

Feasibility Analysis and Business Case:
The re-establishment of the Harakeke Industry
in Aotearoa New Zealand

GROWING WITH HARAKEKE

TE HONONGA HAPORI HARAKEKE
THE HARAKEKE COMMUNITY ALLIANCE

JUNE 2026

MAURI

LIFE FORCE

O TE

OF THE

TAIAO

NATURAL WORLD



Feasibility Analysis and Business Case:

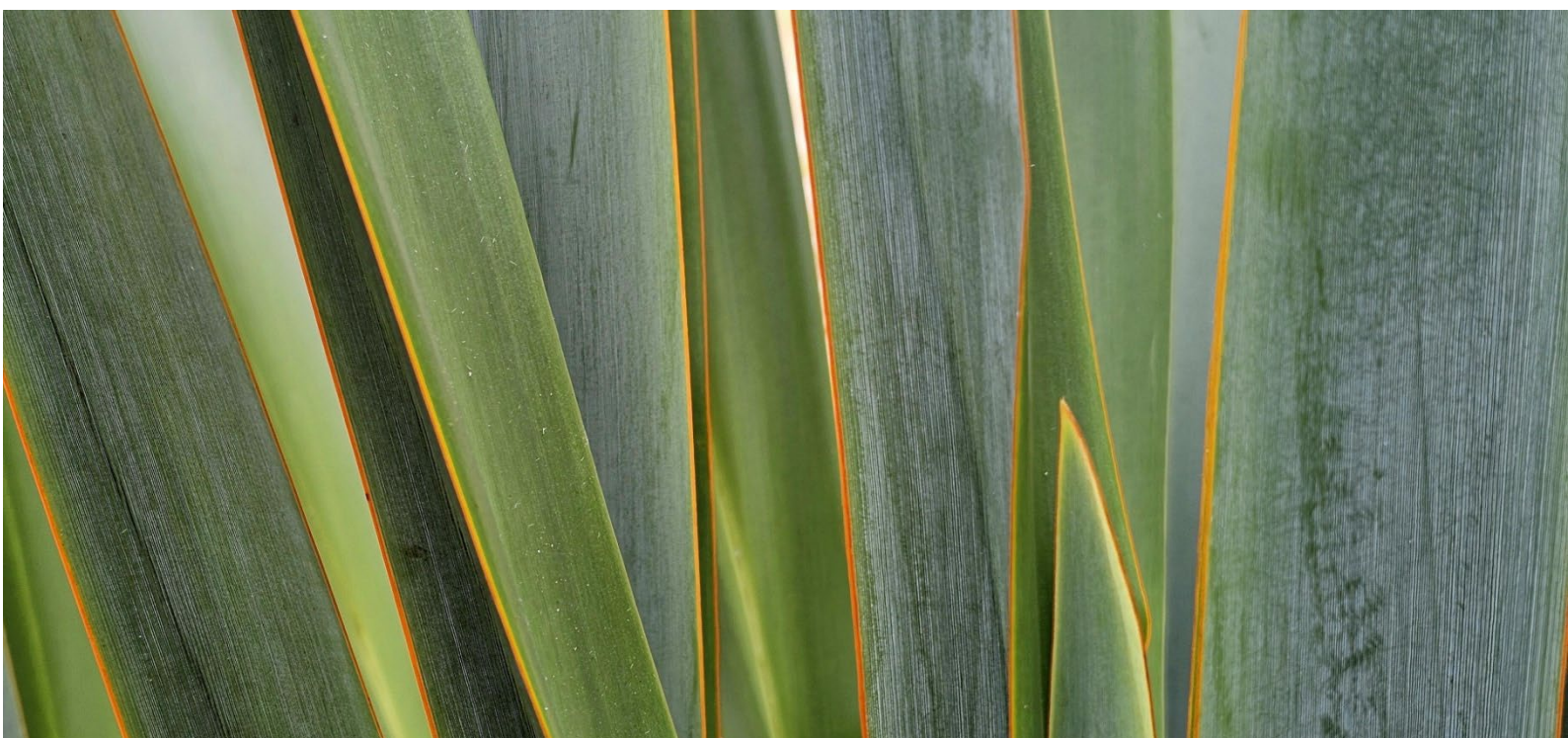
The re-establishment of the Harakeke Industry in Aotearoa New Zealand

June 2026

Te Hononga Hapori Harakeke | *The Harakeke Community Alliance [HHH]*

 **BIOTENAX** Biotenax Limited

 **NGĀTI RUAPANI**
KI UTA | KI TAI Ngāti Ruapani ki Uta ki Tai Co-operative Society Limited.



Cover images courtesy of Biotenax Ltd ©2018 - 2026

HE MIHI



Whāia te Mātauranga hei oranga mō tatou.
Kia kaha, kia māia, kia manawanui.
Tātou katoa!
Kia kotahi ai te hoe, ki te pae tawhiti e rāhiri nei.
Tīhei mauri ora!

E ngā mana, e ngā reo, e rau rangatira mā,
Nau mai, haere mai, piki mai ra.
Ki te mana whenua, ki ngā hapū, ngā tangata
hōnore.
Ngā mihi nui ki a koutou katoa.

*Let knowledge be our lifeline.
Be strong, be brave, and be patient.
All of us!
Let us row together to the far horizon that
awaits us.
Long live the spirit of life!*

*O powers, O languages, a hundred chiefs.
Welcome, come, come up.
To the land, to the hapū, to the honoured
people, Thank you all.*



Table of Contents

HE MIHI	2
How to Read This Report	7
Part I. Project Scope & Executive Summary	8
Ngā mōhihio kaupapa Project information and Scope	8
HHH Cluster Members	8
Scope of this Project	8
Intended Research Outcomes.....	9
Principal Acknowledgements	10
Executive Summary	12
Project Summary.....	12
Why This Matters Now	13
Core Value Proposition	13
Te karere o te Tumu Whakarae / Lead Facilitator’s Message	15
Karere mai i te Heamana / Chair’s message	16
Part II. Overview and Context	18
Chapter 1. What is Harakeke?	18
Chapter 2. Fundamental Conditions.....	20
Collaboration and capability	20
Government and institutional support	20
Land use and planting resource	20
Market demand	20
Chapter 3. Questions at the heart of this kaupapa	21
Chapter 4. The Prior Position	22
Te Whenua me te Ngahere <i>The Land and the Forest</i>	22
Te Ahumahi Harakeke o mua <i>The Harakeke Industry of the past</i>	22
The Early Muka Trade (Late 1700s – 1830s)	22
Industrialisation and the Boom Years (1860s – 1918)	23
Stripping & Scutching [Past].....	24
Decline and Final Closure (1920s – 1985)	26
A renewed interest (1990’s to date).....	26
Chapter 5. Te Ao Māori and its application	29
Harakeke and Māori [Brief]	31
The role of our Youth	31
The role of Marae	32
Our Raranga Weavers and Rongoā Practitioners: An imperative resource.	33
Access and Benefit Sharing [ABS]	34
Provenance and Benefit-Sharing	34
Chapter 6. The New Position	35
Chapter 7. HHH Multi-phase Longitudinal Study	37
1. Overview of Harakeke Community Development [COMMENCED 2022]	37
2. Strategic Land Use and Industry Planning [COMPLETED 2023]	37
3. Formation of Harakeke Industry Alliance [COMPLETED 2026]	37
4. Riparian and Land Restoration Trials [COMMENCE 2026]	37
5. Ecological and Biodiversity Research	38
6. Mid to Downstream Processing Technology	38

7. Harvesting and Commercial Viability Model [COMMENCED 2024].....	38
8. Post-Harvest Processing and Market Development [IN PROGRESS]	39
9. Market Feasibility and Business Planning [COMPLETED 2026]	39
10. Market Development and Demand Creation	39
Further Research Pathways	40
Chapter 8. Primary Variable Influences & Conditions	41
Primary Business Case Resources	41
Primary Feasibility Analysis Resources	41
Primary Economic Conditions	43
Chapter 9. Feasibility Analysis Measurements	44
Chapter 10. Business Case [Land Resource]	45
Land Ownership Models	45
Process Intervention Proportions: Scutched Fibre	48
Land Use Impacts and Applications	49
Plants & Biodiversity Recourse	50
Plant [Biomass] Resource.....	50
Land Type Nuances	51
Biodiversity	52
Part III. Infrastructure	53
Chapter 11. Business Case Metrics	53
Business Case Process Workflow and Implementation Planning	53
Process Workflow	53
Implementation Planning	53
Chapter 12. Planting site Initiatives.	55
Initiatives [Utilised Land Transition]	55
Initiatives [Under-utilised Land Transformation]	56
Chapter 13. RRRT – The Concept	57
RRRT Explained	57
RRRT Benefit Matrix.....	57
Riparian Planting Option.....	58
The Riparian Challenge	58
The Riparian Solution	58
Revegetation Planting Option.....	60
The Revegetation Challenge	60
The Revegetation Solution Proposal.....	60
Restoration Planting Option	63
The Restoration Challenge.....	63
The Restoration Solution Proposal	63
Transition Planting Option	65
The Transition Challenge	65
The Transition Solution Proposal	65
RRRT – A Proposed Architecture.....	67
Comparative RRRT Aspects [Current vs Future]	67
Current Biotenax Resource	68
Riparian Planting Model Illustrated	69
RRRT – The Rationale	74
Chapter 14. Harakeke versus other natural fibres	79

Comparative fibres.....	79
Chapter 15. Upstream Market.....	82
Chapter 16. Mid-stream Market.....	83
Midstream Market Opportunities	83
Midstream Market Outputs.....	83
By-products.....	84
Chapter 17. Downstream Market	85
Downstream Opportunity Areas.....	85
Chapter 18. Market Research 2026.....	86
Overview: Report on Global Natural Fibre Upstream & Midstream Market [Plant] 2016 – 2032	86
Limitations:	86
Key Insights:	86
Credence Report Download`	90
Harakeke Market Comparison	90
By Volume Projection.....	90
By Revenue Projection	90
Chapter 19. Market Research – Berl Report 2025	91
Whenua-Māori-in-primary-production BERL REPORT [<i>Online Link</i>].....	91
Overview of Whenua Māori in Primary Production	91
Current Land Use & Economic Contribution.....	91
Opportunities for Improving Land Utilisation.....	91
Potential for New Primary Production.....	92
Constraints and Challenges Facing Whenua Māori	92
Land Use and Capability Classifications	92
Land Use Classification Chart	93
Chapter 20. Transport & Supply Chain.....	94
Transport Capabilities and Capacities.....	94
Supply Chain Capabilities	95
Summary	96
Chapter 21. Government: How it can play a part.	97
Chapter 22. Climate Change: How can we play our part.....	99
Chapter 23. Harakeke Industry Body	101
Part IV. The Business Case Findings	102
Chapter 24. The Business Case Summary.....	102
Summary of Business Case Site.....	103
Site Location and Description	103
Site Yield and Output	104
Site Financial Projection Synopsis.....	104
Site Intervention Proportions & ROI.....	105
Site Specific Key Notes	105
Summary	106
Chapter 25. Work Force and Vocation Pathways	106
Labour rates	106
Vocation pathways.....	106
Chapter 26. The Business Case – Financial Projections.....	107
Capital Expenditure.....	107
Type 1A [EXAMPLE 100Ha Site]	107

Type 3C [EXAMPLE 100Ha Site].....	107
Expense Profile.....	108
Part V. Is this Feasible?	109
Chapter 27. The Feasibility Summary.....	109
What are the conditions	109
How are we to be competitive?.....	109
How will we do this?	109
Who is 'we'?.....	110
What are our goals?	110
Where is this industry resourced from?	111
How much investment is needed?.....	112
Potential Site Investment Milestone Groups.....	112
Potential Industry Development Investment	113
Potential Investment beyond Scutched Fibre.....	114
Investment Summary [NZ\$]	114
Chapter 28. Summary and Next Steps.....	115
Financial Characteristics	115
Feasibility Findings	116
Key Conditions for Success	119
Next Steps	120
Chapter 29. References	121
Website and Online Sources	121
Reports, Publications, and Formal Citation Sources.....	121
Research, Institutional, and Event Sources.....	121
Additional Organisations Referenced as Sources or Contributors	122
Image, Figure, Chart, and Table Credits.....	122
Chapter 30. Glossary	123

How to Read This Report

This report is organised to move from context and project scope; to the proposed planting architecture, relevant land use options and market pathways; then to the feasibility analysis and business case evidence, outlined in the following parts:

- **Part I Project Scope & Executive Summary:** introduces the project scope, facilitator acknowledgements, leadership messages and executive summary.
- **Part II Overview & Context:** sets the historical, strategic, and feasibility context for re-establishing the Harakeke industry.
- **Part III Infrastructure:** explains the supportive infrastructure, RRRT model, market pathway, and enabling systems.
- **Part IV** brings together the business case findings.
- **Part V** presents feasibility conclusions, next steps, glossary, and supporting references

The detailed Table of Contents can be found on Page 3.

Key contact details:

Mark Henderson

E mark@biotenax.nz

W www.biotenax.nz

Copyright information:

Mark Henderson

E mark@biotenax.nz

W www.biotenax.nz

© 2026 Mark Henderson, Biotenax Limited, Ngāti Ruapani ki Uta ki Tai Co-operative Society Limited, and Te Hononga Hapori Harakeke | The Harakeke Community Alliance. All rights reserved. No part of this document may be reproduced, distributed, or used without prior written permission, except where expressly permitted by law or acknowledged source licence.

Disclaimer: *The facilitators* have made every effort to ensure that the material and analysis underpinning this report are accurate. However, *the facilitators* make no warranty, representation, or guarantee that the report is free from error. Any errors brought to our attention will be assessed by *the lead facilitator*, and any necessary corrections will be issued by way of an erratum and reflected in corrected versions available on request. If an identified error is considered by *the lead facilitator* to materially affect any part of this report, MABx and/or MPI will be notified as soon as practicable.

Disclosure statement: As contemplated by the contractual agreement between *Ngāti Ruapani Co-op* and *MPI*, *the facilitators* represent a range of disciplines and interests, including Harakeke organisations and entities, Māori and non-Māori landowners, specialists in Te Ao Māori and Mātauranga Māori, ecologists, tertiary and research institutions, and private businesses. Many of these contributors have informed the content of this report, including some who do not hold formal scientific credentials. Every effort has been made to ensure that the material presented is appropriately substantiated. Note also that the author, Mark Henderson, held executive roles during this project in *Biotenax Ltd.* and *Ngāti Ruapani Co-op* (the recipient).

Part I. Project Scope & Executive Summary

Ngā mōhiohio kaupapa | Project information and Scope

This report forms the final presentation of work contracted to Biotenax Limited (company No. 8551930) (*'Biotenax'*) as *lead facilitator* on behalf of Ngāti Ruapani ki Uta ki Tai Co-operative Society Limited (Company No. 8250201) (*'Ngāti Ruapani Co-op'*) for Te Hononga Hapori Harakeke | The Harakeke Community Alliance (*'HHH'*). The HHH is comprised of a number of site facilitator members (*'site facilitator'*), who have contributed land, human resource, and knowledge to the project research material. (*inclusively, 'the facilitators'*).

In addition, this project has benefited from the support of three rangatahi (our young minds) in *Shadow Facilitator* roles in the North, Central and Eastern rohe.

Related research has been co-funded by all facilitators with the support of Manatū Ahua Matua | Ministry for Primary Industries (*'MPI'*) – Māori Agribusiness – Extension programme (*'MABx'*).

Funding from MABx was facilitated through a FUNDING AGREEMENT for Te Hononga Hapori Harakeke Project, between MINISTRY FOR PRIMARY INDUSTRIES and Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd.

Project Number: 2024MABX044 of the 25th of September 2025

HHH Cluster Members

<i>Name / Entity (MLC number where applicable)</i>	<i>Current land use</i>	<i>Avail. Ha.</i>
Matekuare Whānau Trust, Tawhitwhiti ID 36345 [TE UREWERA] [HHH Member]	Papakāinga (planned), Nursery, Agr.	20
Utakura 7 Incorporated, ID 29468 [TAI TOKERAU] [HHH Member]	Forestry, Honey, Oils, Tourism, Agr.	30
Whangara Farms, [Incorporating Pakarae A and Other Blocks, and Whangara B5 Tairāwhiti, and Tapuwae Whitiwhiti] [TAIRĀWHITI] [HHH Member]	Agri. (Beef, Lamb, Wool). Biodiversity	30-40
Awarua Fibres Ltd (Pohokura Trust Farm) (TAIHAPE MĀORI LANDOWNERS COLLECTIVE [RANGITIKEI] [HHH Member]	Sheep and Beef Farming	10-20
Biotenax, Bio-discovery Gardens, 26 Homeward Bound Drive, Wellsford 0974 [HHH Member, Ngāti Ruapani Co-op]	Harakeke RRRT, R&D, HHH support, Lead Facilitator	18
Total hectares available for work plan		~118

Table 1 NB: Collectively, within and outside our Harakeke Alliance (currently fifty-five members) we have further whenua resources not included in this cluster.

Scope of this Project

This project enables members of Te Hononga Hapori Harakeke | The Harakeke Community Alliance (HHH) cluster to participate in the Harakeke Resource Development Programme, envisaged in Phase II. It examines Harakeke as a pathway for economic development and environmental enhancement on under-utilised land generally, and under-utilised whenua Māori, with potential benefits for Māori landowners nationally and for farming communities more broadly.

The programme supports the case for research planting of 3-5 hectares of Harakeke across five mana whenua land blocks in Te Tairāwhiti, the Bay of Plenty, and Te Tai Tokerau, as the basis for commercially

viable research asset development. It also investigates optimal methods for harvesting Harakeke fibre at scale and explores product development pathways for the replacement of man-made fibres.

Intended Research Outcomes

- Demonstrate the economic viability of re-establishing the Harakeke industry, for composite fibre, natural textiles, by-product extracts, and returns associated with sequestration and biodiversity enhancement.
- Establish readiness to trial a Riparian, Revegetation, Restoration and Transition (RRRT) Harakeke planting model that is sustainable, ecologically sound, and compatible with harvest, with anticipated outcomes including:
 - Enhanced biodiversity, waterway health, and flood resilience
 - Improved erosion control
 - Delivery of environmental and economic benefits for farmers and landowners
 - Reduced greenhouse gas emissions and nitrate discharge to waterways
- Position under-utilised Māori land as a viable contemporary horticultural asset, supporting greater autonomy and improved social, cultural, and economic wellbeing for Māori.
- Establish viable land-use pathways for farmland affected by the increasing impacts of climate change.
- Expand international market opportunities through the generation of commercial and environmental value from fibre products, extracts, sequestration, and biodiversity enhancement.
- Strengthen the protection of taonga through tikanga and Mātauranga Māori, while supporting pathways for education, employment, and future leadership.



Image 1 Image courtesy of Biotenax Ltd © 2020-2026

Principal Acknowledgements

While further to detailed references to the following acknowledgement are presented in [Chapter 29](#), Te Hononga Hapori Harakeke | The Harakeke Community Alliance acknowledges the organisations and people who supported this first phase of research into the re-establishment of the Harakeke industry in Aotearoa New Zealand.

Ministry for Primary Industries
Manatū Ahu Matua



Specifically, we would like to thank the following principal contributors:

Manatū Ahua Matua | Ministry for Primary Industries ('MPI') through the Māori Agribusiness – Extension programme ('MABx') **Māori Partnership & Investment**, including Senior Adviser Wally Lee and North Team Manager Daniel Phillips, for guidance and support through the funding and reporting process.

- **Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd**, as recipient, principal co-facilitator, and kaupapa partner.
- **Biotenax Ltd**, as lead facilitator and contributor of research, strategy, technical development, field assessment, and business-case material.
- **Te Hononga Hapori Harakeke | The Harakeke Community Alliance (HHH)**, including its members, facilitators, and wider alliance participants.
- **Delegates of the first HHH Symposium 2026** an event that contributed considerably to this report. The findings are viewable here: [HHH Symposium Proceedings_0326](#).
- **HHH cluster members and land contributors**, including Matekuare Whānau Trust, Utakura 7 Incorporated, Whangara Farms, Awarua Fibres Ltd / Pohokura Trust Farm, and Biotenax Biodiscovery Gardens.
- **Whakato Tairawhiti**, Alfred Tuhura through collaborative Harakeke Seed Oil project.
- **Kath Peebles**, Chair and Director of Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd, for leadership, governance and support.
- **Ngāti Ruapani ki Uta ki Tai directors and contributors**, including Kath Peebles, Kera Mita, Dr Rāpata Wiri, Arahina Rahiti, Johnson Warner, administrator Dr Shirley Cranston and Mark Henderson (lead facilitator, report author, and industry development work). Thanks also to past directors, Anita Loveriche and Te Hira Pere for support in the early stages of this kaupapa.
- **Dr Rāpata Wiri**, for Te Ao Māori, tikanga, Mātauranga Māori, and Te Whare Taparima contributions.
- **Raranga weavers, rongoā practitioners, Kaumātua, Rangatira, whānau, hapū, iwi, marae representatives, and kaitiaki** whose knowledge, guidance, tikanga, and lived experience have shaped the kaupapa.
- **Rangatahi and North Island shadow facilitators** Sapphire Davenport (supporting the North), Jade Broughton (supporting Central, and Southern rohe), and Arihia Te Kira Poi (supporting the East) contributing to the wider intergenerational aspirations of the project.
- **Research, tertiary, and science partners**, including Bioeconomy Science Institute (AgResearch, SCION and Manaaki Whenua) in particular Alec Foster (BSI), University of Waikato (Dalour Beg and Kim Pickering), and other tertiary research contributors referenced in the report.

- **KiwiFibre Innovations Ltd**, for contemporary fibre-processing development and related technical contributions, also instrumental in collaborative market development.
- **Templeton Flax Milling Heritage Trust** Vaughan Templeton, Steve Logie, and the Mill curators, for historical knowledge of flax milling, stripping, scutching, and industry practice.
- **Far Sky Consulting**, for support to the feasibility analysis, business planning process and in particular spearheading natural fibre market research.
- **Indigenous Biodiscovery Wānanga contributors**, in particular Manu Caddie and Maui Hudson, including Te Kotahi Research Institute, Kānuka Charitable Trust, Bioeconomy Science Institute, Kanapū, and participating experts, for access and benefit-sharing, provenance, and Indigenous intellectual property insights.
- **BSI Indigenous Fibres Symposium contributors**, including weavers, researchers, Māori partners, and industry participants, for advancing discussion on indigenous fibre innovation, sustainability, and Mātauranga-led value chains.
- **Anna Hayes-Moeau / Anna Hayes Creative**, for her contribution to contemporary Raranga weaving in the creative space, tikanga Māori and imagery.
- **Greg Billington**, for his collaborative inputs on branding, messaging and communication.
- **All landowners, growers, farmers, ecologists, historians, engineers, technical specialists, business contributors, government representatives, community participants, and industry supporters** who contributed information, discussion, field insight, technical knowledge, or encouragement to this work. In particular our research interviewees who contributed knowledge as follows:

Invaluable face to face interviewee contributors:

Akef Rahman (WCG, Germany), Alfred Tuhura (Whakato Tairāwhiti, NZ), Bayden Barber (Ngāti Kahungunu Iwi Incorporated, NZ), Ben Scales (KiwiFibre Innovations Ltd, NZ), Conrad Coleman (Aotearoa Ocean Racing, France), Dorothee Betz (DITF, Germany), Elizabeth Palmer (Te Whakaari Inc. / Iwitea Marae Trust, NZ), Felix Wollenhaupt (DITF, Germany), Frank Dolberg (Robco Eng., Denmark), Gerhard Mulder (Langman Ropes, Netherlands), Grant McMaster (Closeburn Station, NZ), Greg Billington (BillingtonGreen, NZ), Ian McGregor (Biotenax Ltd, NZ), Joan Galle (Galle Fibres, Belgium), Johnson Warner (Oranga Tamariki, NZ), Krystina Te Kanawa-Coffin (Muka Innovations Ltd), Lars Munch Antonsen (Robco Eng. Denmark), Luigi Maffioli (Gottifredi Maffioli S.r.l. Italy), Maggie McGregor (Biotenax Ltd, NZ), Miriam Preinfalk (DITF, Germany), Ngaio Tiuka (Ngāti Kahungunu Iwi Incorporated, NZ), Oliver Reimer-Wollenweber (WCG, Germany), Rowan Gyde (Aotearoa Ocean Racing, France), Ryan Johnson-Hunt (Torora Fund, NZ), Sylvie Vanhauwaert (Vanhauwaert & C° NV, Belgium), Thomas Bressler (WCG, Germany), William Murrell (KiwiFibre Innovations Ltd, NZ)

Invaluable online interviewee contributors:

Brad Green (BillingtonGreen, Canada), Ihapera Paniora (Te Rūnanga o Ngāti Whātua, NZ), Kim Henderson (KlipTank Ltd, NZ), Ray Leach (HHH Cluster Member – **Whangara Farms Partnership**, NZ), Steve and Kat Stoney (HHH Cluster Member – **Pohokura Trust Farm**, NZ), Tamalene Painting (HHH Cluster Member – **Utakura 7 Incorporated**, NZ), Tony and Hinerangi Goodman (HHH Cluster Member – **Matekuare Whānau Trust**, NZ)

Executive Summary

Phase I research—the feasibility analysis and business case for re-establishing the Harakeke industry—shows that Te Hononga Hapori Harakeke | The Harakeke Community Alliance (HHH) can move forward with confidence.

A collaborative model that avoids duplicating technology development would further improve the chances of success.

Across Q1 and Q2 conferences, including the first three-day HHH symposium in Auckland in March 2026, the clear view was that shared resources and pooled grant or co-funding for R&D, and an Industry Development Plan would be the fastest and most cost-effective path forward.

Project Summary

Te Hononga Hapori Harakeke (HHH): Feasibility Analysis & Business Case (2026)

This report assesses the case for rebuilding a modern **Harakeke (Phormium tenax) industry in Aotearoa New Zealand**, grounded in Te Ao Māori and aligned with current environmental, economic, and technological conditions.

The central finding is that a **viable, scalable, and culturally grounded Harakeke industry is achievable** if action is coordinated across land use, processing, markets, and investment.

Strategic Opportunity

Harakeke is more than a fibre crop. As a **taonga species**, it could underpin an industry that delivers:

- Economic returns through fibre and by-products
- Environmental restoration, including improved water quality, erosion control, and biodiversity
- Climate resilience, particularly in flood-prone and marginal land
- Social and cultural outcomes, strengthening Māori land utilisation and intergenerational knowledge transfer

While framed as the re-establishment of a New Zealand industry that was active 150 years ago, HHH is better understood as a **first-mover opportunity to build a new, high-yield natural fibre industry** in Aotearoa New Zealand around Harakeke (Phormium tenax).

Rather than a conventional agricultural or horticultural model, this is a **regenerative land-use platform** combining fibre production, environmental restoration, and diversified by-product revenue. It targets underused land, especially Māori land and climate-affected farmland, to unlock value from low-performing assets.

Why This Matters Now

Global demand is accelerating for:

- low-carbon, natural fibre alternatives
- traceable and ethical supply chains
- regenerative and restorative land-use solutions

Simultaneously, New Zealand faces:

- increasing pressure to transition marginal farmland
 - growing investment in environmental restoration
 - a need for new export-aligned industries
-

Core Value Proposition

1. High Productivity

- Harakeke delivers significantly higher fibre yield per hectare than comparable fibres
- Permanent crop system eliminates annual replanting and intensive cultivation
- Minimal inputs (no irrigation, fertiliser, or chemical dependency)

2. Multi-Stream Revenue Model

Revenue is generated across three layers:

- **Primary:** long staple fibre and by-product capture (farmgate output)
- **Secondary:** scutched fibre market (industrial, textile, composite markets)
- **Downstream:** high value fibre and by-products
- **By-products (critical to margins):** extracts, gels, lignans, seed oil
- **Co-benefits:** honey production, carbon, biodiversity assets, rongoā

Result: diversified income with strong margin resilience

3. Low-Cost Land Strategy

- Focus on **non-productive or underutilised land**
- Reduced capital burden compared to conventional crops
- Extremely high yield per hectare
- Strong alignment with ESG and climate investment frameworks

4. Regenerative Production System (RRRT)

The RRRT model integrates:

- riparian planting
- land restoration
- biodiversity development
- harvestable fibre systems

Outcome: revenue-generating assets and environmental repair.

Conclusion

Harakeke presents a rare opportunity:

To build a **next-generation indigenous fibre and by-products industry** that aligns economic growth with environmental restoration, social and cultural resilience, positioning Aotearoa as a global leader in regenerative natural fibre systems.

Mark Henderson
Lead Facilitator

CEO | Managing Director | **Biotenax Ltd**
Director & Business Advisor | **Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd**

Te karere o te Tumu Whakarae / Lead Facilitator's Message



Te karere o te Tumu Whakarae / Lead Facilitator's Message
Tēnā tātou. Ki ahau nei, ehara te pakihi i te mahi kimi pūtea noa. Ko te pakihi tōtika he mahi e waihanga ana i ngā hua, i ngā ratonga, me ngā huarahi e

whakapiki ai te oranga o te tangata, o te hapori, me te taiao. Ka hua mai te pūtea hei painga o taua kaupapa, engari ehara i te mea hetino whāinga. Koinei te āhua o te kaupapa whakahou i te umanga Harakeke.

Ko tēnei pūrongo he whakatakotoranga tuatahi mō ngā tūāpapa e hiahiatia ana kia ara anō te umanga muka i tautoko i a Aotearoa i mua. Ko to mātou whakapae, ki te tika te hoahoa me te whakatū, ka taea e te Harakeke te tū hei umanga kawē hua nui e taurite ai te tangata, te whenua, te kaupapa, me te whai huamoni mō te pae tawhiti.

Ko ngā rangahau i roto i tēnei pūrongo he hua nō te mahi ngātahi a ngā kaiārahi, ngā kairangahau, ngā pakihi, ngā whare wānanga, me ngā ringa mahi maha. Ahakoa he rerekē ngā pūkenga, kua whakakotahingia aua Mātauranga i raro i te kaupapa Māori me te tirohanga o Te Ao Māori hei hanga i tētahi tūāpapa pakari mō te anamata.

E whakapono ana mātou he wā tēnei e tūtohu ai te ahunga whakamua. E tipu ana te hiahia o te ao ki ngā muka māori, ā, he tā onga tō Aotearoa e taea ana te whakatipu hei whakahou whenua, hei whakapiki i te oranga o ngā hapori, hei waihanga huarahi mahi, ā, hei tuku hua mō ngā whakaturanga kei te heke mai. Mā te mahi ngātahi, te haumi tika, me te mahere mārāma ka taea te whakatū i tētahi umanga hou e whai hua ana mō te whenua me te tangata.

E mihi ana ahau ki ngā kaiārahi, ngā kairangahau, ngā pakihi, ngā whare wānanga, me ngā hapori kua tautoko i tēnei mahi. E mihi ana ahau ki ngā kaiārahi, ngā kairangahau, ngā pakihi, ngā whare wānanga, me ngā hapori kua tautoko i tēnei mahi, ā kua whakatū i tētahi tūāpapa kaha ake mō te wāhanga whai muri o tō mātou whanaketanga umanga.

June 2026

Greetings. I do not see business as simply a way to make money. At its best, business creates products, services, and opportunities that improve the lives of people, communities, and the environments they depend on. Financial return matters, but it should be the result of purposeful work, not the sole reason for it. That is the spirit in which I view the re-establishment of the Harakeke industry.

This report sets out the first foundations for rebuilding a once-thriving fibre industry in Aotearoa New Zealand. Our view is that, if designed well, Harakeke can support an export industry potentially larger than kiwifruit and aquaculture that puts people, purpose, place, and profit on equal footing while creating durable social, environmental, cultural, and economic wellbeing.

The research in this report reflects the work of many contributors. It has been shaped through Kaupapa Māori, informed by Te Ao Māori, and strengthened by practical experience across fibre, by-products, land use, and innovation.

We believe this is a defining moment. As global demand for natural fibres escalates, Aotearoa New Zealand possesses a profound taonga capable of restoring our land, strengthening communities, creating sustainable employment pathways, and unlocking long-term economic value. Backed by disciplined investment, practical partnerships, and enduring collaboration, the foundations are now in place to rebuild the Harakeke industry on far stronger terms than before.

I acknowledge the practitioners, researchers, businesses, tertiary partners, and communities who have helped shape this work. Their contribution, has created a stronger platform for the next phase of our industry development.

Nōreira tēna tātou katoa.

Mark Henderson

CEO | Managing Director | Biotenax Ltd
Director & Business Advisor | Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd

Karere mai i te Heamana / Chair's message

E ngā rangatira, tēnā koutou katoa.

Ko Panekiri te maunga

Ko Waikare taheke ki Waikaremoana te awa

Ko Ngāti Hinekura me te Whānau Pani ngā hapu

Ko Te Kuha te marae

Ko Ngāti Ruapani, ko Ngai Tuhoe, ko Ngāti Kahungunu ngā iwi

Ko Kath Peebles ahau, te tiamana o Ngāti Ruapani ki Uta ki Tai.

Mā te te Poari o te Kōpui o Ngāti Ruapani Ki Uta ki Tai, ā, hei kaiwhakahaere ngātahi hoki mātou ko Biotenax, ka nui te mihi ki a koutou katoa kua whai wāhi mai ki te rangahau me te whakawhanaketanga o tō mātou kaupapa Kōtahitanga, e whai ana kia whakaarahia anō te Ahumahi Harakeke o Aotearoa, he Taonga nō Aotearoa.

E hiahia ana ahau ki te mihi ki ngā Kaihautū o te Kōpui o Ngāti Ruapani Ki Uta ki Tai, ki a Kera Mita, ki a Tākuta Rapata Wiri, ki a Arahina Rahiti, ki a Johnson Warner, ki te kaiwhakahaere hoki ki a Shirley Cranston, ā, tae rawa hoki ki a Mark Henderson, te kaihautū mō te kanorau koiora me te kaitohutohu pākihi. Ko tōna hiahia me tōna ngākau nui ki te Pā Harakeke kua hono tonu ki ngā tūmanako me ngā whāinga matua a te Kōpui, hei tūāpapa pakari mō te taha ahurea, te taha hapori, te taha ohaoha hoki mō te Māori – mā te whai i ngā urunga katoa o te harakeke, ā, he maha tonu aua painga!

Nā te ngākau hautū o Mark, kua hangaia e mātou tētahi Kōtahitanga Hapori pakari (Te Hononga Hapori Harakeke) e whai pānga nui ana ki te whakawhanake i te Harakeke hei ahumahi whakaora mō Aotearoa. Mai i te wā i hihiri ai te ahumahi "Flax" o Aotearoa i ngā tau mai i te 1800, ā, rātou ki te wā nei, ā, haere ake nei.

E whakapono ana mātou he nui te pūmanawa ohaoha o tenei kaupapa mō te Māori, mō ngā kaingāhua whenua Māori, mō ngā tāngata ehara i te Māori hoki i roto o Aotearoa, kia tū hei wāhi nō tētahi ahumahi e tupu ora ana a mua ake nei.

“Harakeke ngā taonga tuku iho – he taonga kua tuku iho mai i ngā rā onamata”

Kua tino hihiri te Kōpui o NRKUKT ki te whai wāhi ki tēnei huarahi, ā, kei te hiahia ahau ki te mihi ki ō mātou Kaihautū katoa kua tū hei

tautoko i a Mark me Te Hononga Hapori Harakeke (HHH) ki te whakaoti i te wāhanga tuatahi o tētahi pūrongo whānui mō ō mātou kaiwhakarato pūtea, arā, mō Manatū Ahu Matua (MPI). Kei te mihi nui hoki ki te Kaitohutohu Matua, ki a Wally Lee, me te Kaiwhakahaere o te Rōpū ki te Raki, ki a Daniel Phillips o MPI, mō tā rāua arataki me tā rāua tautoko.

Kei te kaingākau, kei te hihiri hoki mātou mō te rā e tū mai nei mō tētahi ahumahi harakeke e puāwai ana i Aotearoa, e hāngai ana ki te Māori.

“Tāwharautia a Ruapani mai uta ki tai”

Ngā mihi nui ki a tātou katoa.

Kath Peebles - Chair and Director | Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd



Esteemed people, greetings to you all.

On behalf of the Ngāti Ruapani ki Uta ki Tai Co-op Board and our principal co-facilitators, Biotenax, we express our sincere thanks to everyone who participated in the research and development of our Alliance project. Together, we seek to re-establish the Aotearoa New Zealand Harakeke industry—a significant national Taonga.

I wish to acknowledge the Directors of Ngāti Ruapani ki Uta ki Tai Coop: Kera Mita; Dr Rāpata Wiri; Arahina Rahiti; Johnson Warner, and Administrator, Dr Shirley Cranston. I extend a special acknowledgement to Mark Henderson, Director of Biodiversity and Business Advisor, whose interest and passion for Pā Harakeke align perfectly with the Coop's key objectives to build a strong cultural, social, economic, and community base for Māori. This work utilises all the benefits of Harakeke—and there are many!

Together with Mark's leadership, we have built a strong Community Alliance of members (Te Hononga Hapori Harakeke) who share a key interest in developing Harakeke as a revitalised New Zealand industry. Drawing on the legacy of New Zealand's once-thriving 1800s "flax" industry, we can rebuild it better and brighter.

We believe this industry offers massive economic potential for Māori, Māori

landowners, and non-Māori across New Zealand, allowing everyone to participate in a thriving future market.

“Harakeke ngā taonga tuku iho- treasures that have been handed down through the ages”

The NRKUKT Co-op has been excited to be part of this journey. I wish to mihi to all of our Directors, who have played an important role in supporting Mark and the HHH Alliance to finalise the first stage of this comprehensive report for our co-funders, Ministry for Primary Industries (MPI); we also sincerely thank Senior Adviser Wally Lee and North Team Manager Daniel Phillips of MPI for their invaluable guidance and support throughout the process..

We are enthusiastic and excited for the future of a Māori focused Aotearoa New Zealand-based, flourishing Harakeke industry.

“Tāwharautia a Ruapani mai uta ki tai - Unite the Descendents of Ruapani from Forest to Coast”

Ngā mihi nui ki a tātou katoa.

Kath Peebles - Chair and Director | Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd

June 2026

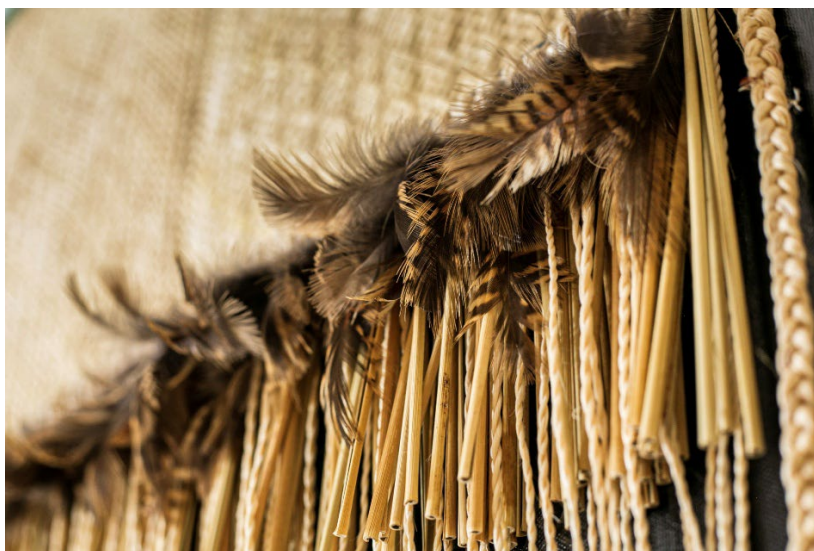
Part II. Overview and Context

Chapter 1. What is Harakeke?

Harakeke (*Phormium tenax*), also known as kōrari in Te Tai Tokerau, is an important part of Aotearoa New Zealand's natural environment. Early Europeans incorrectly called it 'flax' or 'New Zealand flax' because its long staple fibre, once scutched, resembled linen flax. However, the two plants are different. Linen flax, or common flax (*Linum usitatissimum*), is a flowering plant in the *Linaceae* family. Harakeke belongs to the *Hemerocallidaceae* family, which also includes daylilies (*Hemerocallis*).

Two species are recognised: *Phormium tenax* (Harakeke), often described swamp flax, and *Phormium cookianum* (Wharariki), often described as mountain flax ¹

Harakeke is the species most commonly used in raranga.



Images: Courtesy of Anna Hayes-Moeau © Anna Hayes Creative 2026



¹ However, this project pursues uses of Harakeke only at this stage.

From a fibre perspective, linen flax is a bast fibre, meaning the fibre comes from the outer stem. Bast fibres are stronger, more flexible, and sustainable than plant fibres obtained from the phloem of dicotyledonous plants, such as hemp, jute, and ramie.

Harakeke is an herbaceous monocot, which means it is soft-stemmed rather than woody and has parallel-veined leaves with flowering parts. Other monocots include grasses, lilies, palms, orchids, and staple grains. Its robust, sword-like leaves grow in two opposing rows around the central growing point, or rito (new shoot), forming a fan. A distinctive feature of Harakeke and related plants is that the lower third of each leaf is folded along the midrib, or keel, creating a stiff, heavy base.

In Te Ao Māori, Harakeke represents the whānau (family). The rito is the child, protected by the awahi rito (parent leaves), while the outer leaves represent the tūpuna (grandparents and ancestors). This expresses Harakeke whakapapa through the genealogical, cultural, and structural relationship between the plant and the whānau.

Harakeke is robust, fast-growing, and tolerant of flooding, wind, drought, and frost.

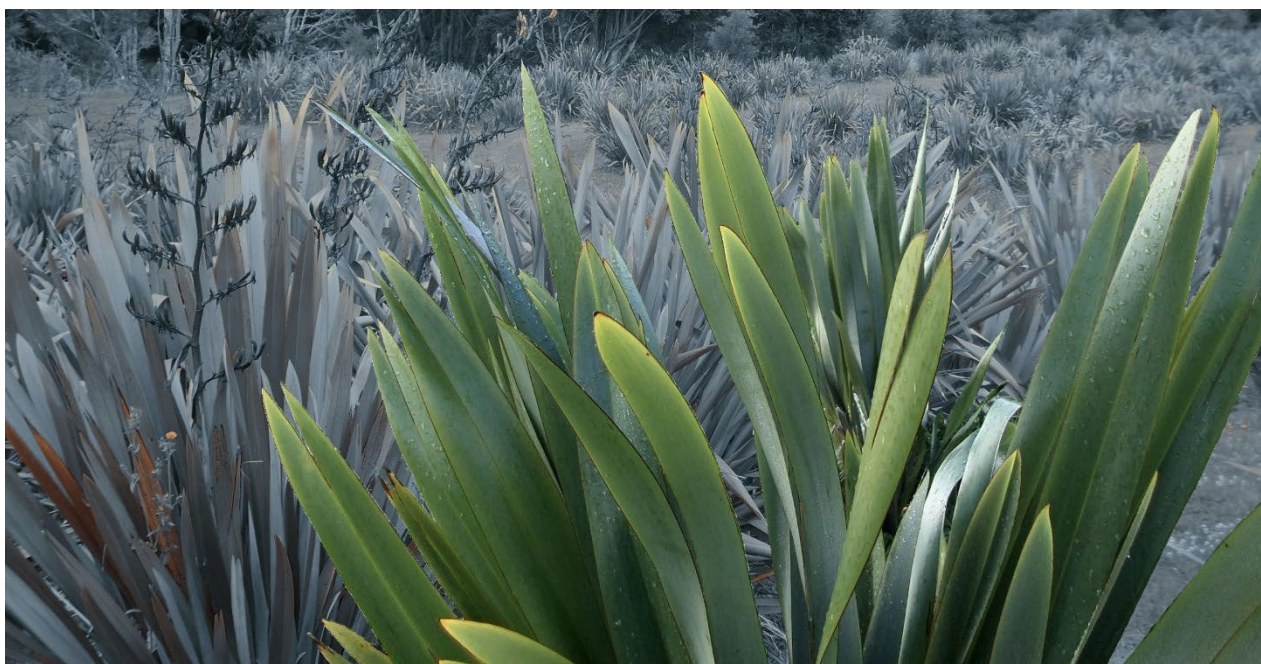


Image 2 Courtesy of Biotenax Ltd © 2023-2026

Chapter 2. Fundamental Conditions

Building a valuable Harakeke industry depends on several enabling conditions, including collaboration, public support, research capability, land use, and market demand.

Collaboration and capability

- Māori, and the agricultural and horticultural sectors, must be willing and able to work together in a coordinated national effort and share in the resulting benefits.
- Clear guidance must be available for participants entering the industry, whether their interest is investment, resource development, production, social and cultural outcomes, or environmental restoration.

Government and institutional support

- Government agencies must be willing and able to support the industry through co-funding and investment, not only in science, research, and innovation, but also in product development and market development.
- Research institutes and tertiary providers must have the willingness and capability to underpin industry development, while also creating pathways for rangatahi (young people) to carry the industry forward across generations.

Land use and planting resource

- Appropriate land and planting resource must be available in ways that are both environmentally sound and commercially viable.
- Land use should prioritise riparian planting, revegetation, and restoration on underutilised land that is not well suited to food production, particularly whenua Māori or mana whenua.
- The industry should also create viable options for livestock farmers to retire land affected by climate change, extreme weather events, or water-quality pressures in catchments.

Market demand

- A substantial global market must exist for the products and benefits Harakeke can provide. This report brings together research and perspectives from members and contributors to examine how these enabling conditions can be met. The core questions below, frame the scope of the analysis and the outcomes identified at the beginning of this document.

Chapter 3. Questions at the heart of this kaupapa

Purpose and pathway

- What is Harakeke, and why is it a taonga species for Māori?
- Why re-establish the Harakeke industry, and what could economically viable returns look like in the short and long term?
- How can the industry be re-established in ways that are sustainable, ecologically sound, and harvestable, without displacing high-value land uses?

Land use and industry design

- What forms of planting resource, land use, plant cultivars, and planting architecture can best support ecological, environmental, and economic wellbeing for people, whenua, the environment, and the industry?
- What should the industry framework look like, and what model best meets the needs of whānau, hapū, iwi landowners, the agricultural sector, and Aotearoa New Zealand more broadly?
- How can under-utilised Māori land contribute to the industry's viability and competitive position while also supporting greater financial resilience for whānau?

Environmental and social outcomes

- How can industry development strengthen biodiversity in ways that also create economic pathways?
- How can it improve waterway health, flood resilience, and erosion control?
- How can it deliver environmental and economic options for farmers and landowners beyond current farming practice?
- How can this lead to improvements in social and cultural wellbeing?
- How can it help reduce Aotearoa New Zealand's greenhouse gas (GHG) emissions?

Mātauranga, protection, and partnership

- How can Mātauranga Māori, tikanga, and Te Ao Māori shape how the industry operates and strengthen its value proposition?
- How can the industry respond to international market volatility in supply chains, demand, pricing, and trade rules while protecting taonga and upholding access and benefit-sharing (ABS) principles?
- How can the industry, within this framework, attract Māori, non-Māori, and international investment, and collaboration in research, development, commercialisation, and trade?

This research intends to develop the framework to answer many of these questions.

Chapter 4. The Prior Position

Te Whenua me te Ngahere | *The Land and the Forest*

Kupe and Toitehuatahi, important pre-canoe ancestors, would have encountered an extraordinary land and seascape stretching from the mountains to the coast. Today, only about 7–10% of Aotearoa New Zealand's indigenous rainforest cover remains.

Before Europeans reached Aotearoa, more than 80% of the land was covered in dense native forest and shrubland. According to the Department of Conservation (DOC), about 10–15% of New Zealand's total land area remains covered in native vegetation, from tall kauri and kohekohe forests to rainforests dominated by Rimu, Beech, Tawa, Mataī, and Rātā, as well as ferns, Harakeke, dunelands with Spinifex and Pingao, alpine and subalpine herb fields, scrub, and tussock.

More than 80% of Aotearoa New Zealand's land-based birds, bats, reptiles, and frogs are now considered at risk.

One species especially associated with wetlands, Harakeke (*Phormium tenax*), has also declined over the past two centuries as native ecosystems were destroyed through wetland drainage, land clearing, and weed invasion. This has significantly altered both the structure of natural ecosystems and the geographic distribution of Harakeke, beyond the movement of the plant by early Māori. Early Māori also developed significant trade in Harakeke (muka) fibre, exporting some 300 tons by 1830.

A revival of traditional techniques since the mid-twentieth century, together with the growing use of Harakeke in ecological restoration plantings, has encouraged increased research into its ecology, genetics, morphology, and uses. However, the lack of a reliable pollen record has limited understanding of its historical ecology and indigenous management.

The methods described in this report may help support the recovery and enhancement of this resource while also contributing to a sustainable harvestable base.

Te Ahumahi Harakeke o mua | *The Harakeke Industry of the past*

The New Zealand flax (Harakeke) industry evolved from a critical indigenous resource to a major global export commodity before eventually collapsing under the pressure of synthetic alternatives and disease.²
3

The Early Muka Trade (Late 1700s – 1830s)

Originally a vital material for Māori clothing, medicine, and cordage, Harakeke became New Zealand's first major export crop as European explorers sought its strong **muka** (fibre) for ship rigging.⁴

- **Late 1700s:** Māori first demonstrated flax "dressing" (manual stripping) to European visitors.
- **1820s – 1830s:** A booming trade developed, predominantly with Australia. Māori bartered hand-stripped muka primarily for muskets and iron tools. Trading stations were set up on the coasts of Northland, Waikato, Taranaki, Coromandel, the Bay of Plenty, the East Coast, Southland, both sides of Cook Strait, and Banks Peninsula. Fibre exported from New Zealand to Australia could be re-exported

² <https://www.doc.govt.nz>

³ <https://www.alibrown.nz>

⁴ <https://teara.govt.nz>

to Britain at a good profit. In 1831, for instance, a ton of flax that sold for between £13 and £22 in Sydney fetched between £27 and £44 in Britain.⁵

- As a result, the "musket trade" had a devastating impact, as iwi moved to unhealthy swamplands to cultivate flax for arms, leading to escalated tribal warfare and the neglect of food crops.⁶

Industrialisation and the Boom Years (1860s – 1918)

As highlighted in the **Sustainable Farming Fund [SFF]**: Project 03/153 45, Integrating NZ Flax into land management systems, authored by Elizabeth McGruddy in 2006⁷, In 1846, the NZ Spectator reported:

"Two gentlemen... lately returned from England...reported that a manufacturer of the name of Donallan had completely overcome the difficulties which have hitherto stood in the way of the application of the flax to those kinds of fabric... brought specimens 1) exceedingly strong cloth, waterproof, suitable for tarpaulin; 2) sail cloth, superior to navy canvas; 3) a beautiful white cloth, for which Mr Donallan has a very large order for cavalry trousers; 4) a piece of cambric, so exquisitely fine, that it has to be laid upon a piece of paper to render it clearly visible; 5) white sewing thread, of the size usually employed for sewing on buttons... not only has Mr Donallan sent out these specimens of what he can produce, but... he has sent back samples of the raw material in order to show the conditions in which he requires it... the finest and most highly prized specimen was of well-dressed Tihore, just as Māori prepare it for their finest mats..."

Manual production declined during the New Zealand Wars, leading to the invention of mechanical stripping.⁸

- **1860s:** Mechanical strippers were patented, allowing a single machine to produce 250kg of fibre per day compared to 1kg by hand.



Image 3 Image courtesy of Templeton Flax Mill Heritage Museum

- **1870:** The industry exploded with 161 flax mills operating nationwide and 300+ by WWI with about 5,000 workers.
- **1901 – 1918 (The Peak):** Flax fibre accounted for nearly 5% of New Zealand's total export value. Exports reached a record 32,000 tons in 1916 during World War I.⁹ Peak Years: The industry flourished during two boom periods, the primary peak during this period, particularly around 1905–1907 and during World War I.
- Wartime demand and the temporary shortage of other fibres (like sisal) drove prices to an all-time high of £52 per ton by 1918.

⁵ <https://www.royalsociety.org.nz> Flax and flax working by Swarbrick N.

⁶ <https://www.royalsociety.org.nz> Flax and flax working by Swarbrick N.

⁷ Sustainable Farming Fund: Project 03/153 45, Integrating NZ Lax into land management systems, authored by Elizabeth McGruddy in 2006

⁸ <https://www.researchgate.net> Research Note - The New Zealand Flax Fibre Industry Cruthers N, Carr D and Laing R. also Vaughan Templeton - Templeton Flaxmilling Heritage Trust [Harakeke Industry - Research Gate Cruthers Carr Laing.pdf]

⁹ www.taongatauranga.net-te_puke_flaxmill_book_-_richard_hart.pdf

Stripping & Scutching [Past]

A historical account: ¹⁰

Vaughan Templon, a farmer near Riverton *Aparima* in Southland *Murihiku* is a fifth generation 'Flaxie' and presides over much of the Harakeke stripping at the Templeton Flax Milling Heritage Trust museum. His family operated three flax milling sheds on their farm at Otaitai Bush from the early 1900s to 1972. Their flax milling business closed in 1972. Vaughan shared some of the important history of how the industry operated at a time when Harakeke (called 'New Zealand Flax' at the time) at the Harakeke Alliance's first symposium held in March 2026, some of these were summarised as follows:



Image 4 Steve Logie, a fellow relative and trustee operator of the Templeton Flax Mill Museum

¹⁰ Courtesy of Vaughan Templeton, curator at the Templeton Flax Milling Heritage Trust, the only remaining operational NZ Flax mill and scutching plant.

Harakeke fibre was processed by hand and in significant quantities. Historical accounts suggest that three hundred tons of dry fibre (in handmade muka form) was exported by Māori prior to 1830.

- ❖ The milling plant consisted of a system of feeding rollers holding the blades against a spinning stripping drum, emulating the Māori muka process.
- ❖ The industry peaked in the 1890's when over 600 mills were operating all over New Zealand. It was New Zealand's largest export volume for near 20 years.
- ❖ The fibre was used predominantly for making ropes and twines, and for other coarse fibre applications.
- ❖ As the 20th century progressed, livestock farming became a more economic use of land. When the Templeton mill closed in 1972, only six mills remained and they all closed within a year.
- ❖ Harakeke for fibre was the only sustainable use of a native New Zealand plant on an industrial scale.
- ❖ A hooked sickle-shaped knife was used for harvesting leaf, and the whole fan was cut, resulting in a clear-fell monoculture. Recovery of harvestable resource took 4-6 years in the North Island, and 6-8 years in the South.
- ❖ The Templeton mill had 6-8 cutters, with an optimum harvest of 3tn/day (75 bundles or one every 6 minutes!).
- ❖ Cutters were paid per ton. Two 6t loads of flax/day kept ahead of the mill output, with another 8 unloading, stripping, washing, and hanging.
- ❖ Two men unloaded and classed the leaf into lengths to maximise the yield of fibre.
- ❖ Six were required to strip and wash the blades and cart it out to fences for drying and retting. One million litres of water was used in the process.



Image 5 An open view of the rotor, beater bar and feed rollers. Courtesy of Templeton Flax Museum



Image 6 Cut of the day. Courtesy of KiwiFibre Innovations Ltd



Image 7 Contemporary Retting, the same as during a bygone era. Courtesy of KiwiFibre Innovations Ltd

- ❖ After 10-14 days of drying (retting) in the environment, fibre was brought in and scutched.
- ❖ Scutching produced a by-product of tow (all the flaxy tips and short threads), which was also usable
- ❖ The scutched fibre was baled (180kg) trucked to the rail head for transport to Waikuku near Christchurch for manufacture into twine for baling hay.



Image 7 Scutching Plant at Templeton Flax Mill Museum: Courtesy of Biotenax Ltd

- ❖ The tow was sent to a mill at Foxton (Bonded Felts) for production of wool packs and carpets.

Decline and Final Closure (1920s – 1985)

The industry struggled through the mid-20th century due to biological and economic factors. ¹¹

- **1920s:** "Yellow leaf" disease, caused by bacteria, began killing large plantations. This is thought to have led to the use of Moutoa Estate "Ngaro". Māori-cultivated varieties showed resistance. "S.S." and "Tihore" were found to be resistant to the yellow leaf disease, which was later determined to be a phytoplasma spread by the native flax hopper.
- **1930s:** The Great Depression led to a collapse in export prices. The industry pivoted to local manufacturing of woolpacks and floor coverings at factories like the New Zealand Woolpack and Textiles Ltd in Foxton. ¹²
- **1970s:** The removal of government import protections and the rise of cheaper synthetic fibres (like nylon) made natural flax milling uneconomic.
- **1985:** The industry officially "died" when the last commercial flax manufacturing plant closed its doors.

The SFF report by Liz McGruddy, also points out *"In NZ, the shortcomings of the mechanised stripping process have been recognised for many years... the stripping weakens the fibre, and unfortunately beats out part of the fibre, as well as the extraneous matter in the leaf. There is still a need for a stripping machine which does not weaken the fibre"*

(Eggers, 1958); *"I do not think we will ever produce a superior article until we get right away from the drum and beater bars. The green blade is stripped merely by subjecting it to a series of blows"*.

(Manawatu Herald, 1938). Des Templeton (former President of the NZ Flax Millers Association) was adamant a new approach to stripping flax fibre is required.

A renewed interest (1990's to date)

Renewed interest in Harakeke over the last thirty years has primarily been tempered by:

1. Loss of harvestable resource

¹¹ <https://onlinelibrary.wiley.com>

¹² Templeton Flaxmilling Heritage Trust

2. Loss of processing and production capability
3. Limited appetite for investment in a ground-up re-creation

Developments:

1996: Significant expansion of the National New Zealand Flax Collection, including 25 new cultivars obtained by Sue Scheele for the Landcare Research collection in Havelock North.

1990s: A major research project led by Sue Scheele investigated 12 Harakeke varieties across 10 sites, examining fibre extraction, plant texture, and weaving quality.

2000: Publication of research on the strength, extraction, and fibre content of different *Phormium* varieties, with a particular focus on traditional Māori weaving.

2003: A three-year Sustainable Farming Fund (SFF) project linked Harakeke cultivation with biotechnology, culminating in Elizabeth McGruddy's 2006 report, *Integrating New Zealand Flax into Land Management Systems*.

2007–2008: Intensive observation of the Orchiston reference collection at Manaaki Whenua, Lincoln, examined flowering patterns and environmental influences on different cultivars.

2010s: Increased focus on DNA fingerprinting (genotyping) within the Orchiston Collection helped examine genetic diversity and confirm species origins.

2015: Research at the Dunedin Botanic Garden used a kaupapa Māori approach to investigate Harakeke taonga and weaving properties in collaboration with experts including Kahutoi Te Kanawa and Roka Ngarimu-Cameron.

2015: The NZ Flax Forum at SCION Rotorua brought together contributors from SCION, BPN, and Callaghan, among others. Topics included contemporary muka extraction and pathways to apparel textiles, Harakeke paper production, industrial fibre extraction, and wider uses of Harakeke.

2020: Ongoing research examined the effects of climate change on Harakeke growth and documented tikanga-based harvesting practices to support sustainable management.

2022: Development of the white paper *He Mahere Rautaki Harakeke | A Strategic Harakeke Plan* (MRH), authored by Mark Henderson as a joint self-funded project between Biotenax Ltd and Ngāti Ruapani ki Uta ki Tai Co-operative.

2023–2024: Research examined the microscopic structure of Harakeke leaves as a potential biodegradable alternative to synthetic polymer membranes in water filtration.

2025: KiwiFibre Innovations Ltd established the first viable twenty-first century fibre-stripping capability.

- FXM is a containerised fibre extraction machine designed for the separation of harakeke fibre and leaf matter. *The prototype built by KiwiFibre in 2023 carried out Lab Scale Production in 2024, generating data necessary for further production years. FXM2 was a new machine built in 2025 is significantly more advanced, with precision adjustment capabilities and built to the highest electrical and operational safety standards.*

- Input: Approx 1000kg of harakeke leaf per day, hand-fed, one leaf at a time. There is potential for automated in-feed and computer vision leaf selection and grading which KiwiFibre is working on.
- Output: Extracted leaves picked off a conveyor belt. Green matter collected off the end of the conveyor.
- Site requirements: 32 amp three-phase electrical supply (current setup). The physical site must allow for loud noise. Water supply required for supplementary washing system.



Image 9 Courtesy of KiwiFibre Innovations Ltd ©2026

2025: Creation of Pā Harakeke book by Bioeconomy Sciences Institute [BSI], an updated resource on the Rene Orchiston collection, in support of cultivar identification and our raranga weavers ¹³

2025–2026: Biotenax Ltd and Ngāti Ruapani ki Uta ki Tai Co-operative commenced Phase I research through Te Hononga Hapori Harakeke | The Harakeke Community Alliance (HHH), focused on the feasibility analysis and business case for re-establishing the Harakeke industry in New Zealand, supported by the Māori Agribusiness Extension programme (MPI).

2026: The first Te Hononga Hapori Harakeke Symposium helped shape and substantiate many of the findings in this report. It also reinforced the need to consolidate effort to secure more meaningful funding and support from government and research institutions.

2026 (March): Researchers at Waipapa Taumata Rau, the University of Auckland, demonstrated that chemically treated Harakeke fibres could remove persistent “forever chemicals” (PFAS) from water, highlighting their potential to help remediate contaminated ecosystems.

2026 (June): ¹⁴ New research has revealed New Zealand’s fibre industry is worth more than \$926 million at the farm gate. The first-of-its-kind research, which looks at the fibre industry as a whole, has also revealed the industry’s untapped potential. Those are the initial findings ahead of the release of the Future of Fibre Report due out in August. It’s being led by Fashion & Textiles New Zealand and supported by the Agricultural and Marketing Research and Development Trust. The bulk of the fibre industry comes from wool, but also includes harakeke, hemp, hides, mohair and even emerging biomaterials.

Drawbacks:

1990–2016: It became increasingly clear that much of New Zealand’s processing and production capability had been lost.

2006–2015: The agricultural sector showed limited interest in engaging with the opportunities identified in *Integrating New Zealand Flax into Land Management Systems* (2006).

¹³ Tawiri, K.; Jones, A.; Maxwell, H.; Smissen, R.; Scheele, S.; Andersen, T.; Heenan, P.: 2025. PĀ HARAKEKE. Manaaki Whenua Press, Lincoln

¹⁴ <https://www.nzherald.co.nz/the-country/news/nz-fibre-sector-valued-at-926m-new-research-reveals-untapped-growth-potential/PHFSUKOG3NC7XKUWQX67WZEIWU/>

Chapter 5. Te Ao Māori and its application

The following contribution was prepared by Dr Rāpata Wiri on behalf of Ngāti Ruapani Co-operative Society Ltd.¹⁵

It highlights the following questions and perspectives:

1. How Te Ao Māori perspectives should shape the Harakeke Industry framework through:
 - a. Consensus on the application of tikanga, and historical and contemporary Mātauranga Māori.
 - b. Adoption of principles that support social, cultural, environmental, and economic wellbeing.
 - c. Planning that recognises long-term, multi-generational benefits.
2. Financial and commercial issues.
3. Trademark and legal issues relating to Māori interests, including te reo names, taonga status, provenance, and legal protection.
 - a. Contractual approaches that support inclusive, collaborative, and unifying whanaungatanga among iwi, hapū, whānau, and Pākehā.
 - b. Governance models suited to the industry, including those that may draw on western models.
4. The importance and application of te reo Māori.
5. Recommendations for wānanga and Kura kaupapa.
6. Te Whare Taparima methodology.

From a Te Ao Māori perspective, commercialisation of Harakeke is about restoration of the environment, land, forests, and people's wellbeing. In this sense, the project is holistic, with Harakeke understood as part of the multi-generational 'Pā Harakeke'.

The Hononga Hapori Harakeke project treats the protection and continuation of Te Ao Māori perspectives on Pā Harakeke, the environment, and people as central to this research. It calls for Kaitiakitanga-led governance, operations, and policies so that industry, the environment, and future generations can thrive together through this tikanga. These perspectives are reflected in the proverb: 'Mā te kaupapa pā Harakeke nei e ora ai te whenua me te tangata' — 'This pā Harakeke project will provide sustenance for the land and the people'. The aims of Te Hononga Hapori Harakeke (HHH) are also underpinned by Dr Rāpata Wiri's philosophy: 'Kia āiō te whenua, kia āiō te tangata' — 'Restore balance and peace to the land and the people.'

This work also seeks to protect cultural intellectual property — including traditional knowledge, language, tikanga, genetic resources, and Mātauranga Māori — as taonga under Article 2 of the Treaty of Waitangi. While reform of IP law and cultural IP policy is sought in response to the Waitangi Tribunal's WAI 262 recommendations, the industry is also likely to seek legal recognition of Kaitiakitanga over taonga such as Pā Harakeke, its tikanga, and Mātauranga, with or without legislation.

¹⁵ TKRI-IP-Guidelines-29-July-2024-Interactive.pdf <https://share.google/US8U3GEB6zbPEOznw> | Watson, A., & Julian, R. (2025). Te Paa Harakeke: A Framework for Supervision. *MAI Journal: A New Zealand Journal of Indigenous Scholarship*. <https://doi.org/10.20507/maijournal.2025.14.2.9>. | Watson, A., & Julian, R. (2025). Te Paa Harakeke: A Framework for Supervision. *MAI Journal: A New Zealand Journal of Indigenous Scholarship*. <https://doi.org/10.20507/maijournal.2025.14.2.9>. | McCallum, R., & Carr, D. (2012). Integrating Indigenous Knowledge and Western Science for Developing Culturally Sustainable Resources. *Journal of Natural Fibers*, 9, 168 - 179. <https://doi.org/10.1080/15440478.2012.705993>. | Lai, J. (2013). Chapter 4 Guardianship and the Wai 262 Report. , 223-310. https://doi.org/10.1007/978-3-319-02955-9_4.

This initial research phase highlights the need for inclusive and collaborative sharing between iwi, hapū, whānau, and non-Māori communities through a bicultural ‘Waka Hourua’ model — a double-hulled canoe that brings together Mātauranga Māori and Mātauranga Pākehā. Within this model, te reo Māori me ōna tikanga can play a central role in ongoing research for both Māori and non-Māori participants.

Participants have been encouraged not only to learn Te Ao Māori perspectives, but also to begin reading, writing, and pronouncing Māori names and proverbs, and to build positive, lasting relationships with whānau, hapū, iwi, and non-Māori communities.

The project’s longitudinal research approach also encourages Kaupapa Māori methods. Many oral interviews have been conducted, with te reo Māori and Mātauranga Māori integrated and recorded bilingually.

Te Whare Taparima o Te Wao nui a Tāne

Te Whare Taparima o Te Wao nui a Tāne is a Mātauranga Māori methodology developed by Dr Rāpata Wiri for wānanga within a Te Ao Māori framework. The illustration below shows a five-pillared whareniui representing the Pā Harakeke within the Great Forest of Tāne.



Image 10 Courtesy of Dr Rāpata Wiri, Ngāti Ruapani

Pā Harakeke sits within an ecosystem of healing plants, or rākau rongoā. This model describes five forest levels: ‘Te Taha Whenua’ (shrub layer), ‘Te Taha Whānau’ (small tree layer), ‘Te Taha Tīnana’ (understory), ‘Te Taha Hinengaro’ (lower canopy), and ‘Te Taha Wairua’ (upper canopy).

Each layer aligns with a domain of human wellbeing:

- ‘Te Taha Whenua’ (The Earthly Domain), linking people to the earth and environment.
- ‘Te Taha Whānau’ (The Family Domain), linking people to family and community.
- ‘Te Taha Tīnana’ (The Physical Domain), linking people to physical wellbeing and health.
- ‘Te Taha Hinengaro’ (The Mental Domain), linking people to mental wellbeing and health.
- ‘Te Taha Wairua’ (The Spiritual Domain), linking people to spiritual wellbeing.

The shrub layer includes Harakeke alongside Kawakawa, Aruhe, Pikopoko, and Mamaku.

Above, are small trees such as Mānuka, Kānuka, Koromiko, Māpou, and Whauwhaupaku, followed by the understory of Patete, Karamū, Manono, Makomako, and Māhoe.

The lower canopy includes taller trees such as Pukatea, Tataramoa, Rimu, Hīnau, and Tawa, varying by rohe.

The upper canopy includes trees such as Rātā, Pōhutukawa, Kahikatea, Mataī, Kauri, and Tōtara. Harakeke is one part of the Great Forest of Tāne, and each layer is interconnected with the others and the wider environment.

The five domains of human wellbeing are likewise interconnected; if one is weakened, overall wellbeing is affected. This relationship between Pā Harakeke and the environment is captured in the proverb:

‘Ka ora te whenua, ka ora te tangata’
‘If the land is well, the people are well’.

As a healing plant, Harakeke can support earthly, family, physical, mental, and spiritual wellbeing. But this depends on caring for the land, forests, and environment, or succumbing to the impacts of climate change and flooding.

Through the RRRT planting model, especially on floodplains alongside other native trees, Harakeke can help restore the land while also supporting family, physical, mental, spiritual, cultural, and economic wellbeing.

Harakeke and Māori [Brief] ¹⁶

What were the key points in the history of the Harakeke industry for Māori in the 19th century?

Summary Table: The Evolution of Harakeke

Period	Primary Use	Economic Driver	Production Method
Pre-1800	Survival/Culture	Internal Exchange	Hand-dressing (Muka)
1820–1840	Export Trade	Muskets & Iron Tools	Hand-dressing (High Labour)
1860–1900	Industrial Export	Global Shipping/Rope	Mechanical Mills (Low Quality)

What do our Kaumātua / Rangatira say about the re-establishment of the Harakeke industry in New Zealand?

Comparison of Traditional vs. Industrial Perspectives

Aspect	Traditional/Cultural View	Industrial/Revitalisation Goal
Focus	Preservation of tikanga and whānau structure.	Sustainable, circular bioeconomy.
Harvesting	Hand-cut; protecting the rito and awhi rito.	Mechanical extraction of muka (fibre).
Outcome	Spiritual and cultural health (Hauora).	Economic growth and carbon reduction.
Scale	Localised Pā Harakeke (plantations).	Global textile and composite markets.

The role of our Youth

What are the pathways for Tamariki / Rangatahi with the re-establishment of the Harakeke industry in New Zealand?

¹⁶ Courtesy of Dr Shirley Cranston, English/ESOL teacher Ngāti Ruapani, Ngāi Tūhoe, Ngāti Kahungunu

Summary of Career Roles

Field	Possible Roles for Rangatahi
Agriculture	Resource Manager, Sustainable Harvesting, Nursery Technician
Manufacturing	Materials Engineer, Fibre Processing Technician
Science	Ethnobotanist, Biochemist, Environmental Researcher
Creative Arts	Master Weaver (Kairaranga), Product Designer, Gallery Curator
Business	Social Entrepreneur, Marketing Specialist for Taonga Products, Māori Enterprise

Harakeke Mātauranga might also be provided by the industry through wānanga for rangatahi, high schools, marae.

Further research suggested Kura Kaupapa integration into how Oranga Tamariki could adopt insights into Tamariki and Marae reconnection endeavours, especially if a thriving Harakeke industry underpins Marae land use. The interviewee¹⁷ shared that many children in their care system are disconnected from family and marae. Most are in mainstream schools rather than Kura kaupapa, and many are in state care away from family. Key reconnection strategies focus on identifying specific marae connections rather than broad iwi affiliations, because belonging to a specific marae provides connection to where children were born and will be buried.

A successful example for instance, involved transitioning three tamariki from one local rohe to their paternal family's marae in a completely different rohe over six months, avoiding state care placement. If those Marae are supported by a local Harakeke Industry, this may lead to a new nurturing environment for our displaced youth.

Discussion explored how the Harakeke initiative could create safe, inclusive environments for tamariki through activities like working with raranga weavers, seed collecting, cleaning seed pods, and planting projects. These hands-on activities could provide meaningful engagement with their whenua and culture.

The interviewee noted growing interest in gardening spaces at marae, such as at Tūhoe, though maintenance remains challenging. The Harakeke Industry could facilitate such initiatives. There is potential for revival of traditional food-growing practices. Tangible outcomes may generate the most interest.

The role of Marae

Discussion touched on Ngāti Kahungunu Iwi's strategic plan (Ngāti Kahungunu 2050) which includes economic resilience for marae. The initiative aims to support not just large, incorporated blocks but also marae with land resources to create circular economies. Some marae have land resources currently leased to conventional farming operations that are sometimes not resilient against flooding.

How can we include marae in the re-establishment of the Harakeke industry in New Zealand?

Potential Economic Model

Role	Benefit to Marae	Benefit to Industry
Cultivation	Land utilisation & jobs	High-quality, traceable raw material
Primary Processing	Retention of by-product (muka)	Reduced transport costs for bulk leaf
Cultural Validation	Protection of Mātauranga Māori	Authentic storytelling & branding

¹⁷ Courtesy of Johnson Warner, Kairaranga ā- whanau, Senior Leadership Oranga Tamariki, Ngāti Ruapani, Ngāi Tūhoe, Ngāti Kahungunu.

Harakeke Mātauranga might also be provided by the industry through wānanga with different iwi who are part of HHH.

Our Raranga Weavers and Rongoā Practitioners: An imperative resource.

How can our Raranga Weavers and Rongoā Māori practitioners contribute to the re-establishment of the Harakeke industry in New Zealand?

Industry Sector	Practitioner Contribution
Pā Harakeke	Tikanga: Resource practices.
Textiles	Raranga: Expertise in muka extraction and natural dye compatibility.
Cosmetics & Healthcare	Rongoā: Knowledge of plant properties for topical and internal health.
Construction	Raranga: Understanding structural integrity of Harakeke

In May 2026, BSI’s Indigenous Fibres Symposium brought Raranga weavers, researchers, practitioners and Māori partners to Rotorua to examine opportunities in Aotearoa’s plant fibre sector. Grounded in kaupapa Māori, the event focused on innovation, sustainability and future applications for indigenous fibres.

Speakers highlighted how Mātauranga Māori and contemporary science can together advance applications for harakeke, including bio-based materials, sustainable land use and regional development.

A central theme was collaboration. Discussions emphasised the need for enduring partnerships between our weavers, Māori landowners, researchers and industry to build fibre value chains that reflect cultural values, enable equitable participation and deliver long-term benefits for whānau and whenua.

The symposium also showcased emerging research across BSI Maiangi Taiao, from KiwiFibre’s fibre processing, to Utakura 7’s whenua restoration initiatives, to Rangi Te Kanawa’s journey to end-use applications from muka, and underscored the potential to position Harakeke within the wider bioeconomy.



A key takeaway by the author, who presented on HHH achievements, was consensus amongst all participants that our weavers are crucial to ensure our industry gets the best out of tikanga Māori.

Image 8 Courtesy of BSI [Indigenous Fibres Symposium - Rotorua, May 2026]

Access and Benefit Sharing [ABS]

Proposals from the Indigenous Biodiscovery Wānanga, held in March 2026 hosted by Te Kotahi Research Institute and Kānuka Charitable Trust and sponsored by BSI and Kanapū including others¹⁸, included:

- Development of Industry Standards and Playbooks: Co-create overarching principles, guidelines, and case studies for Access and Benefit-Sharing (ABS), Indigenous IP protection, and commercialisation.
- Support for Institutional and Industry ABS Policies: Encouraging research institutes, and companies to adopt robust Access and Benefit-Sharing policies.
- **Standardising of ABS Practices and IP Protection:** Creating industry-wide standards and templates for Access and Benefit-Sharing, intellectual property, and commercialisation protocols to ensure consistency and protect communities.

Provenance and Benefit-Sharing

How should we deal with provenance and non-monetary benefit sharing?

Key Points tabled:

- Understanding provenance and repatriation of data and resources to kaitiaki
- Non-monetary benefits including co-authorship and publication
- Utilising collective interest entities and iwi chairs forums
- Licensing and IP transfer arrangements for commercial use
- "Know-how" protections through controlled disclosure
- Reciprocity for knowledge collection and sharing
- Importance of biodiversity conservation and giving back to taiao alongside commercial activities.

¹⁸ MBIE Endeavour Grants (UOWX2346; PFR2432; UOWX2308), Vail Moran Community Fund (MA-006644), Welcome Trust 328785/Z/25/Z) and AgResearch Flagship 2.

Chapter 6. The New Position

Compared with the position over the past three decades, the Harakeke Alliance and its collaborators are now better placed than ever to build the Harakeke industry from the ground up. The knowledge, innovation, and strategic planning developed in recent years have significantly reduced many of the barriers, capability gaps, and structural deficits that previously constrained progress.

Chart 1- Technological Knowledge & Capabilities

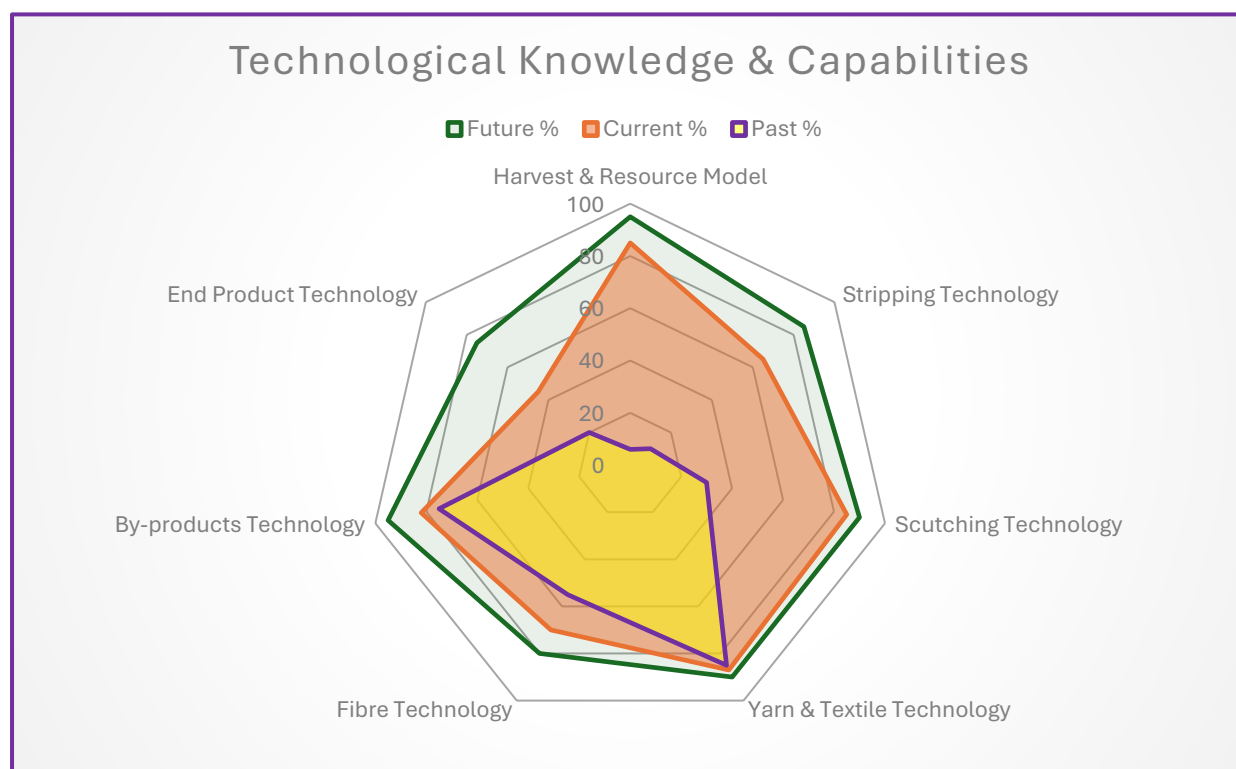
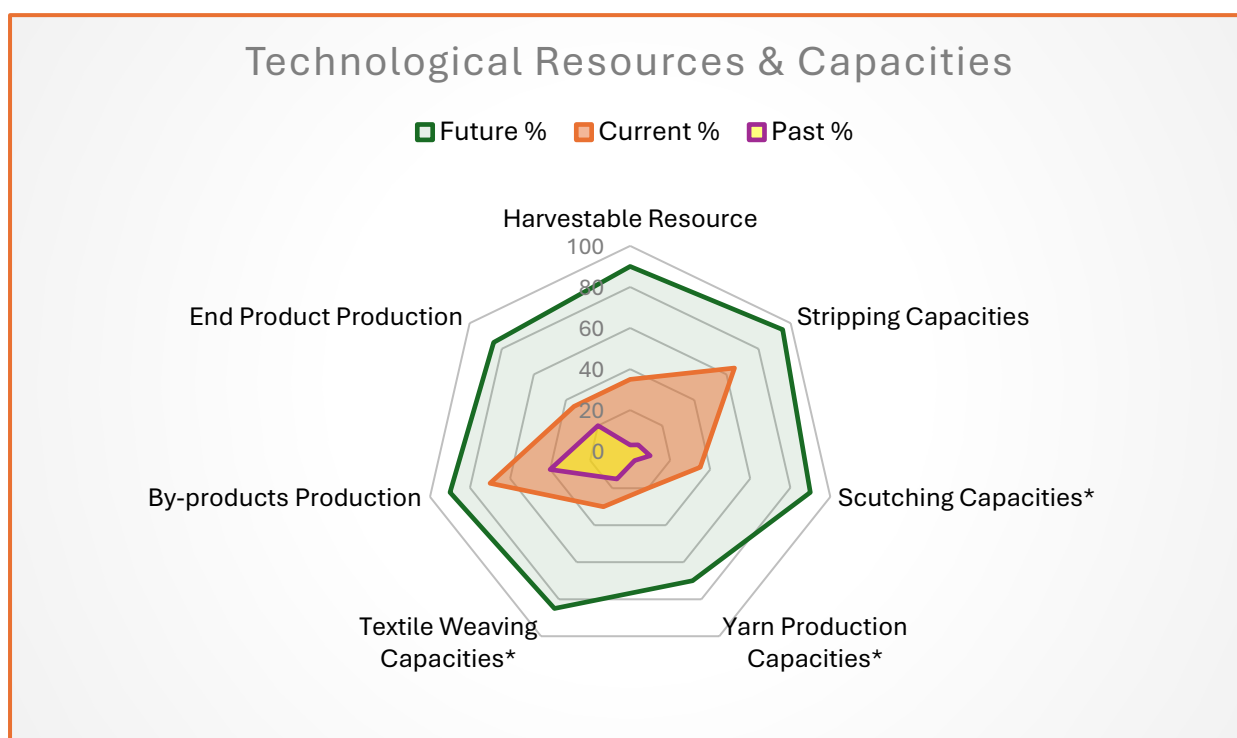


Chart 1 shows that, over time, work undertaken by many different entities has significantly reduced the knowledge barriers that once limited the development of upstream capabilities. As a result of sustained effort across businesses, tertiary institutions, research organisations, and independent Māori enterprise, the technical understanding needed across key parts of the pathway to market is now far more advanced.

0 = None at all / 100 = Total	Past %	Current %	Future %
Harvest & Resource Model	6	85	95
Stripping Technology	10	65	85
Scutching Technology	30	85	90
Yarn & Textile Technology	85	87	90
Fibre Technology	55	70	80
By-products Technology	75	82	95
End Product Technology	20	45	75
Weighted Mean	40.14	74.14	87.14

Table 2 Technological Knowledge & Capabilities

Chart 2- Technological Resources & Capacity for Production



* Includes collaboration with offshore capability in EU, India, China

The level of technological resource and production capability largely reflects the extent of investment in capital plant and manufacturing infrastructure. In practice, this depends on whether industry development is sufficiently aligned with the following:

- Completion of the necessary research, development, and refinement work
- Market development, including customer identification, partnership formation, and demand alignment
- Business model development and the establishment of industry guidance structures
- Availability of investment capital

As shown in Chart 2, some areas currently have limited domestic capacity to meet production requirements. In these cases, offshore manufacturers already producing other natural fibres may be able to provide interim support until local capacity is established. However, the business model presented here does not include the additional costs that such arrangements would likely involve.

0 = None at all / 100 = Total	Past %	Current %	Future %
Harvestable Resource	3	35	90
Stripping Capacities	5	65	95
Scutching Capacities*	10	35	90
Yarn Production Capacities*	5	20	70
Textile Weaving Capacities*	15	30	85
By-products Production	40	70	90
End Product Production	20	35	85
Weighted Mean	14.00	41.43	86.43

Table 3 Technological Resources & Capacity for Production

Chapter 7. HHH Multi-phase Longitudinal Study

This ten-part longitudinal study sets out the Harakeke Community Alliance's strategic work programme from 2022 to 2032.

1. Overview of Harakeke Community Development [COMMENCED 2022]

This phase establishes the overall programme context. It frames the Harakeke Community Alliance's long-term objective: to develop a sustainable, culturally grounded Harakeke industry that benefits landowners, communities, and the environment.

2. Strategic Land Use and Industry Planning [COMPLETED 2023]

Purpose: To develop the strategic foundation for a modern Harakeke industry.

Key activities and outcomes:

- Development of the strategic plan He Mahere Rautaki Harakeke (MRH)
- Assessment of harvestable Harakeke resources and sustainable harvesting methods
- Capacity-building through whanaungatanga with whānau, hapū, researchers, ecologists, farmers, and industry experts
- Establishment of a tikanga Māori-informed framework for alliance development
- Identification of social, cultural, environmental, and economic opportunities, including fibre, by-products, and biodiversity assets

3. Formation of Harakeke Industry Alliance [COMPLETED 2026]

Purpose: To establish a durable industry body capable of coordinating research, resource sharing, and market development over the long term.

Key activities and outcomes:

- Formation of a working group that evolved into a sustainable industry alliance
- Development of a structure intended to operate in perpetuity from October 2025 and beyond
- Coordination of resources and leadership of the Feasibility Analysis and Business Case for re-establishing the Harakeke industry
- Focus on building a viable resource and supply chain from research assets

4. Riparian and Land Restoration Trials [COMMENCE 2026]

Purpose: To test RRRT planting architecture in real-world settings and evaluate its performance as a model for Harakeke cultivation, land restoration, and environmental repair.

Key activities and outputs:

- Establishment of three to seven trial sites of approximately three hectares each
- Trial locations including Tāwhitiwhiti, Utakura, Whangara, Rangitīkei, and Biotenax Biodiscovery Gardens

- Use of desktop and on-site assessment, drone mapping, biodiversity evaluation, and design procedures
- Monitoring of environmental conditions, plant health, soil stability, and flood resilience through to 2030

5. Ecological and Biodiversity Research

Purpose: To understand the ecological function of different RRRT planting types and ensure that industry development remains environmentally sound.

Key activities and outputs:

- Research into the ecological and biodiversity functions of riparian, revegetation, and wetland restoration plantings
- Integration of Mātauranga Māori with environmental and ecological expertise
- Monitoring of birdlife, pest dynamics, soil repair, watercourse health, and plant loss over five to ten years
- Development of ecologically sound models to support the Harakeke value chain

6. Mid to Downstream Processing Technology

Purpose: To identify the research and development pathways needed to move beyond upstream fibre production into yarn, textiles, and by-product processing.

Priority pathways for further R&D:

- Processing scutched fibre into twisted and zero-twist yarns
- Converting yarn into textile, industrial, geotextile, composite tape, and substrate products
- Development of dyeing capability
- Processing by-products generated through fibre extraction, including gels, extracts, green matter, lignans, and tow fibre
- Processing non-fibre by-products such as Harakeke seed oil, phytosterols, antioxidants, anti-inflammatory compounds, and kōrari stem derivatives
- Economic modelling of each pathway and its amortisation effects across the wider industry

Indicative timeframe: April 2026 to 2032, subject to research support and investment partnerships.

7. Harvesting and Commercial Viability Model [COMMENCED 2024]

Purpose: To develop a harvesting model that optimises economic output while remaining consistent with tikanga and practical operating conditions.

Key activities and outputs:

- Development of a competitive and sustainable harvest model
- Use of existing resources and partners, including Biotenax and KiwiFibre Innovations Ltd
- Research on yield, blade length, harvest intervals, and processing efficiency
- Ongoing model development through 2026–2027

Indicative duration: 3 to 4 years.

8. Post-Harvest Processing and Market Development [IN PROGRESS]

Purpose: To build the post-harvest systems needed for vertical integration, reduced offshore dependency, and broader value capture from fibre and by-products.

Key activities and outputs:

- Research into processing Harakeke into yarn and textiles
- Development of pre-yarn processing techniques, including stripping, drying, and scutching
- Investigation of by-product outputs arising from fibre processing
- Reduction of reliance on overseas processing to lower costs and emissions
- Integration of Mātauranga Māori and traditional techniques into development pathways
- Support from Harakeke Alliance industry partners

Timeframe: April 2024 to December 2030.

9. Market Feasibility and Business Planning [COMPLETED 2026]

Purpose: To assess the economic viability, market potential, and business case for re-establishing the Harakeke industry.

Key activities and outputs:

- Assessment of market potential and economic viability for Harakeke products
- Commissioning and lead facilitation by Biotenax Ltd, administered by Ngāti Ruapani ki Uta ki Tai Co-operative
- Support from HHH, MABx, and Far Sky Consulting
- Exploration of Harakeke as both an economic and environmental asset on Māori land and within the wider agricultural sector
- Focus on fibre, by-products, and natural textile markets
- Generation of findings to support investment decisions and land-use transition planning

Timeframe: April 2025 to July 2026.

10. Market Development and Demand Creation

Purpose: To stimulate demand for Harakeke fibre and by-products and establish the foundations of a sustainable supply chain.

Key activities and outputs:

- Industry initiatives to grow market demand for fibre and by-products
- Support for resource development, fibre processing, and product-market alignment
- Progressive establishment of a sustainable supply chain

Timeframe: Ongoing from April 2022, with activity currently planned through September 2030.

Further Research Pathways

Several related research pathways sit alongside the ten core phases and are expected to strengthen future industry capability.

- Study of Harakeke's resilience to extreme weather and its role in climate mitigation.
- Focus on carbon sequestration, biodiversity, and soil health.
- Collaboration with research institutes to quantify environmental benefits.

Chapter 8. Primary Variable Influences and Conditions

Primary Business Case Resources

This project examines the feasibility of re-establishing the Harakeke industry only to the point required to establish a farm-gate pricing and output model. While the wider programme has been designed as a multi-phase longitudinal study, **Phase I** focuses on the core inputs needed to test topline feasibility.

- Define land types and related ownership models.
- Define land uses and applications that minimise impacts on other viable land-use options.
- Define a planting architecture that can be trialled against specific land-use applications.
- Define the core metrics and variables needed to understand harvest outputs, labour requirements, process definitions (up to scutched fibre), yields, costs, and timeframes.
- Compare capital and expense profiles across land types and ownership models.
- Develop a resulting business case using an 8-hectare hypothetical model.

Primary Feasibility Analysis Resources

In addition to the business-case inputs above, a wider set of variables has been considered to test viability and sustainability from social, cultural, environmental, and financial perspectives. Some of these variables are discretionary, but others point to conditions that are likely to be mandatory if the industry is to be viable.

Resources	Variables
Land Resource	Land Type Comparisons, Land Ownership Models, Utilisation index, Associated Biodiversity, Related Capital demand nuances, Related Expense profile nuances.
Human Resources	Managers / Leaders / Kaumātua, Planters, Growers / Farmers, Land and Environmental guardians / Kaitiakitanga, Harvesters, Processors / Producers, Logistics personnel, Marketers, Scientists / Mātauranga, Industry Governance, Government / Ministerial awareness, Engineers, Technical Specialists, Historians, Te Reo speakers, Ag / Hort sectors collaboration, Offshore expertise
Environmental	Environmental Sciences / Ecology, Plants / Cultivars, Planting Architecture [RRRT], Bio-diversity considerations, Land management, Crop / Plant Maintenance
Te Ao Māori	Te Ao Māori appropriation, Mātauranga Māori (Historical vs Contemporary), Mātauranga Māori influence on Science, Influence of Maramataka, Tikanga Māori, Taonga Kaitiakitanga / IP protection, Access and Benefit Sharing, Contractual Framework for Industry, Māori economy reach, Strategic timeframes / Multi-gen. view, Whakawhanaungatanga, Wananga / Kura kaupapa, Kōrero / Messaging / Brand, Te Tiriti o Waitangi, Value in heritage, History (Māori whakapapa / Harakeke authenticity value), Social, Cultural, Economic resilience (whānau), Māori Lore vs New Zealand Law.

Resources	Variables
Finance/Capital	Projections (Farmgate WSP ¹⁹) / Scutched Fibre, Expense Budgets, Capital Return on Investments [ROI] expectations, Capital Investment options / Phased, Intervention modes, Business Case / Suggestive options, Infrastructure development / Micro-Macro scale, Pricing Models - WSP / RRP / Margins all phases, Accounting rules / Xero Bolt-on / Accounting (ready 2 go), Funding models - R&D / Capital Investment / Lending / Banking support, Funding entities defined, Foreign investment, Foreign owned land, Planning > Preparation> Implementation, Import taxes / Duties.
Government	Government Funding models - R&D Funding models - Capital / Investment / Ministerial awareness and advocacy, Councils / Local Govt. partnerships, Runanga, CRI and Tertiary support.
Technology	Processing / Stripping, Processing / Retting & Drying, Planting Architecture [RRRT], Processing / Scutching (Historical), Processing / Scutching (Contemporary), Retting, Carding (Adaptation of Existing), Sliver Process (Adaptation of Existing), Twisting / Spinning / Yarn, Twines (Adapt to Existing), Weaving (Adaptation of Existing), Rope profiles (Adaptation of Existing), By-product tech, Testing / Laboratory / QAQC / AI Utilisation / Software development, Sustainability Measures, Robotics, Efficiency metrics, Composite Tape Production, Biaxial / Triaxial Weave.
Innovation / R&D	Fibre (Low hanging fruit), By-products (Pure extracts and fractions), Fibre composites, Prototyping / Pilot / Lab capabilities (Industry biased), Prototyping / Pilot / Lab capabilities (EU partner bias), AI Utilisation / Software development, Field Analysis / Traceability, Harvesting Tools, Process Automation / Engineering design.
CRI / Tertiary	Bioeconomy Science Institute [BSI], Waikato University, Auckland University, Leveraging Rangatahi, R&D funding (local), R&D funding (international), Prototyping / Pilot / Lab capabilities (CRI biased), Lincoln / AgResearch Cultivars, Field Analysis / Traceability, Cultivation / Harvest / Tikanga / Modelling, Improve efficiencies w/out detriments.
Market	National, International, Market Research (Comparatives), Competitive SWOT, Other SWOT, Logistics, Branding, Messaging, Marketing, Social media.
Compliance	Biosecurity, CITES, Toitū Climate Positive, Inc. Tax (Concessions / Incentives), Organic certification, Industry Guidelines, Quality Standards Compliance / Intl. Norms, Performance / Durability, Nagoya Protocol.
Legal/IP/TM	Taonga Kaitiakitanga / IP protection, WAI262, Contractual Framework for Industry, Industry Framework - Ownership model, Licencing, Imperatives in a Te Ao Māori perspective, Trademarks, Government assistance.
Risk Analysis	Risk Assessments, Risk Impacts - Social / Community, Risk Impacts - Environmental / Ecological, Risk Impacts - Economic / Financial, Risk Impacts - Insurance / Extreme weather, Risk Impacts - Bordering activity, Mitigation Options.

¹⁹ WSP – Wholesale Price

Resources	Variables
Supply chain	Land types vs. Land Resource / Whenua (Land), Plants / Planting / Ecology, Growers / Farmers, Husbandry / Maintenance, Harvesting, Farmgate logistics, Processing / Fibre Products, Processing / By-Products, Wholesale market (Semi-finished / Primary), Wholesale market (Finished / Secondary), Logistics (Refer Logistics Tab), Marketing & Sales (Brand development), Industry development (Support systems), Capacity / Capability resilience, Talent spread, Tertiary focus.
Product Pathways	Fibre Products (Low hanging fruit), Non-Fibre By-Products, Honey, Sequestration, Rongoā Medicine, Associated Biodiversity outputs, Harakeke Seed Oil, Propagated Products (Refer Product Pathways whiteboard)
Education, Awareness & Commitment	How-to Guides for industry participants, effective and continual dissemination of information to and from all stakeholders, building public awareness and support, building a NZ Inc brand for offshore markets

Primary Economic Conditions

- **Cost amortisation** opportunities must be identified to support viability.
 - By-product market pathways are essential, particularly those arising from fibre-processing technologies.
 - Harakeke resource development should, where possible, be integrated with environmental repair, restoration, and floodplain resilience initiatives.
 - Local authority assets may also provide opportunities if planting is designed with future harvestability in mind.
 - Regional stripping and retting capability, supported by principal grower partners and potentially cooperative structures, is likely to be necessary. Scutching is more likely to remain centralised but regionally accessible, as seen in linen and hemp industries.
- **Efficiency gains** must also be developed to reduce production costs.
 - Land use should leverage co-habitant resources such as biodiversity plantings that generate additional value through sequestration, honey, food, rongoā, or native forestry.
 - On-site stripping, retting, and baling may materially improve efficiency.
 - Industry standards for grading, quality assurance, and certification will be necessary.
- The relative **strengths of Māori land** should be assessed against higher-value food and fibre production systems.
 - Under-utilised whenua Māori often carries low or no historic return-on-capital expectations.
 - Its use for Harakeke is less likely to displace high-value food production.
 - Such land is often better suited to Harakeke and associated biodiversity because of its proximity to floodplains, waterways, peat soils, and wetlands.
 - Land-management costs are often lower than those associated with intensive food-production systems.
 - Over time, this may support stronger social, cultural, and financial resilience for whānau.

Chapter 9. Feasibility Analysis Measurements

To measure feasibility in the frame of this research, we are not focusing on analysis of ‘Costs versus Return’ on Investment or associated financial metrics alone.

For the purposes of comparative analysis, the following parameters and units are important:

Variables/Influences	Measurements	Units	Business Case Related
Land Resource	Land types vs. Ownership model	Ha	Yes
Human Resources	Separate Governance & Ops	FTE ²⁰	Yes
Other Resources	Weighted status	% ²¹	Partial
Environmental	Weighted status vs Land Type	%	Partial
Te Ao Māori	Adoption appetite (anecdotal)	%	Feasibility only
Finance/Capital	Monetary	NZ\$	Yes
Government	Support Mechanisms vs Appetite	Nil	Highlight only
Technology	Knowledge vs Capacity	%	No (Capex only)
Innovation / R&D	Capabilities vs Funding (anecdotal)	%	Highlight only
CRI / Tertiary	Capabilities vs Funding (anecdotal)	%	Highlight only
Market / Volumes	Monetary / Competition ²²	NZ\$/USD	Yes
Compliance	Weighted status	%	Feasibility only
Legal/IP/TM	Weighted status	%	Feasibility only
Risk Analysis	Weighted status	%	Feasibility only
Supply chain	Volumes vs Monetary	NZ\$	Partial (Farmgate only)
Product Pathways	Weighted status (approximations)	NZ\$	Yes (in summary)

Table 4 Feasibility Analysis Measurements

Harvest data in support of the business case indicates that the RRRT planting model²³ is viable and feasible when weighing up non-monetary returns.

²⁰ Possible role overlap

²¹ 0% being absolute deficit vs 100% being fully serviced/satisfied.

²² Comparatives to Linen, Hemp, Jute, Sisal, Abaca

Chapter 10. Business Case [Land Resource]

Land Ownership Models

Type No.	Primary Description	A	B	C
1	Private Title (Māori or Non-Māori)	Major capital investment including land acquisition with security liens / ROI on capital expectation 5-7% p.a.	Major capital investment without security liens / ROI on capital expectation 3-4% p.a.	Major capital investment unencumbered / ROI on capital expectation 2-3% p.a.
2	Incorporated Trust Land (Māori)	Customary land and/or Incorporated blocks / Possible local govt dispensations / With security liens / ROI on capital expectations 4%	Customary land and/or Incorporated blocks / Local govt dispensations / Without security liens / ROI on capital expectations 2.5%	Customary land and/or Incorporated blocks / Local govt dispensations / Without security liens / Unencumbered ROI on capital expectations 1%
3	Māori Trust Land	Customary land / Local govt dispensations and exemptions / ROI on capital expectations only on bricks and mortar 1%	Productive customary land / Local govt dispensations and exemptions / ROI on capital expectations 0%	Non-productive customary land / Local govt dispensations and exemptions / ROI on capital expectations 0%

Table 5 Land Ownership Models

To identify the land types most likely to support long-term viability and sustainability from an economic perspective, it is necessary to assess the material cost implications associated with different land types and ownership structures. Within current research constraints and limited availability of sensitive landowner financial information, the above table provides an indicative assessment of likely cost profiles and expected return-on-investment (ROI) parameters.

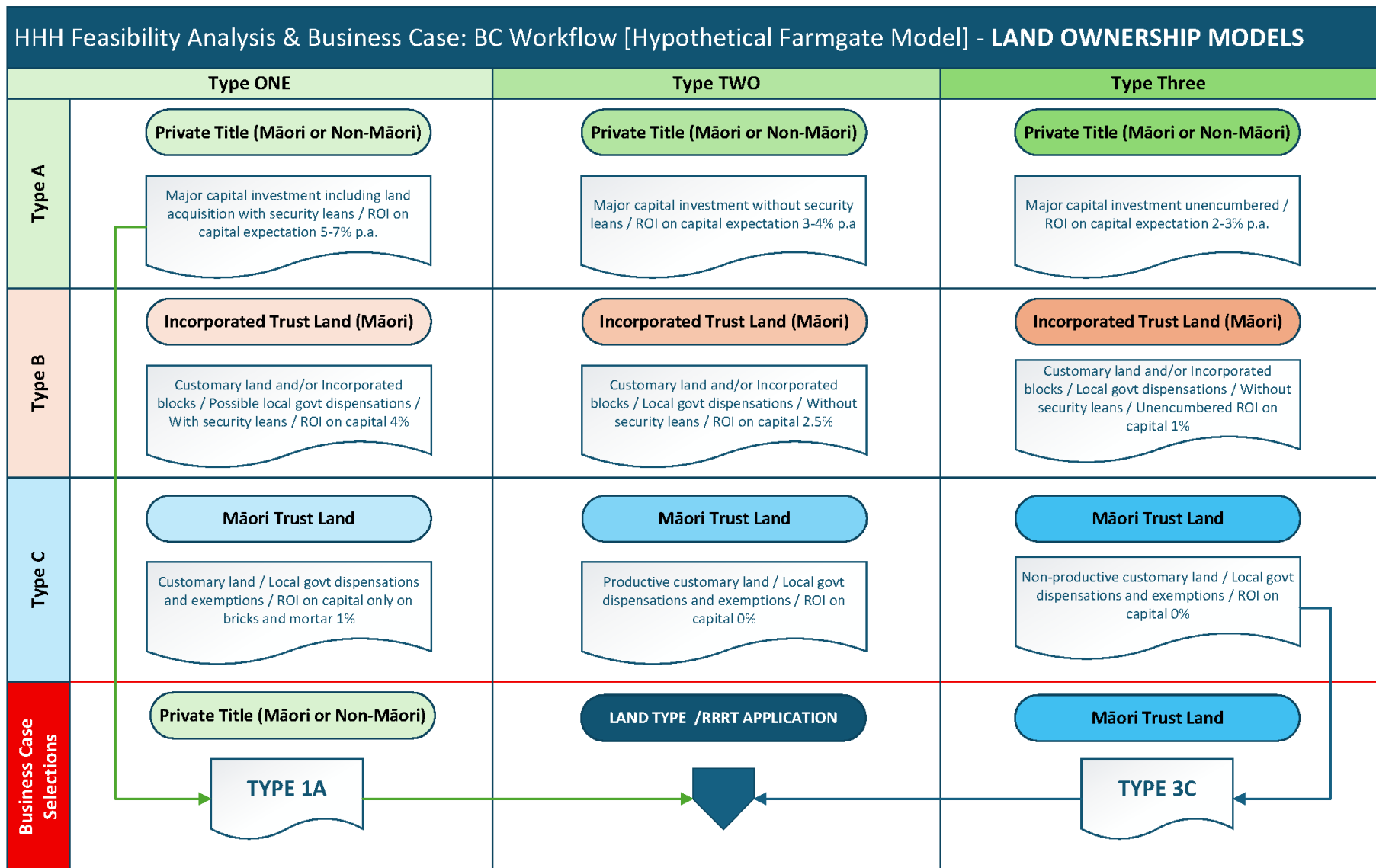


Chart 3 Land Ownership Model: Comparative selection for Business Case

HHH Feasibility Analysis & Business Case: Land ownership model by CapEx and Expense profile Type 1A vs 3C

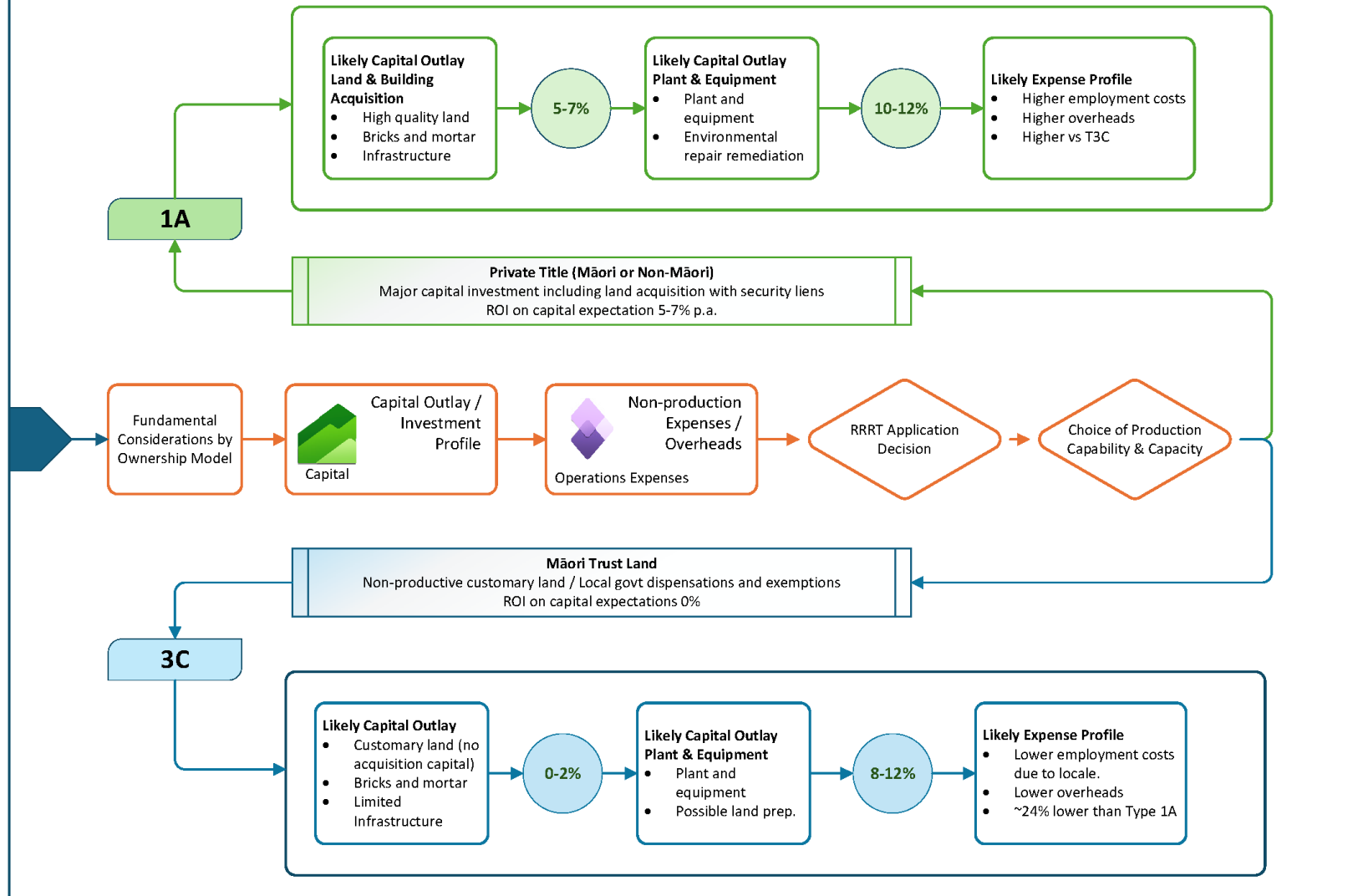
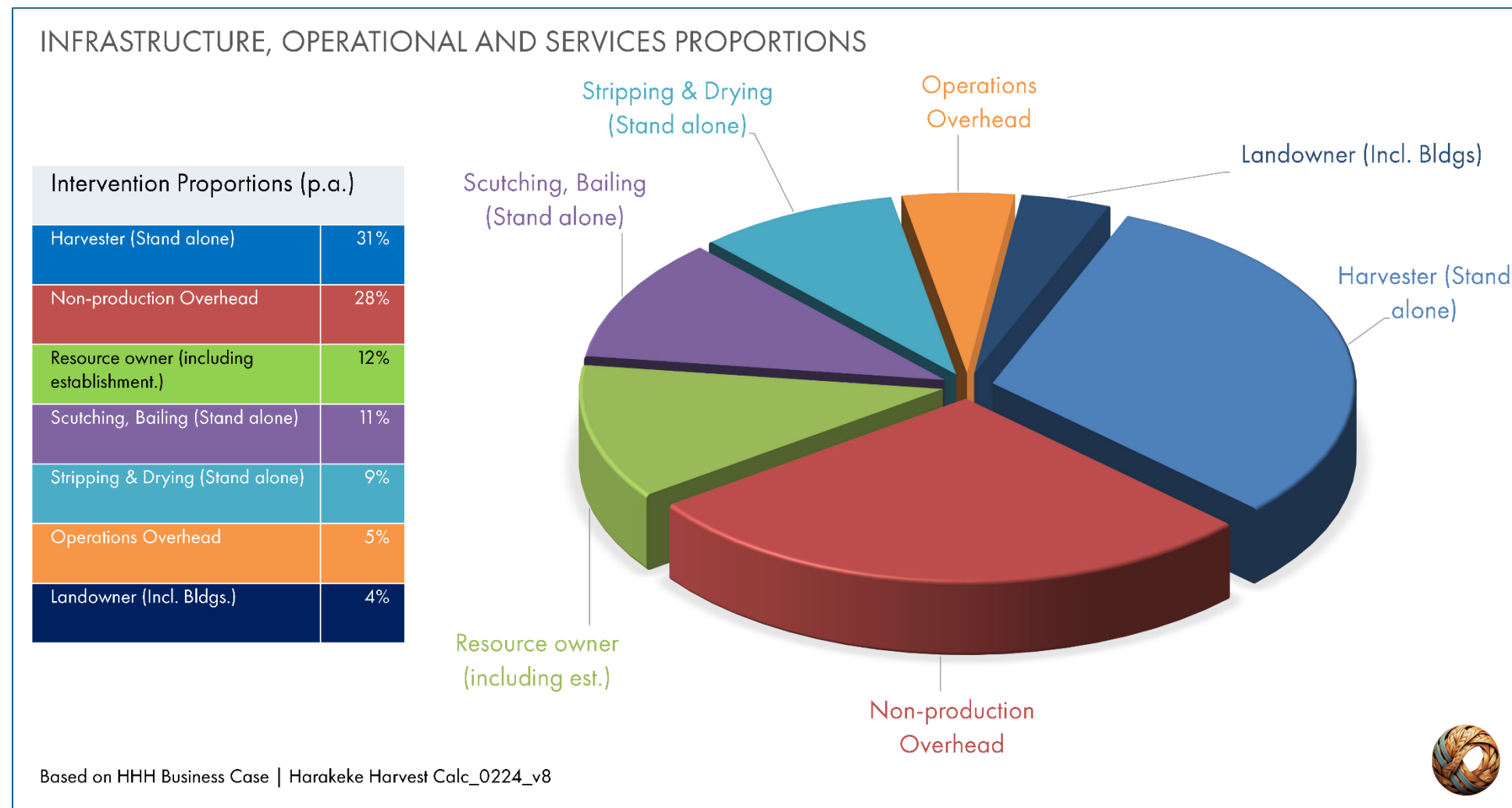


Chart 4 Landownership models: Business Case selections (CapEx and Expense Profile comparative impacts. Ref. Chapter 26).

Process Intervention Proportions: Scutched Fibre



Graph 1 Intervention of activity proportion / Scutched Fibre. (Discussed in [Chapter 22: RRRT Rationale](#) and [Chapter 25: Business Case Summary](#))

Land Use Impacts and Applications

The scenario illustrating the business case is based on the following criteria:

- Focus on underutilised land not suited to food production
- Prioritise land with low return-on-capital expectations
- Create value from restoration, riparian, wetland, and retired farmland
- Improve flood resilience and support environmental repair
- Strengthen community, social, and economic resilience
- Best starting point: underutilised whenua Māori

Further explained in [Chapter 11](#). Planting Architecture: RRRT.



Image 9 Courtesy of Biotenax Ltd © 2020-2026

Plants & Biodiversity Recourse

Plant [Biomass] Resource

A viable Harakeke industry requires a sustainable, harvestable leaf and seed resource aligned with demand and pricing. The business case assumes that this resource is designed for harvest, established on economically and environmentally appropriate land, (using the RRRT framework), and supported by associated biodiversity gains.

There will likely be a need to develop selected cultivars and reliable supply streams for fibre types that meet market and processing requirements.

Planting resource (in particular Harakeke) are normally in the form of the following:

Size	Description	Approx. time to 1st harvest	Image
Division	A single root ball of tenax from a divided plant. Achieved by removal of a chosen plant, divided into single divisions, with tūpuna leaves cut back, awhi rito trimmed and remaining rito intact. Cleaned and long root hairs removed. ²⁴ One healthy mature plant result in approx. 40-50 divisions.	Approximately 3 years	
T28 (0.5ltr)	T28 Cells (tray of 28 plants propagated from seed)	Approximately 5 years	

Table 6 Planting stock options [Examples]

Land Type Nuances

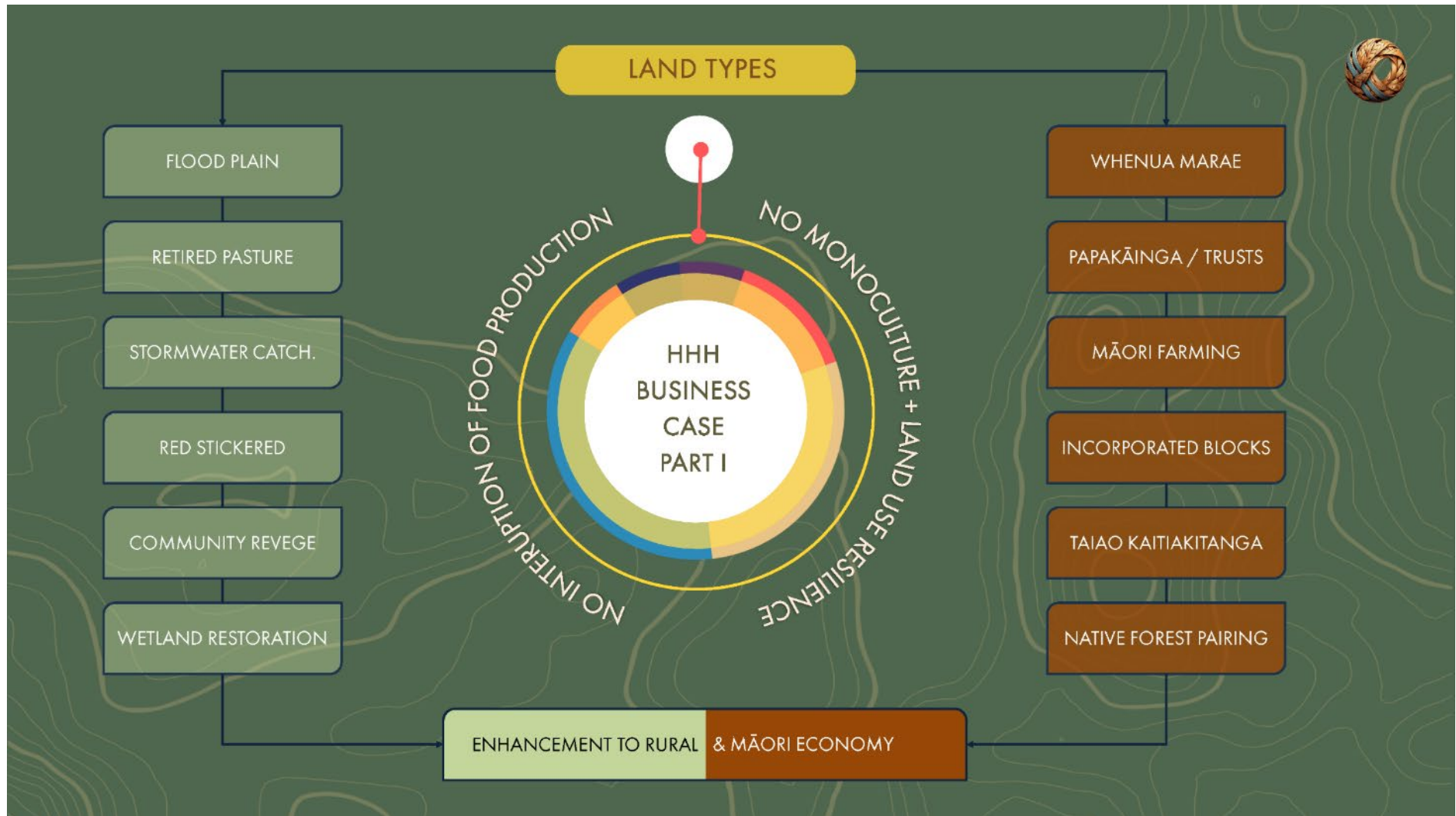


Figure 1 Land Type Nuances

Biodiversity

Appropriate ecologically sound biodiversity co-habitation planting forms part of the proposed [RRRT planting architecture](#) that essentially satisfies the following land use and resource development results:

- a) Provides resilient appropriate habitats for birds²⁵ especially in a revegetation or restoration projects, urban or rural.
- b) Provides additional harvestable resource beyond Harakeke for the landowner contributing to product pathways and economic resilience. In particular other clustering species such as Mānuka *Leptospermum scoparium*, Kānuka *Kunzea ericoides* and others that are not berry producing. Such opportunities lend to Rongoā Māori medicine resource and/or honey or oil biases.
- c) Through habitat development for the likes of our small birds like the Fantail *Pīwakawaka* ²⁶, Silvereye or Wax eye *Tauhou* and Robin *Toutouwai* which are almost entirely insectivorous, (feeding on small invertebrates, including moths, flies, beetles, spiders, and wasps), these birds form an important defence to the likes of Gall fly, Looper moth and Notch caterpillar. In particular, evidence has shown in Murihiku Southland, New Zealand that a lack of biodiversity in proximity to Harakeke, allowed seed pods to be susceptible to Gall fly larvae rendering kōrari seed non-harvestable²⁷.



Image 10 Courtesy of Biotenax Ltd

- d) Although the early establishment of biodiversity islands is an important first step, it also creates opportunities to develop an understory of additional rongoā species while strengthening food sources for native birds. Over time, and particularly after 5–7 years of growth, the margins may also support native forestry and fruit-bearing species, creating further resource development opportunities.

Where sufficient native biodiversity already surrounds RRRT planting sites, additional biodiversity planting may not be necessary, as reflected in the hypothetical business case model.

²⁵ Elliot Noe, E., Innes, J., Barnes, A. D., Joshi, C. & Clarkson, B. D. (2022). Habitat provision is a major driver of native bird communities in restored urban forests. *Journal of Animal Ecology*, 91, 1444–1457. <https://doi.org/10.1111/1365-2656.13700>

²⁶ <https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/fantail-piwakawaka/>

²⁷ Biotenax 2022 seed harvest in Southland

Part III. Infrastructure

Chapter 11. Business Case Metrics

Our Business Case development as defined in [Chapter 25](#) shows the workflow and related costs, outlays, yields, outputs, Full Time Employment [FTE] counts, plant counts, revenue, cost of production, overheads, and net return after depreciation but pre-tax.

Business Case Process Workflow and Implementation Planning

Process Workflow

For the purposes of this business case and its resulting overview of a Farmgate product output (incorporating contracted services for stripping, retting and scutching if any) the following Process Workflow is applicable.

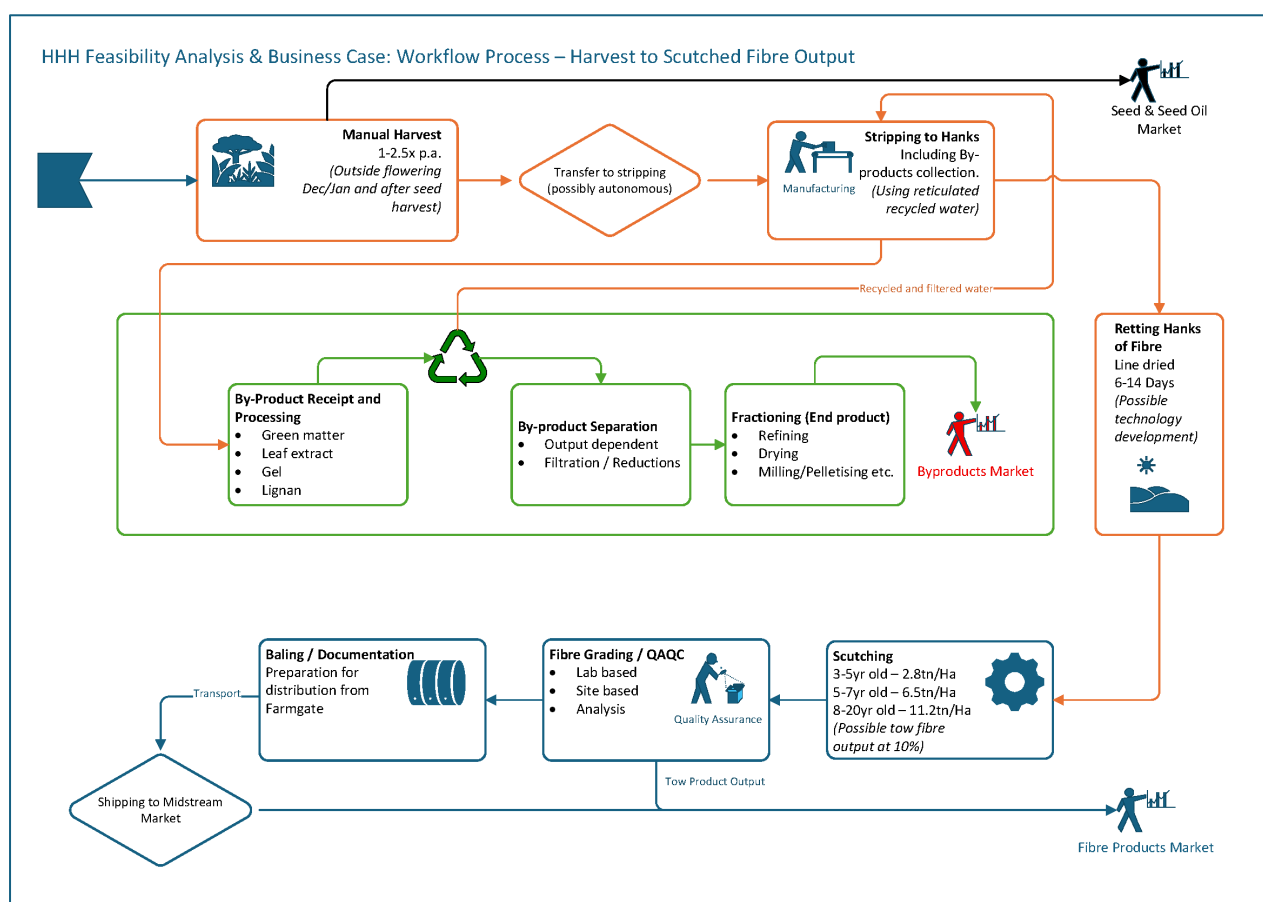


Chart 5 Courtesy of Biotenax Ltd

Implementation Planning

Implementation Planning would result in separate work related to progressive milestones as follows:

- **Year 1** - Site identification, desktop assessment, site assessment, planting plan and RRRT application goals, funding development, resource planning, plant acquisition and planting.

- **Year 2-3** - Ongoing husbandry and grounds maintenance, monitoring, pest control, training, asset management and budgeting.
- **Year 4** – First harvest (or year 5 if planted with seedlings), process to farmgate output.

It is expected that the most common industrial processing pathways that form the Midstream Industry from Scutched Fibre will result in a wide variety of fibre specifications and qualities to service a plethora of applications.

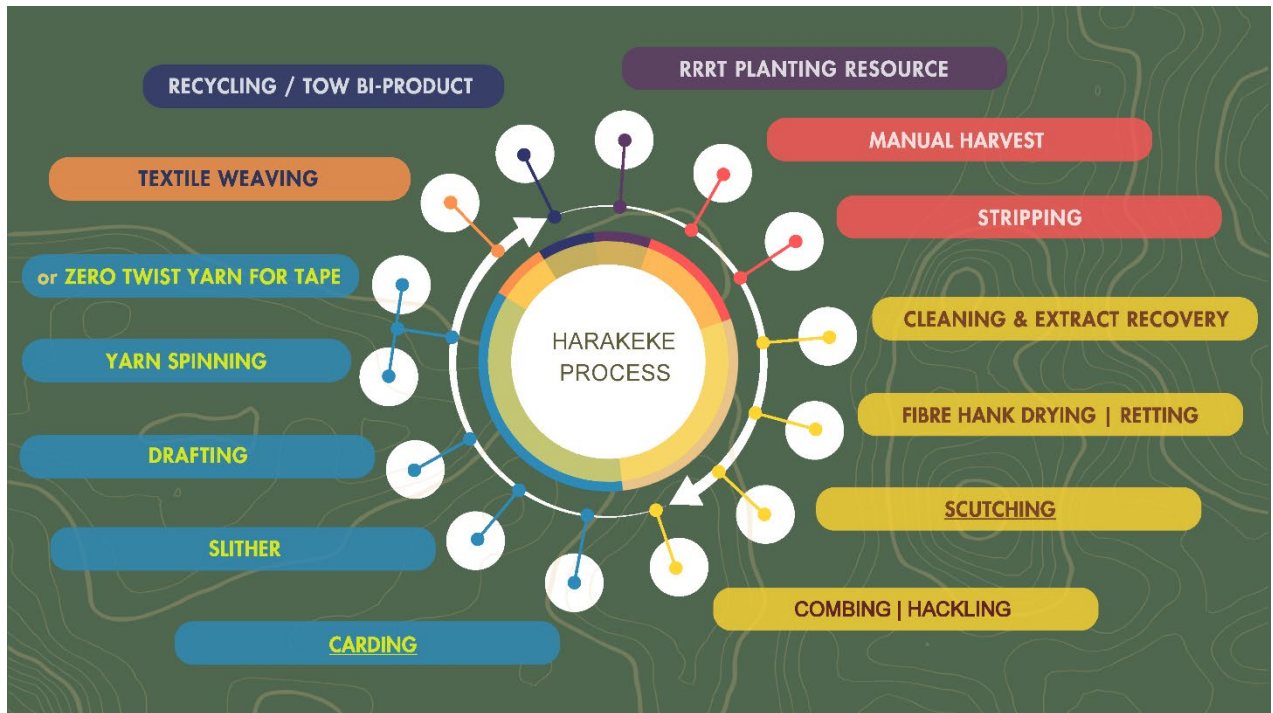


Image 11 Courtesy of Biotenax Ltd

For the purposes of this study, the business case does not extend to financial gains from everything outlined in the Mid-stream Market and the Downstream Market, with the exception of Scutched Fibre at the Farmgate.

Chapter 12. Planting site Initiatives.

Initiatives [Utilised Land Transition]

Referring to [Figure 1, Chapter 10 \[Land type nuances\]](#), we suggest that multiple community, local authority and individual landowner initiatives for planting native flora already exist, some of which:

- a) Have allocated funding and are ready to implement, or
- b) Do not have funding allocation but are in the process of securing for development and implementation.

These planting projects will likely lead to environmental improvements as originally intended but ultimately:

- c) Will likely not incorporate harvestability in their designs therefore inhibiting access
- d) May not adopt appropriate consideration towards cultivar uses and ecologically sound practice by region
- e) Will likely not consider or apply principles related to clustering species in their natural settings and will therefore, lead to an un-natural biodiversity mixture that does not necessarily emulate the natural habitat.

In this context, the following are a few examples, based on our field work and discussions with a number of contributors ²⁸, that might result in planting with broader economic and ecological benefits:

- **Council land** development that may be incorporated into new parks and recreation due to retirement of land affected by prohibiting residential and/or industrial build.
- **Farmland** retirement due to erosion/waterway remediation obligations and/or wetland re-wetting and restoration.
- **Wetland and estuary restoration** due to coastal environmental degradation as a result of intense historical agricultural.
- **Urban Catchment** development that addresses urban overland flow, stormwater and civil pressure on creeks, streams and rivers feeding wetlands, estuaries and harbours. ²⁹
- **Flood plain** resilience development.



Image 12 Courtesy of Biotenax Ltd [During flooding]



Image 13 Courtesy of Biotenax Ltd [After flooding]

²⁸ HHH Site Facilitators and other members, Christchurch City Council (Red Sticker Zone), Whakamana te Waituna – A project safeguarding the long-term health of the Waituna wetlands, D Cain, Fonterra.

²⁹ Community developments where improvements in stormwater runoff is a focus (Ngāi Tahu's Te Whāriki for example: <https://tewhariki.co.nz/live-here/your-environment/>)

Initiatives [Under-utilised Land Transformation]

Referring to [Figure 1, Chapter 10 \[Land type nuances\]](#), RRRT planting on un-utilised land is highly advantageous, especially for Māori landowners – but noting that.

- a) the average size of a Māori freehold land block registered in the Māori Land Courts is approximately 52 to 54 hectares. While roughly 1.4 million hectares of Māori freehold land exist, these are typically divided into small, fragmented blocks, with around **50% of titles being less than 5 hectares**, yet the average is skewed higher by larger blocks.³⁰

Metric	Comment
Total Blocks:	Approximately 27,500 individual blocks (titles).
Ownership:	An average block has about 111 beneficial owners however many have 1000+
Location Concentration:	Concentrated in the North Island, particularly the Waiariki (Bay of Plenty), Tairāwhiti (East Coast), and Aotea (Manawatu/Wanganui/Taranaki) districts
Small Block Frequency:	Smaller blocks without management structures often have the highest fragmentation, with many under 5 hectares.

Table 7 Māori Land Court: Assessment of prominent land profiles

- b) **Suitability Assessment for RRRT:** Via Google Earth review and/or site visit. [See [HHH Phase 4: Riparian and Land Restoration Trials](#)]. Suitability assessment eliminates rugged terrain, covenanted and/or protected sensitive ecological areas [SEA] of native bush, ridgelines, alpine (with the exception of sub-alpine), established wetlands and peat lands, undeveloped urban or rural sections, blocks less than 2Ha.

Based on our field work and discussions with a number of contributors³¹, the following might attract development funding and/or investment to establish a harvestable Harakeke resource:

- **Marae land** that may be incorporated into community resource development, Kura kaupapa, cultural and kairaranga weaving development with associated Pā Harakeke development.
- **Māori trust land** restoration and/or re-establishment of use on Kaitiakitanga grounds.
- **Papakāinga** resilience. Establishing a multi-faceted land use model to support community that includes Harakeke and clustered Biodiversity enhancement.
- **Perpetual Lease Exit.** The opportunity for reclaim or partial reclaim for use of un-utilised whenua.
- **Forestry Exit** or transition to native forestry with fringe watercourse / floodplain use.

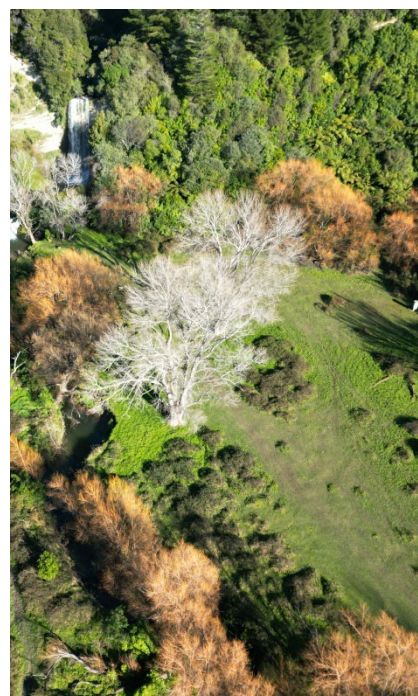


Image 14 Courtesy of Biotenax Ltd [Te Rere Falls, Te Kopani]

³⁰ [Māori Land Administration](#): Client Service Performance of the Māori Land Court Unit and the Māori Trustee.

³¹ HHH Site Facilitators and other members, Ngāti Ruapani Co-op engagement with local Marae.

Chapter 13. RRRT – The Concept

RRRT Explained

Riparian, Revegetation, Restoration and Transition [RRRT] planting architecture developed by Biotenax Ltd of Wellsford, Auckland, is derived from an existing Harakeke and associated biodiversity model initially established for harvestable Harakeke Seed for oil production. Further reference material is presented in [RRRT – A Proposed Architecture](#).

Harakeke planting from divisions [[Refer: Chapter 17. Plant Biomass Resource](#)]

Compared to existing environmental repair and restoration models (CRPM), the RRRT model has several advantages. , while it's more contemporary iteration requires further assessment [further research in [HHH Phase 4: Riparian and Land Restoration Trials](#)] in terms of performance, design substantiation, fulfilment metrics to service the Harakeke Industry and maintaining bio-diversity resilience, the intention is to provide landowners and managers with the following benefits comparative to contemporary environmental repair or restoration models [CRPM]: Key (Optimum vs Not-at-all). Further rationale is provided later in the [RRR Rationale section](#).

RRRT Benefit Matrix

Beneficial outcomes to landowners	RRRT	CRPM
Improves water quality in Wetlands and Riparian areas.		
Mitigates erosion around water courses, estuaries and harbours.		
Improves biodiversity.		
Emulates nature in relation to natural propagation of species.		32
Provides for harvestable resource.		
Provides appropriate access for harvest.		
Promotes a flowering bias.		
Provides resilient habitat for native birds.		
Improves pest control pathways.		
Results in monetary investment return ³³ .		
Reduces flood flowrate, thus improving kinetic resilience.		34
Reduces silt run-off.		
Justifies early retirement of floodplain due to extreme weather.		
Provides an enduring social and cultural asset for community.		35
Eco-tourism benefit.		36
Becomes a carbon sequestration asset.		37
Improves carbon storage in soils.		
Eventually eradicates or reduces costs of weed control.		
No requirement for herbicide.		
No requirement for fungicide (as a pseudo horticultural block).		
No requirement for irrigation.		
No requirement of plant pesticides.		38

Table 8 Benefit Matrix for RRRT of standard planting models.

³² Not in practice due to common random selection of mixed biodiversity. This often excludes clustering species.

³³ Provided the resource becomes an integral part of industry supply chain.

³⁴ Very little, due to narrow 'barn-door' effect on flood water flow. Associated exotics also disappear in flood water. Expensive repair.

³⁵ Generally, only during establishment and occasional maintenance, if community engaged.

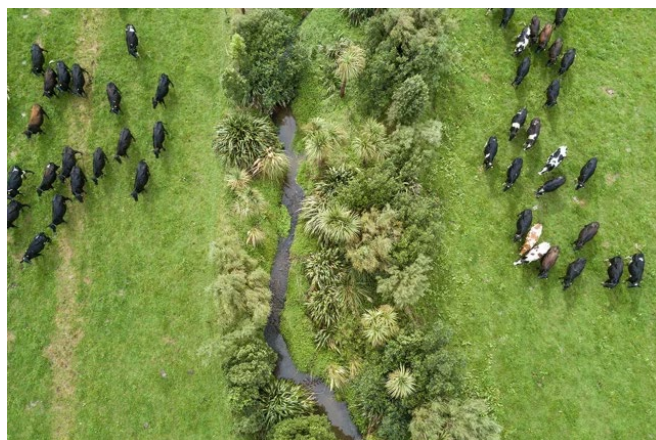
³⁶ Possibly if incorporated with walking/cycling paths. Not a common feature on private land.

³⁷ Only if of a meaningful total area (50Ha+)

³⁸ Not generally needed unless non-native species incorporated.

Riparian Planting Option

Riparian - The land, vegetation, or organisms located along the banks of rivers, streams, lakes, or other water bodies. It describes the interface between land and a river or stream, forming a unique, often lush, ecological zone.



Our riparian zones have often been cleared due to agricultural and horticultural practices with well-recognised negative impacts.

Image 15 : Common Riparian Planting Strip [courtesy Dairy NZ]

The Riparian Challenge

Typical remediation (for example [Dairy NZ](#).) has been to fence off and plant approximately 2-5mtrs from the top of the bank. Full native planting versus native sedge only, improves stream shading; bank stability; generates a seed bank of native plants and improves biodiversity benefits.

However, for farmers challenges remain³⁹:

- Establishment and Plant costs
- Retirement area required.
- Not an ideal option in a large or steep catchment.

The Riparian Solution

Given that the benefits in [Table 8](#) outweigh the drawbacks there is incentive for landowners to invest in a RRRT Riparian Model (subject to the following conditions):

- A viable, sustainable and resilient Harakeke Fibre and By-products industry has been established.
- RRRT research has been completed, and the model is proven to provide superior environmental and economic benefits.
- There is sufficient human and technical resource to support RRRT establishment, and
- The site is fit for purpose, as suggested in [Chapter 11](#).

Example:

Plant selection

Within the RRRT framework, Riparian planting would be expected to adopt principles outlined in [Chapter 10 Plant \[Biomass\] Resource and Biodiversity](#) and would require:

³⁹ As referenced by Dairy NZ [Planting \(Waterway Technote\)](#)

- Appropriate species and cultivars relevant to the region.
- Adequate preparation of land.
- Adequate divisions and/or plant stock to satisfy design, in advance.

Whenua selection

Within the RRRT framework, Riparian planting would typically require:

- A water course fringed by native bush in need of repair (either cleared and used for animal grazing or cleared in the past and now under-utilised).
- Good access.
- Non-tidal.
- Non-alpine (sub-alpine OK).

Land use application

Within the RRRT framework, Riparian planting would apply to land use applications outlined [Chapter 10. Land Use Impacts and Applications](#). Whenua Māori either in a current agricultural setting or under-utilised land status.

- Pā Harakeke development that extends further than cultural need.
- Farmland riparian repair to satisfy either nutrient reduction in waterways (by choice or otherwise) or through retirement due to flooding impacts that lead to non-viability of farming operations.
- Council storm water and overland flow re-utilisation.
- Riparian planting targeting water quality improvement, due to excessive erosion issues and resulting silt inundation (this might be a community, joint landowner and council collaboration).

Revegetation Planting Option

Revegetation - The process of replanting, restoring, or encouraging the return of vegetation to areas where it has been removed, damaged, or disturbed by human activity or natural events.



Revegetation aims to rebuild ecosystems, control soil erosion, and increase biodiversity using native or appropriate plant species.

Image 16 : Common Revegetation Planting Strip [courtesy Biotenax Ltd]

The Revegetation Challenge

A common revegetation methodology adopted by landowners, councils and farmers has been to plant a variety of trees and plants without consideration for those species which naturally cluster. While such planting has a very positive impact on environmental health, such methods limit harvestability of biomass due to densification and biased resource availability.

These conventional practices have disadvantages/challenges ⁴⁰:

- Expensive establishment and Plant costs
- Retirement area required for revegetation.
- Special care needed in catchment planning.
- Ecological studies can be expensive.
- Resource consents maybe required, resulting in inhibiting costs from local bodies.

The Revegetation Solution Proposal

Given that the benefits in [Table 8](#) outweigh the drawbacks, landowners are incentivised to invest more meaningfully, as follows:

Plant selection

Within the RRRT framework [Chapter 10. Land Use Impacts and Applications](#). Plant selections for RRRT **Revegetation** planting would require:

- Appropriate species and cultivars relevant to the region.
- Adequate preparation of land.
- Fast growing species to be planted first, including Harakeke, resulting in a potential fringe canopy for eventual planting of legacy trees.
- Adequate supply of divisions and/or plant stock to satisfy design, in advance.

⁴⁰ As referenced by Dairy NZ [Catchment Group Support](#)

Tiered Planting Synopsis⁴¹

Revegetation planting in New Zealand will often use a successional-tiered approach to restore native ecosystems, resulting in a nurse crop. The nurse crop usually incorporates hardy, fast-growing pioneer species of native plants, which we can call Phase I over the first 5-7 years, to create a shelter environment for permanent canopy species such as Mānuka (*Leptospermum scoparium*), Kānuka (*Kunzea ericoides*), Kōhūhū (*Pittosporum tenuifolium*), Tarata (*Pittosporum eugenoides*), Harakeke (*Phormium tenax*), Toetoe (*Austroderia*), Koromiko (*Hebe (Veronica) stricta*), and Hoheria (*Hoheria populnea*). Within the RRRT architecture, the biased plant is Harakeke.

Biodiversity co-habitant plants are proposed as 250-400m² per 10,000m² (1Ha) i.e. ~3.0% per Ha.

Phase I - These species create conducive soil conditions, shelter resource and shade. They are looked after for the first few years (pests⁴² and invasive weeds) by:

- Planting 1m apart within 1–3 weeks of clearing weeds and preparing ground (with pretreatment with Haloxyp⁴³ for Kikuyu).

Phase II: Canopy trees and secondary tree species (normally slower growing and planted 3-5 years later) especially if:

- There is a desire to establish native timber resource in the long term
- Biodiversity to satisfy bird feeding is not present.

Phase II species, depending on region, could be Tōtara (*Podocarpus Tōtara*), Kauri (*Agathis australis*), Titoki (*Alectryon excelsus*) Pūriri (*Vitex lucens*), Kahikatea (*Dacrycarpus dacrydioides*), Rimu (*Dacrydium cupressinum*), Rewerewa (*Knightia excelsa*) and Ribbonwood (*Plagianthus regius*).

- Generally planted at wider spacings once nurse species offer appropriate shelter. Typically, 5-7m depending on species.
- Understory will take hold by birds, propagating ferns etc.

Understorey

These might include *Carex secta*, *Carex virgata*, *Gahnia*, and various ferns. These maybe established to ensure harvestable access for Rongoā Medicine assets.

Whenua selection

Within the RRRT framework, Revegetation planting would require:

- Flood plain and no steep terrain. Adjacent steep terrain may be more suitable for livestock and/or native forestry⁴⁴.
- Good access.
- Non-tidal but could co-exist with a wetland **restoration** project.
- Non-alpine (sub-alpine OK).

⁴¹ Dependent on local ecology.

⁴² Tree guards maybe required if there is rabbit infestation.

⁴³ Haloxyp is a selective, post-emergent systemic herbicide used to control annual and perennial grass weeds in broadleaf crops, forestry, nurseries, and orchards (except around Toetoe) and if Kikuyu heavy.

⁴⁴ Note exotic forestry will not likely provide a biodiverse co-existence to impacts on soil acidity and reduce mitigation of flood damage.

Land use application

Within the RRRT framework, Revegetation planting [Chapter 10. Land Use Impacts and Applications](#) can apply to:

- Whenua Māori either in a current agricultural setting or under-utilised land status.
- Papakāinga development that seeks to extend viable economic, social and cultural resource beyond just Harakeke. This may form a specific Kaitiakitanga initiative.
- Improvement of bird corridors for ecological improvement and improved conditions for honey production.
- Council storm water and overland flow re-utilisation.
- Co-habitant projects with Riparian, Wetland Restoration and Farmland Transition projects/initiatives.

Restoration Planting Option

Restoration - The rehabilitating of degraded wetlands (or even re-wetting) to improve water quality, enhance biodiversity, and provide flood protection. Key actions include fencing to exclude stock, weed/pest control, and planting native species, ideally restoring at least 0.5ha for significant ecological benefit.



Image 17 Re-wetting project at Biotenax Biodiscovery Gardens (2025)

New Zealand's wetlands have declined by roughly 90% since European settlement, dropping from an estimated 670,000 hectares to roughly 89,000 hectares by the 21st century. Historically vital to Māori as sources of food and materials, these "swamps" were viewed by settlers as unproductive land, leading to, intense draining for agriculture and farming in the 20th century.

The Restoration Challenge

Most wetland restorations projects have been successful but typically present the following impediments or challenges ⁴⁵:

- Expensive establishment and Plant costs
- Retirement area required for Restoration in particular when re-wetting utilised land.
- Special care needed in catchment and outflow planning.
- Ecological studies can be expensive.
- Resource consents are likely required, resulting in inhibiting costs from local bodies.

The Restoration Solution Proposal

By Restoration, we are referring to, in particular, Wetland Restoration. Given that the benefits in [Table 8](#) outweigh the drawbacks, landowners are incentivised to invest more meaningfully. (which maybe part in parcel with a RRRT Farm Transition application), the Restoration solution proposed is subject to the same conditions as explained in other RRRT solutions.

Plant selection

Within the RRRT framework [Chapter 10. Land Use Impacts and Applications](#), RRRT **Restoration** planting would require:

- Appropriate species and cultivars relevant to the region.
- Adequate preparation of land to ensure highest rates of plant uptake, especially if a re-wetting project was undertaken.
- Any re-wetting of a wetland will require appropriate analysis to identify the top watermark once drainage geography is returned to its original state.

⁴⁵ As referenced by Dairy NZ [Catchment Group Support](#)

- Fast growing species to be planted first, especially sedge grasses and shade species, as well as Harakeke outside the watermark.
- Sufficient divisions and/or plant stock to satisfy design, in advance.

Planting Synopsis⁴⁶

Effective wetland restoration requires ecological, hydrological and environmental expertise. Furthermore, water depth is going to be crucial to ensure optimum water health and temperature control to sustain fish life. This in itself may suggest expensive resource consent needs and the navigating of local challenges.

Biodiversity co-habitant plants are fundamental in the wetland Restoration story.

The planting mix will be heavily determined by the region and of course proximity to coastal areas or otherwise, tidal flow if any, and floodplain performance expectations.

Whenua selection

Within the RRRT framework, [Chapter 10 Land Type Nuances](#), plant selections for RRRT **Restoration** planting would require:

- A water course ideally fringed by native bush. Regeneration land that adopts RRRT planting for Harakeke resource development in need of repair will best be served on a flood plain and in the case of re-wetting, an understanding of what the new topography is going to look like.
- Allowable access onto relatively firm ground not susceptible to 'bogging'.
- For harvestable Harakeke resource development, non-tidal, not wetland but would co-exist with the wetland **restoration** project.

Land use application

Plant selections for RRRT **Restoration** planting would apply to:

- Whenua Māori repair and restoration to address specific Kaitiakitanga initiatives.
- Development that seeks to extend viable economic, social and cultural resource beyond just Harakeke. Re-establishment of food source and materials for Māori and Rongoā Medicine.
- Improvement of bird corridors for ecological improvement and increased honey production.
- Co-habitant projects with Riparian, Revegetation and Farmland Transition projects/initiatives.

⁴⁶ Dependent on local ecology and expertise.

Transition Planting Option

Transition - The rehabilitating of degraded wetlands (or even re-wetting) to improve water quality, enhance biodiversity, and provide flood protection. Key actions include fencing to exclude stock, weed/pest control, and planting native species, ideally restoring at least 0.5ha for significant ecological benefit.



Image 18 Courtesy of Whangara Farms Partnership

New Zealand's wetlands have declined by roughly 90% since European settlement, dropping from an estimated 670,000 hectares to roughly 89,000 hectares by the 21st century. Historically vital to Māori as sources of food and materials, these "swamps" were viewed by settlers as unproductive land, leading to intense draining for agriculture and farming in the 20th century.

The Transition Challenge

Most farmland retirement initiatives come with excessive costs. A RRRT Transition project is intended to enhance viability. Typical impediments or challenges are: ⁴⁷:

- Expensive establishment and Plant costs
- Retirement area required for Transition in particular when losing agricultural outputs.
- Special care needed in catchment and outflow planning.
- Cost of ecological studies.
- Resource consents are likely required, resulting in inhibiting costs from local bodies.

The Transition Solution Proposal

By Transition, we are referring in particular to Transition of retired farmland. Given that the benefits in [Table 8](#) outweigh the drawbacks, the RRRT Transition Model offers the same benefits and is subject to the same conditions applicable to other land use RRRT solutions. I.e.

Plant selection

- Appropriate species and cultivars relevant to the region.
- Adequate preparation of land, especially if a wetland re-wetting project was undertaken.
- Given proximity to farming operations, the area will need to be fenced, just as a typical riparian strip would be.
- Transition planting development could include any or all RRRT applications depending on topography and application.
- Fast growing species to be planted first, especially sedge grasses and shade species, as well as Harakeke outside the watermark.
- Sufficient divisions and/or plant stock to satisfy design, in advance.

⁴⁷ As referenced by Dairy NZ [Catchment Group Support](#)

Planting Synopsis ⁴⁸

Farmland transition planting requires ecological, hydrological and environmental expertise, especially if the purpose is to mitigate destruction due to serious flooding.

The planting mix will be determined by the region and proximity to coastal areas and tidal flow if any, and floodplain performance expectations.

Whenua selection

Land transition to a RRRT model may require a mix of Wetland Restoration, Riparian and Revegetation. In any event, given farmland is generally void of biodiversity (associated native bush), there may be a need to enhance this resource.

A considerable advantage in farmland transition is a minimal need for land preparation due to it being relatively clear and accessible.

Land use application

RRRT **Transition** planting would apply to:

- Retirement of sheep and beef farming and/or feedstock cropping.
- Floodplain repair to assist in protection of downstream infrastructure and related assets.
- Improved farm output resilience off season, with related incremental income streams.

⁴⁸ Dependent on local ecology and expertise.

RRRT – A Proposed Architecture

The proposed RRRT model defined in this Feasibility Analysis and Business Case [FABC]⁴⁹ is similar to the current Biotenax model, however, it proposes refinements that result in significant improvements to access, yield and viability.

Comparative RRRT Aspects [Current vs Future]

Comparisons are explained as follows:

Aspects	Current Biotenax RRRT	Proposed RRRT [FABC] & Phase II Trial
Access	Moderate, however improved if leaf harvested rather than for seed source only.	Optimum, based on spacings, island geometry and consistent leaf harvest.
Plant spacing	3m	1.5m
Plants ⁵⁰ per Hectare (Ha)	1500	2500
Island geometry	Large oval resulting in lack of efficiency for harvest 40-100 plants each	3 organic, topography centric rows 60-100 plants long.
Plant health	Determined by cultivar, mix of cultivars, invertebrate control (associated small bird habitats) and less related to leaf harvesting. Cross pollination may also lead to reduced output quality.	Expected to be very good, due to RRRT husbandry/maintenance expectations, regular tūpuna leaf harvest cycles (1-2.5x p.a.), mitigating cross-pollination related dilution.
Grazing	Trials underway (promising)	Further research (Division planting only and maybe after Yr1)
Biodiversity portion	1%	3%
Biodiversity model	Mixed Biodiversity although some clustered biases	Mostly clustered to suit local ecology
Flood resilience	Exceptional	Exceptional however may improve due to intensification

Table 9 RRRT Comparisons - Current vs Future model proposition

⁴⁹ Expected to be developed through [Phase IV of the research initiatives](#).

⁵⁰ Harakeke (phormium tenax)

Current Biotenax Resource⁵¹

Aspects	Remark
Land area	22.5Ha
Sensitive Ecological Area	4.5Ha
Harakeke Plants	10,000 (3-20yrs old)
Biodiversity planting (since 2007)	5,500
Facilities	Offices, accommodation, engineering, laboratories, cleanrooms, production, research and development.
Location	Wellsford, Auckland, New Zealand

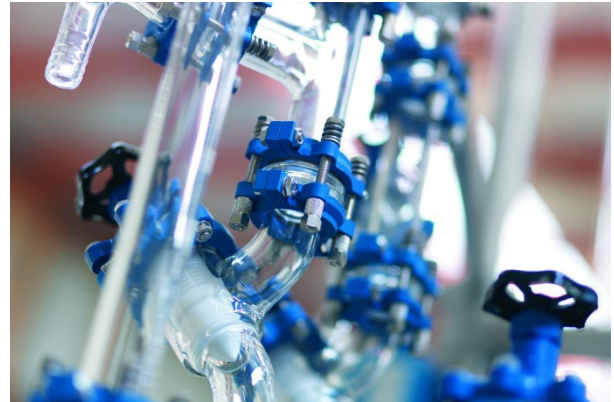


Image 19 Courtesy of Biotenax Ltd © 2024-2026

⁵¹ As of Q2, 2026

Riparian Planting Model Illustrated

The following information is hypothetical for the purposes of defining optimum resource size options for the basis yield output and resulting economic return, should the Harakeke Industry succeed in developing a sustainable supply chain. RRRT Dimensions & Plant Counts are defined per Hectare

Te Hononga Hapori Harakeke The Harakeke Community Alliance [HHH]								
RRRT Interim model [To be trialled in Phase IV]								
Description	Qty	Unit	Island (w) m	Island (l) m	Island m²	Islands per Ha	Plants per Ha	Comment
Spacing (Longitudinal)	1.5	m						Divisions or planters
No of rows	3	ea.						To optimise access for manual harvest of tūpuna (outer) leaves. <i>Subject to review.</i>
Space between islands	3	m						To optimise access for collection vehicles, robotic or otherwise. <i>Subject to review.</i>
Gaps at end of islands	6	m						To optimise turning circle for collection vehicles, robotic or otherwise. <i>Subject to review.</i>
Harakeke (20/row)	20	per row						Per row count is arbitrary as much will be dictated by topography, firm ground, obstacles and preference.
Harakeke (20/row)	60	per island	8	36	270	37	2223	Shorter rows result in lower per Hectare count.
Harakeke (40/row)	40	per row						Per row count is arbitrary as much will be dictated by topography, firm ground, obstacles and preference.
Harakeke (40/row)	120	per island	8	66	495	20	2425	Shorter rows, result in lower per Hectare count.
Harakeke (60/row)	60	per row						Per row count is arbitrary as much will be dictated by topography, firm ground, obstacles and preference.
Harakeke (60/row)	180	per island	8	96	720	14	2500	Optimum count for purposes of Feasibility Analysis and Business Case.

Table 10 RRRT Interim model to be trialled - Plant count per Hectare

RRRT Biodiversity & Plant Count per Site

Description	Qty	Unit	Island (w) m	Island (l) m	Island m ²	Comment
Biodiversity % target	3%	Increment/Ha				Arbitrary count, ideally 2-5% depending on available fringed biodiversity.
Biodiversity (Plants/Ha)	300	@ 1mtr spacing	17	17	300	Based on 3% of incremental addition.

Table 11 Biodiversity proportion (approximate) per Hectare

RRRT Plantable Land size (with Biodiversity increment if required)					
Viability	Ha	Gross Ha	Harakeke per site	Biodiversity per site	Comment
Non-viable	1	1.03	2,223	300	May form a resource for division development.
Break even	4	4.12	9,700	1,200	May form a resource for division development.
Business Case Model	8	8.24	20,000	2,400	Option for Pohokura Trust Farm
Viable	12	12.36	30,000	3,600	Option for Biotenax Gardens (addition)
Viable	20	20.60	50,000	6,000	Option for Matekuare Whānau Trust
Viable	40	41.20	100,000	12,000	Option for Utakura 7 Incorporated
Viable	100	103	250,000	30,000	Option for Whangara Farms Partnership

Table 12 RRRT Plants by Site relevant to available land

RRRT Forward Projection Count

Subject to suggested growth path and industry success rates being attained.

Year	Accumulated RRRT (Ha)	Gross Ha	Harakeke Plants	Biodiversity Plants ⁵²
2030	360	371	900,000	108,000
2033	1,000	1,030	2,500,000	300,000
2036	3,000	3,090	7,500,000	900,000
2040	6,000	6,180	15,000,000	1,800,000
2045	25,000	25,750	62,500,000	7,500,000
2050	50,000	51,500	125,000,000	15,000,000
2060	100,000	103,000	250,000,000	30,000,000

⁵² Biodiversity plants exclude legacy and native forest trees in Chapter 22.

Riparian Strip – Farmland Retirement example



Suitable riparian strip on utilised farmland because of:

- Flooding issues.
- Excessive nutrients downstream.
- Biodiversity need.
- Sustainability impacts.

Image 20 Example Farming Transition example: Courtesy Wi Pere Trust



Image 21 [AI] Presentation of a common mixed biodiversity planting in a Riparian strip, for farmland transition.

Conversion of a riparian strip on utilised farmland will result in:

- Improved biodiversity.
- Improved water quality at outflow.
- Improved habitat for birds.
- Improved flowering resource for bush honey.
- Carbon sequestration.

However, in this example, harvest access is not practical and therefore a potential return on investment is lost.

Riparian Strip – New Riparian Planting Model [NRPM] that contributes to the RRRT Model



Image 22 [AI] Presentation of a biodiversity planting in a Riparian strip, for farmland transition that emulates nature, but provides for harvest access.

Conversion of a riparian strip on utilised farmland resulting in:

- Improved biodiversity.
- Improved water quality at outflow.
- Improved habitat for birds.
- Improved flowering resource for bush honey.
- Carbon sequestration.
- Clustered species leading to biomass bias.
- Access for harvest activity and therefore a superior return on investment.
- Carbon sequestration.

RRRT – The Rationale

The RRRT Planting model [Benefit Matrix](#) compares this model with common mono-culture fibre costs (specifically bast fibres and monocot fibres) in two frames, up to a [scutched fibre process point](#):

1. **Environmental and Social comparisons** specific to land preparation impacts, chemical use, water use, carbon sequestration, ecological resilience, flood resilience, weather sensitivities, social and cultural wellbeing for example.
2. **Comparisons based on proportional financial and cost impacts** specific to costs related to land preparation, chemical use, water use, production plant, employment, by-products amortisation opportunities for example.

Environmental and Social Impact Comparisons

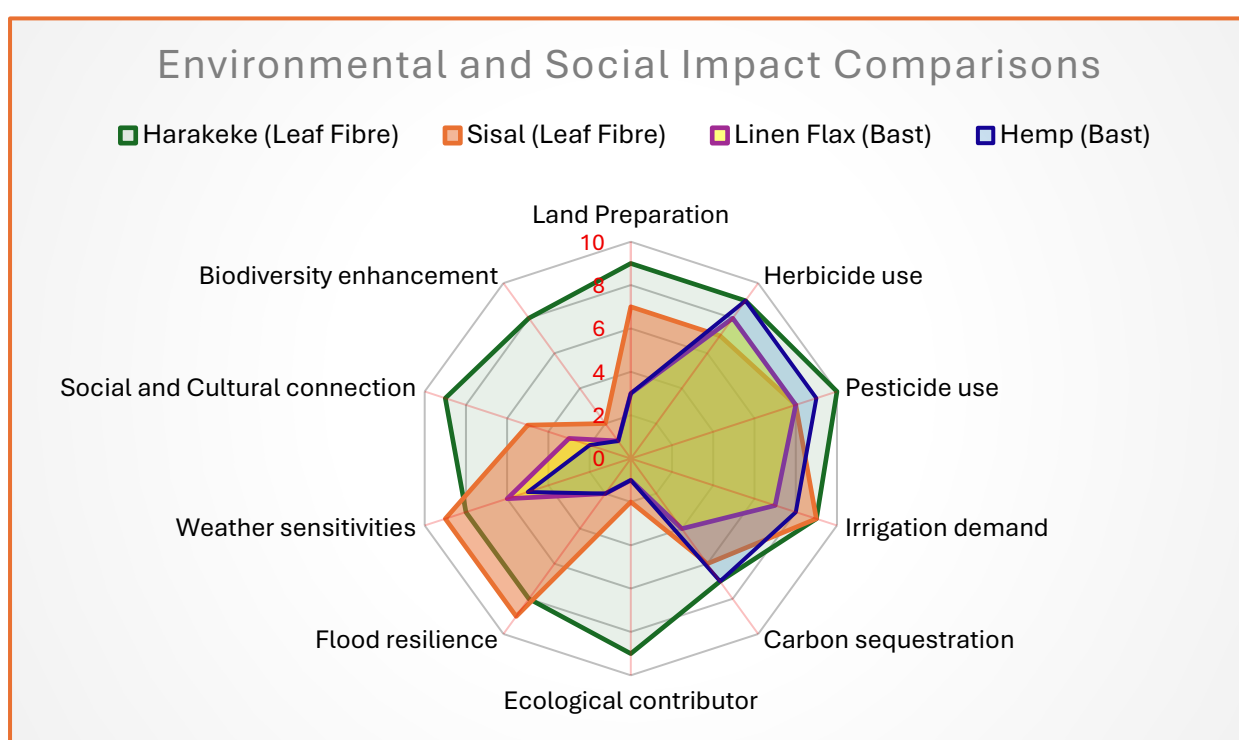


Chart 6 Environmental and Social Impact Comparison [Bast vs Leaf Fibres] (0 being Poor, 10 being Best) ⁵³

Many of the natural fibre industries globally, especially those highlighted above in addition to Abaca (Manila Hemp) and Jute, are considered environmentally sustainable and/or have a low carbon and environmental footprint.

However, Harakeke cultivation for commercial application avoids typical environmental impacts or has other benefits:

- Harakeke has no need for deep ploughing, tilling and turning of soil in preparation (with possible herbicide application)
- Harakeke does not require annual cultivation and tilling of soils and application of fertilisers (and sometimes trace horti-chemicals). Less so with Sisal possibly.
- Harakeke does not require irrigation, although many of the suggested fibres satisfy this concern.
- Carbon sequestration, although Hemp seems to perform very well on this metric.

⁵³ Referenced data sourced from [NZ Hemp Industry Association](#), Sisal industry (various), Various [Hemp industry](#) sites, Various [Linen](#) industry sites.

Furthermore:

- Given the RRRT model is based on a permanent resource possible improvements in carbon storage in soils is possible.
- Ther positive impacts not seen in monoculture cropping will lead to:
 - Improved ecological wellbeing
 - flood plain resilience all year round
 - limited concerns for pH adjustment
 - no fertilisers required
 - social and cultural resource preservation and connection
 - and biodiversity enhancement.

These favourable attributes contribute to an authentic Harakeke brand story and value proposition not typical of other natural fibre industries. There are also potential synergistic opportunities in blending Harakeke fibre with other New Zealand derived fibres such as Wool.

As presented below, it should be noted that those weighted metrics are anecdotal and would require individual assessments outside the scope of this research. Key: '0' being 'Poor' / '10' being 'Best'.

Environmental & Social SWOT	Hemp (Bast fibre)	Linen Flax (Bast fibre)	Sisal (Leaf Fibre)	Harakeke (Leaf Fibre)
Land Preparation	3	3	7	9
Herbicide use	9	8	7	9
Pesticide use	9	8	8	10
Irrigation demand	8	7	9	9
Carbon sequestration	7	4	6	7
Ecological contributor	1	1	2	9
Flood resilience	2	2	9	8
Weather sensitivities	5	6	9	8
Social and Cultural connection	2	3	5	9
Biodiversity enhancement	1	1	2	8

Table 13 Comparative over other natural fibres

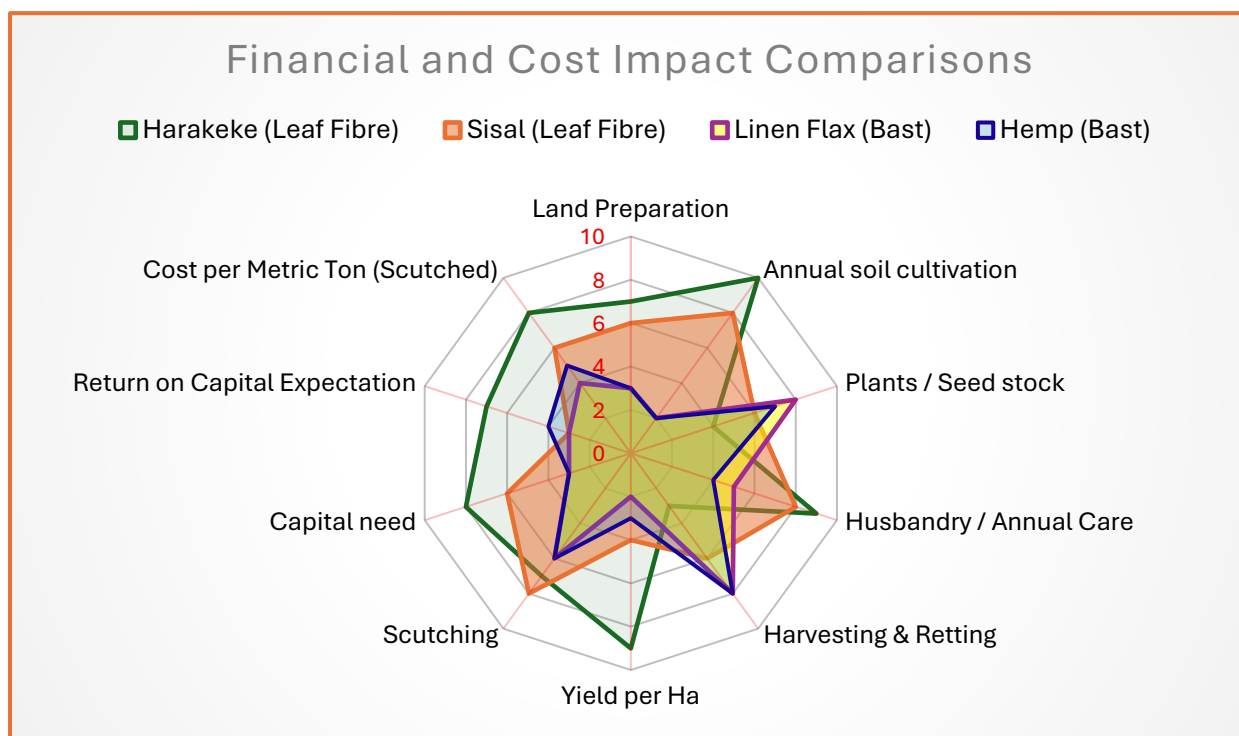


Chart 7 Financial and Cost Impact Comparison [Bast vs Leaf Fibres] (0 being Expensive, 10 being Minimal Cost) ⁵⁴

While the enclosed information is based on topline calculations of process and available industry research, there are many arbitrary variables that impact on final costs. To this extent common settings across the four fibre types (*two leaf and two bast fibre varieties, including Harakeke under the RRRT model*) include the following assumptions:

- Sites are 10Ha in size on appropriate land resource.
- Researched costings where relevant are mid-point.
- Each site is inclusive of a new establishment, and to this extent with Harakeke and Sisal harvest excluding Y2-3 until first harvest, this results in a higher average per annum.
- Processing, Retting, Scutching and transportation is in nearby proximity.
- Sisal growing regions will experience far lower labour costs and overheads.

While the harvest and pre-scutching costs of Harakeke are considerably higher than Hemp and Linen pre-scutched costs, the yield from Harakeke is markedly higher offsetting these issues.

Metric	Hemp (Bast)	Linen Flax (Bast)	Sisal (Leaf Fibre)	Harakeke (Leaf Fibre)
Yield of Long Staple Fibre (Tn/Ha)	1.54	1.05	1.50	11.17
Yield of Long Staple Fibre 10Ha (Tn)	15	11	15	112
Post scutching fibre cost per (Tn) NZ\$ ⁵⁵	\$9,416	\$9,667	\$3,050	\$4,655
Post scutching fibre cost per (Tn) USD	USD 5,649	USD 5,800	USD 1,830	USD 2,793
Revenue 10Ha (LSF) assume 45% WM ⁵⁶ (NZ\$)	\$322,222	\$225,556	\$101,667	\$1,155,907
Average costs p.a. NZ\$ per 10Ha site (@10yrs)	\$145,000	\$101,500	\$45,750	\$520,158
GM (Wholesale pricing)	45%	45%	45%	45%

Table 14 Comparative revenue metrics vs Harakeke

⁵⁴ Referenced data sourced from Biotenax market research and Credence Research 2026.

⁵⁵ Excludes establishment costs and land prep.

⁵⁶ Wholesale Margin (anecdotal).

As presented in Chart 5 it should be noted that those weighted metrics are anecdotal and would require individual assessments outside the scope of this research. Key: '0' being 'Expensive' / '10' being 'Minimal Cost'.

Financial Costs Comparisons	Hemp (Bast)	Linen Flax (Bast)	Sisal (Leaf Fibre)	Harakeke (Leaf Fibre)
Land Preparation	3	3	6	7
Annual soil cultivation	2	2	8	10
Plants / Seed stock	7	8	6	4
Husbandry / Annual Care	4	5	8	9
Harvesting & Retting	8	8	6	3
Yield per Ha	3	2	4	9
Scutching	6	6	8	7
Capital need	3	3	6	8
Return on Capital Expectation	4	3	3	7
Cost per Metric Ton (Scutched)	5	4	6	8

Table 15 Comparative over other natural fibres [Chart 5] Key: '0' being 'Expensive' / '10' being 'Minimal Cost'

As presented in Chart 15 it should be noted that those weighted metrics are anecdotal and would require individual assessments outside the scope of this research. Key: '0' being 'Expensive' / '10' being 'Minimal Cost'.

Financial Costs Comparisons	Hemp (Bast)	Linen Flax (Bast)	Sisal (Leaf Fibre)	Harakeke (Leaf Fibre)
Land Preparation	3	3	6	7
Annual soil cultivation	2	2	8	10
Plants / Seed stock	7	8	6	4
Husbandry / Annual Care	4	5	8	9
Harvesting & Retting	8	8	6	3
Yield per Ha	3	2	4	9
Scutching	6	6	8	7
Capital need	3	3	6	8
Return on Capital Expectation	4	3	3	7
Cost per Metric Ton (Scutched)	5	4	6	8

Table 16 Comparative over other natural fibres [Chart 5] Key: '0' being 'Expensive' / '10' being 'Minimal Cost'

Rationale in Summary SWOT

The RRRT planting architecture has been hypothetically assessed with the following strengths, weaknesses, opportunities and threats. These are perceptions until proven wrong through scientific assessment. This presents the Harakeke Industry, subject to successful outcomes from physical trials, with a choice to establish a Harakeke resource that is likely:

- Economically viable
- Environmentally sustainable
- Enhances social and cultural wellbeing
- Supports land use initiatives that mono-culture cropping does not
- Carries less financial risk if the primary initiative is environmental repair and/or enhancement
- Provides landowners, Māori or otherwise, with land use options that may otherwise been untenable
- Increases flood plain resilience that exotic planting or mono-culture cropping does not.

Strengths ⁵⁷

- ❖ Economic and environmental reliance for un-utilised whenua Māori.
- ❖ Capital need lower over a 10yr period than mono-culture cropping.
- ❖ Does not impact on food production land.
- ❖ Improves waterway health and resilience against floods and climate change.
- ❖ Blends easily with environmental planting initiatives already proven but in a harvestable way.
- ❖ Higher yield of quality biomass per Ha.

Weaknesses

- ❖ Expensive harvesting due to manual approach (*but offset by plethora of potential product pathways and yield per Ha*).
- ❖ Capital and working capital needs are high due to limited mechanisation.

Opportunities

- ❖ Expansion of product pathways from not only Harakeke fibre and extracts but also associated clustered and biodiversity.
- ❖ Amortisation of high harvest with by-product industry development.
- ❖ Development of AI and robotics to improve resource development, operational activity and land use modelling.
- ❖ The potential to position Harakeke once again as one of New Zealand's premier export industries!

Threats

- ❖ Cross-pollination due to monoecious nature. (*mitigated through appropriate seed management and selective removal*)
- ❖ Foreign theft of IP, limited or ineffective Taonga protection and provenance dilution.
- ❖ Environmental planting initiatives refuse to adopt or uptake RRRT model.
- ❖ Limited capital and/or investment for Māori landowners to transition.
- ❖ Weak national strategy and/or leadership
- ❖ Lack uptake and/or lack of cooperation and collaboration

Table 17 RRRT model SWOT Analysis [Hypothetical]

⁵⁷ Box not big enough!

Chapter 14. Harakeke versus other natural fibres

Comparative fibres

For the purposes of this report, the following fibres are considered competitors.⁵⁸

Plant Fibres	Specifications	Results
Linen Flax <i>[Bast fibre]</i> <i>(Linum usitatissimum)</i>	▪ Slightly silky when heavily scutched and combed. ▪ Stiff and somewhat crisp. ▪ Low elasticity 2-2.5%. ▪ Breathable, cool-to-wear summer apparel. ▪ Hygroscopic. ▪ Softens and weakens after wash and wear. ▪ Prone to wrinkling as a textile. ▪ Succumbs to photodegradation. ▪ Difficult to dye and bleach. ▪ Anti-static ▪ Biodegradable 	 Elementary fibres $\emptyset$ 10-18 μm L ~20-50 mm Single Fibre TS: 900 to 1000 MPa.
Hemp <i>[Bast fibre]</i> <i>(Cannabis sativa)</i>	▪ Slightly silky when heavily scutched and combed. ▪ Stiff and somewhat crisp. ▪ Low elasticity 1-1.5%. ▪ Breathable, cool-to-wear summer apparel. ▪ Hygroscopic. ▪ Softens and weakens after wash and wear. ▪ Prone to wrinkling as a textile. ▪ UV resistant. ▪ Difficult to dye and bleach. ▪ Anti-static ▪ Biodegradable 	 Elementary fibres $\emptyset$ 16-40 μm L 5-50 mm Single Fibre TS: 550-1100 MPa.

⁵⁸ Information courtesy of Textilepedia REF:TP1094

Plant Fibres	Specifications	Results
Jute <i>[Bast fibre]</i> <i>(Corchorus)</i>	- Coarse and low cost. - Limited industrial applications. - Stiff and Brittle - Low elasticity 1.1-1.5%. - Not ideal for apparel. - Dyes well. - Anti-static. - Biodegradable. 	 $\emptyset$ 15-20 μm L 15-30 mm Single Fibre TS: 390-850 MPa.
Abacá (Manila Hemp) <i>[Leaf fibre]</i> <i>(Musa textilis)</i>	- Coarse and low cost. - Limited industrial applications, mostly rope and upholstery. - Stiff (stronger and softer when wet) and can be soften with treatment. - Elasticity 1-3%. - Not ideal for apparel but accessories. - Dyes well. - Anti-static. - Seawater resistance. - Biodegradable. 	 AI $\emptyset$ 120-150 μm L 5-6 mm Single Fibre TS: 580-790MPa.

Plant Fibres	Specifications	
Harakeke <i>[Leaf fibre]</i> <i>(Phormium tenax)</i>	- Strong long staple fibre. - Multiple applications. - Flexible - Elasticity 1.5-4%. - Excellent vibration dampening performance. - Radio transparent. - Dyes OK (however can reduce strength). - Anti-static. - Resilience in seawater and freshwater. - Biodegradable.	 Single fibres Ø 7-15 µm L 5-30 mm Fibre bundles Ø 40-140 µm ⁵⁹ L 70-120 mm Fibre TS: 540-900 MPa. ⁶⁰ 1050-1450 MPa ⁶¹
		



Image 23 Courtesy of Biotenax Ltd © 2025-2026

⁵⁹ Traditional scutched fibre from Templetons mill will result in measurements of between 220-400µm or with Muka fibre (60-120µm) so process method is crucial.

⁶⁰ Based on historical studies using heavily broken scutched fibre bundles.

⁶¹ Combined results from contemporary stripping process Ref. Biotenax Ltd. To be confirmed through robust analysis.

Chapter 15. Upstream Market

This feasibility analysis identifies the essential requirements for processing fibre to the scutched fibre stage, which is the precursor to a wide range of downstream fibre products. For clarity, the market is described in three segments. However, this business case is focused solely on the **Upstream Market** opportunity at the farmgate level.

- **Upstream Market.** This includes all activities and capabilities required to support primary industry development and the production of scutched fibre and tow. It covers plant stock, planting, husbandry services, harvesting and related logistics, stripping, retting, scutching, baling, by-product collection (including harakeke seed), associated primary processing, and industry governance and management.
- **Midstream Market.** This includes the marketing and wholesale distribution of scutched fibre and primary by-products, both locally and internationally. It supplies processors and manufacturers who add further value through products such as yarns, twines, ropes, threads, textiles, composite substrates, and personal care and pharmaceutical ingredients.
- **Downstream Market.** The midstream market supports a broad range of end-use applications. Selected examples are outlined in [Chapter 16](#).

For the purposes of this report, the processing assets, capabilities, capacities, and indicative capital requirements identified are limited to the Upstream Market. The business case is nevertheless informed by proprietary market research undertaken by the authors on the past, current, and future size of the comparative fibre markets discussed in [Chapter 13](#).



Image 24 Courtesy of Biotenax Ltd & Templeton Mill [Scutched and Baled fibre]

Chapter 16. Mid-stream Market

The **Midstream Market** comprises all activities within the Harakeke Industry related to the marketing and wholesale distribution of scutched fibre and primary by-products, both domestically and internationally. At this stage, the focus is on natural fibres for industrial, technical, and functional applications rather than fashion-led or finished consumer textiles such as apparel, home furnishings, and bedding. It also includes the secondary value-adding and marketing of by-products.

The scope of this report is limited to identifying selected product and market pathways that are currently relevant to supporting demand generation for the primary upstream industry and the supply of upstream product outputs.

Although the infrastructure that underpins the Upstream Market may also contribute to [Climate Change Resilience](#) and [Environmental Protection](#) initiatives outlined in the RRRT section, its long-term economic viability depends on the strength of a robust Midstream Market.

Midstream Market Opportunities

For the Harakeke Industry, the most accessible Midstream Market opportunities are likely to be in sectors currently served by fibres such as hemp and linen. Additional competitive opportunities may also exist in markets currently supplied by jute, sisal, and abaca, particularly where one or more of the following conditions apply:

- Harakeke delivers superior performance for the intended application.
- Environmental authenticity and a strong brand proposition influence a purchasing decision.
- Harakeke supply can meet demand where other fibres cannot.

There is also potential for the Harakeke Industry to collaborate with other natural fibres through blended products. Examples include wool, where harakeke can contribute strength while complementing wool's fire-suppression properties; other animal fibres; hemp, as part of a collaborative New Zealand supply chain; and manufactured-fibre hybrids, such as high-performance ropes and yarns designed to reduce the synthetic fibre footprint.

Midstream Market Outputs

1. **Scutched fibre** for further processing through carding and sliver production.
2. **Tow** for further processing into short- and long-fibre blends, felting, and aligned fibre pulp.
3. **By-product extracts**, including non-fibre outputs obtained through:
 - a. the fibre stripping process, such as green matter, leaf juices, and gels; and
 - b. other non-fibre resources not produced through stripping, such as seed oil and kōrari stem collection.

By-products

Although this business case does not calculate or present financial returns for by-product outputs from a harakeke resource, the potential opportunities are extensive. These opportunities can be grouped into two broad categories:

- a) By-products derived during fibre extraction or stripping, including:
 - i. green matter, including the epidermis and associated chlorenchyma or mesophyll material removed during processing;
 - ii. leaf juice and gel, with potential applications in cosmetics and personal care; and
 - iii. tow fibre, for uses such as matting, felting, and micro-greens substrates.
- b) By-products derived separately from fibre extraction or stripping, including:
 - i. kōrari stem, with potential applications in sustainable panel board.
 - ii. Harakeke seed (oil) (for uses in cosmetics and personal care, amido betane emulsifier, phytosterols)⁶²



Image 25 Courtesy of Biotenax Ltd © 2016-2026 [Harakeke Seed Oil]

⁶² Harakeke Seed Oil has a unique free fatty acid profile making for exceptional topical product applications. Current development of this industry pathway is being developed by HHH member Whakato Tairawhiti, Gisborne, also supported by MPI [MABx].

Chapter 17. Downstream Market

Downstream Market. The downstream market presents a wide range of potential product pathways. The opportunities outlined below are indicative rather than exhaustive and highlight areas where harakeke-derived materials may support viable commercial applications.

Downstream Opportunity Areas

1. **Composites** (including tapes, weaves, and natural fibre reinforced plastic substrates)
 - a. Automotive, including panelling, structural components, vibration dampening, and related applications.
 - b. Aerospace, including drone components, flow surfaces, radio-transparent uses, semi-structural elements, and related applications.
 - c. Marine, including foiling, sail structures, hull production, antennae, and related applications.
 - d. Sports and recreation, including winter equipment, bicycles, bats, racquets, seating, and related applications.
 - e. Industrial applications, including selected replacements for carbon fibre and fibreglass where performance, safety, and sustainability benefits are material, as well as plastics-reduction initiatives.
 - f. Interior applications where aesthetic and/or structural benefits are important.
2. **Textiles and yarns** (supporting demand for sustainable natural fibre products)
 - a. Industrial textiles, including geotextiles, weed suppression products, primary and secondary carpet backing, interior finishes, ropes, twines, threads, and blends with other natural fibres.
 - b. Apparel.
 - c. Footwear.
 - d. Furnishings and soft furnishings.
 - e. Bedding.
 - f. Automotive interiors.
3. **Other downstream opportunities** (not necessarily yarn-derived)
 - a. AI tool development.
 - b. Carbon sequestration and related environmental applications.
 - c. Software and planning tools.
 - d. Eco-tourism.
 - e. Packaging.
 - f. Lignan derivatives.
 - g. Building materials.
 - h. By-product-derived ingredients for over-the-counter, pharmaceutical, personal care, and potentially food applications.

These opportunities should be regarded as preliminary and would require further research, validation, and market testing before they could be substantiated commercially.

Chapter 18. Market Research 2026

Overview: Report on Global Natural Fibre Upstream & Midstream Market [Plant] 2016 – 2032

Market research was undertaken by Biotenax Ltd (*with a special thanks and support from Far Sky Consulting Ltd, Auckland*) to identify The GLOBAL NATURAL FIBRE MARKET [PLANT], 2016 – 2032 study and is summarised below.

The Natural Fibre Market refers to the production, processing, and wholesale trade of plant-based fibres such as linen (flax), hemp, jute, sisal, and abaca, which are sourced from renewable agricultural crops and primarily supplied in bulk, semi-processed, or industrial yarn or textile forms.

Limitations:

- Some of the companies in this Market are privately owned, and their revenues are not available in the public domain. Hence, the revenues for those companies are estimated based on paid primary interviews and surveys along with paid external third-party databases.
- The weighted average price for each product category has been considered while estimating and forecasting Market revenue on a global basis.
- Inflation is not a part of pricing analysis and revenue calculations in this report. Prices of Natural Fibre and its derivatives vary in each region, and hence revenue estimates cannot be uniform.
- Regional weighted average prices have been considered while breaking down this Market by all segments in each region.
- Company developments not reported in the public domain are not included in the report.

Key Insights: ⁶³

Regional Market Performance

Global Natural Fibre Upstream & Midstream Market [Prominent plant fibre only]

- Asia Pacific region dominates, generating NZ\$10,908 million in 2024, projected to reach NZ\$18,870 million by 2032.
- North America and Europe are value-driven, with North America expected to grow from NZ\$3,446 million (2024) to NZ\$5,524 million (2032).
- Europe leads in specification-driven demand for geotextiles and technical textiles.
- Latin America, Middle East, and Africa show moderate growth, with Africa and Middle East at CAGRs below 4%.
- Regional attractiveness is highest in Asia Pacific due to abundant raw materials and cost-efficient processing.

⁶³ All NZD amounts shown are derived from a yearly average of 0.58USD to 1.00NZD exchange rate and extracted from the Biotenax commissioned Report on Global Natural Fibre Upstream & Midstream Market [Plant] 2016 – 2032 by Credence Research.

Key Drivers and Restraints

- **Drivers:**

- Substitution of synthetics with natural fibres for sustainability and performance gains.
- Regulatory mandates for biodegradable materials in packaging and infrastructure.
- Professionalised supply chains enabling batch consistency and traceability.

- **Restraints** (in a global perspective):

- High exposure to agricultural variability and climate-driven supply risk.
- Processing intensity and yield losses can increase unit costs.
- Performance constraints limit suitability for long-life or high-stress applications.

- **Opportunities:**

- Expansion into advanced composites and regulated infrastructure projects.
- Supply chain transparency and Environmental, Social, and Governance reporting create new value-added segments.

Natural Fibre Pricing and Volume Trends 2025

Raw Material	Av. Global Price (Per KG)	2025 Volume (K Tons)	CAGR (Volume)
Linen (Flax)	NZ\$ 21.11	293	6.16%
Hemp	NZ\$ 8.30	425	7.05%
Jute	NZ\$ 3.66	2,636	4.34%
Sisal	NZ\$ 3.43	388	3.59%
Abaca	NZ\$ 1.29	223	6.26%

- Jute leads in volume and cost efficiency, while linen (flax) commands premium pricing.
- Hemp shows highest volume CAGR, reflecting emerging demand in composites and technical textiles.

The pricing shown presents a strong opportunity for an eventual Harakeke Scutched Fibre wholesale price [WSP] of NZ\$12.00/kg reflecting a 58-64% gross margin depending on land type.

Initial pricing at establishment is expected to be NZ\$20.00/kg moving to NZ\$15/kg in the following 2-3 years.

Natural Fibre Pricing NZ\$ / kg trends 2025 by Region

Raw Material	Global Average	North America	Europe	Asia Pacific	Latin America	Middle East	Africa
Linen (Flax)	21.11	19.88	22.24	18.57	19.40	20.66	25.91
Hemp	8.30	9.40	10.10	7.69	8.26	7.36	7.05
Jute	3.66	4.22	4.34	3.31	3.55	3.34	3.26
Sisal	3.43	4.05	4.40	2.64	3.19	3.29	3.28
Abaca	1.29	1.07	1.43	0.90	1.16	1.41	1.93

Credence Report Summary⁶⁴

The Credence Research report analyses and forecasts the global natural fibre market from 2016 to 2032, with a focus on linen, hemp, jute, sisal, and abaca only. Cotton, coir, ramie, bamboo, kapok, and all protein or animal fibres and are excluded, as they are not considered comparable to Harakeke.

Key summary points:

- The global natural fibre market is expanding steadily, driven by increasing demand for sustainable industrial materials across multiple regions and sectors.
- Asia Pacific remains the dominant market, accounting for the majority of current demand and projected future growth, while North America, Europe, and Latin America also show continued expansion.
- The market is structured across upstream fibre production, midstream processing, and downstream industrial applications, with activity concentrated primarily at wholesale and industrial levels rather than in finished consumer textiles.
- Key processed products include twine, yarns, ropes, and textile yarns, with major applications in sacking, geotextiles, composite reinforcement, carpet backing, and non-woven textiles.
- Principal end-uses include industrial and technical textiles, packaging, construction, agriculture, automotive, and related industrial applications.
- Market growth is being driven by environmental regulation, corporate ESG commitments, circular-economy policy, and the increasing substitution of synthetic materials with natural alternatives.
- In automotive and construction applications, natural fibres are valued for reduced weight, lower processing energy, improved acoustic performance, and suitability for biodegradable geotextile and reinforcement uses.
- Supply chains are becoming more professionalised and standardised, with improvements in retting, scutching, quality consistency, traceability, and batch performance supporting longer-term industrial demand.
- Regulatory frameworks are reinforcing demand by embedding natural fibres into procurement, infrastructure, packaging, and sustainability compliance requirements.
- The market nevertheless faces significant constraints, including inflationary pressure, agricultural variability, climate-related supply risk, regulatory compliance burdens, and ongoing competition from synthetic substitutes.
- Natural fibre processing remains comparatively complex and inefficient, with multiple conversion steps, substantial material loss, and higher labour and infrastructure costs than

⁶⁴ All NZD amounts shown are derived from a yearly average of 0.58USD to 1.00NZD exchange rate and extracted from Biotenax commissioned Report on Global Natural Fibre Upstream & Midstream Market [Plant] 2016 – 2032 by Credence Research.

synthetic alternatives. *It is expected Harakeke product pathway amortisation will maintain a competitive position.*

- Technical limitations also restrict some applications, particularly where long-term durability, moisture resistance, or high-load performance are required.
- Notwithstanding these constraints, natural fibres are expanding into higher-value opportunities in advanced composites, industrial packaging, and regulated infrastructure applications.
- Overall, the outlook for the global natural fibre market remains positive, with sustained growth projected through 2032 and continued demand for standardised, high-quality fibre inputs.

Key Metrics

The market is expanding steadily, driven by increasing demand for sustainable materials across regions, with Asia Pacific leading in demand and growth.

- 2024 global market size: NZ\$18,765 million, projected to reach NZ\$30,500 million by 2032
- Asia Pacific dominates with NZ\$10,900 million in 2024, 58% of the market, projected to reach NZ\$18,850 million by 2032 representing Compound Annual Growth Rate [CAGR] of 7.00%
- North America is expected to grow at 6.0% CAGR, reaching NZ\$5,525 million by 2032
- Europe and Latin America also contribute significantly to regional growth.

Market Volume Trends by Raw Material (K Tons)

The market's total volume is projected to rise from 52.98K Tons to 76.96K Tons over the same period, driven by consistent growth in jute, linen, and hemp.

Global Natural Fibre Market Volume, by Application, 2016 - 2024 (K Tons)

Application	2016	2017	2018	2019	2020	2021	2022	2023	2024
Sacking	976	985	1,014	1,074	863	1,038	1,189	1,319	1,429
Geotextiles	407	416	431	455	364	437	511	579	637
Composite tapes	479	485	503	544	436	524	595	655	707
Carpet backing	365	369	384	413	345	414	471	516	557
Other non-woven / industrial Technical textiles	280	282	274	296	225	278	332	384	426
Total	2,507	2,537	2,607	2,782	2,232	2,690	3,097	3,454	3,755

Table 18 Global Natural Fibre Market Volume, by Application, 2016 - 2024 (K Tons)

Global Natural Fibre Market Volume Growth Expectations, by Application, 2025 - 2032 (K Tons)

Application	2025	2026	2027	2028	2029	2030	2031	2032
Sacking	1,503	1,579	1,653	1,728	1,803	1,880	1,955	2,030
Geotextiles	680	726	771	819	868	918	970	1,023
Composite tapes	751	796	841	888	936	985	1,035	1,086
Carpet backing	583	610	635	661	687	713	734	752
Other non-woven / industrial Technical textiles	448	471	494	517	540	563	593	625
Total	3,965	4,182	4,395	4,612	4,833	5,058	5,286	5,517

Table 19 Global Natural Fibre Market Volume Growth Expectations, by Application, 2025 - 2032 (K Tons)

Credence Report Download`

The full Credence Report commissioned by the author is available for download here.

Download Link: [Report Global Natural Fibre Market, 2016 - 2032.pdf](#)

Harakeke Market Comparison

In terms of scutched fibre alone, the following table indicates where the industry might be positioned.

By Volume Projection

Comparative Mid-stream Market Positions (As scoped and as per defined conditions) (K Metric Tons)

Raw Material	2027	2028	2029	2030	2033	2036	2040	2045	2050	2060
Linen	361	375	390	406	456	512	598	726	882	1,300
Hemp	431	448	466	484	544	611	714	867	1,053	1,552
Harakeke	0.06	0.11	0.28	3.90	11	33	65	271	542	1,084
Harakeke % ⁶⁵	0.01	0.01	0.03	0.44	1.07	2.81	4.72	14.54	21.89	27.54

Table 20 Comparative Mid-stream Market Positions – Volume (K metric ton)

- Average CAGR Harakeke (Post 2040) ~ 15.96% (Biotenax)
- Average CAGR ~ 3.96% (Credence and WCG)

By Revenue Projection

Comparative Mid-stream Market Positions (As scoped and as per defined conditions) NZ\$m

Fibre	2027	2028	2029	2030	2033	2036	2040	2045	2050	2060
Linen	7,620	7,922	8,235	8,562	9,619	10,808	12,623	15,328	18,613	27,444
Hemp	3,581	3,723	3,870	4,024	4,521	5,079	5,933	7,204	8,747	12,898
Harakeke	1.1	2.2	5.6	41	130	391	781	3,252	6,504	13,007
Harakeke % ⁶⁶	0.01	0.02	0.05	0.32	0.91	2.40	4.04	12.61	19.21	24.38
Business Case (T1) NZ\$m ⁶⁷	0	0	0	55	154	462	925	3,852	7,704	15,409

Table 21 Comparative Mid-stream Market Positions – Revenue (NZ\$m)

⁶⁵ Market Share/Vol

⁶⁶ Industry Market Share by Rev.

⁶⁷ FABC Business Case represents financial metrics before Credence Research and European market review was formed. Suggesting a close proximity to market speculation.

Chapter 19. Market Research – Berl Report 2025 ⁶⁸

Whenua-Māori-in-primary-production BERL REPORT *[Online Link]*.

This section draws on contributor input, commissioned market research, and the 2025 BERL report prepared for MPI. The BERL report assesses the current and potential economic contribution of whenua Māori in primary production.

It does not consider the role of HHH initiatives in rebuilding the Harakeke Industry through LUC Classes 7 and 8.

The summary below highlights BERL's key findings. Comments marked in *HHH* note additional issues for government consideration.

Overview of Whenua Māori in Primary Production

Whenua Māori already makes a substantial economic contribution and has further growth potential through optimisation and new development.

Current Land Use & Economic Contribution

More than 1.4 million hectares of whenua Māori are in primary production, mainly forestry and livestock, supporting about 33,700 FTEs and generating around \$5.3 billion in GDP in 2023.

- Māori freehold land: 1,065,364 hectares; contribution of \$10.6 billion in output, \$4.7 billion in GDP, and 30,809 FTE jobs.
- Land held by PSGEs: 363,473 hectares; contribution of \$1.5 billion in output, \$607 million in GDP, and 2,910 FTE jobs.
- Primary land use includes forestry (710,468 hectares), livestock (store livestock and stock finishing), dairy, arable farming, and other rural uses.
- Forestry is a unique land use with challenges like ETS participation, long production cycles, and land management complexities.

Opportunities for Improving Land Utilisation

There is substantial scope to lift productivity by improving underperforming land, including:

- 603,593 hectares of Māori freehold land and 229,480 hectares of PSGE land performing below regional benchmarks.
- According to the report, unlocking this could add \$2.9 billion in output, \$1 billion in GDP, and support 7,447 additional FTEs.
- Focus areas include governance support for over 59,500 hectares of livestock land and better land management practices.

⁶⁸ Courtesy of Whenua Māori in Primary Production: Economic Contribution and Productive Potential by Business and Economic Research Ltd [Berl] on behalf of the Manatū Ahua Matua | Ministry for Primary Industries ('MPI'), supplied to HHH by Māori Agribusiness at the first HHH symposium, March 2026 for reference.

HHH Comment – Government could also consider whenua Māori better suited to restoration, flood resilience, or environmental planting, but supporting commercial harakeke outputs.

Potential for New Primary Production

Introducing new primary industries on currently unused Māori land could generate substantial economic gains:

- 216,988 hectares of Māori freehold land and 58,817 hectares of PSGE land identified as suitable for agriculture, horticulture, or forestry.
- According to the report, this could generate an additional \$1.86 billion in output, \$752 million in GDP, and create nearly 6,500 new FTE jobs.
- Suitable land includes high-quality (LUC classes 1 and 2) land, vacant, or lifestyle land, with many blocks under twenty-five hectares.

HHH Comment – LUC Classes 7 and 8 should also be considered, as many may suit harakeke development under the [RRRT framework](#).

Constraints and Challenges Facing Whenua Māori

Several factors continue to constrain land development and productivity:

- Nearly 75% of Māori freehold land faces physical limitations affecting land use.
- Climate change impacts are significant, especially in the upper North Island.
- About 21% of Māori freehold land is landlocked with no road access within one hundred metres.
- Many land blocks lack governance structures, which are vital for decision-making and resource access.
- Land use change is influenced by biophysical, economic, technological, social, and personal factors, with economic factors being the most prominent driver.

HHH Comment – Many of these issues may be partly addressed through the Harakeke Industry framework, particularly for climate resilience, flood mitigation, and landlocked sites.

Land Use and Capability Classifications

Classification of land by use and physical capability.

- Land uses include arable farming, dairying, forestry, market gardens, rural industry, and vacant land.
- Primary land uses identified: arable, dairying, forestry, market gardens, rural industry, specialist livestock, stock finishing, store livestock, and multi-use rural industry.
- Land use capability (LUC) classes range from 1 (most versatile) to 8 (least suitable), based on physical limitations.
- LUC classes consider soil quality, slope, erosion risk, flooding, salinity, and other environmental factors.
- Land with higher CVs generally indicate higher productivity potential.

HHH Comment – LUC Classes 7 and 8 should be considered, as many may suit harakeke development under the [RRRT framework](#), particularly on whenua Māori.

Land Use Classification Chart ⁶⁹

	LUC Class 1	Arable. Most versatile multiple-use land, minimal limitations, highly suitable for cropping, viticulture, berry fruit, pastoralism, tree crops, and forestry.
	LUC Class 2	Arable. Very good multiple-use land, slight limitations, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops, and forestry.
	LUC Class 3	Arable. Moderate limitations, restricting crop types and intensity of cultivation, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops, and forestry.
	LUC Class 4	Arable. Significant limitations for arable use or cultivation, limited crop types, suitable for occasional cropping, pastoralism, tree crops, and forestry. Some Class 4 is also suitable for viticulture and berry fruit.
	LUC Class 5	Non-arable. Highly productive pastoral land, not suitable for crops but only slight limitations to pastoral, viticulture, tree crops, and forestry.
	LUC Class 6	Non-arable. Slight to moderate limitations to pastoral use, suitable for pasture, tree crops, and forestry and in some cases vineyards. Erosion is generally the dominant limitation.
	LUC Class 7	Non-arable. Moderate to very severe limitations for pastoral use. High-risk land requiring active management to achieve sustainable production. Can be suited to grazing with intensive soil conservation measures but more suited to forestry.
	LUC Class 8	Very severe to extreme limitations to all productive land uses, arable, pastoral, or commercial forestry. Suitable for erosion control, water management, and conservation.

Overall Summary: BERL Report

This comprehensive analysis consolidates Māori land data, assesses land use, capability, and productivity, and models potential economic benefits through land use optimisation and scenario planning. For detail of the report, download here: [70974-Whenua-Maori-in-primary-production BERL REPORT.pdf](#)

⁶⁹ Courtesy of [Manaaki Whenua Landcare Research](#)

Chapter 20. Transport & Supply Chain

A thriving Harakeke Industry can be aligned with other New Zealand staple fibre industries. This feasibility analysis and business case outlines current capabilities, key pinch points, and potential solutions across each operating market stream in relation to:

- Transport Capabilities and Capacities
- Supply Chain Capabilities and Capacities

Transport Capabilities and Capacities

The following outlines a standard transport methodology. Current infrastructure indicates these requirements are manageable.

Key:	Abundant	Scarce
------	----------	--------

Transport Requirements

Operating Market	Operation / Location	Destination	Transport mode
Upstream	Harvest output from grower. <i>[This may or may not include leaf stripping and/or By-product capture]</i>	Primary Processing Facility (National, Regional, and/or local) <i>[This may or may not include Retting, Grading and Baling]</i>	Trucked bundle or bale and By-product IBC (if appl.) <i>[May include micro deliveries by growers' light vehicles]</i>
Transport Capability & Capacity satisfied			
Midstream	Primary Processing of leaf and By-products. <i>[Fibre processing (where reqd.) will include scutching, retting, grading, testing/QAQC, baling, By-product refinement (which may include preservation, filtration, pack-off, water recycling)]</i>	Distribution and Warehousing <i>[For wholesale market supply for Downstream Market secondary process]</i>	Trucked bales and By-product IBC. <i>[Truck, Rail, Sea (FCL/LCL)]</i>
Transport Capability & Capacity satisfied			
Downstream	Secondary Processing of Fibre and By-product. <i>[Where fibre is processed into tapes and weaves, cards, slivers, yarns, textiles, twines, ropes as finished products or otherwise. In the case of By-products, functional ingredients in liquid or solid form.]</i>	Secondary Processing Facilities (Regional, National & Int'l.) <i>[Carding thru to woven product, By-product processing, related packaging]</i>	Trucked. <i>[Truck, Rail, Sea (FCL/LCL)]</i>
Transport Capability & Capacity satisfied			

Table 22 Operating Market by Transport Mode capacities and capabilities.

Supply Chain Capabilities

Many of the operational capabilities required for supply chain readiness and resilience are achievable, but depend in part on:

- Ongoing investment in training for staple fibre and related processing technologies.
- Adoption of RRRT-led resource development.
- Adequate investment in product R&D, supported by realistic commercialisation pathways and robust market research.
- Potential establishment of a Harakeke Industry Body to coordinate knowledge, best practice, and shared information.
- Establishment of a Taonga Protection Framework to protect intellectual property internationally for Māori, New Zealand businesses, and innovators.
- Operational readiness also requires the following process capabilities:

Operational Requirements – Upstream Market ⁷⁰

Capabilities	Proportion of capabilities affecting supply chain readiness
Land Resource ⁷¹	
Harakeke Plants	Planters can easily be developed. Divisions in abundance.
Existing planting projects ⁷²	Unsure of appetite.
Harvestable Resource ⁷³	Improved through RRRT initiatives.
Harvest to Process logistics	
Fibre Stripping	Significant process in Capability. Capacity wanting.
By-product retrieval ⁷⁴	Significant process in Capability.
Retting (drying, sun bleaching)	Abundant Capability & Capacity. Wanting for efficiency.
Scutching	Technology satisfied. Needs equipment for capacity.
Grading and Baling	

Table 23 Upstream Market Operational Requirements.

⁷⁰ Operational requirements to the Business Case scope only [i.e. Scutched Fibre]

⁷¹ All relevant land recommended types, T1-T3

⁷² Available current and future funded environmental projects that could be influenced to adopt RRRT model.

⁷³ Harvestable resource development is intended to be developed in sync with demand.

⁷⁴ That which is a direct output of fibre stripping.

Operational Requirements – Midstream Market

Capabilities	Proportion of capabilities affecting supply chain readiness	
Gilling	Significant process in Capability.	Capacity wanting.
Carding ⁷⁵	Extreme limitations, dependent on international resource.	
Sliver and Yarn Spinning	Extreme limitations, dependent on international resource.	
Tow fibre processing		
Twine production		
Rope production		
Tape production	Local dev.	Limitations, dependent on international.
Composite substrates	Local dev.	Limitations, dependent on international.
Tow fibre processing	Existing local Capabilities / Capacities	
By-product processing ⁷⁶	Satisfactory local Capabilities and Capacities	
By-product processing ⁷⁷	Limited local Capabilities and Capacities	
Marketing & Distribution	Needs adequate resourcing.	
Business Development	Conditional on pinch points being reduced / satisfied.	

Table 24 Midstream Market Operational Requirements

Operational Requirements – Downstream Market

Capabilities	Proportion of capabilities affecting supply chain readiness	
Woven textile production ⁷⁸	Limited local resource.	
Knitted textile ⁷⁹	Existing local Capabilities / Capacities	
Composite products		
Bioactive Ingredients		
Marketing & Distribution	Well resourced	
Business Development		

Table 25 Midstream Market Operational Requirements

Summary

Supply chain readiness presents several pinch points, but none appear insurmountable over the short to medium term within the scope of this business case.

Some Midstream and most Downstream markets will require significant investment and resources.

⁷⁵ Including hackling, combing, aligning.

⁷⁶ Fibre processing derived.

⁷⁷ Secondary non-fibre processing output (Harakeke Seed Oil, kōrari stem utilisation, honey, sequestration, biodiversity harvest.

⁷⁸ At least plain or twill weave.

⁷⁹ Possible co-fibre blends.

Chapter 21. Government: How it can play a part.

Suggested roles for local and central government are set out below.

A modern **Harakeke** industry is viable if developed as a high-value, culturally grounded, sustainability-led sector rather than returning to the bulk fibre commodity model that failed last century.

Critical Success Factors are:

1. **Establishing the right industry model.** Any re-establishment should focus on:

- High-value, low-volume products (for example textiles, composites, nutraceuticals, and design goods) with Medium-value, high volume following once amortisation opportunities allow.
- Premium branding (indigenous, regenerative, traceable, sustainable)
- Niche export markets, not commodity pulp

Premature scaling into mass production would likely repeat past failure.

2. **Building Māori partnership** as a foundation. Harakeke is a **taonga species** with deep cultural significance. Effective partnership requires:

- Strong collaboration across iwi, hapū, and the agricultural sector
- Māori ownership across the value chain, not just land supply
- Embedding Mātauranga Māori in cultivation and harvesting systems
- Supporting Māori-led enterprises, not only stakeholder participation

This could further align MPI Māori Agribusiness with iwi entities, Crown research institutes, tertiary providers, and innovation businesses.

3. **Investing in commercially focused R&D.** Modern success depends on science as well as planting.

Priority research areas include:

- Improved fibre extraction that is clean, efficient, and scalable
- New materials, including bioplastics, composites, and textiles
- Selective breeding for fibre quality, disease resistance, and yield, supported by RRRT planting model research
- Soil carbon and environmental performance
- Support for underutilised land development
- AI-enabled tools

4. **Supporting multiple high-value product pipelines** and pathways from the outset.

Promising sectors include:

- Premium natural fibre outputs
- Sustainable textiles
- Biodegradable packaging
- Construction materials, including panels and composites

- Automotive interiors
- Health products, including extracts and Harakeke seed oil

Partnering with companies early, including offshore firms where NZTE support could assist.

5. **Supporting tertiary and workforce development.** The industry will need practical capability in:

- Harvesting and land management
- Processing plant operation
- Product manufacturing

Link this to regional employment strategies.

6. **Targeting funding to environmental initiatives** using RRRT. Harakeke aligns naturally with:

- Wetland restoration
- Erosion control
- Low chemical input farming
- Carbon sequestration
- Biodiversity development

Government can:

- Integrate a Harakeke industry with climate policy
- Provide carbon credits or biodiversity payments
- Incentivise planting on marginal land, especially land that is not fit for food production and monocropping.

Government could also support industry development through:

- Leveraging Made in New Zealand branding
- Building a strong national Harakeke brand
- Regulatory and land-use alignment
- Long-term commitment beyond election cycles
- Championing Harakeke as the next Kiwifruit/Aquaculture success story

Final priorities:

- A unified industry body could oversee branding and standards.
- A practical five-year rollout plan could provide the first meaningful step in scaling a modern Harakeke Industry beyond what business alone is likely to achieve.
- Grant or co-funding support should be sufficient to let businesses hire skilled staff rather than rely heavily on costly research institute or tertiary resources.

Chapter 22. Climate Change: How can we play our part.

The latest Climate Change Commission (CCC) report ⁸⁰ makes clear that fit-for-purpose biodiversity and adaptation planning are essential to reduce future damage from extreme weather. This presents an opportunity for a collaborative partnership between the Harakeke Industry and Government.

In relation to the *CCC report of 2024*, we propose the following areas of overlap with the Harakeke industry as underlined:

1. The Harakeke Industry could provide harvestable solutions to the initiatives highlighted by the report.
 - a. Local action is increasing across the country to build the resilience of natural systems to climate change (see the story about Maketū residents taking adaptation into their own hands). As with other community and iwi/Māori-led action, however, this can struggle to scale without stronger coordination and support from central government.
 - b. The Department of Conservation has a three-year plan to increase the resilience of wildlife and conservation land to climate impacts. Its Climate Change Adaptation Action Plan 2025–28 is intended to support prioritisation within existing resources.
 - c. Policy and legislative reforms are underway, including in resource management and local government, that relate directly to environmental management. However, these reforms focus on access to resources and miss opportunities to systematically address climate exposure, vulnerability, and resilience. To build resilience and avoid maladaptation, climate change and adaptation needs should be integrated into all land use, land management, environmental management, and conservation policies.
 - d. Persistent barriers to adaptation include limited funding, investment uncertainty, data gaps, weak research support, and slow implementation. Removing these barriers and increasing investment to prevent degradation and restore ecosystems would strengthen climate resilience.
 - e. These findings should be integrated into biodiversity and biosecurity planning. Strong support for natural resilience is critical to reducing climate risks. Integrated, responsive environmental policy would strengthen the country's natural infrastructure.
 - f. Intact and resilient ecosystems are better able to absorb change and shocks while continuing to provide services such as food and fibre, storm protection, recreation, cultural and spiritual connection, and underlying processes like nutrient cycling.
2. The Harakeke Industry could adopt learnings, Mātauranga Māori, and contemporary science on floodplain adaptation design where climate change initiatives have been enacted:
 - a. The country's natural systems require an integrated, holistic approach to management that responds to rapidly changing climate impacts. This will also require greater investment in science to provide data and improve understanding of climate impacts and the effectiveness of different interventions.
 - b. Robust monitoring and further research into how ecosystems may change under different climate scenarios are needed to understand thresholds and other non-linear changes.

⁸⁰ Monitoring Report - Emissions Reduction - July 2024 -FINAL [<https://www.climatecommission.govt.nz/our-work/monitoring/emissions-reduction-monitoring>]

These findings should be integrated into biodiversity and biosecurity planning. Strong support for natural resilience is critical to reducing climate risks. Managing resources to maintain these services can directly reduce risks to water systems, transport networks, homes, businesses, the economy, and people's health and wellbeing."

3. A Harakeke Industry Body could advocate for these initiatives.

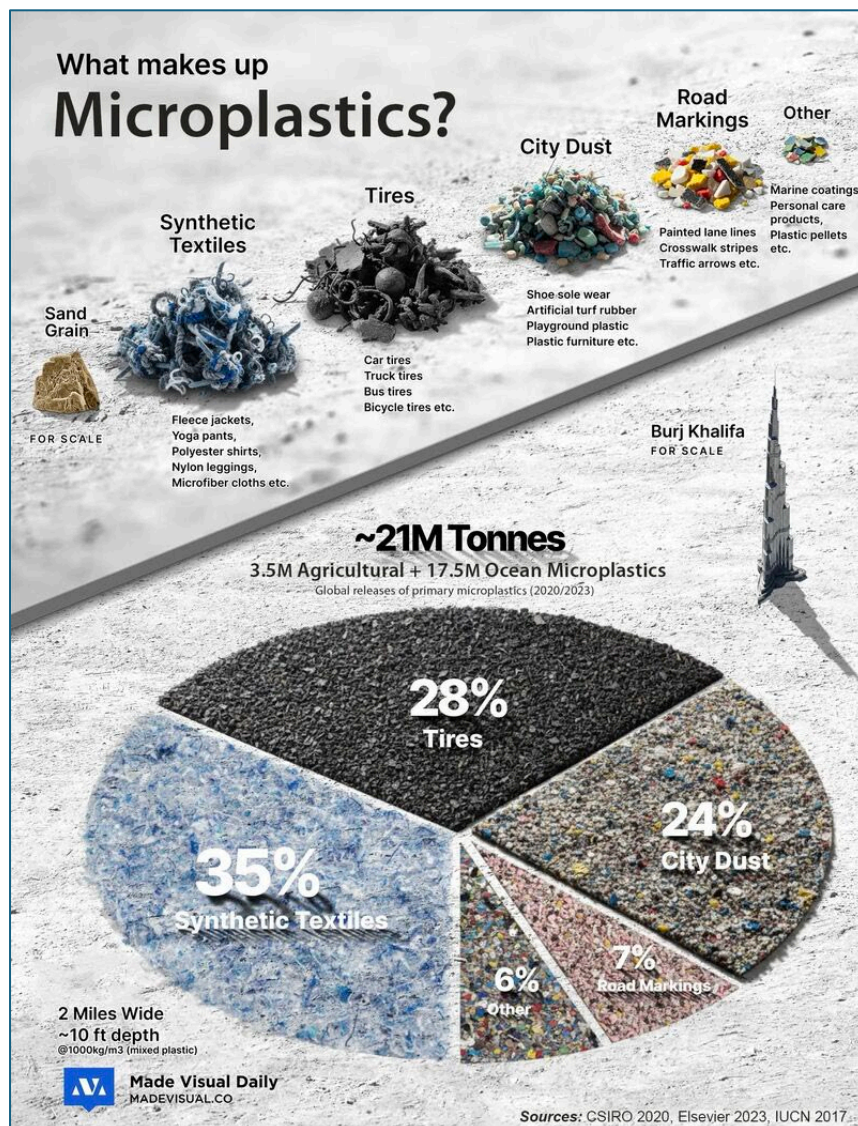


Image 26 Courtesy CSIRO

Keynote:

- Over one-third of microplastic pollution comes from synthetic textiles like fleece jackets and polyester shirts.
- Tire wear and city dust are also major contributors, accounting for a combined 52% of the total.
- An estimated 21 million tonnes of microplastics have accumulated in the environment, enough to cover 3.2km² by 3m deep.

Chapter 23. Harakeke Industry Body

In a Nutshell

The HHH Harakeke Symposium in March 2026 highlighted four key points.

- There is a strong economic case.
- There is strong support for re-establishing the Harakeke Industry.
- Extensive expertise and capability are available.
- A Roadmap is needed to guide next steps.

To support an effective Harakeke Industry Body that can guide interested parties, this study proposes the following:

The proposal centres on a Roadmap and an Information Hub.

1. Roadmap

- a) A living document that builds credibility and confidence across industry participants, including landowners, growers, researchers, businesses, investors, educators, Government, media, and Mātauranga Māori communities.
- b) Define the contents of an Industry Development Plan and how it could evolve within a Te Ao Māori framework.
- c) Identify who needs to be directly involved and in what way.
- d) Benchmark against other industry planning processes and outputs.
- e) Explore how an Industry Advisory Council, or similar body, could be formed, what functions it would serve, and how it could sponsor the Roadmap.
- f) Use the first version of the HHH FABC as a foundation for further development.

2. Info Hub

- a) A portal and proactive hub for information sharing and exchange.
- b) Define and provide the practical 'how-to' information participants need.
- c) Support industry and the wider community awareness, messaging, and branding.
- d) Provide guidance on Mātauranga Māori, Harakeke whakapapa, tikanga, and their role in industry messaging.
- e) Support te reo Māori application.
- f) Include a history portal.

We also expect this proactive initiative to promote whanaungatanga (relationship building) through engagement.

As noted in Sustainable Farming Fund material from 2006, Alan McDermott (AgResearch) highlights the importance of mature, collaborative behaviour: *"Food supply chains are shifting from adversarial, commodity-focused spot markets to tightly aligned relationships supplying differentiated products. Success in these supply chains depends on communication, shared knowledge and resources, shared gains, and treating the supply chain as the unit of strategy and management. Without this, stakeholders work from opposing positions rather than asking how all can benefit. Face-to-face interaction will become more important, and the key challenge for high-value differentiated markets is building successful supply chain relationships and communication processes"*⁸¹

⁸¹ McDermott et al, Communication challenges in the 2010 supply chain (extract from Sustainable Farming Fund: Project 03/153 45, Integrating NZ Lax into land management systems, authored by Elizabeth McGruddy in 2006)

Part IV. The Business Case Findings

Chapter 24. The Business Case Summary

Defined by [Type 1A versus 3C](#) Land Ownership Model and using a hypothetical example of an 8Ha under-utilised whenua Māori site, with a LUC classification of 6-8, the Business Case findings show the opportunity for establishing a viable Harakeke resource, in this case on whenua Māori.

Link to raw data: [Harakeke Harvest Calc_0224_v8.xlsx](#)

Key factors are: Light vehicle access exists

- A willing and able workforce is available
- A robust supply chain has been developed underpinned by a sustainable and thriving Harakeke industry
- Upstream costs can be amortised over by-products and other directly related income generators (*not absolutely necessary but assists in realising the 56-60% gross margin defined*)
- Consistency in quality relative to market demand.

Specific to each phase of the business case, the following assumptions are made:

Harvest Metrics

- RRRT Planting of phormium tenax ⁸²
- Appropriate land types applied
- Planting of divisions (add 2yrs if T28 cells)
- Staff are trained and efficient
- No serious mitigating climate impacts
- Adequate plant and equipment resource is available
- Appropriate processing infrastructure is available and accessible

Cost of Production

- Pay rates attractive enough
- Appropriate land types applied
- Appropriate processing infrastructure is available and accessible

Revenue Projections by Resource Age & Size

- Harvest Metrics satisfied
- Production costs controlled and satisfied
- Reducing WSP pricing by scale over maturity status

⁸² Cultivar Ngāro or similar (greater yields with Gigantea or Taiore)

Summary of Business Case Site

Hypothetical Scenario for FABC - HHH Symposium 2026

Site Location and Description

TE KOPANI 36, TŪAI, WAIKAREMOANA, (Te Rere Falls), Māori Freehold Land

7-8Ha Net [Part of 224Ha]

RRRT Land Type 3C - Under-utilised (Non-productive customary land / ROI on capital expectations 0%).
Current

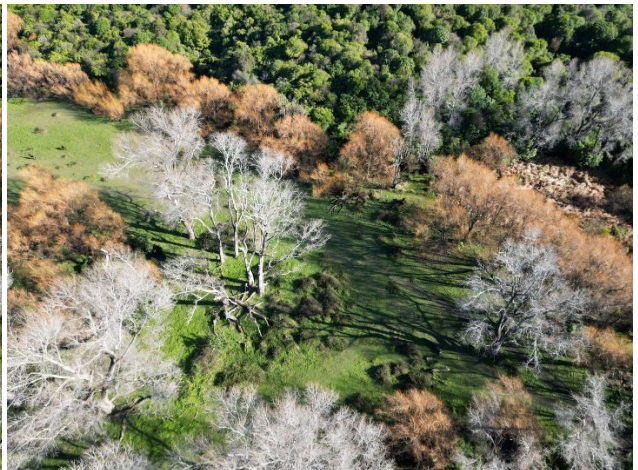




Table 26 Courtesy Ngāti Ruapani

Site Yield and Output

Total Harakeke Plants (RRRT Model @2,500/Ha) 8Ha	20,000 Harakeke (+ 2,400 Biodiversity)		
Assuming planting from divisions (Ngāro)	(3-4yr)	(5-7yr)	(8-20yr)
* Harvesting/QC/Bundling/Weighing	Kgs	Kgs	Kgs
Harvest / wt. per plant p.a. [Wet]	10.81	25.09	43.19
Scutched Fibre / Plant p.a. (kgs)	1.24	2.89	4.97
Resulting Tow fibre by-product	0.12	0.29	0.50
~ Harvests p.a.	1.25	1.75	2.00
Net Scutched Fibre* / Ha p.a.	2,796	6,493	11,174
Scutched Fibre* p.a. (MT) for 8Ha Block	22.37 MT	51.94 MT	89.39 MT

Site Financial Projection Synopsis

NZ\$		(3-4yr)	(5-7yr)	(8-20yr)
		WSP	WSP	WSP
[WSP = Wholesale Price NZ\$] Current Price \$25/kg		\$20,000	\$15,000	\$12,000
Revenue [All processes**] Based on stated WSP		\$447,327	\$779,142	\$1,072,715
(Avg.)				
Production Employment costs	52.7%	-\$136,293	-\$290,848	-\$447,816
GP	63.5%	\$311,034	\$488,293	\$624,899
Non-production Overhead / Management / Admin	40.5%	-\$191,244	-\$198,894	-\$206,850
Operations Overhead	6.8%	-\$28,440	-\$29,625	-\$47,400
Total Costs	100%	-\$355,977	-\$519,367	-\$702,066
EBT p.a. (after interest and depreciation) ⁸³	29.4%	\$91,350	\$259,774	\$370,650
EBT p.a. per Ha (after interest and depreciation)		\$11,419	\$32,472	\$46,331

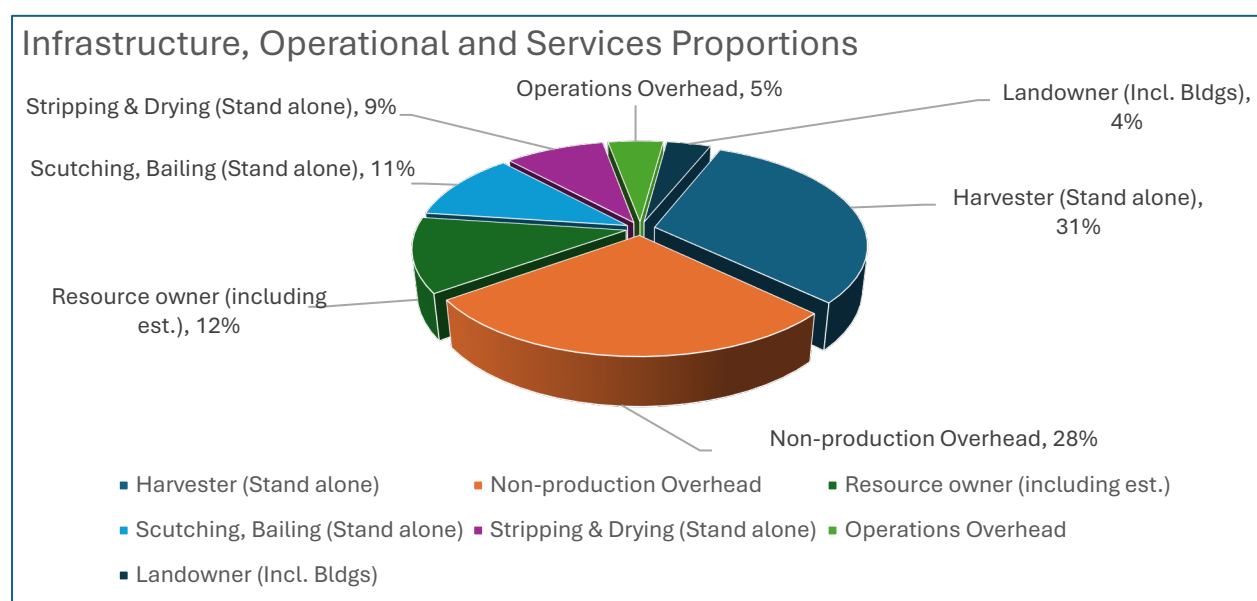
Table 27 Te Kopani Hypothetical Site: Financial Projections Synopsis

⁸³ NB: The first 2-3 years of establishment, erodes this outcome to 20+ % depending on capital outlay.

Site Intervention Proportions & ROI

Infrastructure, Operational and Services Proportions			NZ\$	
Intervention Proportions per annum				
Harvester (Stand-alone)	31%	\$28,319	\$80,530	\$114,901
Non-production Overhead	28%	\$25,578	\$72,737	\$103,782
Resource owner (including est.)	12%	\$10,962	\$31,173	\$44,478
Scutching, Bailing (Stand-alone)	11%	\$10,049	\$28,575	\$40,771
Stripping & Drying (Stand-alone)	9%	\$8,222	\$23,380	\$33,358
Operations Overhead	5%	\$4,568	\$12,989	\$18,532
Landowner (Incl. Bldgs.)	4%	\$3,654	\$10,391	\$14,826
ROI Net 3.22% on capital				
Farmgate EBT Total	100%	\$91,350	\$259,774	\$370,650

Table 28 Te Kopani Hypothetical Site: Intervention Proportions & Return on Investment Expectation



Site Specific Key Notes

The following brief shows the difference in returns based on differing relevant appetite the owner has for capital investment.

This business case is intended to present outcomes relevant to risk/investment appetite option one and two.

7 Year Timeframe (Including 1st 2-3 years of preparation and establishment)

Risk Appetite Option 1: Land ownership, Plant resource, Upstream infrastructure, Harvesting (Leaf supply only)

Total Revenue	\$2.7M
GP [After Production Cost]	\$1.7M
EBT (Pre-Tax Net Earnings)	-\$0.07M
Break-even	Year 5
Investment returned	Year 8

Risk Appetite Option 2: As (1) but including contracted processing onsite Stripped and Retted (including contracted Scutching offsite)

Total Revenue	\$3.5M
GP [After Production Cost]	\$2.2M
EBT (Pre-Tax Net Earnings)	\$0.48M
Break-even	Year 3
Investment returned	Year 6-7

Summary

- This Business Case is supported by significant research findings. Raw data [Harakeke Harvest Calc_0224_v8.xlsx] is available by contacting Biotenax Limited at contact@biotenax.nz
- Positive feasibility and viability is indicated for an 8Ha site, but calculations suggest viability on sites as small as 5Ha with 4Ha.
- Sites less than 4Ha might consolidate locally with other small titles to form co-operatives that pool resources to ensure viability.

Chapter 25. Work Force and Vocation Pathways

Labour rates

It is clear from other horticultural (and some agricultural) industries that market pricing impacts on the ability to pay wages much beyond the minimum wage \$23.95⁸⁴ or even the living wage⁸⁵.

Fruit picking and pruning rates normally command between \$25-\$30/hr⁸⁶. In addition to these rates sometimes accommodation and/or supplements are provided.

The HHH Business Case works with wage rates per hour gross (NZ\$)⁸⁷ standardised as follows and not including supplements, and only for Harvest to Scutched Fibre output:

Land Type	Harvesting	Stripping & Retting	Scutching / Bailing / QC
1	\$35.64	\$39.20	\$37.42
3	\$34.65	\$38.02	\$36.29

Type 3 is assumed to be located in regions with lower accommodation and living costs.

Vocation pathways

We would expect that for a thriving and growing industry, multiple employment pathways open up for rangatahi at primary and secondary industry levels.

We would also expect to see tertiary bodies offering Harakeke Industry-specific training and possible apprenticeships.

⁸⁴ <https://www.employment.govt.nz/news-and-updates/minimum-wage-is-increasing-on-1-april-2026>

⁸⁵ According to Living Wage Aotearoa New Zealand, the 2026/27 Living Wage rate is \$29.90 paying the Living Wage rate is voluntary.

⁸⁶ With the exception of higher rates at some peak seasons. <https://www.hortnz.co.nz/news-events-and-media/media-releases/what-the-horticulture-industry-is-doing-to-attract-and-retain-new-zealanders>

⁸⁷ Including holiday pay.

Chapter 26. The Business Case – Financial Projections

Capital Expenditure

Type 1A [EXAMPLE 100Ha Site]

Asset scenario: Type 1 | Private Title Land [NEW or PAST ACQUISITION]

Related to HHH Co-op member capital investment [assuming with financing]

Currency: NZ\$ excluding GST

- Interest: Operating Debt ~ (Type 1 land) 3.28%
- Interest: Debt on Capital Plant ~ 6.85%
- Ret. on Capital expectations [Land] 5.00%
- Ret. on Capital expectations [Other] 12.00%

Capital Need - Type 1 Private Title Land		Investment	ROI Expected (p.a.)
Buildings	19.62%	\$850,000	\$102,000
Land and Infrastructure	35.60%	\$1,542,000	\$185,040
Crop	8.96%	\$388,000	\$46,560
Harvesting Equip	6.74%	\$292,000	\$35,040
Stripping and Drying Equip	8.73%	\$378,000	\$45,360
Scutching Equip	20.36%	\$882,000	\$105,840
Total		\$4,332,000	\$519,840

Table 29 Type 1A [EXAMPLE 100Ha Site] Capital requirements.

Type 3C [EXAMPLE 100Ha Site]

Asset scenario: Type 3 | Customary Whenua Māori / Non-productive customary land / possible local govt dispensations and exemptions.

Related to HHH Co-op member capital investment [assuming with financing on capital plant]

Currency: NZ\$ excluding GST

- Interest: Operating Debt ~ (Type 1 land) 3.28%
- Interest: Debt on Capital Plant ~ 5.50%
- Ret. on Capital expectations [Land] 0.00%
- Ret. on Capital expectations [Other] 12.00%

Capital Need - Type 1 Private Title Land		Investment	ROI Expected (p.a.)
Buildings	18.88%	\$420,000	\$50,400
Land and Infrastructure	4.86%	\$108,000	\$12,960
Crop	15.26%	\$339,500	\$40,740
Harvesting Equip	12.45%	\$277,000	\$33,240
Stripping and Drying Equip	14.57%	\$324,000	\$38,880
Scutching Equip	33.99%	\$756,000	\$90,720
Total		\$2,224,500	\$266,940

Table 30 Type 3C [EXAMPLE 100Ha Site] Capital requirements.

Notably Type 3C site may experience 25% Less Capital demand considering land and/or building acquisitions and possibly 12% less Capital demand excluding land and/or building acquisition.

Expense Profile

Type 1 and **Type 3** land opportunities and likely expense profile comparisons are made. While the Type 1 scenario has a weighted disadvantage due to inherently higher costs, **both** options appear to be viable.

Note: Salaries stated exclude all operational/production labour costs already accounted to reflect true Cost of Goods Sold [COGS]

Type 3 - Expense / Overhead consolidation	100Ha p.a.	8Ha p.a.	Less than Type 1
Account / Bank / Consult / Legal	\$18,000	\$4,320	-29%
General / Ent. / Insurance / Office / IT	\$18,925	\$4,542	-31%
HHH Fees / Subs / Rates	\$16,400	\$3,936	-36%
Interest*	\$96,891	\$9,373	-48%
Salaries / Kiwi Saver	\$578,400	\$138,816	-19%
Sub total	\$728,616	\$160,987	-26%
Depreciation (based on Yr1 p.a.)	\$290,950	\$29,538	-17%
Other Expenses	\$3,000	\$720	-50%
Total (non-production expenses)	\$1,022,566	\$191,244	-24%

Table 31 Type 3 - Expense / Overhead consolidation [Non-production]

Type 1 - Expense / Overhead consolidation	100Ha p.a.	8Ha p.a.	
Account / Bank / Consult / Legal	\$25,200	\$6,048	
General / Ent. / Insurance / Office / IT	\$27,325	\$6,558	
HHH Fees / Subs / Rates	\$25,800	\$6,192	
Interest*	\$186,940	\$30,120	
Salaries / Kiwi Saver	\$717,600	\$172,224	
Sub total	\$982,865	\$221,142	
Depreciation (based on Yr1 p.a.)	\$352,100	\$66,425	
Other Expenses	\$6,000	\$1,440	
Total (non-production expenses)	\$1,340,965	\$289,007	

Table 32 Type 1 - Expense / Overhead consolidation [Non-production]

Part V. Is this Feasible?

Chapter 27. The Feasibility Summary

What are the conditions

What are the necessary pre-conditions for a Harakeke Industry?

- There is the willingness and ability of all sectors to collaborate and invest in the industry at a national scale.
- There is willingness and capacity in government bodies to support the industry through funding and investment in Science, Research, and Innovation.
- There is willingness and capability in our research institutes and tertiary sectors that can underpin this development, in a multi-generational effort.
- There is sound guidance for participants willing and able to enter the industry and in a way that ensures taonga protection.
- There is appropriate land and planting resource available to satisfy demand in an environmentally sound but viable way, ensuring resulting land use leads to:
 - Harvestable planting of underutilised land along with associated biodiversity.
 - Farmers have the tools and investment to viably retire agricultural land where necessary.
- There is a market and efficient supply chain! A market that is driven by increasing demand for the performance and technical superiority Harakeke can provide.

How are we to be competitive?

The feasibility analysis indicates that these multiple product pathways will allow for **Cost Amortisation** across primary products (especially fibre production). This will in turn result in a more **Competitive Position**. Furthermore, it expected that associated biodiversity development could also lead to further returns for the landowner.

In turn, this would strengthen the competitive position of the industry's primary outputs.

How will we do this?

This depends on a sustained momentum and effort by many of the existing HHH members and beyond, to:

- Innovate
- Develop
- Trial
- Collaborate
- Implement (on the back of successful achievement in the product, resource and supply chain development).

Further to this, and in unison:

- Leverage local expertise/Mātauranga and scientific capability both here and abroad to this end

- Attract meaningful investment (especially locally) from these successes.
- Understand and develop our market demand.
- Ensure the development of a robust supply chain that provides extensive product pathways that can allow for amortisation of upstream market costs. By this nature, to ensure a highly competitive fibre and by-product pricing position.

Who is 'we'?

As stated, there are many of us already heavily engaged in this endeavour either privately, at a community level, and/or through support from Government entities like Māori Agribusiness [MPI]. Besides the [HHH cluster members](#) instrumental in this research previously acknowledged, other early adopters are acknowledged in [Chapter 29](#).

Others who can support the re-establishment of the Harakeke Industry are suggested as a few examples:

Entity	Field of Support
Bioeconomy Science Institute [BSI] <i>Maiangi Taiao</i>	Bio-based products & technology, land use, processing technology.
Bio Processing Alliance [BPA]	Seed funding for innovation, connection to processing capabilities.
University of Waikato	Research support, materials.
Auckland University of Technology [AUT]	RRRT research support (AUT Regenerative Environments Research Network [RegEN]), Textiles
Government	MBIE, MPI support
Toroa Fund	Toroa Fund is a private credit fund created to support the next chapter of growth in the Māori economy

What are our goals?

We plan to re-establish the Harakeke industry by 2030. We expect the industry will look somewhat like the following:

- Adopts a trialled and proven Riparian, Revegetation, Restoration and Transition [RRRT] model for planting of Harakeke in a sustainable, ecologically sound, and harvestable way that leads to:
 - The enhancement of biodiversity, water course health, and flood resilience
 - The development of under-utilised land or viable transition of farmland, with focus on influence over existing funded native planting projects; LUC 6-8 classified land use.
 - Improving erosion control
 - Help reduce GHG emissions and nitrates to waterways.
- To realise the utilisation of whenua Māori towards a viable, contemporary horticultural asset that provides a pathway to independence and increasing export value for Aotearoa.
- Taps into international markets for fibre and related by-products that could result in a 1% global market share [NZ\$155M] in scutched fibre alone by 2033 and a 27% share [NZ\$16B] by 2060. Noting of course that all follow on Midstream and Downstream product revenue is going to be incremental.

- Results in meaningful protection of taonga Māori on an international level, without stifling social, cultural, environmental and economic development, in perpetuity.
- Has adopted a collaborative industry governance model that also embraces multi-generational involvement.
- And becomes a mainstay industry in Aotearoa New Zealand that is authentic, honourable, innovative and sustainable.

Where is this industry resourced from?

A Harakeke Industry [in terms of a Scutched Fibre farmgate output] is likely to be resourced from whenua Māori but equally from our farming sector more generally, motivated to retire farmland due to extreme challenges. The industry is also expected to be viable and sustainable without the need to impact on highly productive land.

The industry resources that fulfil supply chain needs can also be located for efficiency and resilience positioning.

The following overview presents ideal proximity. However much of this logistic arrangement is going to be driven by appetite for:

- Investment into relevant capability
- Infrastructure (roading, access, electricity, water)
- Labour resources
- Market demand.

Resource	Regional Location Options	Ideal Proximity to Process
RRRT Planting	Local Rural	Up to 50kms
Harvesting	Local Rural	Up to 75kms
Stripping	Local Rural	Up to 90kms
Retting	Local Rural	Up to 90kms
Scutching	Regional Rural	Up to 150kms
Grading / Bailing QAQC	Regional Rural	Up to 150kms
Distribution	Regional Urban	Up to 500kms
Export	Regional Urban	Main centres

How much investment is needed?

Investment requirements are anecdotal however based on collaborative discussion through HHH members during the 2023-2026 period to date. ⁸⁸

An approximate Investment range is defined against specific milestones and assumes only T3 type land (*therefore T1 has relevant incremental capital needs*). Investment milestones are presented in the following groups.

Potential Site Investment Milestone Groups

Harakeke Industry (Anecdotal) Investment Projections: 2027-2035. Based on a **100Ha site Type 3C** Land ownership model. Self-sufficient to a Scutched Fibre Farmgate Output.

Table 33 Potential Site Investment Milestone Groups: NZ\$'000's ⁸⁹

Group	Investment Groups	Y1-2	Y3-4	Y5	Y6	Y7	Y8
0	Working Capital (Non-production)	\$2,086	\$2,169	\$1,128	\$1,173	\$1,220	\$1,269
1	Land Preparation and RRRT design	\$95		\$25		\$25	
1	Plants and Planting	\$340	\$125	\$70	\$70	\$70	\$35
1	Production Bricks and Mortar / Services		\$320			\$225	
1	Roading / Tracks	\$25		\$25		\$25	
2	Ancillary Plant & Equipment: Harvesting / Mobile		\$232				
3	Ancillary Plant & Equipment: Stripping		\$200				
3	Water storage / Filtration		\$65			\$85	
3	Ancillary Plant & Equipment: By-product collection (from stripping process)		\$65				
3	Ancillary Plant & Equipment: Retting		\$33		\$45		\$25
4	Ancillary Plant & Equipment: Scutching / Tow handling		\$700			\$250	
4	Ancillary Plant & Equipment: QAQC / Grading		\$22				\$75
4	Ancillary Plant & Equipment: Bailing / Packaging / Labelling		\$15			\$20	

⁸⁸ Further research and business planning would be required to substantiate. Undertaken by all relevant stakeholders.

⁸⁹ Data established through the interview process with members, suppliers and internet searches. [Please refer to Disclaimers statement Page 4](#)

Group	Investment Groups	Y1-2	Y3-4	Y5	Y6	Y7	Y8
4	Ancillary Plant & Equipment: Ancillaries (HVAC, inflow/outflow, Handling)		\$45		\$35		\$13
5	Ancillary Plant & Equipment: Warehousing / Distribution			\$158			\$350

Table 34 Total Site Investments by Groups: NZ\$'000's

Group	Resource	Y1-2	Y3-4	Y5	Y6	Y7	Y8
1	Establishment	\$460	\$445	\$120	\$70	\$345	\$35
2	Harvest		\$232				
3	Stripping, Retting and By-product collection		\$363		\$45	\$85	\$25
4	Scutching / QAQC / Bailing		\$782		\$35	\$270	\$88
5	Warehousing / Distribution			\$158			\$350
Total Capital Investment		\$460	\$1,822	\$278	\$150	\$700	\$498
Total Working Capital need		\$1,043	\$2,169	\$1,128	\$1,173	\$1,220	\$1,269
Total Investment (Gross)		\$1,503	\$3,991	\$1,406	\$1,323	\$1,920	\$1,766
Production GP Return		\$0	\$1,893	\$5,997	\$6,237	\$6,487	\$6,746
~ Net Earnings EBITDA		-\$1,503	-\$2,099	\$4,591	\$4,914	\$4,566	\$4,980

The above projections are purely dependent on hypothesis and stated conditions being met through the period stated.

Potential Industry Development Investment

Presented over an eight-year period from 2027-2035 with an estimated annual market revenue of ~NZ\$444M in 2036.

Based on Industry need: NZ\$ '000's							
Group	Resource	Y1-2	Y3-4	Y5	Y6	Y7	Y8
6	Industry Body / Governance	\$85	\$250	\$325	\$500	\$825	\$925
6	IP / Taonga Protection / Legal	\$125	\$65	\$125	\$35	\$35	\$25
7	Market Development / Export tools	\$0	\$350	\$350	\$350	\$550	\$625
7	Brand / Communication / Training / Messaging	\$65	\$175	\$250	\$125	\$125	\$125
7	Export (Licencing, CITES, Agreements, Other)	\$25	\$125	\$75	\$175	\$175	\$175
Total Capital Investment		\$300	\$965	\$1,125	\$1,185	\$1,710	\$1,875

Table 35 Scutched Fibre Annual Rev NZ\$'000's

Potential Investment beyond Scutched Fibre

Further to the above, an estimate of Midstream and Downstream Investment Capital need is tabled.

Group	Resource Investment	NZ\$ (m) Range
8	Twine / Rope Production	0.5 - 0.9
9	Yarn Production	20.0 - 100.0
10	Textile Weaving (Excluding dying & jacquard)	2.0 - 10.0
11	Textile Weaving (Including dying & jacquard)	12.0 - 25.0
12	Composite Tape and Bi-Axial Weaving	4.0 - 12.0
13	By-Products Processing / Fractioning	0.8 - 6.0
14	Harakeke Seed Oil [SCFE]	1.2 - 3.5
15	Harakeke Honey Production	0.1 - 0.3

Table 36 Approx. Capital Need NZ\$m

Investment Summary [NZ\$]

- Depending on site size, ownership type, application and capability adoption, establishment investment could range from approximately:
 - \$175,000 for a 4Ha site to
 - \$2,250,000 for a 100Ha site.
- Depending on site size, ownership type, application and capability adoption, working capital investment needs could range from approximately:
 - \$165,000 for a 4Ha site to
 - \$1,150,000 for a 100Ha site.
- Depending on site size, ownership type, application and capability adoption, return on investment time frame could range from approximately:
 - 4-7 years for a 4Ha site to
 - 3-4 years for a 100Ha site.
- In terms of a **Midstream Market** minimum investment, an optimum goal for the industry to realise incremental gain for the economy, and to meet long term resilience in the Harakeke Industry is likely to be:
 - All Harakeke Based Midstream Products NZ\$350M
 - All Harakeke Fibre Derived Midstream Products NZ\$315M

Chapter 28. Summary and Next Steps

Financial Characteristics

Strengths

- High yield per hectare
- Low ongoing input costs
- Multiple revenue streams
- Access to low-cost land

Constraints

- higher harvest costs (manual processes in early phases that require amortisation)
- upfront investment in processing capability
- staged scale-up required

Value Drivers

- by-product commercialisation (mandatory)
 - regional processing hubs
 - cooperative production models
 - future automation and efficiency gains
-

Path to Scale

Phase 1 (0–3 years)

- pilot RRRT sites
- validate yield and cost models
- establish initial processing capability
- nurture markets

Phase 2 (3–7 years)

- expand land footprint
- scale production and outputs
- leverage and develop markets
- develop regional hubs

Phase 3 (7–15 years)

- manufacturing to mid-stream and downstream market needs
 - global market integration
-

Risk & Mitigation

Key Risks

- early-stage capital requirements
- processing scale-up
- market development timelines
- weak momentum

Note: We do not envisage challenges from contemporary climate, irrigation, invasive species and land use issues associated with other horticultural crops to be as relevant to RRRT planting resource.

Mitigation

- phased rollout
- support for Harakeke based businesses on a collaborative basis
- alignment with government and environmental funding
- partnerships with Māori landowners and research institutions
- taonga Māori protection
- diversified revenue streams
- nationwide awareness and buy-in

Investment Thesis

HHH provides exposure to:

- a **new regenerative industrial sector**
- strong ESG-aligned investment
- scalable, land-based assets
- multi-product revenue diversification

Harakeke has the potential to re-emerge as a major export industry—this time as a high-value, sustainable, and globally differentiated fibre platform.

Capital Use

Investment will accelerate:

- RRRT land development
- processing infrastructure
- fibre and by-product commercialisation
- industry coordination and scaling

Feasibility Findings

1. Technological Readiness

- Substantial progress has been made across harvesting, fibre processing, and product pathways
- Historical processing limitations are being addressed through new stripping technologies and research advancements
- Remaining gaps are manageable and investable

Conclusion:

Technology is no longer a primary barrier to industry development.

2. Land and Resource Advantage

The strongest competitive advantage lies in the availability of:

- underutilised whenua Māori
- floodplain, riparian, and marginal land not suited to food production
- land requiring environmental remediation

These land types:

- lower capital expectations
- align with Harakeke's natural growth conditions
- support co-benefits (carbon, biodiversity, water health)

Conclusion:

Land suitability strongly supports both viability and sustainability, benefiting agricultural sectors also.

3. Production Model (RRRT)

The proposed **RRRT (Riparian, Revegetation, Restoration, Transition)** planting architecture is central to the business case. It integrates:

- environmental restoration
- biodiversity development
- harvestable fibre production

Key advantages:

- No annual replanting or intensive soil cultivation
- Low chemical and irrigation requirements
- Permanent, regenerative biomass system
- Supports multiple revenue streams beyond fibre

Conclusion:

RRRT provides a **foundational model for a regenerative, harvestable landscape industry.**

4. Economic Viability

The analysis demonstrates that:

- Harakeke produces significantly higher fibre yield per hectare than comparable natural fibres
- While harvest costs are higher (due to manual processes), these are offset by:
 - yield volumes
 - by-product value
 - co-benefits from biodiversity and land use integration
- Viability improves substantially when:
 - by-product pathways are developed (mandatory)
 - processing is regionally coordinated
 - land cost expectations are low (e.g. Māori land)

Conclusion:

The business case is **economically viable under the right land, processing, and market conditions.**

5. Market Potential

Harakeke competes within the global natural fibre market alongside:

- hemp
- linen flax
- sisal
- jute and abacá

However, it offers distinct advantages:

- strong fibre properties and versatility
- environmental credentials
- unique cultural provenance
- potential for premium positioning

Conclusion:

Market entry is achievable, particularly in **high-value, sustainability-driven segments.**

Business Model

An **upstream-first approach** focused on:

- planting and resource development
- harvesting and logistics
- fibre processing (to scutched fibre stage)
- primary by-product extraction

This establishes:

- early revenue pathways
- supply chain control

- platform for downstream expansion (textiles, composites, biomaterials)
-

Market Position

Harakeke competes within the global natural fibre market but is positioned as:

- a premium, sustainability-led product
- a high-performance fibre with multiple industrial applications
- a distinctive, provenance-rich material tied to Aotearoa

Target markets:

industrial fibres, composites, sustainable materials, personal care and specialised textile segments.

Key Conditions for Success

To realise this opportunity, several critical conditions must be met:

Mandatory

- Development of a harvestable resource without impacting on high quality land
- Development of by-product markets to improve economics
- Establishment of regional processing capability
- Creation of industry standards (QA/QC, grading, certification)
- An informed investment community

Highly Advisable

- Integration with environmental restoration programmes
- Use of underutilised Māori land
- Development of co-habitation revenue streams (honey, rongoā, carbon, biodiversity assets)

System-Level

- Strong collaboration between Māori, government, and industry
 - Sustained investment in R&D and market development
 - A coordinated industry governance framework
-

Strategic Value Proposition

The proposed Harakeke industry delivers a unique combination of:

- Economic resilience (diversified revenue streams)
- Environmental regeneration (restoration + production)
- Cultural integrity (grounded in Te Ao Māori)

- Global competitiveness (sustainable fibre markets)
-

Next Steps

The pathway forward:

1. **Establish pilot RRRT sites** to validate proposed planting models at scale (commercially usable)

To this extent Te Hononga Hapori Harakeke [HHH] | Harakeke Resource Development - Phase II RRRT Project has been presented for further support from Māori Agribusiness [MPI]. Including but not limited to the following scope:

- i) Conduct site assessments, RRRT mapping and design, plant inventory planning, and supply chain analysis across all cluster sites, covering riparian, revegetation, restoration, and RRRT planting model case applications. Deliver onsite shadow facilitator workshops.
- ii) Prepare for and deliver RRRT planting for the 2026 season from July to September 2026,⁹⁰ including planting across 3–5 hectares. This work covers management, plants and planting, mapping and oversight, and includes one shadow facilitator supporting planting preparation, engagement, and training.
- iii) Consolidate the draft report on RRRT model development, related research objectives, and the monitoring plan, along with the draft RRRT handbook and review of the Harakeke Industry roadmap.
- iv) Continue developing the industry body (non-final), including the website, stakeholder familiarisation, governance structure, and mandate.
- v) A Phase II budget has been provided to Māori Agribusiness [MPI] in conjunction with this report.

2. **Invest in processing infrastructure and capability**
3. **Develop market pathways for fibre and by-products**
4. **Formalise industry governance and partnerships**

⁹⁰ Note according to NIWA, there is a considerable risk of severe El Niño weather cycle 2026-2027 rendering very dry conditions in north & east.

Chapter 29. References

Appendix: References and Web Sources

This appendix consolidates the principal website references, citation-style sources, reports, organisations, events, and image credits identified in the report. It is intended to support final source checking and should be updated if additional formal citations or publication details are added before release.

Website and Online Sources

- Te Kooti Whenua Māori | Māori Land Court registry — referenced for Māori land block, ownership, and site-assessment information.
- Whenua Māori in Primary Production BERL Report 2025 — referenced in the Market Research – BERL Report 2025 section as an online report source.
- Credence Research report download — referenced in the Market Research 2026 section in relation to the global natural fibre upstream and midstream market.

Reports, Publications, and Formal Citation Sources

- McGruddy, Elizabeth. 2006. Integrating New Zealand Flax into Land Management Systems. Sustainable Farming Fund Project 03/153 45.
- NZ Spectator. 1846. Historical report cited in relation to flax processing and manufactured fabric samples.
- Eggers. 1958. Cited in relation to the limitations of mechanised stripping and its effect on fibre strength.
- Manawatu Herald. 1938. Cited in relation to criticism of drum-and-beater-bar stripping methods.
- Henderson, Mark. 2022. He Mahere Rautaki Harakeke | A Strategic Harakeke Plan. Developed as a joint self-funded project between Biotenax Ltd and Ngāti Ruapani ki Uta ki Tai Co-operative Society Ltd.
- Ngāti Kahungunu 2050. Referenced as Ngāti Kahungunu Iwi's strategic plan, including economic resilience for marae.
- Bioeconomy Science Institute. 2025. Pā Harakeke book, referenced as an updated resource on the Rene Orchiston collection and cultivar identification.
- Rene Orchiston Collection / Orchiston reference collection. Referenced in connection with cultivar observation, flowering patterns, environmental influences, and genetic diversity.
- Waipapa Taumata Rau | University of Auckland research. 2026. Referenced in relation to chemically treated Harakeke fibres removing PFAS from water.

Research, Institutional, and Event Sources

- Indigenous Biodiscovery Wānanga. 2026. Hosted by Te Kotahi Research Institute and Kānuka Charitable Trust, with sponsorship and support from Bioeconomy Science Institute, Kanapū, and participating experts.

- BSI Indigenous Fibres Symposium. 2026. Hosted by Bioeconomy Science Institute in Rotorua, bringing together weavers, researchers, Māori partners, and industry participants.
- NZ Flax Forum. 2015. Held at Scion Rotorua, with contributors from Scion, BPN, Callaghan Innovation, and others.
- Te Hononga Hapori Harakeke | HHH Symposium. 2026. First symposium held in Auckland, referenced as a source of participant perspectives, historical knowledge, and technical discussion.
- Templeton Flax Mill Heritage Museum / Templeton Flax Milling Heritage Trust. Referenced for historical knowledge of flax milling, stripping, scutching, and industry practice.

Additional Organisations Referenced as Sources or Contributors

- Department of Conservation
- Waipapa Taumata Rau | University of Auckland
- Callaghan Innovation
- Te Kotahi Research Institute
- Kānuka Charitable Trust

Image, Figure, Chart, and Table Credits

- Biotenax Ltd. Credited for multiple images, charts, figures, business-case resources, RRRT models, and Harakeke imagery, including image credits dated 2020–2026 and 2023–2026.
- Anna Hayes-Moeau / Anna Hayes Creative. Credited for contemporary raranga and Harakeke imagery, including images © Anna Hayes Creative 2026.
- Templeton Flax Mill Heritage Museum. Credited for historical flax milling imagery.
- KiwiFibre Innovations Ltd. Credited for contemporary retting and fibre-processing imagery and related technical contributions.

Chapter 30. Glossary

This glossary provides concise meanings for key Māori, technical, industry, and business terms used throughout this report.

Term	Meaning in this report
ABS	Access and Benefit Sharing; principles for fair access to biological resources, knowledge, data, and resulting benefits.
Awhi rito	The parent leaves that protect the central rito in a Harakeke fan.
Biodiversity	The variety and resilience of native plants, animals, habitats, and ecological relationships associated with Harakeke planting.
Biomass	Plant material available for harvest, processing, or ecological contribution.
BSI	Bioeconomy Science Institute; research partner referenced in relation to indigenous fibres, science capability, and cultivar resources.
By-products	Secondary outputs from Harakeke processing, including green matter, extracts, gels, lignans, seed oil, tow, and related materials.
CapEx	Capital expenditure required for establishment, infrastructure, equipment, or processing capability.
CRI	Crown Research Institute; research organisations supporting science, innovation, and industry development.
Farmgate	The point at which product value is assessed before further midstream or downstream processing.
FTE	Full-time equivalent; a measure of labour or workforce requirement.
Harakeke	Phormium tenax; a taonga plant species central to the proposed industry, cultural practice, land restoration, and fibre production.
HHH	Te Hononga Hapori Harakeke The Harakeke Community Alliance.
Kaitiaki	Guardians or custodians with responsibilities to protect whenua, resources, knowledge, and future generations.
Kaitiakitanga	Guardianship and stewardship grounded in responsibility to land, people, taonga, and ecological wellbeing.
Kaupapa	The purpose, principles, and collective direction underpinning the project.
Kaupapa Māori	A Māori-led or Māori-centred approach grounded in Māori values, knowledge, tikanga, and aspirations.
Kōrari	The flowering stalk of Harakeke; also used regionally as a name associated with Harakeke.
MABx	Māori Agribusiness – Extension programme, referenced as part of MPI support.
Mana whenua	Those with customary authority and responsibilities in relation to land and place.
Marae	A cultural, community, and governance base for whānau, hapū, and iwi.
Mātauranga Māori	Māori knowledge systems, including traditional, contemporary, ecological, cultural, and practical knowledge.
Midstream market	The processing stage where fibre is converted into intermediate products such as scutched fibre, yarn, textiles, or industrial inputs.
MPI	Manatū Ahu Matua Ministry for Primary Industries.
Muka	Prepared fibre from Harakeke, traditionally extracted by hand and valued for strength and cultural use.
Pā Harakeke	A Harakeke planting or family-like cluster; also, a cultural model linking the plant to whānau structure.

PFAS	Persistent “forever chemicals” referenced in relation to research on Harakeke fibre and water remediation potential.
Phormium tenax	The botanical name for Harakeke.
Provenance	The origin, source, whakapapa, or traceability of plants, knowledge, materials, or outputs.
Rangatahi	Young people; future contributors, learners, workers, and leaders in the proposed industry.
Raranga	Māori weaving practice using Harakeke and other natural materials.
Rito	The central new shoot of a Harakeke fan, symbolising the child in the Pā Harakeke model.
ROI	Return on investment.
Rongoā	Māori healing practice and plant-based knowledge, including potential use of Harakeke and associated biodiversity plants.
RRRT	Riparian, Revegetation, Restoration and Transition; the proposed Harakeke planting architecture.
Scutching	A fibre-processing step that removes remaining plant matter and prepares fibre after stripping and retting.
Taiao	The natural environment.
Taonga	A treasured thing, species, knowledge, or resource requiring protection and respect.
Te Ao Māori	The Māori world view, including values, tikanga, language, knowledge, relationships, and responsibilities.
Te Tiriti o Waitangi	The Treaty of Waitangi, referenced in relation to taonga, Māori rights, and protection of knowledge and resources.
Tikanga	Correct practice, values, protocols, and customary principles.
Tow	Shorter or coarser fibre by-product produced during fibre preparation or scutching.
Upstream market	The early production stage, including land, planting, harvesting, and raw or primary output.
WAI 262	Waitangi Tribunal claim and policy context relating to Māori rights in taonga, Mātauranga, genetic resources, and cultural intellectual property.
Wānanga	A learning, discussion, and knowledge-sharing forum grounded in kaupapa and tikanga.
Whakapapa	Genealogy, relationships, origin, and connectedness between people, whenua, plants, and knowledge.
Whānau	Family or extended kin group; also reflected symbolically in the structure of the Harakeke fan.
Whanaungatanga	Relationship-building, connection, mutual obligation, and collective participation.
Whenua Māori	Māori land, including trust, incorporated, marae, papakāinga, or under-utilised land contexts considered in the report.
Wharariki	Phormium cookianum; a related Phormium species often referred to as mountain flax.