1 Systematic Review Methods

*1.1 Article identification and selection*

Literature from 2007 until 2017 was consulted from the existing bank of SLMACC reports, a previous unpublished draft gap analysis review carried out in 2015 (Flood 2015) and a literature review carried out for the CCII project in 2016 (McKim 2016). The online resource Climate Cloud; a repository of New Zealand primary sector literature, was also consulted using a targeted key word search. A targeted systematic review of the research databases ISI Web of Science, CAB Abstracts, and Academic Search Complete was also carried out. Both peer reviewed academic journal articles and published government reports (grey literature) were considered in the database searches. Inclusion/exclusion criteria were used to screen the relevance of each article/report. Included articles and reports focus on adaptation in the primary sector in New Zealand. All references were initially downloaded to Endnote online or Mendeley.

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Tables 1-4 document the article selection and screening process. The search terms used to interrogate the ISI Web of Science, CAB Abstracts, and Academic Search Complete research databases are provided in Table 1. The search terms were compiled to capture the full range of relevant research outputs associated with climate change adaptation and the primary sector in New Zealand. The search terms for the Climate Cloud database (Table 2) are limited compared to those used with the other search engines as the database didn’t respond well to longer strings of search terms. The relevant reports and papers were easily retrievable using more targeted searches in this database focused on climate change and land-based sectors in New Zealand. Article screening (Table 3) enables the search returns to be fit for purpose by filtering papers and reports to match the targeted search criteria and constraints. The screening steps (Table 4) clarify the robust and repeatable process carried out to remove irrelevent and duplicate returns from the search outputs.

|  |
| --- |
| **Search Terms** |
| climat\* change | OR | primary\* | OR | sheep\* | OR |
| global warming | OR | primary\* production | OR | arable\* | OR |
| change\* in climate | AND | agricultur\* | OR | farm\* | OR |
| adaptation\* | OR | pasture\* | OR | beef | OR |
| adapt\* | OR | horticultur\* | OR | lamb | OR |
| planning\* | OR | fruit\* | OR  | wool | OR |
| vulnerability\* | OR | kiwi\* | OR | meat | AND |
| Impact\* | OR | dairy\* | OR | New Zealand |  |
| implication\* | AND | cropping\* | OR |  |  |

**Table 1** Search terms for ISI Web of Science, CAB Abstracts, and Academic Search Complete

(“New Zealand” AND Adaptation AND Primary AND Agriculture) under the climate change filter

**Table 2** Climate Cloud search terms

|  |  |
| --- | --- |
| **Included** | **Not Included** |
| Peer-reviewed journal article | Not Peer-reviewed journal article |
| Research report | Not research report |
| Written in English | Not in English |
| Published on or after 1 January 2007 / on or before 31 June 2017 | Not published on or after 1 January 2007 / on or before 31 June 2017 |
| Substantial focus on the primary sector and climate change | Not substantial focus on the primary sector and climate change |
| Substantial focus on adaptation or decision-making | Not substantial focus on adaptation or decision-making |
| New Zealand focused | Not New Zealand focused |

**Table 3** Article Screening

|  |
| --- |
| All returns |
| Duplicates removed |
| After title screen |
| After abstract read/article scanFinal considered |

**Table 4** Screening Steps

1. Results

Through completion of the steps outlined and clarified under the research methods, a totally of 22 research papers/reports met the requisite criteria (Table 5). Papers and reports meeting the criteria were drawn from four research databases.

**Table 5** Returns documented for ISI Web of Science, Climate Cloud, CAB Abstracts, and Academic Search Complete databases

|  |  |
| --- | --- |
|  | **Databases** |
| **Subset** | ISI Web of Science | Climate Cloud | CAB Abstracts | Academic Search Complete |
| All returns | 180 | 123 | 164 | 158 |
| After de-duplication | 180 | 123 | 159 | 158 |
| After title screen | 88 | 35 | 38 | 8 |
| After abstract read/article scan | 23 | 19 | 14 | 4 |
| Final considered | 12 | 8 | 6 | 3 |
| Final considered once duplicates removed | **22** |

An Initial summary analysis of the papers/reports (Table 6) ranks the papers in order of citation count as measured by Google Scholar. Lead authors are indicated as well as the year of publication and the journal where the paper was published. The largest number of papers are published in *Climatic Change* (4) and *Regional Environmental Change* (2)*.*

 **Table 6** Included studies in order of citation count (Highest to lowest as measured by Google Scholar as of June 9th 2017)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author(s)** | **Title** | **Journal** | **Year** | **Citations** |
| King et al. | Māori environmental knowledge of local weather and climate change in Aotearoa - New Zealand  | Climatic Change | 2008 | 57 |
| Kalaugher et al. | An integrated biophysical and socio-economic framework for analysis of climate change adaptation strategies: The case of a New Zealand dairy farming system | Environmental Modelling and Software | 2013 | 42 |
| Niles et al. | How limiting factors drive agricultural adaptation to climate change | Agriculture, Ecosystems and Environment | 2015 | 29 |
| Kenny  | Adaptation in agriculture: Lessons for Resilience from eastern regions of New Zealand  | Climatic Change | 2011 | 28 |
| Lee et al. | Climate-change effects and adaptation options for temperate pasture-based dairy farming systems | Journal of British Grassland Society | 2013 | 21 |
| Zhang et al. | Spatially explicit modelling of the impact of climate changes on pasture production in North Island New Zealand | Climatic Change | 2007 | 19 |
| Sturman and Quenol | Changes in atmospheric circulation and temperature trends in major vineyard regions of New Zealand | International Journal of Climatology | 2013 | 17 |
| Sylvester-Bradley and Riffkin | Designing resource-efficient ideotypes for new cropping conditions: Wheat (*Triticum aestivum L.*) in the High Rainfall Zone of southern Australia | Field Crops Research | 2012 | 17 |
| Prokopy et al. | Farmers and Climate Change: A Cross-National Comparison of Beliefs and Risk Perceptions in High-Income Countries | Environmental Management | 2015 | 14 |
| Orwin et al. | Effects of climate change on the delivery of soil-mediated ecosystem services within the primary sector in temperate ecosystems: a review and New Zealand case study | Global Change Biology | 2015 | 11 |
| Niles et al.  | Farmer's intended and actual adoption of climate mitigation and adaptation strategies | Climatic Change | 2016 | 9 |
| Manning et al. | Dealing with changing risks: a New Zealand perspective on climate change adaptation  | Regional Environmental Change | 2015 | 10 |
| Cradock-Henry | Exploring Perceptions of Risks and Vulnerability To Climate Change in New Zealand Agriculture | Political Science | 2008 | 7 |
| Gray et al. | The management of risk in a dryland environment | Proceedings of the New Zealand Grassland Association | 2011 | 7 |
| Keller et al. | Grassland production under global change scenarios for New Zealand pastoral agriculture | Geoscientific Model Development | 2014 | 5 |
| Fowler et al. | Vulnerability of pastoral farming in Hawke's Bay to future climate change: Development of a pre-screening (bottom-up) methodology | New Zealand Geographer | 2013 | 4 |
| Hopkins et al. | Climate change and Aotearoa New Zealand | WIRES Climate Change | 2015 | 4 |
| Weller et al. | Retaining Adaptive Capacity in New Zealand's ecological systems  | New Zealand Journal of Agricultural Research | 2008 | 3 |
| Weaver | Climate change and food security | Institute of Policy Studies Working Paper | 2008 | 2 |
| Cradock-Henry | New Zealand Kiwifruit growers' vulnerability to climate and other stressors  | Regional Environmental Change | 2016 | 1 |
| Lieffering et al. | Exploring climate change impacts and adaptations of extensive pastoral agricultural systems by combining biophysical simulation and farm system models | Agricultural Systems | 2016 | 1 |
| Nettle et al. | Empowering farmers for increased resilience in uncertain times | Animal Production Science | 2015 | 1 |