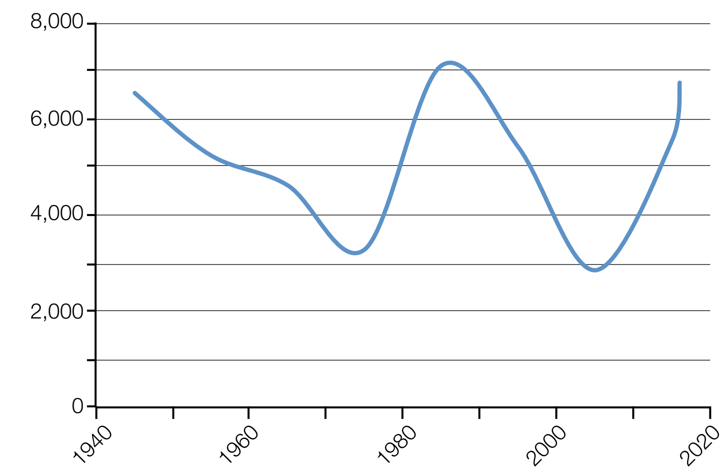

Figure 4: Total beekeepers in NZ 1940–2020

The area under current natural mānuka forest is largely the result of supplementary minimum prices (SMPs) being removed on sheep, beef and wool in 1984, which made traditional farming on significant areas of marginal land unprofitable, including a large portion on Māori-owned land. The land abandoned for livestock has since regenerated into vast areas of pioneer mānuka and kānuka forests. Given the rapid expansion of the mānuka honey harvest in recent years, it is unlikely that physical production can increase much further from this type of land, although apiarists and landowners are seeking to access mānuka forest not previously harvested for honey. Given the limitations of the existing natural mānuka forest resource, it is unlikely that it alone is capable of achieving the government's export target, nor will the target arise solely from changes in price.

The mānuka plant has a natural life span of 25-50 years, due to the fact that it is a 'pioneer' species which provides a protective environment for larger tree species to establish and then replace the mānuka forest after some years. The risk with the mānuka industry is that much of the natural resource is already 30 years old and there has been little attempt to increase, manage or replace the plantings since the mid-1980s. This means that the only way for the mānuka industry to reach the $1.2 billion target per annum is through new plantings of mānuka forest or through managing existing areas as mānuka orchards.

Impact of increasing demand

To understand the impact of the explosion of interest in mānuka honey, consider the increase in the number of bee hives, apiary sites and beekeepers in the past five years compared to the 70-year trend (see Figure 2).

The boom in the mānuka industry since about 2005 has seen hive, apiary and beekeeper numbers double (see Figures 3 and 4), and the growth in hive numbers has been exponential in the last five years. These increases show that pre-existing areas are being harvested more intensively, which can place pressure not only on the mānuka resource for the honey bees and the native bees, but also on food resources for bees outside the mānuka flowering period. This last point is of particular significance given that mānuka only flowers for about six weeks each year, and bees require year-round food to build up their colony strength for the summer harvest and to prepare strong bees for winter survival.

No-one knows if there are currently enough floral resources to sustain a doubling of hive numbers. However the evidence that there are not enough resources can be seen in the exponential increase in the amount of protein supplement and sugar syrup that all beekeepers are forced to feed their hives now and the complaints about overcrowding, overstocking, boundary stacking and boundary poaching.

The rapid increase in beekeeper numbers also means that there is a preponderance of inexperienced beekeepers working in the industry. It is estimated that two-thirds of the beekeepers are novices with less than two years' experience (Goldsworthy, 2016), and it is generally agreed that it takes about five years to train a novice beekeeper well enough to go solo. Taken together with the rapid increase in the number of hives each beekeeper is looking after, this indicates potential risks in hive management such as pests, diseases and difficulties in maximising honey yield.

Thirty years ago the value of mānuka honey was so low that the only use beekeepers had for frames of it was to leave them in the hive over winter as bee feed. Today it has been compared to the Wild West, with poisoning and theft of hives, beekeepers boundary riding their competitors' land, overstocking of mānukahoney sites, as well as overcrowding and competition for wintering sites. Many companies are now paying farmers for overwintering sites that they require for post-harvest colony recovery and the development of robust bees to survive winter. Competition for spring build-up sites is also high with overcrowding and boundary transgressions.

Traditionally beekeepers always kept apiary sites at least 3 km apart. This provided enough distance between neighbouring apiaries to allow sharing of forage depending on the number of hives in the apiary. However the flying range of bees can extend up to 5 km or even more to find forage. At present, wherever there is a reasonable sized block of wild mānuka growing many beekeepers are encroaching well within the traditional 3 km boundaries and placing excessive hives as close as 500 m or even 100 m to mānuka sites or to wintering and spring sites. This hive overstocking has created friction among beekeepers and generated border disputes between landowners. Hive overstocking reduces honey yields because excessive bees for a given area means proportionally more honey is used up by bees for their own energy requirements and for making wax for brood cells. Anecdotal reports of honey yield reductions are variable from no honey to 50–70% reduction.

The increase in hive numbers has also placed significant pressures on resources, with replacement hives more than trebling in cost from $200 up to $800 per hive or more. It has also translated into land costs, with beekeepers and investors paying up to $5,000/ha to buy bare land and $500/ha/year or more to lease. Landowners with mānuka are now obtaining much higher value for hives placed on their land and some also receive a share of honey profits. Many landowners are now also benefiting from companies that compete by paying for wintering sites. In the past, wintering sites did not cost beekeepers cash because the landowner received free pollination for pasture clover in summer.

Mānuka honey is now seen to be so attractive that an increasing corporatisation of the apiculture sector is predominant, with investors starting up or buying up existing operations including apiary sites, and significant overseas capital coming into the sector to drive these purchases and to gain access to apiary sites that are already occupied.

Outside of the mānuka sector there are also significant changes, particularly for pollination services to the pastoral, arable and horticultural sectors. While mānuka honey exports currently earn around $150 million and have a target of $1.2 billion by 2025, a conservative estimate of the value of bee pollination services to the wider agricultural sector is between $5–6 billion per annum. This figure was estimated in the early 2000s following the varroa mite outbreak and is currently being updated. With the rapid expansion of the mānuka sector, the hive overstocking has created increased pressure on wintering sites which means bee colonies face a shortage of forage in late summer/autumn and during the spring build-up. As a consequence, bee colonies struggle to build up to the required size and vigour to undertake pollination services or honey harvesting, which results in inferior pollination services and lower honey yields per hive.

Two further threats facing pollination services for horticulture, arable and pastoral crops are that beekeepers are being drawn away by the prospect of higher returns from mānuka honey, or by greater profits from selling their hives to mānuka honey producers. At a sale price of up to $800 per hive, this exceeds the income gained from pollination at $200–$300 per hive. In the pastoral farming sector, the issue for hill country farmers is their ability to attract beekeepers to pollinate their clover pasture, as clover honey is worth considerably less than mānuka or other monofloral honeys. While some have argued that apiarists should pay landowners for the use of their land on the basis of honey income, in cases where pollination is needed the benefit is mutual as the landowner receives significant pasture and crop pollination if the hives are left on-site. The balance of economic value between the landowner and the beekeeper depends on the income obtained from the honey versus the income derived from pollination. The balance differs depending on the type of honey and the pollinated crop yield.

Ultimately, pollination services in these three sectors are under considerable new pressure, and this is from a sector considerably smaller than itself in total value yet essential for good yields for those crops requiring or improved by honey bee pollination. In New Zealand the income from honey subsidises pollination services, but some countries have the reverse relationship (e.g. Canada).

Taken together, these factors highlight some of the sustainability risks in the mānuka honey sector, and have led many to compare the current situation with that of the early kiwifruit boom and the heady days of the dairy bubble. To understand the business case for mānuka (with its attendant potential and risks) requires an evaluation of mānuka honey and oil harvesting, apiculture practices and the management of mānuka plantations.

Mānuka honey and oil harvesting, apiculture and management

Taxonomic experts familiar with mānuka say that there are at least five species, but formal taxonomic treatment has not yet been completed. In contrast, kānuka has been taxonomically defined as 10 species (de Lange, 2014). Mānuka, like kānuka, has different flowering times according to the species or genotype, site factors and climate. This variability extends to nectar flow rates and dihydroxyacetone (DHA) levels in the nectar of the flower, which is the marker for the biological activity of the resulting honey. Higher MGO in the honey is mostly derived from higher DHA in the nectar.

The industry development of mānuka plantations is therefore focused on improving the genetic selection for biological activity, flowering density and flowering times, as well as nectar quality and quantity. The aim is to match the mānuka genotype to the right plantation locations, and then manage the crop to maximise high-quality nectar yield.

Genetic improvement

Genetic improvement is following two broad approaches. The first is a classical tree breeding approach crossing plants with desirable traits from various locations to improve the density and timing of flowering and provide higher grade nectar. (See www.manukafarmingnz.co.nz about a study of a range of mānuka genetic material provided by Comvita NZ Ltd from its mānuka breeding programme.) It also allows the plantation owner to select a combination of cultivars to extend flowering times as practised in fruit orchards. As mānuka is a native plant, this raises the issue of eco-sourcing to prevent the contamination of local native genotypes by external genotypes. This contamination can be avoided if the highly bred genotypes are sterile (e.g. triploid) and incapable of out-crossing into native mānuka. In some areas there has been a push back against planting highly-bred mānuka from external sources, particularly from Māori landowners and conservation managers.

The second approach is to select existing superior genotypes in each region, which are then multiplied by vegetative propagation or through seed orchards (see www.kauriparknurseries.co.nz/keeping-manuka-sweet). This allows the landowner to plant the highest-performing genotype from the local region. While this might not extend the flowering season, the emphasis here would be on maximising nectar yield and quality during the flowering period that matches the regional climatic conditions for the bees. For example, some landowners have planted early flowering mānuka from external sources only to find that the weather is too cold for bee flight during the early flowering, hence no honey crop or a poor one.

Mānuka plantings of superior genotypes are expected to result in a quantum leap forward in biological activity levels of the nectar, and volume of

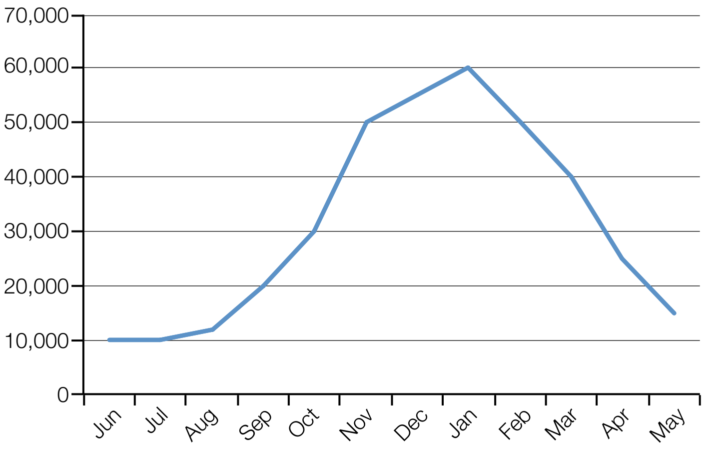

Figure 5: Number of bees in one hive in 12 month period

honey harvested per hectare, although this is yet to be demonstrated at a large scale.

Plantation location and management

In planning a mānuka plantation it is important to understand how a beehive works in terms of the colony's population growth, peak pollen demand and timing of the mānuka honey harvest. Every autumn a bee colony is reduced to approximately 10,000 bees to survive winter as shown in Figure 5. This nucleus of overwintered bees must then build-up in spring to reach a peak population size in time for the start of the honey harvest. The colony must grow to peak size of around 60,000 or more bees by approximately November/December, the usual mānuka flowering time, otherwise there are fewer bees to perform honey harvesting or pollination services. To reach the peak on time, the colony requires a significant supply of nutritious pollen to feed protein to their brood as soon as the weather is warm enough. This supply must be sustained because any interruption in pollen results in bees cannibalising their larvae to feed protein to the older brood. This has a compounding effect on colony population growth and can cause population crashes.

Pollen demand remains strong through the summer, while bees focus on surplus nectar collection for honey storage for winter. During mānuka flowering, it is best to ensure that there is an alternative pollen source available, as honey bees do not normally collect mānuka pollen and need a pollen protein source during honey harvesting to keep the colony going. At the end of summer, the colony will decline in population size with the cold weather. The colony needs to ensure sufficient honey stores for overwintering by replenishing the honey removed by the beekeeper. This is one of the most critical periods in hive management, as the winter bees must be robust enough to live for several months over winter in order to retain a strong population that can rapidly build-up in the spring.

Table 1 shows the timeframe when mānuka and other types of honey are produced during the annual bee colony and flowering cycles at the national level throughout New Zealand. Note that the start and stop times of flowering and nectar flow will vary from north to south, but this table shows the total range at the national level.

It is clear from the above explanation of the colony life-cycle that for a residential apiary system of harvesting, the mānuka plantation system will need to provide year-round bee feed plants to supply sufficient pollen for spring build-up, a pollen source during mānuka flowering, and both pollen and nectar sources for developing robust winter bees and replenishing the honey stores. Figure 6 shows a bee feed planting programme for a residential apiary and mānuka plantation, using native species, as part of the Trees for Bees project (www.treesforbeesnz.org) funded by MPI's Sustainable Farming Fund. This planting programme and calendar show phase one of a comprehensive multi-year programme of planting conducted on the East Cape (Newstrom-Lloyd, 2016). Each year more plants are being added as time and budget allow.

If a residential apiary system is not opted for when a new mānuka plantation is installed then the landowner/beekeeper partnership will have to deal with the intense competition elsewhere for apiary sites for autumn, winter and spring bee forage. Non-residential apiary systems for mānuka therefore risk a lack of adequate bee forage to guarantee peak colony size in time for the honey harvest. If the landowner or beekeeper has guaranteed access to overwintering and spring apiary sites this may not be a problem. In some cases, seasonal shifting between summer honey sites and wintering sites is necessary due to microclimate issues.

The scale and location of the plantation is important because one of the risks for mānuka plantations is that bees may not forage on the mānuka flowers at all. Mānuka is not a preferred nectar species for honey bees. Bees will fly past mānuka flowers to other more preferred nectar sources flowering within foraging range at the same time (e.g. clover, kamahi, tawari, rewarewa). This will result in the dilution of

Table 1: National level seasons for bees, flowers and honey in NZ

<table>
<tr><th colspan="12">National Level Seasons for Bees, Flowers and Honey in New Zealand</th></tr>
<tr><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td><td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td></tr>
<tr><td colspan="3">Spring Build-up</td><td colspan="4"></td><td colspan="5">Over-wintering</td></tr>
<tr><td colspan="2"></td><td colspan="5">Honey Flow</td><td colspan="5"></td></tr>
<tr><td></td><td colspan="5">Pollination Services</td><td colspan="6"></td></tr>
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Pollen source (Oct) — Target crop (Jan)

Number of trees		June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Leptospermum scoparium	Mānuka												
Pittosporum eugenioides	Lemonwood					40	40	40					
Pseudopanax arboreus	Five-finger	35	35	35									
Vitex lucens	Pūriri	20	20	20	20	20							1
Hebe stricta	Koromiko		100	100	100	100							
Coprosma robusta	Karamu			100	100								
Pseudopanax lessonii	Houpara							30	30	30			
Hoheria populnea	Houhere	40									40	40	40
Hoheria sexstylosa	Houhere	40									40	40	40
TOTAL (not including target crop)		135	155	255	220	160	40	70	30	30	80	80	81

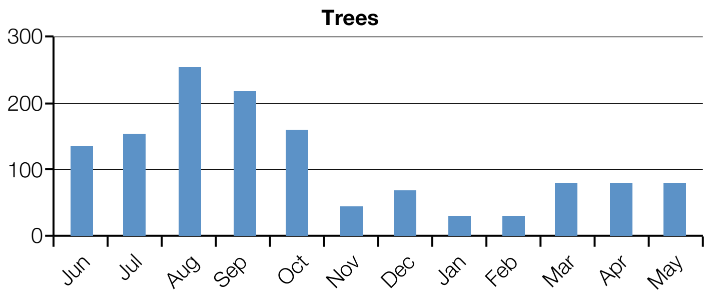

Figure 6: Flowering calendar and bee feed budget

the mānuka honey harvest and reduce the biological activity. Large-scale land holdings or cluster farms of cooperating neighbours can help to gain control over what competing nectar sources are flowering within range of their new mānuka plantation.

In summer, honey bees readily forage from 2–5 km radius from the hive. In some instances, bees have been recorded flying 12 km if a highly preferred nectar source is discovered by the scout bees who will then recruit the colony's foraging bees to the superior source. The quantity of the flowering plants of a given species also plays a role in the choices bees make (they prefer large patches or clusters of the same flower). It therefore becomes critically important to have a sufficient scale of mānuka plantation that will ensure as far as possible that the bees target your mānuka. While a 5 km radius from the apiary site might not be feasible (7,854 ha), a more modest 1–2 km radius (314 to 1,257 ha) is a useful target, and as a rule of thumb you shouldn't plant a block of less than about 50 ha.

When selecting a site for a new mānuka forest, take into consideration the proximity of indigenous mānuka forests and competing alternative flowers that are preferred by bees. A good planting site is a sheltered valley with high hills on either side. Mānuka thrives particularly well on northern and eastern-facing hillsides, and does well in a wide range of soil types.

Mānuka's limitations as a pioneer plant could be prevented if the crop is managed more like any other domesticated tree crop rather than a forest. It is possible, if the demand for medical grade mānuka is sustained, that the plants will become fully domesticated from the wild types and then become as highly selected as other tree crops such as citrus, pip or stone fruit. This would be accompanied by the management of weeds, replacement of senescent trees, and pruning or other practices to force abundant and consistent annual flowering.

The business case for mānuka

Natural forest mānuka

Before looking in detail at the business case for plantation ma¯nuka, it is essential to understand the inherent variability in mānuka nectar production, largely driven by climate but also impacted on by competition, especially when there is a poor to average flowering season. Poor weather (cold or rain) that curtails bee flight is a significant factor as well. Figure 7 shows actual variability in production (kg honey/hive) and the NPA for a single apiary site on natural ma¯nuka over eight seasons. There is very little competition from other apiaries at this site, and this has not changed over time, so the main competition comes from other native flowering species and white clover.

In this case study, production has varied from 5–31 kg/hive over the eight years, with NPA within the range expected for natural forest mānuka. It is interesting to note that while yield per hive has remained fairly strong over the past four years, NPA has trended downwards, which is an indication of the dilution of the honey by competing floral resources at this particular apiary site. It is necessary to consider this variability when looking at projected returns from plantation mānuka.

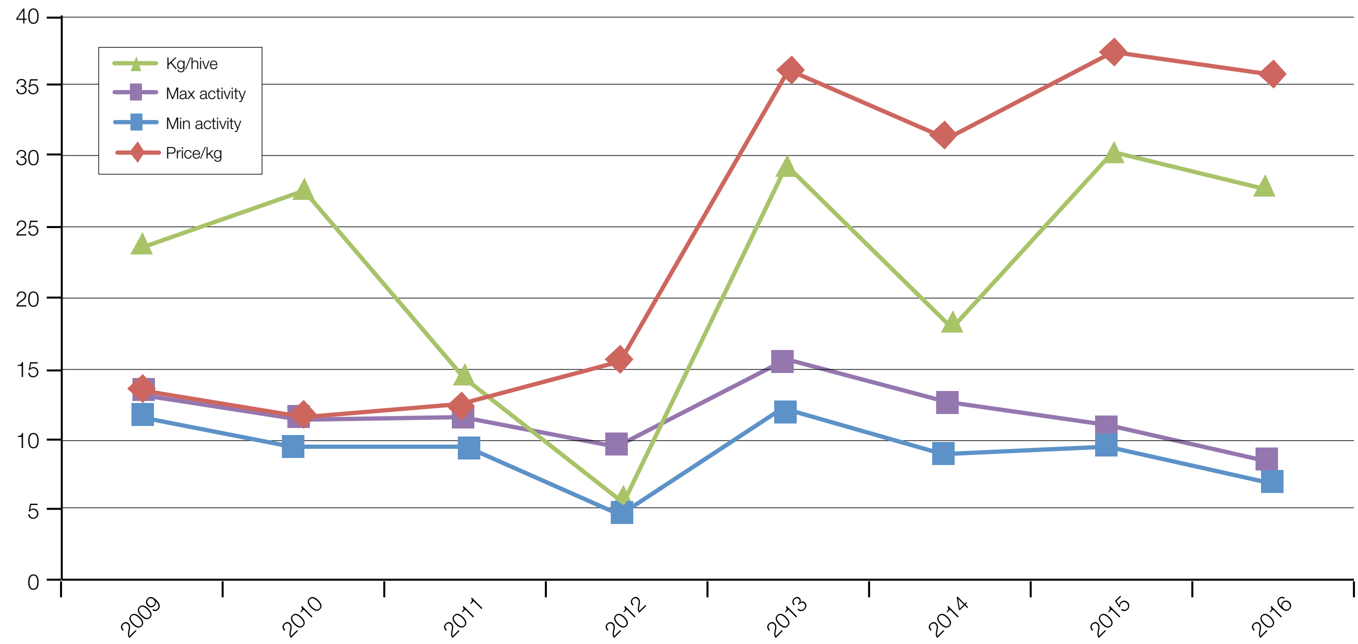

Figure 7: Mānuka production 2009–2016

Table 2: Beekeeper yield and income from natural mānuka forest

Natural Mānuka Reversion	Traditional Beekeeping	Current Beekeeping		
Hives/ha	1	1	1	1
Yield/hive	20	20	30	10
Honey/ha	20	20	30	10
Price	$15	$35	$35	$35
Income	$300	$700	$1,050	$350
Hive purchase	$200	$700	$700	$700
Operational Costs/hive	$250	$450	$450	$450
Landowner share/ costs	$30	$210	$315	$105
Annual Costs	$280	$660	$765	$555
Annual Net income	$20	$40	$285	$(205)
NPV – 25 yrs @ 9%	$(4)	$(307)	$2,099	$(2,714)
IRR %	9%	3%	41%	N/A

It is also important to understand how natural forest mānuka harvesting works for beekeepers, as it is this that plantation mmānuka seeks to complement and potentially replace over time. Traditionally beekeepers would gather 20–35 kg/hive, pay the landowner a hive rental or 10% of gross honey income, and the new hive and hive management costs were reasonable. Even at 20 kg/hive and $15/kg, a beekeeper could therefore make a reasonable income off their hives, and of course could make exceptional income if the yield and prices were strong, hence the boom in mānuka honey.

More recently, the growth in the mānuka sector has pushed the price to purchase a full hive with bees up to over $700/hive for quality colonies, annual operational costs to $400 to $500/hive, and landowner income share up to 30%. If the beekeeper achieves the same yield and activity in their honey, then with the increase in honey prices they will earn slightly more per hive than traditionally, but achieve a lower return because their costs are higher. Should they achieve a higher yield then returns correspondingly increase, but because of the variability noted earlier they are just as likely to run at a loss in any given year.

The increased competition from the doubling of hive numbers in the last five years will adversely affect these profits, particularly in years where there is average to poor flowering. Overstocking hives within foraging range of an apiary site forces bees onto alternative nectar sources, which will dilute the mānuka honey. Furthermore, the more bees competing for the same forage, the less honey is available for harvest because the bees use the honey for their own energy and to make wax to build brood cells.

Plantation forest mānuka

The business case for plantation mānuka is driven by strong demand and high prices for mānuka honey, along with the expectation of higher yields and activity from plantation mānuka with improved cultivars. Table 3 is based on presentations from Comvita and Kauri Park, updated for more recent pricing, and shows what a landowner might expect to earn from having a beekeeper place hives on their land under a range of assumptions including number of hives, kg/hive, honey price and costs.

Until recently, the expectation from promoters was that while a beekeeper might have one to two hives/ha on natural mānuka, including reverting scrubland, this would increase to two to four hives/ha on plantation mānuka with superior cultivars. More recently, most promoters have assumed one hive/ha on plantation mānuka, and the four hives/ha scenario is shown here for comparative purposes. For mānuka established from January 1990 it can also be registered in the ETS and earn carbon credits (New Zealand Units or NZUs).

Table 3: Comparison of yield and income between natural and plantation mānuka

Factor	Reversion	Low Cultivar	Med Cultivar	High Cultivar	Max. Hives
Hives/ha	1	1	1	1	4
Honey yield range kg/hive	20	30	35	40	40
Average Honey UMF	5+	10+	15+	18+	18+
Mānuka honey price $/kg	$35	$45	$50	$60	$60
Honey Income $/ha	$700	$1,350	$1,750	$2,400	$9,600
Landowner share (10–30%)	$70	$405	$525	$720	$2,880
NZU/ha	8.6	8.6	8.6	8.6	8.6
$/NZU	$18	$18	$18	$18	$18
NZU income $/ha	$155	$155	$155	$155	$155
Landowner total income /ha	$225	$560	$680	$875	$3,035

A landowner might therefore expect to earn significantly more from plantation mānuka than natural forest mānuka, but what are the costs? Seedlings are typically $0.70–0.75/plant, planting costs around $0.70/plant and fertiliser $0.10. Depending on weed issues and whether releasing is also required, land preparation and weed control can be up to $500/ha. Pest control might also be required for goats, possums, rabbits and hares.

The key determinant on cost/ha then is stocking at establishment. No firm guidelines exist at this stage, other than where a minimum stocking rate is specified to qualify for funding support (e.g. Afforestation Grant Scheme, regional council land stabilisation or riparian protection funds, typically 1200–1500 stems per hectare or sph). Otherwise the typical planting stocking promoted is 1100 sph, but up to 2500 sph has been promoted where quick canopy cover is recommended or for producing mānuka oil, and as low as 825 sph has been established where the landowner wanted bushy mānuka plants to maximise floral density.

Canopy cover by mānuka is counterproductive as you will only get top canopy flowers and not flowers on the sides of plants because they are shaded, and so floral density is reduced. Lower to medium stocking rates are therefore recommended if you are seeking to grow mānuka for honey production only, depending on the survival risk to seedlings, but higher stocking can be used where you are on easy contour land and can mechanically harvest the mānuka for oil. Table 4 summarises the impact of establishment stocking on up-front costs.

Table 4: Stocking rates and establishment costs

Stocking	825	1100	2500
Land Prep	$500	$500	$500
Planting	$1,279	$1,705	$3,875
Total	$1,779	$2,205	$4,375

Table 5: Beekeeper costs and income for different land use options

Plantation	Buy land	Lease land	Income share
Hives/ha	1	1	1
Yield/hive	35	35	35
Honey/ha	35	35	35
Price	$50	$50	$50
Income	$1,750	$1,750	$1,750
Land purchase	$5,000		
Establishment	$2,205	$2,205	
Hive purchase	$700	$700	$700
Operational Costs/ hive	$450	$450	$450
Landowner share		$500	$525
Annual Operating Costs	$450	$950	$975
Annual Net income	$1,300	$800	$775
NPV – 25 yrs @ 9%	$1,400	$989	$4,773
IRR %	11%	11%	94%

Before looking at potential landowner income and returns, let us first consider what a beekeeper might earn from plantation mānuka honey under a range of assumptions. Table 5 assumes a medium level cultivar in terms of expected yield and activity and three mechanisms for participation by the beekeeper – purchase land, lease land and income share with the landowner. As mentioned, beekeepers have been paying up to $5,000/ha for bare land for planting and up to $500/ha/year for leasing bare land. In both cases, the beekeeper will meet the costs of establishing the mānuka plantation. For the income share scenario, the landowner establishes the plantation and in return receives 30% of gross honey income.

Both buying and leasing land provide a strong return to the beekeeper of 11% over 25 years, although the land purchase option provides a higher annual net income. Compared to this the income sharing option provides similar annual net income to the beekeeper as leasing, but an elevated net present value (NPV) and internal rate of return (IRR) by virtue of the fact that the beekeeper has very low initial costs (i.e. no establishment costs and just the purchase of hives).

Looking in more detail at income sharing, we can examine landowner returns and the impact of variability in the mānuka yield and/or activity as noted earlier. Table 6 takes the income sharing scenario from above and compares it with changes in yield and activity and their impact on annual net income for landowner and beekeeper, and their respective returns.

Table 6: Landowner and beekeeper income for different honey yields

Plantation	Income share			
Hives/ha	1	1	1	1
Yield/hive	35	40	20	10
Honey/ha	35	40	20	10
Price	$50	$60	$35	$25
Income/ha	$1,750	$2,400	$700	$250
Landowner				
Establishment	$2,205	$2,205	$2,205	$2,205
Income	$525	$720	$210	$75
NPV – 25 yrs @ 9%	$2,348	$4,039	$(384)	$(1,555)
IRR %	20%	26%	7%	–2%
Beekeeper				
Hive purchase	$700	$700	$700	$700
Operational Costs/hive	$450	$450	$450	$450
Landowner share	$525	$720	$210	$75
Annual Costs	$975	$1,170	$660	$525
Annual Net income	$775	$1,230	$40	$(275)
NPV – 25 yrs @ 9%	$4,773	$8,094	$(592)	$(2,892)
IRR %	94%	240%	–2%	N/A

The table shows the impact of potential variability in the mānuka honey harvest which, because it is largely climate driven, is outside the control of the beekeeper and landowner. Higher yields can provide exceptional returns, and while the landowner still receives an annual income at lower yield and activity levels, the return from this income quickly becomes unsatisfactory relative to the cost of establishing the mānuka plantation. However at these lower yield levels the annual net income to the beekeeper is negative, and if poor seasons persist then their operation will become unviable and the landowner may also lose their income stream. In evaluating potential returns it is therefore prudent to consider the influence of the variability in honey income and how it might impact on your investment.

Is mānuka a viable alternative?

Plantation mānuka has shown the ability to provide attractive financial returns and should be considered a viable land use alternative on marginal hill country as part of an integrated sustainable land use matrix. Nevertheless there are a number of factors that need to be understood in terms of market drivers, market and resource risks, and the inherent variability in mānuka yield and biological activity. Before making any decision it is therefore important that the investor seeks to understand these drivers, proceeds using conservative assumptions around yield and price, and goes into the investment with their eyes wide open.

It is also critical, whether it is part of a migratory beekeeping operation or for a residential apiary system, that sufficient resources are provided for the establishment of bee feed plants for spring build-up, autumn replenishment and wintering. This is to ensure as far as possible that the bees have an adequate supply of nutrition so that they can reach peak population size to maximise their honey harvest and sustain bee health in the long term. Residential apiary systems and large-scale plantations provide greater control of risks due to competing apiaries near the plantation or competing nectar sources. Investigation of weather patterns and experimentation with trial plantings to understand likely flowering times and nectar yields, as well as bee flight conditions in your location, will help to ensure success.

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