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Adaptive value chain approaches

Understanding adaptation in food value chains

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1 June 2016
Department of Agriculture and Water Resources

CITATION

Lim-Camacho L, Crimp S, Ridoutt B, Ariyawardana A, Bonney L, Lewis G, Howden SM, Jeanneret T and Nelson R (2016) Adaptive value chain approaches: Understanding adaptation in food value chains. CSIRO, Australia. EP163611

RESEARCH ETHICS

This project is compliant with ethical standards. Ethics approval was obtained from the CSIRO Social Science Human Research Ethics Committee (reference number 080/13). Case study participants and survey respondents provided informed consent prior to participating in this project.

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Acknowledgments

This project was supported by funding from the Australian Government Department of Agriculture and Water Resources, as part of the Carbon Farming Initiative, Filling the Research Gap Program as well as co-investment from CSIRO, University of Tasmania and University of Queensland.

We would like to thank our case study participants who are central to this research project, in particular Brett Pemberton, Janine Cannell, Gioia Small, Kieren Brown, Paul Petrie and Nick Hazell. Thank you for collaborating with us in developing a better understanding of the relevance of value chains in climate adaptation.

We also acknowledge the contribution to conceptualisation, design and reviews of Prof Ray Collins and Dr Vince O'Brien, as well as the initial input from Dr Simon Somogyi. Lastly, our sincere gratitude for the creativity, innovative approach, and critical thinking of Mr Paul Kotz and his team at Small Studio, for co-creating the Climate Chains tool with us.

Abbreviations

The following abbreviations have been used in this report:

GHG	greenhouse gas/gases
IPCC	Intercontinental Panel on Climate Change
LCA	Life Cycle Analysis
SCM	supply chain management
TWE	Treasury Wine Estates
VCA	value chain analysis

Executive summary

The impacts of climate change are felt along the whole chain of actors that produce, handle, process and market agri-food products. This project aims to help agri-food companies to systematically identify, assess, prioritise and act against risks and to seize opportunities that extreme weather and a changing climate might offer to their chains using a value chain approach.

A holistic and systematic evaluation of the risks that climate change poses, both direct and indirect, is crucial for adaptation planning. Understanding the complexity of interactions between biophysical, social and economic drivers in the context of climate change enables businesses within a value chain to have line of sight of indirect, but impactful, effects. It also enables businesses, from farming all the way to retailing, to begin to understand their 'tipping points' better – where the impacts of multiple events along the value chain result to one or multiple stages of the chain unable to recover or remain competitive.

There are three key outcomes from this study:

1. Our study has found that climate change, in itself, is not enough to encourage consumers to accept an adapted product, because there is a lack of understanding of how climate change can impact day-to-day life in general. At present, adaptation for agri-food businesses serves as a risk mitigation strategy, rather than a marketing opportunity. This however, may prove to be a competitive advantage for those who are in touch with consumer sentiment on adaptation, as sentiments may change in the future.
2. Value chain adaptation needs to consider the impact of any action on the value created and received by the chain. Our study has found that approaching value chain adaptation using a future storylines approach allows agri-food businesses to consider not only the adaptation benefits of a strategy, but also benefits to GHG mitigation and competitiveness. The process we have developed here enables business to gauge the merits of an adaptation action against multiple, and potentially competing, priorities.
3. Based on the findings of this study, an adapted value chain is one that is able to sustain its competitive advantage in a changing climate. A non-adapted value chain can only continue to exist up to a certain point where climate and weather risk and threats, both direct and indirect, are insurmountable and hence the value chain can no longer be profitable on an ongoing basis. Non-adapted value chains also miss opportunities presented by a changing climate. An adapted value chain is one where participating businesses, from farmers to retailers, are able to harness joint strategies to continue delivering value to the consumer, and as such, deliver value to the members of its chain.

Approaching adaptation using a value chain lens then means that a stronger focus on sustainable competitive advantage is required, in addition to mitigating risks. Adaptation takes sustainable competitive advantage a step further by also taking advantage of opportunities, in a changing competitive and physical environment. For Australian agriculture, this means looking beyond the farming system level and understanding what consumers truly value, harnessing strengths from value chain partners, and working within a changing physical, social and policy environment.

Background

Food value chains are critical systems for delivering food security, contributing significantly to economic stability and consumer confidence.

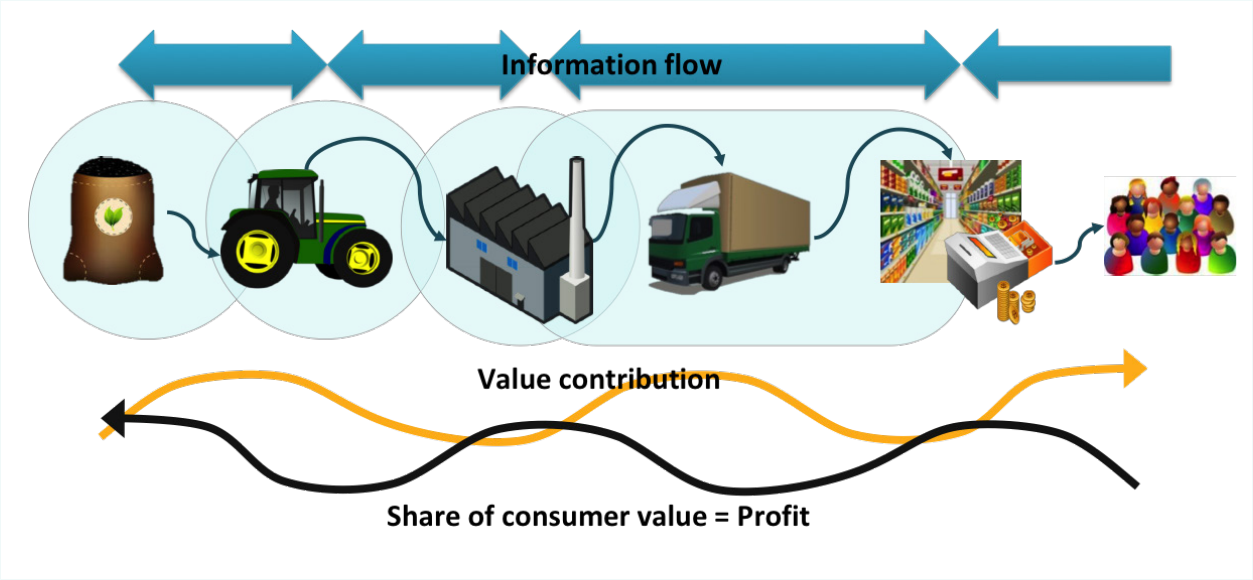
The impacts of climate change are felt along the whole chain of actors that produce, handle, process and market agri-food products. Whilst there is this growing level of concern about climate change impacts, there is still minimal guidance for companies in understanding the extent of their supply chain risk. To remain competitive and deliver value to end consumers, agri-food companies must consider whole-of-chain approaches to climate change adaptation and mitigation.

This project aims to help agri-food companies to systematically identify, assess, prioritise and act against risks and to seize opportunities that extreme weather and a changing climate might offer to their chains using a value chain approach.

BOX 1

What are value chains?

A value chain, put simply, is defined as the path by which a product or service is created and marketed. In the case of agri-food products, this path might include input suppliers, growers, transport and storage, processors, wholesalers, retailers and consumers, as well as governance and support institutions. This 'path' however, involves multiple flows of value adding activities. The figure below illustrates how different activities, such as production processes, logistics, information management, relationship management and returns on value can be manifested in a value chain. Value creation is therefore not a simple step-by-step process where participants contribute equal value. Value contribution is also a function of how relationships are managed, how information is shared and used, and how efficiently processes are handled.



Value chains are complex systems that span multiple activities, where operational efficiency, relationship management (the bubbles) and information management (top arrows) play a crucial role in value creation.

- Metz, P. (1998) Demystifying supply chain management. Supply Chain Management Review Winter 1998, 46-55.
- Wilson, N. (1996) Supply chain management: a case study of a dedicated supply chain for bananas in the UK grocery market. Supply Chain Management 1.

Objectives

The overall objective of this research is to identify a robust approach to value chain management as a climate adaptation strategy – principles that would likely improve the resilience of Australia's food chain in light of climate change. The project aims to provide a platform that encourages agri-food firms and networks to adapt to climate change through the use of an innovative whole-of-chain management process. This multidisciplinary 'hands-on' approach to working with value chain partners will enable scientific findings to be more readily applied commercially by landowners and their networks through the identification of value chain weaknesses and opportunities.

Specific objectives of the project are:

1. To increase capability of businesses to take effective adaptation action through awareness of the impacts of climate change on value chains,
2. To increase awareness of new and relevant adaptation and mitigation options available for businesses to consider within their value chains, and
3. To enhance the capacity of agrifood businesses to collaboratively evaluate and adapt to the impacts of climate change.

Theoretical context

The consideration of the effects of climate change on value chains is a relatively new, yet important, area of research (Ashby et al., 2012; Carter and Easton, 2010), with majority of agricultural adaptation research still focusing on farming. There is still limited attention drawn to the whole system that creates and delivers value (the value chain), and the implications that climate change, and resulting actions, have on other actors in a chain (Fleming et al., 2014; Lim-Camacho et al., 2015).

A review of literature on supply chain management (SCM), sustainability (as a function of greenhouse gas mitigation) and adaptation for supply/value chains was conducted. This review identified six key concepts where SCM capabilities can be compared and contrasted with adaptive capacity and sustainable SCM attributes. Strategy, culture, relationships, information, operations and risk were identified as core concepts whereby businesses can identify common or complimentary approaches to addressing competitive, sustainability (or climate change mitigation) and adaptation priorities.

The comparison shows that strategy and culture are similarly manifested across SCM and sustainable SCM capabilities, as well as adaptive capacity attributes. Others, such as relationships, information and operations, while having similarities, have either contrasting or differing priorities in their manifestation. Across adaptation and SCM literature, strategic relationships are vital, though the nature of these relationships vary. For example, collaborative relationships and partnerships are considered strengths in SCM theory, whilst research in transformational adaptation indicates that transformers are selective about relationships (Dowd et al., 2014). Likewise, efficiency, or 'lean' thinking is a common strategy for SCM and sustainable SCM, but not strongly supported for adaptation because of the need to be flexible, or agile, given uncertain futures. In practice, it is recognised that choosing one strategy over another is not optimal, thus the development of the 'leagile' paradigm which recognises that strategies must be tailored based on market needs (Mason-Jones et al., 2000).

This analysis indicates the possibility that conventional value chain objectives can significantly overlap adaptation and mitigation objectives, although, and not unexpectedly, not all value chain initiatives contribute to achieving adaptation goals and vice versa. It's clear however, that greenhouse gas (GHG) mitigation and climate adaptation objectives have the capacity to unite a value chain in the same way that competitive objectives do. Figure 1 illustrates how supply chain management, sustainability and adaptive capacity capabilities and attributes overlap to identify potential win-win (between two objectives) and nexus strategies (across all three).

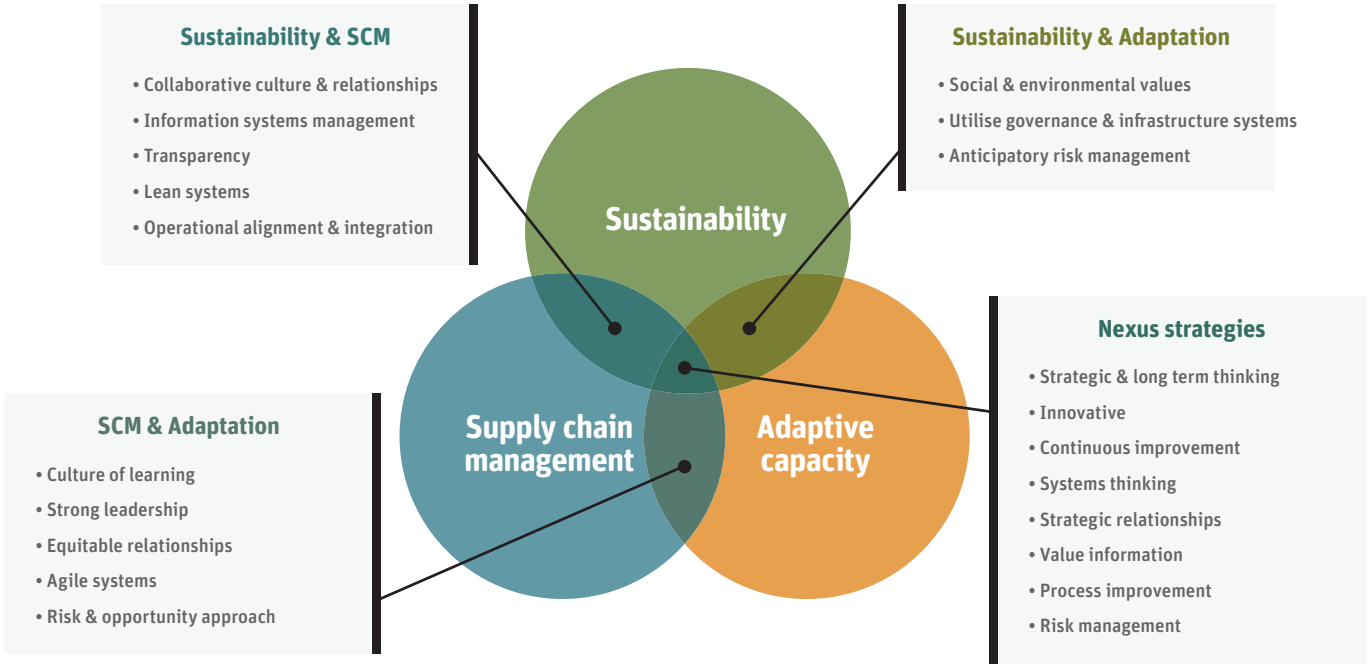


FIGURE 1

Supply chain management, adaptation and sustainability: Identifying nexus strategies for value chains

Methodology

This study has been designed to elicit detailed insight into how enterprises in food value chains can collaboratively adapt to the impacts of climate change.

Two key considerations were made in the development of its methodology: 1) the need for a multidisciplinary approach to reflect the complexity of adaptation decision making for businesses, and 2) the need to understand the nature of adaptation decision making with enough detail to inform agri-food businesses, as well as form the foundations for future research.

As such, the research design integrated qualitative and quantitative methods from management science, environmental impact assessment, climate science and futures thinking. These methods were applied using a case study approach to investigate the context by which climate adaptation is and can be implemented within food value chains. Value chains, extending from primary producers and their suppliers to the final consumer, are the units of analysis. The figure below illustrates the project's research design. A brief description of each method follows.

CHALLENGE

Staying relevant

We allowed for flexibility to cater to the specific characteristics of the case studies involved in this project. The research design is flexible and allows the team to tailor to the specific needs of participants, which supports use of findings through the life of the project and when it has been completed.

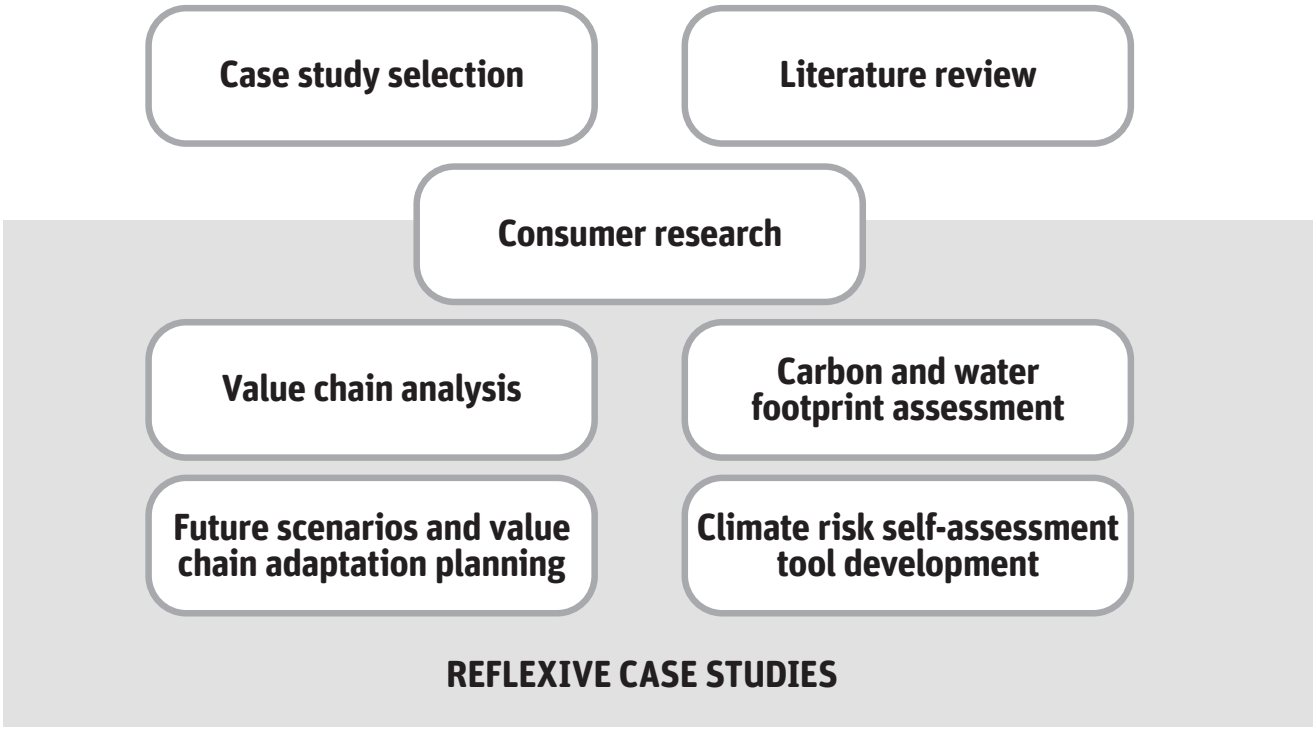


FIGURE 2

The Adaptive Value Chain Approaches Project research design.

Case study selection

Choosing the right case studies for the project was considered critical to its success. In order to achieve this, case study criteria (listed below) were developed to ensure the involvement of relevant and diverse value chains, as well as participants who were likely to stay involved throughout the life of the project.

1. Presence of a chain champion
2. Complexity of chain
3. Climate risk
4. Willingness to adapt
5. Evidence of adaptation
6. Type of adaptation, i.e. incremental, transformational
7. Geographical spread
8. Cropping cycle
9. Product type, i.e. fresh vs processed
10. Product value, i.e. high vs low value
11. Market type, i.e. niche vs mass market

The project team nominated candidates based on their known networks, to increase the likelihood of selecting participants who have a good track record of collaborating with research organisations. The project team and its advisors then assessed and ranked each candidate before selecting the top three: The Smiths Snackfood Co. Pty Ltd, Harvest Markets Pty Ltd and Treasury Wine Estates (TWE). The scope of each case study was bound to a product where possible.

As such, the case studies featured three very different supply chain structures driven by the product categories – a fresh fruit product with a simple, direct chain (Calypso™ mangoes), a processed food product with a moderately complex chain that is mostly managed by a large company (Smiths natural potato chips), and a beverage product (TWE wine) with a complex chain managed by a centralised company.

Consumer research

Climate change will have an impact on the production of food products and these changes may change the nature of the products consumers are presented with, and potentially affect their purchasing decisions. It is then important to understand consumer behaviour and preferences around the three product types featured in this research (potato chips, mangoes, wine), as this serves as a baseline for comparing any potential change in preferences as a result of climate change and/or climate adaptation. This allows companies and their chains to consider how strategies to adapt to climate change can impact on the overall value that consumers receive.

Qualitative research was conducted to explore perceptions of adaptation in food, followed by quantitative survey research to measure the extent to which these perceptions occur across a broader population.

Qualitative research

Eight focus groups (n=62 participants) were conducted in Brisbane, with the first four targeting consumers of mangoes and potato chips, and the next four targeting wine consumers. The mango and potato chip groups were stratified by age, while the wine groups were stratified by frequency of consumption. Respondents gave informed consent prior to participation, and were informed that the topic for discussion was about food and broad drivers to change. Focus groups were recorded and transcribed, with a thematic analysis conducted to identify key concepts as well as develop language to inform survey instrument development.

Quantitative research

A 15-minute survey of consumers of potato chips, mangoes and wine was conducted, with a target sample size of n=500 per product category, achieving n=1532 for the whole survey. The survey comprised of 96 questions in total, covering topics such as preferred product and brand attributes, importance of social and environmental issues, perceptions of climate change, perceptions of climate adaptation, and adaptation scenarios. The survey instrument is available as an appendix in the full consumer survey report, available on: https://publications.csiro.au/rpr/download?pid=csiro:EP148715&dsid=DS3.

A pilot survey of n=30 respondents conducted on 17 April 2014 indicated no errors and appropriate survey completion times, and the full survey was administered online1 on 18-28 April 2014. Respondents qualified on the basis of being the main or joint purchaser of at least one of the three product categories included in the study. Respondents gave informed consent prior to participating in the survey, and were informed of the broad topic of the survey – climate change and food products.

Several techniques were used to analyse the data, including cluster analysis to identify broad archetypes of consumers according to their perceptions of climate and adaptation, linked to demographic characteristics. Willingness to support adaptation initiatives for each product category was also measured, drawing from data collected from adaptation scenarios.

Value chain analysis

The aim of value chain analysis (VCA) is to understand in detail how a chain creates value, and as such, explore how activities and underlying processes contribute to the overall offering that consumers are willing to pay for. In applying VCA to climate adaptation, the aim is to also identify where climate change will, or potentially will, create or diminish value created by the chain.

VCA data was collected through a series of qualitative interviews with participants representing the different activities within each of value chain case studies. The majority of the interviews were conducted within the site of operations for the particular product, i.e. on farm, the packing shed, the winery, within sales offices. This 'walking the chain' perspective allowed the project team to visualise the path of products, as well as identify through observation, aspects of the chains processes and management that can be impacted by climate change and variability.

As a baseline, data on product flow, operations, logistics, information, relationships, governance, consumer value perceptions, and value contributions and distribution was collected during interviews. To explore how the value chains are influenced by climate change, interviews also covered known and perceived impacts of climate change on the chain and its ability to create value. Internal organisational culture, management strategies and innovation, especially with respect to climate and environment were also discussed.

Analysis focused on understanding the adaptive capacity of the chains – their ability to plan for and implement adaptation strategies, given other priorities such as competitive strategies and sustainability objectives.

* The survey was administered by Colmar Brunton, who is a member of the Association of Market and Social Research Organisations (AMSRO) and thus abides by the Market and Social Research Privacy Principles (MRSPPs). Colmar Brunton has ISO Quality Assurance Management System (ISO AS/NZS 9001:2000). Respondents were sourced from research-only panels managed by Research Now who is a member of the European Society for Opinion and Marketing Research (ESOMAR) and have ISO 20252 accreditation.

Carbon and water footprint assessments

Carbon and water footprint assessments offer important information needed to understand physical, financial and reputational risks associated with climate change and the adaptation possibilities. These risks are all pertinent today and have the potential to be exacerbated by continuing climate change.

Carbon and water footprint assessment was based on Life Cycle Assessment (LCA) as well as internationally recognised technical specifications and standards (e.g. BSI PAS2050 and ISO/TS14067 for carbon footprinting and ISO/DIS 14046 for water footprinting) (Ridoutt and Pfister, 2010; Pfister et al., 2009; Food SCP RT, 2013; Ridoutt and Pfister, 2013). The purpose is to identify 'hotspots' in order to contribute strategic insights about product GHG emissions, water impacts and risks. A screening level assessment, as opposed to a comprehensive assessment, was conducted to inform climate adaptation planning and strategy development (Ridoutt et al. 2016).

BOX 2

What does our carbon and water footprint assessment involve?

1. Defining the functional unit (i.e. the product) and system boundary (i.e. the relevant stages)
2. Building a process map (i.e. list of major operations in the product life cycle)
3. Material flow assessment including product conversion factors (e.g. kg of raw potatoes per kg of potato chips) and co-products
4. Collection of activity data for each process under study (i.e. inputs and outputs of resources and emissions)
5. Impact assessment modelling: IPCC latest 100-year global warming potentials for GHGs used for carbon footprint, with results reported as CO2 equivalents; consumptive water use and water scarcity footprint were used as measures for water footprint
6. Interpretation, identifying environmental 'hotspots' and opportunities for strategic intervention, with consideration for data constraints and other modelling uncertainties

Value chain adaptation planning for multiple futures

The aim of this stage of the research is to develop a process for agri-food value chains to adapt to the impacts of climate change. This process was built from previous work conducted by other researchers, as well as the project team's experience in future scenario development and adaptation planning in multiple industries and sectors.

Developing Australian future scenarios

To effectively study the effects of climate change on value chains, physical, social, economic and policy dimensions of change need to be examined jointly. Because it is impossible to know precisely which changes will eventuate or even the precise nature of future climates, uncertainty needs to be incorporated into scenario development by considering a variety of plausible scenarios. These scenarios form the basis for adaptation planning.

Our approach represents a specific use of scenario modelling. Some scenario modelling endeavours are intended to facilitate specific and detailed exploration of consequences for individual scenarios (e.g. Francis and Hamm, 2011; Melbourne-Thomas et al., 2011). But in this instance, because we sought general principles that might apply across futures, our scenarios were designed to be collectively plausible rather than each one representing individual likely outcomes. In other words, they incorporate a reasonable amount of variation such that reality is likely to lie somewhere within the general variation modelled. We modelled our approach on that of the IPCC presentation of storylines and families of emissions scenarios (IPCC, 2000). The storyline approach permits conceptual linking of plausible drivers of and responses to climate change that will naturally be linked.

To contextualise these scenarios and develop relevant storylines, we used a partial consensus expert elicitation process (Kuhnert et al., 2010) through a one day-workshop with case study participants and the project team. The workshop developed a consensus set of key drivers of and barriers to change under climate change, including plausible upper and lower bounds, as well as likely intermediate states. We specifically included the IPCC emissions scenarios (i.e., future temperature and rainfall) as one of these drivers. Consensus story lines then evolved, each describing key characteristics of the physical, social, economic and policy environment in the future. Participants were then shown the draft structure of the four storylines, and then asked to populate components of the storyline with information relevant to them to formulate the extent of the impacts across each stage of the value chain. This set the basis for value chain adaptation planning.

Value chain adaptation planning

Following the development of scenarios, value chain adaptation planning sessions were held for each of the case studies. Participants identified the possible direct impacts at each stage of the chain as well as the indirect impacts on other stages.

As a group, a range of adaptation options relevant to each stage/node for each of the different future storylines were then developed, with participants prioritising key impacts to develop strategies for. Finally, a prioritisation exercise was conducted, whereby participants ranked adaptation options on the basis of ease of implementation, potential benefit, and flow-on impact on other stages of the value chain.

To check for consistency of data, follow up meetings were conducted to immediately review entries and amend inconsistencies where they were identified. All three case studies chose to complete only two storylines, Business as Usual, and Global Fix with a Proactive Australia, which represent the two extremes of the scenarios (see Box 3 in page 19).

Results and Discussion

This section presents a summary of the results of this project. First, findings of the broader consumer study are presented, followed by the results of case studies, which feature value chain analysis findings, case study specific consumer survey results, carbon and water footprinting, and adaptation planning.

Consumer response to adaptation in food

Attitudes to climate change

Cluster analysis of our survey results show different groups of consumers, based on their attitudes towards climate change and socio-demographic characteristics (Lim-Camacho et al. 2014; Lim-Camacho et al. 2016). A more nuanced analysis of survey data reveal five groups:

- Sceptics (8%): Older males who either do not believe that climate change exists or believe that it is a natural phenomenon.
- Abdicators (16%): Mostly males who believe that climate change is a natural fluctuation in the earth's temperature.
- Undecided (31%): A slight female skew, this group believes that climate change is happening but is undecided on what causes it.
- Eco-friendlies (30%): Slightly skewed to females, the majority believe climate change is largely being caused by humans.
- Eco-warriors (14%): Predominantly females who strongly believe that human activity is causing climate change.

These groupings have the potential to better define consumer market segments for product categories with consideration of environmental values, climate change belief, and adaptation.

Adapting to climate change

Both qualitative and quantitative research show that climate adaptation in general is not a widely understood concept, and consumers are uncertain about how they themselves can adapt to the impacts of climate change. They are however concerned about how climate change might impact on the affordability of food in the future, with 70% either agreeing or strongly agreeing to this concern. This aligns with their opinion that the food supply chain is vulnerable, as shown in Figure 3.

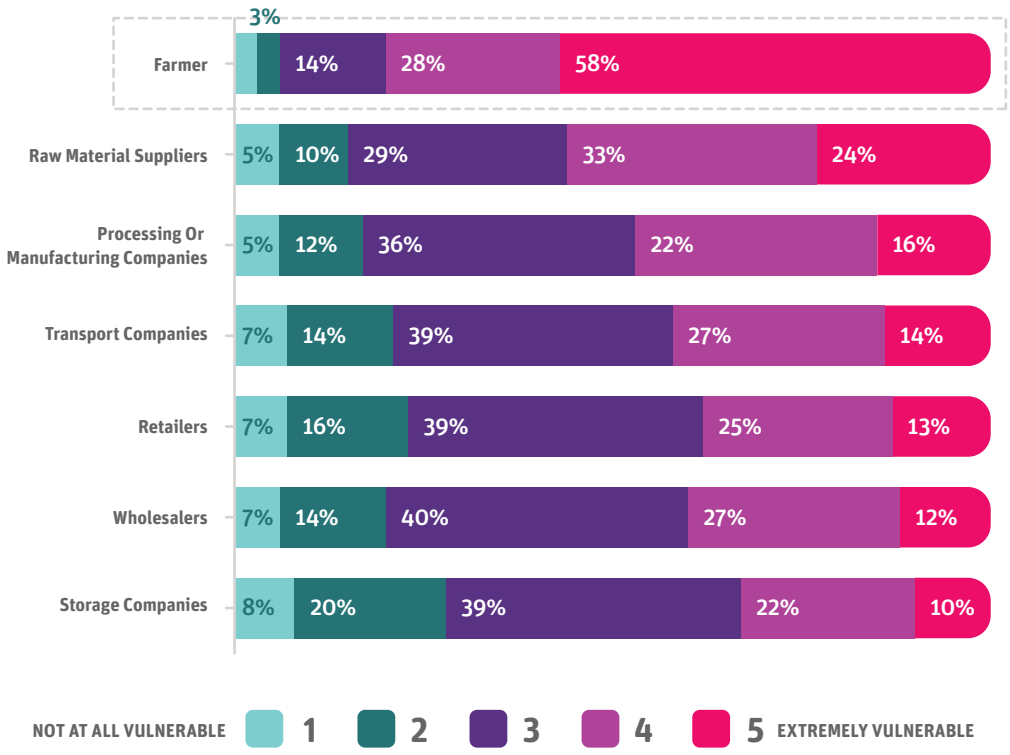


FIGURE 3

Perceived vulnerability of each stage of the value chain, n=1532

Farmers are perceived to be the most vulnerable to the impacts of climate change. This appears to have a flow on effect along the food chain with the businesses more closely aligned with farmers perceived to be more vulnerable than others. However, a majority of the respondents (over 70%) think that governments and multinational corporations should take responsibility for adapting to the impacts of climate change.

Climate change, in itself, is not enough to encourage consumers to accept an adapted product. Not unexpectedly, their willingness to support businesses that implement mitigation and adaptation initiatives depend on the impact of these strategies on affordability and expected quality. For now, not all adaptation initiatives will translate to recognisable consumer value. Rather, short term adaptation serves to protect agri-food chains from business risks. This may change however, with the continuing change in social dynamics, policy environments and climate. Preparing for multiple futures with consumer perspectives in mind can enable agri-food value chains sustainable competitiveness in a changing world.

Adaptive value chain case studies

The findings from value chain analysis, consumer research, carbon and water footprint assessment and adaptation planning are integrated as case studies, as data for these research activities have been collected in the context of each of the three value chains featured in this study. The following pages feature the findings of the three adaptive value chain approaches case studies.

Case Study 1: Smith's Potato Chips

The impacts of climate change are felt along the whole chain of businesses that produce, handle, process and market agri-food products. Whilst there is a growing level of concern about impacts on chains, there is still minimal guidance for companies to understand and act on the potential risks. Featuring insights from value chain analysis, consumer research and carbon and water footprint assessment, this case study demonstrates the balance that value chains need to strike between productivity, sustainability and adaptation goals in order to remain competitive.

The Smith's Value Chain

The Smith's Snackfood Company is one of PepsiCo Australia & New Zealand's four business units, offering a range of brands such as Smith's Chips, Doritos Corn Chips, and Sunbites Grain Waves, among others. The company operates as a vertically integrated business that aims to manage their internal and external chains in order to consistently deliver high quality products to consumers, in the most efficient and sustainable way possible. Value chain functions span beyond boundaries to ensure seamless flow of product from one end to another, driving efficiencies.

Impacts and adaptation along the chain

The Smith's value chain is exposed to the risk of climate change and variability, especially at the farming stage. These risks indirectly affect other activities in the chain, particularly processing. Efforts are in place to adapt potato production to current and future climate risks. Due to the highly integrated and coordinated management of the Smith's chain, adaptation in the farming stage has direct benefits to efficiencies and performance of multiple stages further down the chain, including logistics, manufacturing and retail performance.

Although adaptation is predominant at the farming stage, the Smith's chain shows evidence of adaptation across multiple activities along the chain (Figure 4).

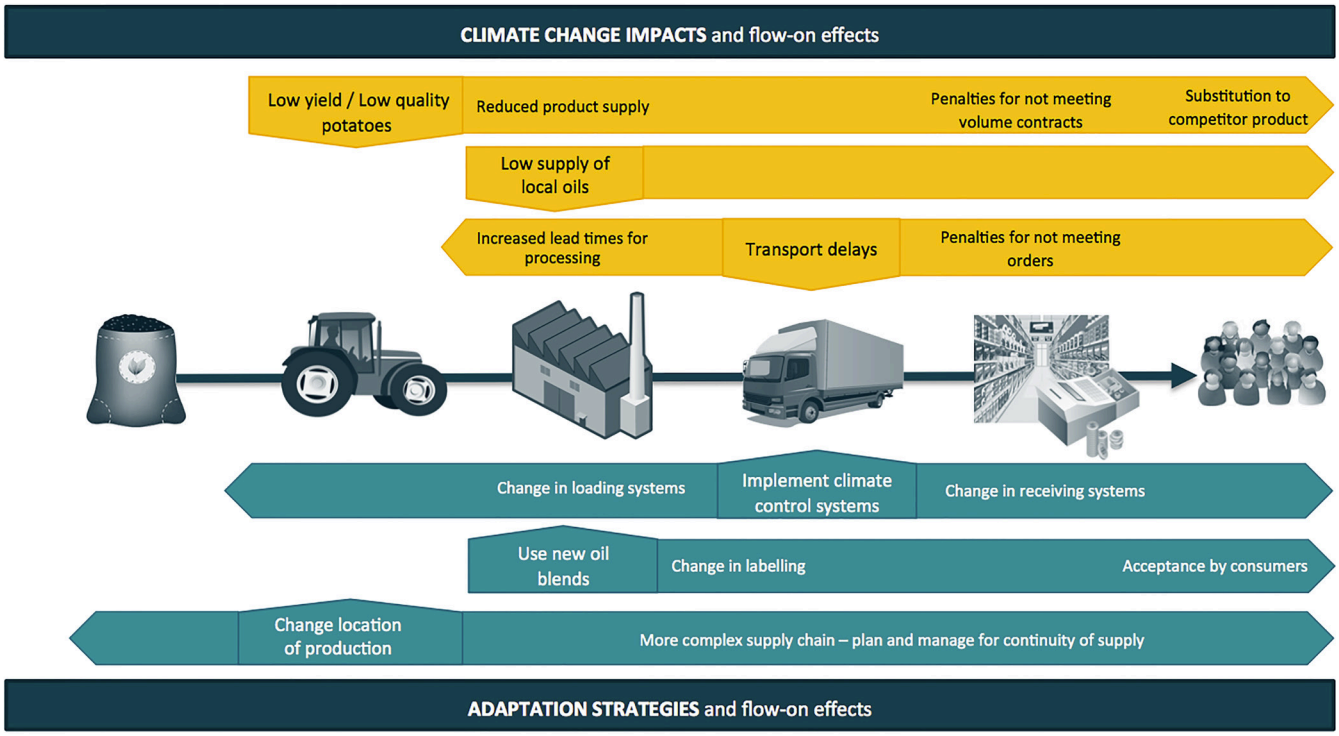


FIGURE 4

Examples of how climate change impacts and adaptation along value chains can have direct, and indirect, effects on multiple stages along the chain

Consumer perspectives of adaptation[1]

Consumers have the potential to drive adaptation along the chain, especially if adaptation strategies create additional value that consumers are willing to pay for. Potato chips are a fast moving consumer good in a highly competitive category, which Smith's leads. The range of products available in this category and the constant introduction of new product types indicate that there is a strong need for companies to constantly innovate and create consumer value in order to remain competitive.

Consumers are less likely to respond favourably to adaptation strategies in this category because of the large number of fairly priced and comparable substitutes. Consumers place little value in adaptation in the potato chip category, showing a high degree of price sensitivity. Adaptation in this food category is more likely to be valued if its primary purpose is to protect farmers.

Carbon and water footprint assessment[2]

Information from carbon and water footprint assessments can help a chain understand the physical, financial and reputational risks associated with climate change and the adaptation possibilities. A screening level assessment was designed to identify hotspots in the carbon and water availability footprints of Smith's chips produced at Smith's Brisbane-based Tingalpa operation. The rapid assessment involved the integration of primary data from Smith's with data from a previous study of chip production at Smith's Regency Park (South Australia) operation and secondary data from databases.

The carbon footprint of Smith's potato chips manufactured at Smith's Tingalpa factory was assessed as Category C (2-5kg CO_2e per kg product sold, Figure 6), with potato production and supply having the greatest contribution (38%, Figure 5). On the other hand, the consumptive water use in the life cycle of Smith's chips was assessed as Category D (>500L per kg product sold, Figure 6). Irrigation water use for potato cultivation was the greatest contributor (95%).

A key risk faced by the Smith's chain in terms of its water footprint is that some of its production areas are in high water stress locations, which could further be at risk from climate change, in addition to a potential reputational risk as a result of the high GHG contributions of the same value chain activity. While this activity is outside the direct operational scope of Smith's, the business recognises the opportunity to mitigate risk through the whole chain.

Through the Sustainable Farming Initiative[3], Smith's helps guide sustainable practices by its suppliers. Consistent with its adaptation strategies, mitigation strategies are likewise addressed across the value chain.

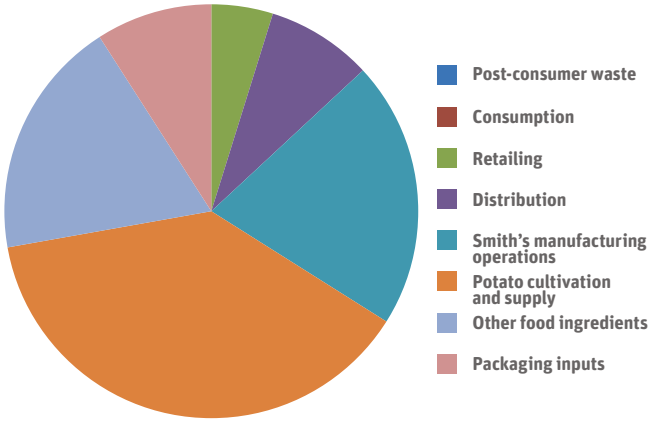


FIGURE 5

Profile of life cycle GHG emissions (CO_2e) for Smith's chips produced at Tingalpa

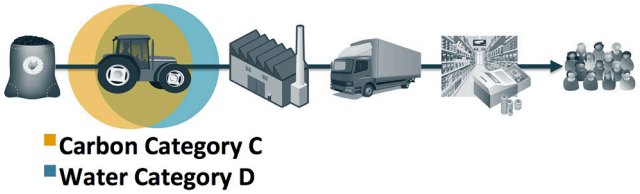


FIGURE 6

Carbon and water footprint hotspots along the Smiths value chain

The Smith's case study demonstrates how adaptation across value chains can be approached. Considering the implications of risk and action across multiple activities in a chain is a start. By building on management strengths across the value chain, this case study shows that adaptation and mitigation initiatives can be embedded in existing company competitive strategies, creating win-win opportunities.

[1] The summary consumer report is available on: https://publications.csiro.au/rpr/download?pid=csiro:EP148832&dsid=DS2

[2] For further information about the use of carbon and water footprint assessment for this project, and categories, see the paper 'Climate Change Adaptation Strategy in the Food Industry – Insights from Product and Carbon Footprints' on: http://www.mdpi.com/2225-1154/4/2/26

[3] Read more about the PepsiCo Sustainable Farming Initiative http://www.pepsico.com/Purpose/Environmental-Sustainability/Agriculture

Case Study 2: Calypso™ Mangoes

The impacts of climate change are felt along the whole chain of businesses that produce, handle, process and market agri-food products. Whilst there is this growing level of concern about impacts on chains, there is still minimal guidance for companies to understand and act on this risk. Featuring insights from value chain analysis, consumer research and carbon and water footprint assessment, this case study illustrates how companies can consider climate change impacts and adaptation across the value chain.

The Calypso™ Value Chain

The Harvest Markets Pty Ltd Calypso™ mango chain produced and supplied approx. 40% of one of Australia's premium mango varieties via road and rail. It is one of the longest value chains in the nation with fresh product travelling up to 4500 km from farm gate to market. The chain is largely vertically integrated with strategic alliances with service providers and marketers throughout the chain. The company's stringent production and marketing protocols provide process compliance benchmarks for all staff and service providers. Harvest's management of these protocols provide them with a strategic advantage over competitors, enabling them to command a premium price for their products.

Impacts and adaptation along the chain

The majority of climate and weather risks for this chain were at the mango growing stage, as this activity is the most exposed to the natural environment. However, other more indirect climate impacts were also felt across the chain (Figure 6). As a fast moving fresh product, any impact felt at the farming end is likely to translate to a deterioration in quality at the consumer end. This risk provides Harvest with a strong imperative to adapt. However, the current adaptation strategies along the chain are currently autonomous – changes made are not necessarily designed to address a climate risk directly. Such adaptation action, while addressing risk at one stage of the chain, could pose challenges to another if not carefully considered from a whole-of-chain perspective.

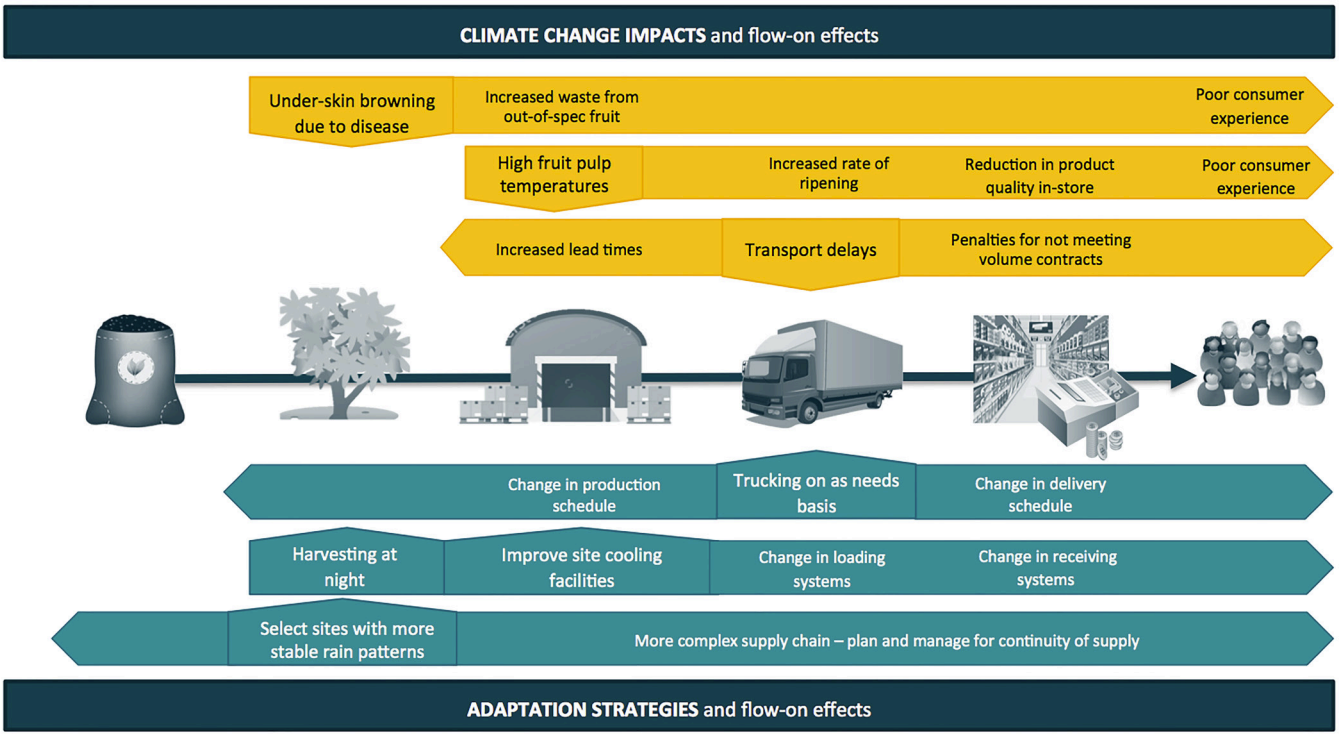


FIGURE 7

Examples of how climate change impacts and adaptation along value chains can have direct, and indirect, effects on multiple stages along the chain

Consumer perspectives of adaptation[1]

Consumers have the potential to drive adaptation along the chain, especially if adaptation strategies create additional value that consumers are willing to pay for. Mangoes are considered a high-value product by consumers, driven by its seasonality and use as a special occasion fruit or dessert.

In response to the potential impacts of climate change, most consumers are less likely to sacrifice quality over frequency of purchase, and some would even be willing to purchase mangoes off-season.

Consumers are also likely to support adaptation in mangoes to a greater degree than other food products if it means preserving the product attributes that they most value (i.e. freshness, taste), regardless of season. In which case, adaptation could act as a market-competitive strategy for a fresh food chain faced by the risk from climate impacts.

Carbon and water footprint assessment[2]

Information from carbon and water footprint assessments can help a chain understand the physical, financial and reputational risks associated with climate change and the adaptation possibilities. A screening level assessment was designed to identify 'hotspots' in the carbon and water availability footprints of Calypso™ mangoes near production centres in Darwin and Katherine, delivered to markets in Sydney and Melbourne.

The carbon footprint of Calypso™ mangoes was assessed as Category A (<1kg CO_2e per kg of product sold, Figure 9) delivered from Katherine to Sydney or Melbourne. Over half (55%) of this was determined by the transport stage of the chain, given the vast distance the product travels to major retail markets. However, the carbon footprint was sensitive to the type of transport used – road transport resulted in higher emissions compared to rail.

Consumptive water use was assessed as Category B (5 to 50L H2Oe per kg sold, Figure 9), with orchard irrigation accounting for 98% of this volume. However, the Calypso™ orchards in the Northern Territory are located in regions that are currently regarded as having very low water stress. As such, orchard irrigation represented only 63% of the water availability footprint.

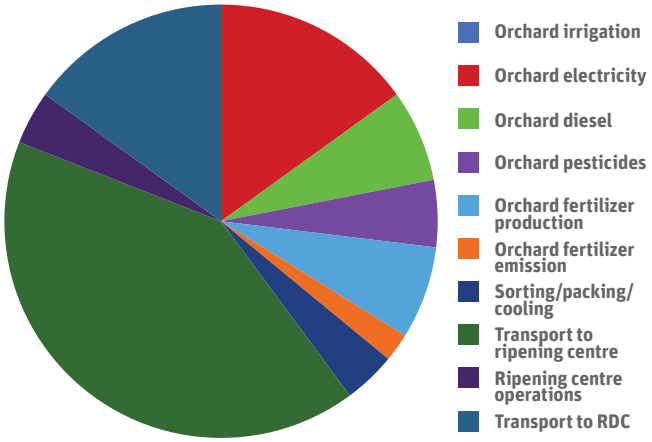


FIGURE 8

Profile of life cycle GHG emissions (CO_2e) and water footprint for Harvest Calypso™ mangoes

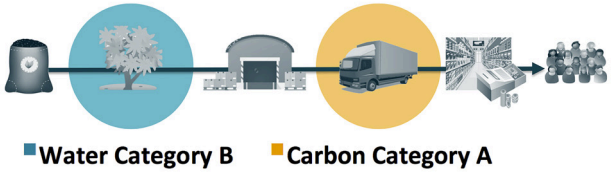


FIGURE 9

Carbon and water footprint hotspots for the Harvest Calypso™ value chain

The Harvest Calypso™ case study shows how opportunity for adaptation can come from multiple perspectives. In the case of this chain, the farming stage faces climate risk, while the consumer end indicates possible support for adaptation. Without a whole-of-chain perspective, there is a potential to lose line of sight of climate risks, as well as adaptation opportunities. Thus, development of adaptation strategies based on a greater understanding of the interplay of climate impacts and adaptation strategies across the chain would lead Harvest Markets to be in a more competitive position.

[1] The summary report is available on: https://publications.csiro.au/rpr/download?pid=csiro:EP148832&dsid=DS2

[2] For further information about the use of carbon and water footprint assessment for this project, and categories, see the paper 'Climate Change Adaptation Strategy in the Food Industry – Insights from Product and Carbon Footprints' on: http://www.mdpi.com/2225-1154/4/2/26

Case Study 3: Treasury Wine Estates wine

The impacts of climate change are felt along the whole chain of businesses that produce, handle, process and market agri-food products. Whilst there is a growing level of concern about impacts on chains, there is still minimal guidance for companies to understand and act on this risk. Featuring insights from value chain analysis, consumer research and carbon and water footprint assessment, this case study demonstrates how supply chain management competitive strategies support chain-based climate adaptation and mitigation.

The Treasury Wine Estates wine value chains

Treasury Wine Estates (TWE) is one of the world's largest wine companies. Its chains carry a multiplicity of brands and products, sold in over 70 countries across the world. The company operates large scale winemaking and bottling facilities in key new world wine regions, as well as smaller facilities for iconic brands.

TWE has a complex value chain due to the company's size, the range of products and brands that it carries, and its goals of achieving efficiencies through optimal use of company assets. To manage this complexity, TWE is involved in all levels of the value chain including: owning and managing vineyards, winemaking, bottling and distribution functions.

Impacts and adaptation along the chain

The wine industry is experiencing the impacts of climate change. For example, harvesting periods are changing, affecting scheduling of logistics and receivals at wineries. Extreme events impact wine production operations at all stages of the chain. As a result, TWE carries a significant amount of risk in terms of asset exposure to climate change impacts.

The company is addressing this risk by mobilising value chain assets to remain flexible and agile when needed. This enables the company to reduce the impacts of change through strategies on another node of the chain. The examples of adaptation options in response to impacts shown below demonstrate this.

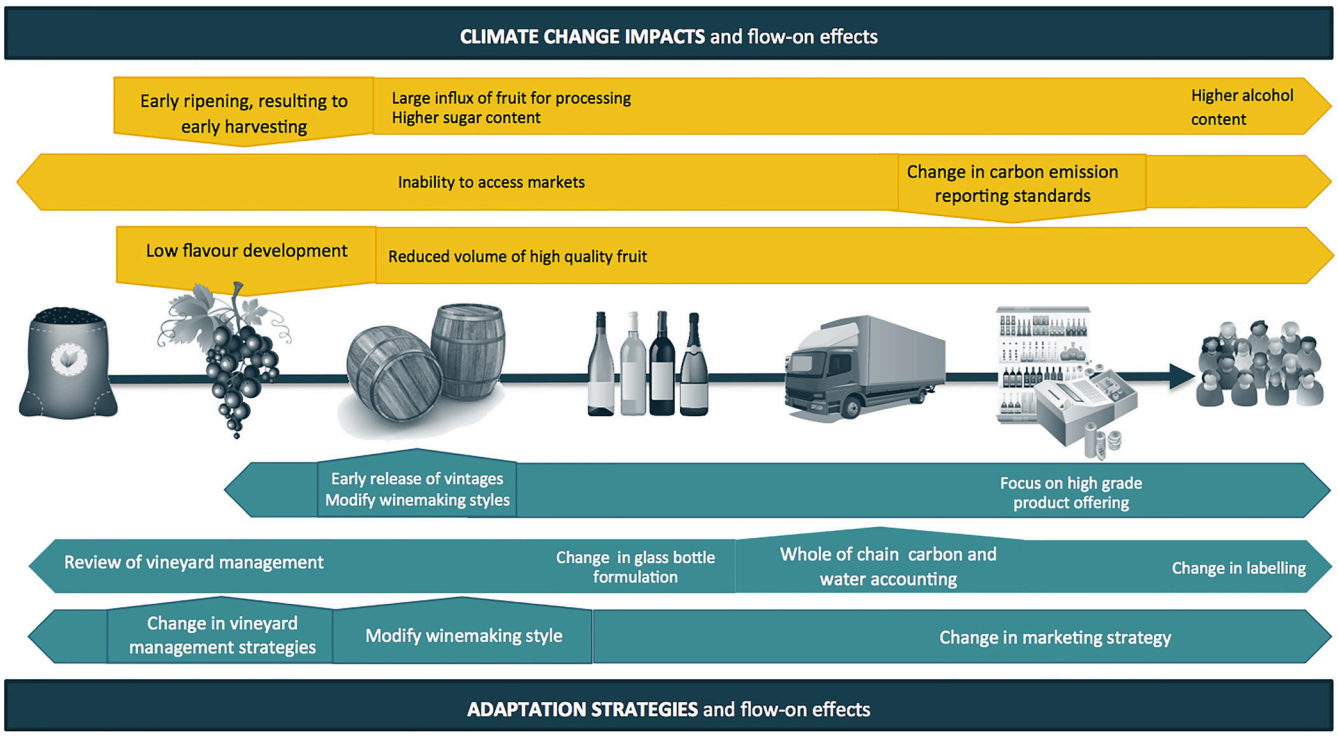


FIGURE 10

Examples of how climate change impacts and adaptation along value chains can have direct, and indirect, effects on multiple stages along the chain

Consumer perspectives of adaptation[1]

Consumers have the potential to drive adaptation along the chain, especially if adaptation strategies create additional value that consumers are willing to pay for. Wine is a high involvement product, one that consumers tend to have a deeper emotional attachment to. Competition for consumer dollar is high, with a significant range of brands and products in this category. Quality, pricing and reputation are key considerations for consumers when purchasing.

Consumers are open to supporting adaptation in wine, particularly if it is in response to a product or brand that they are loyal to. This indicates that any adaptation occurring along the chain needs to be considered from a marketing perspective for its potential to increase consumer value.

Carbon and water footprint assessment[2]

Information from carbon and water footprint assessments can help a chain understand the physical, financial and reputational risks associated with climate change and the adaptation possibilities. A screening level assessment was designed to identify hotspots in the carbon and water availability footprints of selected wine supply chains of TWE.

The carbon footprint of the selected TWE range (cradle to distribution hub and including returns) was assessed as Category D (5 to <10kg CO_2e per L wine, Figure 12), with distribution having the greatest contribution (74%). On the other hand, the consumptive water use for single region wine was assessed as Category C (50 to <500L H2Oe kg, Figure 12). Values vary year on year, largely due to irrigation demand. On the other hand, multi-region wine has higher consumptive water use, but still within the same category, due to the variation in climate of source regions.

The two value chain hot spots for TWE products are distribution (carbon) and wine grape growing (water). Operationally, these two hotspots present actionable options, i.e. reduction of bottle weight, reduction of evapotranspiration.

However, indirect impacts of climate change (Figure 10) present another hotspot: market access. Inability to meet market access requirements will limit TWE's growth potential. The company has been addressing this through its involvement in Entwine3, carbon and water footprint assessments, and actively addressing the hotspots previously identified.

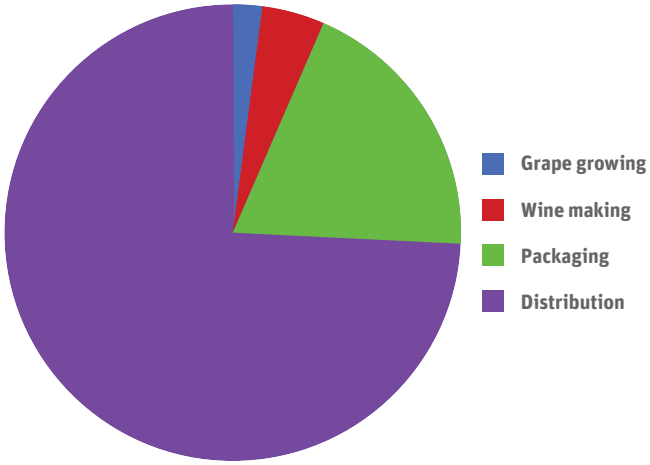


FIGURE 11

Profile of life cycle GHG emissions (CO_2e) for one Treasury Wine Estate product supply chain, 2007-10 data

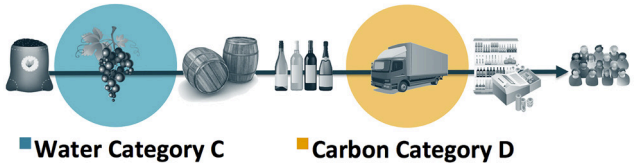


FIGURE 12

Carbon and water footprint hotspots along the TWE value chain

This case study demonstrates how interdependent value chain activities are, reinforcing the importance of considering the whole value chain when understanding the impacts of climate change on a business. It also demonstrates how supply chain management strategies are utilised as an approach to adaptation. Lastly, this example illustrates the nexus between adaptation and mitigation. In business, these lines blur with the potential to be addressed hand-in-hand to harness the competitive merit of a strategy.

[1] The summary report is available on: https://publications.csiro.au/rpr/download?pid=csiro:EP148832&dsid=DS2

[2] For further information about the use of carbon and water footprint assessment for this project, and categories, see the paper 'Climate Change Adaptation Strategy in the Food Industry – Insights from Product and Carbon Footprints' on: http://www.mdpi.com/2225-1154/4/2/26

[3] Entwine Australia is as an 'umbrella' sustainability program developed by the Winemakers' Federation of Australia (WFA). The program provides benchmarking tools and resources to enable planning, evaluation, control and communication. http://www.awri.com.au/industry_support/entwine/

An approach to value chain adaptation planning

Identifying and understanding climate change impacts across the value chain

This study has identified, through its participatory engagement process, that a holistic and systematic evaluation of the risks that climate change poses, both direct and indirect, is crucial for adaptation planning. This is considered the first step in our process – identifying what physical impacts climate and weather events have had on all activities in the value chain. These historical impacts enable us to define potential risk exposure. In addition, we also identified indirect impacts, or flow on effects, of any particular event.

Table 1 identifies what these direct impacts and flow on effects are in the case of heatwaves, a consistently impactful event across the three case studies. As more climate change events impact on the chain, the flow on effects increase in magnitude. The value chain diagrams in the case studies show examples of how these effects interact, where an impact such as change in harvesting times at farming stage, will also affect transport scheduling at logistics stages, and product quality at processing. With this in mind, it is possible to reach a 'tipping point', where the impacts of multiple events no longer allow a value chain to recover, and transformational adaptation will be needed (Park et al. 2012).

TABLE 1

Heatwave impacts across the value chain – direct and indirect impacts

	Farming	Post-harvest	Transport	Processing	Retail and consumption
Direct impacts	Reduced yield at grade quality	Increased downtime	Transport delays	Increased downtime; increased complexity in product formulation; reduction in quality	Decrease in retail quality
Flow on effects		Reduction in product throughput; increased waste	Reduction in product throughput; reduction in efficiency gains	Reduction in product throughput; increased costs per unit manufactured	Increased costs per unit sold; poor consumer experience; reduction in sales

The engagement process required to elicit these direct and indirect impacts involved significant time and resources, which, for agri-food businesses, may serve as a barrier to involvement. To address this limitation, we developed Climate Chains – an online climate risk exposure tool aimed to guide users through the process of identifying impacts. Further information about Climate Chains can be found under Publications and screen shots and user instructions can be found in Appendix A.

Constructing multiple futures

Value chain adaptation needs to consider the impact of any action on the value created and received by the chain. This value is not only impacted by physical risks from climate change, but also financial and reputational risks. For example, from an environmental footprint perspective, energy and water price increases, along with price volatility, can impact the profitability of businesses in an agri-food chain. Future policies related to GHG mitigation also have the potential to impact energy prices and the cost of production for businesses that are significant energy users and thereby impact the value chain overall. These are financial risks to value chains, with the potential to also become reputational risks as business stakeholders increase expectations that businesses operate in an environmentally responsible manner and are actively working to improve their environmental performance. Therefore, the impacts of climate change are not only displayed through biophysical factors, but also through social and economic dimensions.

Storylines were designed to be developed by case study participants to display the complexity of interactions between biophysical, social and economic drivers in the context of climate change. As a result, four generic storylines were developed, as shown in Box 3. Agri-food businesses can use these futures to continue their process of adaptation planning by adding context specific information. Table 2 provides a consolidated example of two futures, as developed by case study participants. These futures vary on a case by case basis, to provide more nuanced contexts for businesses to develop adaptation strategies from.

TABLE 2

Australian future storylines across the value chain

Drivers	Adaptation without Global Mitigation	Global Fix with a Proactive Australia
Future temperature and rainfall	Based on RCP 8.5, high sensitivity	Based on RCP 2.6, medium sensitivity
	2.0C by 2030 and 5.8C by 2055	0.7°C by 2030 and 1.2°C by 2100
	Between 5 and 12% less annual rainfall on average by 2030 and 15-30% less annual rainfall by 2100.	Between 2-7% less annual rainfall on average by 2030 and 5-15% less annual rainfall by 2100.
Relative profitability of food, fuel, carbon	Food most profitable, dramatic price volatility.	Increase in value of carbon, significant increases in value of fuel, production costs higher, making food slightly less profitable
Societal conservatism	Autonomous adaptation, but not specific to climate; maladaptation is likely.	Proactive adaptation predominates this future, with support from legislation and policies. Broader acceptance of adaptation allows broader use of recycling for food production. Reduction in maladaptation.
Water availability	Low water availability, becoming a speculative investment with high pricing. Future trading likely to occur, and legislation focuses on needs for health and urban use.	Less competition for water, with substantial regulation and change in water recycling measures.
Energy use	Energy much more expensive, with likely doubling of energy costs (fuel, electricity, LPG).	Energy expensive as a result of investment into new energy technologies, with broader support for renewable energy use. Use is regulated.
Legislation	Focus on public health and food security, penalising rather than encouraging. Increased competition likely and reduced Government support. Support for agricultural intensification and increased productivity.	Support for technological innovation, incentivised legislation, with reduced cost of adaptation and mitigation.
Tariffs, taxes and subsidies	Fewer subsidies for environmental efficiencies and adaptation, with knee-jerk subsidies and trade liberalisation leading to increased access to international markets.	Greater availability of subsidies for environmental efficiencies with greater market for waste streams.
Population projections	Global population growth is on the upper end.	Global population growth is on the upper end.
Growing	More disruptions to supply, with loss in quality and increased production costs, Australia loses its competitive advantage as a food supplier.	Disruptions in supply continue, but management interventions enable companies to keep pace with climate change.
Other raw material supply	Greater volatility in supply and cost.	Some volatility in supply and cost, with reduction in chemical use as legislated by governments and influenced by consumer.
Transport	Transport costs double, triggering innovations in transport.	Transport costs increase by 20%; new infrastructure investment available for transport solutions; private investment in infrastructure is greater.
Manufacturing	Increased waste due to lower quality raw material, increased efficiency imperatives, greater disruption, increased legislation for OHS&E.	Increased recycled water use and energy efficiency with legislative support for innovations
Packaging	Increased cost due to change in packaging types.	More efficient packaging options, with consumers open to alternative packaging.
Distribution	Increased transport costs, more disruption, revised transport options.	Increased transport costs with innovative transport solutions as supported by government
Retail	Change in retail peaks; retailers transfer increased costs to suppliers.	More marketing opportunities for alternative products
Consumption	Shift to alternative products.	Greater demand for green products and packaging, with a health and environment focus. Social pressure for environmental credentials.

BOX 3

Australian futures storylines

Storyline 1, Adaptation without Global Mitigation

The world's major greenhouse gas producers fail to make significant emissions reductions. As a result, Australia does not advance its own mitigation policies much further than it has already. However, Australia recognises that even if it must rely on the rest of the world to achieve significant mitigation, it still has control over its ability to adapt to a changing climate. Thus, some effort is devoted to coping with the effects of climate change, though not so much that it might weaken our economy relative to other countries. Without a strong carbon market to make efficiency gains more profitable, main purpose becomes adaptation for business is to reduce input costs.

Storyline 2, Late Wake-up Call

Both Australia and the rest of the world continue with largely business-as-usual practices for the next two decades, making only minor incremental efforts at mitigation and adaptation. However, as the rate of climate change begins to increase and the effects become more apparent, more significant mitigation and adaptation measures are put in place globally with increasing public acceptance of the need to change. As the action comes a bit late, some opportunities are missed, actions become more expensive, and responses are less coordinated and less well planned than they might otherwise be.

Storyline 3, Global Fix with Reactive Australia

The world's major greenhouse gas producers tackle mitigation seriously and relatively early, employing a combination of many different solutions such as increased reliance on renewable energy sources as well as increasing carbon sequestration. Australia increases its efforts at mitigation, but our efforts lag behind those of the rest of the world and/or we opt to essentially buy mitigation services from other countries (e.g. by investing in overseas forest protection). We still experience the benefits of global mitigation, but concentrate more on adaptation. Because the rest of the world is somewhat successfully working on mitigation, we also have less need to adapt relative to some other storylines in which climate change continues to accelerate.

Storyline 4, Global Fix with Proactive Australia

Likewise, in this storyline, the world's major greenhouse gas producers tackle mitigation seriously and early, employing a combination of many different solutions such as increased reliance on renewable energy sources as well as increasing carbon sequestration. As a forward-thinking developed nation, Australia joins with this group of leading nations. Australia concentrates on both mitigation and adaptation both in significant ways. But because the world is somewhat successfully tackling mitigation, we have less need to adapt relative to some other storylines in which climate change continues to accelerate.

Developing value chain adaptation options for alternative futures

Adaptation options for both future storylines were identified across each of the value chains. Each option was evaluated against their potential impact on each stage of the chain, resulting in a 'traffic light' system to identify nodes negatively, positively and neutrally impacted by an adaptation strategy. Adaptation options for each stage were further assessed against their overall impact on the business and finally prioritised.

Strategies developed for Adaptation without Global Mitigation in general lean heavily on the farming stage of the value chain, with more strategies developed for this stage. However, once evaluated, adaptation at the farming stage did not deliver the most benefits across the value chain as the strategies were mostly transformative with uncertain impacts given a volatile future. The processing and packaging stages had the most positively evaluated strategies, focusing on efficiency improvements in light of high costs of water and energy and maintaining product quality.

Likewise, efficiency improvements in processing and packaging stages were also positively evaluated for the Global Fix with a Proactive Australia future. However, the farming stage had the largest suite of adaptation alternatives that were positively evaluated across the chain. These strategies were mostly focused on improved farm management practices, off the back of improved technologies and a policy environment supportive of innovation.

Many adaptation options identified were applicable for both scenarios, such as geographical diversification, improved irrigation management, and climate control at transport stage. However, if these strategies were to be implemented, the impact on the rest of the chain would differ due to differing costs, legislative barriers and consumer sentiment. In addition, there are more positively evaluated adaptation options further down the chain from manufacturing to consumption for the Global Fix with a Proactive Australia scenario. This is likely due to the clearer legislative and market signals for this future, as opposed to the reactive social and policy environment expected of the Adaptation without Global Mitigation future.

Summary of findings

The impacts of climate change are felt along the whole chain of actors that produce, handle, process and market agri-food products.

This project aims to help agri-food companies to systematically identify, assess, prioritise and act against risks and to seize opportunities that extreme weather and a changing climate might offer to their chains using a value chain approach. Our study has found that climate change, in itself, is not enough to encourage consumers to accept an adapted product, because there is a lack of understanding of how climate change can impact day-to-day life in general. At present, adaptation for agri-food businesses serves as a risk mitigation strategy, rather than a marketing opportunity. This however, may prove to be a competitive advantage for those who are in touch with consumer sentiment on adaptation, as sentiments may change in the future.

A holistic and systematic evaluation of the risks that climate change poses, both direct and indirect, is crucial for adaptation planning. Understanding the complexity of interactions between biophysical, social and economic drivers in the context of climate change enables businesses within a value chain to have line of sight of indirect, but impactful, effects. It also enables businesses, from farming all the way to retailing, to begin to understand their 'tipping points' better – where the impacts of multiple events along the value chain result to one or multiple stages of the chain unable to recover or remain competitive.

Value chain adaptation needs to consider the impact of any action on the value created and received by the chain. Our study has found that approaching value chain adaptation using a future storylines approach allows agri-food businesses to consider not only the adaptation benefits of a strategy, but also benefits to GHG mitigation and competitiveness. The process we have developed here enables business to gauge the merits of an adaptation action against multiple, and potentially competing, priorities across a period of time. This process enables value chain members to consider risks and threats over extended timeframes, as well as scan for opportunities in the horizon.

Approaching adaptation using a value chain lens then means that a stronger focus on sustainable competitive advantage is required by bringing together strategies that 'resist erosion by competitors or industry evolution' as Michael Porter had described in (1985). Adaptation takes sustainable competitive advantage a step further, by not only 'resisting' risks or threats, but by also taking advantage of opportunities, in a changing competitive and physical environment.

For Australian agriculture, this means looking beyond the farming system level and understanding what consumers truly value, harnessing strengths from value chain partners, and working within a changing physical, social and policy environment.

What is an adapted value chain?

An adapted value chain is one that is able to sustain its competitive advantage in a changing climate. A non-adapted value chain can only continue to exist up to a certain point where climate and weather risk and threats, both direct and indirect, are insurmountable and hence the value chain can no longer be profitable on an ongoing basis. Non-adapted value chains also miss opportunities presented by a changing climate. An adapted value chain is one where participating businesses, from farmers to retailers, are able to harness joint strategies to continue delivering value to the consumer, and as such, deliver value to the members of its chain.

Future research needs

This project is at the forefront of business and adaptation research, as it is one of, if not the first to delve into detail, what adaptation means for value chains.

However, it is only the beginning. There are multiple areas of research that have yet to be further investigated to understand how agriculture and its value chains can effectively adapt.

Some areas for further exploration are:

- Further understanding the impact of extremes on value chains, and the resulting tipping points across the chain
- Tracking Australian consumer perspectives of adaptation over time, and comparing with international markets
- Exploring opportunities in adaptation, such as value creation strategies in product portfolios such as new product categories based on improved market segmentation
- Exploring the dynamics of economic and market risks with climate risks across the value chain
- Quantifying value chain losses from climate change impacts, and gains from specific value chain adaptation strategies
- Exploring new ways of evaluating adaptation decisions across the value chain
- Understanding adaptation of global value chains and the dynamics of impacts and adaptation in other regions with Australian industry

The Climate Chains self-assessment tool has been designed to allow further modules to be added to aid decision making for food value chains. Work in understanding extremes and how they interact with value chains will be conducted in the 2016-17 financial year, funded by CSIRO. This work will be added onto Climate Chains as another layer of information that users can access.

The significant interest garnered from results of the consumer survey from the wine industry indicates that there is value in continuing this research, as it provides farmers themselves with a connection to consumers and climate. Expansion into international markets is worth considering.

Publications

Websites and webpages

1. Lim-Camacho L, Crimp S, Jeanneret T, and Kotz P (2016) Adaptive value chains. CSIRO. https://adaptivevaluechains.org
2. CSIRO (2015) Consumer choices and climate adaptation for the food value chain. Online: http://www.csiro.au/en/Research/LWF/Areas/Social-economic/Climate-change/Food-value-chain

Tools

3. Lim-Camacho L., Crimp S, Jeanneret T, and Kotz P (2016) Climate Chains: An adaptive value chains self-assessment tool. https://adaptivevaluechains.org

Climate Chains is designed for any business involved in the agri-food value chain, from input suppliers, farmers, processors, transport providers and marketers. It also takes into account the non-agricultural inputs that food requires. Businesses set up an account, where they can evaluate multiple products and multiple value chains. A key strength of the Climate Chains tool is that it recognises that the value chain is managed by multiple individuals, and as such encourages collaboration to more accurately assess risk exposure to chains.

Climate Chains can be accessed on the project website: adaptivevaluechains.org. For more information, see Appendix A.

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12. Lim-Camacho L, et al (2016) How does climate risk impact primary industry sector competitiveness – from farm inputs to consumers? Presentation at CCRSPI 2016 National Conference, Sydney, 27 April 2016.
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Appendix A: Climate Chains: An adaptive value chains self-assessment tool

What is the Climate Chains Tool?

The Climate Chains Tool provides a mechanism and process for agrifood businesses to map their supply chains for specific products, and rate the severity of climate change and weather related impacts. These ratings are then used to generate a risk exposure report.

Interaction with the Climate Chains Tool can occur at two levels: undertake the self-assessment process or access information only.

What is involved?

The Climate Chains Tool self-assessment process involves:

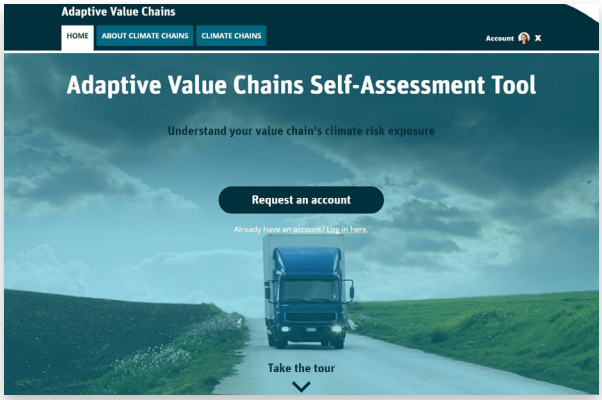
- Creating and logging into a private account
- Data input: products, supply chain stages and locations, and climate and weather events impacting on the supply chain
- Based on this data, a brief summary report on risk ratings is created

General access to information involves the ability to browse the website containing background information on the project.

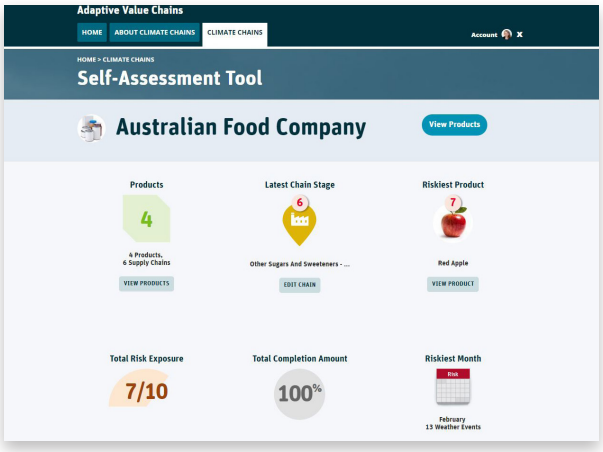
What does it look like?

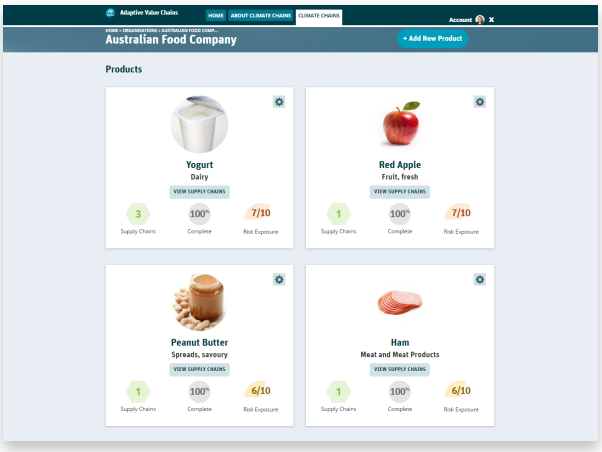
Visit https://adaptivevaluechains.org and request for a demonstration to access the tool. The following screenshots show what users encounter when using Climate Chains.

- Visitors request for an account

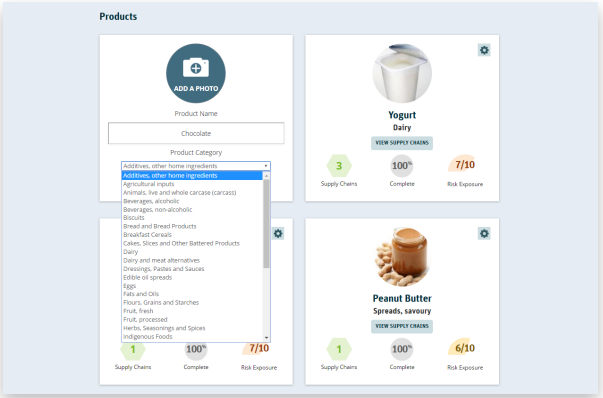


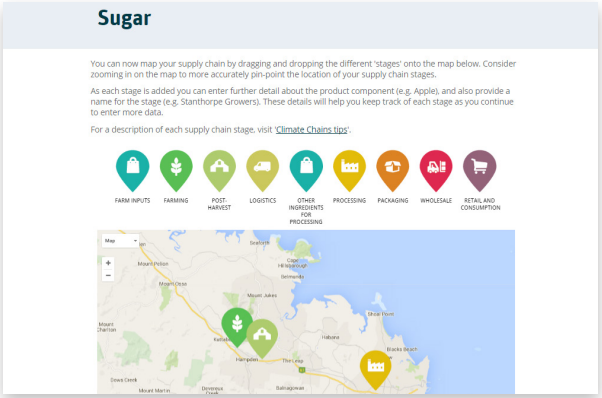
- A member sets up a company, and multiple products can be evaluated

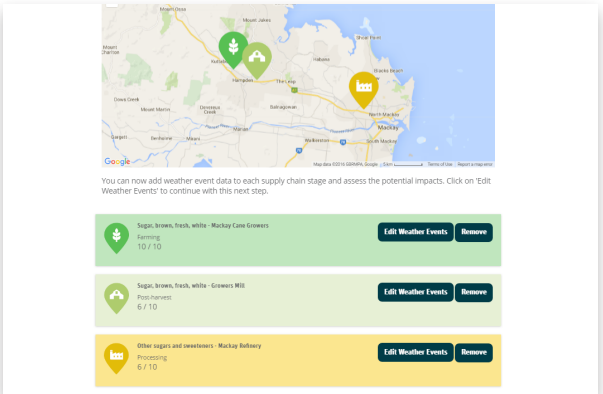


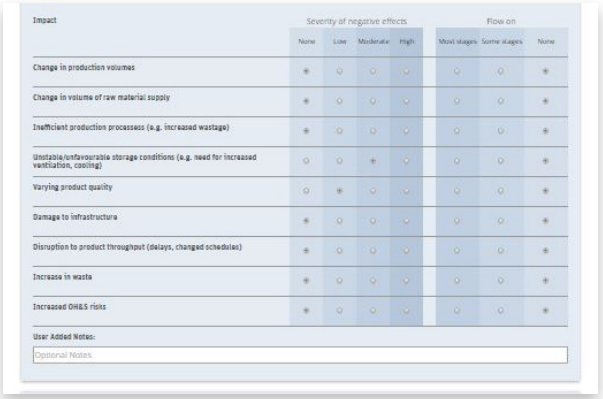


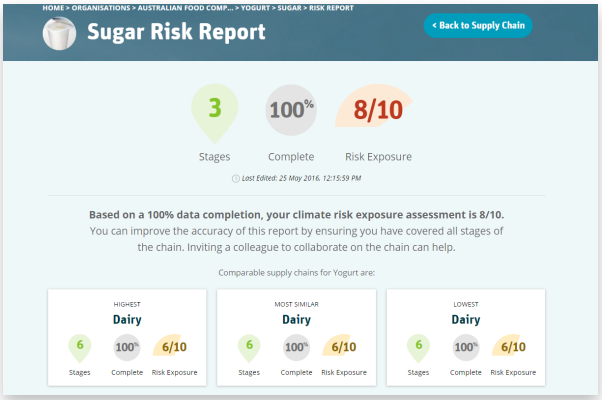
- Products are categorised and multiple supply chains can be mapped for each product
- Each supply chain stage is defined and evaluated against weather and climate events using a calendar
- Users evaluate the direct and indirect impact of each event, resulting in a risk report for each supply chain











- This risk report can be saved, and compared with other risk reports from other product supply chains.

How will the data be used?

The researchers will use the data to better understand the risks and impacts of climate change on agrifood supply chains in Australia, and may use the data for research purposes, including publication in journal articles, and conference presentations and posters.

Data that has been aggregated at the product, sector and regional level will eventually be publicly available and may be viewed by the broader public to learn about the risks posed to supply chains from climate change and weather related events.

What about confidentiality?

User accounts will be password protected. In order to collaborate with others on the same supply chains or products, an invitation from the account holder must be sent to new collaborators. User details will be handled according to the Australian Government Privacy Act.

This is a secure website and data will be stored on secure CSIRO servers. User specific data will only be accessible to CSIRO researchers and website administrators.

Entry of data and use of the tool is completely voluntary. Supply chain data may be changed or deleted at any time by users.

Risks

Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. However, it is possible to identify points of weakness in the value chain as part of this study, which may pose a business risk to you and your chain. The aim of this project is to assist chains to manage such risks.

The Climate Chains Tool provides a mechanism for businesses to start thinking about potential risks to their supply chains and is not designed to be a detailed risk assessment. CSIRO encourages businesses to seek advice on decision making regarding adaptation and CSIRO is not liable for any damages incurred from decisions made based on risk exposure ratings.

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