Manaaki Whenua
Landcare Research

Determining the economic and market potential of regenerative agriculture

Prepared for:
Our Land and Water National Science Challenge & the NEXT Foundation

November 2021

‘Think piece’ on Regenerative Agriculture in Aotearoa New Zealand: project overview and statement of purpose

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Extracted from: Grelet G, Lang S 2021. ‘Think piece’ on Regenerative Agriculture in Aotearoa New Zealand: project overview and statement of purpose. Manaaki Whenua – Landcare Research Contract Report LC3954 for Our Land and Water National Science Challenge & The NEXT Foundation.

Find the full project overview, white paper, and topic reports at

ourlandandwater.nz/regenag and www.landcareresearch.co.nz/publications/regenag

This report is one of a series of topic reports written as part of a ‘think piece’ project on Regenerative Agriculture (RA) in Aotearoa New Zealand (NZ). This think piece aims to provide a framework that can be used to develop a scientific evidence base and research questions specific to RA. It is the result of a large collaborative effort across the NZ agri-food system over the course of 6 months in 2020 that included representatives of the research community, farming industry bodies, farmers and RA practitioners, consultants, governmental organisations, and the social/environmental entrepreneurial sector.

The think piece outputs included this series of topic reports and a white paper providing a high-level summary of the context and main outcomes from each topic report. All topic reports have been peer-reviewed by at least one named topic expert and the relevant research portfolio leader within MWLR.

Foreword from the project leads

Regenerative Agriculture (RA) is emerging as a grassroot-led movement that extends far beyond the farmgate. Underpinning the movement is a vision of agriculture that regenerates the natural world while producing ‘nutrient-dense’ food and providing farmers with good livelihoods. There are a growing number of farmers, NGOs, governmental institutions, and big corporations backing RA as a solution to many of the systemic challenges faced by humanity, including climate change, food system disfunction, biodiversity loss, and human health (to name a few). It has now become a movement. Momentum is building at all levels of the food supply and value chain. Now is an exciting time for scientists and practitioners to work together towards a better understanding of RA, and what benefits may or not arise from the adoption of RA in NZ.

RA’s definitions are fluid and numerous – and vary depending on places and cultures. The lack of a crystal-clear definition makes it a challenging study subject. RA is not a ‘thing’ that can be put in a clearly defined experimental box nor be dissected methodically. In a way, RA calls for a more prominent acknowledgement of the diversity and creativity that is characteristic of farming – a call for reclaiming farming not only as a skilled profession but also as an art, constantly evolving and adapting, based on a multitude of theoretical and practical expertise.

RA research can similarly enact itself as a braided river of interlinked disciplines and knowledge types, spanning all aspects of health (planet, people, and economy) – where curiosity and open-mindedness prevail. The intent for this think piece was to explore and demonstrate what this braided river could look like in the context of a short-term (6 month) research project. It is with this intent that Sam Lang and Gwen Grelet have initially approached the many collaborators that contributed to this series of topic reports – for all bring their unique knowledge, expertise, values and worldviews or perspectives on the topic of RA.

How was the work stream of this think piece organised?

The project's structure was jointly designed by a project steering committee comprised of the two project leads (Dr Gwen Grelet[1] and Sam Lang[2]); a representative of the NZ Ministry for Primary Industries (Sustainable Food and Fibre Futures lead Jeremy Pos); OLW's Director (Dr Ken Taylor and then Dr Jenny Webster-Brown), chief scientist (Professor Rich McDowell), and Kaihāpai Māori (Naomi Aporo); NEXT's environmental director (Jan Hania); and MWLR's General Manager Science and knowledge translation (Graham Sevicke-Jones). OLW's science theme leader for the programme 'Incentives for change' (Dr Bill Kaye-Blake) oversaw the project from start to completion.

The work stream was modular and essentially inspired by theories underpinning agent-based modelling (Gilbert 2008) that have been developed to study coupled human and nature systems, by which the actions and interactions of multiple actors within a complex system are implicitly recognised as being autonomous, and characterised by unique traits (e.g. methodological approaches, world views, values, goals, etc.) while interacting with each other through prescribed rules (An 2012).

Multiple working groups were formed, each deliberately including a single type of actor (e.g. researchers and technical experts only or regenerative practitioners only) or as wide a variety of actors as possible (e.g. representatives of multiple professions within an agricultural sector). The groups were tasked with making specific contributions to the think piece. While the tasks performed by each group were prescribed by the project lead researchers, each group had a high level of autonomy in the manner it chose to assemble, operate, and deliver its contribution to the think piece. Typically, the groups deployed methods such as literature and website reviews, online focus groups, online workshops, thematic analyses, and iterative feedback between groups as time permitted (given the short duration of the project).

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[1]Senior scientist at MWLR, with a background in soil ecology and plant ecophysiology - appointed as an un-paid member of Quorum Sense board of governors and part-time seconded to Toha Foundry while the think piece was being completed, and to the NZ Merino company just before the release of this report.

[2]Sheep & beef farmer, independent social researcher, and project extension manager for Quorum Sense

Determining the economic and market potential of regenerative agriculture

Contract Report: LC3954-8

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Please cite as follows: Grelet GA, Perley C, Driver T, Garland C, Good H, Saunders J, Tait P, Ridder B, Saunders C 2021. Determining the economic and market potential of regenerative agriculture. Manaaki Whenua – Landcare Research Contract Report LC3954-8 for Our Land and Water National Science Challenge & The NEXT Foundation.

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1 Introduction

1.1 Acknowledgements:

The authors thank and acknowledge the many constructive comments from Bill Kaye-Blake and Suzie Greenlagh, which have considerably strengthen this report.

1.2 Disclaimer

This report is constrained in scope and depth. A more comprehensive description of issues and methodologies required to assess the economics of RA would need to be underpinned by a thorough assessment of the current and predicted economic landscape of New Zealand (NZ) food production, including NZ's exports, relevant policies/regulations, how production and distribution are financed, labelling and certification schemes, global trade trends and disruptive innovations at various levels of the food system. Although these topics have been mentioned in the report where relevant, such a thorough assessment, requiring a wide range of specialised expertise, would be a research project in itself and is therefore beyond the scope of this report.

1.3 Addendum November 2021.

Market trends, trade agreements as well as regulations concerning food and fibre products, all of which have direct impact on farm economics, are currently changing at pace. Hence, while the generic concepts discussed in this report will remain relevant in the foreseeable future, the specifics of how these concepts are currently applied to farm economics should be considered relevant at the time of publication but **not** necessarily relevant at the time of reading of this report.

1.4 Purpose and scope of this report

This report is a perspective paper. It seeks to provide an overview of issues / topics relevant to determining the economic and market potential of regenerative agriculture (RA), and to more widely appraising the economic benefits or costs of adopting RA. In doing so, the report also highlights key knowledge gaps and proposes methodologies to fill these gaps.

One of the first economic question that people ask (be they researchers, farmers, policy makers or others) is whether or not RA farming businesses are profitable. The second question is whether the adoption of RA will lead to similar, lower or higher profitability at the farm level, compare to status quo (no adoption of RA). The first part of this report focuses on metrics and methodological approaches that could be used for answering these questions.

In March 2021, primary industries accounted for around 7% of NZ's gross domestic product[1]. When calculations were extended to all economic activities linked to agriculture, the Ag sector contributed approximately 12.4% of GDP and 78% of total exports in 2020[2]. Hence the performance of NZ farming businesses now and in the future will have a substantial impact of the country's economy. The second part of this report therefore highlights modelling approaches that could be used to investigate the future economic impact of RA adoption on farming businesses, entire ag sectors and on the entire country.

Other questions often asked are whether RA produce is marketable. Indeed the profitability of farming businesses is heavily impacted by the market position (price taker at the farm level, price maker or taker at other levels), commodity and premium prices, and market opportunities for the products (food or fibre) grown on-farm. It is therefore necessary to understand the behaviour of food and fibre markets, and this ultimately involves not only understanding consumers' preferences for different product attributes, but also their perception of what RA is (and if they are aware of it) – as discussed in the third part of this report. A full understanding of the marketability of RA food & fibre products will not be gained until we can better appraise how these products are differentiated from other products, both in domestic and export markets. This might be achieved via a certification / labelling system and / or by other means (e.g. story-telling).

Finally, RA has evolved and is gaining attention worldwide for its intent on mitigating some of the negative environmental and social impacts of agriculture. Its proponents argue that RA is not only a key solution to reducing atmospheric CO_2 concentration, but also to increasing the resilience of our landscapes to climate change (See Grelet et al. 2021). In NZ, RA is also posited as a possible pathway to reducing excessive nitrogen leaching into waterways. As producers experience increased pressure from climate change (e.g. severe droughts), coupled with mounting pressure from regulations and taxes designed to prevent or revert negative impacts of agriculture (e.g. nitrogen leaching), the adoption of RA might have potential to alleviate some of those pressures. Hence, the fourth and final part of this report looks at possible options for assessing the economic benefits and / or costs of the environmental impacts of RA.

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[1] https://www.stats.govt.nz/information-releases/gross-domestic-product-march-2021-quarter

[2] https://www.interest.co.nz/rural-news/102105/agricultural-gdp-catches-well-under-one-quarter-agribusiness-system-such-it-fails

2 PART I: Assessing farm profitability in the context of RA

This section discusses the choice of metrics. First, a standard set of metrics is described. These standard metrics are those most commonly used by current industry models to assess and compare the profitability and productivity of farming operations in NZ. Second, we examine how the adoption of RA principles might affect the standard approaches. Third, methodological approaches are outlined, to investigate whether the adoption of RA will alter farm profitability, compared to status quo (no adoption of RA).

2.1 Standard metrics

The table below lists some of the key metrics used to assess the profitability of a farming business, and highlights where the impact of RA is unknown (knowledge gaps). Many of these metrics will be specific to the type of land use / farming operation investigated. We focus, as an example, on the financial metrics for sheep & beef operations.

All metrics described here are usually calculated using an averaging approach to provide annual farm-level values. This is to account for both spatial and temporal variability within the farm system.

Some of the metrics can also be considered on a weekly or monthly basis, or for a particular area of the farm system (i.e. not aggregated over time and space) – as part of a partial-budgeting analysis (see subsequent section).

Table 1. Standard economics metrics to assess profitability and business performance of farming operations

Indicator	*Calculation /method*	*Comment & knowledge gaps are marked in bold italicized*
Economic farm surplus (EFS)	Gross farming revenue Less farm operating expenses Less wages of management Less depreciation	These are standard industry measures of profitability. They account for production, but also for the price obtained for the sale of the product, and for all operating expenses. The emphasis is placed on profitability instead of production & stocking rate, because at the end of the day, EFS is a truer indicator of financial performance than production. Needs to be measured over 3–4 years to take out the seasonal and market variability. ***RA may or may not increase EFS, depending on various factors, but especially on market trends***.
Animal health expenditure per stock unit	$ spent on animal health and breeding divided by opening stock units	As RA seeks to improve animal health, ***this metric is likely to differ between RA and other types of farm management strategies.***
Fertiliser expenditure per stock unit	$ spent on macronutrients, trace elements, nitrogen, lime, and any other additives divided by the opening stock units	As RA seeks to reduce or eliminate fertiliser inputs not produced on-farm, ***this metric is likely to differ between RA and other type of farm management strategies***.

Seed expenditure per stock unit	$ spent on multispecies pasture or wider crop mixes divided by the opening stock units	As direct-drilled multispecies mixes are mostly specific to RA, ***this metric is likely to differ between RA and other management strategies***.
Feed expenditure per stock unit	$ spent on mineral and supplementary feed (winter) divided by the opening stock units	As RA seeks to optimise mineral balance in pastures and for animals (e.g. offering them free choice), and eliminate reliance on winter feed imported from outside the farmgate, ***this metric is likely to differ between RA and other management strategie***s.
Feed conversion efficiency (FCE)	Kg of dry matter fed to produce 1 kg of carcass weight (product) Requires a full farm system model (Farmax[3], E2M[4] or others) to be maintained for the business to derive this accurately	RA seeks to increase pasture and fodder crop diversity. The feed conversion efficiency for highly diverse forage is a knowledge gap to be filled for many aspects of RA: animal welfare, productivity, profitability, and food/fibre quality. RA practitioners claim that the forage they grow has superior nutritional qualities due to its diversity and their management strategy; if that is the case, then FCE will increase under RA. ***This is a major knowledge gap required to be filled to better assess the potential benefits of transitioning to RA in NZ pastoral farms***.
Return on capital	EFS divided into the total capital of the business (land, stock, and plant).	Another indicator of financial viability and long-term sustainability, ***which may increase with adaption of RA***.
Price per kg product	The total receipts or revenue divided by the total kg lamb, mutton, beef or wool (calculated separately for each category of livestock)	***This metrics is likely to increase with the adoption of RA*** if a market premium can be derived for RA-produced product.

2.2 Quantifying profitability and business performance specifically for RA farming businesses

Whilst RA's definition is still evolving, and is still being adapted for NZ (Grelet et al. 2021), RA farming systems operate under a common set of principles (see Lang 2021, Grelet et al. 2021) that can affect how the farm business is organised and / or how its profitability is quantified. The table below examines how each RA principle (or set of RA principles) might affect the quantification of farm profitability. When relevant, alternative economics metrics are proposed. The considerations included in Table 2 might also be applicable to farming businesses who do not self-identify with RA, because non-RA farms might apply some elements of RA principles as part of their management strategy.

[3] https://www.farmax.co.nz/

[4] https://www.landcare.org.nz/current-project-item/farm-systems-project

Table 2. Relationship between RA principles and farm economics

RA principle	*Implication for the assessment of farm profitability*
Harness diversity	Many RA farming businesses are diversifying their operations. Diversification might occur in various ways (land-use choices, honey production, eco-tourism, etc.) including via agrobiodiversity (stock classes, species composition, fit with seasonal pattern, etc.). There will be competition, complementarity and facilitation between the various operations (Martin et al. 2020). EFS might not be a suitable indicator of farm profitability in this context. Other metrics such as marginal return / marginal cost might be more informative.
Manage livestock strategically / holistically	Livestock handling: holistic grazing is perceived as time-consuming. A better indicator of farm profitability might be EFS per hours worked. It is worth noting that systematic assessments of time requirements associated with holistic grazing are inexistent and so the impact of RA adoption on labour cost (in terms of time and / or wages) is also a knowledge gap. Genetic selection : the deliberate on-farm selection for desirable traits such as resistance to zoonotic disease, adaptability to mob grazing, superior meat, wool, and milk products, etc. will yield a higher return on investment in the medium to long term.
Plan for what you want, start with what you have	Instead of standard EFS, a more relevant approach to quantifying farm profitability is the calculation of the ratio between Marginal Return and Marginal Cost. This type of calculation will yield insight into the profitable use of resources, rather than insight into what may produce more (Anderson & Ridler, 2010).
Minimise disturbance / /maximise photosynthesis year-round	Biological inputs designed to improve soil health: Such inputs include bio-amendments (e.g. fish hydrolysates, biochar, 'humates') but also diverse cover crops and multispecies mixes. The improvement in soil health is expected to yield positive financial gains in the medium to long term, for example, through reduced rates of fertiliser application without any associated decrease in production. The return on investment is likely to occur after a variable number of seasons or years (currently unknown). The impact of investment in these biological inputs on farm profitability must be calculated over multiple years, likely over time-scales that are not usually accounted for in standard farm economic assessments.
Minimise disturbance	This RA principle is implemented via a reduction or elimination of inputs containing synthetic nitrogen, no-till and maximising ground cover, all of which will lead to a reduction in excess nitrate leaching and sediment loading into waterways. A reduction in N fertiliser load is also likely to reduce nitrous oxide emissions. This in turn will decrease compliance costs and any taxes imposed to control greenhouse gas emissions – so the impact on farm profitability will be via reduced compliance costs and reduced input costs (see Yang et al. 2020).
Maximise photosynthesis year-round / Harness diversity	These RA principles increase the likelihood of accruing carbon and biodiversity credits. Carbon credits can be gained from trees on the current emission trading scheme (ETS), or from soils in future possible iteration of NZ ETS. Other credits can be gained via voluntary credit markets (e.g. carbon, biodiversity). Other types of credits might be gained, as voluntary credit markets emerge. These credits will in turn impact on the profitability of the farming business, but over time-scales that are not usually accounted for in standard farm economic assessments.
Make context-specific decisions / the farm is a living system	RA farms might put greater emphasis on decarbonisation and lowering greenhouse gas emissions. Profitability might be assessed using metrics that quantify trade-offs (e.g. EFS per kilogram of carbon-equivalent emitted).

2.3 Methodological approaches to assess the economic impact of transitioning to RA at farm level

The methodological approaches outlined in this section are proposed to investigate whether the adoption of RA will lead to similar, lower or higher farm profitability, compared to status quo (no adoption of RA).

- Pairwise comparisons of commercial farms:

It can take multiple years for all components of the farm system to be transitioned to RA. An alternative to waiting until the farm system has transitioned, is to use a paired site or chronosequence approach, whereby space is substituted for time. This approach involves comparing two similar farm systems that contrast only in their farm management systems (e.g. organic vs. non organic farms, Shadbolt et al. 2009) . The farms are paired to be as similar as possible, to reduce confounding factors (e.g. soil type, topography, climate, size, etc.), except for the different management systems (Charnet & Beaver 1988). Often this implies that the paired farms are neighbouring or in close distance to each other.

To apply this approach to economic metrics capturing economic performance of the farming system as a whole (e.g. EFS), neighbouring farms must be comparable in their biophysical attributes, size (business or property size) and type of operations. Size is especially critical, as differences in economy of scale might confound the results of pairwise comparisons, should sizes within each pair differ. In practice, this study design is almost impossible to organise such that it is perfect, because neighbouring farms rarely have similar size & biophysical attributes (even if they run the same type of operations).

An alternative to adequate matching of the two farms within each pair is to design the study with large number (>100) of replicated pairs, and account for differences in size or biophysical attributes using metrics that quantify these differences as covariates in the statistical data analysis (but see Schneider et al. 2015).

Another alternative is to restrict the pairwise comparison to economic metrics which are indicative of relationships between different components of the farm system, but already account for size and scale (e.g. marginal return / marginal cost). The impact of RA adoption on these types of metrics may be assessed using pairwise comparisons with a smaller number of replicates.

- Benchmarking:

Assessment of RA commercial farms against regional or national benchmark data (i.e. averages and max/min/percentile for the region, catchment, sector, etc.) – this approach works best for metrics that use aggregated data (Francks and Collis 2003, Kahan 2013). However, unless benchmarking data have been obtained from a network of farms that captures the full range of business and biophysical conditions, those benchmark data will only represent a certain fraction of the farming population in a given region or country which might bias the results of the assessment (Chibanda et al. 2020).

- Partial-budget analysis:

This approach is suited to determine the on-farm economic impact of changes from one set of farming practices to another (Sohe 2014, Hady et al. 1994), and relies on field, paddock, or herd-level data. For example, in the context of RA, this approach has recently been used to assess the economic impact of adopting soil health-enhancing practices in US farms growing corn or soybean[5,6]. The study, involving 100 growers distributed throughout the corn- and soybean-growing regions of the USA, was based on costs and benefits data at field-level collected via interviews. Expenses identical in the two sets of practices (soil health-enhancing versus status quo) are excluded. The economic gain from adopting the soil health-enhancing set of practices is calculated from the net change in costs and benefits compared to status quo. The study's preliminary results indicates that net income and yield is increased for 85% and 67% of growers, respectively. The same approach could be applied to assess the on-farm economic impact of adopting RA practices such as multispecies primer / cover crops, reduction in inputs containing 'synthetic' fertilisers, soil amendments containing biochar and / or 'humates', etc. (see Grelet et al. 2021, Schon et al. 2021 for further descriptions of these practices).

- Experimental research farms:

These can provide insights on cause-effect relationships between RA principles and practices, and economic outcomes, in much more controlled conditions.

- Modelling:

The choice of financial models will strongly affect the relevance of the outputs from these models to RA farming systems. In the context of appraising the impact of RA, farm financial models should account for key indicators of performance that are likely to be affected by the adoption of RA and will have a direct or indirect impact on farm financial performance. For example, in the case of pastoral farms, a narrow focus on EFS risks ignoring the interdependencies and relationships between various aspects of the farm system, such as pasture/forage quality and quantity, animal intake, meat / milk / wool production, animal behaviour, and farm management. How these relationships interplay and change with RA is what will determine how productive and profitable is the farm. Consequently much more insight will be gained from financial models capable of describing / predicting the behaviour of these relationships, than those focussing mostly on the description / prediction of standard economic metrics such as EFS. As it is difficult in these models to account for all the aspects of the farm system that will likely impact the financial performance of the farming business, the challenge is to select which of these aspects must be represented in the model and to choose the most relevant indicators for inclusion in the model (Malcolm et al. 2021). In the context of pastoral farming, as more data on feed quality levels, pasture utilisation and regrowth, any beneficial impacts on soil and water quality accumulates, it

[5] https://soilhealthinstitute.org/economics/

[6] A detailed description of the methodology used in this US study can be found here: https://soilhealthinstitute.org/wp-content/uploads/2021/02/Partial-Budget-Methodology-used-by-SHI-v.-02-08-2021.pdf

should become easier to quantify these aspects and include them in the modelling of farm financial performance.

Another important consideration for the choice of farm financial models is whether they can account for (1) non-linearity in relationship between different aspects of the farm system, (2) non-constant return to scale, and (3) whether the model is designed to be used by farm managers as a tool to optimise farm performance from a financial and/or environmental standpoint. A number of models have been developed for NZ farming systems, some of which are more apt to handle non-linearity and non-constant return to scale than others, may or not optimise (see Samarasinghe & Greenhalgh 2008; Anderson & Ridler 2010; Hurley et al. 2013; Addis et al. 2021) and vary in their ability to provide outputs beyond financial metrics and include farm environmental performance (e.g. greenhouse gas emissions, see Journeaux et al. 2021).

Farm financial models will provide information on the financial and productive capacity of the farms and help understand the comparative output and structure of RA farm management strategies versus others.

3 PART II: Assessing the potential economic impacts of increased RA adoption at multiple scales

3.1 Scenario analyses

The performance of NZ farming businesses now and in the future will have a substantial impact of the country's economy. This section discusses modelling approaches to assess the financial impact of RA adoption on farming businesses under scenarios of interest.

Farm financial models can be constructed (as discussed in section 2.3) based on a range of indicators for farm economic performance, as well as other indicators of the farm's biophysical context, its business model, pathway to market, and the range of farming operations occurring on farm.

Modelling approaches can then be used for time series analysis (e.g. Saunders & Saunders 2015) to assess impacts over different time periods and across a range of parameters. Scenario analyses can also be used to estimate the impact of adopting RA at different rates and scales across given ag sectors, on the performance of the sectors considered.

Scenarios tested as part of this type of analysis should be chosen with stakeholders (e.g. Shadbolt et al. 2017), and may include: increased frequencies of extreme weather events (droughts and flooding); changes in NZ's global trading environment; changing consumer preferences for product attributes and/or changes in domestic environmental policy (i.e. implementation of carbon tax or inclusion of agriculture into the Emissions Trading Scheme), creation of RA certification / labelling systems, changes in requirements from processors and distributors[7,8,9]. To be meaningful, scenario analyses must be underpinned by credible (e.g. data-backed) assumptions of future states, that will allow reliable parameterisation of the scenarios tested. Such data can be drawn from past and on-going aligned research addressing climate change predictions (e.g. Wooley et al. 2020) or time-sensitive evidence on consumer preferences (e.g. Tait et al. 2021). There are however many knowledge gaps still to be filled. For example, there is a limited data on the economic consequences of market restructuration in a COVID19 era, including increased emphasis on the domestic food market[10], increased direct selling[11,12], and blockchain technologies (van Hilten et al. 2020, Xiong et al. 2021).

3.2 Assessing the impact of RA exports overseas on NZ financial returns from agriculture

In 2020, the Ag sector contributed approximately 12.4% of GDP and 78% of total exports (based on calculations extended to all economic activities linked to agriculture). The latest situation and outlook for NZ's primary industries[13] suggests export revenues from the food and fibre sector to "rebound and reach a record $49.1 billion" as export markets recover from changes triggered by the outbreak of the COVID19 pandemic. There are dynamic feedback loops between the performance of NZ farming businesses, the behaviour of NZ export markets and the country's economy. Major buyers of NZ food and fibre products are signalling their upcoming and increasingly more stringent requirements for ingredients to be produced with much lower environmental footprints (e.g. the Farm-to-Fork strategy of the EU green deal[14], global brands requirements for RA-sourced products[7,8,9]). An increase in the adoption of RA might facilitate NZ export products to meet these requirements – although the properties of any required food and fibre certification and labelling system and the consequences on securing premium pricing are still undecided / unknown.

Scenarios analyses relating to the NZ trading environment can be undertaken using trade models. Trade models perform time series analyses of various chosen scenarios and can therefore be used to illustrate the impact of RA adoption on the whole of NZ agriculture, in the context of the international environment. The trade models can be used in conjunction with farm-level modelling and outputs from choice modelling analyses (see Appendix 2) to provide evidence and theoretical backing for the impact of the different farm management

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[7] https://www.danone.com/impact/planet/regenerative-agriculture.html

[8] https://www.nestle.co.nz/csv/regeneration/regenerative-agriculture

[9] https://www.potatopro.com/news/2021/mccain-foods-commits-regenerative-agricultural-practices-all-its-potatoes-2030

[10] https://www.stuff.co.nz/business/farming/124700980/local-farmers-grow-quality-wheat-but-most-of-us-arent-eating-it-heres-why

[11] https://www.nzherald.co.nz/sponsored-stories/nz-exporters-seize-direct-to-consumer-model/K3FND2ZKYCK2CCAH5K6Q4H4YQU/

[12] https://www.euromonitor.com/direct-selling-in-new-zealand/report

[13] https://www.mpi.govt.nz/resources-and-forms/economic-intelligence/situation-and-outlook-for-primary-industries/

[14] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

strategies, and estimates of their uptake and influence in the context of global markets. Several trade models can be considered for this type of analyses, but only a few of them are capable of handling scenarios that also incorporate products credence attributes (e.g. the Lincoln Trade and Environment Model (LTEM)).

Scenario analyses might focus on financial returns from selling RA produce in commodity markets. As mentioned above, the probability for these scenarios to unfold in the future is significant, given changes in requirements from certain export markets and brands / global food corporations. This could be done using the LTEM trade model, for example. The LTEM model has been extended to include environmental impacts (Çağatay et al. 2003; Saunders & Çağatay 2004) and also has bilateral trade analytical capability, which has already been successfully used to look at the impact of the EU–Mercosur free trade agreement and of a possible EU–NZ free trade agreement (Revel et al. 2013; Saunders & Saunders, 2015). Noteworthy is the fact that LTEM can be used for forecasting, but is strongest when used to analyse differences in outcomes as a result of different scenarios designed by the analyst (Saunders et al. 2016, p. 72). To assess the impact of increased RA adoption and exports of RA products overseas, a scenario might be constructed, in which a trade agreement liberalises exports of NZ exports to a large market, for particular produce delivered by RA. LTEM will then determines the impact this would have on producer returns or net trade values at the end of the modelling period compared with a base case with no change in trade liberalisation. This approach requires the properties of the export commodity market to be known e.g. its consumer preferences and / or regulatory requirements for export entrance[15].

Financial gains may also arise from securing high-value premiums and / or access to niche markets. There are already multiple RA 'certification' or labelling schemes currently emerging overseas and in NZ[16,17,18]. Therefore understanding premium potentials in overseas markets for regeneratively farmed food and fibre produce is also key to assess the economic impact of RA adoption on NZ producers and financial gains from NZ agriculture. This is discussed in the subsequent section.

[15] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

[16] https://rodaleinstitute.org/regenerative-organic-certification/

[17] https://savory.global/land-to-market/

[18] https://www.discoverzq.com

4 PART III: Understanding overseas market potential for regenerative farm produce

4.1 Why a focus on overseas markets?

Economic returns are often a major influencing factor for growers, farmers, producers, etc. making changes on farm. Therefore, establishing whether there are financial benefits to producers via market premiums or better market access for regeneratively farmed products is a critical step to support adoption of RA.

Views of local consumers and producers (i.e. in NZ) are an important consideration but the NZ market is typically small in comparison to the global market for NZ produce. There is a export focus of many NZ food production sectors, for example, about 90% of sheep and beef products are consumed outside of NZ. This section focuses on examining suitable methodologies to understand the potential value of labelling and marketing our products as regenerative outside of NZ.

The potential value benefits include:

- **Generating a price premium for NZ regenerative products versus non-regeneratively produced products**, either from NZ or elsewhere: price premiums achieved could be medium to long term, depending on how other producer countries adopt similar production practices, and how long it remains a point of difference for our export products.
- **Defending existing value** i.e. protecting market share in markets NZ operates in by differentiating our production systems in consumer's minds.
- **Adding value to intangibles such as (but not exclusively) a 'brand NZ' food story** (i.e. in general, how NZ food and beverage products are perceived globally). Due to the interconnectedness of agricultural systems, identifying mechanisms for securing a value premium within one sector of NZ agriculture is likely to be applicable to other sectors. Conversely, depending on marketing strategies, and depending on the properties of markets in which the product might be exported, value-added intangibles might be product- and market-specific.

4.2 Methodologies for identifying premium market potential for NZ's 'regenerative' produce

The following describes a four-step approach to identify the export market potential for NZ's RA produce.

- Step 1: Determine which markets to explore to assess the potential for a regenerative price premium

RA, when treated as a subset of wider sustainability trends, is likely to move at different paces internationally, and studying its trajectory everywhere, simultaneously, will be neither desirable nor useful. Food and fibre export markets differ based on country of location, potential size, consumers segments (e.g. millennials versus other age groups), size, product types and in their interest in product attributes linked to sustainability.

Market prioritisation and narrowing of focus will therefore be necessary to determine the most appropriate markets to explore whether there is a price premium associated with RA (or its component attributes). Determining this would involve consultation with exporters in NZ (one-to-one in-depth interviews) and the use of secondary data (e.g. data sourced from literature reviews, website data searches, web scraping for social media data) to understand what trends are currently present and growing in different markets. In the case of the red meat sector, for example, this might involve conversations with red meat processors and analysing the social media conversations in our major export markets (US, China, UK, Germany).

- Step 2: Understanding the view of the food/beverage/fibre and policy sectors within these markets

After determining which markets to look at, the views of those working in the value/supply chain need to be understood to know how RA is viewed, and what is seen as the potential for products making regenerative claims in their markets. These individuals may include retail gatekeeper roles such as those people making decisions about what products are stocked in supermarkets. In addition, discussions with people working in markets producing or advocating for regenerative products and systems locally (farmers, growers, processors) will help understand the likely trajectory of regenerative production in their markets. Discussions with people working in agricultural and environmental policy roles in these markets will provide information on any required food production conditions for commodities being imported as this will influence future access for NZ products. These people can also provide an understanding on whether a regenerative story would support access for and relevance of NZ agricultural products in these markets. Qualitative one-to-one interviews with policy and supply chain experts are likely to be the most effective approach.

- Step 3: Understanding the consumer view of RA

Consumer willingness to purchase and pay a price premium for regeneratively produced food and its attributes are also required, alongside knowledge of what consumers define as and expect from regeneratively produced food. The types of consumers to include in any assessment should range from those who have an interest in and awareness of issues relating to food production and sustainability to the more 'typical consumer' to understand how broad the appeal of regeneratively produced food may be.

Studies of consumer views and willingness to pay can use both small-scale **qualitative** and large-scale **quantitative** research methodologies (see section 4.3). On the one hand, because RA is a relatively new concept for consumers, and is still undefined, qualitative research provides an opportunity to explore, understand, and test ideas. Qualitative research is also more amenable to taking a more adaptive reflective approach to developing a questions and adapting the questions based on consumers responses as the study progresses. Data collection can be undertaken digitally/online, rather than via in-person face-to-face interviews. On the other hand, quantitative research methodologies can provide information on the scale of appeal of regenerative products, or of the attributes associated with these products, as well as some guidance on pricing. These quantitative methodologies include traditional questionnaire survey methods targeting representative samples in each market of interest, or more advanced choice experiment analysis.

- Step 4: Modelling the impact of meeting market expectations

Once the market data are collected, modelling approaches would be used to understand the impact RA might have on production and what proportions of producers will need to adopt RA to meet market demand.

4.3 Putting it all together: Insight from recent studies investigating the premium market potential for NZ's RA produce

4.3.1 Insights from studies using qualitative methodologies

Research commissioned by Beef+Lamb NZ & NZ Winegrowers, with funding support from the Government through the Ministry for Primary Industries' Sustainable Food and Fibre Futures fund as part of its Fit for a Better World programme, represents one of the most comprehensive reviews into the market potential of regenerative agriculture (Beef+Lamb NZ & NZ Winegrowers 2021a, 2021b). It sought to understand the current state and future market potential of regeneratively produced food and wine within three of NZ's international markets – the United States, Germany, and the United Kingdom, using methodologies for steps 1 to 3 described in Section 3.2. The outputs, based on a market (processors and brands) scan and a consumer scan, highlighted that regenerative narratives focused on the potential taste, health, and environmental benefits of regeneratively produced food products resonated strongly with consumers, specifically the potential for regenerative agriculture to be part of a climate change solution. It also gave direction for farmers and processors around both the opportunity and how to realise that opportunity through a NZ-specific accreditation programme (e.g. recently released NZ Farm Assurance Programme Plus (NZFAP Plus), or other tailor-made accreditation programmes). An exploration of the research that would be required to understand the advantages and disadvantages of relying on certification programmes to capture a premium or access particular markets is beyond the scope of this report.

4.3.2 Insights from studies using quantitative methodologies:

Quantitative methodologies allow the assessment of consumers' Willingness to Pay, and can provide insights on the potential for consumers to buy / pay for products with various credence attributes including social, cultural, and environmental attributes (e.g. Tait et al. 2020). Consumers' willingness to pay can vary by consumers segments, countries, and commodities.

In November 2020, Californian and UK consumers were surveyed to assess how much consumers know about RA, what benefits they associate with RA, and what produce attributes they value (Tait et al. 2021). Samples of 1,000 consumers in each of the UK and California were surveyed using online Likert scale questionnaires. The results for this study indicates that:

- Knowledge of RA was similar between the UK and Californian samples, with about 40% of respondents knowing at least a little about RA (Appendix 1, Fig. 1)
- Respondents who knew at least a little bit about RA were then asked to indicate which factors they thought were associated with this system. The strongest association for both UK and Californian respondents was care for the environment (Appendix 1, Fig. 2).
- The same groups of respondents were asked to indicate which attributes are important for the products of regenerative agricultural practices (Appendix 1, Fig. 3). There was some variation in what each country's respondents consider the most important attributes, but in general terms, attributes representing environmental impacts and animal welfare are important attributes of these products for both countries. A main difference is the elevation in importance of health considerations by Californian respondents compared with those in the UK.

5 PART IV: Assessing the value (benefits or cost) of externalities

The financial return from agricultural activities has often been criticised for not accounting for the full cost of their impacts on the environment and society, or the cost of 'environmental externalities'. For example, the costs of the negative environmental impact of the NZ dairy industry were estimated in the early 2010s (Foote 2014). A gross upper estimate of the cost of some of the environmental effects exceeded the 2012 dairy export revenue of NZ$11.6 billion (Foote et al. 2015).

However, agriculture activity and food production have externalities that can be both negative or positive. Many methods have been developed and are still evolving, to determine the monetary value of externalities in terms of both benefits and costs. These can be classed as revealed or stated-preference methods that assess society's willingness to pay or accept compensation for an externality, or as production-based techniques that assess the alternative cost of ameliorating or providing an externality. Many of these methods can also be applied to assessing the benefits/costs of RA in NZ. Two potential methodological approaches to assess externalities are outlined below.

5.1 Assessing the value of environmental benefits of RA using Non-market valuation

One example of a stated-preference method is non-market valuation (NMV). The application of regenerative farm management systems is likely to have environmental benefits for biodiversity, water quality, and reduce net greenhouse gas emissions. These environmental benefits are typically not traded in markets but can be evaluated using NMV methods to estimate monetary values. For example, two studies including representative samples of NZ population (Tait et al. 2016, 2017), and using NMV, found that almost all New Zealanders (90%) are willing to pay to increase native biodiversity and would be willing to pay up to $7.39 annually for each 1% increase in freshwater quality. See also Canning et al. (2021) for alternative approaches to valuation of ecosystem services.

One method for estimating the NMV of environmental improvements is discrete choice experiments. This involves developing a choice experiment analysis of consumer and citizen preferences for the attributes associated with RA. Discrete choice modelling is particularly appropriate when it involves choices and trade-offs between multiple attributes, some of which are unobservable (Hanley et al. 2001; Birol et al. 2006; Czajkowski et al. 2014). Embodied attributes associated with regenerative agricultural practices fit this description, e.g. reduced negative impact on freshwater quality, increased sequestration of carbon in soils, increased habitats and food supply for native biodiversity. External validity of the method has been tested with market data. Best-practice approaches are used to ameliorate hypothetical bias (Loomis 2014) and undertake tests of internal validity, including for scope of provision, information non-attendance, heterogeneity in scale versus preferences, and diminishing marginal returns (Hess & Daly 2010). To be robust, the research design needs to include a sufficiently large sample for statistical significance, and a survey can be developed in consultation with stakeholders and the science team. The seven steps for discrete choice modelling (Bennet & Adamowicz 2001) are described in Appendix 2.

5.2 Assessing the value of environmental costs (and benefits) of RA using True cost accounting (TCA)

True cost accounting (TCA) seeks to account for those hidden costs and to promote both transparency and accountability in the food and fibre sector. TCA is 'an evolving holistic and systemic approach to measure and value the positive and negative environmental, social, health and economic costs and benefits [of farming] to facilitate business, consumer, investor and/or policy decisions'. TCA can be applied at different scales – that of the product itself (e.g. packaged beef meat, or wheat flour); that of the entity producing the product (organisation, e.g. farming business); that of the system (e.g. ag sector, supply and value chains, etc.); that of the geographical unit (catchment, region country, etc.); and at the investment scale (de Adelhart Toorop et al. 2021).

Many TCA frameworks have been developed and are still developing. Currently, available frameworks largely focus at the product and/or organisation scales. Still lacking are well-developed frameworks for TCA at system, geographic and investment scales (de Adelhart Toorop et al. 2021). A recent review of TCA frameworks and methodologies (de Adelhart Toorop et al. 2021) found that TCA studies usually or always seek to assess and value externality/dependency on effects pertaining to economic, environmental, and social domains. However, the authors report diverging choices of indicators, as well as different methodologies for the monetarisation of the effects and their aggregation.

TCA approaches for assessing the impact of RA adoption are particularly relevant because RA has evolved – and is gaining attention worldwide – for its focus on restoring (regenerating) natural capital, on minimising or mitigating the environmental impacts of food and fibre production and on revitalising the social fabric of rural communities (Merfield 2021; Grelet et al. 2021; Giller et al. 2021). Concepts with high relevance to RA, and inherently embedded in TCA, include natural capital valuation (NZIER 2017; Whitaker 2018), the valuation of ecosystem services (van den Belt & Blake 2014; IPBES 2018), soil change (Robinson et al. 2012; Samarasinghe et al. 2013), valuation and measurement protocols relating to social and human capital and well-being (Liu & Opdam 2014), and quality-adjusted, life-year losses and food system-related costs of health (FAO 2017).

While TCA is a relevant and promising avenue for assessing whether increasing the adoption of RA would decrease the cost of externalities, key knowledge gaps remain to be filled. TCA approaches in NZ would be valuable to assess the economic impact of RA adoption on restoring freshwater health, by comparing TCA if an entire catchment was farmed regeneratively, or farmed under status quo (no adoption of RA) but with a range of catchment restoration interventions (e.g. sediment traps) or converted to other land uses. However, the methodologies for TCA at catchment scale are still poorly developed.

There also remain issues to address in terms of interpretability of TCA results and subsequent impacts on future decision making at the scale at which TCA is being deployed. When true costs are being estimated, who shall be held responsible for paying these costs, and by which mechanisms? Existing mechanisms are currently indirect, often mediated via regulatory taxes on producers, processors, and consumers.[19]

However, additional indirect mechanisms are emerging, not necessarily for paying but as incentives for reducing the costs of negative environmental and social impacts, including:

- Via dedicated pathways to market[20,21,22]
- Via the finance and impact investment sectors:[23] e.g. EU green deal,[24] NZ's Sustainable Agriculture Finance Initiative,[25] green and social bonds,[26] sustainability-linked loans,[27] impact investment platforms,[28] to name a few
- Via environmental credits: e.g. emission trading scheme (ETS) for carbon and possibly biodiversity[29], or via voluntary credit markets including for carbon[30]
- Via inclusion of environmental data in blockchain technologies for agricultural applications (van Hilten et al. 2020, Xiong et al. 2020).

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[19] For example, future greenhouse gas pricing schemes (https://hewakaekenoa.nz/our-work/).

[20] https://rodaleinstitute.org/regenerative-organic-certification/

[21] https://savory.global/land-to-market/

[22] https://www.discoverzq.com

[23] https://croataninstitute.org/soilwealth/

[24] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[25] https://www.theaotearoacircle.nz/sustainablefinance

[26] https://www.nzx.com/services/listing-on-nzx-markets/debt/green-bonds

[27] https://news.anz.com/new-zealand/posts/2021/05/kathmandu-sustainability-linked-loan

[28] https://www.calmthefarm.nz

[29] https://www.newshub.co.nz/home/rural/2020/06/james-shaw-will-consider-biodiversity-credits-for-farmers-planting-trees-on-their-land.html

[30] https://www.environmental-finance.com/content/awards/voluntary-carbon-market-rankings-2021/

6 Conclusion – the challenges ahead

An economic evaluation of RA should not be restricted to standard and/or short-term financial measures within the farm gate. Economic assessments that don't account for the future dynamism and uncertainties – including changes in trade regulations, market trends and climate change – risk being misleading.

At the farm scale, RA may require a wider suite of financial indicators to evaluate on-farm performance. Many of these indicators are not currently available and/or benchmarked. Therefore, research methodologies ought to include and validate a wider suite of indicators, expanding beyond readily measurable financial indicators of farm performance.

The choice of farm system models for whole farm budgeting and time series analyses will determine the relevance of their outputs – models that can incorporate non-linear feedbacks between various components of the farm system, non-constant return to scale, and that are designed to optimise resource use and environmental impacts might be more suitable for RA farming systems. If RA promotes diversification of enterprises at farm level, additional modelling challenges might arise, as most models are usually tailored for specific land uses.

A wider perspective on impacts may be required to adequately assess and value the externalities of farming; NMV is a well-tested approach suitable for estimating the monetary value of possible non-marketable environmental and social benefits. TCA is another approach that could be explored to estimate costs – but the methodologies are still in development, particularly for assessment at scale of highest interest (catchment, system, investment).

RA farms may be able to capture a market premium as compensation for the benefits RA aims to produce. Evidence suggests that consumers see RA as having environmental and animal welfare benefits. Further research would be required to estimate the size of the price premium. Additional requirements for market access for agricultural products (e.g. low carbon, waste, water, biodiversity, footprints, etc.), with or without a price premium, might also impact farm financial performance. Hence research looking at the potential for markets to support an RA sector in NZ must be carefully designed to account for uncertainties and rapid changes in market-driven mechanisms, such as certification and labelling systems or blockchain technologies . Similarly, the impact on NZ farm businesses, and on the NZ ag sector as whole, of green financing, and of the fast-growing environmental credits markets is unknown. These emerging market regulations and trends pose additional challenges to the modelling of farm financial performance, as highlighted by Yang et al. (2020).

Scaling up from individual farm businesses to regions, value chains, and sectors also offers considerable challenges that will require the use of broader modelling tools (e.g. LTEM) with outputs updated frequently because of fast-changing regulations, consumer behaviour, and market trends. Scaling up might also require development of other modelling approaches that can cater for high levels of uncertainty.

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8 Appendix 1: Results obtained from a market study undertaken by Tait et al. (2021) investigating consumers' willingness to pay for RA products.

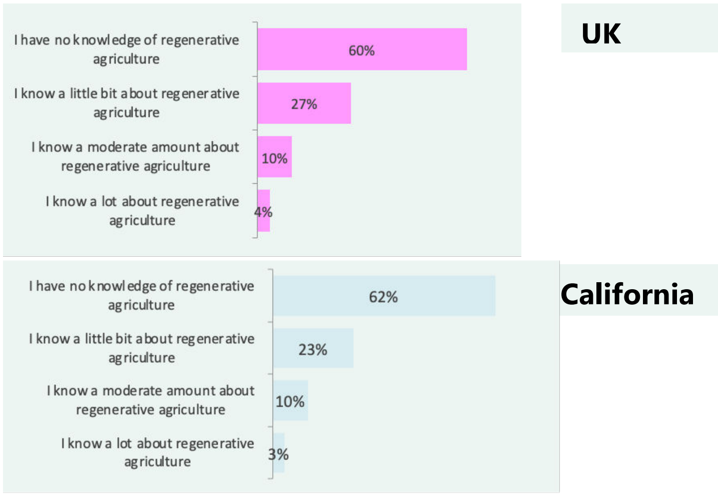

Figure 1. Knowledge of RA in UK (pink) and Californian (blue) consumers (adapted from Tait et al. 2021, with permission).

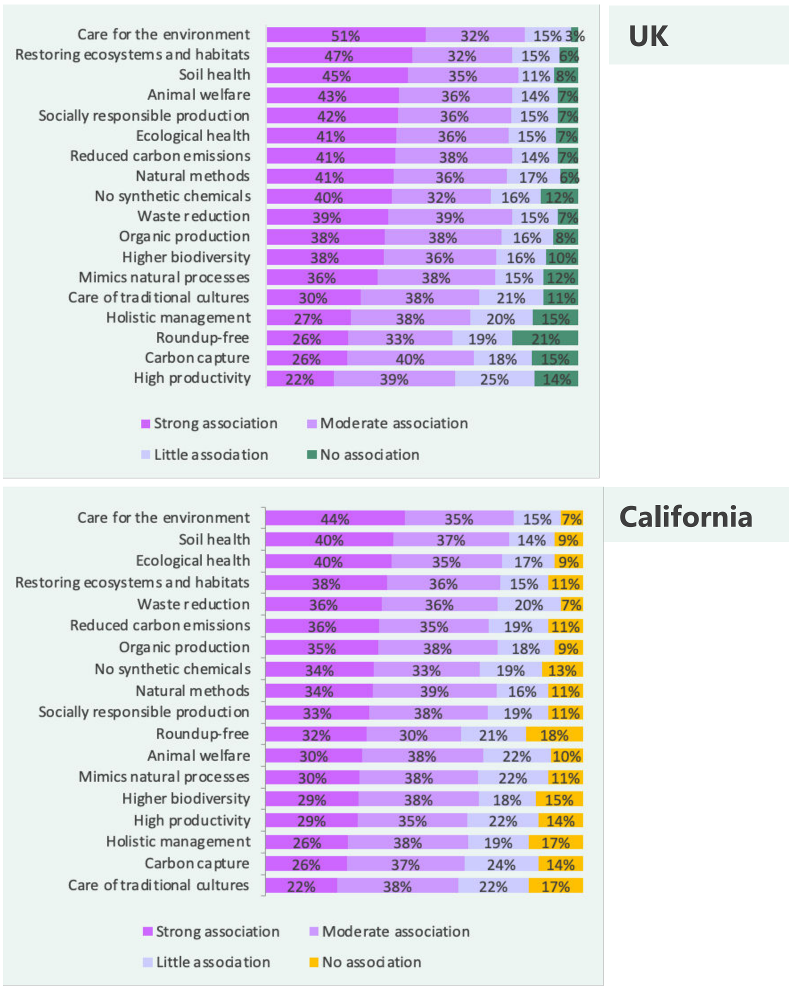

Figure 2. Factors associated with RA in the UK (top chart) and California (bottom chart) (adapted from Tait et al. 2021, with permission).

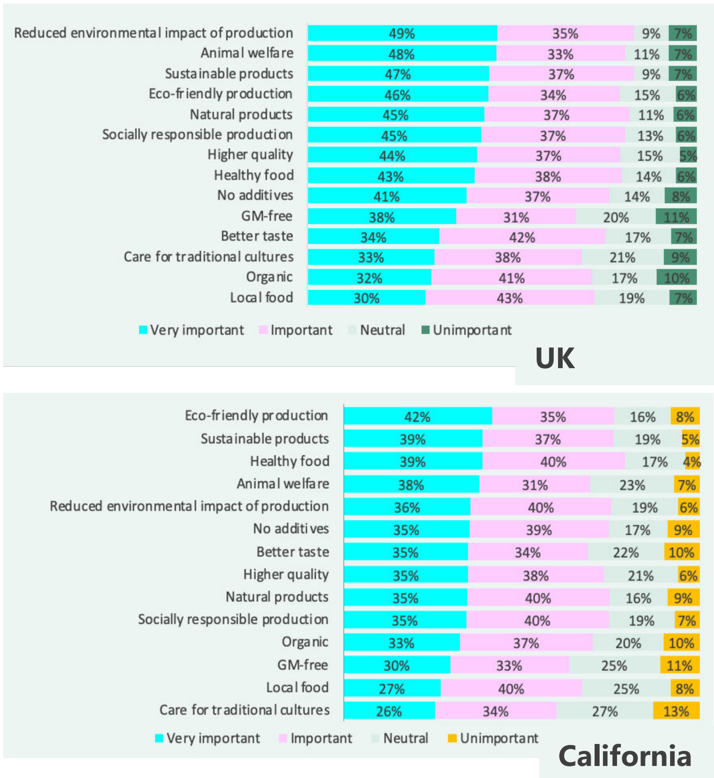

Figure 3. Importance of regenerative agricultural product attributes for consumers in the UK (top chart) and California (bottom chart) (adapted from Tait et al. 2021, with permission).

9 Appendix 2: The seven steps for discrete choice modelling.

This list is based on Bennet & Adamowicz (2001).

(1) Clarify the decision problem, including context, policy framing and study objectives

(2) Select the attributes and attribute levels, paying attention to the relevance of the attributes, their measurability, and the possible causal relationships between them (Blamey et al. 2002)

(3) Develop the questionnaire, including appropriate framing of questions and sample characteristics

(4) Develop an experimental design using statistical techniques to select which choice sets to include in the choice experiment, because experimental efficiency depends on selected attribute combinations (Rose & Bliemer 2009; Griener et al., 2014)

(5) Consider the sampling frame and the survey mode for the data collection

(6) Prepare and analyse the data within a suitable econometric model

(7) Publish the key results, inferences, and useful implications.