NUTRIENT BALANCE IN SOIL-PLANT SYSTEMS AFTER 30 YEARS OF WASTEWATER IRRIGATION

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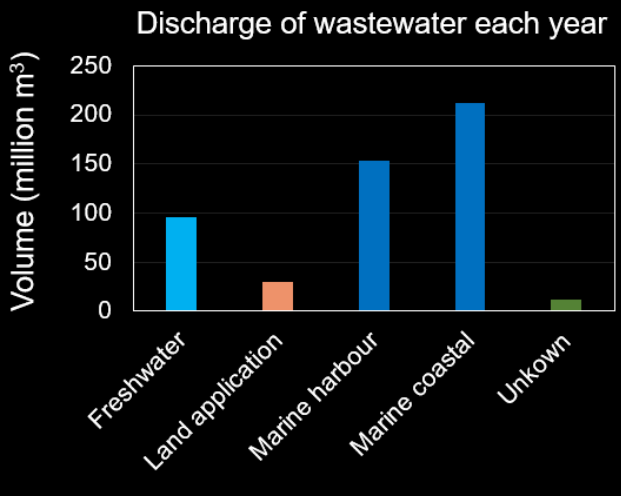
Issues



> 500 million m^3 annually produced

Site description

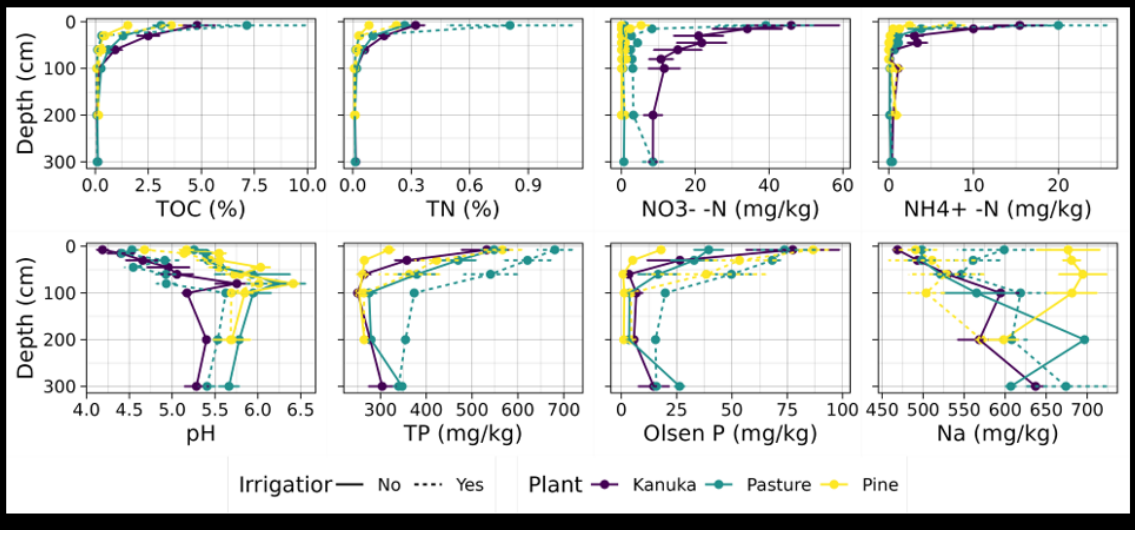
Site description

Parameter	# analysis	Mean ± SE	Median	Range	DW Standards	Application kg/ha/y
EC (mS/m)	(N = 121)	68 ± 1.9	66	(29 - 167)		
TN	(N = 2)	46, 47				1860
NO_3^--N	(N = 123)	12 ± 1.2	3.9	(< 0.005 - 61.8)	11.3	488
NH_4^+-N	(N = 123)	6.2 ± 0.99	0.32	(< 0.005 - 37)		248
TP	(N = 2)	6.1, 7.1				264
Ca	(N = 2)	11, 12				460
Mg	(N = 2)	3.1, 3.3				128
K	(N = 2)	23, 24				940
Na	(N = 2)	63, 65				2564
SAR		8.1				

Soil Sampling

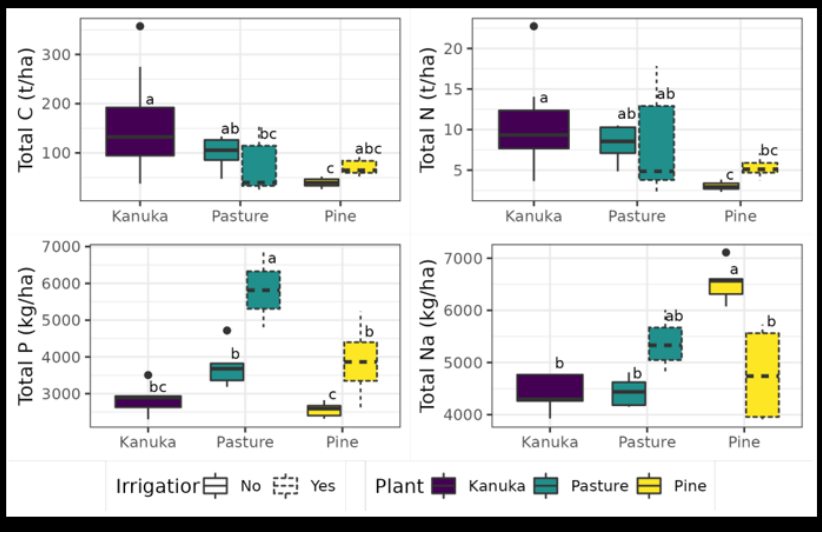
Soil Sampling

Results



Results

Total mass of elements in the 0 – 80 cm of soil



Results

Potential losses of nutrients

- Inputs – vegetation uptake – soil accumulation = losses
- N (kg N/ha/y) : 1,800 kg – 200 kg – 0 kg = 1,600 kg/ha/y
- P (kg P/ha/y): 260 kg – 40 kg – 50 kg = 170 kg/ha/y

Conclusions

Land Treatment?

Acknowledgements

The diggers: Charlotte Sizt, Sky Halford, Izzie Alderton, Vikki Ambrose

MfE Freshwater Improvement Fund

ESR's Pioneer Fund

Science for Communities
He Pūtaiao, He Tāngata

Questions?

DEVELOPING GUIDANCE FOR THE BENEFICIAL USE OF BIOWASTE TO IMPROVE DEGRADED LAND AND ESTABLISH NATIVE PLANTS AND ECOSYSTEMS

Jo Cavanagh [A, D], Robyn Simcock [A], María Jesús Gutiérrez-Ginés [B], Brett Robinson [C], Kristin Bohm [B], Alexandra Meister [B], Claudia Garces [C]

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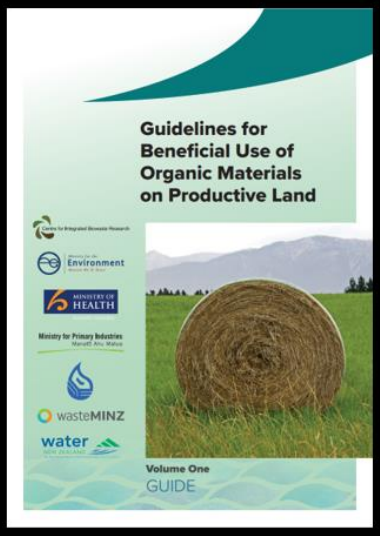
Current [draft] guidance

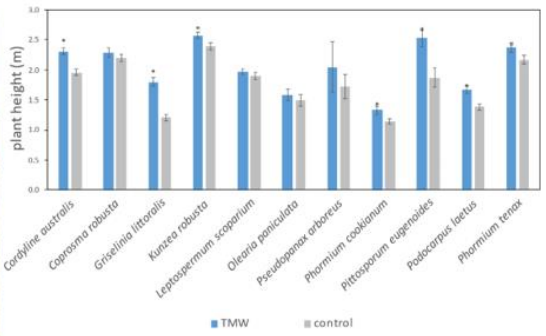


- Update of biosolids guidelines
- Focussed on beneficial use of wide range of organic material
- Key criteria based on total N limit 200 kg ha^{-1}
  - Metal limits based on N application rate
- ***Prevents large one-off rates of slow-release N***
- **Relevance to native plantings also debateable but……**

Centre for Integrated Biowaste Research

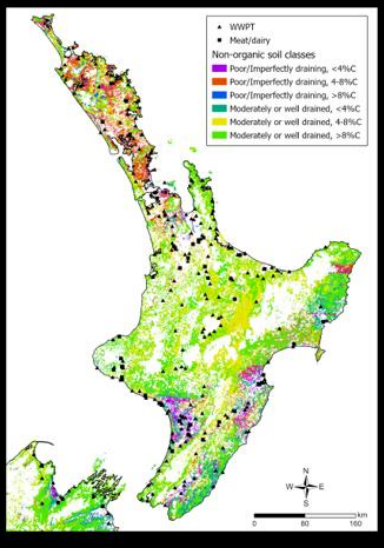
Christchurch City Council | UC University of Canterbury | Lincoln University Christchurch, New Zealand | E/S/R Science for Communities

2019

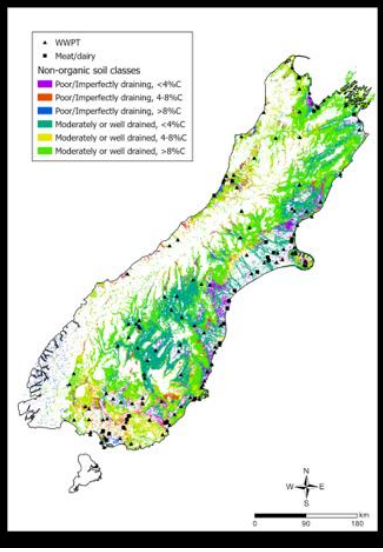


Meister et al. 2020. A field trial to determine the effect of the land application of treated municipal wastewater onto selected NZ-native plants on Banks Peninsula. A report for CCC (see ccc.govt.nz)

Area of potential application



- Landuse
  - Excludes food production land, conservation estate
- Soil C content
- Excludes organic soils
- Slope class
- (buffer around streams)



Critical factors for consideration

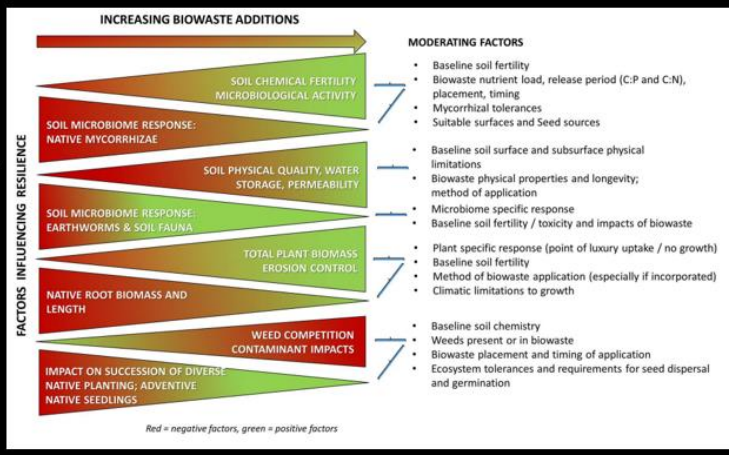

frontiers in Sustainable Food Systems

REVIEW

Using Biowastes to Establish Native Plants and Ecosystems in New Zealand

Robyn Simcock*, Jo Cavanagh, Brett Robinson and Maria J. Gutierrez-Gines

- Weed competition
- Ecosystem succession
- Resilience (especially to drought and storms)
- Soil microbiome responses to elevated N, P, OM and contaminants



Native ecosystem recreation enables broader and greater flexibility in the use of different NRWs (biowastes)

Guide for establishing native plantings and ecosystems using biowastes– proposed structure

- Introduction
- Types of biowastes
  - Characteristics of different biowastes – beneficial, constraints
  - Methods of application e.g. heterogeneous application creates diversity response
  - Frequency of application e.g. 'priming the pump', linking to maximum plant water need (summer) or nutrient demand (espec pines)

Sources

Industry	Types of nutrient-rich waste	Potential use
Forestry	Harvest/slash	Planting media, plant media amendments
	Pulp waste from processing	Planting media, plant media amendments
	Wastewater from processing liquor	Irrigation/fertigation
Meat processing	Effluent from onsite wastewater treatment plant	Irrigation/fertigation
	Sludge from wastewater ponds	Planting media, plant media amendments
	Stock yard solids 11–19% TSS	Planting media, plant media amendments
	Screened solids (paunch grass + other solids)	Planting media, plant media amendments
Dairy	Farm dairy effluent	Planting media, plant media amendments
	Milk factory wastewater	Irrigation/fertigation
	Milk factory sludge	Planting media, plant media amendments

Cavanagh et al 2021

Sources cont..

Industry	Types of nutrient-rich waste	Potential use
Horticulture	Orchard prunings, unwanted fruits	Planting media, plant media amendments
	Canning/processing factory wastewater	Irrigation/fertigation
	Canning/processing wastes	Planting media, plant media amendments
	Wine-making wastewater	Irrigation/fertigation
	Wine-making – grape marc	Planting media, plant media amendments
	Mushroom compost	Planting media, plant media amendments
Municipal wastewater treatment	Wastewater (<2% TSS)	Irrigation/fertigation
	Pond sludge	Planting media, plant media amendments
	Waste-activated sludge	Planting media, plant media amendments
	Biosolids	Planting media, plant media amendments

- Ideal is better characterisation of biowastes
  - +ve, -ve attributes

Guide to beneficial use for native plantings and ecosystems – proposed structure

- Introduction
- Types of biowastes
  - Characteristics of different biowastes – beneficial, constraints
  - Methods of application
- Site considerations
  - Flow charts to assist with decision-making focussing on BENEFICIAL attributes of biowaste, and how the site can benefit – i.e. what the site needs to achieve a 'better' condition (e.g. erosion control, biodiversity, human amenity)

Constraints in application

- Largely dependent on source
  - Contaminants
  - Excess nutrients – or water and/or unsuitable texture
  - Cultural considerations, particularly for human derived wastes
    - Early and ongoing engagement can mitigate concerns/find mutually beneficial approaches
- But also site (slope, trafficability, drainage, uses)
- Resource consent may be required
  - Type of biowaste
  - Rate of application
  - Environmental considerations and risk (proximity to water, erosion risk)

Guide to beneficial use for native plantings and ecosystems – proposed structure

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- Types of biowastes
  - Characteristics of different biowastes – beneficial, constraints
  - Methods of application
- Site considerations
  - Flow chart to assist with decision-making focussing on BENEFICIAL attributes of biowaste
- Wastewater disposal to native plantings
- Biowaste use based on characteristics of biowaste

Native plantings

Waste type	Use	Incentives for use with suitable waste
Woody debris, woody mulches	Site preparation Site maintenance	Protects microsites, prevents erosion, conserves water in dry/warm sites, suppresses weeds, excludes browsers (deer, hares, rabbits) Enhances nutrition when mixed with compost

Native plantings

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Woody debris, woody mulches	Site preparation Site maintenance	Protects microsites, prevents erosion, conserves water in dry/warm sites, suppresses weeds, excludes browsers (deer, hares, rabbits) Enhances nutrition when mixed with compost
Sludges and modified sludges	Site preparation	Improves degraded soils Increase soil volume and rooting depth Improves water-holding capacity Improves soil structure Improves organic matter Adds slow-release nutrients
Wastewater – municipal	Irrigation after planting	Decrease the amount of clean water needed to sustain plant growth in drought

To realise enhanced use of biowastes..

- Recognise that greatest benefit in improving degraded soils
- **Partnerships between providers and recipients**
  - Mutual understanding of needs and benefits i.e. beneficial properties
  - Ensuring consistency in nutrient composition
- Better information on the nutrient and physical qualities of different biowastes from producers.
  - Enables evaluation of how suitable they are for different purposes
  - Enables evaluation of co-disposal (e.g. mulch & pond sediment).