

FIRE NOTE

TOPICS IN THIS EDITION

- ECONOMICS
- NATURAL ENVIRONMENT

ISSUE 125 JUNE 2014

SUMMARY

Addressing the impacts of climate and global change on fire regimes is one of the most important strategic issues confronting bushfire managers in Australia. This *Fire Note* discusses the findings of research that has investigated future scenarios for Australian bushfires and explored the role of economic evaluation in informing bushfire management and policy decisions into the future.

This project has provided new insights into future bushfire scenarios for Australia, demonstrating that fire activity is likely to increase in mesic (wetter) environments, but decrease in arid environments. Economic evaluation is a potentially useful tool in exploring management adaptation to these changes, but it is currently under-utilised within agencies. Reasons identified for this include: a lack of accessible economic applications; limited economic expertise within agencies and limited broader organisational support for economic evaluations; and policy-related factors affecting the flexibility agencies have in resource allocation decisions. A number of key actions have been identified that will be needed to increase the use of economic evaluation methods, including: (i) increasing the economic expertise among bushfire management and policy professionals, and (ii) designing economic evaluation that connects to the broader social and political context of bushfire management decision-making.

ABOUT THIS PROJECT

This *Fire Note* summarises the final outcomes of the *Economics and future scenarios* project conducted under the Bushfire CRC *Managing the Threat* theme. It is the final *Fire Note* from this project.

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LINKING ASSESSMENT OF FUTURE BUSHFIRE SCENARIOS AND ECONOMICS

CONTEXT

Strong evidence suggests that some degree of climate change is now unavoidable and flow-on consequences for fire activity in Australia are expected. In response to the likely need for climate adaptation within fire management, this research investigated what bushfires might look like in Australia in the future, and the role that economics can play in informing fire management decision-making.

BACKGROUND

An expanding body of scientific literature indicates that by the middle to the end of this century, south east Australia will have experienced significant increases in the frequency of severe fire weather. This will be coupled with an expansion of the rural/urban interface, resulting in increasing risk to environmental, social and economic assets. Adapting to these changes will require new and innovative approaches to land and fire management.

Interest in economic evaluation for informing land and fire management decisions is increasing in Australia, and it is a potentially useful tool in the context of climate adaptation. In particular, economics has a role to play in informing resource allocation priorities, evaluating the efficiency of current and alternative management practices, evaluating changing community

preferences for managing bushfire risk to assets, and in exploring the changing cost-of-impact of bushfires under future climate and fire scenarios. Economic analyses can help guide resource allocation decisions given anticipated rises in suppression costs, increased pressure on monetary resources, and the increasing focus on efficiency and resource-use optimisation.

This project has taken some key steps towards integrating the application of economic analyses in climate adaptation of land and fire management by:

- Providing updated information on the expected changes to Australian fire regimes under climate and global change.
- Engaging with land and fire management agencies on the use of economic information to address climate and global change issues.

BUSHFIRE CRC RESEARCH

The *Economics and future scenarios* project was comprised of two streams. The economics component was led by Dr Helena Clayton and Professor Stephen Dovers, while the future scenarios stream was undertaken by Dr Geoffrey Cary. Each stream had review, research, and end-user engagement phases. This *Fire Note* reports on the outcomes of both sections of the project.

FIGURE 1: RESPONDENTS' PERCEPTION OF PROJECTIONS OF CHANGING COST-OF-IMPACT OF BUSHFIRES CAUSED BY CLIMATE CHANGE

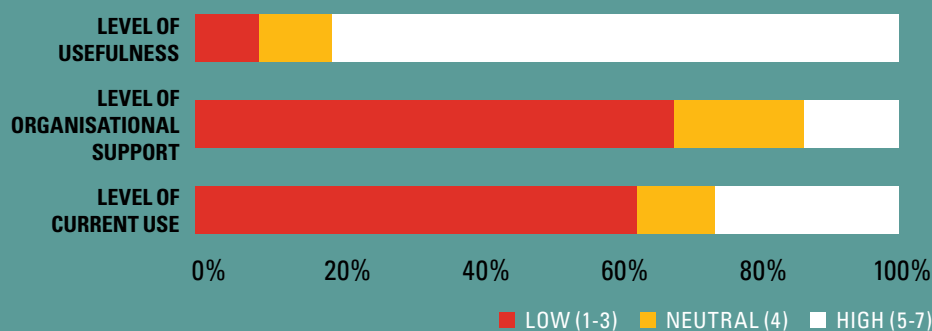
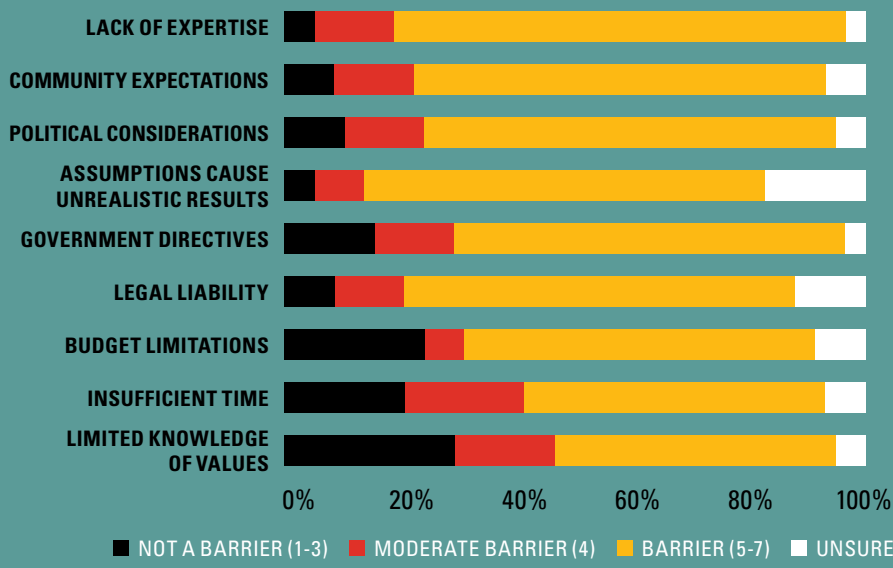


FIGURE 2: BARRIERS TO THE USE OF ECONOMIC EVALUATION IN AGENCIES



REVIEW

In both streams existing literature was diverse and warranted an updated synthesis of recent major findings. Regarding economics, the quantity of published research has recently increased, but was disparate and required critical assessment of its relevance to bushfire policy and management. Therefore, two reviews were conducted, the first considering the full range of economic evaluation methods applied to bushfire management (Clayton *et al.* 2013), and the second specifically focusing on the evaluations of benefits and costs of bushfire management (Milne *et al.* 2014).

Regarding future scenarios, there was a long-standing body of relevant literature that was scattered over a range of disciplines and has continually evolved as climate impact modelling has developed. Cary *et al.* (2012a) have written a contemporary review addressing this.

RESEARCH

Following the review phase, researchers undertook further research to address the key issues raised. Importantly, a key knowledge gap was an understanding of the existing level of use and support for economic evaluations to inform bushfire management and policy decisions. Therefore, a major survey of Australian bushfire decision makers was undertaken to explore the current level of use of, and perceived relevance of, economic evaluations applied to these decisions (Mylek *et al.* 2013; Clayton *et al.* 2014).

Concerning future bushfire scenarios, possible outcomes from interactions among various factors influencing fire regimes (Bradstock 2010) were highly uncertain. To address this, simulation modelling of bushfire dynamics in two contrasting Australian landscapes was undertaken (King *et al.* 2013).

END USER ENGAGEMENT

End user engagement was critical throughout the project, and included convening two

END USER STATEMENT

Understanding changes in demographics, population, vegetation and land use, coupled with how cities, urban/rural interface and rural areas develop, is essential for fire and land management agencies moving forward. If agencies are going to be able to evaluate, using our economic models of the future, a range of decisions that are made with some really long term outcomes, we need to recognise what our environment is going to look like in the next 20, 30 or even 50 years. This comprehension will enable agencies to play a role in influencing land use planning, building codes and other parts of regulated government.

This research is highly regarded because of the fiscal pressures the states and territories are under. It will enable agencies to present long term plans to government and the community with confidence. As end users, we must now develop our capacity to understand which economic frameworks to apply to which question, and how to ensure quality data is sourced for the models to ensure robust outputs.

– Andrew Stark, Chief Officer, ACT Rural Fire Service

workshops attended by lead end users and representatives from a range of fire and land management and research agencies. A future scenarios workshop was held at the Australian National University (ANU) in November 2011 and explored the effects of global change on fire regimes, implications for socio-economic and environmental assets, and potential management and policy responses. Outcomes of this workshop were published in the *Australian*

Journal of Emergency Management (Cary *et al.* 2012b). A workshop on future directions for economic research in fire management was held at ANU in June 2013 to present draft findings from this study and other relevant Bushfire CRC projects, and to discuss the experiences of various agencies investigating bushfire and natural resource economics.

RESEARCH OUTCOMES

ESTABLISHING THE STATE OF KNOWLEDGE

A review of the economics literature (Clayton *et al.* 2013) identified that the economic evaluation methods relevant to bushfire management and policy can be summarised under three key areas:

- (i) Decision-support frameworks (which includes benefit-cost analysis).
- (ii) Institutional and behavioural analysis.
- (iii) Political-economic analysis.

The review highlighted the diversity of economic evaluation methods, each suited to a specific decision setting. Arguably the best known economic methods involve the monetary evaluation of benefits and costs of fire and its management, and this was the subject of an additional review (Milne *et al.* 2013). Both reviews illustrated the versatility of economic evaluation methods and the variety of questions that economics can be used to answer. Given this range, economics has a potentially important role in informing climate adaptation strategies.

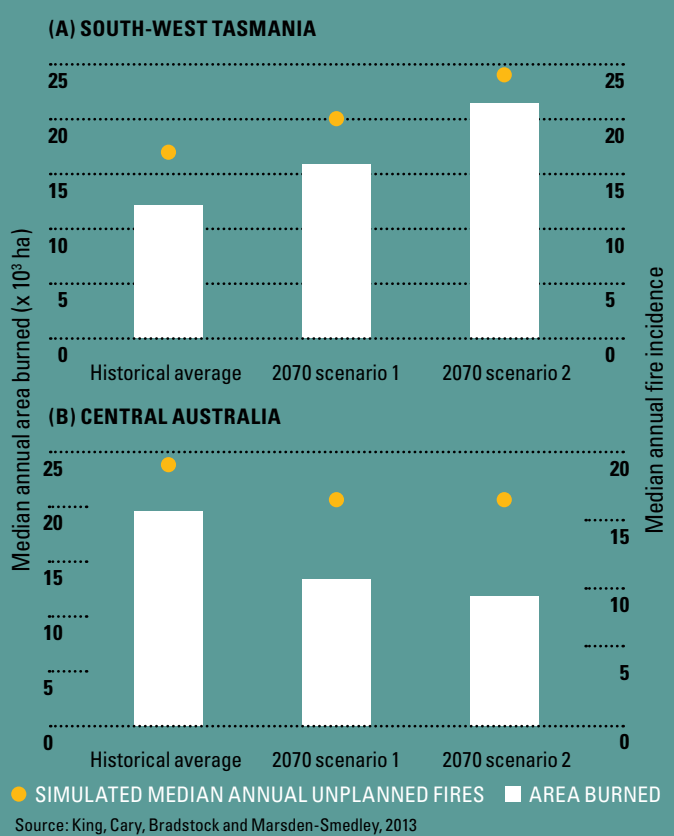
Current understanding of the effects of global change on fire regimes in Australia was synthesised by Cary *et al.* (2012a). This synthesis identified a consensus from existing research for an expected increase in annual summed fire danger index, changes in rates of fuel accumulation and decomposition, changes in species composition, and increases in both natural and human-caused ignitions. The resultant effect on fire regimes will be the product of the interactions between these variables; however, the overall outcome is still largely unclear, partly because in any given ecosystem such interactions can be reinforcing, opposing or unrelated in nature depending on existing limiting factors (Bradstock 2010; Cary *et al.* 2012a).

CRITICAL NEW INSIGHTS

Insights into the needs and barriers to the use of economic information were gained from a survey of 59 managers and policy professionals employed in the fire and emergency services industry across Australia (Clayton *et al.* 2014). The survey asked respondents about:

- Their familiarity with and use of a range of economic information relating to bushfire management.
- Factors that affect their use of and access

FIGURE 3: AVERAGE ANNUAL UNPLANNED FIRE WITHOUT PRESCRIBED BURNING



DEFINITION: ECONOMIC EVALUATION

In the bushfire context, economic evaluation involves analysis of costs and benefits associated with a management or policy proposal or set of proposals. The purpose is to identify which option is likely to deliver the highest social benefits for the budget available. There are a range of economic evaluation approaches that draw upon both quantitative and qualitative data across biophysical, social and economic domains. This study investigated use and relevance of information from six economic approaches or tools identified from the literature as relevant to bushfire management and policy decision-making settings. These were:

- (i) Cost-benefit analysis of bushfire management/policy options.
- (ii) Non-market valuation to identify community values for the outcomes of bushfire management or policy.
- (iii) Cost-effectiveness analysis to identify bushfire management options that provide the highest benefits per dollar spent.
- (iv) Investment decision-support tools to identify bushfire management investment priorities.
- (v) Economic optimisation modelling to identify bushfire management decisions that maximise benefits and minimise costs.
- (vi) Cost-of-impact assessment after a bushfire event to assess the damage costs of the event.

to economic evaluation of bushfire management and policy options.

- Their perception of the usefulness of this information.

As shown in Figure 1 (page 1), the survey found that only 24% of respondents reported a high level of current use of information about the changing cost-of-impact of bushfire under climate change, but that 79% of respondents reported this information to have a high level of usefulness. Emergency managers and policy makers who do not use such tools currently may find the application of them valuable. A majority of respondents perceived that their organisation provided a low level of support to facilitate the use of this kind of information. The survey also explored the respondents' perceived barriers to the use of economic evaluation (Figure 2, page 2), finding that a lack of expertise, or at least familiarity, and knowledge of economic evaluation was the biggest barrier to the use of economic information.

Research was conducted to explore uncertainties surrounding the future scenarios for bushfires in Australia, as well as the research needs and barriers to increasing the use of economic analysis in bushfire management and policy decisions. The future scenarios of bushfires were explored across two environments with contrasting average yearly rainfall (south west Tasmania and central Australia) by King *et al.* (2013), and shown

in Figure 3 (above). Simulation modelling showed that existing limiting factors play a key role in determining the response of the fire regime to climate change. In mesic (wetter) south west Tasmania, where fire is largely limited by fuel availability, an increase in warm and dry weather will likely result in an increase in fuel availability, in turn resulting in an increase in fire activity. In arid (drier) central Australia, where fire is generally limited by fuel amount, an increase in warm and dry weather will cause a decrease in fuel productivity, connectivity and load, resulting in a decrease in fire activity. Further, King *et al.* (2012) explored the interacting effects of changing climate and atmospheric carbon dioxide (CO₂) concentration on grass fuel loads and expected fire intensity in southern Australia under a range of future scenarios.

HOW COULD THE RESEARCH BE USED?

Adaptation to climate change will be an ongoing issue for Australian bushfire management agencies, and economic evaluation is likely to provide much needed guidance for fire management decisions into the future. The outcomes of this research have:

- (i) Contributed to the understanding of what future bushfires might look like.
- (ii) Provided insights into the emerging role of economics in bushfire management and policy.

Results have reduced uncertainty concerning the areas that are most likely to face increases, and in some cases decreases, in fire activity with global change. Adapting to these changes will require the refinement of current approaches or the exploring of alternative management responses and investment priorities. An array of economic evaluation methods can play a role in informing these kinds of decisions. Encouraging wider use of economic evaluation within agencies is likely to increase the capacity of these organisations to deal with the challenges posed by climate and other changes. This project found the relevance of economics extends beyond evaluation of the traditional benefits and costs of bushfire impact and management, and can be used to evaluate policy, institutional and political responses to changing bushfire activity. However, the results from the survey indicate that, despite economic information about bushfire management being considered useful, currently it is not widely used by agencies, and there is limited support within organisations to facilitate use in the near future.

Findings suggest that one avenue for increasing support and encouraging wider use of economic information is to improve the capability of the industry to identify where economic evaluation could best support critical management and resource allocation decisions. Education, training or professional

development could provide the support needed for agencies to increase their familiarity with and use of economic evaluation.

While dealing with economic analysis is a challenge for the industry, there are examples of its application. For example, Gibson and Pannell (2014) applied integrated economic analysis to explore fire risk management strategies and what offered the best value for money with case studies in New Zealand and South Australia. See *Fire Note 124*.

FUTURE DIRECTIONS

Future fire management and policy priorities will be affected by a number of interrelated considerations including changes to:

- (i) Bushfire activity.
- (ii) Consequential risk to social, economic and environmental assets (Gill *et al.* 2012).
- (iii) The influence of macro-level changes such as changing land use or demographics on the assets at risk.
- (iv) The benefits and costs of management responses.

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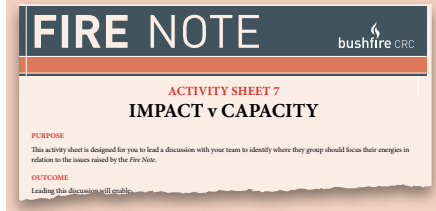
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NOW WHAT?

What three things stand out for you about the research covered in this *Fire Note*? What information can you actively use, and how? Tools are available at www.bushfirecrc.com/firenotes to help, along with activities you can run within your team.



While integrated economic assessment is likely to be useful for supporting the prioritisation of adaptation responses to the anticipated changes in fire activity, this study shows that its use is not widespread. The broader use of economic information and related methods in bushfire management decision-making now and into the future will require increased expertise. Continued collaboration between

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researchers and agencies will ensure the economic evaluations developed and applied are appropriate to the decision-problem and context at hand.

The Bushfire and Natural Hazards CRC has a number of research projects related to economics and strategic decisions. See www.bnhcrc.com.au.

Understanding the economic implications of future scenarios will also require thinking through emerging challenges. This includes understanding individual and social preferences with regard to changing bushfire risk to public and private assets, as well as how organisations and the community will evolve and respond over time to future bushfire risks. For example, Flannigan *et al.* (2009) argue that for some northern hemisphere forest areas experiencing more frequent fire in the future, there could be shifts to greater tolerance of natural fire over large areas, with greater emphasis on protection of assets and resources in a narrower geographic range. Whether or not such re-assessments will occur will depend on social, political, economic and organisational change, with the pathways for such change uncertain.

It is possible that any increased risk arising from changing bushfire activities will at least partially be addressed through market mechanisms, such as through the insurance or real estate market. However, it is also possible that there will be an expanding (and economically justified) role for regulatory policy mechanisms to reduce the burden of changing fire regimes on fire agencies. This could include regulations around the design and location of urban and rural/urban housing developments and the use of fire resistant housing materials. Economics could help to guide future public policy responses by evaluating and comparing the economic efficiency and effectiveness of markets, private investment and public investment in fire risk management as well as other public policy responses (e.g. regulations or education) for meeting social objectives.

Fire Note is published jointly by the Bushfire Cooperative Research Centre (Bushfire CRC) and the Australasian Fire and Emergency Service Authorities Council (AFAC).

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