Science for Communities
He Pūtaiao, He Tāngata

Towards Waste Minimisation in Aotearoa New Zealand

A realist review and systemic analysis of waste interventions

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Disclaimer

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Cover Image

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EXECUTIVE SUMMARY

The effects of waste on the environment and human health continue to increase despite behavioural, technological and policy actions for the management and minimisation of waste. Waste is a complex problem and demands a comprehensive research approach to both understanding the problem and identifying pathways to effective action in Aotearoa New Zealand (Aotearoa). Waste minimisation interventions that only focus on changing individual behaviour do not appear to have been effective. Moving beyond behaviour change theories towards a social practice perspective, this study focused on developing a workable theory of change to influence a shift in the waste system for a sustainable future.

The study combined a realist review of waste minimisation interventions with a system mapping approach (i.e., causal loop diagramming) to visualise the waste system. Realist review is a theory guided approach that seeks to understand the context-mechanism-outcome configuration of an intervention and generate insights on what works for whom, under what conditions and how. In this study the realist review was informed by both literature and stakeholder interviews. The analysis utilised an integrated theoretical framework of three social theories (social learning, collective action and social practices), aligned with an indigenous Māori implementation framework, He Pikinga Waiora. The review generated a set of four interlinked programme theory propositions that proposed potential mechanisms of action for waste minimisation in Aotearoa.

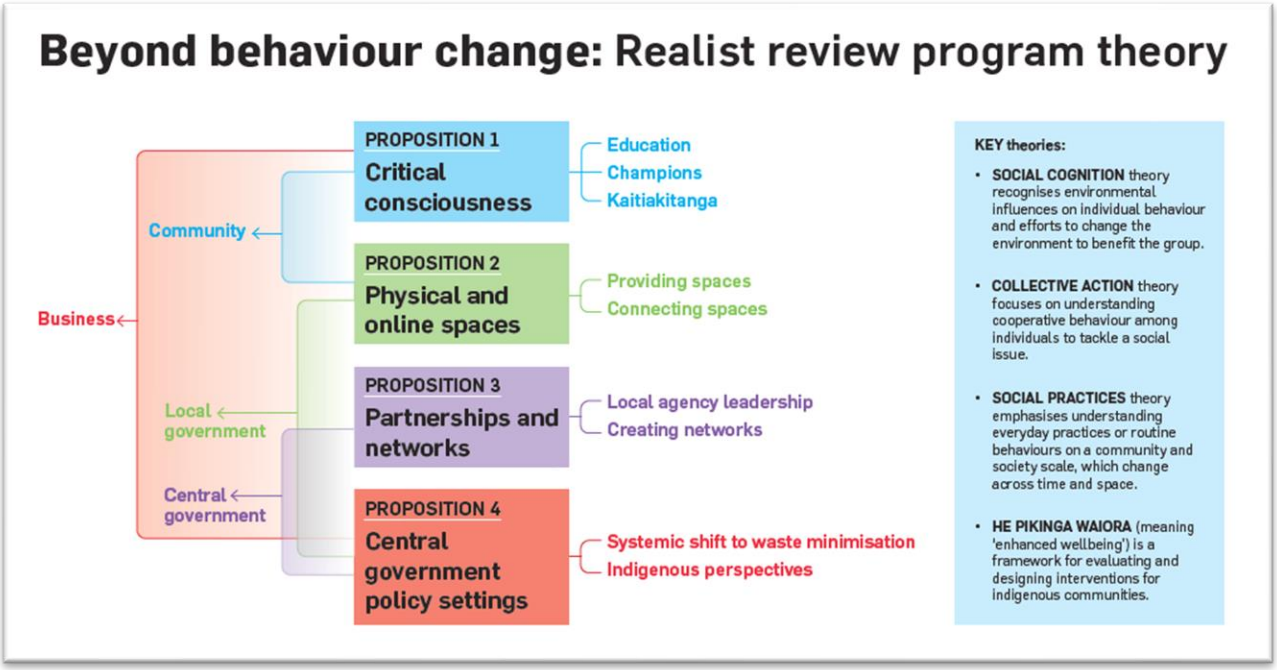

Figure 1 Programme theory for waste minimisation in Aotearoa New Zealand

The four interlinked propositions related to raising critical consciousness of a significant proportion of the community, the effect of physical and online spaces enabling communities to come together around local champions, the role of local government agencies in the waste

system, and systemic policy making at central government level. Threaded through these propositions was the value of including Māori perspectives and holistic systems thinking approaches for effective change within the context of Aotearoa New Zealand.

The qualitative data from the realist review was used to develop a causal loop diagram (CLD) that illustrated the current waste system and enabled insights from a systems perspective.

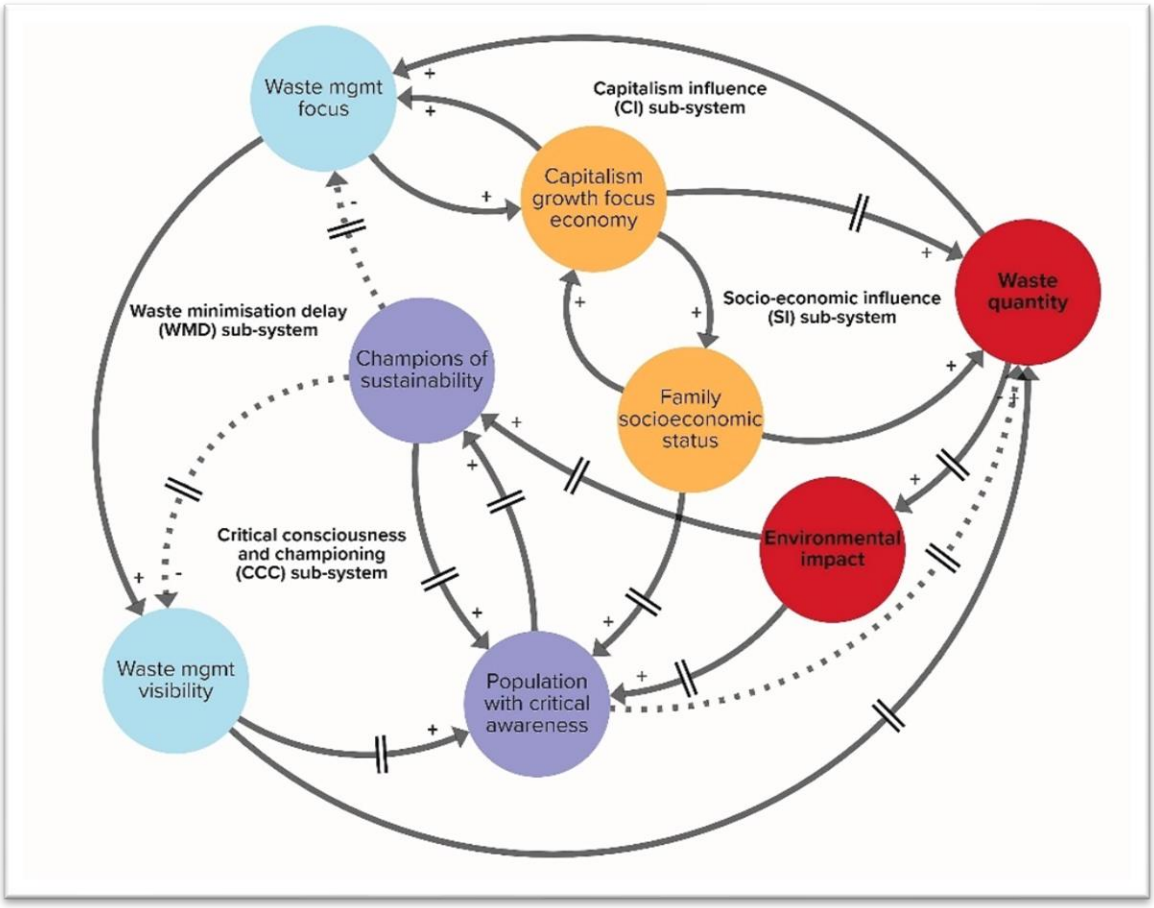

Figure 2 Visualising the system – high level causal loop diagram of the realist review programme theory interacting withing the waste system in Aotearoa

Four sub-systems within the CLD were identified to make sense of the complexity and generate system insights: critical consciousness and championing (CCC), waste minimisation delay (WMD), capitalism influences (CI) and socio-economic (SE). These sub-systems collectively highlighted the systemic barriers to waste minimisation interventions. A leverage point analysis then showed the areas of the waste system where intervention had the potential for significant impact. Raising the critical consciousness of the population was shown to be a key leverage point, as was systemic redesign of the system away from waste management and disposal towards waste minimisation, changing the underlying paradigm of the waste system to sustainability, and interfacing with Māori worldviews. These changes will take long-term systemic thinking, courageous leadership and adaptive strategies.

METHODOLOGICAL INSIGHTS

A second objective of the study was a methodological exploration combining realist review and systems dynamics approaches with methods encouraging stakeholder collaborative engagement. The results showed that these methods could be successfully combined and complement each other to provide richer insights into the complex problem than would be achieved by either method alone. Undertaking this study during the COVID-19 pandemic with the accompanying restrictions on in-person meetings meant that the collaborative aspects were undertaken through internet technology. This was largely successful, with useful learning about effective means of communicating with stakeholders.

CHAPTER I: INTRODUCTION AND METHODOLOGY

THE WASTE PROBLEM IN AOTEAROA NEW ZEALAND

Globally, solid waste is increasing rapidly with serious human health, societal and environmental impacts [1, 2]. Mitigating those impacts by reducing the quantity of waste is an urgent and complex challenge, with some global initiatives being undertaken. The Sustainable Development Goals (SDGs) led by the United Nations have specific indicators around waste (goals 11, 12 and 13) with waste minimisation and management indirectly contributing to all the SDGs [3]. Ideas of structuring economies for sustainability are being promoted globally, for example the concepts of the 'circular economy' and 'doughnut economics' [4-10]. Both these economic approaches take a holistic view of the waste system and its challenges.

Aotearoa New Zealand ('Aotearoa') shares the need for urgent action on the waste problem. Waste minimisation and management in Aotearoa is the responsibility of local government authorities (councils), operating under legislation set by central government. When faced with existing waste, local authorities must manage the immediate problem of the waste and therefore allocate resources, infrastructure and people to waste collection, recycling and disposal. Waste reduction strategies are often a secondary concern and, where implemented, have traditionally focused on influencing consumer behaviour through information and education campaigns [11, 12] despite research which questions the effectiveness of such approaches [13].

Waste interventions have been framed by the waste hierarchy, and versions of it, for many years. Early versions focused on recycling and disposal infrastructure, which tended to prioritize consumer actions. An updated hierarchy discussed in a recent policy document consists of '6Rs', starting with rethink, refuse, replace, then reduce, reuse, recycle, and disposal, which includes an awareness of the impact of both production and consumption behaviour (see Figure 3) [11].

This has led to more systemic policy interventions such as regulating for product stewardship schemes and banning single-use plastics [11, 12]. There is also increasing integration of holistic Māori indigenous worldviews into waste policies [11, 13].

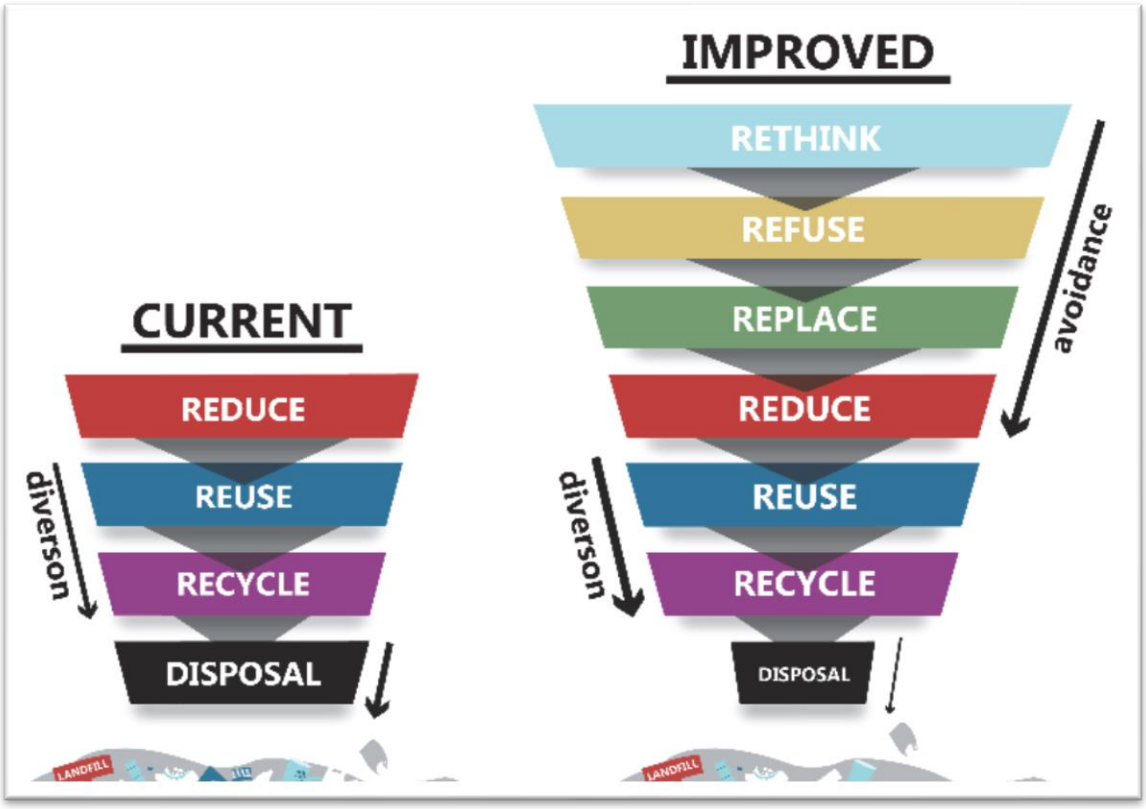

Figure 3: Waste hierarchies, from 'Rethinking plastics in Aotearoa', p.34. [11]

Thinking about waste has tended to be dominated by reductionist thinking, treating parts of the system as isolated and ignoring the interactions [8, 14, 15]. Interventions that focus predominantly on individual behaviours, and the waste hierarchy that de-emphasises waste production as an issue, are examples of reductionist thinking. A system thinking lens is a more dynamic and holistic way of understanding the complex issue of waste [14]. With this lens, the impacts of waste are understood as unintended consequences of the human social system, held in place by interlinked sub-systems as diverse as transportation, economics and government policies to generate relatively stable behaviour over time [16, 17]. This dynamic interaction of sub-systems over time has contributed to societal progress such as urban development and extensive transport systems but has also given rise to unintended consequences such as waste and climate change. Systems dynamics is one approach for understanding complex unintended consequences, through mapping of causal mechanisms, and identifying feedback loops and systemic patterns. Visual mapping of a system and its dynamics enables insights into the leverage points where actions can influence and shift the system towards new emergent behaviour.

AIM AND SCOPE

The study had two main objectives:

- Develop a theory of change to shift the waste system in Aotearoa towards waste minimisation that moved beyond individual behaviour change to more realistic models informed by social practices and Māori worldviews.

- Explore the compatibility of combining a realist review and systems dynamics approaches.

The starting point of a social practices based theoretical framework was a deliberate challenge to the underlying philosophy of the many interventions that focused on changing individual behaviours [18, 19]. These psychological approaches assumed that information leads to changes in individuals' attitudes which then leads to a change in behaviour. Yet research has shown that there is a weak correlation between holding pro-environment attitudes and acting in line with those attitudes, and the assumptions of a knowledge-attitude-behaviour causal chain has been questioned [20, 21]. In contrast, social practice theory recognizes that people and organisations are embedded in complex contexts, where economic, social, cultural and technical influences combine, converge and need to be addressed simultaneously to create change in practices [21, 22].

Within environmental management there is growing awareness of Māori knowledge and practices that were marginalized through processes of colonisation [23, 24]. Māori approaches and frameworks for environmental management are holistic and systemic, and can usefully inform a purposeful shift in social practices towards waste minimisation. It is also the case that poor waste management by local agencies impacts on Māori communities through limiting the ability to exercise effective kaitiakitanga (guardianship) in their area and negatively affecting mahinga kai (traditional food gathering practices) and the associated mana (prestige, dignity) for those communities, amongst other impacts [25-27]. It was therefore important for an Aotearoa context that any theory of change for waste minimisation was inclusive of Māori knowledge and values.

COMBINING REALIST REVIEW AND SYSTEMS ANALYSIS

Identifying casual mechanisms is a key aspect of the realist review approach [28], while system mapping and identifying leverage points is part of systems dynamics [29]. Both can be said to have roots in critical realism, and have a focus on understanding causality within social phenomena that are produced through interactions of multiple factors [17, 30]. These approaches could therefore be complementary [30, 31]. It was therefore decided to utilise the combination of the two approaches with an acknowledged complex problem. Waste was chosen as an issue of focus due to the research team's ongoing research in areas of enviornmental contaminants.

The general methodology followed by the research team was to conduct a realist review to identify programme theory propositions, then use the qualitative data from the review to develop a systems map in the form of a causal loop diagram (CLD). Systems insights for action (i.e. leverage point analysis) were then generated through iterative discussions considering both the programme theory and CLD. This process is depicted in Figure 4.

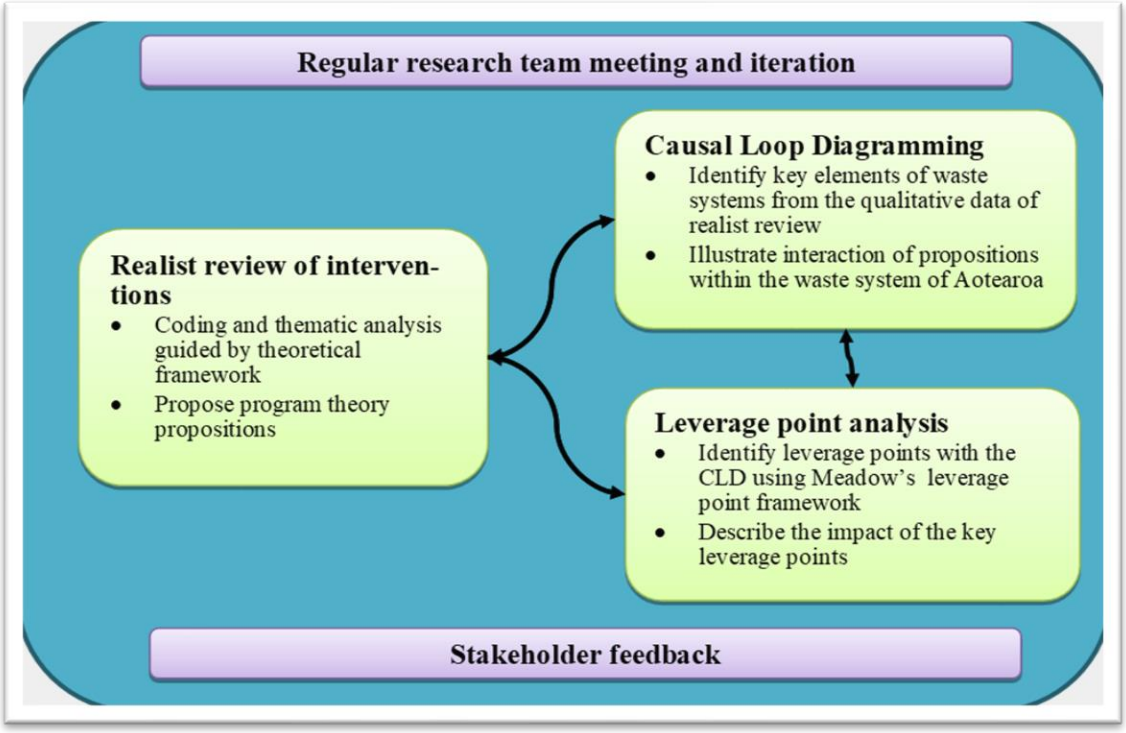

Figure 4: Overview of methods for Beyond Behaviour Change project

Realist review

The realist review approach is a theory-based process which focuses on making explicit the underlying causal mechanisms of interventions, while keeping in mind the context and the outcomes [28, 30, 32]. The full protocol of the realist review has been published elsewhere [33]. The realist review started with developing an integrated theoretical framework (Figure 5) using social cognition, collective action, and social practice theories within a kaupapa Māori centred implementation framework, He Pikinga Waiora [34]. This integrated framework was used to widen the thinking about systemic understanding of waste interventions and move beyond a focus on individual behaviour change to focus on social practices to minimize waste.

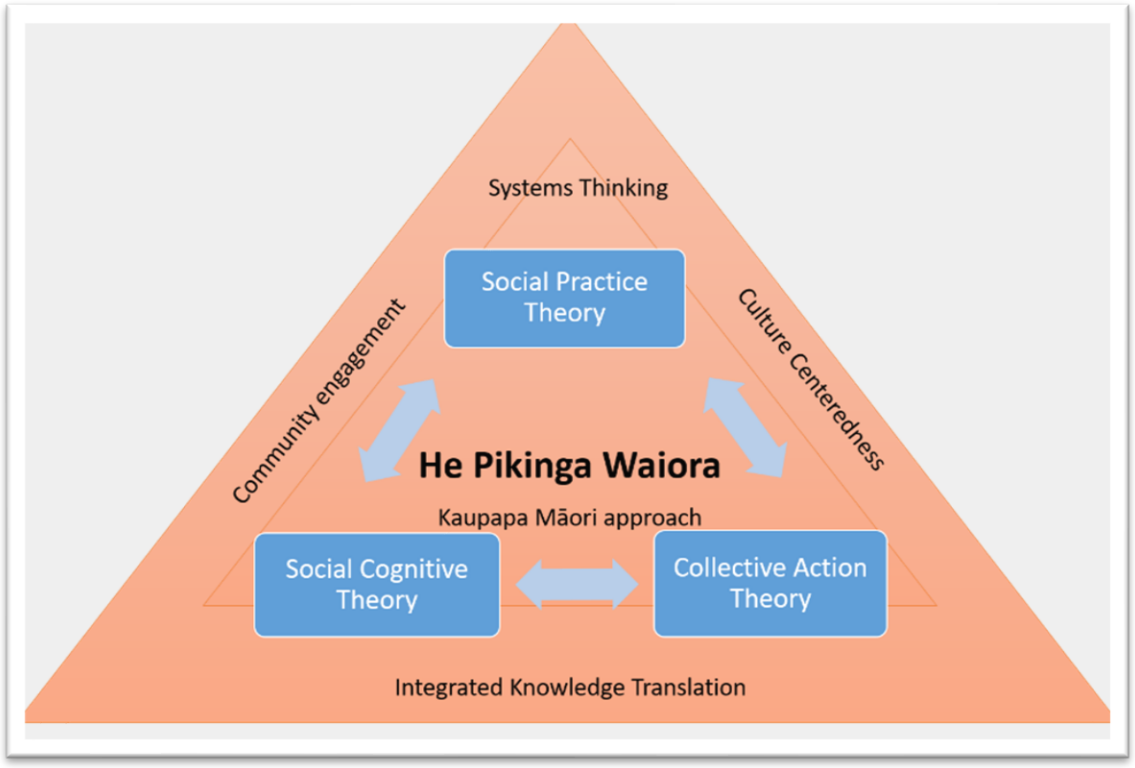

Figure 5: Integrated theoretical framework for Beyond Behaviour Change project

An initial programme theory of change was produced from a rapid review of ten relevant papers, which was subsequently refined through interviews with eight key informants identified from the research team's existing networks. Finally, a larger literature review was conducted. The interviews with expert practitioners experienced in designing waste minimisation initiatives added insights from Aotearoa specific programmes not available within published literature. Further there was a deliberate attempt to interview Māori informants, as indigenous thinking and knowledge was underrepresented in the waste intervention literature. Two of the eight participants were Māori. Interview participants were asked about waste minimisation interventions they had been involved in and encouraged to articulate what they saw as the underlying mechanisms that created change, along with any named theories of change they used to create the interventions. They were also asked about future interventions, and what mechanisms they would think of using.

The larger literature review included forty-two articles based in Aotearoa. A combination of systematic searching using Google and snowballing methods was carried out during January-June 2020 (see Appendix I for details). Each piece of literature was coded for the specific combinations of context, underlying mechanism of change, and outcomes, and cross-checked by the research team at regular intervals. The initial programme theory was refined to produce the final programme theory consisting of four interconnected propositions for creating change. The programme theory is discussed in Chapter III.

Causal loop diagramming

Causal loop diagramming is a qualitative system dynamics approach to map a system through indicating causal interactions between variables and using the diagram to identify feedback loops and sub-structures within that system [35]. Variables are connected by arrows denoting causal influence (mechanism) i.e., a change in one variable causes a change in a second variable. If an increase/decrease in one variable causes a similar increase/decrease in the second, there is a + sign by the arrowhead to indicate the causal influence is in the same direction (in this diagram, the line is solid). If an increase in one variable causes a decrease in the second, or vice versa, there is a – sign by the arrowhead to indicate the causal influence is in the opposite direction (in this diagram, the line is dotted). When there is a significant delay between the cause and the subsequent effect, this is indicated by a // sign in the middle of the arrow.

A feedback loop is created when a causal chain, from variable to variable, can be traced back to its originating variable. These loops are generally balancing (indicated by a 'B' in the middle of the loop in the diagram) or reinforcing (indicated by a 'R'). A balancing loop acts to stabilise a variable and maintain status quo in the system, so that when the variable changes, the feedback loop acts to reverse the change. In contrast, reinforcing loops involve a chain of actions that amplify the original change in the variable, producing a cycle of continuous growth or decline. Delays can be built into the various loops, where mechanism of actions producing outcomes is visible only after an extended time. Where loops compete, the dominant loop is often the one with the least delays. Clustering closely interacting loops into smaller sub-systems can aid interpretation and analysis.

The CLD for this study was developed from variables identified from the qualitative data of the realist review drawn using the Kumu application (https://kumu.io/) and refined through iterative discussions. The CLD is discussed in more detail in Chapter II.

Leverage points analysis

Leverage points are places in a system where a small shift in one variable could produce significant changes in the system. Meadows' framework consists of 12 points for intervention (Figure 6), arranged in order of impact [29]. The framework emphasises targeting 'deeper' leverage points for greater effectiveness, such as rules, goals and mental models underpinning the system. The 'shallow' leverage points are more visible yet tend to be less effective in creating widespread and long-lasting change.

The whole CLD along with programme theory was examined and iteratively discussed identifying combination of leverage points for effective waste minimisation. We acknowledged that the CLD represents only one possible model of the waste system, which is why we needed to check that the model made sense where it mattered – with those who design and implement waste minimisation interventions.

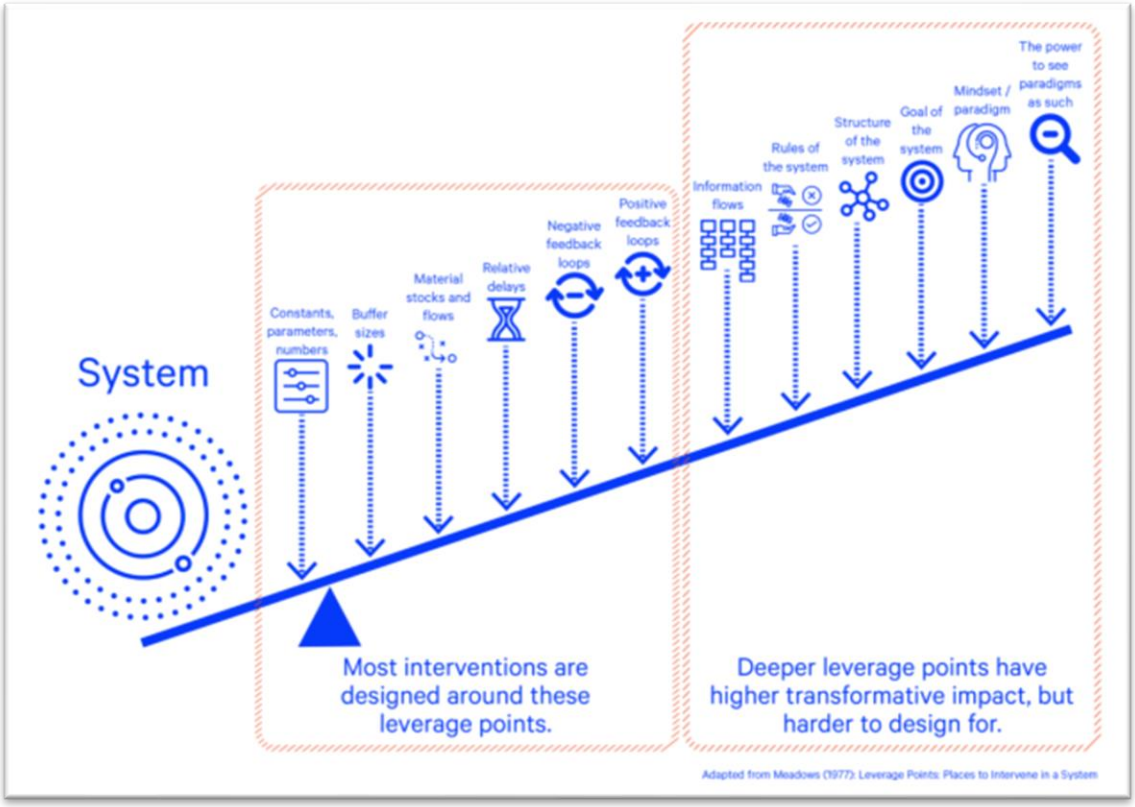

Figure 6: Leverage points, adapted from Donella Meadows by Corina Angheliou, shared under Open Government Licence v3.0 [36]

Sense making with stakeholders

A sense making workshop was planned with stakeholders to share and reflect on the findings of the realist review and systems analysis. While a face-to-face workshop was initially planned, due to COVID-19 restrictions we had to use online tools. We used a Kumu presentation, where we could give a summary of the findings and allow stakeholders to spend time investigating the CLD. We followed this with a Qualtrics survey for feedback, which was used to further improve both the CLD and our systemic interpretations.

METHODOLOGICAL REFLECTIONS

Combined approaches

Methodological pluralism is a theoretical basis for combining methods, and new combinations can be considered novel even when the methods themselves are not new [30, 37]. The literature relating to combining a realist approach with system mapping (i.e., CLD) is very limited. While systems mapping has been combined with other review methods such as rapid review or systematic review [38, 39], the combination with realist review made sense to our informants who were practitioners rather than academics. All the participants had undertaken waste minimisation interventions and had informed ideas about what makes an intervention effective. The system mapping analysis allowed them to view their assumptions in a different way, and therefore more fully appreciate the inter-relationships and causal mechanism between elements they knew existed in the waste system.

Stakeholder engagement

Scholarly reviews seldom engage informants within the process, mainly for reasons of objectivity. Despite tremendous growth in participatory research [e.g. 40, 41, 42], systematic reviews are seldom participatory in design. The integrated methodological approach in this study offered the opportunity to engage informants in collaborative sense-making, although also acting as a partial barrier for effective engagement. The informants were unfamiliar with CLDs, and such diagrams can appear overwhelmingly complex at first sight. Further, due to the COVID-19 pandemic, we were using online and asynchronous methods for gathering feedback, and the participants were relatively unfamiliar with the technology. Therefore, instead of asking for specific feedback on causal linkages in the CLD, as originally planned, the team asked for more generic feedback on both the programme theory and the CLD. The positive feedback from the informants indicated that the process of interacting with the Kumu presentation was useful for them to understand the results of the study.

It is acknowledged that this collaborative approach used was not a participant-guided process. Whilst the expert knowledge and experience of key informants supported the sense-making, of the power of analysis and interpretation remained with the researchers, in contrast to what the research team sees as the more ideal approach where control of research is in the hands of the participants [43]. However, such a collaborative study can be time consuming and resource intensive, both for researchers and participants. The process of engagement in this review can be argued as a middle ground approach. Researchers ensured quality and rigour through controlling the process, and engaged informants at the critical junctures of developing the programme theory and giving feedback on the CLD. The research team felt that this produced satisfactory results given the amount of time and resources available. Furthermore, the combined methods for critical realist review and collaborative sense making have supported the development of a richer and more useful ‘real world’ model for the design of more effective waste interventions.

Limitations

An acknowledged limitation of the report is that the variables in the CLD were populated from the qualitative data of the realist review, including the programme theory. Therefore, the programme theory and systems analysis cannot be said to be fully independent and alignment between them must therefore be considered in that light. Further, if the CLD had been developed from first principles in consultation with stakeholders before being compared with the literature, then the CLD may have looked different. This reflects that all models are partial reflections of reality, and the CLD presented here is one possible model. However, within these limitations, this particular model has some insights to offer that could be useful to support actions for a systemic shift towards waste minimisation in Aotearoa.

CHAPTER II: MAPPING THE WASTE SYSTEM IN AOTEAROA NEW ZEALAND

In this study, the realist approach to the literature review and interviews provided rich qualitative data that was then visualised in a CLD (Figure 7). The overall picture from the CLD is that there are strong feedback loops which reinforce an emphasis on managing waste that has been produced, which includes recycling and disposal. This emphasis means that resources are targeted to waste management and there is little left to pursue waste minimisation strategies. Yet the CLD suggests that it is minimising waste production, rather than managing existing waste, that will have the greatest long term beneficial impact. Unfortunately, trying to shift the system towards waste minimisation is counteracted by capitalist and socio-economic influences, which seek to maintain the status quo of continual economic growth through ongoing production and consumption of good, with waste as a by-product. On the positive side, there are several factors which will support a shift towards waste minimisation. Increasing the number of the population who are critically aware of the need for change is one important action, and this can be strongly influenced by champions who act at community, industry and policy levels of the waste system. Another supportive factor is increasing the widespread understanding and use of Māori concepts of kaitiakitanga, based on reciprocal responsibilities to care for the environment which nurtures us all. Finally, political courage and commitment is necessary to hold to an overall waste minimisation policy despite the long timeframe before the beneficial impacts become visible.

To look at this in more detail, there were four key sub-systems identified that offer both systemic challenges and opportunities for waste minimisation in Aotearoa: critical consciousness and championing (CCC), waste minimisation delay (WMD), capitalism influence (CI), and socioeconomic influence (SE). Further, three leverage points were identified from the CLD (elaborated in Chapter IV) to shift the system from waste management orientation to waste minimisation. These leverage points based on the CLD unearth some deeper systems insights and facilitate systems thinking based learning, action and reflection towards waste minimisation [44, 45].

The sub-systems are outlined with reference to the programme theory propositions, which will be discussed in more detail in Chapter III.

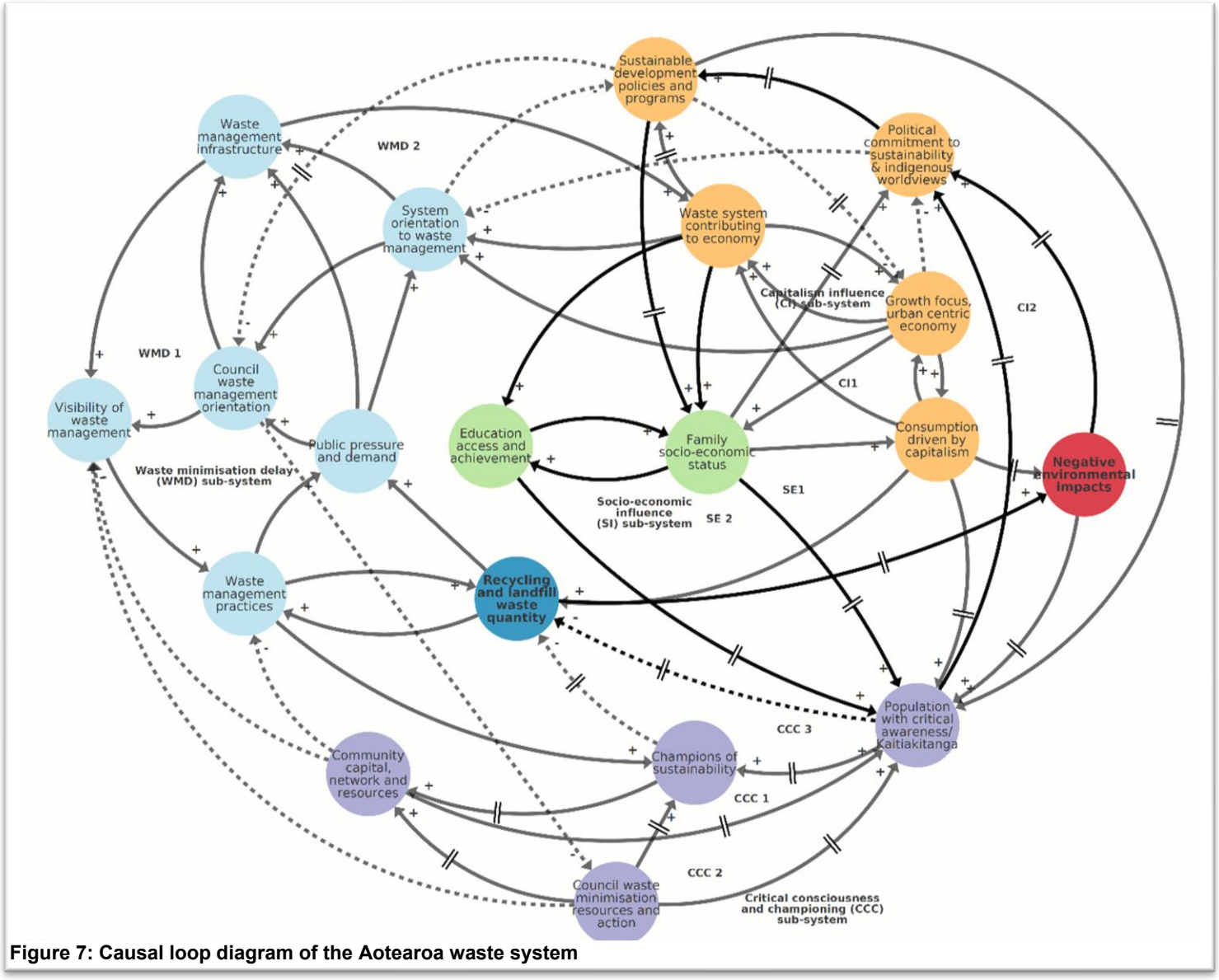

Figure 7: Causal loop diagram of the Aotearoa waste system

CRITICAL CONSCIOUSNESS AND CHAMPIONING (CCC) SUB-SYSTEM

The critical consciousness and championing (CCC) delay sub-system (coloured purple in the CLD) has three key loops relating to community champions, critical consciousness raising and negative consequences. These loops correspond to the first and second propositions of the programme theory, which operate at the community level. Overall, the CCC delay sub-system highlights the importance of raising critical consciousness of the waste issue at the population level, and the effect of the delay in making this happen.

The community champions loop (CCC1) is a delayed reinforcing loop, where an increase in critical awareness of the population would lead to more champions, and then to more community resources, further increasing the critical awareness of the population. However, all the linkages have delays, which means this loop would tend to be dominated by others such as the loops in the waste management subsystem (WMD1-2). This could lead to competition amongst scarce resources, where waste management and its immediately visible effects dominates over initiatives for waste minimisation and their delayed effects.

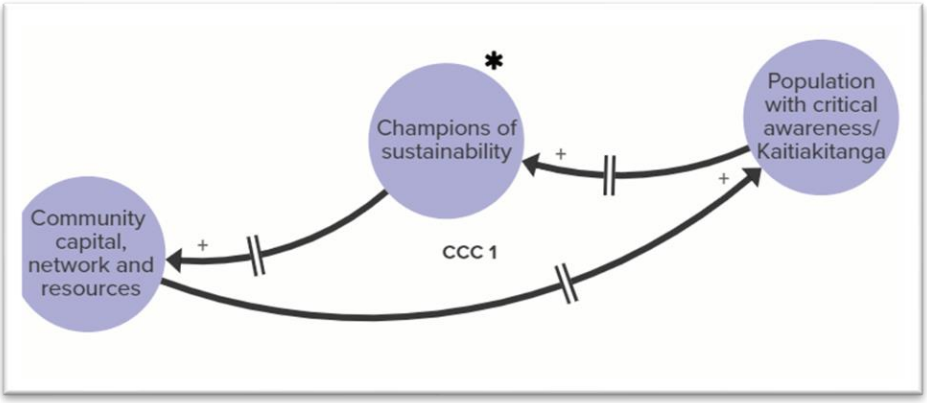

Figure 8 Community champions loop (CCC1)

The critical consciousness raising loop (CCC2) is also a delayed reinforcing loop, extending to the political environment. In this model, an increase in population critical consciousness would lead to greater political commitment to environmental health including increased use of Māori worldviews and sustainability concepts in policy making, which in turn would reinforce population critical consciousness. The political pressure would be on local authorities to shift from waste management to minimisation strategies, and again, to greater population consciousness – but all with delays. The delays mean that the shift of resources by local authorities from waste management to minimisation would be very slow.

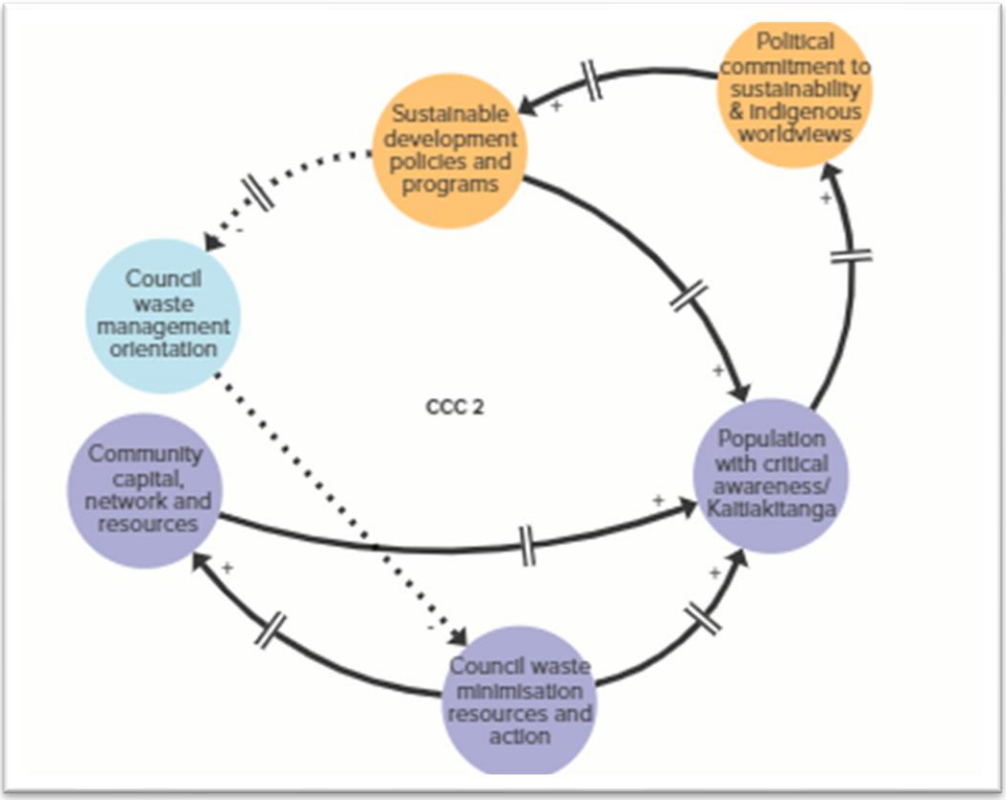

Figure 9 Critical consciousness raising loop (CCC2)

The third loop is the negative consequences (CCC3), a delayed balancing loop. Negative impacts of the waste issue, such as pollution and climate change, would lead to increased awareness in the population, more champions for sustainability, and less waste in the landfills, leading to less pollution. However, this last link is severely delayed, so that the impacts of efforts to decrease waste would not be visible for years and in the meantime, the effects of the increasing waste of previous years would continue. This delay hinders the effectiveness of the balancing loop, especially if political commitment shows short term variation rather than steady long-term commitment to the end goal.

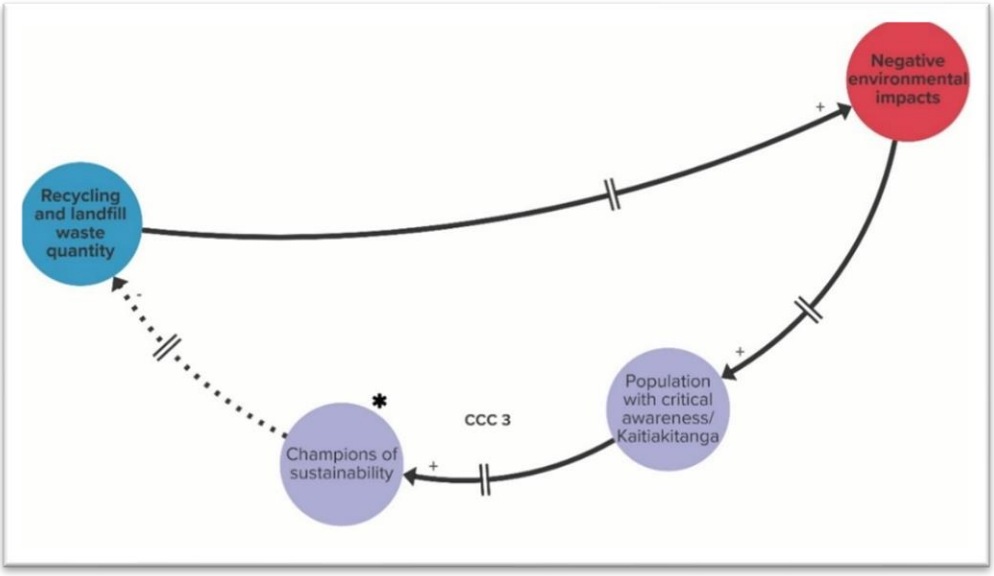

Figure 10 Negative environmental impacts loop (CCC3)

WASTE MINIMISATION DELAY (WMD) SUB-SYSTEM

The waste minimisation delay (WMD) sub-system (coloured blue on the CLD) has two key loops that correspond mainly to proposition 3, relating to the role of local authorities in the waste system. Overall, the sub-system illustrates the reinforcing nature of the demand and supply of waste management services, where the ever-increasing amount of waste is a visible reinforcement for the focus on waste management practices.

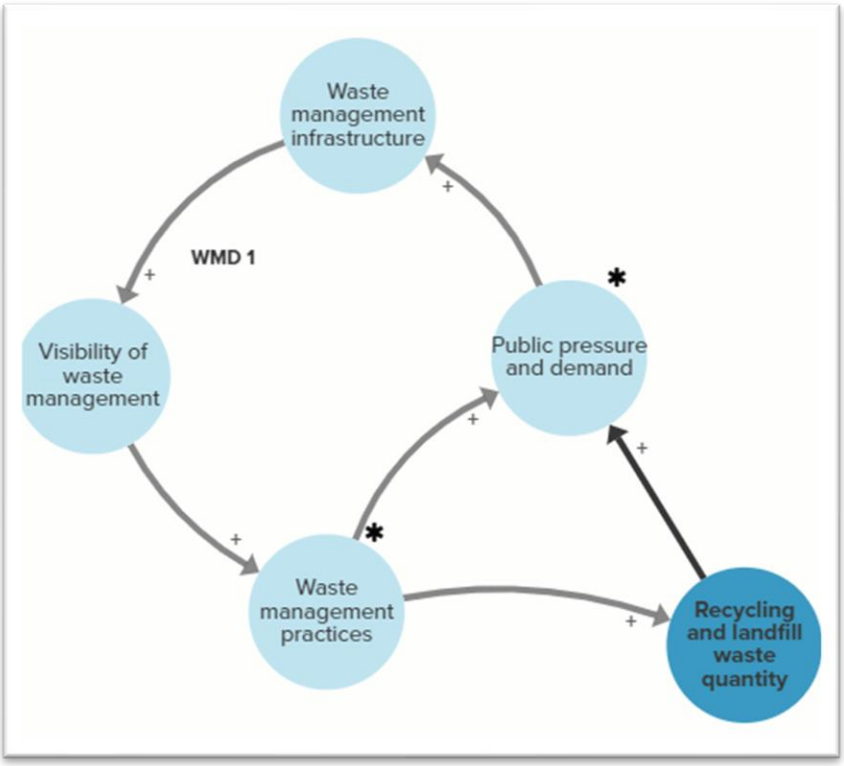

Figure 11 Systemic infrastructure loop (WMD 1)

The systemic infrastructure loop (WMD1) is a dominant reinforcing loop, where increasing waste quantities trigger public pressure for visible and immediate solutions, leading to a focus on developing infrastructure and other strategies to manage – rather than minimise – the waste. These system cues reinforce, rather than reduce the waste management activities, as valuable resources are simply dumped at the end of the waste lifecycle, creating need for extraction of more raw materials often resulting in negative environmental impact.

The WMD1 loop is dominant because of the lack of delays between cause and effect, so that this loop will cycle faster than other loops with delays (such as CCC1) and generate more effects, more quickly. This visibility of effects can focus attention on this sub-system, away from actions that focus more on reducing waste before it is generated.

A second dominant reinforcing loop is revenue and employment (WMD2), which overlaps and extends the infrastructure loop. Increased investment in waste management infrastructure such as landfills and recycling schemes leads to increased employment and revenue through waste management services, both publicly and privately operated. The positive effects on the economy would then put political pressure on the waste system to continue to expand waste management services and infrastructure.

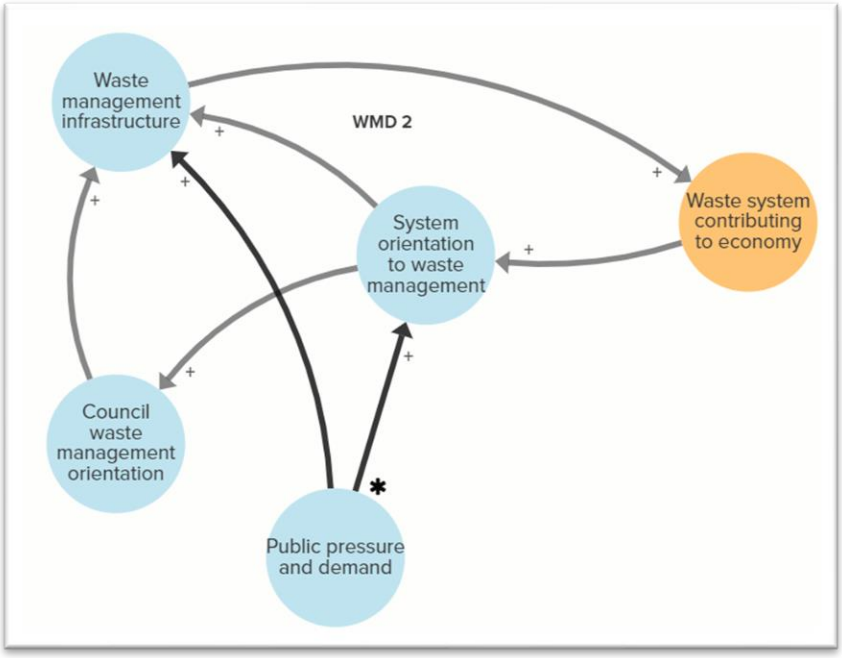

Figure 12 Revenue and employment loop (WMD 2)

CAPITALISM INFLUENCES (CI) SUB-SYSTEM

The capitalism influences (CI) sub-system (coloured orange on the CLD) with its two loops illustrates the significance of proposition 4, which relates to the influence of national policy settings. The sub-system shows that capitalism is acting as a key barrier for shifting the waste system towards more sustainable policies and practices.

The economic growth loop (CI1) is a dominant reinforcing loop, showing how a growing economy increases socio-economic status in general, raises employment levels and increases consumption. These effects contribute to a feedback loop that increases the growth of the economy. A recessive economy would operate in the same spiral reinforcing fashion to lower socio-economic status and consumption and depress the economy further.

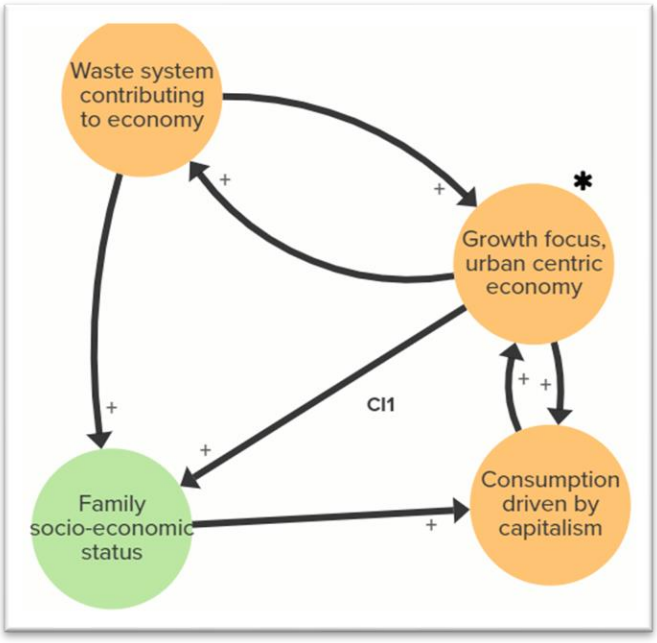

Figure 13 Economic growth loop (CI1)

The economic growth loop (CI1) dominates the second sub-system loop, the sustainability delay loop (CI2). This is a delayed balancing loop, where economic growth leads to negative consequences such as climate change, which leads to increased political commitment to sustainable development. However, the delays in this system means that these sustainable actions are far slower and far less visible than the effects of the economic growth. Similarly, sustainable policies can lead to increased socio-economic status and increased political commitment to sustainability, but the delays mean that the capitalist, economic growth loop (CI1) is more dominant and resists the systemic change.

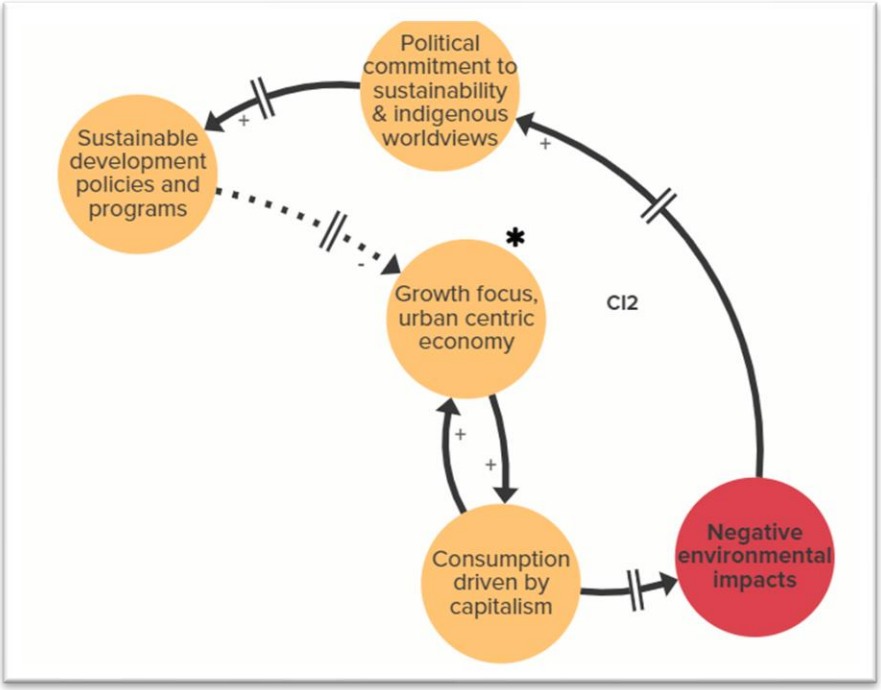

Figure 14 Sustainability delay loop (CI2)

SOCIO-ECONOMIC (SE) SUB-SYSTEM

The socio-economic sub-system (coloured green on the CLD) shows feedback mechanisms corresponding to all four propositions, encompassing community, local authority and national policy levels of influence. It consists of two key loops: socio-economic loop 1 (SE1) and socio-economic loop 2 (SE2).

The SE1 is a reinforcing loop, where systemic infrastructure and businesses of waste management contributes to improved socio-economic conditions of the low-income families (gainful employment and revenue) and due to the way the current socio-economic system is designed, such families are pushed into engaging in consumerism and generating more waste.

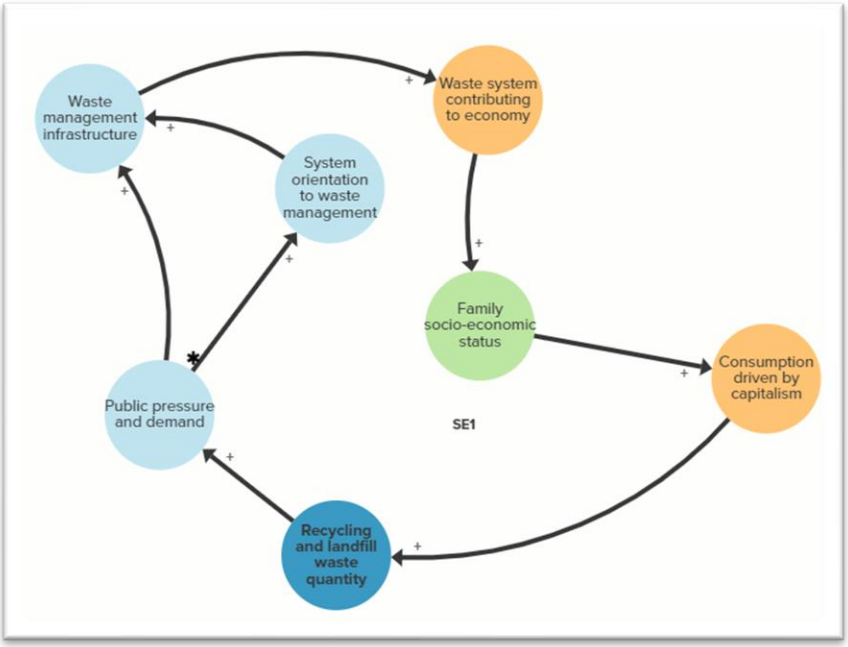

Figure 15 Socio-economic loop 1 (SE1)

However, improved socio-economic status also means greater access to education, leading to more ability to implement sustainability practices (SE2 loop). As shown earlier in the CCC sub-system, this leads to decreased waste (albeit with a delay). Unless there is a way to decouple economic continual growth, socio-economic status, and wellbeing, then the negative impacts on the environment through increasing waste will continue.

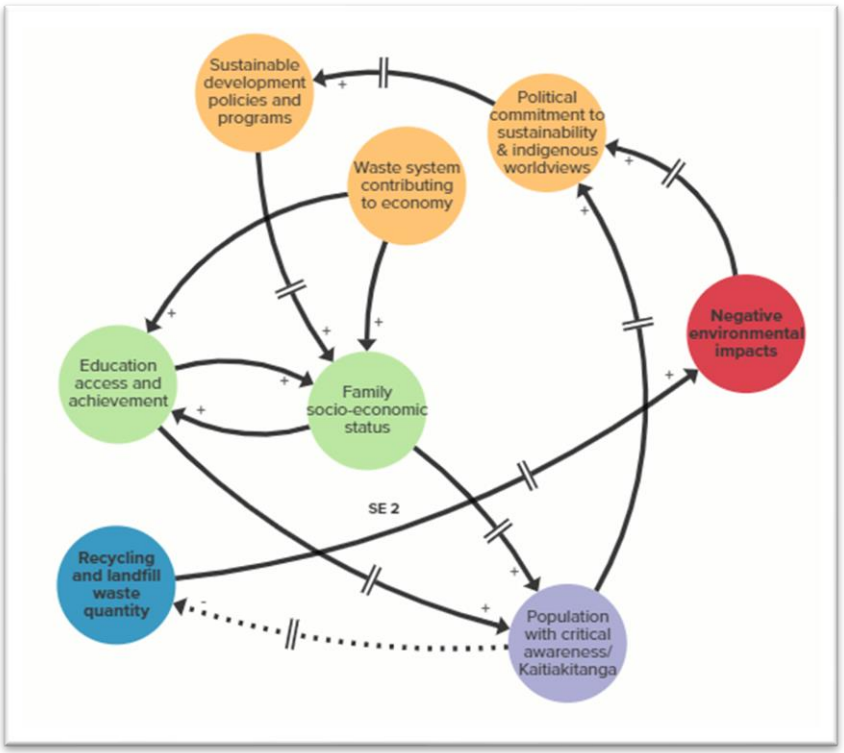

Figure 16 Socio-economic loop 2 (SE2)

CHAPTER III: HOW TO CHANGE THE WASTE SYSTEM

The realist review asked the question of how to create effective change towards waste minimisation. The result is a programme theory consisting of four mutually reinforcing propositions. The programme theory is presented graphically in Figure 1 (executive summary and below). The four broad propositions related to community-led interventions (propositions one and two), local government interventions (proposition three) and policy level interventions (proposition four). All the propositions are interconnected and working synergistically.

The overview of the propositions is given here, before discussing each in detail and providing the qualitative evidence for each proposition and sub-proposition.

Proposition One: Critical consciousness raising concerning the need for environmental and social sustainability and kaitiakitanga (guardianship) must be part of any successful waste minimisation intervention, as a shared level of knowledge is necessary to change social practices. The critical consciousness of local champions, who drive change initiatives in communities and businesses, is a key factor in effectiveness of interventions through their influence on other people.

Proposition Two: Creating physical community spaces and resources, inclusive of the range of cultures within that community, can raise critical consciousness, empower people, develop relationships and support sustained involvement in environmental action. These spaces support and coordinate collective action resulting in improved community wellbeing and social cohesion, as well as a shift in social practices towards waste minimisation.

Proposition Three: The success of interventions is enhanced by effective partnerships between local agencies, communities and businesses. Local government are in positions to create and encourage these partnerships, through the provision of services, advice and selective resource allocation. Local government can provide leadership, role modelling the use of indigenous worldviews and systems thinking, influence the critical consciousness of the community and businesses and provide a supportive context for change in social practices.

Proposition Four: Shifting social practices requires the support of policies focused on waste minimisation rather than waste management, which would be facilitated by policy makers who are themselves critically conscious of the need for sustainability, and who apply systems thinking and indigenous knowledge principles.

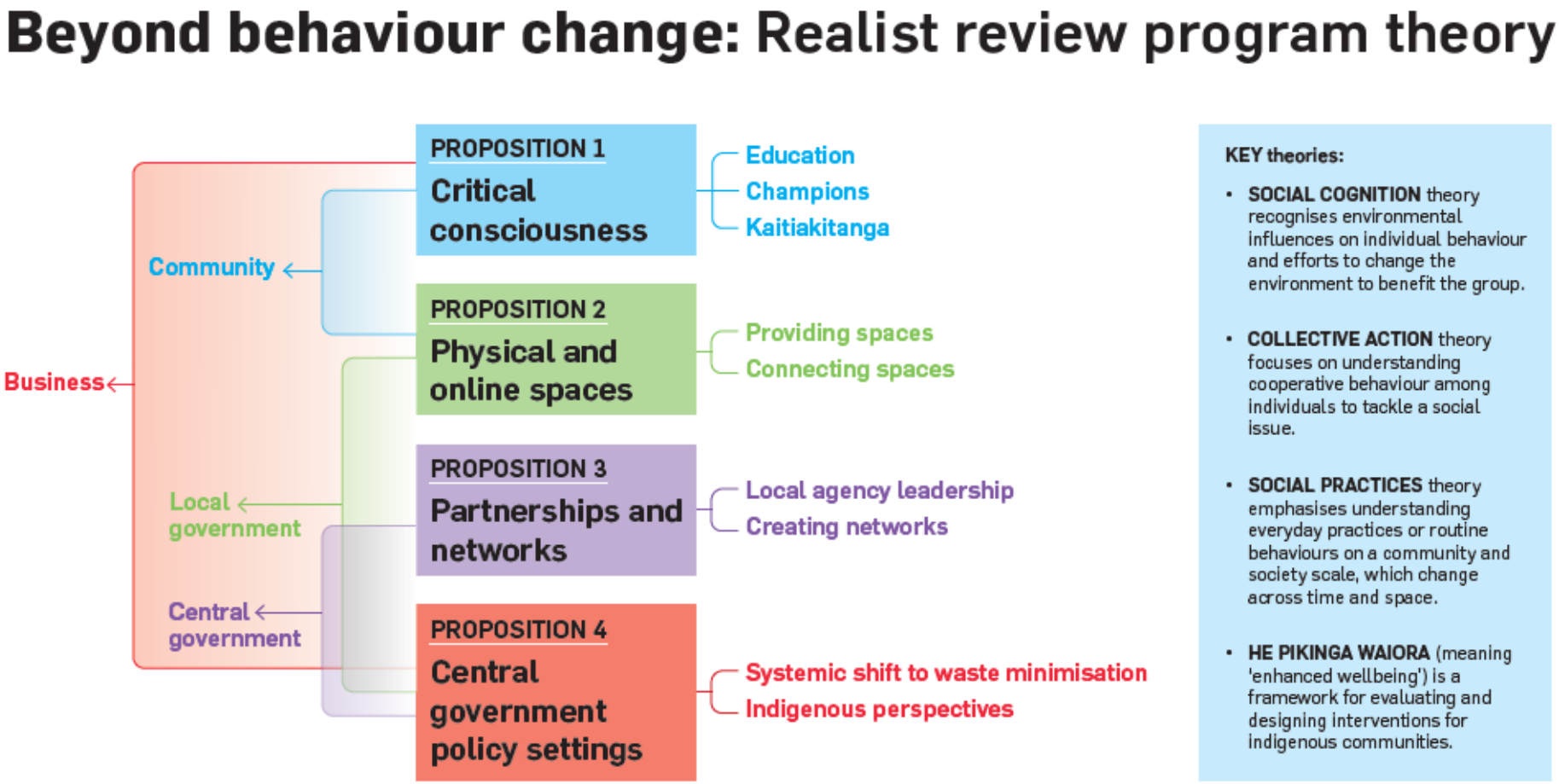

Figure 1: Programme theory for waste minimisation in Aotearoa

PROPOSITION ONE: CRITICAL CONSCIOUSNESS RAISING

Critical consciousness is often linked with situations of inequity and oppression [46, 47]. The term is broadly interpreted here that a socio-politically informed understanding of reality is a necessary precursor for the design of effective social change. The term 'critical consciousness' is used in this programme theory to represent people's social cognition of human exploitation of nature, particularly regarding the generation and disposal of waste, the impact on the environment and ultimately, on human wellbeing.

Interventions emphasised concepts such as environmental justice or indigenous perspectives to generate a critical consciousness of the need for action regarding waste

Many of the reviewed interventions emphasised concepts such as environmental justice, or indigenous perspectives of the connection between humans and the environment, to generate a critical consciousness of the need for action regarding waste. For instance, a school-based intervention utilised a Māori worldview and an environmental justice lens to generate emotional responses to encourage students towards sustainable practices.

> *The national identity of Aotearoa New Zealand is informed by a sense of kaitiakitanga (guardianship) towards local landscapes and as an island nation, beaches and the ocean are of great significance. Protecting a local dolphin was therefore considered a powerful way to emotionally engage students.[48]*

The use of a local example was particularly important in provoking a collective emotional response, and therefore contributing to a collective critical consciousness, which was considered the first step in the process of sustainable change. Many other interventions also assumed that raising critical consciousness was the first step for change, and the use of emotional reactions to achieve this was a common theme.

Education and Action Intertwined

Education when intertwined with action appeared as the most effective mechanism for raising critical consciousness, especially when linked to people's cultural, moral or ethical values.

> *For some donor participants there was a clear sense of frustration with the current food system that generates so much waste, when food that requires a lot of energy or care to produce is thrown out. Some talked about the ethics of this and noted that food rescue helped alleviate their personal frustration and guilt at having to throw out quality food. [49]*

However, the combination of education and action did not guarantee a shift in social practices. While critically conscious individuals worked to create social change, they were often negated by the emphasis on consumerism which dominates Western societies and works to maintain the status quo. Policy settings needed to be sympathetic to the sustainability agenda, as suggested in proposition four.

Influence of local champions

Many interventions were driven by the activities of a local champion with a high level of critical consciousness. Such champions were key to raising critical consciousness in others, because of respect for the champions' work, enthusiasm and knowledge. Neither impersonal community-wide awareness campaigns or the provision of services without reciprocal personal involvement were as effective in consciousness raising as the personal influence of local champions.

Champions were key to raising critical consciousness in others

> *She listened to me [when I did a presentation], and then she started [her] blog, and then she spoke, and then [someone else's] daughter started something else. (Interview 4)*

One intervention enlisted well-known personalities as champions to encourage people to make a personal commitment to action.

> *The campaign asked Kiwis to make a simple pledge and share it with their friends on social media. We involved politicians, sports and media personalities as well as students and communities making their pledge. … the science says pledges work to change behaviour. [50]*

Organisations often form around champions, and then the organisations themselves can be considered as a 'local champion'. Many organisations provided enthusiastic, person-centred leadership, while providing for consciousness raising through information, participation opportunities and by role modelling sustainable practices.

> *The emphasis on sustainability is normalized through everyday practices. For example, there is a visible absence of both plastic and rubbish bins … Waste is framed as something to be reduced and redirected from the landfill. [51]*

Business-centred organisations working for sustainability also developed around local champions, who used their personal influence to raise critical consciousness within businesses, for example the Sustainability Business Network which works in partnership to support individual businesses to become more sustainable and run advocacy campaigns [52]. This example shows that mechanisms of support, advice and personalized leadership are as relevant for businesses as for community initiatives. It highlights the connections between proposition one, critical consciousness, and proposition three, partnerships.

Kaitiakitanga

The indigenous Māori concept of kaitiakitanga (guardianship) is based on the idea of an intimate connection between people and the environment [53-55]. Many features of the environment are conceived of as ancestral entities, therefore prompting obligations of care, respect and reciprocity. Thus, environmental entities (such as waterways) provide resources for human sustenance and wellbeing, and in return, people must care for and sustain their environmental entities. Kaitiakitanga is governed by complex bodies of knowledge, customs and rituals. However, due to processes of colonisation, the full expression of kaitiakitanga by Māori has been restricted.

> *Kaitiakitanga involves practices that nurture wellbeing in a socio-environmental context. As such, kaitiakitanga incorporates a practical philosophy, protecting reciprocal relationships between people and the environment. Legislation such as the Resource Management Act supports the philosophy of kaitiakitanga by enabling environmental management, mitigation and protection of our natural environment. However, the RMA uses a definition of guardianship, or environmental stewardship pertaining to kaitiakitanga that only weakly aligns with the philosophy and current practices in Māori communities. [25]*

Kaitiakitanga is holistic and intergenerational, where people and the environment are seen as intimately and permanently related

Critical consciousness raising within Māori interventions was successful when grounded in a Māori worldview, utilising culturally appropriate knowledge, concepts and practices, a finding consistent with the centrality of culture in *He Pikinga Waiora*. Kaitiakitanga is holistic in approach and embedded in an intergenerational timeframe, congruent with the idea of people and the environment being intimately and permanently related.

> *Being a kaitiaki, you're being a protector. That is how I think of it. I think we all should be kaitiaki of New Zealand. … I guess I've kind of grown up with it; looking after yourself, looking after your people, and looking after the land. (Interview 8)*

PROPOSITION TWO: SPACE AND RESOURCES FOR COLLECTIVE ACTION

An important route to achieving critical consciousness raising was providing physical spaces, resources and support networks at a community level which enabled people to come together and interact. Online spaces for dialogue and sharing resources were useful although they lacked the power of the physical spaces and opportunities for learning face to face.

Space to bring people together

Community-based spaces and resources not only facilitated awareness raising and provided opportunities for learning by doing, but also fulfilled social needs and encouraged social networks. People were attracted to the spaces because of the chance to interact with like-minded people. These spaces also brought together people with diverse backgrounds, where cultural ideas and worldviews were shared and generally appreciated. Physical presence enabled people to encounter and be influenced by enthusiastic local champions (reinforcing proposition one – critical consciousness).

> *Our regular nursery volunteer groups reflect our community diversity. People of all ages, ethnicities and abilities join us for many different reasons. People come to learn, to share knowledge, socialize, meet new people and get hands on experience. [56]*

A common place-based mechanism was a community hub where volunteers gathered for some practical purpose, such as repairing bikes or caring for community gardens. Many interventions also held workshops, which interview participants saw as having two important purposes: creating social connections and learning through hands-on activities. Effective

mechanisms were highly collaborative, where people worked together rather than individually. In terms of social practice theory, this allowed for an increase in skills through participation in meaningful activities.

> *Our steady growth since 2004 has allowed us to refit a central [city] space to create a warm and busy EcoCentre, which now houses 25 staff and dozens of volunteers all focused on supporting people to reduce their impact on the environment. [57]*

Some of these spaces were funded through local government or grants, showing the importance of proposition three – partnerships with local agencies. Many community spaces were social enterprises where goods and services were sold to raise funds, blurring the distinction between 'community' and 'business' initiatives. Financial sustainability of community hubs was important because interventions required a timeframe of years to become embedded in the community and influence social practices. The social enterprise model provided meaningful activity for volunteers, especially for those who equated such activity with business and paid employment, and financial independence for the organisation.

Community-based spaces and resources fulfilled social needs and encouraged social networks

> *The project started by converting a disused soccer field at [the] school into a garden that grew enough food to help feed the school children three times a week. From there it has grown to include a range of social enterprises. [51]*

Connecting spaces and social practices

Social practices evolve in different settings and individuals move between these settings – their homes, schools, community hubs, marae and workplaces. The more congruence there was between social practices in different settings, the more sustained the practices were. Businesses had an important reinforcing role in influencing changes to sustainable social practices.

> *So, when you're out in a public place, or you're at a service station, or you're in your office building you're going to see the same colours for a recycling bin, landfill bin. (Interview 1)*

Transfer of practices between settings was mediated by availability of resources and other pressures.

> *I think basically the families that are more comfortable economically and they're not just surviving, I'm sure the message goes home [with the school children], but in those areas where you're facing poverty or families are struggling, I don't know if that will ever register because they've got so many other issues on their plates. (Interview 5)*

Peer groups created strong norms of behaviour, and some interventions highlighted the struggle to normalize new behaviours within a setting.

> *If someone's just chucking all their rubbish into the same black bag, we want that to be frowned upon, uncool, last century behaviour. So, we're trying to normalize that the milk bottles are rinsed, and the food waste is separated. (Interview 4)*

In a Māori worldview, the social practices and experiences associated with local places were governed by cultural narratives which provided continuity between past, present and future, as a holistic approach to wellbeing.

> *It was through this restoration project that we began to appreciate our narratives and values more deeply, and in particular, how these connected to actions to heal our places. Familiar narratives of Papatūānuku [earth mother] and the many Māori gods, as well as our local tūpuna (ancestors) surfaced during this process and subsequently highlighted the importance of the river to our histories and identity, especially within an urban context. The project gave us an opportunity to be reminded of the living characteristics of the river and to continue to view it as part of our community. The lessons we learnt, and the days we spent planting and monitoring, are embedded into both our minds and our landscapes for future generations. [25]*

PROPOSITION THREE: PARTNERSHIPS WITH LOCAL GOVERNMENT

Local government (councils) have a critical role in the waste system in Aotearoa, as owners of key infrastructures such as landfills and wastewater pipes which provide waste disposal, as well as recycling and other waste management services. They provide funding and support to community and business initiatives that promote waste minimisation, and leadership for change in social practices through the types of services provided and initiatives supported. However, local councils in diverse geographical areas have different community recycling requirements, for example segregated or co-mingled recyclables, drop-off points or a collection service. Public understandings and expectations tend to align with their specific local council's recycling systems.

Leadership

Local councils are governed by the Waste Minimisation Act 2008 and the Waste Strategy 2010 [58]. The waste management and minimisation plans tend to focus on waste diversion strategies as these are visible to the public and have immediate impact. This example from a local council plan shows the emphasis on diversion and absence of waste avoidance objectives.

> ***Waste free Objective**: To reduce the total quantity of waste to landfill, with an emphasis on wastes that create the most human and environmental harm.*
>
> ***Objective**: To provide environmental, social, economic and cultural benefits by increasing the amount of waste diverted from landfill via reuse, recovery and/or recycling.*
>
> ***Objective**: To investigate the use of available recovery and treatment technologies and service methodologies and apply these where appropriate. [59]*

One reviewed study focused on how (in)effective various local councils were in achieving Zero Waste goals, concluding that focus on recycling, and technological rather than behavioural solutions, can divert attention away from more impactful waste minimisation strategies.

> *The persistent attachment that Zero Waste to Landfill proponents have to recycling in particular is a notable element in the overall preference for technological solutions. … Recycling is even cited by some critics as a net detriment to waste reduction efforts, as it is argued that its 'feel-good' image diverts attention, support and energy away from more meaningful strategies at the top-of-pipe. [60]*

Local councils are centrally placed in the waste system, due to their ownership and control of infrastructure and services. They are well placed to influence social practices by leading changes in public opinion and practices as a conscious choice, instead of perpetuating existing social practices and norms.

> *Achieving the 100 percent diversion goal would require … strong leadership from government in the face of industry resistance and public apathy/antipathy. [60]*

There are many ways that local councils could use their position and influence to lead the adoption of sustainable practices by businesses. This could be through policy making and planning, including influencing central policy making (proposition four), but also through setting standards for sustainability practices in the council's own interactions with businesses.

> *One of the limitations we have with the waste reduction scheme is our service providers to work with us on those schemes … we've written that into the specifications, so that managing waste is part of the contract. (Interview 6)*

Creating networks and partnerships

The review showed that successful intervention programs were often connected with other initiatives and organisations in a tight network. For example, several neighbouring community organisations partnered with a local council agency to run a collective composting initiative [61]. The community organisations provided volunteers for doing the work and the local council provided funding, advice, and promotional support. In another example after the large earthquakes in Christchurch, local and regional government and organisations collaborated with central government collaborated to recover hazardous wastes from damaged houses [62]. The power and reach of a networked approach were articulated well by a successful community organisation.

Businesses had an important reinforcing role in influencing changes to sustainable social practices

> *There are hundreds of organisations, businesses, government departments … who are working towards achieving positive social and environmental outcomes. Yet for the most part, organisations are focused on isolated interventions, and no one organisation has all the answers. … [Our program] is committed to applying a collective impact framework to our work in the coming years. [63]*

Successful intervention programs were often connected with other initiatives and organisations in a tight network

Local councils had a critical role in establishing and sustaining such partnerships, through funding, sharing information and advice, and advocacy at central government (proposition four). They also provided venues, administration support or input from council staff (supporting propositions one and two).

It was the Regional Council that were calling the meeting in the beginning. Someone wrote the first scoping report, and it was recommended that we apply to the Sustainable Management Fund. (Interview 4)

Not only did the local councils have a role in supporting networks, but they needed to develop their own partnerships with Māori and the community to fulfil their planning and service obligations. Effective partnerships involved a high degree of sharing decision-making power whilst still maintaining local government responsibility.

> *The iwi (tribe) management plan further sets out the desired outcomes of the iwi in exercising their kaitiaki role within their rohe (region). The iwi management plan supports … including cultural values into urban management plans. This contrasts with more usual … community engagement in urban restoration projects [which] frequently focuses on ecological and physical processes but may not incorporate relational aspects. [25]*
>
> *As Treaty partners with the Crown, Māori consider themselves partners to state entities, … rather than simply stakeholders. [23]*

The attitudes that the local council took towards working in partnership affected the outcomes of initiatives and the priority given to resourcing networks and relationships outside specific projects. This study showed that implementation of partnership processes was still a work-in-progress for many local councils.

PROPOSITION FOUR: WASTE MINIMISATION POLICIES AND PRACTICES

As people become critically conscious of the need for action to minimise waste, the enormity of the problem becomes apparent. Individual and community-based actions, and to some extent local council actions, tend to focus on pragmatic solutions such as recycling schemes. Changing social practices towards waste avoidance requires more systemic intervention.

> *Diverting waste from landfill is undoubtedly better than not acting at all, but ultimately, we are an ambulance at the bottom of the cliff. We need to make fundamental changes to the structure of our society and economy to disincentivize the use and disposal of precious resources. [63]*

Systemic intervention requires action at all levels, including central government policy.

Systemic intervention towards waste minimisation

Generation of waste, such as non-biodegradable packaging, was seen as inherent properties of a system focused on creating wealth through consumerism [64]. In an economy based on

profit margins, the cost of managing and disposing of waste was disconnected from production, making it 'someone else's problem'.

> *Getting high quality food from certain donors was useful to address food poverty but was also an example of unethical overproduction and waste built into the food market structure. [49]*

Systemic change to a more sustainable economic system was an underlying aspiration for many interventions, with 'circular economy' [4, 10] currently the term most favoured in Aotearoa interventions. A sustainable economy is focused on reusing resources rather than exploitation and unlimited growth, and accounts for social and environmental costs along with financial costs. There have been recent central government initiatives to drive systemic change, which have previously been advocated for by communities, businesses and local councils, for example reviewing the Waste Disposal Levy [65, 66].

Indigenous systems thinking

Increasingly, central government policy in Aotearoa is working at the interface of mātauranga Māori (Māori knowledge) and Western science to develop systemic approaches to environmental management. However, there was more evidence of this being a policy intention, rather than actualised.

> *Such a dynamic and inter-connected perspective locates Māori knowledge and ways of knowing within the domain of 'systems thinking', which places greater emphasis on understanding the relationships between the components of a system. [11]*

> *We embrace the Māori concept of Te Taiao, a deep relationship of respect and reciprocity with the natural world. The health of the climate, land, water and living systems comes first. And when nature thrives so do our families, communities and businesses. [67]*

The concept of kaitiakitanga fitted particularly well with the concept of a circular economy, as it is based on interconnected, sustainable and reciprocal relationships [4, 10]. As a holistic approach to sustainability, kaitiakitanga was applicable at all levels – for communities and businesses, local and central government policy.

The programme theory was developed from a realist review of interventions whose purpose was to change behaviours, practices and/or systems related to waste. The four propositions suggest mechanisms to provoke sustained change, based on what was shown to be effective in the reviewed interventions. In summary these propositions related to raising the critical consciousness of the population, providing spaces and resources to connect people, leadership from the local government, and systemic change from central government. Although presented as separate propositions, they are not independent of each other. The proposed programme theory assumes that to be effective, all four propositions should be implemented simultaneously and would therefore be mutually reinforcing. Further, while the propositions are located at different levels of society – community, local government and central government – the programme theory as shown in Figure 1 has the propositions working across multiple levels, including business and industry. The programme theory is deliberately holistic in approach.

CHAPTER IV: WHERE TO FOCUS OUR EFFORTS WITHIN THE WASTE SYSTEM

The programme theory discussed in Chapter III identified four propositions that provide a guide for thinking through causal mechanisms and types of actions to influence waste minimisation intervention design at community or national levels in Aotearoa. The system map (i.e., CLD) shown in Chapter II drew on causal mechanisms and influences to better visualise the problem context within which the identified programme theory may operate. Dynamics identified within the CLD that suggest high levels of waste are difficult to change due to number of negative feedback loops and delays. This chapter provides a complementary lens on increasing waste minimisation practices and outcomes, by considering leverage points within the current system (as represented by the CLD), to increase waste minimisation outcomes.

Leverage points are critical points in a system where a small change could produce significant shift in the system towards desired behaviour. Meadows' framework consists of 12 types of leverage points for intervention, arranged in order of impact (Figure 6 in Chapter I) [36]. Impact is seen as the intersection of the degree of difficulty to identify and action interventions, with the degree of systemic change produced. Shallow leverage points include things like delays and feedback loops, which are easy to identify but produce comparatively little change, whereas deeper leverage points include things like rules, goals and paradigms, which are harder to target for intervention but produce the greatest change within the system. Using this framework, three leverage points were identified within the CLD: critical consciousness, redesign for waste minimisation, and a paradigm shift towards circular economies.

LEVERAGE POINT 1: CRITICAL CONSCIOUSNESS IS PIVOTAL FOR CHANGE

Critical consciousness is arguably a pivotal element in all social change. It forms the basis of proposition one and two in the programme theory, and the Critical Consciousness and Championing (CCC) sub-system. Critical consciousness is a concept introduced by the Brazilian educator, Paolo Freire, and refers to people becoming more aware of systemic inequities in order to take steps to resist the norms and processes that produce these inequities [46, 47]. Although this awareness does not always result in action on an individual level, the larger the mass of people who are critically conscious of the need for change, the greater the possibility of change occurring. The 'mindset' of people is a deep leverage point and has the potential to create a significant shift in the system.

Raise critical consciousness by connecting people with sustainability champions, with the environment, and with Mātauranga Māori

To raise the critical consciousness of the general population, ways should be found to bring people together to learn alongside and be influenced by sustainability champions. This potential can be realised through creating physical spaces for

communities to connect with each other and can be complemented by the use of social media and opportunities for networked knowledge building. Champions help through changing people's worldviews and supporting the idea that collective thought and action can have greater impact on the world than individual actions alone, again targeting the deep leverage point of 'mindset'.

In Aotearoa, the indigenous worldview of te ao Māori already supports critical consciousness of systemic inequities and the obligations people have to care for the environment which nurtures them and gives life. In te ao Māori, people are seen as connected closely with the environment through reciprocal responsibilities and kinship [53-55]. Mātauranga Māori, the body of knowledge that has been built up over many generations, provides guidance on how these responsibilities should be carried out. If this worldview and body of knowledge were to underpin the waste system in Aotearoa, there would be great potential for shifting the system towards waste minimisation and sustainability, according to Meadow's framework.

However, Māori worldviews in Aotearoa have been systemically marginalised by the process of colonisation [68]. Systemic structural change, another deep leverage point, is required to enable mechanisms for including and acting upon multiple worldviews. This means displacing colonial worldviews as the single dominant perspective and learning to work with multiple perspectives. A lens on waste colonialism [69] shows how decolonisation could open the way for much needed paradigm shifts and more radical change in widespread social practices. In turn this would help raise the critical consciousness of the waste issue among decision makers, from community to national policy level, in a reinforcing feedback loop.

LEVERAGE POINT 2: SYSTEMIC REDESIGN OF WASTE SYSTEM

The CLD shows that waste management strategies do not adequately address the key issue of waste production and try instead to deal with an ever-increasing waste load for redirection and disposal. Recycling in this system is an intermediary step, a mitigating strategy and not a long-term sustainable solution [14, 60]. Yet the emphasis on dealing with the immediate needs of waste disposal, and the appeal of recycling as an immediately visible sustainability strategy, leaves less operational resources to implement waste minimisation strategies. Further, the CLD shows that the Capitalism Influences (CI) sub-system works against moving to longer term sustainability settings. These interconnections are the reason that proposition three of the programme theory, although focused on the role of local authorities and their practical role in waste management, requires the support of community and central government (propositions one, two, four) to be effective. The whole waste system needs to be redesigned so that waste minimisation can be achieved.

Incentivise and prioritise initiatives to reduce waste by redesigning the waste system with a minimisation focus

Policy work for waste system redesign should use economic levers. Everyone should share the costs of waste just as everyone shares the negative environmental impacts, acting as a change incentive within a capitalist economic system. This is a 'rules' change, which Meadows' framework suggests is a 'deep' level and therefore effective systemic change. Better still to change people's mental models, an

even deeper level change, and normalise a ‘green’ and sustainable economic system as recommended by many commenters [e.g. 70, 71, 72]. However, shifting an entrenched economic system that has strong global connections is difficult as the system continually acts to absorb change while maintaining stable overall behaviour. Delays between action and results within the system also complicate behaviour.

The problem of plastic pollution is an example of the complexity of system behaviour [72-75]. Within Aotearoa, the problem of plastic waste continues to grow and pollute beaches and rivers [11, 76, 77]. Using the simplified CLD in Figure 17 (produced to explain the system concept to stakeholders, and based on the full CLD), it can be seen that a growth-focused economy incentivises consumption of plastics, which generates income that reinforces the growth focus of the economy, in a spiral manner. Greater use of plastics leads to increased pollution which slowly leads to greater critical awareness of the problem within the population. The increased plastic waste drives an immediate focus on recycling and recycling infrastructure, which delays the end point of waste needing to be disposed of but does not prevent it. Sooner or later, the plastic ends up needing disposal and goes to the landfill. To get out of this systemic trap, the waste system needs to be redesigned so that its goal is sustainable waste minimisation, and correspondingly, the economic system needs to be redesigned so that its goal is holistic health and wellbeing rather than continual economic growth through exploitation of resources [5, 71, 78, 79].

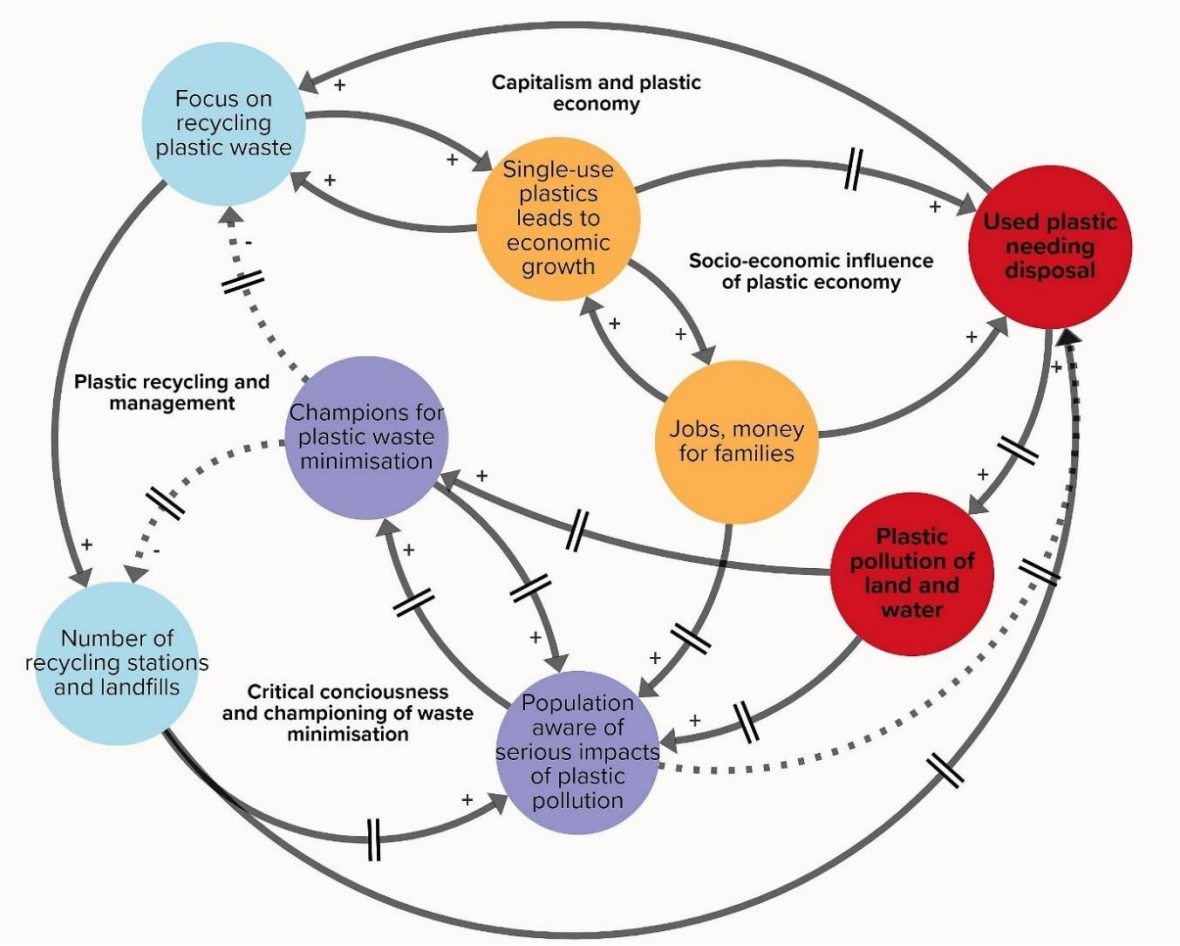

Figure 17: Simplified causal loop diagram showing a plastic waste example

LEVERAGE POINT 3: PARADIGM SHIFT TO CIRCULAR ECONOMIES

The CLD highlights that the capitalist economic system is a major influence on the waste system, through the uncritical acceptance that economics is about money more than wellbeing and that continual growth is primary goal of the economy. The paradigm of continual growth creates a consumerist society where 'more is better' and the by-product is increasing waste, with subsequent negative impacts on the environment. Raising population critical consciousness and redesign of the waste system will only have limited effect unless this paradigm is changed. Conversely, changing the paradigm, one of Meadow's deepest leverage points, has the potential to significantly shift the waste system towards minimisation.

There is growing support for normalising alternatives to a growth focused paradigm, at both a community and policy making level [4-10]. Further, shifts to regenerative and redistributive economies are well supported in mātauranga Māori [4, 10]. In Aotearoa the influence of circular economy thinking can be seen in a review of the plastics system [11] and introducing policies such as banning microbeads in cosmetics [80], single use bags in retail outlets [81], and selective mandatory product stewardship [12]. However significant challenges remain and there will be a significant delay before the impact of these policies are visible, because of the need for structural change and refinement alongside dealing with people's reactions to change.

Normalise the idea that the economy should be regenerative and not exploitive

CHAPTER V: IMPLEMENTING CHANGE

Creating social change was at the heart of this research project. The aim was to develop a theory of change to guide actions that could shift the waste system in Aotearoa towards sustainability. The success of this project will be measured in how well the theory of change and systemic insights might support further design interventions by stakeholders in the waste system, including community groups, local government, industry and central government.

The premise underlying the project was that an intervention design focus on individual behaviour change was insufficient to create social change to the level that is required to reverse the trend of increased waste and environmental degradation. A systemic approach was proposed as an alternative that incorporated social practices and the design of more effective and connected actions. Further, Māori worldviews were seen as effective for the context of Aotearoa, given that mātauranga Māori has been developed over centuries of living sustainably in, on, and with this land.

Two complementary methods were used to develop the theory of change for the waste system. The first was a realist review, drawing on literature of waste minimisation interventions in Aotearoa alongside interviews with practitioners in the field. The realist review focused on the underlying mechanisms that made the interventions effective, and produced a programme theory of four interrelated propositions (see Figure 1). The propositions related to different sites of activity and different stakeholders, from community groups through to central government. A collective action approach was critical to effective implementation of change, as highlighted in systems dynamics mapping which was the second complementary method used in developing the theory of change (see Figure 7). The causal loop diagram enabled a visualisation of the waste system based on the programme theory, allowing the analysis of the salient sub-systems and feedback loops. The system insights gave a different perspective on the propositions of the programme theory, showing that critical leverage points were raising the critical consciousness of the population to sustain long-term change, a deliberate redesign of the waste system to focus resources on waste minimisation more than waste management and disposal, and a paradigm shift to sustainability (not economic growth) as a priority for societal wellbeing, based on Mātauranga Māori and Indigenous models of reciprocity between people and the environment.

The focus on raising critical consciousness of all stakeholders in the waste system is an accessible starting point for implementing this theory of change. Complementing the traditional academic publications as outputs from research, the research team has developed a lay person's presentation of the findings using the online application Kumu, which allows viewers to interact with the causal loop diagram to more fully understand the causal connections. The presentation was refined with feedback from stakeholders to make it more easily understood by a general audience, showing the importance of involving stakeholders in collaborative sense making. The presentation can be found at https://esr.kumu.io/beyond-behaviour-change-project.

GLOSSARY

Aotearoa	Māori name for New Zealand
Hapū	Māori sub-tribe(s)
He Pikinga Waiora	Māori-centred implementation framework
Iwi	Māori tribe(s)
Kaitiakitanga	Guardianship, stewardship
Kaupapa	Purpose, practice, ways of doing things
Mahinga kai	The practices of traditional food gathering
Mana	Prestige, dignity, influence, status, spiritual power
Māori	Indigenous people of Aotearoa New Zealand
Mātauranga Māori	Māori knowledge systems
Papatūānuku	The Earth (Mother)
Tūpuna	Ancestors
Te ao Māori	The Māori world/worldview

APPENDICES

APPENDIX I: LITERATURE SELECTED FOR THE REALIST REVIEW

Community	
Farrelly and Tucker (2014)	Residential waste minimization action research in a provincial city.
Walker et al. (2019)	Urban restoration based on kaitiakitanga – a Māori worldview of environmental management
Long, Harre, and Atkinson (2014)	Recycling intervention in a school, focusing on peer influence
Mason, Brooking, Oberender, Harford, and Horsley (2003)	Implementation of Zero waste programme at a university
Niimi, Wakes, and McGuire (2014)	Design intervention to improve the waste stream of a local farmers' market
Parr (2013)	Educational intervention to reduce food waste in families
Simon et al. (2019)	Case studies of community-led initiatives for climate adaptation and mitigation
Stanway-Thorpe (2019)	Reflection on 20 years of a community-based recycling initiative.
Compost Collective (2018); (Compost Collective, 2019) and website information	Annual reports from a composting intervention run by a collaboration between the local agency and community groups
Ecomatters (2019) and website information	Annual report of a charitable trust that implements community based environmental initiatives
Enviroschools (2018) and website information	A national initiative which partners with schools to promote environment friendly behavior and practices
Lee and Diprose (2018)	Research to understand the success factors for a food rescue organization.
Kaipātiki Project (2019) and website information	Annual report of a community organization that promotes sustainable living
Sustainable Business Network (2019) and website information	Annual report of a network of businesses that aims to build a culture of sustainability within business practices
Sustainability Trust (2019) and website information	A charitable trust and social enterprise that promotes sustainable living
Townrow et al. (2016)	A school litter reduction project linked with saving Maui dolphins
Zero Waste Network (2018); (Zero Waste Network, 2019) and website information	Network of community enterprises across NZ that works towards zero waste
Local Government	
Auckland Council (2017)	Council waste assessment
Auckland Council (2018)	Council waste management and minimization plan
Bradshaw (2003)	'Reduce your Rubbish' national campaign pilot, collaboration between Councils and Ministry for the Environment
Bryce, Day, and Olney (2005)	Urban kerbside recycling incentives trial in a city
Dean (2006)	Long term Council-run waste minimization educational intervention in schools, in one province
Eunomia Research & Consulting Ltd (2016)	Joint Council waste assessment
Eunomia Research & Consulting Ltd and Waste Not Consulting Limited (2016)	Joint Council waste assessment
Goven et al. (2015)	Transdisciplinary approach to waste management, involving local agency and Māori working in partnership

Krausz et al. (2013)	Analysis of the zero waste action plan adopted and then discontinued by a city council
WasteMINZ (2015)	Collaborative intervention between multiple local agencies and central government to manage safe disposal of hazardous waste from earthquake damaged residential properties
Seadon (2010)	Urban case study of increasing recycling container volume
WasteNet Southland, Peterson, and Meads (2017)	Communication intervention to reduce recycling contamination
Councils of the Wellington Region (2017)	Collaborative waste management and minimization plan
WasteNet Southland et al. (2017)	Implementation of Love Food Hate Waste campaign in one province
Scott and Curtis (2018)	Rural waste minimization project
Litter Less Recycle More project (2020)	A collaborative project to reduce litter in a major city and its surrounds
McNeil (2019)	Regional litter intervention project led by a local agency
Leckinger (2018)	Joint business, local agency and community initiative to influence littering behavior
Policy	
Blake, Farrelly, and Hannon (2019)	Evaluation of voluntary e-waste product stewardship
Gertsakis et al. (2012)	Review of five years of ‘E-waste day’ intervention
Ministry for the Environment (2010)	Revised NZ waste strategy to guide local government, businesses and communities
Ministry for the Environment (2017a)	Cabinet paper that formed the basis for microbeads ban law
Ministry for the Environment (2017b)	Review of effectiveness of Waste Disposal Levy
Sustainable Coastlines (2018)	Long term collaboration between community organization and central government agencies to produce a national beach litter database
Office of the Prime Minister’s Chief Science Advisor (2019)	Rethinking Plastics report: A policy working group document for preventing plastic pollution

APPENDIX II: REALIST REVIEW INTERVIEW SCHEDULE

Background – things to remember:

- Realist interviews are about identifying programme theories. That is, what do people understand the **activities** of their programme does to influence **mechanism**. In what **context** do these mechanisms work, and what **outcomes** are achieved and **for whom.**
- Also useful to understanding programme theories is to ask about if there is any theory informing the programme e.g. social psychology theories of behaviour change, sociological theory …
- While we are interested in the opinions, experience and perspective of those people we interview, it is for the purpose of helping to identify programme theories.
- The interview and participant can also swap roles during the interview. That is, we are going into the interview with some initial ideas about programme theories. It is legitimate to run some of these ideas past the participant – thereby getting them to react to our suggestions, rather than taking only a naïve inquirer approach.

Context setting questions

- Can you please describe your background experience that has led you to your current role?
- Please briefly describe the programmes or initiatives you are involved in related to [nutrition] [waste minimisation]?

Note each programme, Ask the participant to choose the 2 or 3 programmes they think are most successful or important. We will ask questions about each of these programmes in turn.

Programme level questions:

Ask these questions for each programme described above:

- Can you briefly describe how this [programme] came about?
- For [programme], what are the intended outcomes?
    - historical and contextual background?
    - What was the issue, who identified it, who took the leadership in issue identification and planning phase?
    - Are these factors being considered in the intervention? How?
- Have you noticed these outcomes so far?
- Are the outcomes different for different people (is there a difference in level of outcome you see, who for)?
- Have you noticed difference in outcomes depending on different contexts?
    - Context examples: different schools, workplaces, marae, communities…?

- We are very curious about how programme may have caused (or expected to cause) the desired outcomes. How do you think the intervention has worked (or is working if ongoing, or intended to work if just starting) towards desired outcome?

    - What is it that you think contributes to achieving the intended outcomes? In other words, what do you think creates the change?
        - Clarify: We often refer to these things that create change as mechanisms. It is ok if there are multiple causes or mechanisms, but we are also interested if you think these causes/mechanisms interact or work together and if so how?
    - Why do you think these mechanisms create change?
    - What is required for these mechanisms to work?
        - Clarify: are there particular pre-requisites?
    - Is there any difference in the mechanisms you think are needed in different contexts?
    - How do you think the mechanisms are related to the outcomes you described earlier?
    - What about the activities or interventions with the programme do you think will make the mechanisms work?
-
    - Does the programme draw on any particular theories about how people, organisations or communities change?
    - Do you think this programme would work other places? Why / why not?
    - Who would this programme not work for? Why?

Possible Future Programmes

We are aware that there are practical limits of funding or availability of other resources that create practical constraints on the programmes you run.

We are interested, if you could develop and run any programme you want – there are no constraints, what would this programme be?

What outcomes would you hope to achieve?

How would this programme create change?

- What are the mechanisms that would lead to this change?
- What activities would make these mechanisms work?
- What conditions (context) would be needed for this programme to work?
- Do you think the programme would work differently for different people?

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