Blossoming Blueberries?

An analysis into the opportunity for the commercial expansion of blueberry production in New Zealand

Report prepared by:

Perrin Ag Consultants Ltd

For:

New Zealand Agricultural Greenhouse Gas Research Centre

perrin ag
NEW ZEALAND AGRI-BUSINESS ADVISORS

NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

Prepared by Perrin Ag Consultants Ltd

Registered Farm Management Consultants
1330 Eruera Street, PO Box 596
Rotorua 3010
New Zealand

Phone: +64 7 349 1212
Email: consult@perrinag.net.nz
www.perrinag.net.nz

Date of report: 23 February 2023

This Report was prepared for the New Zealand Agricultural Greenhouse Gas Research Centre as a service.

The content of this Report is based on the information which NZAGRC have provided to Perrin Ag and other information currently available to Perrin Ag.

Unless expressly stated otherwise in this Report, Perrin Ag will have no liability whatever to any person in respect of any loss or damages arising from the information contained in this Report, or in respect of any actions taken in reliance on such information (which actions are taken at the reader's sole risk). The reader acknowledges that Perrin Ag does not proffer an opinion with respect to the nature, potential value, financial viability or suitability of any farming activity, transaction or strategy referred to or connected with this Report.

Due care has been taken by Perrin Ag in the preparation of this Report. Notwithstanding, Perrin Ag does not provide any warranty as to the accuracy, reliability or suitability for any purpose of the information and advice contained in the Report, whether to the reader or to any other person.

To the fullest extent permitted by law Perrin Ag will not be responsible for any errors or misstatements in this Report, or be liable - whether in contract, tort (including negligence) or otherwise - for any loss or damage the reader may incur as the result of any such errors or misstatements (including direct, indirect, consequential or special loss, or any loss of profits).

Document Quality Assurance

Written by:	Braydon Schroder BAgSc (Hons), MNZIPIM ASNM Consultant
Reviewed by:	Lee Matheson BApplSc (Hons), FNZIPIM (Reg.) ASNM Principal Consultant
Approved for release:	Lee Matheson BApplSc (Hons), FNZIPIM (Reg.) ASNM Managing Director
Status:	FINAL

Bibliographic reference for citation:

Schroder, B. 2023: Blossoming Blueberries? *An analysis into the opportunity for commercial expansion of blueberry production in New Zealand*. Final report on alternative land use analysis 3: Blueberries. A report prepared for the New Zealand Agricultural Greenhouse Gas Research Centre. 55 pages.

Executive Summary

"Blossoming Blueberries?" is the third in a series of reports prepared for the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC). These reports examine potentially viable diverse land uses in New Zealand that could provide alternatives to the largely monoculture and ruminant-dominated pastoral agriculture systems across our landscapes at a more expansive farm systems perspective.

This report builds on the recommendations derived from earlier work on the potential for expanding the commercial production of blueberries, which identified several potential supply chain challenges to this occurring (Appendix 1). "Blossoming Blueberries?" provides analysis and research into the significant investment required for infrastructure for a range of growing systems, the return-on-investment length of land conversion to blueberries and explores the provision of post-harvest infrastructure, quality control on exports, freight costs and improved market relationships. Additionally, required scale for profitability within the sector, the opportunity for blueberry supply chain integration along with commentary on the environmental and workforce implications of blueberry expansion in New Zealand is also considered.

Based on the apparent financial returns from blueberry production (internal rates of return between 6 and 11%) and there being no obvious limits to capital availability, the primary reasons limiting blueberry expansion appear not to be financial. The main limitation to the expansion of blueberries would seem to be the fragmented structure of the sector, product shelf life causing higher freight and biosecurity costs, labour availability, access to technical support and expertise and existing post-harvest infrastructure – all things that might limit the long-term potential of the sector and with it, the confidence of farmers to invest given the long (11-16 year) pay-back period of development.

Expanding the commercial production of blueberries in New Zealand has several potential benefits, including diversification of income through farm scale integration, reduced greenhouse gas emissions compared with pastoral farming and high investment returns. New Zealand has numerous opportunities to expand the blueberry sector and improve its overall supply chain success and sustainability. It also has a significant number of hurdles to overcome before being able to make the most of the identified opportunities.

Several solutions for the sector to overcome these challenges include:

- Improve yields from new and existing varieties and improved management practises not yet achieving their potential due to inadequate training labour and inadequate lighting.
- Invest as larger scale collective developments to reduce weighted average cost of capital and improve margins from the ability to invest in larger scale developments with pooled capital for economies of scale.
- Limit the costs of compliance to growers by streamlining processes and information sharing.
- Invest or partner with owners of existing commercial post-harvest infrastructure (including other horticulture sectors infrastructure such as kiwifruit) to achieve economies of scale in this aspect of the supply chain.
- Make better use of marketing the credence attributes achieved by New Zealand growers to achieve a higher price per kg.
- Partner with other exporting businesses to establish scale and contracts with freight businesses to give improved consistency and stability of freight scheduling to reduce overall freight costs whilst having the contracted product prioritised.

- Invest or Partner with key international market importers and industry bodies to secure trust within the supply chain and the New Zealand product quality to gain efficiencies in logistics and biosecurity among achieving a greater economy of scale.
- Propose alternative fumigation techniques in key export markets such as irradiation fumigation or others that do not require lifting the temperature of the product, ultimately to limit degradation of imported product at international boarders so price per kg product is not significantly reduced.
- Utilise controlled atmosphere storage and shipping methods to distribute supply more evenly with market demand to improve shelf life of fruit and receive a greater return per kg of product.
- Create a cooperative for all New Zealand and Australian growers to improve access to market, access to resources and expertise whilst producing one brand for New Zealand produce that can be more easily recognised in international and domestic markets.
- Create further demand for New Zealand branded blueberries to lift price/kg, through continuing negotiations with countries in East and Southeast Asia (particularly China) and investigate the price competition of products in European markets when taking advantage of the controlled atmosphere shipping option.
- Assist or incentivise uptake of autonomous or high-tech harvesters to reduce cost of production and improve overall returns whilst reducing risk of having labour shortfalls.
- Attract and retain a network of quality seasonal workers to complete any additional work required from further blueberry developments.
- Develop and train workforce within the sector to secure the succession of the sector and encourage innovation and improved management within operations.

All these elements require a degree of industry cooperation and coordination that seems not to currently exist within the sector. It seems unlikely that individual growers or small groups of growers will be able to sufficiently address these issues themselves. While there is no requirement for (or evidence to justify) a single-desk seller, sole exporter or exclusive supplier of plant varieties for the blueberry sector, there does seem merit in having a large number of growers being part of a pan sector entity/organisation that could provide clear industry leadership, coordinate grower efforts to address supply chain inefficiencies, advocate for grower interests in market and lead investment in research and development.

Assuming the New Zealand blueberry sector can overcome the challenges described in this report and can make the most of the numerous opportunities available to it, the capital cost of land conversion into blueberries remains high. As a result, land use change to blueberries from the pastoral sector seems unlikely to occur at a scale to significantly contribute to New Zealand meeting its national emissions reduction targets; but it may still be a worthy contributing “piece of the puzzle” to doing so.

PERRIN AG CONSULTANTS LTD

February 2023

CONTENTS

Tables

Figures

1 Introduction

The New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) has initiated and funded a Future Farm Systems Research Programme. It has two key parts – the first looking at case studies and co-designed solutions for the primary sector transitioning to a low emissions future [Part 1] and a second part envisioning what that low emissions future might look like [Part 2].

"Blossoming Blueberries?" is the third in a series of reports prepared for the NZAGRC programme. These reports examine potentially viable diverse land uses in New Zealand that could provide alternatives to the largely monoculture and ruminant-dominated pastoral agriculture systems across our landscapes at a more expansive farm systems perspective.

This report builds on the recommendations derived from earlier work on the potential for expanding the commercial production of blueberries, which identified several potential supply chain challenges to this occurring (Appendix 1). "Blossoming Blueberries?" provides analysis and research into the significant investment required for infrastructure for a range of growing systems, the return-on-investment length of land conversion to blueberries, and explores the provision of post-harvest infrastructure, quality control on exports, freight costs and improved market relationships. Additionally, required scale for profitability within the sector, the opportunity for blueberry supply chain integration along with commentary on the environmental and workforce implications of blueberry expansion in New Zealand will also be considered. Although some growers are leaving the sector, ultimately the New Zealand blueberry sector is currently in a phase of growth (Coriolis, 2020). This growth has been particularly encouraged by significant positive research about the health benefits of blueberries (Blueberries New Zealand, 2023a). Currently Blueberries New Zealand ("BBNZ"), the national industry body, has approximately 60 grower members, 13 exporter members and 10 associate members. Fresh facts (2016) by Horticulture New Zealand and Plant & Food Research along with Coriolis (2020) suggest there is around 700 hectares of blueberries currently planted or being planted at present in New Zealand. Note only around 400 ha is associated with levy paid membership that sell at least 500 kg of blueberries in the year prior. This is due to paid membership of the sector's industry body, Blueberries New Zealand, being optional, which suggests segmentation of businesses within the sector.

Blueberries are ideal in acidic (low pH) soil types and have a range of varieties suitable in various climatic conditions, thus are suitable in many locations throughout New Zealand. Traditionally most plantings have been in the Waikato and Hawkes Bay, but new areas in the far North and South Island are now being planted (Blueberries New Zealand, 2023a). Other areas throughout New Zealand are being identified as suitable for blueberries such as the Tararua District (Country, 2021) if suitable expertise and supply chain infrastructure is in place. There are currently 31 recently imported varieties available through BBNZ (Blueberries New Zealand, 2023b) which excludes other variety types owned by various New Zealand growers.

Key opportunities have been identified by experts in the past, however sector segmentation, minimal domestic expertise and a large initial investment or long investment payback period are restricting the success of current growers and further expansion of blueberries in New Zealand. Domestic packing and processing infrastructure also limit the ability for increased value of blueberry exports from additional land conversion to blueberries or for value added product processing.

Expanding the commercial production of blueberries in New Zealand has several potential benefits, including diversification of income through farm scale integration, reduced greenhouse gas emissions compared with pastoral farming, replacing the imported frozen berries with domestic product and further investment in high-tech labour-saving machinery. The blueberry sector currently has several strengths and opportunities whilst facing several weaknesses and threats as suggested in Table 1.

Table 1: Strengths, weaknesses, opportunities, and threats analysis for the development of a sustainable blueberry sector supply chain

Strengths: Competitive marketing advantage Unique blueberry varieties Investment in research & development Export relationship with Australia	**Weaknesses:** Access to larger markets Scalability Intensive management requirements Cost of freight Segmented industry
Opportunities: Increasing domestic demand Controlled atmosphere shipping Expansion to Southeast Asia Blueberry value-added products	**Threats:** Biosecurity requirements in Australia Capital cost of development to growers Airfreight priority

For the New Zealand blueberry sector to successfully expand and capture further demand in international markets, the New Zealand blueberry supply chain needs to deliver higher profits to compete with other alternative land use options. This report will explore how this might be achieved.

2 Requirements for sustainable industry expansion

Initial capital investment required

Outdoor systems

Figure 1: Outdoor blueberry orchard (Rotorua Land Use Directory, 2022)

The traditional blueberry developments have been the outdoor systems seen in Figure 1 generally in free draining soils. Currently, most of New Zealand's blueberry crop is grown outside, usually with no cover other than bird protection. Climate change, specifically unpredictable seasonal climate, is now a major risk in the outdoor blueberry systems. With a frost as late as October and continuous rain between fruit set and harvest in the 2022-23 season, there exists a large amount of damaged fruit, unhappy growers and cash deficit blueberry businesses (personal communication Shirly Miller, January 2023).

While the resilience of this system is being tested by climate, it does require a lessor initial capital outlay than other blueberry system options. The initial capital investment required for a 6 ha outdoor orchard is estimated to be $1,116,000 based on inflation adjusted numbers from Wilk & Simpson (2015) and from New Zealand growers and orchard experts. This estimate include provision for a cool store and packing facilities alongside the orchard. The breakdown of this capital requirement assumed is presented in Table 2.

The outdoor orchard scenario assumes 2000 plants per ha achieving a yield of 4.5kg/plant/year at maturity (year 6-10). A 9% shrinkage has been factored in assuming punnets of a nominal 125 grams were initially weighed at 140 grams when packed to allow for the likely shrinkage.

Table 2: Outdoor orchard capital requirements

Initial capital requirements for 6 ha outdoor blueberry orchard and packing facility.		
Item	**Cost/unit**	**Notes**
Ground preparation/plant beds	$112,400	Based off figures from Wilk & Simpson (2015) and pers. Comm. Shirly Miller (January 2023) adjusted for inflation
Bird protection	$397,200	
Irrigation/fertigation	$115,400	
Plants & planting ($10 each)	$158,700	
Machinery/plant	$10,500	
Scales, tables	$3,700	
Packing line	$60,200	
Cool room	$60,200	
Packing shed	$120,400	
Air conditioning	$5,300	
Shelter	$0	Outdoor system
License	$72,000	Based off Berryco Licence price (Pers. Comm. Alan Mclean January 2023)
Total	**$1,116,000**	

These sources also provided detailed physical performance expectations, revenue and expenses for both outdoor and indoor systems. The assumptions for the outdoor system financial analysis can be found in detail in the discounted cash flow in Appendix 2.

Labour costs are included for all works associated with the orchard, thus there is no owner operator labour at any discounted rate included. If the landowner were to take on some or a large proportion of the management and labour orientated tasks, they may choose to internalise this labour as a cost which could reduce the overall cash operating expenditure considerably. However, the $ value associated with any landowner's management or labour input should be factored in for any individual businesses investment analysis to ensure other investments are easily compared with and the efforts and time of a landowner is not taken for granted.

As shown in the comparison of systems in Table 4, this initial capital required for the 6 ha orchard, cool store and packing infrastructure is showing an internal rate of return ("IRR") of 6.2% pre interest and tax and a net present value ("NPV") of $1,033,000 at a 6% discount rate for a 30 year investment term. This highlights the requirement for this investment to be a long-term investment as the payback period before interest and tax is close to 16 years as shown in Figure 2.

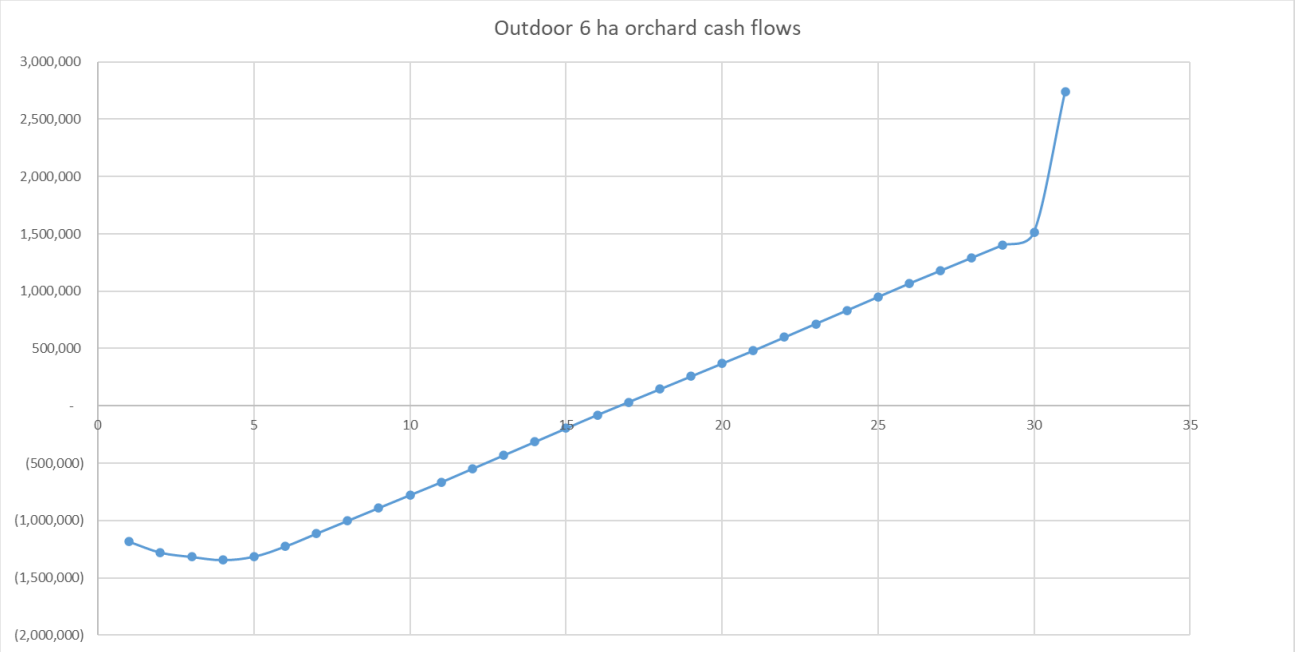


Figure 2: Outdoor 6 ha orchard expected cash flow

Tunnel house system

Figure 3: Tunnel house blueberry system (NZ Herald, 2018)

Although blueberry orchards have traditionally been developed outdoors, growing under cover in tunnel houses has seen a greater adoption in more recent years and provides landowners throughout the country more control over the climate and a more resilient orchard. The industry expects that the move towards covered cropping and intensification will see large improvements in yields that will support continued growth in the market. However, this system is still finding similar climate issues are affecting yields to a lesser extent to the outdoor system, but more so than budgeted (personal communication Alan Mclean, January 2023).

The initial capital investment required for a 6 ha tunnel house orchard is almost double the outside investment, estimated at $2,115,300. This is based on inflation adjusted numbers from Wilk & Simpson (2015) and from Alan Mclean (personal communication, January 2023), the Technical Manager at BerryCo. These numbers include a cool store and packing facilities alongside the orchard. The breakdown of this capital requirement assumed can be seen in Table 3.

Table 3: Tunnel house orchard capital requirements

Initial capital requirements for 6 ha indoor blueberry orchard and packing facility.		
Item	**Cost/unit**	**Notes**
Ground preparation/plant beds	$112,400	Based off figures from Wilk & Simpson (2015) and pers. Comm. Shirly Miller (January 2023) adjusted for inflation
Bird protection	$397,200	
Irrigation/fertigation	$115,400	
Plants & planting ($10 each)	$258,000	Based off Pers. Comm. Alan Mclean January 2023
Machinery/plant	$10,500	Based off figures from Wilk & Simpson (2015) and pers. Comm. Shirly Miller (January 2023) adjusted for inflation
Scales, tables	$3,700	
Packing line	$60,200	
Cool room	$60,200	
Packing shed	$120,400	
Air conditioning	$5,300	
Shelter	$900,000	Based off Pers. Comm. Alan Mclean January 2023
License	$72,000	Based off Berryco Licence price (Pers. Comm. Alan Mclean January 2023)
Total	**$2,115,300**	

New varieties and growing techniques are increasing the number of plants able to be grown per ha and thus the yield per ha. A fibre substrate used in tunnel houses rather than soil gives the grower complete control over the irrigation and water content, which leads to better quality and better yields. It also allows production on any soil type, if the land can support the tunnel house structure.

Covered cropping using substrate, rather than growing plants in the ground, is a hydroponic operation. This means that all plants' nutrients are provided in the water. Water is controlled so that each plant gets exactly what it needs to grow and produce the highest yield and quality of berries. This method of growing requires access to a lot of water. Around 100 litres per square meter per month during summer, and around 10 litres over the cold months of winter (a potential total of 4,500 cube/ha or 27,000 cube for a 6 ha orchard) could be required. Access to water may influence the investment returns on each unique blueberry orchard development. There may also be a need for a water take consent which will add additional cost to the investment and, if not granted, might prevent it.

As with all berries, pest and disease require constant management and control. Biological controls such as predator mites and pheromone traps are more effective in a covered crop than they are in outdoor cultivation. There can be yield limitations due to inadequate light for many blueberry orchards in New Zealand, although artificial lighting is considered uneconomical (Alan Mclean, personal communication, January 2023).

The first small harvest will be one year after planting, assuming 0.3 kg/plant before shrinkage. Full production is assumed to be achieved by year 5. Upfront capital costs are high, but a well-run operation should begin to return an annual net profit by year 2-5. As shown in the comparison of systems in Table 4, this initial capital required for the 6 ha orchard, cool store and packing infrastructure is delivering an IRR of 9.9% pre interest and tax and a NPV of $3,278,000 at a 6% discount rate for a 30 year investment term. The detailed assumptions for the indoor system financial analysis can be found in detail in the discounted cash flow in Appendix 3. This higher upfront capital investment also has a long 11-year payback period, although this is less than the smaller investment outdoor system (5 years difference). This payback period is illustrated on the investment cash flow Figure 4 below.

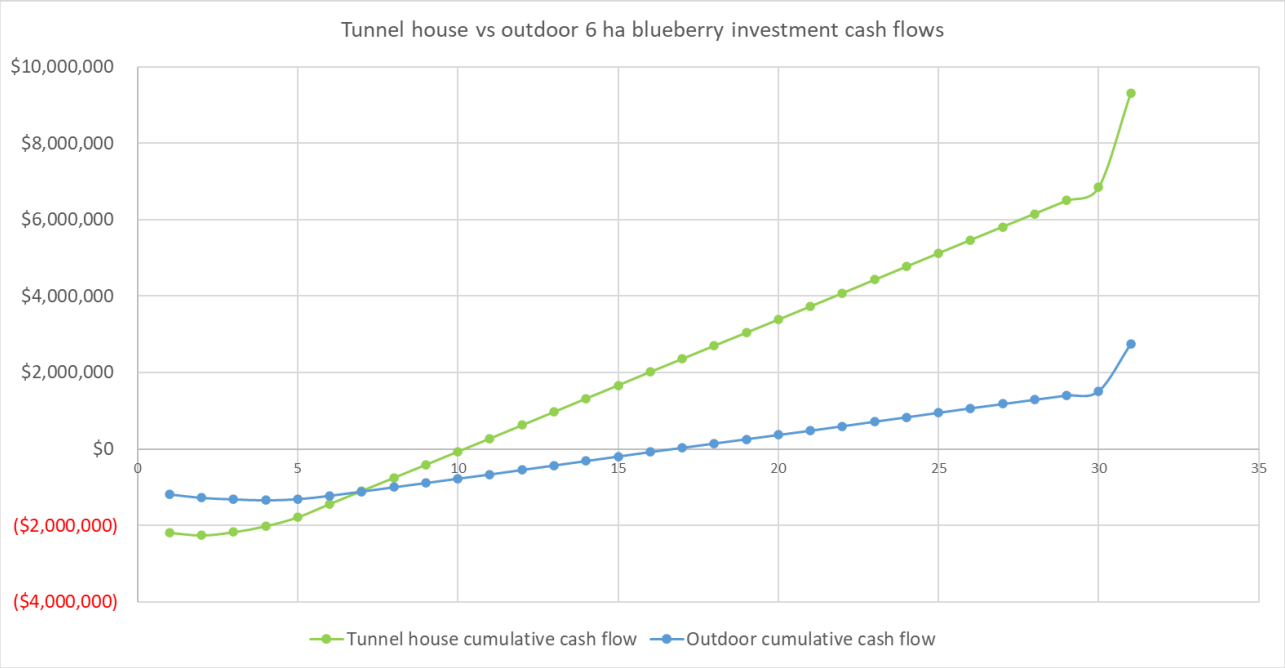


Figure 4: Tunnel house vs outdoor 6 ha blueberry orchard cumulated cash flow

The higher capital investment per ha in this system than the outdoor system could be seen as a premium for the additional investment risk incurred. Although, due to the tunnel house being able to reduce the impacts of climate on the blueberry plants, there is a significant risk mitigated as well within this larger investment. This has been seen particularly in recent years with unpredictable climate causing significant damage to fruit in open outdoor systems.

Alternative system types

There are several alternative system possibilities for a new development from extensive as can be to very intensive, which each suggest could be financially viable options.

There is an option for growers to focus solely on the growing of the blueberry and then outsource packing and processing to avoid the initial capital outlay on the packing shed and machinery. This will reduce the return per kg of blueberries grown, although if the orchard is of small scale (less than 3 ha) the investment in this infrastructure may not warrant itself to capture adequate additional value per kg blueberries supplied. There is a large risk with this system in that there are limited packing and processing facilities that may be able to take product along with incurring risk of taking a lower price per kg to ensure someone takes it to be packed. Thus, this system has less influence on price than if internally owning the post-harvest infrastructure and machinery. However, due to reduced costs, it may still be a viable option. The larger business with the expensive technology to harvest the blueberries around numerous farms could have growing contracts with landowners or establish a cooperative

together to pool capital to invest with economies of scale in the automated processing and packing machinery.

Pick your own orchard businesses may reduce the value of the product (to approximately $12/kg) along with incur greater product wastage, however, it can also reduce picking, packing and freight costs to improve the overall orchard gross margin achieved. If in the unlikely event that all 9 t/ha on 6 ha were able to be sold via pick your own, a 17.47% IRR over a 30-year term is calculated based on this system approach, if it were possible. However, this approach is limited to local demand and may only be an option for a small number of developers at small scale close enough to urban populations. Six ha may be okay near large cities (see Table 8), although it may be unlikely for this product to be all sold via the pick your own system in many locations due to share lack of demand vs supply. A smaller scale 2 ha pick your own operation in many areas may be a more feasible option to ensure supply does not greatly exceed demand. This 2 ha system estimates a 7.77% IRR and a much lower initial capital investment of $252,000 (Appendix 7). This may be a viable option but should only be considered as a small-scale niche expansion opportunity for a select few growers and not of significance to greatly expand the blueberry sector. However, for orchards of larger scale, it is important to note the higher marginal return able to be achieved per kg product from getting customers to pick their own to save the cost of picking, packing and freight. This highlights the opportunity for larger scale orchards to accompany this idea on a small proportion of their orchards for a higher net return whilst supplying to their local communities.

There are a small number of growers in New Zealand that grow blueberries in large greenhouses with retractable roof and walls to ultimately control temperature and maximise yields from a plant and per ha. The Cravo system has automatic retractable roofs to optimise climate for the plants and protection from pests. There is a large range of shelters that Cravo provides (one of these pictured in Figure 5) to suit the requirements of the crop type and location (personal communication Bede Miller, February 2023). The improved yields accompanied by early crop to target the higher market price can largely improve the overall orchard returns per ha. In reality, a well-run system may capture a much higher price per kg product than the conservative assumption in the investment analysis in Appendix 4 if a majority of product reaches the early market.

Figure 5: Retractable roof Cravo production system

Although a small number of companies are doing this currently in New Zealand, many growers are deterred from this system due to being approximately "10 times the initial investment cost of the tunnel houses" (personal communication Alan Mclean, January 2023) and perceived as "too large of an initial investment". This option was described as uneconomical by Alan Mclean. This pricing estimate is in line with the estimate from Bede Miller at Cravo (personal communication, February 2023), although there was a difference of opinion regarding the statement of being uneconomical, as due to controlling the climate around the plant, higher yields and early market supply can be achieved to capture a much higher price per kg product and improve the IRR for this system considerably. This may require further investigation and a potential case study of a company such as Gourmet in Hawkes Bay operating with this system to fully understand this growing approach and confirm its potential returns. Although, for the purpose of this research with the use of indicative numbers (detailed discounted cash flow can be seen in Appendix 4) including an increased yield of 5 t/ha with 6000 plants/ha (compared to tunnel house system), increased price per kg achieved of an additional $10/kg for all fresh blueberries due to an early crop. It is assumed that the capital investment is $1,840,000 per orchard ha plus the $249,600 for a cool store and packing facilities equating to a total of $11,285,000 for the 6 ha investment. Over a 30-year term this investment generates an IRR of 10.35%, which suggests Alan's statement of this system being uneconomical, may be just referring to one specific intensive system design explored, however, there are numerous different system designs available for this intensive system option among various markets to target. If the weighted average cost of capital ("WACC") for this investment is much lower than this IRR, than the reduced risk from being able to control the atmosphere may make this potentially profitable investment more resilient as an option. Pooling capital in a larger collective

type structure to reduce the WACC of the investment might ensure any financial viability risk is mitigated.

Long term lease of land area

This method of enabling land use change has been observed in the kiwifruit sector where developers that specialise in developing kiwifruit orchards and growing kiwifruit lease land for long terms (typically 20 plus years) from landowners with ideal land for growing kiwifruit. Such a mechanism has been analysed for blueberries and presented in Appendix 5. This could be an option for landowners with inadequate capital or other resources such as technical expertise to be able to complete the development themselves. Where the landowner wants to retain land for future generations to succeed to or if they find themselves with illness or other incapacity, leasing the land for a period allows for annual cash inflow from minimal responsibility or input required. This can also be an attractive investment for those leasing the land as this can allow their existing business to increase in economies of scale without the capital outlay of purchasing the land. The industry organisation BBNZ help member growers to connect with domestic and export markets, thus may also be able to connect landowners with developer/grower businesses. As reported above, membership in BBNZ is voluntary. There is a registration fee for new members, with the annual membership fee calculated as a levy on fruit sold.

If the landowner were to develop the orchard prior to leasing (Appendix 6), they would require $311,000 /ha to develop the orchard assets. This excludes the post-harvest infrastructure due to the lessee likely to have their own existing facilities in this situation. A landowner may consider this investment if they have a very low WACC (due to the IRR of 2.7%) or essentially spare cash to invest, whilst aiming to provide the operating orchard as an asset for successors or themselves at the end of the lease term. This situation would allow for a much shorter lease period if desirable. This option may generate an annual net surplus of $48,000 from a 6 ha orchard for the landowner assuming this orchard would be a part of a larger business covering a proportion of the overheads.

If the landowner lacks adequate capital to initially develop an orchard (Appendix 5), a longer 30-year lease term on suitable land may be an option for a larger blueberry business to develop and operate the orchard as part of their greater business to achieve economies of scale, whilst providing the landowner with a net surplus of $41,000 from an annual lease of the 6 ha orchard after annual overheads. This may be a long-term option for a smaller landowner to have a developed blueberry orchard for their successors at the end of the term whilst still diversifying their land and generating $6,900/ha/year and having minimal time commitment. This is also financially viable for the lessee completing the development as the IRR over the 30-year horizon is 9.4% for just the 6 ha, particularly if this is an increase to their overall orchard area and thus economies of scale are achievable (not allowed for in this IRR). This assumes no additional post-harvest infrastructure is required to be invested, as the lessee is expected to already have these facilities. It is assumed that all assets will be upkept by the lessee to be handed over back to the landowner at the end of the lease term. Any change in the value of the land prior to development to the end of the lease term has not been included in this analysis.

In both these scenarios, the landowner would need to invest in some post-harvest infrastructure at or before the end of the lease term, if they wanted to operate the orchard themselves thereafter.

Joint ventures and non-bank capital funding

This investment option can be structured in a variety of ways, with a range of % ownership, capital contribution and time/physical investment/involvement in the development and operations. This can allow greater access to capital to invest at greater scale and reduce the proportionate liability on a specific party. This can provide access to greater resources other than just finance, such as plant varieties, operational expertise, specialised technology and workforce among opportunities to access

new markets and distribution networks. Joint ventures can also be complex though, requiring time and effort of all parties involved to ensure partners have shared values, build the right relationship, agree on objectives and the intended management style. Joint ventures' contractual obligations and limitations can also pose a risk to partners other business operations, depending on the legal structure used.

Given the range of joint venture type structures as described by NIbusinessinfo (2023) (limited co-operation, separate joint venture business and business partnerships), each landowner needs to consider the right partner, the level of management involvement and level of risk they would like in the business before understanding what type of joint venture structure is best for them. A joint venture structure may create more opportunities to invest beyond farm gate in processing, packaging, logistics or retail as a business with more capacity and access to resources, primarily capital. The financial return for each party is determined by the amount of capital each party invests and their share of the returns. Where both parties invest equity and receive a share of the profit proportionate to their investment, the IRR of the investment for each party will be identical. Of course, in a third-party joint venture, the capital contribution of the land by the landowner needs to be considered in the relative share of the investment. Where the land is to be retained by the landowner, this can be managed through mechanisms such as the orchard JV paying lease to the landowner. In some cases, the market access that a joint venture can provide may return a higher number of product sales and an overall greater return.

These options can reduce the level of control a landowner may have on the business, given an equity partner may expect a degree of control and input into the business operations and future direction. Structuring this in a manner where landowners keep control of their business (if desired) and still get the investors contribution in capital (a so called "silent investor") may be a more attractive option to many landowners to better encourage sector expansion.

A structure similar to crowd funding groups such as Project Crimson (2022) may also be an option to source the initial capital for a blueberry orchard. As Project Crimson suggest, developing an incentive to those investing in this land use change may increase the uptake and speed of investment. There are also several potential funding sources for Māori landowners to support the investment and development process into blueberry land use. Miro is a collective of Māori food producers which have gained assistance through government via the Ministry for Social Development to find local workers and train staff. They also received assistance in the development of their orchards from the Provincial Growth Fund, Māori Innovation Fund, Ministry of Primary Industries and New Zealand Trade & Enterprise (Miro, 2023). However, in line with comments above, some of the existing passive investors in Miro speak to wanting to invest in blueberry developments in a more direct role in the future when the time is right for their whānau (Hāmuatanga, 2022). This suggested that the interest to invest in blueberry development is there, although adequate capital and expertise need to be built up prior in order to make this step.

Government and industry partnerships, or government and impact investment partnerships as blended finance may be able to provide the initial capital required for this land use development for many landowners that would have otherwise struggled to fund this scale of investment. Given government emissions targets imply an expected reduction in pastoral farming area and/or emissions in New Zealand than a real opportunity lies in the use of catalytic capital from public and philanthropic or industry sources to increase private sector investment in the development of this lower emission, higher return blueberry land use. With blended finance, a single blueberry development can benefit from the combining of different investor risk tolerances and expected rates of return.

These options may also improve the equity growth within the blueberry sector as it may result in less bank lending or lower WACC among businesses. This is due to members within the blueberry sector being more likely to contribute the capital for development than just commercial banks.

Investment comparison between system types

With the array of system options for aspiring developers and growers, some key figures are summarised in Table 4 from the detailed investment analysis completed for this project. These analyses specifically exclude the value of the land utilised in the orchard development.

Table 4: Investment summary of various blueberry systems for an existing landowner

System Investment Summary					
6 ha orchard	**Outdoor**	**Indoor**	**Cravo**	**Lease Developed Orchard**	**Lease to be Developed**
Initial capital	$1,115,769	$2,115,073	$11,284,570	$1,865,459	$0
IRR*	6.2%	11.4%	10.3%	2.7%	-
NPV (6%)	$1,033,146	$3,884,252	$19,160,403	$687,593	$579,533
SQ annual net surplus*	$117,253	$348,148	$1,925,496	$48,044	$41,606
*This is pre interest and tax IRR over a 30 year horizon					

Any business investing in any one of these systems will need to consider their WACC relative to their specific investment IRR. If their WACC is less than the IRR than financially the investment may make sense. The WACC will differ based on the source of capital and the interest rates, repayment or earning terms of the business partner/lender. If the investment is secured against other assets and thus the initial capital investment is all bank lending, than the IRR would need to exceed the average or fixed interest rate of this lending for the investment to be financially viable as its own standalone business.

With the large amount of upfront capital required for a landowner to invest in either an indoor or outdoor blueberry development, the alternative methods discussed above require less capital and thus provide a more viable option for many landowners. For a landowner that would like to explore different land use but has minimal capital or asset security to cover the initial blueberry development, the options of a joint venture (ability to contribute the value of the land and/or other capital) or long-term lease may be more viable for them to pursue. The value of land has been excluded in all discounted cash flow analysis based on the assumption that the land value will be similar under all scenarios. An outdoor orchard, while not providing the same level of returns as an indoor tunnel house system may just be more viable for some landowners that have not got adequate capital or asset security to develop an indoor orchard on their own. Those that have the adequate funds or security and other resources (labour, water, consents, expertise/support) for the indoor tunnel house blueberry development should further investigate this option due to it providing the greatest level of return out of all options (based on the assumptions used in the analysis) described in this report.

Apart from the leasing out option, all other options may incur several years post development until yields and income are adequate to cover the annual costs and deliver net profits similar to or better than the prior land use. This can make lending from financial institutions more difficult to receive, unless the surrounding business is adequate to fund the first few years of deficits. Therefore, it is crucial for any investor to understand the cash flow implications on their business before pursuing.

With the long payback period of most of these blueberry orchard options, an alternative option may be for a landowner to increase the value of their land by developing an orchard and potentially selling the

asset once developed to capture a faster payback period and return on investment. This could improve the IRR and payback period for the small landowner along with leaving them with additional capital from sale proceeds to invest further in land use change out of pastoral farming or to help secure succession of the existing business. The other purpose of this is to lift the scale of existing or new large blueberry businesses in New Zealand to further improve (and utilise as a sector) their economies of scale for particularly harvesting, packing, freight and marketing. It will also be crucial to provide the support and expertise for landowners to successfully develop an orchard and then manage it through to be sold. Larger businesses or collectives in the sector could support other landowners in the development and for their certainty arrange purchase agreements at certain dates and when the orchard is up to certain standards. Alternatively, the larger business may be able to complete the project development for the ease of the landowner (Baygold developing kiwifruit orchards as an example). They may be able to take the responsibility off the landowner and arrange a development and/or lease to purchase contract.

Investment comparison with kiwifruit

The landowner developing their own indoor system blueberry orchard appears to be the most profitable blueberry development option long-term. To help understand if it is the initial capital outlay or the return on investment or the cash flow implications as to why more landowners are not investing in blueberries, a green and gold kiwifruit discounted cash flow were both developed based on the average orchard in Bay of Plenty. The kiwifruit analysis is based on the mid-point of the 5-year price forecast from Zespri and actual figures for the initial capital investment of 6 ha of orchard. The discounted cash flow for both green and gold kiwifruit have been completed and the summary of these can be found in Appendix 8. To summarise these, Table 5 compares green and gold kiwifruit with the outdoor and indoor blueberry system options.

Table 5: Investment summary of various blueberry systems vs kiwifruit investments

System Investment Summary							
6 ha orchard	**Outdoor**	**Indoor**	**Cravo**	**Lease Developed Orchard**	**Lease to be Developed**	**Green Kiwifruit**	**Gold Kiwifruit**
Initial capital	$1,115,769	$2,115,073	$11,284,570	$1,865,459	$0	$1,959,112	$6,380,800
IRR*	6.2%	11.4%	10.3%	2.7%	-	7.1%	8.1%
NPV (6%)	$1,033,146	$3,884,252	$19,160,403	$687,593	$579,533	$403,256	$1,973,497
SQ annual net surplus*	$117,253	$348,148	$1,925,496	$48,044	$41,606	$237,772	$636,525
*This is pre interest and tax IRR over a 30 year horizon							

When comparing indoor blueberries with green and gold kiwifruit, the capital investment being similar to green and much less of gold and the IRR being higher than both raises the question as to why there are not more blueberries in New Zealand. There is a slight location specific difference for where these orchards can be developed, although there is likely a greater area available in New Zealand for blueberry production than there is kiwifruit based on current climatic conditions. Historical pricing of kiwifruit may have been higher than this analysis and persuaded investors towards kiwifruit instead of blueberries in the past. What this analysis suggests is that based on these system assumptions and pricings of current market forecasts, tunnel house blueberry production stacks up well as an investment option and potentially more so than many other options. Given the exceptional amount of development occurred in the kiwifruit sector recently, the initial high capital requirement for development is likely not the sole reason restricting landowners diversifying land use into blueberries. If such investment is profitable and access to capital is not the sole reason for limited blueberry developments in New Zealand, then it may also be the structure of the sector currently, resilience of

system to weather and fluctuating prices, existing processing and packaging infrastructure, access to technical support and expertise and potentially market demand or access to this market.

Scale for profitability

While the blueberry orchard return on a per hectare scale is significantly higher in comparison to mean operating profit of $3,189 per hectare for New Zealand dairy farms in 2020-21 (DairyNZ, 2023), the lack of free capital to initially make the investment alongside the negative cash flow for first 2-4 years would appear to limit the uptake of this land use change. Among free capital limiting this investment, there is also a lack of knowledge and experience with orchards and specifically berries for many landowners.

Ultimately for a blueberry orchard to be profitable, it can be large scale or small scale depending on the marketing, operating and management structure. Where a grower was to operate the business themselves and supply fresh to local markets and attract higher prices/kg, there is an opportunity for this where there is surplus local demand to local supply. Otherwise, the opportunities are largely in the export market, thus needing the adequate orchard scale as discussed above since there is less ability to influence product price when competing with other countries' produce.

Scale required

The starting point for lower-tech tunnel houses is at least 1 ha of flat land plus space for driveways, bore and pumping systems and supplemental buildings, with this size suggested to be of commercial scale by Te Puni Kōkiri (2023). Wilk & Simpson (2015) suggest in Australia an outdoor blueberry orchard would need to be a minimum of 4 ha to be economical. They also suggest this size or greater would justify investment in cool room and packing shed infrastructure. Although, a PlantWise Consultant and BerryCo representative suggest at least one additional ha for both systems are necessary, declaring at least 2 ha is required for indoor systems and at least 5-8 ha for outdoor blueberries in New Zealand to be commercially viable. This advice is in line with the discounted cash flow analysis for outdoor orchards with 4 ha only generating a 4.37% IRR which if their WACC is low may still be feasible for some developers, however the cash flow and overall return on investment is poor and would need to seriously be considered before going ahead. A 5-8 ha outdoor orchard in the discounted cash flow analysis generated for this report provides a 5.44 – 7.24% IRR which for many developers utilising bank lending leaves little headroom, although in most cases will be viable as the WACC is likely lower than the IRR at this scale operation given the use of equity capital. This compares with the indoor tunnel house system in the discounted cash flow analysis generated for this report suggesting that at least 2 ha is required to generate an IRR of 6.67% as a 1 ha orchard may only provide a 3.27% IRR which may be less than the business' WACC.

Discounted cash flow analysis also suggests the initial investment cost is not able to be recovered in the first 10 years for outdoor systems as even with 20 ha of orchard developed the payback period is still expected to be over 10 years as shown in Table 6 below. This does suggest that the payback period slightly improves with increasing orchard scale. However, the payback period (or cash position in year 10) shows to be much more sensitive to the price received for fresh blueberries (estimated to be 80% of total orchard yield) rather than orchard scale.

Table 6: Outdoor orchard payback period sensitivity to orchard scale and price received for fresh blueberries.

Sensitivity of investment cash position at year 10 with changing scale and Fresh berry price							
		Hectares of orchard developed from year 0					
		2	4	6	8	10	20
$/kg fresh blueberries (80% of yield)	$10	($1,617,748)	($2,534,480)	($3,451,211)	($4,367,942)	($5,284,673)	($9,868,328)
	$15	($1,153,469)	($1,605,921)	($2,058,373)	($2,510,825)	($2,963,277)	($5,225,536)
	$20	($689,190)	($677,363)	($665,535)	($653,708)	($641,881)	($582,744)
	$25	($224,911)	$251,196	$727,302	$1,203,409	$1,679,515	$4,060,048
	$30	$239,368	$1,179,754	$2,120,140	$3,060,526	$4,000,911	$8,702,840

This compares with the tunnel houses only requiring 4 ha developed to achieve a 10-year payback period on this investment as shown in Table 7. This also suggests tunnel houses payback period are more sensitive to changing scale than outdoor orchards when comparing the $ change between the different scale orchards in Table 6 and Table 7.

Table 7: Tunnel house orchard payback period sensitivity to orchard scale and price received for fresh blueberries.

Sensitivity of investment cash position at year 10 with changing scale and Fresh berry price							
		Hectares of orchard developed from year 0					
		2	4	6	8	10	20
$/kg fresh blueberries (80% of yield)	$10	($1,802,190)	($3,078,702)	($4,355,215)	($5,631,727)	($6,908,240)	($13,290,802)
	$15	($1,030,859)	($1,536,041)	($2,041,223)	($2,546,405)	($3,051,587)	($5,577,496)
	$20	($259,529)	$6,620	$272,769	$538,917	$805,066	$2,135,810
	$25	$511,802	$1,549,281	$2,586,760	$3,624,240	$4,661,719	$9,849,115
	$30	$1,283,132	$3,091,942	$4,900,752	$6,709,562	$8,518,372	$17,562,421

This suggests intensified tunnel house systems only require about one third of the area that outdoor orchards require for long term profitability.

These areas are of course calculated based on an individual investor on their own land developing the orchard. Where there is opportunity to invest together in collectives or joint ventures the relative difference in required scale for profitability between systems is likely similar, although, these collective or joint ventures provide greater access to capital and thus may have greater opportunity to increase the scale of a particular blueberry development to then lift the overall profitability of the business. There is an opportunity with this structure to reduce the WACC of a business investment (through leveraging investors equity capital, which often accepts a lower level of return than debt capital) and thus either accept a lower IRR or bank a higher margin return. For example, with greater capital to initially invest in greater orchard scale from pooling developers together, the IRR on a 4 ha indoor system is 10.96% compared to an IRR of 8.44% on a 2 ha indoor system (when not having a partner and only having half the amount of capital to invest).

If someone was to operate a much smaller area than suggested above but provide a large proportion of the labour themselves along with attracting a higher price per kg fresh blueberry due to their marketing or small customer base, this business may be as competitive on an IRR basis as the orchard scales described above. Therefore, this illustrates how much certain variables within the investment can really influence what scale is required for profitability. These main variables in a blueberry orchard are price received per kg for fresh blueberries, yield per plant or ha, labour/picking expense, and the initial capital outlay (predominantly orchard shelter types and post-harvest infrastructure) and the interest/principal associated with it.

Total supply chain costs and profitability

The high capital costs required for blueberry processing and packaging infrastructure in certain areas may result in growers weighing up either supplying direct to market or engaging in a longer supply chain where margins are likely lost at multiple points. With the trend towards covered growing, the blueberry industry in New Zealand is starting to see an elongation in the practical growing season, a reduction to fruit damage, spoilage due to bird strikes and an overall increase in total fruit quality (Coriolis, 2020). These factors help with consistency in both crop yield and quality, which simplifies matters for the supply chain and can reduce total supply chain costs. Where a decision is made to only invest in the orchard itself, then it should be recognised that these orchards may need a larger scale in order to capture economies of scale to be profitable.

In terms of improving overall profitability, much of the opportunity in the blueberry sector lies within finding efficiencies in the picking and packing portions of the business. This is due to picking and packing making up 58.6% of the overall orchard annual costs according to Wilk & Simpson (2015). Therefore, there is great potential for reduced labour and overall costs from using new autonomous harvesting technology such as the Harvy 500 to harvest all blueberries with minimal bruising for fresh market. This machine also gives the option for two pickers to work with the machine to add a more delicate touch if required, although this machine has a patented “NOGAP” system of brushes and a soft catch to ensure plants are sealed and berries cannot be damaged or end up on the ground, which is proven to be a problem with many other berry harvesters. This also takes the berries to the crates which automatically change when full and once passing through the incorporated cleaning system (Fine Field Innovative Agri Solutions, 2023). This harvester is yet to be exported to New Zealand although sector experts believe that by 2025 this technology will be available for New Zealand growers and will have a significant impact on the profitability of blueberry orchards. The Kokan Air-Jet Berry Harvester is another cheaper alternative option already available in New Zealand that reduces labour, allows for harvesting at optimal time and delivers quality fruit with only a “two-year return on investment” suggested (King & Associates New Zealand Ltd, 2023). There is still need for improvements in this technology to reduce the number of fruit ending up on the ground.

Integration for profitable scale

The Peruvian blueberry industry have invested heavily in large irrigation systems and expansive farms to produce economies of scale (Wilkinson & Morris, 2020). The cost of minimum wage labour in New Zealand is the third highest in the OECD and scalability of farming operations is limited. Due to Peru’s competitive advantage over New Zealand (economies of scale and location providing cheaper freight and cheaper pickers and irrigation investment schemes) it may be difficult to easily take up more market and expand compared to Peru. However, to combat this challenge, there may be an opportunity to combine expertise and resources or amalgamate with the different berry type and other horticultural crop industry bodies. Berries Australia is the key industry body, where producers of blueberries, strawberries, raspberries, and blackberries have combined. This is promising and may suggest that New Zealand berry industry bodies could also do a similar arrangement to pool their resources together to achieve greater economies of scale.

Supply chain integration

Research shows that when supply chain members can learn to work together closely the success and efficiency of the whole supply chain improves (Yi-nan & Zhaofang, 2009; Awad & Nassar, 2010). Supply chain integration has also been defined as the limit that a business can tactfully coordinate, collaborate and plan with its supply chain to manage all internal and external activities within the organisation. This is via information sharing, resource allocation and steady flow of goods with the task and goals of supplying significant quality to the end customer at a low spending all through the combination of all parties in the supply chain working as one (Barbara B., Baofeng, & Xiande, 2009; Yi-nan & Zhao-fang, 2009; Katunzi, 2011; Mellet-Parest & Spillan, 2014). An integrated blueberry supply chain would be expected to deliver several benefits to the chain including:

- reduced total costs;
- reduced waste;
- improved production times;
- improved response times;
- prevention of production delays; and,
- reduced storage costs.

The National Research Council (2000) suggest this supply chain integration can be achieved tightly from buying and owning all the various parts of the chain and therefore controlling the whole supply chain. It can also be achieved more loosely by information sharing and working with trusted suppliers where the various parts of the chain are not owned by one person, but everyone is working closely to produce mutually beneficial gains.

Pooling of capital

Zespri is a prime example of the use of a single desk approach for the export of their New Zealand produce that the blueberry sector could learn from to pool the sector resources together to further distinguish New Zealand blueberries from other countries in the global market, ensuring that uniform high-quality product becomes associated with a New Zealand blueberry brand.

With larger collectives, joint ventures and silent investor groups comes more opportunity to increase scale of blueberry orchards as a sector, but also for landowners that have not got the adequate upfront capital to initially invest in such scale. This pooling of capital gives an economies of scale opportunity not only within orchard investments, but also through investment in processing and packing infrastructure required to go with the increased blueberry supply. Blueberries New Zealand as the advocacy group are pushing the idea for growers to pool resources together to further the sectors success (Bezuidenhout et al., 2020). This ownership structure may be able to be formed in several ways, although a cooperative to form integration across the supply chain may be attractive given its historical success in New Zealand's Food & Fibre sectors.

Cooperative structure

The challenge of processing and packaging infrastructure costs may be overcome by options such as cooperatives or alternative grower collective structures, but there still needs to be strong demand at the right price point and improved coordination of plant varieties and logistics scheduling to ensure profitability for all participants in the supply chain.

Cooperatives across growers in New Zealand or a joint venture with a key market such as Australia or South Korea may be a viable opportunity to increase machinery utilisation and spread capital costs. However, in choosing to do this, consideration would need to be taken around the steps and length of the supply chain and whether there is any overall efficiency gain achieved. This may deter joint venture

realisation as the increasing supply chain length from upscaling the product may result in reduced profit margins.

Required packing and processing infrastructure

A cooperative might adequately resolve the challenges of access to appropriate infrastructure, new market streams and high packing and processing costs. Use of pooled equity capital can provide a lower WACC of the supply chain, which can allow participants to accept a low investment margin on the packing and processing of blueberry products, whilst potentially aiding the return of the grower shareholders. There may not be a requirement for the investment in new infrastructure with a cooperative structure, as it may just require bargaining power at scale and negotiations with owners of existing packaging and processing infrastructure to form partnerships or supply contracts. An example of this may be the kiwifruit sector having large packing infrastructure already, which is not operating at full capacity year-round. Blueberries and kiwifruit harvests are different parts of the year potentially allowing for a proportion of the year's infrastructure resources designated to blueberries and then another part of the season for kiwifruit. This would reduce any outlay of capital by the blueberry sector that can otherwise be utilised for sector research, plant variety breeding improvements, marketing and or investments in other parts of the supply chain such as biosecurity or freight or consumer engagement. Additional benefits from this arrangement are that the packing facilities can provide a longer season for temporary workers and work in with other sectors to align a full years' worth of work between the sectors. This should also improve the investment return for the owner of the processing and packaging infrastructure and machinery due to its increasing usage and output per year.

Implementation of an integrated supply chain

As much as there are significant sector gains to be made by implementing integration efforts and coordination throughout the supply chain, successfully implementing these integration efforts within the supply chain can be very difficult. One way suggested by Laureano Paiva et al. (2014) to improve the success of implementing the integrated supply chain is by improving trust levels between the numerous parties in the supply chain. According to Laureano Paiva et al. (2014), supply chain planning positively effects trust. Thus, there is an opportunity for the New Zealand blueberry sector to initially work together on supply chain planning by using both buyer and supplier information, then utilising this information to develop a cooperative supply chain plan to best suit the overall sector so that businesses can increase trust among their supply chain partners. Planning shows all parties that a future commitment has been made between the buyer and supplier and this helps to improve trust. To build trust, the blueberry sector will need to believe in developing close continuous communication and commitments with the rest of the supply chain.

Freight and biosecurity requirements

The key opportunities within freight and biosecurity of New Zealand blueberries tend to be:

- Minimising the sectors costs associated with compliance when implementing only new and existing regulations that are required and/or improving the overall value of New Zealand blueberries;
- Improve biosecurity processes used such as fumigation type;
- To increase the shelf life of blueberries via controlled atmosphere freight and plant variety selection and breeding; and
- Improved coordination of parties to improve logistic efficiencies.

Quality control, compliance and product reputation

Quality control on exports is crucial to maintain or improve the reputation New Zealand blueberry products have and thus the sustainability of the export sector. A recent example of this importance was a concerning recall in 2022 for Pam's frozen blueberry products as a precaution due to a possible link of Hepatitis A associated with frozen berries sourced from Serbia (Ministry for Primary Industries, 2023). While this related to product imported for domestic consumption, the sickness this can cause could damage reputation for this New Zealand brand and supermarkets selling the product. If a similar situation arose for berries exported from New Zealand, any brand and market position of New Zealand fruit could be significantly damaged. This event reinforces the need to protect our image and reputation through world class biosecurity and quality control.

New Zealand Good Agricultural Practice ("NZGAP") provides assurance for the safe and sustainable production of fruit and vegetables grown in New Zealand (NZGAP, 2023). This food safety programme is recognised by wholesalers and retailers. NZGAP is not compulsory for independent operators selling domestically but it is required for export and preferred by domestic wholesalers. It helps growers with all the overheads of keeping up with the wide range of compliance requirements. Becoming NZGAP certified can give growers confidence that they are compliant with food safety and other regulations. It makes it easier to find out when regulations have changed, and it makes the blueberry product more attractive to buyers.

If a grower is not NZGAP accredited they must still meet the requirements of National Programme 1 under the Food Act 2014 to ensure that the blueberries they are supplying to the market are safe to eat (Ministry for Primary Industries, 2023). This includes rules about how the crop is handled, managing spray residue, and withholding periods. "The costs of some of the new and incoming compliance requirements will make it difficult to make a return for the smaller scale blueberry orchard" (personal communication Tony Baker, January 2023). For many landowners, having to understand the ever-changing compliance requirements and how to work within them is speculated as being one of the major reasons causing an observed surge in number of farms on the market at the end of 2022 (Farmers Weekly, 2022; personal communication Federated Farmers, November 2022). Thus, accreditation is a solution for growers to manage and monitor their own systems, and be supported in doing so, to ensure they are compliant and ensure the sectors reputation is protected via this compliance and biosecurity support system.

The cost of airfreight and the challenges with biosecurity in Australia is one of the largest impacts on the value and quality of the final exported blueberry product (personal communication Tony Baker, January 2023).

Biosecurity

The most significant risk to New Zealand's continued exports to Australia is recent changes biosecurity screening causing holdups, where magnification intensity has doubled (from x30 to x60) resulting in mite eggs and other unidentifiable insects being found in 33% of exports (Blueberries NZ, 2022). This results in the shipment being rejected and requiring fumigation. For this fumigation to be successful it requires lifting the temperature around the fruit to above 10°C for the methyl bromide to adequately fumigate the product. Due to blueberries ideally kept around 2°C for optimal shelf life, this process causes rapid breakdown of the fruit and reduced quality to be worth a lower price once reaching retailers. Currently this is the only available and approved fumigation technique within the Australian authorities (personal communication Tony Baker, January 2023).

Irradiation as a fumigation process has been proven to cause little detrimental impact on the fruit and improve shelf life among improving returns of the supply chain. New Zealand is nuclear free so this is unlikely to be accepted domestically, although this could be proposed to the Australian authorities to

implement. Having this accepted as a fumigation option with the Australian authorities and changing the fumigation system at the boarder was described as “extremely difficult to change” (personal communication Tony Baker, January 2023), although should be investigated.

Product shelf life

For exports to Australia, sea freight could, on average, still arrive at market in adequate time to not incur spoilage, however, with any potential delay or if the blueberries are high moisture content, due to rains prior to harvest, spoilage is a risk with this freight option. The majority of New Zealand blueberry export is via airfreight which is much more expensive than sea freight causing product to be commonly 50% higher price at markets compared to competitors to cover the freight costs. This makes the product less competitive and can reduce the gross margins in the supply chain. Opportunities to improve the shelf life of New Zealand blueberries are from breeding and selection of certain plant varieties that store for longer, reduced damage caused during any fumigation phase internationally and controlled atmosphere (carbon dioxide and nitrogen) shipping.

Certain plant varieties store better and for longer than others, so identifying these varieties and breeding from these may allow more cost-effective sea freight to be an adequate transport option. As described above the potential options for fumigation that do not require lifting temperatures or cause rapid breakdown of the fruit will improve the shelf life of berries. Peru currently sends blueberries by sea freight with controlled atmosphere shipping and achieve quality blueberries after a 45-day voyage. This may be an opportunity to open additional markets in the Northern Hemisphere to supply via this shipping method.

Logistic coordination

Having a strong relationship with the freight business is key to being able to trust product will be delivered on time to import markets. An opportunity for reducing peak transport costs is to develop earlier and later flowering varieties to utilize by suppliers to capture a more distributed supply pattern. There are opportunities for the blueberry industry to investigate collaborative planning, forecasting and replenishment (“CPFR”) with logistics providers and integrated systems to make the post-harvest phase more efficient (Bezuidenhout et al., 2020). This may be able to improve the forecasting accuracy, replenishment plans and reduce inventory costs. Time metrics may help the sector determine the time inefficiencies in the supply chain as it measures the time needed for the berries to be picked, packed, transported and all time between orchard and final markets. This can then be used to consider the time difference in supply between current idle time and/or delays as opposed to no delays.

An opportunity for the New Zealand blueberry sector could be to form a partnership or collective with the Australian blueberry importers to improve trust between exporter and importer when managing product freight. This opportunity may also allow for greater volume consolidation of New Zealand blueberry brands arriving in one container to reduce freight costs per kg product. This volume consolidation could work with other New Zealand cool chain export sectors (potentially seafood, wine or other fruits) requiring similar shipping requirements and lack the scale and existing logistic coordination to fill shipments. There is a risk of negative impacts if mixing commodities in shipments results in logistical challenges at the importers end, although the coordination to achieve single commodity product full shipments would be appealing to New Zealand Gourmet exporter Tony Baker (personal communication, January 2023). This coordinated business could also be a large-scale cooperative, which has the potential to open up further opportunities for the sector. This could include investing in logistics infrastructure as a joint venture with an existing logistics business and utilising the expertise that come from all parties involved. Any opportunity to work with or partner with a product exported from Australia to New Zealand may mutually benefit both parties to ensure freight storage in the cool chain is full on return trips to reduce the overall freight per kg product.

Existing market relationships

The New Zealand domestic market, Australian market and Asia market are the key focus markets for the blueberry sector mainly due to freight costs causing NZ product to be highly priced among competitors in other prominent blueberry consuming areas of the world. There are a range of product market avenues including international and domestic fresh, frozen or processed food products including fruit juices, powder, wine, jams, sauces, chutneys, and muffins to name a few. A report by Coriolis (2020) conducted for the New Zealand government looking at the opportunities for the blueberry industry developed a list of strategic priorities to be focused on in each of New Zealand's key blueberry markets as shown in Figure 6. This report suggests why these specific strategies might be valid with a range of data and graphs.

Figure 6: Strategic priorities for key markets (Coriolis, 2020)

Domestic market

A continued push from local food advocates is increasing the awareness surrounding self-sufficiency, supporting local and eating seasonally for food security, and personal health reasons. This became more relevant post 2020 and the issues around food security that came with Covid-19. Organic berries sell for a premium in local supermarkets and at farm gate sales. While New Zealand's consumption of fresh berries appears to remain static, consumption of frozen blueberries has recently increased (Coriolis, 2020). There may be an opportunity here for the blueberry sector to freeze and sell a proportion of blueberries at a higher price to meet the local demand in the off-season. However, the majority of New Zealand's current demand for frozen berry products is being met from berries imported from other countries and being repackaged in New Zealand**.** Large frozen berry manufacturers can import berries cheaper with a reliable supply year-round from a mixture of Northern Hemisphere and Southern Hemisphere blueberry producers. This alone indicates a demand opportunity domestically to replace the imported products with New Zealand grown product, particularly after the damaged reputation potentially caused to some imported products from the Hepatitis A product recall in 2022 (Ministry for Primary Industries, 2023). However, price is the key problem at stores as to why imported products are being purchased more than the New Zealand blueberries. For the New Zealand frozen blueberry products to compete there would need to be gained efficiencies in cost of production (predominately picking and packing costs via use of high-tech

autonomous harvesters and packers), in domestic freight costs (via potential supplier partnerships contract arrangements for their increased scale produce) or potentially be subsidised in some aspect or have the imported product taxed. This reduced price may encourage New Zealand brands to use more of the domestic product rather than the current imported product.

If the demand for larger fresh blueberry punnets/packaging (for example 1 kg or 500 g containers rather than 125 g) for the domestic and Australian markets was sufficient, this could also improve cost efficiency and may be able to drop the price per kg in stores to be competitive. This may be an opportunity to improve the margins with less overall packaging required per kg of blueberries sold to coincide with the higher consumption per household per day (plus further opportunity for this to increase further) in New Zealand and Australia compared to other countries.

As mentioned in the alternative system types section of this report, the opportunity to supply fresh blueberries to the local market could be profitable and reduce substantial freight costs and concerns, although this opportunity may be limited to a smaller number of orchards. This market option has been explored for several urban areas (see in Table 8) where blueberries have the potential to grow locally. Table 8 works off the domestic consumption of 8 million punnets per year (or 1 million kg) based off the actual amount purchased in 2019-20 season and a New Zealand population of 5.123 million people consuming approximately 195 g purchased per person/year in New Zealand.

Table 8: Orchard area to service existing local market demand

Orchard area to service existing local market demand				
Urban area	**Population**	**Consumption (kg/yr)**	**Plants required***	**Orchard (ha)****
Auckland	1,657,000	323,443	109,271	27.3
Hawkes Bay	178,600	34,862	11,778	2.9
Hamilton	165,400	32,286	10,907	2.7
Tauranga	131,500	25,669	8,672	2.2
Whakatane	37,100	7,242	2,447	0.6
Rotorua	77,300	15,089	5,098	1.3

*This is the number of plants required to service the urban area demand assuming 2.96 kg/plant/year (after 9% shrinkage) in tunnel houses with 4000 plants per ha.

**This is the required area in blueberries to potentially cover the current domestic demand in their local urban areas

Based on this existing demand, along with an assumption consumers will purchase their local product over other products if at the same price, there would only need to be 2.7 ha of tunnel houses to supply the annual total blueberry demand for the population of Hamilton. Even if this local demand could increase, this still highlights the limited opportunity for this servicing the local markets in New Zealand. Domestic consumption alone does not provide adequate market demand for large scale expansion of the blueberry sector, although may be a piece of the overall puzzle. The area required to service Auckland's existing consumption is 27.3 ha. This is a reasonably significant area for tunnel house blueberry production and thus may be a good opportunity for several local producers around Auckland.

Australia

Exports are predominately directed to the Australian market with 89% of total blueberries exported from New Zealand in 2019 imported by Australia (Statistics New Zealand, 2020). Up until 2018 New Zealand provided 99% of Australian imports because it was the only country able to meet Australian biosecurity standards (Coriolis, 2020). This has been recently threatened with the Australian-Peru Free Trade Agreement, with Peruvian berries essentially filling the gap in supply that Australian producers

currently are not meeting, and New Zealand has historically filled. Due to the seasonality of blueberries, there is a large demand at the beginning of the season effectively generating a "pull" system within the blueberry supply chain capturing a higher price per kg product. During peak production the market can be flooded and cause the existing pull system to more of a "push" system in the supply chain having to accept a lower price per kg product. Demand rises slightly again towards the tail end of the season as the supply of fresh blueberries diminishes. With any improvements to shelf life from the opportunities described earlier in this report, these together may provide an opportunity to distribute product more evenly from storage to match the supply with the demand along with extend the later part of the season supply.

Approximately 59% of Australians purchase at least one punnet of blueberries each year (Berries Australia, 2022). Blueberries are promoted in Australia as an excellent seasonal fruit which is available when other fruit varieties are not, and for superior nutritional benefits. This is being achieved through consumer facing activities such as tastings and social marketing activities. Australian berry consumption was approximately 0.33 kg blueberries per person in 2016 (Madec, 2022), compared to that of Americans which is 1.5 kg per person per year. Therefore, the potential for the demand to double or more in Australia is possible. Despite increasing production of blueberries in cooler Southern regions of Australia, such as Tasmania, demand for New Zealand imports is still growing on the back of increasing demand from Australian consumers. Segmentation of companies claiming protection of 'intellectual property' could limit further progress in the industry. With increasing alarm surrounding Australian biosecurity protection, collaboration and partnering together may become necessary to prevent the loss of access to the Australian market.

Asia

Currently, "Eureka" berries are exported to Southeast Asia through Berryco, who has exclusive access to the genetic rights out of Mountain Blue orchards in Australia (Berryco, 2022). Coriolis (2020) highlighted East and Southeast Asia as the other opportunity for growth. A bid for access to South Korea is currently being considered which is making good progress. Currently BBNZ is working to provide Ministry for Primary Industries with a proposed risk management measures for pests of concern to South Korea. In South Korea there may be preference for smaller punnets due to less people per household, less kitchens in homes and less consumption per person per day compared to the western world.

Markets that have been highlighted for growth are Thailand and Vietnam, both of whom imported over $1 million worth of fresh blueberries in 2019 (Statistics New Zealand, 2020). Both these countries form part of New Zealand's free trade agreement with the ASEAN countries. Entering more Asian markets will require planning for the blueberry sector in what crops to cultivate for this new market, what the supply chain needs, and when and what types of spray and pesticides will be used.

A formal access request was also placed with China in 2017 (Blueberries NZ, 2022). According to Miller, Driver, Velasquez, and Saunders (2014), "there is significant evidence to suggest that China has a substantial number of wealthy consumers interested in purchasing premium goods." If New Zealand can identify the correct credence attributes, they may gain market share and target a different consumer, giving the country a point of difference to its main competitors Peru and Chile. China is a potential market where favourable access would be highly beneficial if their product regulatory requirements are easily met. The Chinese consumer is proposed to be happy to pay a high premium for high-quality fruit, which New Zealand is able to produce in abundance. While exports of both fresh and frozen blueberries to China have been tariff-free since 2013, imports have been minimal with only 504 tonnes imported in 2015 (Statistics New Zealand 2020). To gain attractive accesses to the Chinese market, further negotiations are required. As an example of the cost of unsuccessful negotiations, the

Australian blueberry industry is estimated to lose $44 million of annual export revenue due to their lack of access to the Chinese market.

3 Other considerations with changing land use to blueberries

Emissions implications for landowners

Potential emissions compared to other land uses

Under the Climate Change Response (Zero Carbon) Amendment Act 2019 there is a requirement for the agricultural industry to reduce gross methane emissions by 10% by 2030 and between 24-47% by 2050, and an independently set methane price will be a driver for this should methane targets not be met.

Under the NZ government's current farm level pricing proposal (Ministry for the Environment and Ministry for the Primary Industries, 2022), the effects of pricing methane and nitrous oxide emissions is expected to result in a reduction in production and revenue from the pastoral sector. With the opportunity of controlled atmosphere shipping, this may allow for a reduction in the overall supply chain emissions.

Unless there is significant improvement for market access for New Zealand blueberries, reduced freight, packing and harvesting costs to improve gross margin returns, along with improved shelf life of the product achieved, the expansion of the blueberry sector seems an unlikely solution to be of sufficient scale to have a nationally significant impact on land use change and greenhouse gas emissions reduction in New Zealand. However, blueberries could be seen as an option in the toolbox for individual properties and collectives to reduce their emissions footprint whilst making a greater return on the land than previously in pastoral farming.

Other environmental impacts

There is potential from the land use change to blueberries from pastoral farming to have reduced environmental impacts from a phosphorus and nitrogen loss perspective, as well as reduced E coli levels found in waterways. However, there are risks of sediment loss and chemical residue from blueberry production. Sediment impacts are mainly associated with the initial development of an orchard where a dam may need to be built for water storage and land may need to be contoured. If any heavy rain event occurs during this development phase where there is bare soil, a significant amount of soil erosion can occur washing away highly fertile topsoil with organic matter including nitrogen and phosphorus. This may cause contamination in nearby waterbodies. The risks associated with contouring and dam developments can be mitigated with the creation of sediment traps. Chemical residue can be minimal in tunnel houses or fully enclosed blueberry systems as these will reduce any chance of spray drift compared to outdoor growing systems.

Workforce requirements

Quantity of workforce

The uptake of new labour-saving harvesting technologies available for growers now, although some improvements able to be made in these technologies, may alleviate some of the labour issues in sector via a reduced demand for pickers. The automation in packaging technologies will also deliver similar results in that there will be reduced demand for number of workers per orchard and packhouse. There will still be labour required in the berry growing process, although majority of this may be more specialised higher skilled labour to operate the technology rather than the intensive picking, sorting and packaging labour roles that have been the main requirement for workforce quantity in the sector. The uptake of these labour-saving technologies will not be instant. Therefore, there is still innovation

required to ensure the sector attracts and retains adequate number of workers to still complete the increasing workload alongside the potential increasing development of orchards.

Working in with other fruit sectors to communicate timing requirements for picking groups may offer these workers longer periods of work annually along with having potentially more experienced pickers on the orchard. As a sector, blueberries could take on the responsibility of speaking with growers to ensure they organise and schedule an adequate number of workers from collaborating with local businesses, other fruit sectors and immigration New Zealand for international seasonal workers.

Quality of workforce

In line with many of the food and fibre sectors, sourcing adequately trained staff can be difficult. The blueberry industry body or large businesses in the sector may need to take a leadership role in this area and coordinate apprenticeship options, courses and other training or establish a work experience programme in order to encourage the good workers to continually develop their skills to succeed the blueberry sector in the future.

With the increased uptake of new labour-saving harvesting and packaging technologies, there will be a requirement for increased upskilling of a smaller proportion of the workforce to ensure these machines and technology continue to operate as efficiently as possible. This may require apprenticeship schemes or other training programmes to ensure adequate number of people are upskilled adequately to manage and operate the new and upcoming technologies.

The blueberry sector in New Zealand needs transformational leaders who push the industry further into the global marketplace to achieve successful expansion of the sector throughout the country.

4 Conclusions

New Zealand has numerous opportunities to expand the blueberry sector and improve its overall supply chain success and sustainability, but it also has a significant number of hurdles to overcome before being able to make the most of the identified opportunities.

Based on the apparent financial returns from blueberry production and there being no obvious limits to capital availability, the primary reasons limiting blueberry expansion appear to not be financial. The main limitation to the expansion of blueberries would seem to be the currently fragmented structure of the sector, product shelf life causing higher freight and biosecurity costs, labour availability, access to technical support and expertise and existing processing and packaging infrastructure – all things that might limit the long-term potential of the sector and, with it, the confidence of farmers to invest.

Blueberries can be grown profitably in tunnel houses in many locations throughout the country, with this production system having the best return and opportunity for expansion than the lower return outdoor system and higher initial investment Cravo system. There are several capital structures, including joint ventures and lease options, that provide viable options for investment to support the expansion of the sector and to compete with alternative land use options. Despite this, the sector has not experienced the rate of expansion that the projected financial returns might suggest. This indicates that potential growers lack confidence to invest in the sector, which would seem to coalesce around several supply chain and market hurdles that need to be addressed for a successful and sustainable expansion of the sector.

Some solutions to what the sector can do to overcome these challenges include:

- Improve yields from new and existing varieties not yet achieving their potential due to management and inadequate light.
- Invest collectively in larger scale developments to reduce weighted average cost of capital and improve margins from the ability to invest in large scale developments for economies of scale.
- Limit the costs of compliance to growers by streamlining processes and information sharing.
- Invest or partner with owners of existing commercial post-harvest infrastructure (including other fruit sector infrastructure such as kiwifruit) to achieve economies of scale in this aspect of the supply chain.
- Make better use of marketing the credence attributes achieved by New Zealand growers to achieve a higher price per kg.
- Partner with other smaller export product businesses to establish scale and contracts with freight businesses to give improved consistency and stability of freight scheduling to reduce overall freight costs whilst having the contracted product amount prioritised.
- Partner with key international markets importers and industry bodies to secure trust within the supply chain and the product quality to gain efficiencies in logistics and biosecurity among achieving a greater economy of scale.
- Propose alternative fumigation techniques in key export markets such as irradiation fumigation or others that do not require lifting the temperature of the product, ultimately to limit degradation of imported product at international boarders so price per kg product is not significantly reduced.

- Utilise controlled atmosphere storage and shipping methods to distribute supply more evenly with market demand to improve shelf life of fruit and receive a greater return per kg of product.
- Create a cooperative for all New Zealand and Australian growers to improve access to market, access to resources and expertise whilst producing one brand for New Zealand produce that can be more easily recognised in international and domestic markets.
- Create further demand for New Zealand branded blueberries to lift price, through continuing negotiations with countries in East and Southeast Asia (particularly China) and investigate the price competition of products in European markets when taking advantage of the controlled atmosphere shipping option.
- Assist or incentivise uptake of autonomous or high-tech harvesters to reduce cost of production and improve overall returns whilst reducing risk of having labour shortfalls.
- Attract and retain a network of quality workers to complete any additional work from further developments.
- Develop and train workforce within the sector to secure the succession of the sector and encourage innovation and improved management within operations.

Fundamentally, all of these elements require a degree of industry cooperation and coordination that seems not to currently exist within the sector. It seems unlikely that individual growers or small groups of growers will be able to sufficiently address these issues themselves. The growth of the Peruvian industry provides a clear example of what a coordinated growth strategy can achieve. While there is no requirement for (or evidence to justify) a single-desk seller, sole exporter or exclusive supplier of plant varieties for the blueberry sector, there does seem merit in having a large number of growers being part of a pan sector entity/organisation that could provide clear industry leadership, coordinate grower efforts to address supply chain inefficiencies, advocate for grower interests in market and lead investment in research and development.

Blueberries are clearly an option to reduce emissions per ha from pastoral farming whilst improving marginal returns per ha. The intensity and large investment required per ha to develop an orchard likely limits how much area of pastoral farming businesses can go into this alternative land use. However, with pooled resources (particularly capital) greater areas of expansion will be able to be achieved on pastoral farming businesses. Any land use change at scale requires an increased demand (and markets) for blueberry produce and the supply chain ultimately addressing some of the challenges identified above.

Assuming the New Zealand blueberry sector can overcome the challenges described in this report and can make the most of the numerous opportunities available to it, the capital cost of land conversion into blueberries remains high. As a result, land use change to blueberries from the pastoral sector seems unlikely to occur at a scale to significantly contribute to New Zealand meeting its national emissions reduction targets; but it may still be a worthy contributing “piece of the puzzle” to doing so.

5 Acknowledgments

Perrin Ag would like to thank the following people and organisations for their contribution to this report:

- Shirly Miller at Plant Wise for orchard costings and development process;
- Alan McLean at BerryCo for orchard costings and development process; and,
- Tony Baker at Gourmet for insights to the blueberry export sector logistics and biosecurity.

The industry expertise provided was invaluable to the development of this report.

6 References

Awad, H. A. H., & Nassar M. O. (2010). *Supply Chain Integration: Definition and Challenges.* Retrieved from https://www.researchgate.net/publication/44260618_Supply_Chain_Integration_Definition_and_Challenges

Barbara B. F., Baofeng, H., & Xiande, Z. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management, 28*(1), 58-71. https://doi.org/10.1016/j.jom.2009.06.001

Berryco. (2022). Our varieties. From Our Varieties — BerryCo. Accessed 22 August 2022.

Bezuidenhout, C. N., Martin, M. R., Williams, A. H., Peiris, A., Wood, K. A., Zhang, T., Shea, G. T., Lavelua, T. D., Cosgrove, M. N., Forman, J. S., Paranjape, M., Kodikara, D. T., Dalglish, P., Weng, L., Cosson, I., Raza, S., Claydon, J. D., Kour, H., Kathara, R. D. (2020). *A Scholarly Review of Supply Chain Integration within the New Zealand Blueberry Industry.* Retrieved from https://www.massey.ac.nz/documents/479/A_Scholarly_Review_of_Supply_Chain_Integration_within_the_New_Zealand_Blueberr_Mc60Wpn.pdf

Blueberries NZ. (2022). *Industry Profile*. Blueberries New Zealand Inc.

Blueberries NZ. (2023a). *Who we are*. Blueberries New Zealand Inc.

Blueberries NZ. (2023b). *Varieties recently imported by Blueberries New Zealand*. Blueberries New Zealand Inc.

Coriolis. (2020). *Opportunities in the New Zealand blueberry industry: Part of emerging growth opportunities, food and beverage information project.* Retrieved from https://static1.squarespace.com/static/62b234e5b82e3f577d752b01/t/63196e214713b02129f03c83/1662611012390/coriolis_ifab_2020_EGO_Blueberries_1.00_CLIENT.pdf

Country. (2021, May 5). *New study finds Tararua District could grow blueberries, hazelnuts, apples and feijoas.* Retrieved from https://www.rnz.co.nz/news/country/441908/new-study-finds-taurua-district-could-grow-blueberries-hazelnuts-apples-and-feijoas

DairyNZ. (2023). *Latest DairyBase benchmarks.* Retrieved from https://www.dairynz.co.nz/business/dairybase/benchmarking/latest-dairybase-benchmarks/

Farmers Weekly. (2022, November 30). *Farm listings surge as tensions rise in rural sector.* Retrieved from https://www.farmersweekly.co.nz/news/farm-listings-surge-as-tensions-rise-in-rural-sector/

Fine Field Innovative Agri Solutions. (2023). *Blueberry harvesting machine.* Retrieved from https://www.finefield.nl/blueberry-harvesting-machine#:~:text=The%20blueberry%20harvester%20%E2%80%9CHarvy%20500,the%20plant%20and%20catch%20it

Fresh Facts. (2016). *New Zealand Horticulture.* Retrieved from https://www.freshfacts.co.nz/files/freshfacts-2016.pdf

Fresh Facts. (2021). *New Zealand Horticultural Exports 2021.* Retrieved from https://freshfacts.co.nz/files/freshfacts-2021.pdf

Hāmuatanga. (2022). *Hāmuatanga annual reports 2022*. Retrived from https://tumaira.nz/wp-content/uploads/2022/11/Rangita%CC%84ne-Tu%CC%84-Mai-Ra%CC%84-Trust-Annual-Report-2022.pdf

Katunzi, T.M., 2011. Obstacles to process integration along the supply chain: manufacturing firm's perspective. *International Journal of Business and Management 6*(5), 105113. https://doi.org/10.5539/ijbm.v6n5p105

King & Associates New Zealand Ltd. (2023). *Kokan air-jet berry harvester*. Retrieved from https://www.airjetberryharvester.com/

Laureano Paiva, E., Teixeira, R., Marques Vieira, L., & Beheregaray Finger, A. (2014). Supply chain planning and trust: two sides of the same coin. *Industrial Management & Data Systems, 114*(3), 405-420. https://doi:10.1108/imds-07-2013-0324

Madec. (2022). *Blueberries from the Americas to Australia*. From https://madec.edu.au/blueberries-from-the-americas-to-australia-talk/

McQuillan Reese, L. (2022). Summary report on base production and supply chain parameters expected within the New Zealand environment for six alternative land uses. A report prepared for The New Zealand Agricultural Greenhouse Gas Research Centre. Final report. 56 pages.

Mellet-Parest, M., & Spillan, J. (2014). Logistics and supply chain process integration as a source of competitive advantage: An empirical analysis. *International Journal of Logistics Management, 25*(2), 289-314. https://doi.org/10.1108/IJLM-07-2012-0066

Miller, S. A., Driver, T., Velasquez, N., & Saunders, C. M. (2014). *Maximising Export Returns (MER): Consumer behaviour and trends for credence attributes in key markets and a review of how these may be communicated.* Retrieved from https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/6349/Maximising%20Exports%20Returns%20report%20July%202014.pdf?sequence=1&isAllowed=y

Ministry for Primary Industries. (2023). Recalled food products list: Pams brand frozen berries. Retrieved from https://www.mpi.govt.nz/food-safety-home/food-recalls-and-complaints/recalled-food-products/pams-brand-frozen-berries/

Ministry for Primary Industries. (2023). *Steps for national programme 1*. Retrieved from https://www.mpi.govt.nz/food-safety/food-act-2014/national-programmes/steps-for-national-programme-1/

Miro. (2023). *Our partners*. Retrieved from https://www.miroberries.com/our-partners

National Research Council. (2000). *Surviving Supply Chain Integration: Strategies for Small Manufacturers*. Retrieved from https://nap.nationalacademies.org/read/6369/chapter/1

New Zealand Good Agricultural Practice ("NZGAP"). (2021). *NZGAP*. Retrieved from https://www.nzgap.co.nz/NZGAP_Public/Programmes/NZGAP/NZGAP_Public/Programmes/NZGAP.aspx?hkey=155ea3e3-f653-4545-a23f-1578adf0f437

NIbusinessinfo. (2023). Joint ventures and business partnerships. Retrieved from https://www.nibusinessinfo.co.uk/content/types-joint-venture

NZ Herald. (2018, March 31). *Blueberry orchard a sweet opportunity*. Retrieved from https://www.nzherald.co.nz/property/blueberry-orchard-a-sweet-opportunity/7N2E6SQIUNK6XOJLT4GGXEXB7E/

Project Crimson. (2022). *Flagship projects*. Retrieved from https://projectcrimson.org.nz/projects/flagship-projects/

Rotorua Land Use Directory. (2022). *Land uses: Blueberries*. Retrieved from https://landusenz.org.nz/blueberries/

Statistics New Zealand. (2020.) *Harmonised Trade –Exports*. Retrieved from http://archive.stats.govt.nz/infoshare/ViewTable.aspx?pxID=ba923504-0de5-43eb-9296-34f77bbd91d0

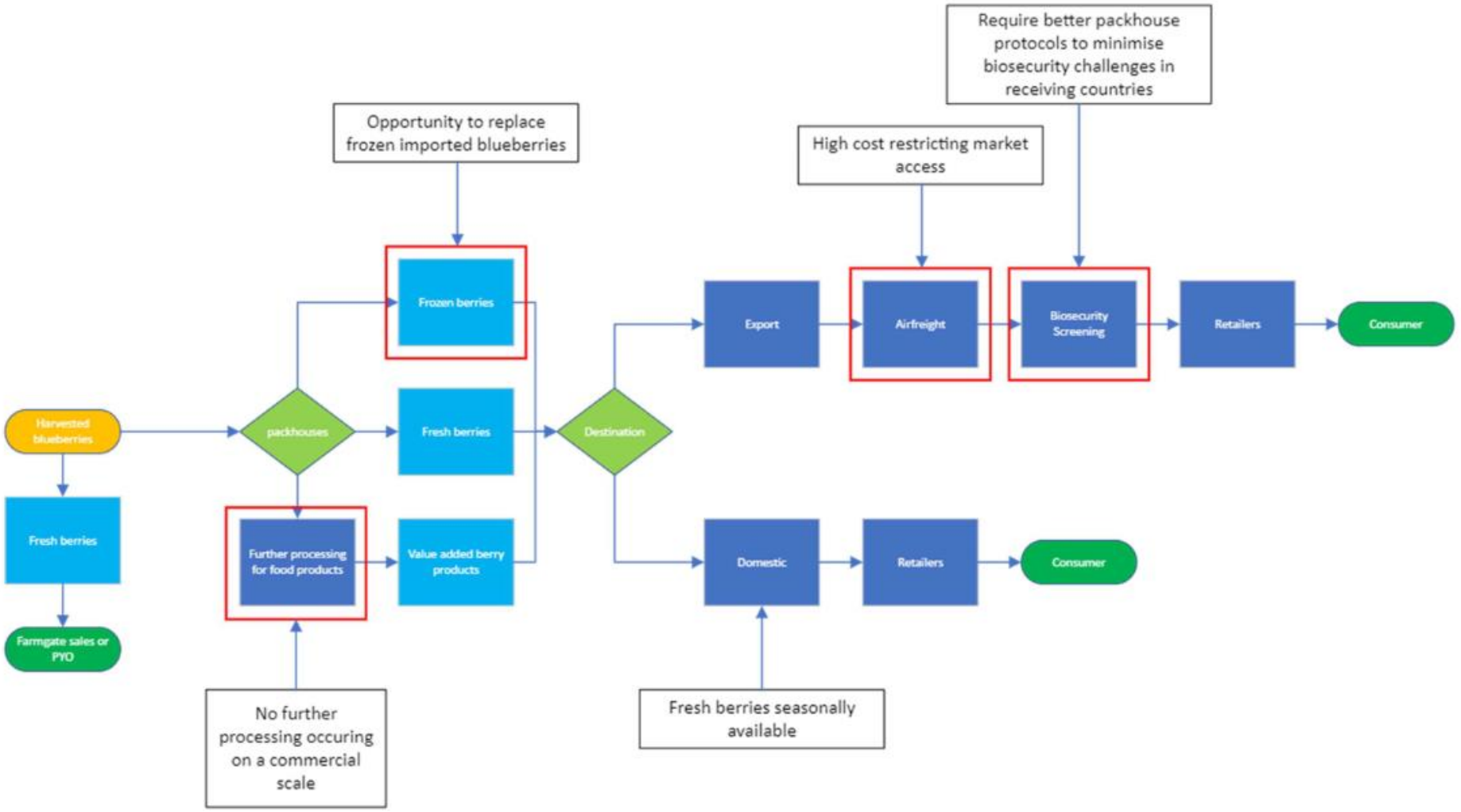
Te Puni Kōkiri. (2023). *Blueberries – covered cropping*. Retrieved from https://www.tupu.nz/en/fact-sheets/blueberries-covered-cropping#:~:text=Blueberries%20have%20traditionally%20been%20grown,and%20picked%20rain%20or%20shine.

Wilk, P., & Simpson, M. (2015). *Blueberry establishment and production costs*. Retrieved from https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/57238/blueberry-establishment-and-production-costs.pdf

Yi-nan, q., & Zhao-fang, C. (2009). *The Impact of Supply Chain Strategies on Supply Chain Integration.* Proceedings of the 16th International Conference on Management Science & Engineering (534-540). IEEE. https://ieeexplore-ieee-org.ezproxy.massey.ac.nz/stamp/stamp.jsp?tp=&arnumber=5317307

Appendices

Appendix 1: Existing blueberry supply chain (McQuillan-Reece, 2022)



Appendix 2: Discounted cash flow analysis for outdoor blueberry orchard.

IRR analysis for a 6 ha outdoor orchard	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue	-	63,120	248,903	382,928	574,392	765,856	861,588	861,588	861,588	861,588	861,588	861,588	861,588
Operating expenditure	(68,889)	(132,264)	(261,899)	(385,376)	(518,975)	(652,574)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)
Operating surplus	(68,889)	(69,144)	(12,995)	(2,448)	55,417	113,282	142,215	142,215	142,215	142,215	142,215	142,215	142,215
Orchard establishment	(866,154)												
Post-harvest infrastructure	(249,614)												
Ongoing re-investment		(24,961)	(24,961)	(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)	(24,961)	(24,961)
Annual cashflow	(1,184,657)	(94,105)	(37,957)	(27,409)	30,456	88,321	111,963	111,963	111,963	111,963	111,963	117,253	117,253
Outdoor cumulative cash flow	(1,184,657)	(1,278,762)	(1,316,719)	(1,344,129)	(1,313,673)	(1,225,352)	(1,113,389)	(1,001,425)	(889,462)	(777,499)	(665,535)	(548,282)	(431,029)
IRR	6.21% for 30 year term												

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588	861,588
(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)	(719,373)
142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215	142,215
																	866,154
																	249,614
(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)	(24,961)	(24,961)	(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)
117,253	117,253	117,253	111,963	111,963	111,963	111,963	111,963	117,253	117,253	117,253	117,253	117,253	111,963	111,963	111,963	111,963	1,227,732
(313,776)	(196,523)	(79,269)	32,694	144,657	256,621	368,584	480,547	597,800	715,054	832,307	949,560	1,066,813	1,178,777	1,290,740	1,402,703	1,514,667	2,742,398

Discount rate	NPV
0%	$2,742,398.50
4%	$1,405,779.46
5%	$1,202,741.73
6%	$1,033,146.50
7%	$890,778.22
8%	$770,671.85
9%	$668,847.82
10%	$582,105.09

Outdoor Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Yield (t/ha)	*0*	*0.60*	*2.37*	*3.64*	*5.46*	*7.28*	*8.19*	*8.19*	*8.19*
Income									
Fresh (80% @ $20/kg)	0	9,600	37,856	58,240	87,360	116,480	131,040	131,040	131,040
Frozen (5% at $4/kg) & Fresh Rejects (10% at $13.33/kg)	0	920	3,628	5,581	8,372	11,163	12,558	12,558	12,558
Gross Farm Revenue	0	10,520	41,484	63,821	95,732	127,643	143,598	143,598	143,598
Operating Expenditure									
Irrigation/frost protection	52	103	103	103	103	103	103	103	103
Mowing (incl. labour)	610	610	610	610	610	610	610	610	610
Fertiliser	919	919	919	1,839	1,839	1,839	1,839	1,839	1,839
Spraying & weed control (incl labour)	3,263	3,263	3,263	6,526	6,526	6,526	6,526	6,526	6,526
Pruning and thinning	3,170	6,340	6,340	6,340	6,340	6,340	6,340	6,340	6,340
Running R&M	811	811	811	1,622	1,622	1,622	1,622	1,622	1,622
Levy/commision	0	395	1,556	2,393	3,590	4,787	5,385	5,385	5,385
Overheads and fixed costs	2,657	2,657	2,657	2,657	2,657	2,657	2,657	2,657	2,657
Freight costs	0	656	2,587	3,980	5970	7959	8954	8,954	8,954
Labour (picking + packing)	0	6290	24,804	38,160	57,240	76,320	85,860	85,860	85,860
Total Operating Expenditure	11,481	22,044	43,650	64,229	86,496	108,762	119,896	119,896	119,896
Operating Surplus per ha	**(11,481)**	**(11,524)**	**(2,166)**	**(408)**	**9,236**	**18,880**	**23,702**	**23,702**	**23,702**

Appendix 3: Discounted cash flow analysis for indoor tunnel house blueberry orchard.

IRR analysis for a 6ha indoor orchard	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue	-	120,794	523,442	805,295	1,006,619	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605
Operating expenditure	(73,754)	(167,322)	(415,810)	(624,885)	(749,130)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)
Operating surplus	(73,754)	(46,528)	107,632	180,410	257,490	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109
Orchard establishment	(1,865,459)												
Post-harvest infrastructure	(249,614)												
Ongoing re-investment		(24,961)	(24,961)	(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)	(24,961)	(24,961)
Annual cashflow	(2,188,827)	(71,489)	82,670	155,449	232,528	348,148	342,858	342,858	342,858	342,858	342,858	348,148	348,148
Tunnel house cumulative cash flow	(2,188,827)	(2,260,316)	(2,177,646)	(2,022,197)	(1,789,669)	(1,441,521)	(1,098,663)	(755,805)	(412,947)	(70,089)	272,769	620,916	969,064
IRR	11.43% for 30 year term												

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605	1,308,605
(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)	(935,496)
373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109	373,109
																	1,865,459
																	249,614
(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)	(24,961)	(24,961)	(24,961)	(24,961)	(24,961)	(30,251)	(30,251)	(30,251)	(30,251)	(30,251)
348,148	348,148	348,148	342,858	342,858	342,858	342,858	342,858	348,148	348,148	348,148	348,148	348,148	342,858	342,858	342,858	342,858	2,457,931
1,317,212	1,665,360	2,013,508	2,356,366	2,699,224	3,042,082	3,384,939	3,727,797	4,075,945	4,424,093	4,772,241	5,120,389	5,468,536	5,811,394	6,154,252	6,497,110	6,839,968	9,297,899

Discount rate	NPV
0%	$9,297,898.99
4%	$5,063,046.79
5%	$4,421,180.95
6%	$3,884,251.83
7%	$3,432,412.87
8%	$3,049,927.40
9%	$2,724,263.13
10%	$2,445,395.44

Indoor Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Yield (t/ha)	*0*	*1.17*	*5.09*	*7.83*	*9.78*	*12.72*	*12.72*	*12.72*	*12.72*
Income									
Fresh (80% @ $20/kg)	0	18,782	81,390	125,216	156,520	203,476	203,476	203,476	203,476
Frozen (5% at $4/kg) & Fresh Rejects (10% at $13.33/kg)	0	1,350	5,850	9,000	11,250	14,625	14,625	14,625	14,625
Gross Farm Revenue	0	20,132	87,240	134,216	167,770	218,101	218,101	218,101	218,101
Operating Expenditure									
Irrigation/frost protection	52	52	52	103	103	103	103	103	103
Mowing (incl. labour)	610	610	610	610	610	610	610	610	610
Fertiliser	919	919	919	1,839	1,839	1,839	1,839	1,839	1,839
Sprays	3,263	3,263	3,263	6,526	6,526	6,526	6,526	6,526	6,526
Pruning	3,170	6,340	6,340	6,340	6,340	6,340	6,340	6,340	6,340
Running R&M	1,622	1,622	1,622	3,244	3,244	3,244	3,244	3,244	3,244
Levy/commision	0	755	3,272	5,033	6,291	8,179	8,179	8,179	8,179
Overheads and fixed costs	2,657	2,657	2,657	2,657	2,657	2,657	2,657	2,657	2,657
Freight costs	0	1,102	4,776	7,347	9,184	11,939	11,939	11,939	11,939
Labour (picking + packing)	0	10567	45,792	70,449	88,062	114,480	114,480	114,480	114,480
Total Operating Expenditure	12,292	27,887	69,302	104,148	124,855	155,916	155,916	155,916	155,916
Operating Surplus per ha	**(12,292)**	**(7,755)**	**17,939**	**30,068**	**42,915**	**62,185**	**62,185**	**62,185**	**62,185**

Appendix 4: Discounted cash flow analysis for indoor Cravo blueberry orchard.

IRR analysis for a 6ha Cravo system orchard	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue		-	271,620	1,177,020	2,059,785	2,574,731	3,347,151	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570
Operating expenditure		(145,284)	(224,503)	(425,162)	(719,468)	(833,592)	(1,004,780)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)
Operating surplus		(145,284)	47,117	751,858	1,340,317	1,741,139	2,342,371	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603
Orchard establishment		(11,034,956)											
Post-harvest infrastructure		(249,614)											
Ongoing re-investment			(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)
Annual cashflow		(11,429,854)	(970,991)	(266,250)	322,210	723,031	1,324,264	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496
Cumulative cash flow		(11,429,854)	(12,400,844)	(12,667,094)	(12,344,884)	(11,621,853)	(10,297,589)	(8,372,093)	(6,446,598)	(4,521,102)	(2,595,606)	(670,111)	1,255,385	3,180,881
IRR		10.35% for 30 year term											

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570	4,119,570
(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)	(1,175,967)
2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603	2,943,603
																	11,034,956
																	249,614
(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)	(1,018,107)
1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	1,925,496	13,210,066
5,106,377	7,031,872	8,957,368	10,882,864	12,808,359	14,733,855	16,659,351	18,584,847	20,510,342	22,435,838	24,361,334	26,286,829	28,212,325	30,137,821	32,063,317	33,988,812	35,914,308	49,124,374

Discount rate	NPV
0%	$49,124,373.56
4%	$25,627,651.69
5%	$22,100,040.98
6%	$19,160,403.12
7%	$16,696,564.51
8%	$14,619,738.38
9%	$12,859,336.59
10%	$11,358,986.85

Cravo System Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Yield (t/ha)	*0*	*1.80*	*7.80*	*13.65*	*17.06*	*22.18*	*27.30*	*27.30*	*27.30*
Income									
Fresh (80% @ $30/kg)	0	43,200	187,200	327,600	409,500	532,350	655,200	655,200	655,200
Frozen (5% at $4/kg) & Fresh Rejects (10% at $13.33/kg)	0	2,070	8,970	15,698	19,622	25,508	31,395	31,395	31,395
Gross Farm Revenue	0	45,270	196,170	343,298	429,122	557,858	686,595	686,595	686,595
Operating Expenditure									
Irrigation/frost protection	103	103	103	207	207	207	207	207	207
Mowing (incl. labour)	610	610	610	610	610	610	610	610	610
Fertiliser	919	919	919	1,839	1,839	1,839	1,839	1,839	1,839
Sprays	2,447	2,447	2,447	4,894	4,894	4,894	4,894	4,894	4,894
Pruning	3,170	6,340	6,340	6,340	6,340	6,340	6,340	6,340	6,340
Running R&M	12,974	12,974	12,974	25,948	25,948	25,948	25,948	25,948	25,948
Levy/commision	0	1,698	7,356	12,874	16,092	20,920	25,747	25,747	25,747
Overheads and fixed costs	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990
Freight costs	0	787	3,411	5,970	7,462	9,701	11,939	11,939	11,939
Labour (picking + packing)	0	7548	32,709	57,240	71,550	93,015	114,480	114,480	114,480
Total Operating Expenditure	24,214	37,417	70,860	119,911	138,932	167,463	195,994	195,994	195,994
Operating Surplus per ha	**(24,214)**	**7,853**	**125,310**	**223,386**	**290,190**	**390,395**	**490,601**	**490,601**	**490,601**

Appendix 5: Discounted cash flow analysis for an indoor tunnel house blueberry orchard to lease to be developed.

IRR analysis for a 6ha lease orchard	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue		49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306
Operating expenditure		(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)
Operating surplus		41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606
Orchard establishment													
Post-harvest infrastructure													
Ongoing re-investment			-	-	-	-	-	-	-	-	-	-	-
Annual cashflow		41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606
Cumulative cash flow		41,606	83,212	124,818	166,424	208,030	249,636	291,242	332,847	374,453	416,059	457,665	499,271	540,877
IRR	#NUM!	for 30 year term											

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306
(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)
41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606
																	-
																	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606	41,606
582,483	624,089	665,695	707,301	748,907	790,513	832,119	873,725	915,331	956,936	998,542	1,040,148	1,081,754	1,123,360	1,164,966	1,206,572	1,248,178	1,289,784

Discount rate	NPV
0%	$1,289,783.91
4%	$731,785.68
5%	$648,753.42
6%	$579,532.61
7%	$521,397.82
8%	$472,218.99
9%	$430,321.92
10%	$394,383.18

Lease Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Income									
Rental income	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306
Gross Farm Revenue	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306	49,306
Operating Expenditure									
Overheads and fixed costs	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
Total Operating Expenditure	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
Operating Surplus per ha	**41,606**	**41,606**	**41,606**	**41,606**	**41,606**	**41,606**	**41,606**	**41,606**	**41,606**

Appendix 6: Discounted cash flow analysis for developing an indoor tunnel house blueberry orchard to lease.

IRR analysis for a 6ha lease	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue		55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744
Operating expenditure		(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)
Operating surplus		48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044
Orchard establishment		(1,865,459)											
Post-harvest infrastructure		-											
Ongoing re-investment			-	-	-	-	-	-	-	-	-	-	-
Annual cashflow		(1,817,415)	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044
Cumulative cash flow		(1,817,415)	(1,769,371)	(1,721,327)	(1,673,283)	(1,625,239)	(1,577,195)	(1,529,151)	(1,481,107)	(1,433,063)	(1,385,019)	(1,336,975)	(1,288,931)	(1,240,887)
IRR		2.70% for 30 year term											

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744
(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)	(7,700)
48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044
																	1,865,459
																	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	48,044	1,913,503
(1,192,844)	(1,144,800)	(1,096,756)	(1,048,712)	(1,000,668)	(952,624)	(904,580)	(856,536)	(808,492)	(760,448)	(712,404)	(664,360)	(616,316)	(568,272)	(520,228)	(472,184)	(424,140)	1,489,362

Discount rate	NPV
0%	$1,489,362.32
4%	$867,142.01
5%	$769,693.72
6%	$687,592.89
7%	$618,109.76
8%	$559,021.32
9%	$508,518.33
10%	$465,127.99

Lease Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Income									
Rental income	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744
Gross Farm Revenue	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744	55,744
Operating Expenditure									
Overheads and fixed costs	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
Total Operating Expenditure	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
Operating Surplus per ha	**48,044**	**48,044**	**48,044**	**48,044**	**48,044**	**48,044**	**48,044**	**48,044**	**48,044**

Appendix 7: Discounted cash flow analysis for niche pick your own outdoor blueberry orchard.

IRR analysis for a 2 ha outdoor pick your own orchard	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Gross farm revenue		-	11,940	47,083	72,436	108,654	144,872	146,683	146,683	146,683	146,683	146,683	146,683
Operating expenditure		(65,470)	(71,913)	(71,913)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)
Operating surplus		(65,470)	(59,973)	(24,830)	(9,463)	26,755	62,973	64,784	64,784	64,784	64,784	64,784	64,784
Orchard establishment		(251,820)											
Customer service requirement			(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)
Ongoing re-investment			-	-	-	-	-	(4,000)	(4,000)	(4,000)	(4,000)	(4,000)	-	-
Annual cashflow		(317,289)	(73,413)	(38,270)	(22,903)	13,315	49,533	47,344	47,344	47,344	47,344	47,344	51,344	51,344
Cumulative cash flow		(317,289)	(390,703)	(428,972)	(451,876)	(438,561)	(389,028)	(341,685)	(294,341)	(246,997)	(199,654)	(152,310)	(100,967)	(49,623)
IRR		7.77% for 30 year term												

Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30
146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683	146,683
(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)	(81,899)
64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784	64,784
																	251,820
(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)	(13,440)
-	-	-	(4,000)	(4,000)	(4,000)	(4,000)	(4,000)	-	-	-	-	-	(4,000)	(4,000)	(4,000)	(4,000)	(4,000)
51,344	51,344	51,344	47,344	47,344	47,344	47,344	47,344	51,344	51,344	51,344	51,344	51,344	47,344	47,344	47,344	47,344	299,163
1,721	53,064	104,408	151,751	199,095	246,439	293,782	341,126	392,470	443,813	495,157	546,500	597,844	645,188	692,531	739,875	787,219	1,086,382

Discount rate	NPV
0%	$1,086,381.72
4%	$537,396.44
5%	$453,670.78
6%	$383,651.03
7%	$324,813.54
8%	$275,139.30
9%	$233,007.21
10%	$197,110.74

Outdoor Pick Your Own Annual Operating Costs/ha

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8
Yield (t/ha)		*0*	*0.60*	*2.37*	*3.64*	*5.46*	*7.28*	*7.37*	*7.37*	*7.37*
Income									
Fresh (80% @ $12/kg)		0	5,760	22,714	34,944	52,416	69,888	70,762	70,762	70,762
Fresh Rejects (5% at $7/kg)		0	210	828	1,274	1,911	2,548	2,580	2,580	2,580
Gross Farm Revenue		0	5,970	23,542	36,218	54,327	72,436	73,341	73,341	73,341
Operating Expenditure									
Irrigation/frost protection		52	103	103	103	103	103	103	103	103
Mowing (incl. labour)		610	610	610	610	610	610	610	610	610
Fertiliser		919	919	919	1,839	1,839	1,839	1,839	1,839	1,839
Spraying & weed control (incl labour)		3,263	3,263	3,263	6,526	6,526	6,526	6,526	6,526	6,526
Pruning and thinning		3,170	6,340	6,340	6,340	6,340	6,340	6,340	6,340	6,340
Running R&M		811	811	811	1,622	1,622	1,622	1,622	1,622	1,622
Levy/commision		0	0	0	0	0	0	0	0	0
Overheads and fixed costs		23,910	23,910	23,910	23,910	23,910	23,910	23,910	23,910	23,910
Freight costs		0	0	0	0	0	0	0	0	0
Labour (picking + packing)		0	0	0	0	0	0	0	0	0
Total Operating Expenditure		32,735	35,957	35,957	40,950	40,950	40,950	40,950	40,950	40,950
Operating Surplus per ha		**(32,735)**	**(29,987)**	**(12,415)**	**(4,732)**	**13,377**	**31,486**	**32,392**	**32,392**	**32,392**

Appendix 8: Summary of green and gold discounted cash flow analysis

BOP Kiwifruit Example	Green		Gold	
Area (Canopy hectares)	**6.00**		**6.00**	
Establishment costs	Total	/ha	Total	/ha
Development expense	$1,959,112	*$326,519*	$2,180,800	*$363,467*
License expense	$0	*$0*	$4,200,000	*$700,000*
Operating loses Yr 1-5 (Capitalise)	$1,135,419	*$189,236*	$923,242	*$153,874*
Total establishment cost (at Yr 5)	$3,094,531	*$515,755*	$7,304,042	*$1,217,340*
Status Quo Operating Budget	Total	/ha	Total	/ha
Key revenue assumptions				
Status quo production (te/ha)	11,000		16,000	
Base Status quo tray price ($/te)	$7.25		$10.00	
Kiwistart Premiums ($/te)	$1.00		$1.00	
Total tray price	$8.25		$11.00	
Revenue (OGR)	**$544,500**	***$90,750***	**$1,056,000**	***$176,000***
Orchard working costs	$120,000	*$20,000*	$156,000	*$26,000*
Vine specific costs	$96,000	*$16,000*	$144,000	*$24,000*
Harvest costs ($0.70/te)	$46,200	*$7,700*	$67,200	*$11,200*
Management costs	$18,000	*$3,000*	$24,000	*$4,000*
Overheads	$16,000	*$2,667*	$16,000	*$2,667*
Total orchard working costs	**$296,200**	**$49,367**	**$407,200**	**$67,867**
Orchard surplus	**$248,300**	***$41,383***	**$648,800**	***$108,133***
Depreciation offset	$10,528	*$1,755*	$12,275	*$2,046*
Operating Surplus (EBIT)	**$237,772**	***$39,629***	**$636,525**	***$106,087***
Pre Interest & Tax IRR (30 yrs)	**7.1%**		**8.1%**	
Pre Interest & Tax NPV (6% Discount rate)	**$403,256**		**$1,973,497**	