Background briefings on emerging issues for fire managers from AFAC and Bushfire CRC.

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FIRE NOTE

TOPICS IN THIS EDITION
● ECONOMICS ● NATURAL ENVIRONMENT

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MAKING STRATEGIC CHOICES

WHAT FIRE RISK MANAGEMENT STRATEGIES PROVIDE THE BEST VALUE FOR MONEY?

▲ This research could be used to target bushfire risk management strategies in areas that produce the most benefits per dollar. Here firefighters control a planned burn in the Sydney suburb of Belrose. *Photo: Anthony Clark, NSW RFS*

SUMMARY

Fire managers have to face a multitude of competing priorities when considering how to reduce losses from future fires. With limited funds, an increasing population to protect from bushfire, and more people living in bushfire-prone areas, fire managers face a significant resource-allocation challenge. Knowing which risk-mitigation strategies provide the best value for money is therefore potentially of great benefit. This study used quantitative analysis that integrated information about risk, management strategies, costs, and values in a spatial context, with high levels of stakeholder consultation. The results highlight the fire risk management strategies (including prescribed burning) that are likely to produce the highest benefit per dollar spent.

Two different case studies were undertaken: Central Otago, New Zealand, and Mount Lofty Ranges, South Australia. Results show that various bushfire risk management strategies have potential to generate benefits when applied in a targeted way. In general, strategies that require implementation over large areas have high costs and are unlikely to provide value for money unless they can generate exceptional levels of fire prevention. The majority of benefits were generated from strategies that were applied within or close to the valuable assets.

Note that these were specific pilot studies and generalisations about prescribed burning for other areas and circumstances should not be drawn from these studies. Both studies show that the methodology works, and it can be used to provide valuable decision-making inputs to fire management programs.

AUTHORS

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CONTEXT

The research investigated the value for money of prescribed burning in two case study locations. In Central Otago, New Zealand, the aim was to evaluate a range of fire-prevention strategies (including prescribed burning) in different parts of the region. In the Mount Lofty Ranges, South Australia, the focus of the analysis was on selecting the locations and areas of prescribed burning that provided benefits greater than costs.

BACKGROUND

Following the Victorian Black Saturday bushfires and the subsequent Victorian Bushfires Royal Commission, there has been increased attention to prescribed burning as a strategy to reduce bushfire impacts. Prescribed burning is likely to have both positive and negative impacts. It costs money, is inherently risky and requires expert management in planning and execution. On the other hand, there can be offsetting benefits for life and property by reducing the risk of catastrophic fires. The challenge is to quantify these pros and cons appropriately. The appropriate balance between pros and cons may be different in different places and different times, depending on local conditions.

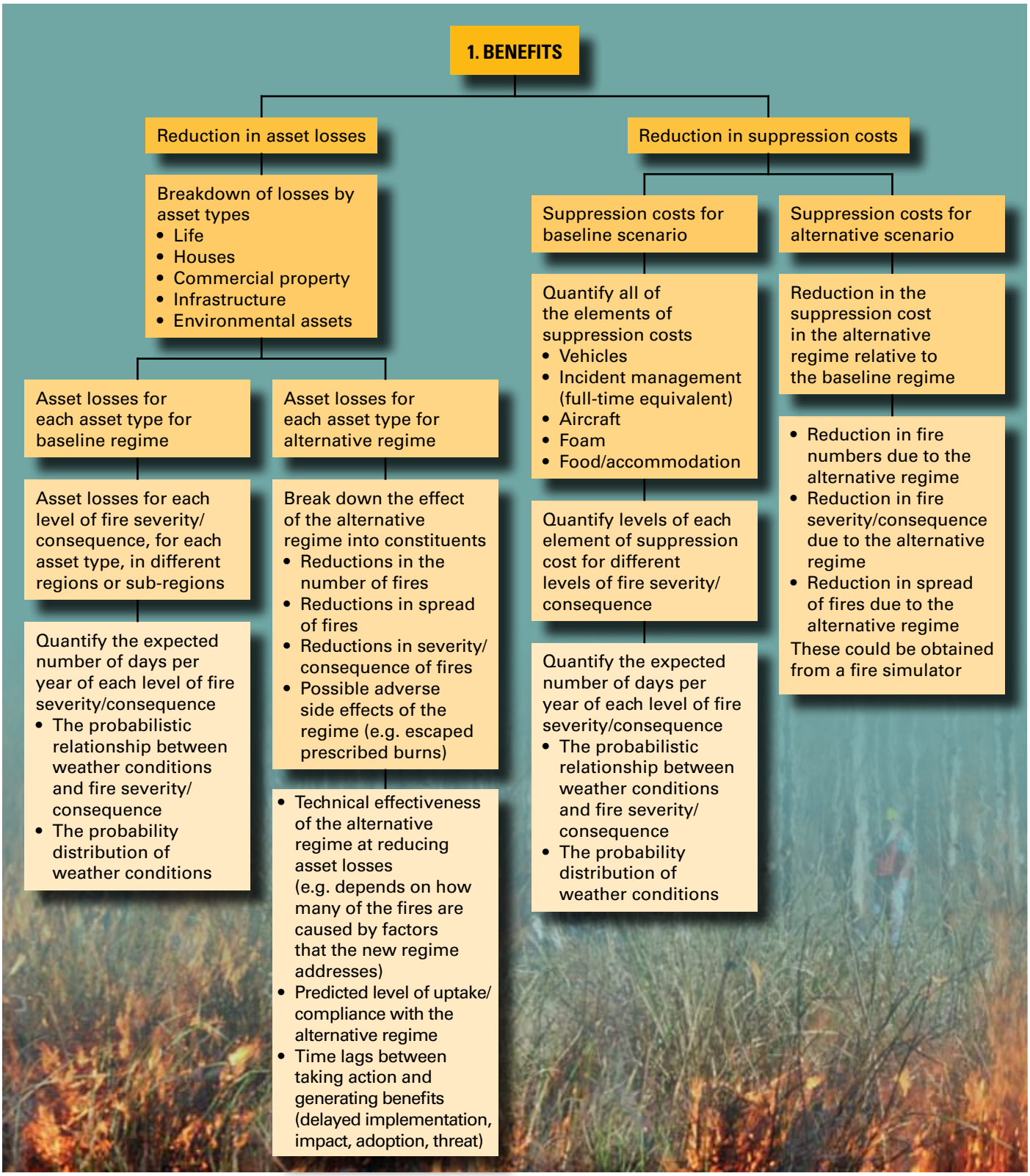
Currently, there is no analysis available that integrates research information on fires, ecology, human behaviour, values and economics. Any such analysis will need to account for existing uncertainties and gaps in the body of knowledge.

The integrated economic analysis used in this study is adapted from experience with the Investment Framework for Environmental Resources (INFFER). It accounts for fire risk, fire spread, the damage caused by fires of different severities, asset values, weather conditions, impacts of fire-prevention options, and costs of those management options. It estimates the benefits and costs of various fire risk management strategies that aim to protect various assets, such as homes, plantations,

DATA REQUIREMENT FOR INTEGRATED ECONOMIC ASSESSMENT

OVERALL ASSESSMENT FRAMEWORK

- **1. BENEFITS**
- **2. RISKS**
- **3. COSTS**



1. BENEFITS

Reduction in asset losses

Breakdown of losses by asset types
- Life
- Houses
- Commercial property
- Infrastructure
- Environmental assets

Asset losses for each asset type for baseline regime

Asset losses for each level of fire severity/ consequence, for each asset type, in different regions or sub-regions

Quantify the expected number of days per year of each level of fire severity/consequence
- The probabilistic relationship between weather conditions and fire severity/ consequence
- The probability distribution of weather conditions

Asset losses for each asset type for alternative regime

Break down the effect of the alternative regime into constituents
- Reductions in the number of fires
- Reductions in spread of fires
- Reductions in severity/ consequence of fires
- Possible adverse side effects of the regime (e.g. escaped prescribed burns)

- Technical effectiveness of the alternative regime at reducing asset losses (e.g. depends on how many of the fires are caused by factors that the new regime addresses)
- Predicted level of uptake/ compliance with the alternative regime
- Time lags between taking action and generating benefits (delayed implementation, impact, adoption, threat)

Reduction in suppression costs

Suppression costs for baseline scenario

Quantify all of the elements of suppression costs
- Vehicles
- Incident management (full-time equivalent)
- Aircraft
- Foam
- Food/accommodation

Quantify levels of each element of suppression cost for different levels of fire severity/ consequence

Quantify the expected number of days per year of each level of fire severity/consequence
- The probabilistic relationship between weather conditions and fire severity/ consequence
- The probability distribution of weather conditions

Suppression costs for alternative scenario

Reduction in the suppression cost in the alternative regime relative to the baseline regime

- Reduction in fire numbers due to the alternative regime
- Reduction in fire severity/consequence due to the alternative regime
- Reduction in spread of fires due to the alternative regime

These could be obtained from a fire simulator

2. RISKS

Risks (these are risks associated with successful implementation of the new management/policy regime, not risks of damage.)

- Technical risks
- Socio-political risks
- Financial risks
- Management risks

3. COSTS

Costs (of implementing the new management / policy regime)

- Administration costs
- Operations costs
- Environmental costs (e.g. adverse environmental outcomes from prescribed burning)
- Compliance cost
- Opportunity cost

biodiversity, life, industrial and commercial assets and infrastructure. The benefits are calculated as reduced damage to the assets and reduced suppression costs.

A baseline level of expected losses due to fire is estimated for a baseline scenario. The levels of losses depend on all of the factors listed previously. The calculations are repeated with a particular management strategy in place. The difference between the two results (with and without management) indicates expected net benefits of introducing the additional management regime, relative to the baseline.

The benefits are measured as *expected* benefits, depending on the probabilities of different possible outcomes. Benefits and costs vary substantially from year to year depending on factors such as the weather. Results should be viewed as providing an indication of average benefits per year over a long run of years. This information, combined with the cost of the management strategy, is used to calculate a Benefit: Cost Ratio (BCR) for each strategy. Users can simulate many different strategies for bushfire risk management and observe the estimated BCRs for each.

Additional Bushfire CRC research on economic contributions to bushfire management and policy are highlighted in Cary *et al.* 2014 and Clayton *et al.* 2013.

BUSHFIRE CRC RESEARCH

The Central Otago case study was facilitated and supported by the New Zealand National Rural Fire Authority. Stakeholders from the Department of Conservation, fire authorities and the farming community were brought together to establish a direction for improved fire risk management. There was significant concern regarding bushfire risk and how best to reduce it. The model provided a platform to facilitate discussion of trade-offs between the benefits and costs of each strategy.

END USER STATEMENT

From a New Zealand perspective, good land owner end user involvement was one of the many benefits that came from this project. In addition, the study has been able to assess the likelihood of the potential exposure to a bushfire impacting on the landscape and communities within the study area. The results of this work will be useful as a tool to share with at-risk communities as an example of how science can assist us in better understanding the community exposure to the impacts of bushfires.

– Murray Dudfield, National Rural Fire Officer, New Zealand National Rural Fire Authority

The stakeholders in the Mount Lofty Ranges case study were representatives of the three state government agencies with key land management responsibilities in the region: the Department of Environment, Water and Natural Resources, Forestry South Australia and South Australia Water. The policy makers were interested in applying economic thinking to fire risk management, with a focus on prescribed burning.

In both studies, extensive consultation was undertaken with scientists, fire regulators, local experts and land managers.

RESEARCH OUTCOMES

For the Central Otago case study, the prescribed burning strategies favoured by some stakeholders were shown by the model to be a poor investment. Instead, strategies that reduced the number of fires starting within the town itself were the best value.

In the Mount Lofty Ranges case study, the findings complemented those by Gibbons *et al.* (2012) and Penman *et al.* (2014) in that reducing vegetation cover close to high valued assets was more valuable.

Findings drawn across both case studies are highlighted below. Full research findings and more details are available in Gibson and Pannell (2014).

Various fire risk management strategies have potential to generate benefits, but they should be carefully targeted. This was particularly the case for prescribed burning around Mount Lofty, where a general prescribed burning strategy across all areas was shown not to not provide value for money, but prescribed burning in targeted areas did.

Some strategies have particularly high costs, and these are unlikely to provide value for money unless they can generate exceptional levels of bushfire prevention. The high cost is usually due to the strategy requiring actions over a large area.

Benefits from reductions in fire spread from one area to another were relatively low in both case studies. The majority of benefits were generated from strategies that were applied within or close to the valuable assets. Although information about fire spread was relatively weak, results were not sensitive to changes in the assumptions about spread within plus/minus 50%.

On average, the models showed that benefits from reducing asset losses are much larger than benefits from reducing suppression costs.

The most severe fires tend to cause the majority of losses, even after allowing for the fact that these are rare events. This means that the majority of benefits from fire

management occur in exteme, less frequent events. In between these events, strategies that offer good value for money on a long-term probabilistic basis may have costs in excess of benefits in most years.

The quantity and quality of available data was low for a number of key parameters. Some information was not collected by the relevant authorities, and some was not in an easily interpretable format.

In both case studies the model results were found to be sensitive to several variables about which uncertainty was high. These provide a potential focus for future data collection.

HOW COULD THE RESEARCH BE USED?

This type of research could be used to target bushfire risk management strategies in areas that produce the most benefits per dollar. It provides useful information on which fires contribute most to risk, and hence which community groups to target. It has provided valuable experience in the conduct of integrated economic assessment of bushfire prevention strategies. Being the first study of its kind in Australia or New Zealand, a number of challenges were faced, particularly around availability of suitable data.

This work is data intensive. It requires data of a variety of different types to be brought together. Experience in other contexts shows that even for issues where technical research has been conducted, it is common for that research not to provide the specific data required for integrated economic assessment. This proved to be the case in these fire case studies.

Integrated economic assessments have great potential to contribute to thinking and decision making about fire management. They can help to identify bushfire management strategies that can deliver the best value for public money, and strategies that should be avoided because their costs are much greater than their benefits. These case studies have been documented as examples of the use of another tool (INFFER) that fire managers may utilise in detailing with multiple and complex, competing land management objectives.

The guidelines on pages two and three have been developed to assist agencies prepare for similar integrated economic assessments.

PREPARING FOR INTEGRATED ECONOMIC ASSESSMENTS

Setting the context

Before determining specific data requirements, it is necessary to define certain aspects of the analysis.

1. Define the baseline regime. Usually this consists of the current fire prevention and fire management regime (a business-as-usual scenario). However, the baseline may be a scenario where there are fewer management actions than in the current real-world regime. For example, in the South Australian case study, the baseline was defined as no prescribed burning. The choice between these two options determines the interpretation of the results, because benefits and costs are estimated relative to the baseline.
2. Define alternative regimes. These are the new management or policy regimes that are to be assessed. For example, in the South Australian case study, several prescribed burning strategies were defined. The analysis then evaluates whether these alternative management or policy regimes are superior to the baseline regime, in terms of value for money.
3. Define the case-study region and sub-regions, and identify their characteristics.

FUTURE DIRECTIONS

The research described in this *Fire Note* is being expanded upon in a new research project by the Bushfire and Natural Hazards CRC. The project aims to fill key knowledge gaps for hazards such as earthquakes, floods, cyclones and tsunamis to illuminate the merits of different decision options. The new study spans issues related to values, risks, and decision making to deliver value for money from public investments in natural hazard management. See www.bnhcrc.com.au for a full description of the project.

REFERENCES /FURTHER READING

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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.


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ACTIVITY SHEET 7
IMPACT v CAPACITY
PURPOSE
This activity sheet is designed for you to lead a discussion with your team to identify where they group should focus their energies in relation to the issues raised by the *Fire Note*.
OUTCOME

Fire Note is published jointly by the Bushfire Cooperative Research Centre (Bushfire CRC) and the Australasian Fire and Emergency Service Authorities Council (AFAC). This Fire Note is prepared from available research at the time of publication to encourage discussion and debate. The contents of the Fire Note do not necessarily represent the views, policies, practices or positions of any of the individual agencies or organisations who are stakeholders of the Bushfire CRC.

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AFAC is the peak body for Australasian fire, land management and emergency services, creating synergy across the industry. AFAC was established in 1993.