

## FINAL PROJECT REPORT

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# OPTIMISING POST-DISASTER RECOVERY INTERVENTIONS IN AUSTRALIA

Final project report

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## EXECUTIVE SUMMARY

Australians are all too familiar with disasters arising from natural hazards, such as bushfires, cyclones, and floods. With climate change, we face the possibility of more frequent and intense natural hazards where they occur as in new and unexpected places.

As we enter an uncertain decade, we find ourselves increasingly asking: What does a disaster-resilient Australia look like? How can we help our most vulnerable Australian communities endure the cumulative effects of frequent disasters? Amid tightening fiscal budgets, how can we make the right policy choices for our communities and economy to prosper in this new reality?

Answering these questions requires deep thinking in order to be able to support our communities, businesses, and the broader economy, and help them become more disaster resilient; to not only adapt to a “new normal” but thrive in a changing climate. From a policy perspective, this becomes more pertinent when we consider that the average annual total economic costs of natural disasters of Australia are forecast to reach \$39 billion per year by 2050 (Deloitte Access Economics, 2017).

This project has estimated the impact of four disasters in recent Australian history on income of individuals residing in disaster-hit areas. By defining individuals' ability to return to their pre-disaster income levels as economic resilience, we focused on the following case studies: The 2009 Victorian Black Saturday bushfires, the 2009 Toodyay bushfires, the 2013 Tropical Cyclone Oswald, and the 2010-11 Queensland floods. Through real-life case studies, our research helps illustrate how these events—of different types, localities, and scales—impact and ripple through communities and the broader economy over time.

We have employed the difference-in-differences modelling approach to pinpoint the income changes due to the disasters. That is, we compared the income levels of individuals living in the disaster-hit areas (treatment group) with incomes of those who resided in comparable areas that were not directly hit by the disaster (control group). The control group provides us with the income path that would have been expected for the disaster-hit population had the disasters *not* happened, and thus enables us to compute any income deviations (losses or gains) in the disaster-hit areas. To identify the economic vulnerabilities, we analysed in detail the income changes with respect to individuals' demographic attributes and sectors of employment. Our primary dataset is the Australian Longitudinal Census Dataset of 2006, 2011 and 2016, which includes 5% representative sample of the Australian population and provides data on a range of our economic, demographic, and sectoral variables.

The research has found that the extent of the economic impact of disasters on individuals' income depends on the type, intensity, and location of the disaster. This finding departs from most policy assumptions, which tend to put all the disasters into the same basket when designing relief and recovery programs.

However, there are also common vulnerable groups across different disasters. We found that certain sectors, such as agriculture and accommodation and food services (of which tourism is part) tend to be the most adversely affected sectors across all types, locality and severity of disasters.



An additional clear insight obtained in this research is that 'economic smallness' is a point of vulnerability. In particular, low income earners, small-business owners and part-time workers are more likely to lose income following a disaster. Middle and high-income earners, full-time workers and owners of larger businesses are far less likely to lose income; indeed, they might even earn more.

Part of the reason why the 'economically smaller' demographic groups are vulnerable to disasters is that they are employed in disaster-sensitive sectors. Thus, the sectoral vulnerability is translated into demographic vulnerability.

We also found that time frame for recovery matters. For example, following the 2009 Victorian Black Saturday bushfires, low-income individuals and the female workforce experienced lower income levels that persisted until 2016. This contrasts with high-income earners, who despite having lost income in the short term, were able to bounce back to their original income trajectory by 2016. Even though it is intuitive to think that economic resilience levels could be different across different demographic and sectoral groups, this project brings this intuition to the fore, and documents exactly what those less resilient groups are, as well as the associated income losses (or gains).

Overall, this research has revealed disaster costs that would not normally be identified by the direct damage estimates. For example, the direct total (tangible and intangible) damages of the 2009 Victorian Black Saturday bushfires were \$7 billion (Deloitte Access Economics 2016). However, we found that, following the Black Saturday bushfires, agricultural employees who lived in the fire-ravaged areas lost an average of A\$8,000 in annual income for the following two years. Employees in the accommodation and food services industries lost an average of A\$5,000 per annum. The indirect loss estimates are typically bypassed in the wake of disasters, as the policy community typically focuses on the direct damage estimates when assessing the economic costs of disasters.

This research has also demonstrated that the burden of lost income due to the disasters is not borne equally. That is, the income gap routinely increased after disasters. For example, following the 2010-11 Queensland floods, the difference between those on low and middle incomes in the Brisbane River Catchment area increased by about \$7,000 a year. This meant that the poor became poorer following disasters in Australia. In addition, female workers tend to lose income after some disasters compared to their male counterparts. Moreover, the income divide persisted in the medium term after some disasters. This finding of rising inequality is novel for Australia and was not documented previously.

In an earlier phase of this research program, during 2014-15, we studied the nation-wide impacts of floods and bushfires and their effects on economic sectors in Australia. This research used national accounts data from six Australian states for the period 1978-2014, and explored whether and how floods and bushfires as well as extreme weather (i.e. extreme precipitation and temperature) impacted the course of sectoral activity in the overall Australian economy. We found that Australia's sectoral output is sensitive to floods – Australia lost more than two years' worth of agricultural output during the period 1978-2014 due to floods. Bushfires, on the other hand, do not affect overall output, though they exhibit sectoral effects. The project *Optimising post-disaster*



*recovery interventions in Australia* complements this earlier research by studying individuals' income changes through four case studies.

The policy implications of this research are clear and important. Decision makers need to have a more disaggregated view to understand the economic impact of disasters. Our findings show that socioeconomic vulnerabilities are concentrated in certain demographic groups and sectors of the economy. In addition, both the poor and female employees exhibit lower economic resilience to disasters, in that they may not be fully able to return to their pre-disaster income trajectory in the medium-term. This highlights the potential for disasters to widen income inequality over time.

In a nutshell, this research suggests that policymakers need to better understand the socioeconomics of disasters and formulate public policies to better distribute scarce budgets and resources towards vulnerable socioeconomic groups and employment sectors that are more sensitive to disasters.

In terms of utilisation, the project has focused on generating awareness and provoking thoughts among the policy and wider community regarding economic effects of disasters on individuals. The project has produced four research reports pertaining to each case study, along with four policy briefs that summarised each report. The project also produced demographic profiling analyses for each disaster analysed. The findings from these four case studies were disseminated to a national audience through a webinar in August 2020, and the feedback received was overwhelmingly positive. The project has also published two articles in 'News and Views: Australian Journal of Emergency Management' and was featured in two articles in the Fire Australia magazine, which helped share the results with the emergency management sector. Finally, our demographic profiling analysis on the VIC Black Saturday bushfires and associated findings have been cited and discussed in the recent CSIRO Report to the Prime Minister Morrison on climate and disaster resilience (CSIRO, 2020).

The project has also made strong media engagement about its findings. These media outputs included, two articles in *The Conversation*, several radio interviews on the economic impact of bushfires (including two at ABC Radio National "The Money" program with Richard Aedy, ABC North Queensland, South Korean eFM), a number of national newspaper articles, quotations and citations, several media releases made by the media team at Deakin University.

Looking ahead, we expect to disseminate our research reports and policy briefs more widely to public and private organisations in Australia. We also expect to disseminate our findings through media and policy engagement in the next bushfire season to create further awareness and provoke thoughts on how Australia can enhance the economic resilience of its communities. The project team is currently involved with new projects on the health and wellbeing analysis of Black Saturday bushfires and Queensland Floods as direct outcomes of the present project. Finally, we will be progressing a number of working papers that have greatly benefited from and been informed by our BNHCRC research program methodology and learnings.

To conclude, we believe that this project is the end of the beginning rather than beginning of the end regarding potential research projects in the economics of disasters in Australia.



## END-USER PROJECT IMPACT STATEMENT

**Tim McNaught**, *Office of Bushfire Risk Management, WA*

In a fire-prone landscape like Australia, as the climate warms and dries, the likelihood of more severe bushfires impacting communities is increasing. The scale of 2019/2020 summer bushfires on the East Coast of Australia demonstrate how integrated the economic elements of communities are and the interconnectedness between towns and communities themselves are to the impacts of natural disasters. Government and non-government organisations that support communities are endeavouring to gain an insight into plausible futures to assist policy, planning and investment decisions that can ensure the most efficient and effective allocation of increasingly stretched resources to protect communities from hazards before, during and afterwards.

One such way to crystal ball a possible future is to understand the past and this research methodology provides an insight into one such method that follows the economic effect on one community impacted by a relatively short-lived, small scale but intense bushfire in Western Australia in 2009. Appreciating the shocks that something like a short-lived bushfire can have on a small community, like Toodyay, measured by economic effect over a longer period can provide some important insight and justify investment in a community's preparedness and prevention activities that reduce the short-term and longer-term shocks and impacts a bushfire could have.

It is hoped that lessons of the past can inform behaviours and choices in the future. The Shire of Toodyay has made some significant changes in response to the 2009 bushfire. It is hoped such a case study may assist government and non-government organisations with a role in managing the hazards an opportunity to consider measures that may mitigate the impacts of future events. It is clear that those communities that are prepared, have undertaken mitigation activities to reduce the impacts of a hazard and are able to respond accordingly have a greater chance of recovering. I hope this case study can demonstrate a methodology that captures the tangible impacts one event can have over time and may be of interest to other communities faced with similar hazards and potential impacts, ultimately guiding decisions about mitigating the impacts of those hazards.

**Marcin Pius**, *Emergency Management Australia, ACT*

Emergency Management Australia (EMA), as the national emergency management coordinating body, including national recovery policy, may have an opportunity to use findings from these reports at various national recovery fora, encouraging the recovery community to consider the findings in the design of future recovery policy and programs. EMA is often involved in reviewing national recovery handbooks, development of guidelines and frameworks and could use the report findings to guide the content of the resources being developed. Finally, in respect of sharing the results of this research, EMA will include these reports in its knowledge management repositories making it available to recovery communities across all jurisdictions.





**Jane Carey**, *Queensland Reconstruction Authority, QLD*

The Queensland Reconstruction Authority welcomes this Report which gives valuable insights into the economic impacts of the devastating 2010-11 flood event on communities in the Brisbane River Catchment Area. Its particular focus on income effects of disasters on certain segments of the workforce highlights the importance of building economic resilience to minimise the impact of disaster induced shocks on Queensland communities that are vulnerable to disasters.

This research aligns with the goals of the Queensland Strategy for Disaster Resilience and its implementation plan, Resilient Queensland by providing an evidence base to enable a better understanding of the disaster risks faced by communities in the Brisbane River Catchment Area. Findings of this Report highlight how economic impacts of disasters are borne differently by particular segments of the community depending on their demographic attributes, employment characteristics and areas of residence. This research highlights the importance of tailored approaches to build economic resilience as a key component of community resilience.

As the lead agency responsible for disaster recovery policy in Queensland, this research is relevant to QRA by demonstrating the important role for government assistance in the form of disaster relief and recovery programs that support the economic and psychosocial needs of vulnerable groups following disaster events.



## PRODUCT USER TESTIMONIALS

### *Department of Communities, Disability Services and Seniors, QLD*

As lead agency for human and social recovery, DCDSS is acutely aware of the relationships between financial resilience and wellbeing. This report provides both insight and validation of DCDSS planning assumptions regarding people who are most likely to experience financial vulnerability, and highlights the important role that financial relief measures play in preventing greater economic inequality for those sectors most at risk. This type of information is useful in guiding how financial relief measures are targeted, but also prompts consideration of how resilience activities could be targeted at workers in particular service sectors that are likely to experience financial risk as a result of disruption in their sectors following a disaster, and/or how post disaster workforce recruitment activities could be targeted to address sectors that experience disruption.

The insights gleaned from this report can be used to:

- strengthen relief programs by testing disaster relief planning assumptions
- validate the important role that relief plays in preventing the widening of economic inequality
- validate the role that personal hardship relief provides as an immediate economic stimulus
- inform different approaches to Commonwealth income support and employer wage assistance measures (particularly part time workers) following a disaster
- inform disaster recovery workforce planning and recruitment strategies that deliberately target sectors that experience loss and disruption.

Inform resilience strategies that could be deliberately targeted to small business owners and workers in sectors highly vulnerable to disasters.

The information provided in this report validates the importance of targeting financial relief to low income earners, small business and primary producers, whilst also highlighting the importance on focusing on a few other particular sectors most susceptible to financial disruption, such as small business owners and people employed in part time/casual type arrangements in service sectors like hospitality and tourism. It also suggests that future policy needs to consider either how we prevent/mitigate from a resilience perspective the impact on individuals and sectors vulnerable to disruption/loss as a result of a disaster, and/or the sufficiency of relief measures combined with income support and/or targeted employer wage assistance measures in terms of addressing/mitigating the longer term personal economic loss versus short term band aid assistance.

It would be good to build upon this work to achieve a more holistic program logic for individual economic disaster resilience. There could be opportunity to collaborate with agencies in the Financial Resilience Sector to truly understand the barriers and opportunities around disaster financial resilience, including small business owners, self-employed contractors and individuals working in sectors which are susceptible to the impact of disasters. This could then be incorporated into a suite of measures (not just relief) that could be applied in the short, medium and longer term, and inform the policy approaches of all levels of government



and non-government (includes private sector) in terms of resilience as well as response and recovery. This will also ensure closer collaboration between the different recovery functions in Queensland.

As the disaster relief measures are already largely applied to low income earners, DCDSS will review its current data metrics in terms of what is captured in terms of specific demographic, employment cohorts, insurance status and financial capacities (ie rebuilds) etc. Deliberately capturing qualitative and contextual information that further informs DCDSS understanding of the personal financial impacts will better inform targeted recovery strategies between and across recovery pillars.

### ***Department of Employment, Small Business and Training, QLD***

While the report did not find a statistically significant association between the Queensland Floods 2010–11 and the income trajectories of affected workers, the Department of Employment, Small Business and Training (DESBT) notes that income losses were found to be more likely among particular cohorts. Of relevance to DESBT, this includes business owners and workers in part-time employment or sectors sensitive to disasters (e.g. tourism).

DESBT is charged with the responsibility of making a recommendation to activate federal support and funding under the Natural Disaster Relief and Recovery Arrangements (NDRRA). DESBT also provides other support in terms of issuing a post-disaster survey to small businesses which informs the recommendation above. Also, the survey provides validation of Queensland Fire and Emergency Services' on the ground assessment of the level of damage, and can be used to support other policy decisions beyond those relating to NDRRA.

DESBT is developing a new Queensland Small Business Strategy. As part of its development, a discussion paper was released for public consultation. The discussion paper proposed five focus areas for action to help small business to grow and employ. The strategy recognises that small businesses are especially vulnerable to extreme weather events and natural disasters and *Focus area 3 – Creating sustainable jobs in regional Queensland*, within the discussion paper, considered ways to increase small business resilience so they can prepare, recover and adapt to disruptive events.

The report provides valuable information on the impacts of the Queensland Floods 2010–11 on the small business sector and employment, which helps to understand better the issues affecting small business resilience and recovery.

The report also reinforces the need to support small businesses through post-disaster recovery and may help inform responses to future disasters, including those in other regions throughout Queensland.

Interestingly, the report found an increase in demand for healthcare services following the floods, which was likely driven in part by the need for psychological support. DESBT's post-disaster survey could be widened to capture mental stress levels to enable targeted psychological support to be made available to small business owners.



Understanding more about the factors that impact loss/income recovery for small businesses and the impacts of psychological stress would be two areas of research that could be pursued.

This report could be used to inform post-disaster survey design to capture consequential financial losses and psychological stress.



## INTRODUCTION

Natural disasters in Australia are very costly. They often have devastating socio-economic effects on impacted communities, with many of the community members not being able to recover economically and socially. As climate change has become more obvious, arguably having ushered in a new climatic regime of frequent and intense disasters such as bushfires, cyclones and floods in many countries including Australia, we find ourselves increasingly asking: How can we make Australia more disaster-resilient? Who are the most vulnerable Australian communities to disasters and how can we help them endure the cumulative effects of such shocks? How can we allocate scarce budgets across different disaster assistance schemes so as to optimise our disaster recovery interventions?

Our pioneering research program has explored the impact of four disasters in recent Australian history on disaster-hit individuals' income, a key measure of economic resilience. These disaster case studies are: The 2009 Victorian Black Saturday bushfires, the 2009 Toodyay bushfires in Western Australia, the 2013 Tropical Cyclone Oswald in Queensland and New South Wales, and the 2010-11 Queensland floods. By analysing Australian Longitudinal Census Datasets of 2006, 2011 and 2016 (ABS 2016 and 2018a), which includes 5% representative sample of the Australian population and tracks individuals over the 10-year period, we have determined whether individuals' income levels were able to recover post disaster in the short and medium term, considering demographic factors and employment sectors. By adopting real-life case studies as well as the said dataset, our research aims to illustrate how different types, localities, and scales of disasters impact and ripple through communities and the broader economy over time, and how we can make the right policy choices for our communities and economy to prosper in this new climatic regime.

We have employed the difference-in-differences modelling approach to compute the income changes due to the disasters. That is, we compared the income levels of individuals living in the disaster-hit areas (treatment group) with incomes of those who resided in comparable areas that were not directly hit by the disaster (control group). The control group provides us with the income trajectory that would have been expected for the disaster-hit population if they had not faced with the disaster, enabling us to identify any income deviations (losses or gains) in the disaster-hit areas. We have closely worked with our research end-users to identify appropriate control groups for the difference-in-differences modelling. To pinpoint the economic vulnerabilities, we analysed in detail the income changes with respect to individuals' demographic attributes and sectors of employment.

This research is pioneering not only in national context, but also in international domain given that studies adopting micro datasets and directly working with policymakers to develop the research design are rare. Specifically, this study is the first in the economics literature to examine the impact of bushfires and riverine flooding on individual income, considering demographic and sectoral heterogeneities at very fine units, and is among the very few that have analysed the microeconomic effects of hurricanes on metropolitan and regional communities (see Gallagher and Hartley 2017 and Deryugina et al 2018 for the effects of Hurricane Katrina 2005 on New Orleans residents).



The 2009 Victorian Black Saturday bushfires were some of the worst bushfire conditions ever recorded in Australia; equivalent to 1500 of the atom bombs dropped on Hiroshima going off (Sydney Morning Herald, 2009). 173 people died; over 2,100 houses and 3,500 structures were destroyed, and thousands more suffered damage; the total area destroyed was around 400,000 hectares (Black Saturday Royal Commission, 2010). The toll was estimated to be \$3.1 billion in tangible damages and \$3.9 billion in intangible impacts (Deloitte Access Economics, 2016).

The 2009 Toodyay bushfire struck Toodyay – a small regional town in Western Australia with a population of 4,450 around the time of the bushfire. The fire conditions were some of the worst seen in Western Australia at the time and burnt around 2,900 hectares. While no casualties were reported, the total cost of damages was estimated at \$100 million (FESA, 2010). This case study represents an example of a small-scale disaster that hit a small regional town in Australia (about 10% of the Australian population live in small regional towns).

Category 1 ex-tropical Cyclone Oswald moved across parts of Queensland and New South Wales in January 2013, causing severe storms, flooding, and tornadoes. The associated flooding and extreme weather events were declared a disaster in 53 Queensland LGAs, with the most devastating felt in the Bundaberg and North Burnett regions. The cyclone damaged key infrastructure including sewerage systems and economically important assets including ports and road networks relied on by agricultural and manufacturing enterprises in the area. The record flooding in Bundaberg forced the evacuation of over 7,500 residents and damaged over 2,000 homes. This case study focuses on small business owners in the Burnett River catchment area and tracks their incomes in the post-disaster period. About 97% of businesses in Australia are small businesses, with about two-thirds of the population being employed by these enterprises.

Finally, the Queensland Floods 2010-11 remain one of Australia's costliest flooding events, causing an estimated \$6.7 billion in tangible damages, with an overall cost of \$14.1 billion (Deloitte Access Economics, 2016). This damage is equivalent to 5.2% of Queensland's GDP in 2011. Host to two million people, the metropolitan city of Brisbane experienced a succession of six excessive rainfall spells during December 2010--January 2011, whereby the flood waters reached 4.46 meters high on January 13, 2011. The waters spread to surrounding regional cities in the following days and ravaged the economy. One in five businesses in Queensland had to close following the floods due to either water inundation or power outage. 48% of all businesses were affected in some way (Queensland Chamber of Commerce 2011). The impact on the population was also huge: the flooding of more than 28,000 homes and a power outage in 480,000 buildings paralysed the economic activity in the succeeding months.

The project has seen the completion of **four research reports** pertaining to each case study, which have been submitted to the BNHCRC and approved in June/July 2020:

- *Disasters and Economic Resilience: The Effects of the Black Saturday Bushfires on Individual Income – A Case Study*
- *Disasters and Economic Resilience in Small Regional Communities: the Case of Toodyay*



- *Disasters and Economic Resilience: The income effects of Cyclone Oswald 2013 on Small Business Owners – a case study on the Burnett River Catchment Area*
- *Disasters and Economic Resilience: The Effects of the Queensland Floods 2010-11 on Individual Income – A Case Study on the Brisbane River Catchment Area*

The project team has also delivered **four policy briefs** summarising each report, their scope, findings, and policy implications for disaster recovery programs. Both the research reports and the policy briefs have been made available on the BNHCRC website to the policy and academic community. The outputs delivered also included **demographic profiling** analyses, which helped check the research design assumptions as well as to put the results into context.

The findings from these four case studies were disseminated to a nation-wide audience through a **Zoom webinar** on 11 August 2020, with participation of 53 attendees. Subsequent feedback showed that the webinar was well received. The project produced two articles that were published in 'News and Views: Australian Journal of Emergency Management'. It was also featured in two articles in Fire Australia, which all helped share the insights with the emergency management sector in Australia.

Prior to embarking on these case studies in early 2016, during 2014-15 the project focused on the nation-wide impacts of floods and bushfires and their effects on economic sectors in Australia. This component used national accounts data from six Australian states over the period 1978-2014, and explored whether and how disaster shocks as well as extreme weather (i.e. extreme precipitation and temperature) impacted the course of sectoral activity in the overall Australian economy. The study has been published as a **journal article** in the **Economic Record** (the flagship journal of the Economic Society of Australia):

- *Floods, bushfires and sectoral economic output in Australia, 1978-2014* (top 10% of the downloaded papers in the Economic Record in 2019)

The project has also made strong **media engagement** about its findings since its inception. Some examples of the media output include:

- Two articles in The Conversation
- Several radio interviews regarding the economic impact of bushfires (e.g., two at ABC Radio National, one ABC North Queensland, South Korean eFM)
- Several newspaper articles, as well as quotations and citations
- Several media releases made by the media team at Deakin University

The findings in the four case studies are significant and informative. The project estimated significant income losses for individuals living in disaster-hit areas within the years following natural hazard disasters in Australia. Using four case studies representing different hazard types, in different parts of the country and covering different scales, **the research revealed additional costs that would not normally be picked by the direct damage estimates.**



For example, according to Deloitte Access Economics (2016), the direct total (tangible and intangible) damages of the 2009 Black Saturday bushfires were \$7 billion. However, we found that, following the Black Saturday bushfires, agricultural employees who lived in the fire-ravaged areas lost an average of A\$8,000 in annual income for the next two years. Employees in the accommodation and food services industries lost an average of A\$5,000.

**This research also found that the burden of lost income because of the disasters is not borne equally.** That is, the income gap routinely increased after disasters. For example, following the 2010-11 Queensland floods, the difference between those on low and middle incomes in the Brisbane River Catchment area increased by about \$7,000 a year.

Low-income earners, small-business owners and part-time workers are more likely to lose income following a disaster. Middle and high-income earners, full-time workers and owners of larger businesses are far less likely to lose income; indeed, they might even earn more. This means that natural hazards caused the income divide to become larger in Australia.

Further, certain demographic groups exhibited lower economic resilience in returning to their pre-disaster income levels in the aftermath of disasters. Following the Victorian Black Saturday bushfires, low-income individuals and the female workforce experienced lower income levels that persisted until 2016, seven years after the fires. This contrasts with high-income earners, who despite having lost income in the short term, were able to bounce back to their original income trajectory by 2016. This suggests that the income divide persisted in the medium term following the Black Saturday bushfires. We delve into these results in the key milestones section.

The journal article published in the *Economic Record* found that Australia's sectoral output is more sensitive to floods – Australia lost more than two years' worth of agricultural output during the period 1978 to 2014 due to floods. Bushfires, on the other hand, do not affect overall output in an economically meaningful way, though it does exhibit sectoral effects.

The policy implications of this research are important. Governments and other organisations need to look beyond the aggregate impacts commonly focused on, to understand an individual's socioeconomic vulnerability to disasters. The findings show that socioeconomic vulnerabilities are concentrated in certain demographic groups and sectors of the economy. In addition, both poor and female residents exhibit lower economic resilience to disasters, in that they may not be fully able to return to their pre-disaster income trajectory in the medium-term. This highlights the potential for disasters to widen income inequality over time.

Focusing on individuals' income stream enables policy advisers to explore how disaster-induced economic shocks can be transmitted to the labour force via income-earning channels, and offers a greater understanding of how the indirect costs of disaster like bushfires, cyclones and floods are borne by different segments of the working population.

By defining economic resilience to be an individual's ability to return to their pre-disaster income levels, this research helps policymakers better understand the





socioeconomics of disasters and formulate public policies in a sustainable way that better distributes scarce budgets and resources towards vulnerable socioeconomic groups and employing industries that are more sensitive to disasters.

Looking ahead, we expect to disseminate our findings more widely through media and policy engagement in the year to come in order to contribute our knowledge on how Australia can enhance the economic resilience of its communities, and better direct recovery efforts to core income generating activities of disaster-hit areas. We also believe that this project is the end of the beginning rather than beginning of the end regarding potential research projects in the economics of disasters in Australia.



## BACKGROUND

Natural disasters in Australia are very costly, and often have devastating socio-economic effects on impacted communities.

With the severity and frequency from natural disasters set to increase (Intergovernmental Panel on Climate Change, 2018), there is a need—now more than ever—for Australia to have a sustainable disaster recovery model that:

- incorporates an evidence-based and disaster-specific assessment of potential damages and impacts of natural disasters on Australian communities, and
- helps build resilience within Australian communities to such disasters.

An important dimension of resilience to natural disasters is economic resilience (Rose, 2007). As income stream represents the economic resilience of individuals to external shocks, economic resilience at an individual level can be defined as the ability to return to the pre-disaster income trajectory. This can happen if the individual has the necessary labour market skills, education and/or experience; the economy is sufficiently diverse to withstand firm/industry-specific losses; or if the government assists the individuals during the recovery and assistance period.

A major research gap is a lack of estimates of the full economic impact of natural disasters covering all the affected sectors and households of the economy. Without understanding both the primary and secondary effects of the natural disasters, we cannot determine the economic resilience of individuals and communities to such disasters. Consequently, persistent losses throughout the economy emanating from various sectors are not adequately accounted for in the disaster recovery model.

Secondly, a framework needs to be established to estimate the indirect economic losses. With the identification of the disaster-specific potential damage and losses, policymakers at different levels can formulate disaster risk reduction-inclusive development policies to mainstream disaster resilience practices. Hence, estimating the impacts of previous natural disasters remains highly critical towards designing more informed national economic policies.



## RESEARCH APPROACH

### OVERVIEW

To address these known research gaps, our research aims to determine the disruptive effects that natural disasters have on economic resilience. While, at the national level, sectoral output is a measure of economic resilience (indeed, 'output equals income' is a national accounting identity), at the individual level, gross income earned from wages, salaries, and other economic activities measure the economic resilience.

As this project is predominantly about the analysis of disaster-economic resilience relationship at the individual income level, we focus on describing the research approach adopted in the four case studies. In particular, the research program utilises a difference-in-difference model and four real life case studies of varying types and scales to illustrate the effects of natural disasters on economic resilience:

- The Victorian Black Saturday Bushfires 2009 (fire, regional, large scale)
- The Western Australian Toodyay Bushfire 2009 (fire, regional, small scale)
- Tropical Cyclone Oswald 2013 of Queensland (cyclone, regional, medium scale)
- The Queensland Floods 2010-11 (flood, city, large scale)

We investigate the disasters-income link with respect to the demographic status of individuals (i.e. gender, age, income status, employment status and type, and education level) as well as considering the sectors they are employed.

### RESEARCH PROGRAM OBJECTIVES

1. **Research objective** – estimate the economic impact of natural disasters on individuals' income levels in Australia:
  - 1.1 estimate the sector-disaggregated economic impact of natural disasters on individuals' income levels in Australia
  - 1.2 estimate the demographic-specific economic impact of natural disasters on individuals' income levels in Australia
2. **Policy objective** – use research outcomes as evidence to optimise and inform a sustainable Australian disaster recovery model:
  - 2.1 Identify pathways for research outcomes to optimise disaster recovery expenditure for individuals affected by natural disasters in Australia
  - 2.2 Identify pathways for research outcomes to inform an evidence-based sustainable disaster recovery model in Australia.



## PRIMARY DATA

The project *Optimising Disaster Recovery Interventions in Australia* exploits individual level economic information as retrieved from the 2006, 2011 and 2016 Australian Census Longitudinal Dataset. This dataset includes a nationally representative 5% sample from each of the 2006, 2011 and 2016 censuses, and links the individual records across these three censuses. In other words, an individual can be tracked over time, including changes in their economic, demographic, and other characteristics.

The availability of such data provides a unique opportunity to explore how Australian citizens are affected over time due to natural disasters, i.e. changes to the individual incomes of the disaster affected individuals as compared with the unaffected cohort, by economic sector.

The richness of this data enables investigation of both social and economic dimensions in Table 1 below:

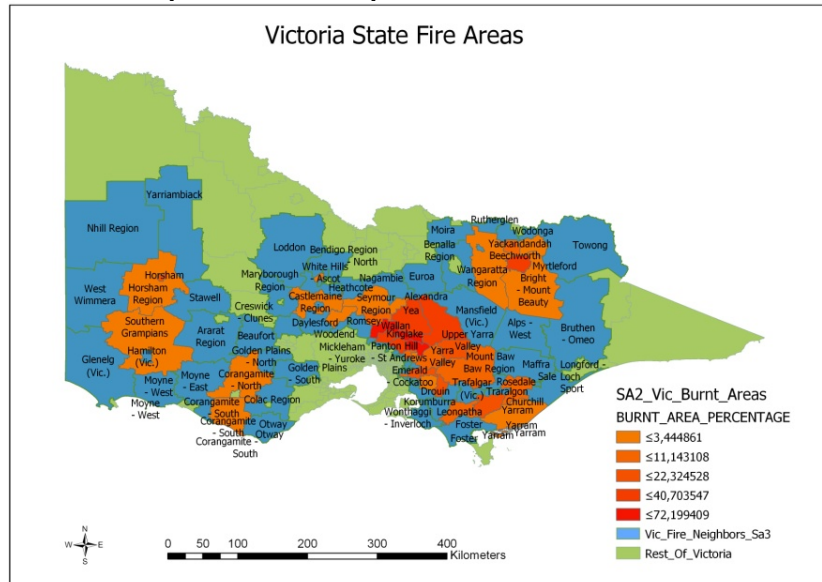
**Table 1 Individual data collected, by dimension**

Economic Dimension	Attributes
Income	Income levels
Employment Status	Employed, Unemployed, Not in Labour force
Employment Type	Full time, Part time Employee, Employer of small business, Employer of unincorporated business, Employer of incorporated business
Employment Sector	ANZSIC classification
Social dimension	Attributes
Gender	Male, Female
Age	Age groups
Educational level	Year 8 or lower, Year 9-12, Bachelor degree, Higher than Bachelor degree
Property ownership	Owner (outright), Owner (mortgage), Renting
Migration	Stayed in bushfire affected area, Migrated out of bushfire affected area
Disability	Has disability, does not have disability
English	English is spoken, English is not spoken

We also capture the magnitude or severity of the 2009 Black Saturday bushfires through a disaster severity measure. In particular, we geo-reference the Black Saturday Bushfires map of the The Black Saturday Royal Commission (2009),

carve out the SA2s<sup>1</sup> boundaries in the State of Victoria, and then compute the share of burnt area in the total SA2 surface area. In this way we find that 37 SA2s in the State of Victoria experienced the fires, with the share of burnt areas ranging from 0.1% to 72.1% across affected SA2s. See Figure 1.

**Figure 1 SA2s affected by Black Saturday bushfires**



Note: The orange colour in the figure displays the burnt of a particular SA2 from the Black Saturday bushfires. The blue part represents the SA2 areas that share a border with a burnt area but were not directly impacted by the fires. The green areas share no borders with the bushfire-hit areas. **Source:** own calculations.

For the other three case studies, we use a binary indicator “disaster-affected, disaster-unaffected” to measure disaster presence in those geographic units.

While for Black Saturday bushfires and Toodyay bushfire we use SA2s as the geographic unit for analysis, we use Local Government Areas (LGAs)<sup>2</sup> for Tropical Cyclone Oswald and Queensland floods.

A more detailed description of the identification of disaster-hit areas (treatment group) and appropriate comparison areas (control group), as well as the rationale behind the choice of geographic units for each case study are provided in the methodology Guidance Note attached to this project.

The project also capitalises on the BNHCRC’s Australian Disaster Resilience Index to obtain SA2-level information on disaster resilience and to interpret certain findings in the light of this measure (Parsons et al 2019).

<sup>1</sup> SA2s are medium-sized geographic units in Australia, which host 3,000–25,000 individuals, with an average population of about 10,000. There are 2,310 contiguous SA2s covering the entire Australian territory (Australian Bureau of Statistics 2016).

<sup>2</sup> LGAs are administrative divisions in Australia that a local government (i.e. municipality or council) is responsible for. The size of an LGA varies in a state.

## MODELLING

The project adopts a difference-in-difference model to analyse each natural disaster case study's short- and medium-term effects on affected individuals' income:

$$Y_{ict} = \text{cons} + \alpha_i + \beta_1 \text{Treat}_{it} + \beta_2 \text{PostDisaster}_{ct} + \beta_3 \text{Treat}_{it} \times \text{PostDisaster}_{ct} + \varepsilon_{ict}$$

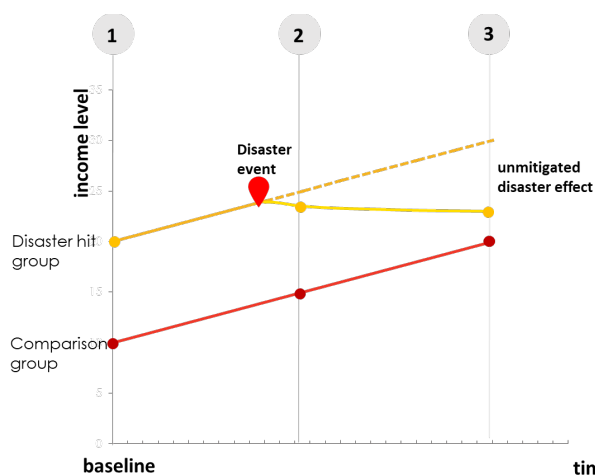
where:

$Y_{ict}$	= Income
$\alpha$	= Individual fixed effect
$\beta_3$	= Coefficient of interest
$i$	= Individuals
$c$	= Cluster/SA2
$t$	= 2006, 2011, 2016
$\varepsilon$	= Disturbance Term

Using advanced mapping and end-user expertise, for each case study, we construct two distinct areas: the disaster-hit areas (treatment group) at either the SA2 or LGA level, and comparator (control) groups that typically have similar characteristics to the disaster-hit areas, including topography and economy, but have not been affected by these disasters. This allows us to pinpoint the specific income effect of the natural disaster (the shock) on the affected (treatment) group.

The difference-in-differences modelling allows us to determine the difference between the incomes of disaster-hit groups before and after the natural disaster, do the same for comparator groups, and see if there is any difference between the two differences (hence, "difference-in-differences"). See Figure 2.

**Figure 2 Difference-in-differences model**



By incorporating a:

- disaster severity measure, the model considers the effect of the magnitude of this shock on these affected groups. The construction of the



disaster measure is case-study specific and may include other information (e.g. topography data)

- vulnerability dimension, we consider the possible differences in the effect of the disasters on different subsets within the affected groups.

This enables observation of the net effect on individual income, post the disaster and any subsequent injections (from government). Ideally, the research model would provide a breakdown of estimates of both these effects on the observed final income levels of affected groups. However, the lack of complete and readily available information of such government assistance at different demographic layers and economic agents renders this analysis difficult.

The project performs the necessary robustness checks, sensitivity analysis and additional analysis recommended by end-users, so that the reported results are statistically significant and robust and provide policymakers with the necessary level of confidence in any subsequent project policy proposals.

As indicated above, a more detailed account of our methodology and identification of the treatment and control group LGA/SA2s can be found in the methodology Guidance Note attached to this project, which has been produced for the replicability of our research and to guide future research in this area.

## OUTCOMES

The immediate outcomes relevant to the objectives are:

1. A robust economic model capable of estimating the economic impact of natural disasters, of varying types and severities, on the income levels of individuals, from various socio-economic demographical backgrounds.
2. Estimates of sector-disaggregated and demographic-specific economic impacts of real-life natural disasters on individuals' income levels in Australia
3. Identification of individuals, and their sectors of employment, most in need of disaster recovery assistance
4. Publications, including journal articles, conference papers, media articles, and guidance notes to disseminate and expand economic research on natural disasters in Australia
5. Policy briefs and other documentation for end-users that inform the budget allocation decisions in both pre-disaster mitigation as well as post-disaster recovery phases.

This project focuses on individuals residing in disaster-hit areas. Disasters have indisputable effects on businesses outside the disaster zones through supply chains, employment, and other links. These spill-over effects may be modeled if one knows the detailed connections between different economic agents inside and outside the disaster-hit area. While these spill-over effects would be a fruitful area for future research, they are out of scope for this present research.



## FINDINGS

We summarise the findings from each of the four case studies in Table 2 below. In the following sections we elaborate on the results and provide the policy implications for government interventions based on the findings of each case study. For more detailed results, including the tables of results from regression analyses, the reader is invited to see the relevant research reports.

**Table 2 Summary of case study results**

Case study	State	Summary of findings
Queensland Floods 2010-11	QLD	No statistically significant overall effects within the first six months post the floods. Income gap widens between the poor and non-poor. Agricultural and food and accommodation sector employees are adversely hit. Part-time employees and small-business owners also experienced lower income.
Black Saturday Bushfires (BSB) 2009	VIC	Overall income losses across all individuals, with agriculture, food and accommodation, low-income groups, female employees, and part-time employees more acutely impacted than others. Those who made the decision to migrate out of the disaster-hit zones suffered notable income losses.
Toodyay Bushfires 2009	WA	Small sample size limited us to demographic analysis only and hampered statistical significance of results. However, the signs of the point estimates reveal similar patterns to those seen in the VIC BSB and Queensland 2010-11 floods case studies. For instance: <b>Low-income:</b> Low-income individuals also experienced some income decrease, consistent with their vulnerability to major shocks and results obtained in the Victorian BSB case study.
Cyclone Oswald 2013	QLD	Small business owners the Burnett River catchment area experienced \$21,000 lower annual income in 2016 compared to their 2011 income levels.

## VICTORIAN BLACK SATURDAY BUSHFIRES 2009

**The 2009 Black Saturday Bushfires were associated with significant income losses within the disaster-hit communities.**

Geo-referencing of the map of the Black Saturday bushfires and overlaying the geo-referenced map on the SA2 boundaries in Victoria reveals that the share of burnt area in the total SA2 surface area of the 37 SA2s that were hit by the bushfires was between 0.1% and 71.2%, with the mean share in our estimation sample being 12.5%. Our subsequent modelling documents that, in this mean group of SA2s, bushfires were associated with losses in average annual individual income of 5.1%, corresponding to about \$2,000 AUD.

Our results also imply that every additional 10 percentage point increase in the share of burnt area in an SA2 (e.g. an increase from 12.5% to 22.5%) is associated with additional reduction in average annual individual income by 5.5%.

These estimates are economically meaningful and statistically significant.

**We must also look beyond overall impacts to understand our socioeconomic vulnerability to disasters.**

Aggregate figures may mask important information we observe between individuals with different demographic attributes and employment characteristics. Thus, we enrich our analysis by investigating the economic





resilience of individuals in relation to their sectors of employment and demographic background.

To illustrate, the Black Saturday bushfires were associated with annual income losses among low-income earners (loss of 8.6%; A\$2,240) and women (loss of 9.7%; A\$2,961) residing in disaster-hit SA2s. Some of these differences are explained by the concentration of these groups' employment in certain vulnerable sectors. There is also evidence that the losses of the low-income earners might have persisted in the medium-run, so we observe continued reduction in their incomes even in 2016. The evidence for the medium-term adverse effects for female residents is much stronger.

Out of all sectors explored, the heaviest income losses were for individuals employed in the agriculture (-23.4%, A\$8,057) and accommodation and food services (-16%, \$4,600). These acute individual-level losses highlight the scale of the devastation in the disaster-hit SA2s and the extent of their economic exposure to the disaster-sensitive industries like agriculture and tourism.

**Economic sectors represent a significant channel through which disaster-induced economic shocks can be transmitted to individuals.**

Our results demonstrate the likely channels through which disaster-induced economic shocks are transmitted to individuals in the labour force. Sectors vulnerable to a disaster are one such a channel. We find that two sectors were particularly vulnerable to bushfires: agriculture, forestry, and fishing, and accommodation and food services.

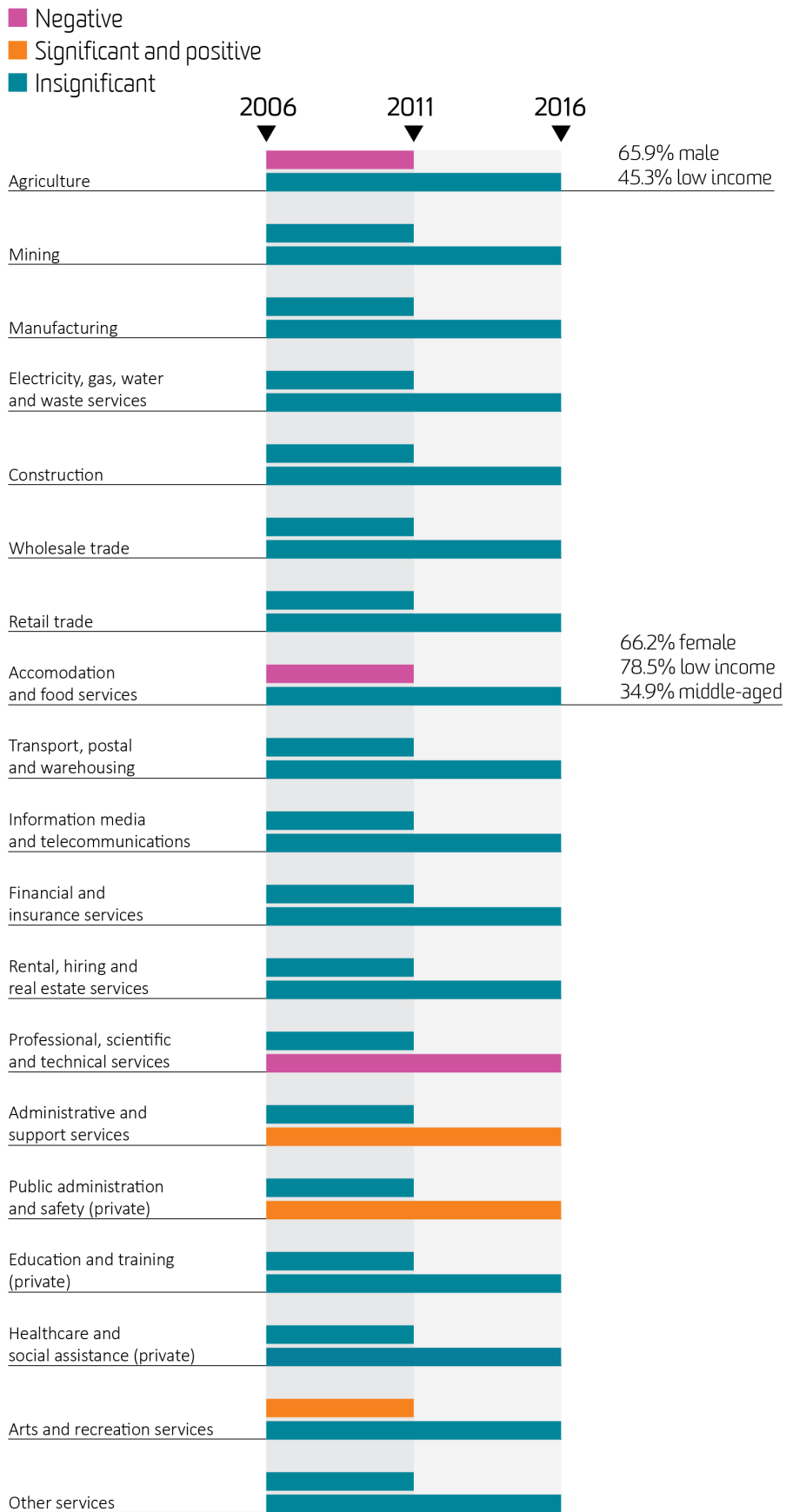
The adverse effects on agriculture, forestry and fishing can be explained by the extent and severity of the Black Saturday bushfires. Given the size of the bushfires, it is plausible to assume that some crops were lost or left unattended during the fires. In addition, livestock losses amounted to 11,000 heads during the bushfires and would have contributed to the overall decline in the sector (see Stephenson, 2010). Moreover, severe bushfires would inhibit resources of an enterprise operating in the forestry industry as the sector highly relies on logging.

Turning to accommodation and food services, part of the tourism sector, the local communities were unavoidably affected by the Black Saturday bushfires. There is significant anecdotal evidence that the bushfires afflicted rural enterprises, such as bed and breakfasts and short-period rental properties, with reduced tourism and business. This would also mean that individuals who were employed in service jobs in these businesses, including part-time employees, lost either employment or work hours until the economic activity resumed fully.

It must be noted that the 2.5 years of time between the Black Saturday bushfires and the 2011 Census may affect our findings. During this time, some demographic groups or sectors may have recovered. Thus, effects picked up are likely to be for those who were severely affected.



**Figure 3 Overlaying Sectoral and Demographic Results**



Note: Percentages reflect baseline year (2006) sector compositions



For example, economic theory suggests that construction may initially experience a boom following a disaster as reconstruction efforts are undertaken. This would boost income for individuals employed in this sector. In Black Saturday bushfires-affected areas, however, we observe relatively limited evidence of increased income in the construction sector. Even though our point estimate is positive, implying a 6% increase in individuals' income in the sector, it is not statistically significant. It might have been the case that the construction sector boomed immediately as a result of the recovery efforts, and then levelled off until the 2011 Census. Supporting this interpretation is the evidence that our medium-run estimate (i.e. 2016) implies no difference in construction income compared to that in the control group.

All of this underscores the need to go beyond the overall results to understand how disaster-induced shocks interact with social and economic dimensions that influence an individual's economic resilience to disasters.

### **Socioeconomic vulnerabilities are concentrated in certain demographic groups and sectors of the economy.**

Our sectoral results are useful to illustrate where some of the socioeconomic vulnerabilities to disasters lie. In a visual representation, Figure 3 overlays some of the demographic groups and employment sectors. The income losses accrued by the agriculture and accommodation sectors seem to explain the losses we estimated for females and low-income individuals. It is particularly evident that the accommodation and food services sector employs a significant number of low-income earners and females. This sector is characterised by a high level of casual employment and lower earnings potential than other sectors. This means that disaster-driven losses cannot be easily absorbed by the workers in this sector given their relatively weak financial capacity.

A useful contrasting finding is related to high-income earners. Our findings highlight that high-income earners also experienced significant income losses as of the 2011 Census (-7.3%, A\$4,382). However, they were able to return to their pre-disaster income levels as of the 2016 Census. By contrast, low-income earners exhibited persistent income losses in the 2016 Census. This finding suggests that the high-income earners are likely to be more economically resilient than low-income earners in terms of ability to return to their pre-disaster income trajectory. The key implication of our findings is that certain demographic groups present acute socioeconomic vulnerabilities to disasters.

### **Government disaster relief and recovery programs have a role to play in supporting individual economic resilience to, and recovery from, disasters.**

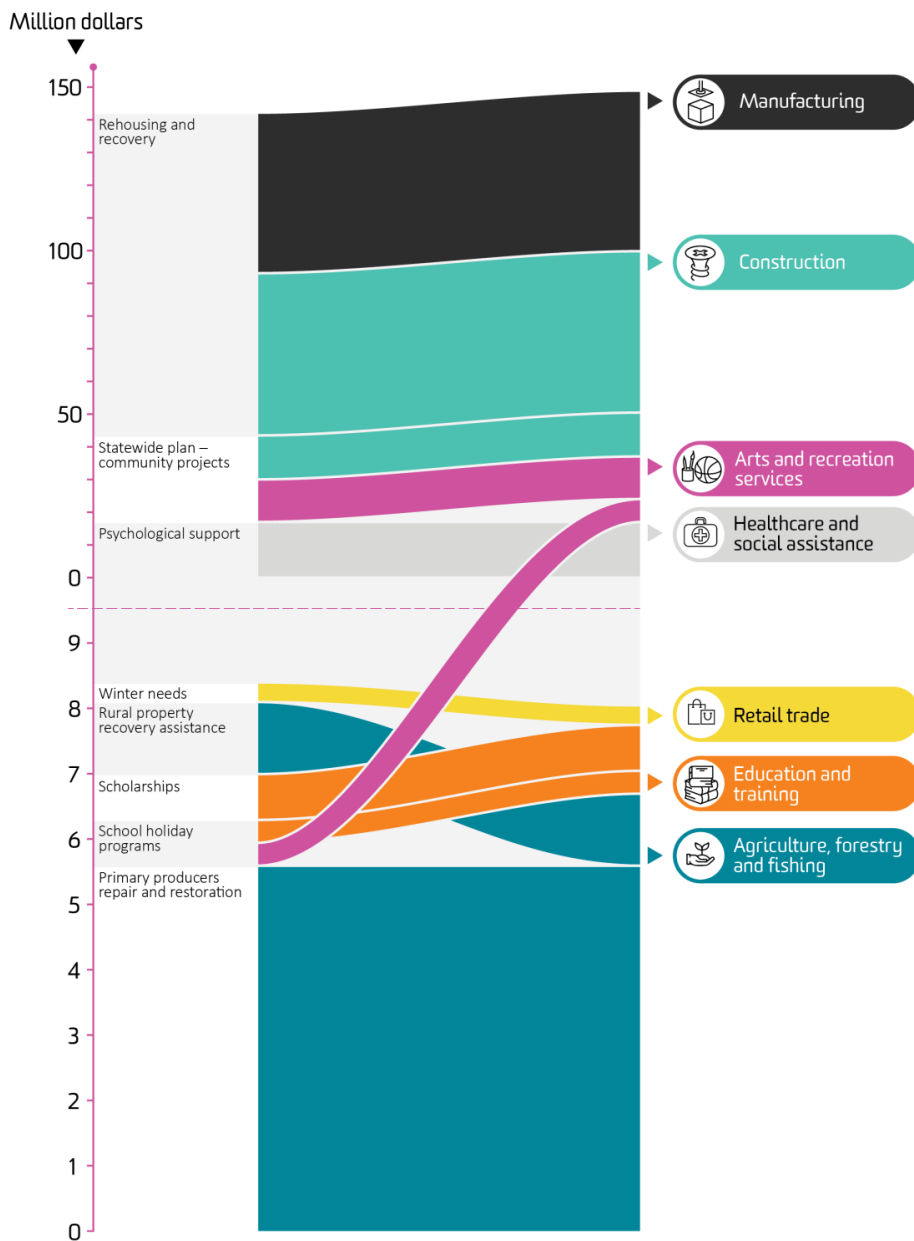
While other market-based recovery means such as insurance payments are available, sovereign interventions are generally the first available and are essential for alleviating the disasters' financial and cognitive burdens and expediting the economic recovery. To ensure a successful rebound, well-designed recovery and relief programs, targeted at both public domain and individual economic wellbeing, are the principal way forward.

Due to data limitations, we were unable to directly assess in our economic modelling whether the substantial government relief and recovery programs played a role in mitigating or reducing the effects of the Black Saturday bushfires.



However, Figure 4 attempts to establish some links between government disaster recovery efforts and subsequent economic activity in different sectors. These recovery programs include, among others, rehousing and recovery, state-wide community projects, psychological support, scholarship, school holiday, and primary producer repair and restoration. Mapping these programs onto economic sectors reveal the beneficiary sectors as: manufacturing, construction, arts and recreation, health care and social assistance, retail trade, education and training, and agriculture, forestry, and fishing.

**Figure 4 Government disaster recovery packages that stimulate economic activity in industry sectors**



Our estimated income results indicate that the recovery programs may not have been sufficient for the agricultural sector given that our economic modelling still identifies persisting negative income effects for this sector. We also infer that the programs may have muted otherwise negative effects accruing to



manufacturing and retail trade sectors given that we estimate insignificant income changes for these sectors. Finally, with some positive income effects identified, there is some evidence that the construction and arts and recreation sectors may have benefitted from the relief and recovery efforts.

## **THE WESTERN AUSTRALIAN TOODYAY BUSHFIRE 2009**

**We find that Toodyay bushfire 2009 did not adversely affect the overall income trajectory of individuals who were in the labour force in 2006.**

We find that the Toodyay bushfire did not adversely affect the *overall* income trajectory of the workforce residing within Toodyay in the 2006 Census period. In other words, the changes in incomes of the bushfire-hit residents between 2006 and 2011 censuses are not statistically different than the changes observed in individual incomes in our control groups -Northam and Chittering-, which are comparable areas not struck by the disaster. This finding can be attributed to the relatively smaller size of the bushfires and/or the 2.5 years of time interval between the Toodyay bushfires 2009 and the 2011 Census. Another explanation is that, Toodyay residents continued to access neighbouring unaffected areas for work, which is likely to have contributed to reducing or eliminating any persistent income losses they would have experienced otherwise.

### **Low-income earners and female employees are vulnerable to bushfires**

Consistent with the existing literature, low-income earners seem to be the most vulnerable groups to the Toodyay bushfire, given that they seem to have experienced some income losses. It also emerges that females are more vulnerable than males given the relatively weaker income change they experienced compared to males.

### **Government disaster relief and recovery programs play an important role in supporting regional economies recover from disasters**

The Shire of Toodyay following the disaster was provided with \$1.7M worth of recovery assistance over the subsequent three-year period. While these recovery packages may have helped an average person, hence explaining the statistically insignificant effect, financially vulnerable demographic and income groups within the community seem to have suffered income losses.

Even though other market-based recovery means such as insurance payments are available, insurance uptake in Australia is rare, with significant rates of under-insurance or no insurance compared to residential insurance (Insurance Council of Australia, 2015). This makes small regional communities particularly reliant on government disaster relief and recovery efforts.

As the income losses arising from the Toodyay bushfire are net losses, this means that the significant post-disaster government relief and recovery efforts could not fully mitigate the disaster's impact on incomes of low-income individuals in the medium-term.

However, as with many natural disasters, government support to reconstruction and rebuild have been critical to support community recovery and in the case



of Toodyay, we consider that without government prioritisation of economically critical rebuilding efforts, it is likely that income losses for low income individuals would have been far greater.

### **Economic impact analysis requires a larger sample size**

The size of our benchmark sample includes a total of 447 observations in treatment and control groups in 2006 and 2011. This is relatively small to obtain precise estimates for income losses, as small samples may result in high standard errors. Thus, we refrain from making statements about the amount of income losses in this report. However, we believe that the direction of the effects found (such as negative income effects for low-income groups) is informative. Income is an important determinant of economic wellbeing, so future studies should obtain larger and representative samples to offer precise estimates for income changes.

## **TROPICAL CYCLONE OSWALD 2013**

### **Cyclone Oswald caused substantial income losses for small business owners in Bundaberg, North Burnett and South Burnett regional councils**

As a result of Cyclone Oswald 2013, small business owners in the Burnett River catchment area LGAs suffered 45.3% income losses, or average income losses of \$21,000 AUD. Based on small business numbers at the time, this equates to overall income losses of at least \$78.2 million.

Given the heavy representation of agricultural small businesses in these areas, these losses reflect the sensitivity of the agricultural sector to disaster-induced economic shocks. They are also consistent with other economic estimations of Cyclone Oswald's impacts on the Burnett region, which put the agricultural losses at \$265 million in Bundaberg and North Burnett alone (Queensland Government, 2018).

### **Small businesses in regional economies are vulnerable to the cascading effects of disasters owing to the composition of their workforces and economies**

It is already well known that disasters can have knock-on effects on supply chains, production and sales. For regional communities, such effects are more amplified, particularly in socioeconomically disadvantaged regional areas with less diversified or more disaster-sensitive economies, and whose workforces often live locally. For small business owners, this means they are often hit "twice" by disasters (Bannock, 2005), which is reflected in the experiences of small and medium enterprise owners in other major disasters like Cyclone Yasi (Kuruppu et al., 2013).

Consistent with these broader trends, our economic profiling reveals that most of the Burnett River region's employed residents (94%) work locally, with disaster-sensitive agricultural and construction businesses – the predominant small business enterprises in these areas.



Compared to other areas in Australia, communities in the Burnett River catchment council areas<sup>3</sup> have been assessed as having low capacity to cope with and adapt to disasters arising from natural hazards (Parsons et al., 2019), which would have flow-on consequences on the ability of small businesses to return to “normal” levels of business activity when disasters strike.

Here, we note that Cyclone Oswald caused widespread damage in the region, with 2,000 houses damaged in Bundaberg alone. Apart from business disruptions, small business owners in these areas may have also suffered flood-related damages to personal property. This could delay business recovery where private household repairs are prioritised over reopening businesses and supporting broader economic recovery in the area, which anecdotally appears to be the case in Bundaberg (Insurance Business Australia, 2013).

### **Government disaster relief and recovery programs play an important role in supporting regional economies recover from disasters**

While other market-based recovery means such as insurance payments are available, small business flood insurance uptake in Australia is rare, with significant rates of under-insurance or no insurance compared to residential insurance (Insurance Council of Australia, 2015). In this setting government disaster relief and recovery efforts typically step in to support small businesses for recovery.

Cyclone Oswald 2013 government relief and recovery assistance totalled over \$1.53 billion, with approximately \$12 million more directly assisting small businesses. As the income losses arising from Cyclone Oswald are net losses, this means that the significant post-disaster government relief and recovery efforts could not fully mitigate the cyclone’s impact on incomes of small business owners in the medium-term.

However, we consider that government prioritisation of economically critical rebuild efforts is likely to prevent income losses for small business owners from being far greater. For instance, the agricultural losses from Cyclone Oswald in North Burnett and Bundaberg were estimated at \$265 million. Thus, prioritising funding and completion of dredging works at Port Bundaberg before the sugar cane harvesting season prevented further losses to the agricultural sector in North Burnett and Bundaberg, which is predominantly made of small businesses.

### **Small businesses must be part of actions to reduce disaster risks in Australia**

The average annual economic costs of natural disasters in Australia are forecast to reach \$39 billion per year by 2050 (Deloitte Access Economics, 2017).<sup>4</sup> This figure does not take into account climate change, which will see coastal communities in the Wide Bay-Burnett region like Bundaberg increasingly subjected to flooding events and inundation from rising sea levels (Queensland Government, 2011), and thus more costly disasters like Cyclone Oswald.

Our small business income findings illustrate how costly such inundations can be on a small but important section of such coastal communities. Given the

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<sup>3</sup> At the corresponding SA2 areas.

<sup>4</sup> This figure is in 2017 prices and does not consider the impact of climate change.



prevalence of small businesses across industry sectors, and importance for employment, it is critical that small businesses are encouraged to more proactively consider and manage the risks associated with the potential for more extreme weather events like Cyclone Oswald.

We note that with its emphasis on collective action to reducing disaster risks, the Australian National Disaster Risk Reduction Framework 2018 is a step in the right direction.

## QUEENSLAND FLOODS 2010/11

### **We must look beyond overall impacts to understand our socioeconomic vulnerability to disasters**

We do not find a statistically significant *overall* association between the Queensland Floods 2010-11 and the income trajectories of employed residents of the four Brisbane River Catchment Area (BRCA) LGAs.

However, this masks the marked differences we observe between individuals with different demographic attributes, employment characteristics and even areas of residence.

To illustrate, the Queensland Floods 2010-11 were associated with short-term income losses among low-income earners (-10.1%; approx. \$3,100 AUD) residing in BRCA LGAs. This contrasts with gains experienced by middle-income (8.5%; \$3,780 AUD) and high-income earners (5.1%; or around \$3,380 AUD) in the short term. Some of these differences are explained by sectors of employment, which are discussed further below. Most of these income changes are not observed in the medium term (i.e., 2016).

Out of all dimensions explored, the heaviest income losses associated with the Queensland Floods 2010-11 occurred for employed residents of the regional BRCA communities with the least capacity to cope and adapt to disasters. Unlike their metropolitan Brisbane counterparts, where no statistically significant income results were observed, employed residents of the regional Somerset and Lockyer Valley LGAs suffered average income losses of 27.3% (or around \$9,780 AUD) in the first six months following the floods.

These acute individual-level losses highlight the scale of the flood's devastation in these regional councils and the extent of their economic exposure to the disaster-sensitive industries like agriculture.

Importantly, the losses underscore the long and difficult economic recovery period ahead for Somerset and Lockyer Valley residents who faced increased council rates and reduced levels of service following the floods.

### **There are several channels through which disaster-induced economic shocks can be transmitted to individuals**

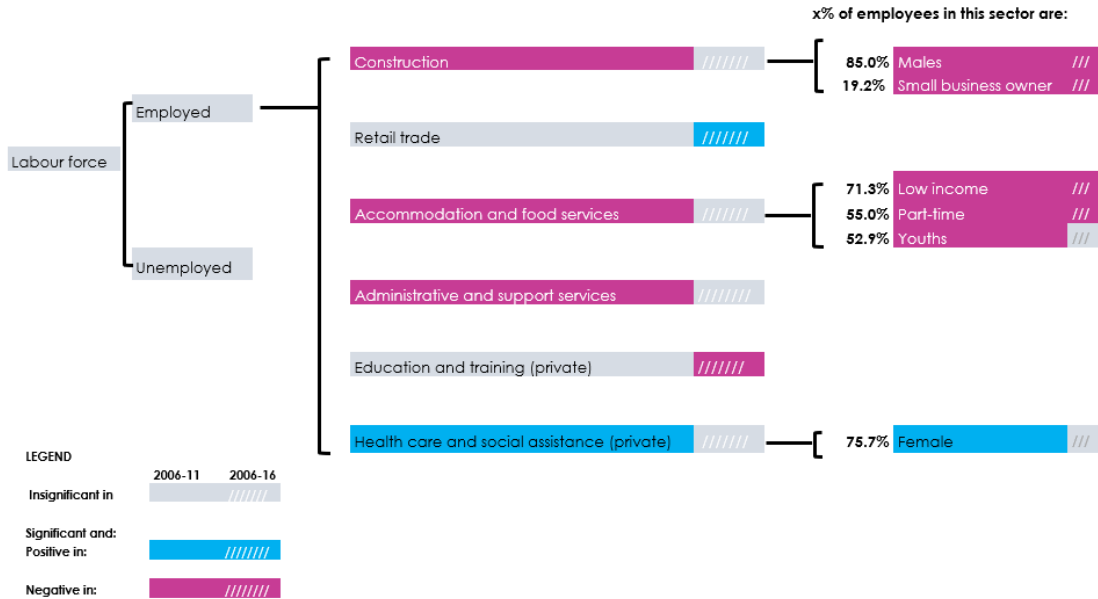
Our results show the likely channels through which disaster-induced economic shocks are transmitted to individuals in the labour force, vis-à-vis income.





Owning a business is one such channel. Regardless of their employment sector, BRCA LGA business owners who suffered significant income losses correlated with the Queensland Floods 2010-11 (FIGURE 5). While average short-term losses were highest for owners of unincorporated businesses<sup>5</sup> (-11.9%; approx. \$5,030 AUD), these findings were not observed in the medium term. In comparison, on average, small business owners experienced losses in both the short-term (-6.1%; around \$3,130 AUD) and medium-term (-9.8%; \$5,350 AUD). Likewise, incorporated business owners experienced income losses throughout the study period (-10.3%; or \$6,030 over 2006-16).

**Figure 5 Statistically significant sectoral and demographic results, by employment sector**



Note: Percentages reflect baseline year (2006) sectoral demographics

Another important channel is part-time employment. Unlike full-time counterparts, whose salaried positions appear to offer an important buffer to shocks, part-time workers include casual workers, and are more susceptible to sudden changes in economic activity, both positive and negative.

The Queensland Floods 2010-11 caused material volatility in labour markets, particularly part-time employment (Queensland Treasury, 2011), and this is reflected in our results. On average, part-time workers in the BRCA LGAs suffered income losses of 5.2% (\$1,820 AUD) in the short-term, and 6% (around \$2,440 AUD) in the medium-term (likely compounded by Cyclone Oswald).

Finally, the sector of employment itself can also play a role, whether through direct exposure to disaster damages (e.g. loss of agricultural production), or increased economic activity induced by the disaster (e.g. hospitals treating an influx of disaster victims). Here, we find that the Queensland Floods 2010-11 were associated with statistically significant income changes for individuals employed in six industry sectors (FIGURE 5), some of which are top employers in the region.

<sup>5</sup> These include sole proprietors and partnerships.



These sectoral results are broadly in line with the widely reported disruptions to economic activity in the aftermath of the floods, and intuitive considering the economic composition of the BRCA LGAs.

To illustrate, it is well documented that following the floods, tourism suffered as tourists initially stayed away from flooded areas, while the retail trade sector economic activity spiked as households replaced flood-damaged household goods (Queensland Treasury, 2011) once businesses reopened.

Associated with this flood-induced economic activity, we observe short-term income losses for workers in the accommodation and food services sector (-8.2%, \$2,740 AUD) and administration and support services sector<sup>6</sup> (-18.2%, \$7,370 AUD), and income gains (13.1%, \$5,500 AUD) for retail sector workers in the medium term.

While economic theory suggests construction may initially experience a boom as reconstruction efforts are undertaken, this will boost individual income where:

- i) such individuals are employed in these efforts, and
- ii) this offsets any income losses from disruptions to usual construction activities these individuals are employed in.

In Queensland and indeed the BRCA, much of the construction activity (and thus a construction worker's income stream) prior to the floods was tied to private dwelling construction which saw significant falls in housing approvals post-floods (Queensland Treasury, 2011). This helps explain the average short-term individual income losses (-9.7%, \$4,950 AUD) for BRCA construction sector workers.

Apart from increased demand for health services following the floods (e.g. hospitalisation), economic activity in the health care and social assistance sector is likely to have been boosted in the short-term by a range of government-led community-focused programs, including ones that focused on alleviating the psychosocial stressors from the floods. This again helps explain the short-term income gains (-9%, \$4,320 AUD) for BRCA health care and social workers.

Importantly, our sectoral results help explain why our gender-based income results run counter to prevailing literature, which suggests that women are more adversely affected by disasters compared to males. Instead, we find that the Queensland Floods 2010-11 were associated with income losses for males in the short (-8.3%, \$4,380 AUD) and medium term (-7.4%, \$4,330 AUD), while females experienced income gains (4.3%, \$1,740 AUD) in the short-term.

The results relating to gender differences were initially surprising, as our female sample is largely comprised of low-income and part-time workers. However, by examining sectors of employment, income losses experienced in the male-dominated construction sector could be behind our overall male income results. Similarly, the income gains for females working in the female-dominated health

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<sup>6</sup> Based on ABS ANZSIC classifications, this sector includes tourism-facing services like travel agency services and tour arrangement services. It also includes employment services which are likely impacted by subdued employment post floods (Queensland Treasury, 2011).



and social assistance sector are likely behind the positive short-term gains reported for females overall.

All of this underscores the need to go beyond the overall results to understand how disaster-induced shocks interact with social and economic dimensions that influence an individual's economic resilience to disasters.

### **Socioeconomic vulnerabilities are concentrated in certain sectors of the economy**

As Figure 5 highlights, our sectoral results are also useful in illustrating where some of the socioeconomic vulnerabilities to disasters lie.

For instance, we find that the floods were associated with short-term income losses among groups such as youths (-7.4%, \$2,940 AUD), low-income earners (-10.1%, \$3,100 AUD) and part-time workers (-5.2%, \$1,820 AUD). Many of these individuals were employed in the accommodation and food services sector, which saw short-term average income losses of 8.2% (2,740 AUD). This employment sector is characterised by a high level of casualisation and lower earnings potential than other sectors. Such losses seem to be disproportionate to the financial capacity of this sector's workforce to absorb them.

The key implication here is that while some sectors might be more economically important (e.g. in gross added value or for state revenue), or more prone to disaster-induced production disruptions (e.g. mining or agriculture), actual and/or acute socioeconomic vulnerabilities to disasters may lie elsewhere and this needs to be considered when developing any economically-focused disaster relief and recovery programs.

### **Government disaster relief and recovery programs have a role to play in supporting individual economic resilience to, and recovery from, disasters**

Due to data limitations, we were unable to directly assess whether the substantial government relief and recovery programs played a role in mitigating or reducing the effects of the Queensland Floods 2010-11.

However, our research suggests that these programs are necessary to reduce any potential income inequalities that may arise from or be widened by these disasters. Here, we note that many of the programs under the Disaster Recovery Funding Arrangements<sup>7</sup> 2018 are already directed at groups that our research suggests are likely to be susceptible to income shocks (e.g. low-income earners, primary producers and small business owners).

With many government disaster relief and recovery programs focused on community outcomes, it is worthwhile examining how economic programs help communities recover in the longer term. Here, the extension of previously implemented wage assistance programs like the Cyclone Yasi program to include part-time employees is likely to help such individuals better cope with disasters when they strike. Likewise, targeting disaster-sensitive sectors where

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<sup>7</sup> Formerly National Disaster Relief and Recovery Arrangements.



socioeconomic vulnerabilities are concentrated may provide a helpful buffer to the most sensitive workforces, particularly those already living on the margin.



## KEY MILESTONES

2020 has seen the completion of our four major case studies. We have wrapped up both the short-term and medium-term findings for both large scale disasters (VIC Black Saturday bushfires and Queensland Flood case studies), the medium-scale disaster (Cyclone Oswald), and our regional, small scale impact Toodyay case study (these reports ranged from 30-100 pages).

In addition, for each case study we have dissected the underlying demographic profiles of the areas hit by each of these disasters, which provided a rich, deep layer of contextual information that enhanced our understanding of the effects these disasters had on the impacted communities. The VIC Black Saturday bushfires demographic profiling analysis has been cited in the CSIRO report to the Prime Minister Morrison on climate and disaster resilience in Australia (CSIRO, 2020).

Moreover, we have summarised the four case studies in policy brief formats (ranging four to eight pages). These policy briefs provide a snapshot of the scope, methodology, findings, and policy implications for each disaster analysis.

Furthermore, we have delivered our other milestones during project completion: a national webinar to disseminate the findings (11 August 2020), a methodology note for the replication of our methodology and to guide future research in the area, and a two-page summary of all findings dissected from each case study, a version of which has also been published in [The Conversation](#).

Finally, we have been very active in disseminating our results in conferences, workshops and media channels. Importantly, we have deepened our relationships with our end-users, and created new connections with other BNHCRC projects and community organisations that play an active role in building community disaster resilience.

## MAJOR MILESTONES

### Research reports for four case studies completed

The project has seen the completion of **four research reports** pertaining to each case study, which have been submitted and approved in June/July 2020:

- *Disasters and Economic Resilience: The Effects of the Black Saturday Bushfires on Individual Income – A Case Study*
- *Disasters and Economic Resilience in Small Regional Communities: the Case of Toodyay*
- *Disasters and Economic Resilience: The income effects of Cyclone Oswald 2013 on Small Business Owners – a case study on the Burnett River Catchment Area*
- *Disasters and Economic Resilience: The Effects of the Queensland Floods 2010-11 on Individual Income – A Case Study on the Brisbane River Catchment Area*



## Demographic profiling for three case studies completed

Natural disaster economic and emergency management literature suggest that certain underlying socioeconomic characteristics can affect a community's vulnerability to natural hazards, and thus its ability to prepare, respond and ultimately recover from disasters (Finch et al., 2010). From the literature we also know that limiting the longevity of income disruptions post-disasters is incredibly important for the mental health of individuals within disaster-affected communities (Gibbs et al, 2016).

For all case studies except for that on Cyclone Oswald, we provided some high-level demographic profiling and descriptive analysis of the disaster affected areas to present a baseline of their overall socioeconomic characteristics, drilling in on particular attributes (e.g. home ownership) to provide further context to some of our more puzzling research findings. The profiling is area-based (either SA2 or LGA, depending on available information) and utilises the ABS Census as the primary data source, in line with project methodology.

For regional communities in particular, where there are challenges in obtaining sufficient sample size for statistical computations, our study reveals that detailed demographic profiling, using publicly available data, could be undertaken as part of disaster risk reduction exercises to help policy makers build disaster resilience and better direct post-recovery interventions to minimise disruptions to important income streams.

For example, in our Toodyay 2009 bushfire case study, a small isolated fire in a regional town, we did not find an overall statically significant effect on income levels. This did not surprise us as, from our demographic profiling, we knew that Toodyay's employed residents – at an SA2 level – mostly worked outside of Toodyay, which naturally limits the fire's effect on income. From a policy perspective, ensuring that these areas remain/are quickly made accessible to community if such disasters were to strike is critical for their longer-term prosperity.

The value of the demographing profiling approach is also demonstrated with a recent citation received to the VIC Black Saturday bushfires from the CSIRO's report to the Prime Minister Morrison on climate and disaster resilience in Australia (CSIRO, 2020). See Table 3 for a summary of demographic profiling analysis.

**Table 3 Summary of demographic profiling analysis**

Case study	State	Highlights
Queensland Floods 2010-11	QLD	The demographic profiling reveals the heterogeneity of the Brisbane river catchment area, which encapsulates regional areas with ageing populations and strong agricultural histories, transitioning economy with a younger population base, and a capital city
Black Saturday Bushfires 2009	VIC	The demographic profiling shows economically significant infrastructure in disaster-hit areas that explains some of the sectoral income losses
Toodyay Bushfires 2009	WA	The demographic profiling reveals work patterns of Toodyay residents and the rapidity of recovery efforts. Shifts away from disaster-sensitive industries (i.e., agriculture and manufacturing) and large percentage of workforce employed outside of Toodyay helped mitigate the income losses.
Cyclone Oswald	QLD	Profiling merged into the research report. A separate profiling was not done.



### Paper published in *The Economic Record*

Our *Floods, bushfires and sectoral economic output in Australia, 1978-2014* paper has been published in the *Economic Record* (of the Economic Society of Australia), the highest ranked economic journal edited from Australia. The paper has been cited in the CSIRO report to the Prime Minister Morrison on Australia's resilience to disasters in relation to differing degrees of disaster impact on sectors.

The paper has gone on to become one of the most popular papers of 2019, being among the top 10% of papers downloaded from the journal that year.

"Your research generated immediate impact," said an acknowledgment from *Wiley*.

In this paper, we found that Australia's sectoral output is more sensitive to floods – Australia lost more than two years' worth of agricultural output during the period 1978 to 2014 due to floods. Bushfires on the other hand do not affect *overall* sectoral output in an *economically* meaningful way, though they do exhibit sectoral effects. The lack of overall effect is likely due to bushfires generally occurring outside of areas of nationally significant economic activity (e.g. cities). The timing of the bushfires in our sample was also generally after harvesting, limiting the potential for more persistent effects on agricultural produce.

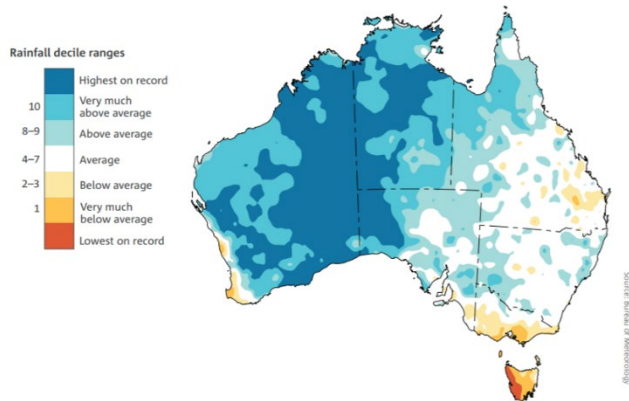
The paper also studies the impact of extreme rainfall and extreme temperature on sectoral output in Australia during the same period. As Figures 6 and 7 indicate, there are strong spatial variations in precipitation and temperature across Australia, which the study exploits to compute the extreme rainfall and extreme temperature volumes. The analysis offers a relatively consistent picture of the output impact of weather extremities in Australia. We find that the Australian mining output is quite responsive to weather shocks, both in rainfall and temperature. Output is sometimes reduced, and other times increased. Also, agriculture benefits from higher-than-average rain in earlier months of the crop cycle, yet it is adversely affected by hotter-than-average months and extreme heat incidents in autumn and summer in Australia. Finally, the least affected sector from weather variations is manufacturing, which is followed by construction and public administration (Ulubasoglu et al 2019, p. 78).

With climate change projected to increase extreme rainfall in Northern Australia and extend the fire seasons in Southeast Australia (Bureau of Meteorology and CSIRO, 2018), there are clear policy implications for this work, as evidenced by interest in this paper from government agencies investigating the impacts of weather events on various economic sectors.

For instance, increased flooding is likely to magnify the effects we observed in our study and exacerbate current well-known weaknesses in our disaster funding arrangements. Historically, insurance payouts have been insufficient to meet natural disaster claims, exerting pressure on fiscal disaster relief expenditure (Commonwealth of Australia Treasury, 2018). In particular, flood insurance premiums are beyond the reach of average households, especially those in high-risk flood areas. In New South Wales, only 2% of these areas have full flood cover, while in Queensland, the figure is 5%. For an average house in these areas, the premium for flood insurance alone can be between \$10,000 and \$20,000, while

other perils in Queensland combined attract an average premium of \$1000 (Munich Re, 2015).

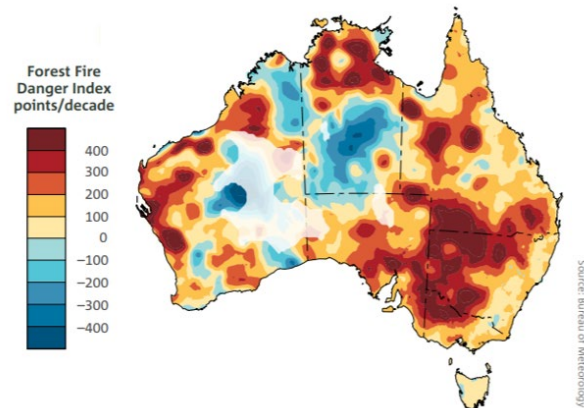
**Figure 6 Rainfall during the northern wet season has been very much above average for the last twenty years**



Source: Bureau of Meteorology and CSIRO (2018)

Additionally, longer fire seasons and more frequent fires in southern Australia may increase the sensitivity of the agriculture sector to bushfires. Policies promoting population and economic expansion in regional areas may also increase the likelihood that a greater share of sectors will be affected by bushfires.

**Figure 7 Fire conditions are worsening, particularly in the south and east of Australia**



Source: Bureau of Meteorology and CSIRO (2018)

### Policy briefs for four case studies completed

Following the completion of the four research reports, we have summarised the scope, methodology, findings and policy implications of the research in policy briefs to improve the accessibility and utilisation of the research. The research reports and policy briefs are available on the BNHCRC [website](#).

### National webinar delivered to sensitise decision makers

On 11 August 2020, we held a webinar over Zoom to a nation-wide audience to disseminate the findings to wider policy community. More than 100 registrations were received, and 53 participants attended the Zoom webinar. The master of the ceremony was Dr John Bates, Research Director of the





BNHCRC, with Mr Ed Pikusa delivering the introductory remarks. Prof Ulubasoglu gave a 20-minute presentation over the scope, objectives, and summary findings of the research. The webinar continued with a Question & Answer session between Dr Bates and Prof Ulubasoglu, with the participants raising about 15 questions and comments through the Zoom platform. The feedback received following the webinar was quite favourable. The [webinar recording](#) is available on the BNHCRC website.

On the same day, a [media release](#) was made by Deakin University's media team to share the webinar and associated commentaries from Dr John Bates and Emma King, CEO of Victorian Council of Social Service (VCOSS), with a wider audience. Finally, the webinar was featured in the Fire Australia magazine, Issue Four, 2020, p. 10.

### Methodology note prepared to guide future research

One of the feedbacks received at the End User Engagement workshop held in April 2018 in Sydney was to make the project methodology available as a separate note for the purposes of replicability and for guiding future research in the area. We have now made this note available as attached to the project.

### Project summary published as an article in *The Conversation*

The project findings, along with the policy implications of the results and a snippet of the project methodology, were published in February 2020 [as an article](#) in **The Conversation**, one of the most widely read and easy-access online platforms globally.

- *Natural disasters increase inequality. Recovery funding may make things worse.*

The article, which was viewed about 3,000 times within the first 28 days after its publication, highlighted the widening income inequality (i.e. who loses and who gains) after disasters in Australia. The article also discussed the ways in which a more sustainable disaster recovery can be built in the light of project findings.

A version of this article has been published in the Australian Journal of Emergency Management "The Unequal Burden of Disasters in Australia" to reach out to a more specific audience in the emergency management sector.

Finally, the project team utilised their learnings from this project on the sectoral structure of the Australian economy to publish **another article in The Conversation**, titled "[Teleworkability in Australia. 41% of full-time and 35% of part-time jobs can be done from home.](#)" in June 2020. As the project completion period coincided with COVID-19 pandemic, it was a timely opportunity to use the learnings in a domain relevant to other hazards and to shed light on the consequent economic recession and the course of the wellbeing of the workforce for the benefit of the broader population.



## UTILISATION AND IMPACT

### SUMMARY

The research phase of our project was completed in the first half of 2019-20. We have worked closely with end-users and potential beneficiaries towards building a clear utilisation pathway for our research. A key avenue for this has been through our quarterly stakeholder engagement reports, which outline our research progression and offer broader trends and insights into natural disaster research that our end-users have found beneficial.

More broadly, we have heavily promoted our research outputs, particularly our Black Saturday bushfires case study, by holding workshops, publishing journal articles and holding media interviews. Most notably, informed by Black Saturday bushfires results, we provided a public submission to the Inspector General-Emergency Management (IGEM) Victoria review of ten years of emergency management reform, picking 3 out of IGEM's 7 themes we think are important to explore as part of this review. Finally, we have shared our project findings in their entirety in a national webinar on 11 August 2020 and through an article published in the Conversation (viewed about 3,000 views in the first 28 days after publication).

We have also actively expanded our utilisation network to incorporate other researchers (e.g. BNHCRC project lead Professor Lisa Gibbs) and community-based organisations with strong utilisation potential, setting us on a solid research utilisation path in the coming year.

### OUTPUT 1 – VIC BLACK SATURDAY BUSHFIRES 2009 FINDINGS

Disasters and Economic Resilience: the effects of the Black Saturday Bushfires on individual income – a case study. BNHCRC Research Report No. 580.

With the major bushfires having struck Queensland and New South Wales during 2019 and 2020 in what is now called the “Black Summer bushfires”, our Black Saturday bushfires results have attracted significant interest from the emergency sector and the media during summer 2019/20.

- Australia bushfires: too early to estimate losses ([International Business Times](#)), Nov 2019
- As a grand-ma-to-be I can no longer stay out of this debate ([Sydney Morning Herald](#)), Dec 2019
- Past research points to potential economic impact of bushfires ([Mirage News](#)), Dec 2019.
- eFM's "This Morning", English-language program in Seoul, South Korea, 8 January 2020, on Australia's summer bushfires.
- Counting the costs of Australia's bushfires ([ABC The Money program](#)), Jan 2020
- Radio interview given to ABC North Queensland, Feb 2020.
- Calculating the losses of this fire season ([Fire Australia](#)) June 2020



Prior to the Black Summer bushfires 2019/20, we presented our findings at the inaugural Centre for Energy, the Environment and Natural Disasters “Expanding the Nexus” workshop in November 2018, which attracted a broad audience, including our end-user IGEM Victoria and representatives from the VCOSS, a primary beneficiary group of our work on the vulnerability dimension of disasters.

We presented our non-peer reviewed paper *Disasters and economic resilience: income effects of the Black Saturday bushfires on disaster-hit individuals* at the AFAC 2018 Conference in Perth and showcased how this research could help in natural disaster risk reduction at the RAF & Northern Australia Fire Managers Forum in Darwin in April 2019.

### Figure 8 Conference and workshop presentations



Prof Mehmet Ulubasoglu, CEEND “Expanding the Nexus” Workshop, Deakin University, Nov 2018



Research Fellow Farah Beaini, RAF Northern Australia, April 2019

In addition to the above conference/workshops, we shared our findings with public and private sector economists via presentations at Deakin University Department of Economics Advisory Board (August 2019), and at the State Department of Treasury and Finance, Victoria (October 2019).

The project team has also connected with Prof Lisa Gibbs and the project’s research learnings have been incorporated into the “financial capital” aspect of the BNHCRC’s complementary project “Factors affecting long term community recovery”.

### Output description

The Black Saturday bushfires case study models the changes in the income of individuals residing in the disaster-hit areas, relative to a control group of individuals residing nearby disaster-unaffected areas, by demographic and sectoral attributes, in the years following the fires (up until 2011) and in the medium term (up until 2016).

By comparing these changes to a control group (neighbours of neighbouring SA2s), we can understand:

- What the income trajectory would have been had the disaster not struck?
- What was the disaster’s effect on the income trajectory of individuals in the disaster-hit areas?
- The degree to which the disaster recovery and relief expenditures have helped individuals’ income.
- If there was an effect, did it differ according to individual attributes, e.g. their sector of employment, their age, gender, income grouping, etc.?



## Extent of use

We have heavily promoted our Black Saturday bushfires research outputs by holding workshops, presenting at conferences, publishing journal articles, holding media interviews, and direct outreach and engagement activities:

- A citation received in the [CSIRO's report](#) to the Prime Minister Morrison on climate and disaster resilience of Australia (July 2020).
- publication of non-peer reviewed paper *Disasters and economic resilience: income effects of the Black Saturday bushfires on disaster-hit individuals*, accepted and presented as part of the AFAC 2018 Conference (September 2018)
- public submission to IGEM Victoria's review of 10 years of emergency management reform, using the short-term findings to advise on which themes the review should focus on (October 2018)
- presenting the findings at Deakin University's Centre for Energy, the Environment and Natural Disasters workshop: "Expanding the nexus" in November 2018 which attracted a multidisciplinary audience including representatives from Victorian IGEM and the Victorian Council of Social Services (November 2018)
- public dissemination of our findings via the Black Saturday Bushfire ABC "The Money" program media interview which examined the economic and mental health costs of the fires, ten years on (February 2019), and counting the cost of Australia's bushfires (January 2020)
- publication of findings within the Deakin Business Newsroom (February 2019) and December 2019,
- publication of the short-term findings in the Australian Journal of Emergency Management, widely read by the emergency management sector (April 2019)
- shared our findings with public and private sector economists via presentations at Deakin University Department of Economics Advisory Board (August 2019), and at the State Department of Treasury and Finance, Victoria (October 2019).
- inputting our findings and analysis of results into the complementary BNHCRC research project "Factors affecting the long-term community recovery", led by Professor Lisa Gibbs. Our learnings have been incorporated into the "financial capital" aspect of the community framework.



## Utilisation potential

- The model assists decision-makers in discerning the short- and medium-term impacts of disasters on individuals, to enable better direction of income-generating activities in the immediate aftermath of disasters
- The model's use of public data (ABS Census) makes it accessible, robust and replicable by decision-makers outside of academic settings
- The results enable policymakers and organisations involved in disaster resilience and relief activities (e.g. VCOSS and the Red Cross) to better direct relief expenditure and resilience activities towards those who need it the most. Combined with other case studies, these results provide evidence-based, robust information of how disasters of different types, sizes and locational settings impact communities, uncovering which groups and sectors are consistently vulnerable/sensitive to disruptions.

## Utilisation impact

- Our impact has focused on generating awareness and provoking thoughts among the policy and wider community in regard to heterogeneous effects of disasters on different demographic and sectoral groups.
- Our demographic profiling outcomes have been cited in the [CSIRO's report](#) to the Prime Minister Morrison on climate and disaster resilience of Australia (July 2020). There was a good deal of discussion about our findings, chiefly about the unequal income effects of disasters, as well as the amounts of income declines in the area hit by Black Saturday Bushfire as estimated by the project team (Table 16 in the Technical Report).

[Our research report and policy brief were not publically available at the time of the publication of the CSIRO report. Nonetheless this citation to our then-existing output indicates a potential interest into our complete set of findings and the policy implications of our VIC Black Saturday bushfires report.]

## Utilisation and impact evidence

The findings have been utilised and disseminated in the following outputs:

- Natural disasters increase inequality. The recovery funding may make things worse. ([The Conversation article](#))
- *Disasters and economic resilience: income effects of the Black Saturday bushfires on disaster-hit individuals* [non-peer reviewed paper](#) presented as part of the AFAC 2018 Conference in September 2018
- News and views: Black Saturday bushfires: counting the cost ([Australian Journal of Emergency Management](#))
- News and views: The unequal burden of disasters in Australia ([Australian Journal of Emergency Management](#))
- Black Saturday Bushfire's Economic Legacy ([Deakin Business Newsroom](#))
- Black Saturday: the economic costs ([ABC The Money program](#)), Feb 2019
- Counting the costs of Australia's bushfires ([ABC The Money program](#)), Jan 2020



- Australia bushfires: too early to estimate losses ([International Business Times](#)), Nov 2019
- As a grand-ma-to-be I can no longer stay out of this debate ([Sydney Morning Herald](#)), Dec 2019
- Past research points to potential economic impact of bushfires ([Mirage News](#)), Dec 2019.
- Dark Mofo art rebuilding bushfire-devastated Huon Valley in Tasmania ([ABC News](#)), June 2019.
- A radio interview given to ABC North Queensland, Feb 2020.
- Calculating the losses of this fire season (by Radhiya Fanham). Featured the project research in Fire Australia. Issue Two, 2020, pp. 36-37.
- Public submission into IGEM Victoria's review of 10 years of emergency management reform (snapshot below):



Monday, 1 October 2018

To whom it may concern,

**RE: THEMATIC EXPLORATION OF TEN YEARS OF EMERGENCY MANAGEMENT REFORM**

Thank you for the opportunity to provide input into IGEM Victoria's review of emergency management reforms.

Since 2014, Deakin University has conducted natural disasters research funded by the Bushfire and Natural Hazards CRC (BNHCRC). Entitled "Optimising post-disaster recovery interventions in Australia", this pioneering research investigates the economic resilience of individuals within disaster hit areas to determine whether their income levels were able to recover post-disaster, considering demographic factors and sectors of employment. Project case studies include the worst recent natural disasters in Australia's history, including the Victorian Black Saturday Bushfires 2009 and the Queensland Floods 2010/11.

Based on our experience to date in researching the Victorian bushfires and other project case studies, we strongly recommend that the review thoroughly explore the following issues within the identified themes:

Identified theme	Issue to explore
<b>Essential services and meeting basic needs</b>	<i>Tailoring relief support to the specific needs of vulnerable population</i>
<p>We strongly support exploration of this theme. Our research has found significant evidence of different effects on different socioeconomic groups: gender, age, employment status and sector, income grouping, and decision to remain/leave bushfire affected areas. For example, we have found that individuals who migrated out of Victorian bushfire affected areas had significantly higher income losses compared to overall losses incurred by individuals within these areas.</p> <p>The timing and extent of monetary assistance also appear to influence outcomes for different vulnerable groups. For example, renters, who are already identified in natural hazard risk analysis research as being a vulnerable cohort, had more severe income losses than home owners with a mortgage. We note VBAF housing-related monetary assistance in the first eighteen months was predominantly directed towards home owners. There also appears to have been a difficulty in identifying affected tenants quickly (due to real estate property closures and privacy laws) which appears to have delayed direct fund distribution (including release of bonds on destroyed properties) to renters, and urgent repairs being undertaken on bushfire affected rental properties.</p>	
<b>Capacity, capability, responsibility and service delivery</b>	<i>Coordination and collaboration between agencies who respond to emergencies and assist communities recover and rebuild</i>
<p>We strongly support exploration of this theme. Every second counts to save lives, property, critical infrastructure, economically significant assets/industries, and our environment. We believe that up-to-date information and information sharing processes are crucial to effective coordination and collaboration between agencies. Based on our experience in researching natural disasters, despite the extensive damage and costs of the Black Saturday Bushfires, data remains fragmented across agencies. No single agency has been able to provide us with a</p>	



## OUTPUT 2 – QLD FLOODS 2010-11 FINDINGS

*Disasters and Economic Resilience: The Effects of the Queensland Floods 2010-11 on Individual Income – A Case Study on the Brisbane River Catchment Area, BNHCRC Research Report No. 577.*

### Output description

The QLD Floods 2010-11 case study models the changes in the income of individuals residing in the flooded Brisbane River catchment area, by demographic and sectoral attributes, in the immediate months following the floods (up until 2011) and in the medium term (up until 2016), relative to a control group of individuals residing in other Australian metropolitan capital cities. Because of difficulties with isolating other disaster impacts during 2011 and 2016 in treatment and control groups, we issue a caveat in regard to the medium-term findings, nonetheless the 2011 findings inform strong correlations.

### Extent of use

The results have been shared with our end-user, Queensland Reconstruction Authority, as well as the Department of Communities, Disability Services and Seniors, *Queensland*, and Department of Employment, Small Business and Training, *Queensland*. All the three organisations have provided end-user statements and product user testimonials.

### Utilisation potential

- The model assists decision-makers in discerning the short-term impacts of disasters on individuals, to enable better direction of income-generating activities in the immediate aftermath of disasters within a regional setting
- The model's use of public data (ABS Census) makes it accessible, robust and replicable by decision-makers outside of academic settings.
- The results are likely to enable policymakers and organisations involved in disaster resilience and relief activities to better direct relief expenditure and resilience activities towards those who need it the most. Combined with other case studies, these results provide evidence-based, robust information of how disasters of different types, sizes and locational settings impact communities, uncovering which groups and sectors are consistently vulnerable/sensitive to disruptions.

Some excerpts below from end-user statements and product user testimonials point to the utilisation potential of the report:

**Jane Carey**, *Queensland Reconstruction Authority, QLD*

*This research aligns with the goals of the Queensland Strategy for Disaster Resilience and its implementation plan, Resilient Queensland by providing an evidence base to enable a better understanding of the disaster risks faced by communities in the Brisbane River Catchment Area. Findings of this Report highlight how economic impacts of disasters are borne differently by particular segments of the community depending on their demographic attributes, employment characteristics and areas of residence. This research highlights the*



importance of tailored approaches to build economic resilience as a key component of community resilience.

### ***Department of Communities, Disability Services and Seniors, QLD***

The insights gleaned from this report can be used to:

- strengthen relief programs by testing disaster relief planning assumptions
- validate the important role that relief plays in preventing the widening of economic inequality
- validate the role that personal hardship relief provides as an immediate economic stimulus
- inform different approaches to Commonwealth income support and employer wage assistance measures (particularly part time workers) following a disaster
- inform disaster recovery workforce planning and recruitment strategies that deliberately target sectors that experience loss and disruption.

### ***Department of Employment, Small Business and Training, QLS***

The report provides valuable information on the impacts of the Queensland Floods 2010–11 on the small business sector and employment, which helps to understand better the issues affecting small business resilience and recovery.

The report also reinforces the need to support small businesses through post-disaster recovery and may help inform responses to future disasters, including those in other regions throughout Queensland.

This report could be used to inform post-disaster survey design to capture consequential financial losses and psychological stress.

### **Utilisation impact**

Our impact has focused on generating awareness and provoking thoughts among the policy and wider community in regard to heterogeneous effects of disasters on different demographic and sectoral groups.

### **Utilisation and impact evidence**

Our findings, which indicated a widening income gap between low-income and middle- and high-income people following the Queensland Floods, have formed the backbone of the Conversation article published in February 2020. Adding to the evidence of increasing inequality was the finding that small business owners and part-time workers were also adversely affected following floods.

- Findings used in *Natural disasters increase inequality. The recovery funding may make things worse.* ([The Conversation article](#)), February 2020.
- *Unpacking the sectoral income effects of natural disasters: Evidence from the 2010/11 Queensland Floods.* [Non-peer reviewed](#) extended abstract presented as part of the AFAC 2017 Conference in September 2017, Sydney.





**Figure 9 Professor Ulubasoglu presenting at AFAC17 in Sydney.**



This case study has also attracted strong end-user engagement in many ways, chiefly in the form of:

- End user statement and product user testimonials
- End user contribution to the research design in determining the treatment and comparison groups via teleconference and telephone meetings

### **OUTPUT 3 – WA TOODYAY BUSHFIRE 2009 FINDINGS**

*Disasters and economic resilience in small regional communities: The case of Toodyay, BNHCRC Research Report No. 581.*

#### **Output description**

The WA Toodyay bushfire 2009 case study model the changes in the income of individuals residing in a small regional town, by demographic and sectoral attributes, in the immediate years following the fires (up until 2011).

#### **Extent of use**

Our end-user for this case study, OBRM, has shared these results within their wider team to consider in ongoing risk management projects (April 2019).

#### **Utilisation potential**

- The model assists decision-makers in discerning the short-term impacts of disasters on individuals, to enable better direction of income-generating activities in the immediate aftermath of disasters within a regional setting
- The model's use of public data (ABS Census) makes it accessible, robust and replicable by decision-makers outside of academic settings
- Our end-user, OBRM, considers that, with a warming and drying climate, and greater potential for these disasters, our findings could be useful to inform future investment strategies

An excerpt below from end-user statement points to the utilisation potential of the report:



**Tim McNaught**, *Office of Bushfire Risk Management, WA*

*The Shire of Toodyay has made some significant changes in response to the 2009 bushfire. It is hoped such a case study may assist government and non-government organisations with a role in managing the hazards an opportunity to consider measures that may mitigate the impacts of future events. ...I hope this case study can demonstrate a methodology that captures the tangible impacts one event can have over time and may be of interest to other communities faced with similar hazards and potential impacts, ultimately guiding decisions about mitigating the impacts of those hazards.*

### Utilisation impact

Our impact has focused on generating awareness and provoking thoughts among the policy and wider community in regard to heterogeneous effects of disasters on different demographic and sectoral groups. In addition, our findings emphasise that, in a small regional town setting, there might be other alleviation mechanisms, such as commuting to another town for work, which should be taken into account in understanding the income effects.

### Utilisation and impact evidence

The findings have been utilised and disseminated in the following outputs:

- Findings used in *Natural disasters increase inequality. The recovery funding may make things worse.* ([The Conversation article](#)), February 2020.
- Our non-peer reviewed paper, *Disaster and economic resilience in small regional communities: the case of Toodyay*, was presented as part of the 12th Australasian Natural Hazards Management Conference in Darwin in June 2019.
- The same paper was presented at the AFAC19 Conference held in Melbourne in September 2019,
- The same paper was published as peer-reviewed monograph in the [Australian Journal of Emergency Management](#), Monograph 4, December 2019.

## OUTPUT 4 – TROPICAL CYCLONE OSWALD 2013 FINDINGS

*Disasters and Economic Resilience: The income effects of Cyclone Oswald 2013 on Small Business Owners – a case study on the Burnett River Catchment Area, BNHCRC Research Report No. 581.*

### Output description

The Tropical Cyclone Oswald 2013 case study models the changes in the income of **small business owners** residing in the Burnett River catchment area (QLD), by demographic and sectoral attributes, in the immediate years following the fires (up until 2016), relative to a control group of small business owners residing in the Richmond River catchment area (NSW).



## Extent of use

The results have been shared with our end-user, Queensland Reconstruction Authority, as well as the Department of Communities, Disability Services and Seniors, Queensland, and Department of Employment, Small Business and Training, Queensland. All the three organisations have provided end-user statements and product user testimonials.

## Utilisation potential

- The model assists decision-makers in discerning the income effects of disasters on small business owners, to enable better direction of income-generating activities in the immediate aftermath of disasters within a regional setting.
- The fact that the Burnett River catchment area hosts regional/agricultural centres such as Bundaberg suggests that our findings could be used to draw inference for other regional centres of similar economic structure in Australia.
- The model's use of public data (ABS Census) makes it accessible, robust and replicable by decision-makers outside of academic settings

An excerpt below from product-user testimonial points to the utilisation potential of the report:

### ***Department of Employment, Small Business and Training, QLD***

*The report provides valuable information on the impacts of the Queensland Floods 2010–11 on the small business sector and employment, which helps to understand better the issues affecting small business resilience and recovery.*

*The report also reinforces the need to support small businesses through post-disaster recovery and may help inform responses to future disasters, including those in other regions throughout Queensland.*

## Utilisation impact

Our impact has focused on generating awareness and provoking thoughts among the policy and wider community in regard to effects of disasters on small business owners. The key aspect that needs to be emphasised here is the supply chain links between regional and metropolitan centers that the regional welfare rests on and that may get hampered in the aftermath of disasters.

## Utilisation and impact evidence

The findings have been utilised and/or disseminated in the following outputs:

- Natural disasters increase inequality. The recovery funding may make things worse. ([The Conversation article](#)), February 2020.
- *Disasters and Economic Resilience: The income effects of Cyclone Oswald 2013 on Small Business Owners – a case study on the Burnett River Catchment Area.* An abstract accepted for the AFAC 2020 (Adelaide), 25-27 August 2020, but the event was cancelled due to COVID-19.



- A poster titled under the same name above submitted to the BNHCRC on 22 June 2020.

## OUTPUT 5 – DEMOGRAPHIC PROFILING

### Output description

For each case study, we provide some high-level demographic profiling and descriptive analysis of the disaster-affected areas.

The profiling utilises the ABS Census as the primary data source (in line with project methodology), at either a SA2 or local government area (LGA) level, depending on available information. It also relies on official government reports for disaster-related statistics.

The reports explore certain underlying socioeconomic characteristics which natural disaster economic and emergency management literature suggest can affect a community's vulnerability to natural hazards, and thus its ability to prepare, respond and ultimately recover from disasters.

### Extent of use

The demographic profiling has been forwarded to each of our end-users, complementing our findings in our research reports, and providing a clearer understanding of the underlying reasons for some of our more curious results.

### Utilisation potential

For regional communities in particular, where there are challenges in obtaining sufficient sample size for statistical computations, our study reveals that detailed demographic profiling, using publicly available data, could be undertaken as part of disaster risk reduction exercises to help policy makers build disaster resilience and better direct post-recovery interventions to minimise disruptions to important income streams.

### Utilisation impact

Our impact has focused on generating awareness and provoking thoughts among the policy and wider community in regard to heterogeneous effects of disasters on different demographic and sectoral groups.

### Utilisation and impact evidence

Our Black Saturday bushfires demographic profiling outcomes have been cited in the [CSIRO's report](#) to the Prime Minister Morrison on climate and disaster resilience of Australia (CSIRO, 2020). There was a good deal of discussion about our findings, chiefly about the unequal income effects of disasters, as well as the amounts of income declines in the area hit by Black Saturday Bushfire as estimated by the project team (Table 16 in the Technical Report).



## CONCLUSION

Our research program has spearheaded the investigation of the impact of disasters on individuals' income in disaster-hit areas in Australia. Considering income a key measure of economic resilience and using data drawn from the Australian Longitudinal Census Dataset of 2006, 2011 and 2016, we have examined individuals' income changes in the aftermath of four recent disasters in Australian history: The 2009 Victorian Black Saturday bushfires, the 2009 Toodyay bushfires, the 2013 Tropical Cyclone Oswald, and the 2010-11 Queensland floods. These four case studies represent different hazard types (i.e. floods, bushfires, cyclones), in different parts of the country (i.e. metropolitan, regional, small town), and covered different scales (i.e. catastrophic, medium-scale, and small scale). Our analysis has determined whether individuals' income levels were able to recover post disaster in the short and medium term. Our examination also considered the income changes with respect to demographic factors and employment sectors. Our research helps illustrate how these events—of different types and scales—impact and ripple through communities and the broader economy over time.

The project has completed **four research reports** pertaining to each case study in June/July 2020. The project has also delivered **four policy briefs** summarising each report, in particular, their scope, findings, and policy implications for disaster recovery programs. The project also produced **demographic profiling** analyses, which helped check the research design assumptions as well as to put the results into context. The findings from these four case studies were disseminated to a nation-wide audience through a **Zoom webinar** on 11 August 2020, and the feedback received was overwhelmingly positive.

In an earlier phase of the project, during 2014-15 the project studied the nation-wide impacts of floods and bushfires and their effects on economic sectors in Australia. This phase made use of national accounts data from six Australian states over the period 1978-2014 for an exploration of whether and how disaster shocks as well as extreme weather (i.e. precipitation and temperature) impacted the course of sectoral activity in the overall Australian economy. The study has been published as a **journal article** in the **Economic Record** (the flagship journal of the Economic Society of Australia). This article was amongst the top 10% of the downloaded papers from the Economic Record in 2019.

The project period has also made strong **media engagement** about its findings. These media outputs included, two articles in The Conversation, several radio interviews regarding the economic impact of bushfires (including two at ABC Radio National “The Money” program with Richard Aedy, ABC North Queensland, South Korean eFM), a number of newspaper articles, quotations and citations, several media releases made by the media team at Deakin University, and two magazine articles in ‘News and Views: Australian Journal of Emergency Management’ and two in Fire Australia.

The project's findings are novel and informative. **The research revealed additional costs that would not normally be picked by the direct damage estimates.** For example, according to Deloitte Access Economics (2016), the direct total (tangible and intangible) damages of the 2009 Black Saturday bushfires were \$7 billion. However, our research has found that, following the



Black Saturday bushfires, agricultural employees who lived in the fire-ravaged areas lost an average of A\$8,000 in annual income for the next two years. Employees in the accommodation and food services industries lost an average of A\$5,000.

**This research also found that the burden of lost income as a result of the disasters is not borne equally.** That is, the income gap routinely increased after disasters. For example, following the 2010-11 Queensland floods, the difference between those on low and middle incomes in the Brisbane River Catchment area increased by about \$7,000 a year.

In general, low-income earners, small-business owners and part-time workers are more likely to lose income following a disaster. Middle and high-income earners, full-time workers and owners of larger businesses are far less likely to lose income; indeed, they might even earn more. This means that natural hazards can widen the income divide among income groups.

Moreover, it is also found that certain demographic groups exhibited lower economic resilience in returning to their pre-disaster income levels following disasters. In the wake of the Victorian Black Saturday bushfires, low-income individuals and the female workforce experienced lower income levels, but this income decline persisted until 2016. This finding contrasts with that related to high-income earners, who despite having lost income in the short term, were able to return to their pre-disaster income trajectory by 2016. This suggests that the income divide persisted in the medium term following the Black Saturday bushfires.

Our *Economic Record* article found that Australia's sectoral output is more sensitive to floods. The findings imply that Australia lost more than two years' worth of agricultural output during the period 1978 to 2014 due to floods. Bushfires, on the other hand, do not affect *overall* output in an *economically* meaningful way, though they exhibit sectoral effects.

This research offers important policy implications. To understand individuals' socioeconomic vulnerability to disasters, the decision makers need to look beyond the aggregate impacts, as we find that socioeconomic vulnerabilities are concentrated in certain demographic groups and sectors of the economy. In addition, both poor and female workforce exhibit lower economic resilience to disasters, in that they may exhibit lower resilience to return to their pre-disaster income trajectory in the medium-term. This highlights the potential for disasters to widen income inequality over time.

Focusing on individuals' income stream enables policy advisers to explore how disaster-induced economic shocks can be transmitted to the labour force via income-earning channels, and offers a greater understanding of how the indirect costs of disaster like bushfires, cyclones and floods are borne by different segments of the working population.

By defining economic resilience to be an individual's ability to return to their pre-disaster income levels, this research helps policymakers better understand the socioeconomics of disasters caused by natural hazards and formulate public policies in a sustainable way that better distributes scarce budgets and resources



towards vulnerable socioeconomic groups and employing industries that are more sensitive to disasters.

## NEXT STEPS

Looking ahead, we expect to disseminate our research reports and policy briefs more widely to public and private organisations in Australia. The potential departments to reach include, Infrastructure Victoria, VIC Department of Health and Human Services, VIC Department of Education and Training, Bushfire Recovery Victoria, Australian Red Cross, regional and metropolitan councils, and universities and other research institutes in Australia.

We also expect to disseminate our findings more widely through media and policy engagement in the next bushfire season to create awareness and provoke thoughts on how Australia can enhance the economic resilience of its communities.

The project team has been engaged in a new project with NSW-based Teacher's Health Foundation in collaboration with Prof Lisa Gibbs. This project will investigate the wellbeing impacts of disasters on school staff during 2020-2021, and our project team is tasked with delivering the economic analysis of the findings. This collaboration is a direct outcome of the current project.

In the coming year, we will also be progressing several working papers. These papers, while strictly outside the scope of our project, nevertheless have greatly benefited from and been informed by our BNHCRC research program methodology and learnings, underscoring the positive externalities that CRCs such as the BNHCRC effect on the quality and relevance of Australian research:

- Onder, Rahman, Ulubasoglu: *The Spillover Effects of Black Saturday Bushfires: A Network Approach*
- Onder, Rahman, Ulubasoglu: *Droughts and Crop Yield in Australia*
- Rahman, Anbarci, Ulubasoglu: *"Storm Autocracies": Islands as Natural Experiments*
- Rahman, Guven, Ulubasoglu: *Floods and Agricultural Productivity: Natural Field Experimental Evidence from Micro Plot-Level Data on Sri Lanka.*

We also believe that this project is the end of the beginning rather than beginning of the end regarding potential research projects in the economics of disasters in Australia.



## PUBLICATIONS LIST

### PEER-REVIEWED JOURNAL ARTICLES

- 1 Ulubasoglu M, Rahman MH, Önder Y, Chen Y, Rajabifard A, *Floods, bushfires and sectoral economic output in Australia, 1978-2014*, 2019: 1-23, Economic record, Chichester, Eng., C1.
- 2 Rahman MH. *Earthquakes don't kill, built environment does: Evidence from cross-country data*, Economic Modelling 2018; 70: 458–468.
- 3 Rahman MH, Anbarci N, Bhattacharya P, Ulubasoglu M, *Can Extreme Rainfall Trigger Democratic Change? The Role of Flood-Induced Corruption*, Public Choice, March 2017;171:331–358.
- 4 Rahman MH, Anbarci N, Bhattacharya P, Ulubasoglu M, *The Shocking Origins of Political Transitions? Evidence from Earthquakes*, Southern Economic Journal, January 2017;83: 796–823.

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2. Ulubasoglu, M. *Disasters and Economic Resilience in Small Regional Communities: the Case of Toodyay*. Bushfire and Natural Hazards CRC Report No. 589. July 2020. <https://www.bnhcrc.com.au/publications/biblio/bnh-7089>
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### METHODOLOGY PAPER

1. Ulubasoglu, M. *Guidance Note for Replication of Case Studies*. Optimising Post-Disaster Recovery Interventions. Bushfire and Natural Hazards CRC.

### POLICY BRIEFS

1. Ulubasoglu, M. *Disasters and Economic Resilience: The Effects of the Black Saturday Bushfires on Individual Income – A Case Study*. Bushfire and Natural Hazards CRC Policy Brief. August 2020. <https://www.bnhcrc.com.au/resources/guide-fact-sheet/7172>
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### DEMOGRAPHIC PROFILING

1. Beaini F, Ulubasoglu M, *Demographic profiling: Toodyay Bushfire 2009 case study*, Bushfire and Natural Hazards CRC, 2019.
2. Beaini F, Ulubasoglu M, *Demographic profiling: Victorian bushfires 2009 case study*, Bushfire and Natural Hazards CRC, 2018. <https://www.bnhcrc.com.au/node/5214>.
3. Beaini F, Ulubasoglu M, *Demographic profiling: Queensland Floods 2010-11 case study*, Bushfire and Natural Hazards CRC, 2018.





## CONFERENCE PAPERS

### Refereed conference papers

- 1 Rahman, M.H., M. Ulubasoglu, P. Bhattacharya, K. Potts, Y. Chen, M. Kalantari and A. Rajabifard (2015). "Natural disasters and economic development: Evidence from Australia", Australian Conference of Economists, 7-10 July 2015, Brisbane.
- 2 Ulubasoglu, M. and F. Beaini. Disasters and economic resilience in small regional communities: the case of Toodyay, [Australian Journal of Emergency Management](#), Monograph 4, December 2019.

### Non-Refereed Conference Papers

- 1 Ulubasoglu, M. *Disasters and economic resilience: income effects of the Black Saturday bushfires on disaster-hit individuals*. AFAC18 (Bushfire and Natural Hazards CRC, 2018).Google Scholar BibTeX XML
- 2 Ulubasoglu M, Onder YK, Rahman MH, *Evaporative Heating: The Negative Income Effects of the Black Saturday Bushfires in Disaster-Hit Areas*, The 2018 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, 5-8 September 2018, Perth.
- 3 Ulubasoglu M, Rahman MH, *Unpacking the Sectoral Income Effects of Natural Disasters: Evidence from the 2010-11 Queensland Floods*, The 2017 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, 3-5 September 2017, Sydney.
- 4 Rahman MH, Chen Y, Potts K, Bhattacharya P, Rajabifard A, Ulubasoglu M, Kalantari M, *Bringing hazard and economic modellers together: A spatial platform for damage and losses visualisation*, 2015, Research proceedings from the Bushfire and Natural Hazards CRC and AFAC conference, Report No. 2015.084, Adelaide.
- 5 Rajabifard A, Ulubasoglu M, Potts K, Rahman MH, Kalantari M, Bhattacharya P. "A pre-disaster multi-hazard damage and economic loss estimation model for Australia", The 2014 Annual Conference of the Australasian Fire and Emergency Service Authorities Council, 2-5 Sep 2014 Wellington.

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2. Fanham, R. *Calculating the losses of this fire season*. Featured the project research in *Fire Australia*. Issue Two, 2020, pp. 36-37.
3. Ulubasoglu M, *The Unequal burden of disasters in Australia*, Australian Journal of Emergency Management, News and Views. Vol. 35. No. 4. October 2020: 8-9.
4. *Economic resilience in the aftermath of natural hazards*. Project webinar featured in *Fire Australia*. Issue Four, 2020. p. 10.

## MEDIA ARTICLES

1. Ulubasoglu, M. *Natural disasters increase inequality. Recovery funding may make things worse*. The Conversation, 27 February 2020. <https://theconversation.com/natural-disasters-increase-inequality-recovery-funding-may-make-things-worse-131643>
2. Ulubasoglu, M. and Onder, Y.K. *Teleworkability in Australia. 41% of full-time and 35% of part-time jobs can be done from home*. The Conversation, 29 June 2020. <https://theconversation.com/teleworkability-in-australia-41-of-full-time-and-35-of-part-time-jobs-can-be-done-from-home-140723>



## TEAM MEMBERS

The project team consists of many stakeholders from a range of organisations. As a BNHCRC project, these stakeholders are categorised into the two groups: researchers, and end user state government agencies responsible or involved in natural disaster policymaking.

### RESEARCH TEAM

#### **Professor Mehmet Ulubasoglu – Project lead**

Professor Mehmet Ulubasoglu is the Head of the Department of Economics and the Director of the Centre for Energy, the Environment and Natural Disasters at Deakin University. Professor Ulubasoglu is one of Australia's foremost experts on the economic impacts of natural disasters, with many years' experience working on these questions with governments in Australia, through his work with the Bushfire and Natural Hazards Cooperative Research Centre, and in South-East Asia with the Asia Disaster Preparedness Centre.

His current BNHCRC research project "Optimising post-disaster recovery interventions in Australia" fills a major gap by estimating economic impacts of several Australian natural disasters on economic sectors and vulnerable groups.

He has published extensively in leading international journals, including the Review of Economics and Statistics, Journal of Development Economics, American Journal of Agricultural Economics, European Economic Review, and American Journal of Political Science.

#### **Ms Farah Beaini – Research fellow**

Farah Beaini was a Research Fellow in the project, and the Industry Program and Research Coordinator at the Deakin Business School's Centre for Energy, the Environment and Natural Disasters. She served in her role until 31 Jan 2020.

Farah brought a wealth of stakeholder engagement and project management experience from her previous state and Commonwealth government roles in digital transformation, service delivery, administrative law and economic research. As part of the BNHCRC project, Farah oversaw the stakeholder management and end-user engagement as the project matured and developed policy briefs. Farah has led research into the demographic profiles of disaster-hit communities, to provide a richer context to the project's research findings.

#### **Other**

In addition to the core research team, Dr Md Habibur Rahman served as a research fellow in the project during July 2014-April 2018. He made significant contributions to project deliverables, including estimations and empirical design in the earlier phase of the project. Habib is currently a Senior Lecturer in Economics at Curtin University. There were also several casual members who contributed valuably to the project by working on the ArcGIS, statistical programming, and performing regression analysis as part of the ABS visits.



## END-USERS

End-user organisation	End-user representative	Extent of engagement (Describe type of engagement)
<ul style="list-style-type: none"> <li>Department for Environment and Water, South Australia</li> </ul>	Mr Ed Pikusa	Direct engagement with the project. Assistance with interpretation of the project results and dissemination of project methodology and findings to broader audience.
<ul style="list-style-type: none"> <li>Emergency Management Australia, Department of Home Affairs</li> </ul>	Marcin Pius	Assistance with interpretation of the overall project results and placing them in emergency management framework in Australia.
<ul style="list-style-type: none"> <li>Queensland Reconstruction Authority</li> </ul>	Dr Mark Drew Ms Jane Carey	Collaboration in research design of the QLD Floods and Cyclone Oswald case studies and assistance with the interpretation of broader project findings.
<ul style="list-style-type: none"> <li>Western Australian Office of Bushfire Risk Management (Department of Fire and Emergency Services)</li> </ul>	Mr Tim McNaught	Collaboration in research design of the Toodyay bushfire case study and assistance with the interpretation of broader project findings.
<ul style="list-style-type: none"> <li>Inspector General of Emergency Management, Victoria</li> </ul>	Ms Julie Hoy	Assistance with the interpretation of the Black Saturday bushfire results and placing them in emergency management framework in Victoria.



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