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ECONOMICS OF NATURAL HAZARDS

Annual report 2018-2019

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The University of Western Australia & Bushfire and Natural Hazards CRC

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ACKNOWLEDGMENTS

We would like to acknowledge our end-users, who have actively participated in the case studies of the project and have brought invaluable input with their comments and feedback. We would also like to acknowledge the BNHCRC for continuous support to the researchers and the opportunity to participate in conferences and forums that are of great value for maintaining and developing relationships and improving the research conducted. We would also like to acknowledge researchers at the University of Adelaide for always including us in their workshops and updates of their DSS applications. Finally, we would like to acknowledge the participants of a focus group conducted at UWA in May 2019 for their invaluable feedback on the survey instrument.

EXECUTIVE SUMMARY

Our project aims to provide information on the economic, social and environmental impacts of natural hazards (tangible and intangible), in order to help hazard managers in their decision making. We investigate the impacts of hazard mitigation on intangible (non-market) values, to shed light on the real (total) costs and benefits of natural hazards.

Our main focus is on developing tools and materials that will provide natural hazards managers with information on the value of mitigation and how intangible (non-market) values affect the costs and benefits of mitigation activities.

Our project will have 4 key outcomes:

1. Provide an online platform for the intangible values database (called the Value Tool for Natural Hazards). The tool will be updated and maintained beyond the project so that managers can easily integrate intangible values in their analyses.
2. Fill major knowledge gaps identified in the literature on intangible values that are affected by the management of natural hazards and improve the value tool with this new knowledge.
3. Develop a Quick Economic Analysis Tool for the evaluation of the (tangible and intangible) costs and benefits of mitigation options that enables managers to conduct economic analyses in weeks rather than months.
4. Create a Free Online Course on the application of economics to the assessment of natural hazard management options.

This year, we have progressed in the 4 outcomes outlined above:

1. A website has been created for the Value Tool. Both the database and the guidelines can now be downloaded from http://valuetoolnaturalhazards.com
   As per the agreement between UWA and BNHCRC, the tool will be freely accessible to end-users and external users. The website also includes the relevant disclaimer information and instructions that users of the tool must agree to comply with.
2. A survey instrument has been designed and road-tested in a focus group for the original non-market valuation study. The next step in this process will be to test the survey in the Shire of York (WA), where we will estimate non-market values associated with cultural heritage and mental health.
3. The draft (Beta) version of the Quick Economic Analysis Tool (QEAT) has been completed. QEAT is currently being improved to include an easy-to-use sensitivity analysis, to be able to perform the analysis of several management options concurrently and to include a summary dashboard where all results are summarised in an easy-to-read manner. These additions are key aspects that our end-users have mentioned in

the past as important to include in a tool such as this one. The Tool now needs to be validated with case studies.

4. Equipment for creating the online videos is being purchased (e.g. green screen for background, microphone and tripod for computer). Filming of the videos will commence in July 2019.

The utilisation outputs from our project this year involved the development and distribution of tools that help natural hazard managers integration intangible (non-market) values in their decision making. The Value Tool for Natural Hazards and the accompanying guidelines are now available online and can be easily downloaded by end-users of the BNHCRC or other organisations. The Beta version of the Quick Economic Analysis Tool (QEAT) is in the process of being improved to include key aspects that were highlighted by end-users as important to include in a tool as this one.

This year there were 4 publications from the project: 3 peer-reviewed and one non-peer reviewed (see Project Publications 2018-2019 section below).

END-USER STATEMENT

Ed Pikusa,
Principal Risk and Audit Coordinator
South Australian Department for Environment and Water

The last year has once again shown the costs of natural disasters to Australia, and the work of the National Resileince Taskforce illustrates how these losses, both financial and non-market, will continue to grow in impact and cost for the foreseeable future.

Choices about mitigation need to be better informed to maximise the benefits to the community for the least overall cost. Much of this cost, some indicate most of it, is not immediately visible. The total cost burden is not well understood beyond direct financial losses. This places many of the intangible and indirect costs on the impacted people. Better recognition and understanding of the non-market losses allow a fuller appreciation of losses, and can open the way to more equitable sharing of losses by society.

This project continues to consist of an engaging and well regarded team of researchers. They continue to deliver what they promise, and also be open to discussing with end users how to improve or blend their new knowledge with other projects, to benefit the sector further.

In the last year, this project has turned the corner from research to product delivery. The website and guidelines on the Value Tool make the outputs of one part of tis research project accessible and transparent for practitioners.

The research team continues to consistently engage with end users in writing and in person through a multitude of publications and forums to ensure the products they are producing are meeting the needs of the sector, and the broader community.

The Quick Economic Analysis Tool, and an update to the Value Tool, are the next products I anticipate will also be well received in the coming months.

PRODUCT USER TESTIMONIALS

Michael Griffith, *Professor of Structural Engineering, University of Adelaide, SA*

"We really like the work you are doing and we need the information from your project to be able to include intangibles in our own economic analyses of earthquake mitigation."

Geoff Morris, *Senior Program Manager - Bushfire, CFA, VIC*

"Your work is very interesting and very necessary for us to be able to conduct comprehensive analysis of mitigation options that include both tangible and intangible values. In Victoria we are just working on doing that at the moment, evaluating the costs and benefits of different mitigation options for bushfires and we will need the type of work that you are doing in our analyses. It would be very good if we could include intangible values in our benefit-cost analyses."

INTRODUCTION

Our project aims to provide information on the economic, social and environmental impacts of natural hazards (tangible and intangible), in order to help hazard managers in their decision making. The purpose of our research is to help emergency service and land management agencies better prioritise their investments in mitigation. Using economic tools and expertise, we assess the impacts of hazard mitigation on intangible (non-market) values, in order to shed light on the real (total) costs and benefits of natural hazards (tangible and intangible) and help agencies better allocate their resources for mitigation.

In previous work with the BNHCRC (2015-2017), we developed a tool for generating estimates of the intangible impacts of natural hazards and the intangible costs and benefits of hazard mitigation (called the value tool). We also produced two integrated economic analyses of management options including intangible costs and benefits: one for floods in Adelaide and one for prescribed burning in private land in the Mount Lofty Ranges of South Australia. In the new phase of the project (2017-2020), we are building on this work and developing tools that will help agencies conduct and utilise more rigorous economic analyses of management options and identify the options that generate the best value for money. These new tools, which consider both market and non-market (intangible) values, will help meet important end-user needs. The intangible values include social, environmental and health related values so that decisions are made to maximise the benefits to society in the management of natural hazards.

BACKGROUND

The Productivity Commission's report released in 2015 (Productivity Commission 2014) on natural disaster funding arrangements in Australia found that governments overinvest in post disaster reconstruction and underinvest in mitigation activities that would limit the impact of natural disasters. Given the multitude of natural hazards that require mitigation and response from government agencies and the tighter budgets at both State and national levels, natural hazards managers are increasingly under pressure to justify the use and allocation of resources for mitigation efforts.

STRATEGIC CONTEXT

Governments need to ensure that the benefits of mitigation justify the costs and that they are getting the best value for money out of mitigation activities. To ensure that government decisions are informed by analyses examining the value for money of different alternatives, more economic analyses are needed in the natural hazards field.

By bringing more economic knowledge into the natural hazards sector, our project is helping address four major issues in the sector:

1. To this date, economic analyses of natural hazard management options remain rare for some hazards (e.g. bushfires) or incomplete in their coverage of the different types of costs and benefits (i.e. intangible values are rarely taken into account).
2. Many (and in some cases the majority) of the benefits from natural hazard management are intangible (or non-market), but they are often excluded from economic analyses.
3. There is a general lack of information to carry out economic analyses and a shift in thinking is needed among land management agencies to ensure that more data is available (and useful) for economic analyses.
4. There is a lack of economics capacity in the sector, which results in government decisions rarely being informed by formal economics analyses.

RESEARCH APPROACH

The focus of this project is on developing tools and materials that will provide natural hazards managers with information on the value of mitigation and how intangible (non-market) values affect the costs and benefits of mitigation activities. This information will help managers in their decision making and resource allocation. The aim is that our end users will be able to use the tools without the need for continuous assistance from researchers.

There will be 4 outcomes for our project:

1. ONLINE PLATFORM FOR THE VALUE TOOL FOR NATURAL HAZARDS

Aim: To provide an online platform for the Value Tool that will be updated and maintained beyond the project so that managers can easily integrate intangible values in their analyses.

In the first phase of the project (2015-2017), we developed an intangible values database (called the Value Tool for Natural Hazards), which consists of a searchable excel database of non-market valuation studies that provide dollar estimates of the intangible values that are affected by natural hazards. We integrated these values into benefit-costs analyses and case studies on flood management, prescribed burning, and earthquake impacts. The accompanying guidelines of the Value Tool explain how to use these values in benefit-cost analyses.

In the new phase of the project (2017-2020) this database will be updated, its usability will be improved based on end-user feedback, and we will develop an online platform for the database so that end users can easily access the material through a website.

2. IMPROVE THE VALUE TOOL WITH NEW KNOWLEDGE

Aim: To fill major knowledge gaps identified in the literature on intangible values that are affected by the management of natural hazards.

The development of the Value Tool required an extensive literature review of existing studies measuring the intangible values affected by natural hazards and their management. In undertaking this review, some important knowledge gaps were identified in key areas such as the environment (e.g. ecosystems, water quality) and mental health, as well as a lack of Australian non-market valuation studies specifically related to natural hazards.

To ensure the ongoing relevance of the value tool for natural hazard managers, we will fill the current knowledge gaps identified by conducting an original, nation-wide non-market valuation study.

3. DEVELOPMENT OF A QUICK ECONOMIC ANALYSIS TOOL

Aim: To provide an economic analysis tool for the evaluation of the (tangible and intangible) costs and benefits of mitigation options that enables managers to evaluate and prioritise the treatment options that are likely to provide the best value for money.

At the State and National levels, there is a need for simple and robust tools that help to prioritise treatment options for different natural hazards. Knowing the risk and the treatment options that are available to reduce that risk is only part of the picture. It is also very important to know how costly those treatment options are and, when they reduce the risk, what benefits they create.

We are developing a tool that can link risk, treatment options and their potential effectiveness with economic data in a simple and robust way. This Quick Economic Analysis Tool that will provide a quick overview of the tangible and intangible costs/benefits of mitigation options, permitting economic analyses to be done in weeks rather than months.

4. FREE ONLINE COURSE ON THE ECONOMICS OF NATURAL HAZARDS

Aim: To provide a Free Online Course with training materials relating to the application of economics to the assessment of natural hazard management options.

This Free Online Course will provide natural hazard managers with information on and explanations of the core economics concepts and models that are relevant to natural hazard management. In this course, managers will be exposed to the different economic analysis available and will be taught how to interpret the results.

The course will help natural hazard managers appreciate the importance and challenges associated with intangible values and recognise the data requirements for economic analyses.

PROJECT PROGRESS (2018-2019)

In this section, we summarise the progress on each of the outcomes outlined above for the financial year 2018-2019.

1. ONLINE PLATFORM FOR THE VALUE TOOL FOR NATURAL HAZARDS

The Value Tool for Natural Hazards and its accompanying guidelines are now downloadable via their own website, available at: http://valuetoolnaturalhazards.com.

An agreement has been reached between UWA and BNHCRC, which will make the Tool freely accessible to end-users of the BNHCRC and external users.

Discussions are continuing with the BNHCRC regarding additional programming work that will enable the tool to be used in a more interactive manner online. The Tool will be shifted later to the BNHCRC website as an interactive searchable database. Therefore, the present website will be made live for those with the direct URL to access it but will not be promoted widely at this stage.

The current website also includes the relevant disclaimer information and instructions that users of the tool must agree to comply with.

The value tool has been presented and promoted at:

- the AFAC/BNHCRC conference in Perth,
- the Research Advisory Forum Northern Australia,
- the Research Advisory Forum in Canberra.

2. IMPROVE THE VALUE TOOL WITH NEW KNOWLEDGE

Through the use of the Value Tool in case studies for flood and bushfire management and through numerous discussions with end-users regarding their needs in terms of intangible values, a number of gaps were identified in the Value Tool in the following areas:

a. Ecosystem values, particularly in relation to threatened species values;

b. mental health values;

c. animal welfare values;

d. cultural heritage values; and

e. memorabilia values.

To fill these gaps in information, we are conducting an original non-market valuation study. The study will explore values associated with earthquake mitigation in the Shire of York, WA and we are conducting

the research in partnership with GeoScience Australia, who have a project in York. The study will be able to contribute to some of the known gaps in the Value Tool, particularly for values associated with cultural heritage and mental health.

As part of the original non-market valuation study, a survey instrument for intangible values of earthquake mitigation was developed and shared with the Geoscience Australia team working in York. This survey instrument was tested and discussed in a focus group in Perth in May 2019. This first focus group was conducted with 10 participants from the Perth metropolitan region to brainstorm important intangible values associated with earthquake mitigation, and to road-test the current draft of the survey instrument.

The feedback from the initial focus group will be compiled to refine the scope of the survey with Geoscience Australia. Subsequent focus groups will be held in both York and Perth in the first few months of next financial year (2019-2020) to finalise the survey and begin sampling.

3. DEVELOPMENT OF A QUICK ECONOMIC ANALYSIS TOOL

The draft (Beta) version of the Quick Economic Analysis Tool (QEAT) has been completed. We will distribute the Beta version of QEAT to our end-users in the following months and seek feedback from them. We will conduct meetings/workshops with end-users to update/refine the Tool and present to them the results that can be obtained with the Tool.

The next steps in the development of the QEAT are:

1. Include a dashboard that summarises the results.
2. Include a full sensitivity analysis.
3. Include a dashboard that summarises the sensitivity analysis with graphs and easy to read tables.
4. Add different options for estimating mitigation effects (instead of proportional reduction in damages, use other metrics that might be more readily available within natural hazard management organisations).
5. Discuss the Tool with end-user organisations and collect feedback.
6. Improve the Tool with end-user feedback.
7. Present the Tool at AFAC 2019 conference in Melbourne.

End-users have emphasised that the usefulness of the tool needs to be tested through case studies and that comparing different case studies would be of great value. We will therefore conduct case studies and improve the tool with the organisations involved in them.

4. FREE ONLINE COURSE ON THE ECONOMICS OF NATURAL HAZARDS

For the free online course on the economics of natural hazards, we have a plan with priority needs from our end-users, these include:

- Be able to justify existing or potential investments in risk mitigation
- Prioritisation of investments (supported by strong evidence)
- Costs and benefits of natural hazards and mitigation options
- Understanding case studies and their transferability
- Uncertainty and validity of results
- Including non-market values (NMVs)
- The role of incentives

These priority needs will be included in the course. End-user preferences for how the economic concepts should be presented have been collected and will be taken into account when drafting the scripts of the videos.

Equipment for creating the online videos is being purchased (e.g. green screen for background, microphone and tripod for computer). Filming of the videos will commence in July 2019.

KEY MILESTONES

The milestones completed for the project during the financial year 2018-2019 are outlined below.

POSTER FOR THE 2018 AFAC/BNHCRC CONFERENCE

A poster showcasing the purpose and development of the Quick Economic Analysis Tool was presented at the 2018 AFAC/BNHCRC Conference (see Figure 1).

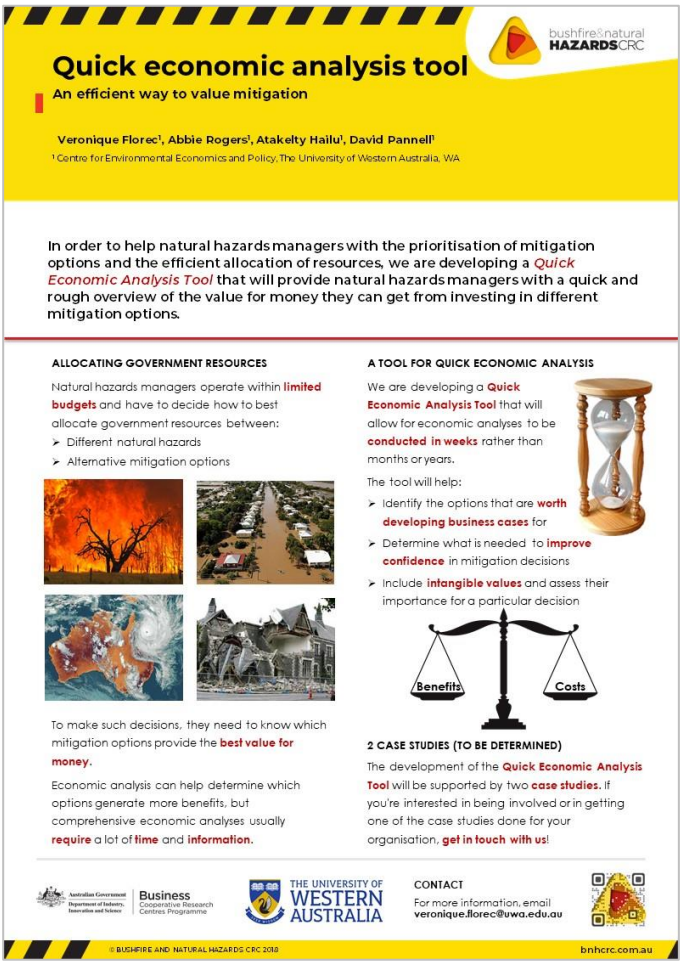

Figure 1. Quick Economic Analysis Tool poster for AFAC 2018

DRAFT SURVEY INSTRUMENT DESIGNED FOR NON-MARKET VALUATION STUDY

A draft of the survey instrument for the non-market valuation study was been developed and sent to Geoscience Australia for comments. The survey instrument focused on cultural heritage and mental health values affected by earthquakes.

BETA VERSION OF THE ECONOMIC TOOL TO EVALUATE TREATMENT OPTIONS COMPLETED

The draft (Beta) version of the Quick Economic Analysis Tool was completed. The Tool now needs to be validated with case studies. We will distribute the Beta version of the Quick Tool to our end-users in the following months and seek feedback from them. We will conduct meetings/workshops with end-users to update/refine the Tool and present to them the results that can be obtained with the Tool. See image of the Beta version in Figure 2.

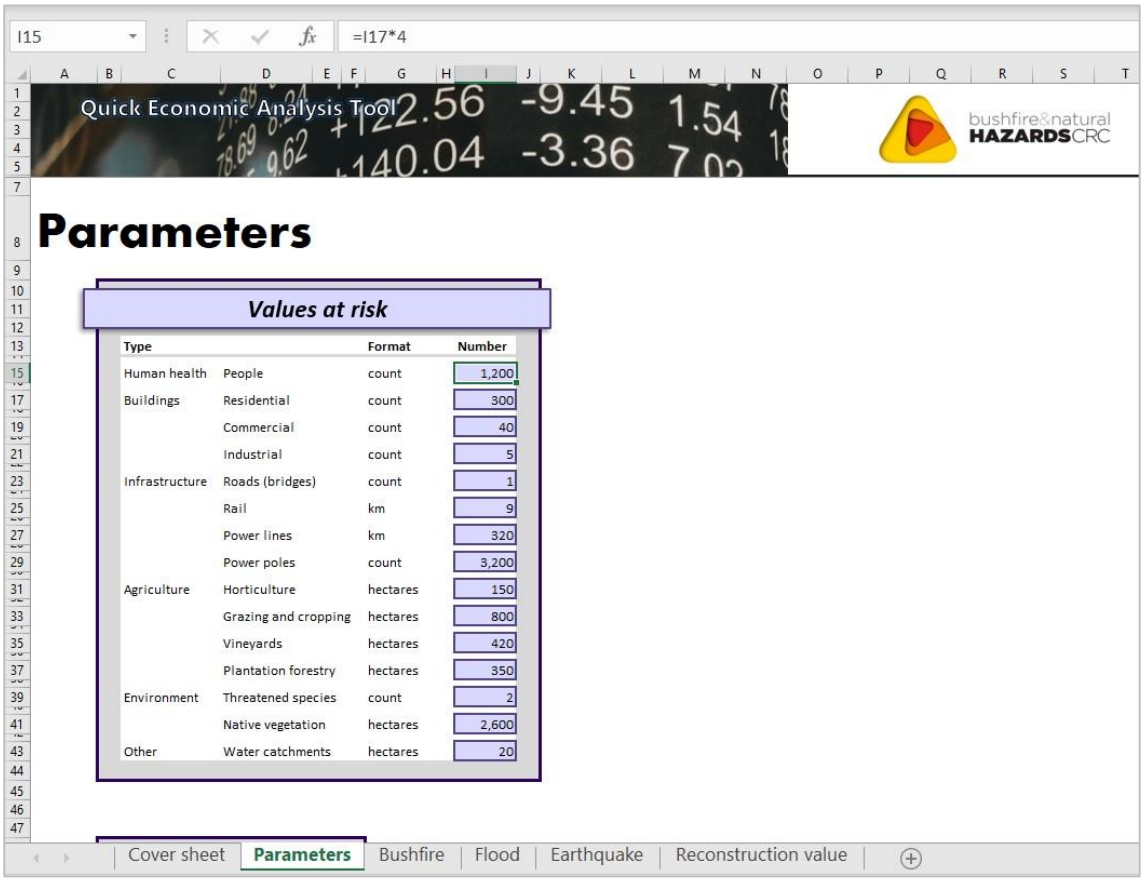

Figure 2. Image of the Quick Economic Analysis Tool

PAPER PROGRESS REPORT TO END USERS

A progress report providing an update on the project was sent to our end-users in December 2018.

MEETING WITH HOLGER AND HIS TEAM TO DISCUSS THE USE OF NON-MARKET VALUES IN THEIR DSS (ISSUES, SUCCESSES AND NEW NEEDS)

We had several meetings during the financial year 2018-2019 with Prof Holder Maier and his team from the University of Adelaide. A report listing these meetings and outlining the key points of the discussions in each meeting was submitted for this milestone.

REPORT ON FOCUS GROUPS CONDUCTED FOR NON-MARKET VALUATION STUDY

The survey instrument developed for the NMV study was tested and discussed in a focus group in Perth in May 2019. This first focus group was conducted with 10 participants from the Perth metropolitan region to brainstorm important intangible values associated with earthquake mitigation, and to road-test the current draft of the survey instrument.

The feedback from the focus group was compiled in a report and submitted for this milestone.

WEBSITE AND ONLINE MATERIAL DEVELOPED FOR THE VALUE TOOL

A website was created to host the Value Tool for Natural Hazards. The Tool and its accompanying guidelines can be downloaded from:

http://valuetoolnaturalhazards.com.

PROGRESS REPORT TO END USERS

Another progress report providing an update on the project was sent to our end-users in June 2019.

UTILISATION OUTPUTS

The utilisation outputs from our project this year include the website created for the Value Tool for Natural Hazards and the Quick Economic Analysis Tool. These two tools can help improve decision making for natural hazard management by assisting managers to integrate intangible (non-market) values in benefit-cost analyses (BCAs) of mitigation options and by giving them a quick overview of the costs and benefits of the different options.

Both tools will further their utilisation potential with the following planned improvements:

1) For the Value Tool, additional programming work wil be done by a programmer hired by the BNHCRC that will convert the tool into a more interactive online searchable database. The Tool will be shifted later to the BNHCRC website in its new format.

2) For the Quick Economic Analysis Tool, further developments to include buttons for selecting the relevant parameters, drop-down menus and a dashboard that summarises the sensitivity analysis with graphs and easy to read tables will significantly increase the utilisation potential of the tool.

PROJECT PUBLICATIONS 2018-2019

Florec, V., Rogers, A., Hailu, A. and Pannell, D.J. (2018) "Filling the gaps: How economics can help make important decisions when information is missing." Non-peer reviewed research proceedings from the Bushfire and Natural Hazards CRC & AFAC conference, Perth, 5 – 8 September 2018.

Florec, V., Burton, M.P., Pannell, D.J., Kelso J. and Milne, G. (2019) "Where to prescribed burn: the costs and benefits of prescribed burning close to houses" *International Journal of Wildland Fire*, published online 3 June 2019. Available at: https://doi.org/10.1071/WF18192

Florec, V., Thompson, M.P. and Rodriguez y Silva, F. (2019) Cost of suppression, in Manzello, S.L. (eds) Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer International, Basel, Switzerland. Edited book will be available in May 2020.

Florec, V. and Milne, G. (2019) "Evaluating the Effectiveness and the Economic Benefits of Fuel Management in the Wildland Urban Interface using Wildfire Simulation." Peer-reviewed research proceedings of the 6th Fire Behaviour and Fuels Conference: Fuels of Today - Fire Behaviour of Tomorrow, 29 April – 3 May 2019, Alburquerque (New Mexico, US), Sydney (NSW, Australia) and Marseille (France). Available at: http://albuquerque.firebehaviorandfuelsconference.com/wp-content/uploads/sites/13/2019/04/George-J-Milne-Marseille.pdf

COLLABORATIONS

We collaborated with Prof Holger Maier and Graeme Ridell (University of Adelaide) to specify the priorities for including non-market values in their DSS and agree on a plan to do so.

We collaborated with leading international experts in the field of non-market valuation, including Professor Robert J. Johnston from Clark University (Massachusetts, US), Professor Peter C. Boxall from the University of Alberta (Canada), and Professor John Rolfe from Central Queensland University, to produce and article entitled "Valuing non-market economic impacts from natural hazards: A review", which has been revised and resubmitted to the journal Natural Hazards.

We collaborated with Joel Kelso and George Milne (from the Department of Computer Science and Software Engineering at UWA) to produce an article entitled "Where to prescribed burn: the costs and benefits of prescribed burning close to houses", which is now published in the International Journal of Wildland Fire.

We collaborated with Matthew Thompson (Research Forrester and Economist, US Forest Service), and Francisco Rodriguez y Silva (Professor, University of Cordoba, Spain) to produce an article on the costs of suppression, which is now published in the Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires.

We have an ongoing collaboration with Professor Kevin Ronan (Central Queensland University) working on the economics of disaster risk education. This collaboration now also includes Dr Ilan Kelman (Reader at the Institute for Risk & Disaster Reduction, University College of London) and Dr Jacob Hawkins from the Centre of Environmental Economics and Policy, UWA.

TEAM MEMBERS

Veronique Florec (project leader)

BA(Econ) Grenoble, France; BA(Econ) Sussex, United Kingdom; MA(Econ) Paris, France; PhD Western Australia, Australia.

After living and studying in Colombia and France, Veronique came to Australia to travel and fell in love with the country. She completed a PhD on Environmental and Resource Economics at The University of Western Australia, investigating the economics of bushfire management in the south-west of Western Australia. Since completing her PhD, Veronique has worked at the Centre for Environmental Economics and Policy at UWA.

Her research focuses on evaluating value for money for investments in natural hazards management. It integrates socio-economic information and technical information about hazard risk, hazard severity and the effectiveness of management options in order to optimise the allocation of available resources for hazard mitigation.

Atakelty Hailu

BSc Alemaya, Ethiopia; PhD Alberta, Canada.

Atakelty is an Associate Professor and the School's Graduate Research Coordinator (GRC). He had a strong and early desire to become a 'scientist' but no interest in economics. That is, until after the devastating (and partly man-made) Ethiopian famine of 1984/5 and until he realised that there was in fact a field of study that put both people and nature (including agriculture) at the centre of it -- Agricultural Economics. He obtained a BSc degree in Ag Econ from Alemaya University (1990). After two years working at Alemaya, he moved to Canada to study for a master's degree at the University of Alberta where he, with the encouragement of his supervisor, ended up pursuing a PhD instead (1998). He then worked as a postdoctoral researcher with the Canadian Sustainable Forest Management Network before joining the University of Western Australia as a lecturer in 2001. Atakelty has received several academic awards, including the Outstanding Doctoral Thesis Award for 1996-1998 from the Canadian Agricultural Economics Society (CAES), and a Chancellor's Gold Medal for his undergraduate academic achievements in Alemaya. His research interests include efficiency and productivity analysis, whole-farm bioeconomic modelling, environmental policy design, and agent-based computational economics.

Abbie Rogers

BSc; PhD Western Australia, Australia.

Having always respected the environment, but recognising that there are limited resources available to manage it, lead me on a path to study a BSc in Natural Resource Management, followed by a PhD in Environmental Economics at The University of Western Australia. Since completing my PhD in 2011, I have worked in the School of Agriculture and Environment and the Centre for Environmental Economics and Policy at UWA, currently as an Assistant Professor in Research.

My primary research interests are in the application of non-market valuation to estimate community values and preferences for environmental conservation and management. This includes applications in the context of marine, terrestrial and aquatic environments. Ultimately, I am interested in improving the application, understanding and accessibility of non-market valuation techniques such that they can be used to improve environmental decision making.

David Pannell

BSc (Agric); BEc; PhD Western Australia, Australia.

David Pannell is Professor of Agricultural and Resource Economics at the University of Western Australia, and Director of the Centre for Environmental Economics and Policy. He was an ARC Federation Fellow, 2007-2012. He has been a prominent commentator on environmental policy within Australia, arguing for policies that better reflect scientific, economic and social realities. He was President of the Australian Agricultural and Resource Economics Society in 2000, a member of the WA Government's Salinity Taskforce in 2001, and a director on the Board of Land and Water Australia 2002-05.

His research includes the economics of environmental conservation; environmental policy; farmer adoption of land conservation practices; risk management; and economics of farming systems. His research has been published in seven books and 200 journal articles and book chapters, and has been recognised with awards from the USA, Australia, Canada and the UK, including the 2009 ARC Eureka Prize for Interdisciplinary Research.

REFERENCES

1 Productivity Commission (2014) *Natural Disaster Funding Arrangements*, Inquiry Report no. 74, Australian Government, Canberra. Released to the public on 1 May 2015.