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WHERE DO WE PUT OUR DOLLARS? ECONOMIC ANALYSIS OF DIFFERENT BUSHFIRE MANAGEMENT OPTIONS IN WESTERN AUSTRALIA

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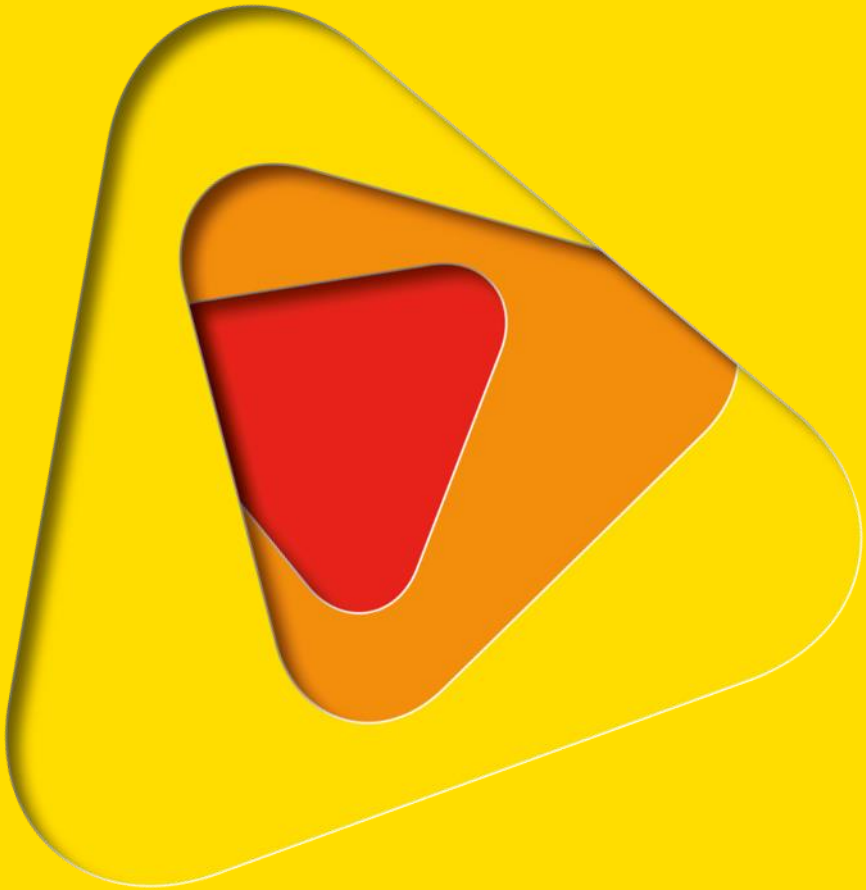

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TABLE OF CONTENTS

ABSTRACT

Funds for bushfire-risk management are limited but the bushfire threat to society continues to increase. Fire managers face a challenging resource allocation problem and they would greatly benefit from knowing which strategies generate the highest benefit per dollar invested. There are many options available for bushfire-risk management, but it is hard to know what benefits they generate and if those benefits exceed the costs of implementation. The aim of this project is to evaluate different bushfire-risk management strategies in contrasting environments to explore which option(s) provide(s) the best value for money and highlight the trade-offs between the different options. This information can be used by fire managers and policy makers to optimise the allocation of the available resources for bushfire management in Western Australia and other States.

Specifically, the analysis evaluates a set of management options that were selected by experts in the field and compares them with the status quo in order to determine which pathways are more likely to generate additional benefits to society. We quantify the costs and benefits of applying the selected management options in two different case study locations in WA and discuss the implications for other localities in the State. We found that in areas with a very large number of high value human assets (i.e. Perth Hills), strategies that remove the assets at risk from the areas concerned have a potential to generate significant benefits, while fuel reduction treatments are most beneficial when large areas are treated in a coordinated manner. Priority strategies for fire management vary by region and it is therefore important not to apply fire management strategies uniformly across the State.

INTRODUCTION

Funds for bushfire-risk management are limited but the bushfire threat to society continuous to increase (1-3), particularly with predictions for climate change (4, 5) and the increasing population living in fire prone areas (6-8). As a consequence, fire managers face a challenging resource allocation problem and they would greatly benefit from knowing which strategies generate the most significant net benefits. However, economic analyses of bushfire management options that illustrate the implications of different uses of the resources available are rare. Despite the significant amounts of money invested in bushfire risk mitigation activities every year, there is little information on the value for money that each option provides and the trade-offs between them to assist fire managers in their decision making. This study aims to provide insights into these issues in the south-west of Western Australia (WA) and infer state-wide implications from these insights.

The south-west of WA presents an interesting case of study because of the complexity of management in the area. In this part of the State, there are numerous areas where highly flammable vegetation and human assets are intermingled, which makes the protection of those assets more difficult because of the spatial interactions between housing and fuels (9). These urban-rural interface areas have become a real challenge for fire managers and policy makers (10). In addition, the south-west is located within an internationally recognised biodiversity hotspot and the environmental significance of the area needs to be taken into account in land management (11, 12). This produces a complex fire management environment, where there are multiple objectives that compete against each other for the use of resources, and knowing which investments provide the highest returns becomes all the more important.

The main purpose of this economic assessment is to determine which fire management option or which combination of options provide the best value for money. We evaluated a set of management options selected with experts in the field and compared them with the *status quo* in order to determine which pathways are more likely to generate additional benefits to society. However, the bushfire management context changes from one location to another, and what could generate large benefits in one location, may only generate little benefits in another. Therefore, it is important to evaluate the same strategies in different settings and understand how a change in settings affects the economic appeal of a management option.

For this purpose, we quantified the costs and benefits of applying the selected management options in two different case study locations in WA that represent contrasting examples of land use combinations: one location has a mix of predominantly urban and peri-urban areas, intermingled with and surrounded by natural areas; the other has a mix of predominantly rural, agricultural and natural areas, with a few interspersed urban areas.

METHODS

The approach taken in this study was inspired by INFFER (the Investment Framework for Environmental Resources) (13), a framework designed to develop, assess and prioritise environmental and natural resource projects. From its application to the Gippsland Lakes (14), INFFER was modified to evaluate fire management options in South Australia and in New Zealand (15). The model used for the application of INFFER to fire management in South Australia and New Zealand was adapted in this study to the Western Australian context. The model performs a quantitative analysis that integrates information about bushfire risk, bushfire spread, the damage caused by fires of different severities, asset values, fire suppression costs, environmental damage caused by the fires, weather conditions, the impacts of applying the management options evaluated, and the costs of those management options. Using this information, it calculates benefit-cost ratios for each of the management options evaluated.

To obtain two contrasting examples of land use combinations, the following locations were selected with a panel of experts: (1) case study area 1 is a combination of two Shires: the Shire of Mundaring and the City of Swan, located East of Perth, at the border of the metropolitan area, in an area known as the Perth Hills. This area has a mix of urban, peri-urban and natural areas. From this point forward, this case study area is referred to as the Perth Hills. (2) Case study area 2 corresponds to the Shire of Bridgetown-Greenbushes, located about 250 km south of Perth. This area represents the mix of rural, agricultural and natural areas with a few urban areas. This case study area is hereafter referred to as the Bridgetown area.

Of the management options discussed with the panel of experts, three were selected for this study:

1) Increased fuel reduction through the application of prescribed burning and/or mechanical works (either carried out by the Department of Parks and Wildlife or by the Shires).

2) Land-use planning to restrict future developments in high-risk areas.

3) Provide land owners with an increased capacity to manage fuels in their own land.

The model evaluates a hypothetical increase in investment in each these options separately and compares it with the *status quo* (i.e. business continues as usual) to estimate the benefits (i.e. asset losses avoided and suppression costs savings).

RESULTS

In the Perth Hills case study area, nearly all strategies generate positive net benefits (Table 1). Only the strategy that increases the capacity of land owners to manage fuels in their land generates benefits that are slightly smaller than the costs, mainly because the total area treated is relatively small and has little impact on fire behaviour, but the costs of implementation are relatively high. The strategy that generates the highest expected benefits per dollar invested per year is the land-use planning strategy, which restricts where people can build new houses in the Perth Hills. Overall, reductions in asset losses for all strategies are much greater than reductions in suppression costs (savings in asset losses are 8 to 11 times larger than savings in suppression costs).

TABLE 1. IMPACT IN THE PERTH HILLS FROM THE IMPLEMENTATION OF EACH STRATEGY

Result	Strategy				
	Increased fuel reduction (DPaW only)	Land-use planning	Fuel management (private landowners)	Increased fuel reduction (Shire only)	Increased fuel reduction (DPaW and Shire)
Proportion of area treated (fuel reduction)	2.97%	2.17%	2.42%	2.24%	3.04%
Cost of strategy	$672,000	$600,000	$468,000	$197,000	$869,000
Savings in asset losses	$2,793,000	$9,154,000	$396,000	$320,000	$3,689,000
Savings in suppression costs	$325,000	$0	$35,000	$30,000	$377,000
Total expected benefit of strategy	$3,118,000	$9,154,000	$431,000	$351,000	$4,066,000
Benefit : Cost ratio	4.64	15.26	0.92	1.78	4.68

These results are to be interpreted within the current fire context in the case study area; that is, the current bushfire risk management program is assumed to continue as it is implemented now, and the strategies presented here are implemented as an addition to the current program. Furthermore, current fire risk and suppression effort are assumed to remain constant over time for business as usual. The implementation of a strategy may have an effect on the probability of occurrence for certain types of fires, but the initial probability obtained from historical data for the *status quo* is assumed to remain constant. Similarly, suppression effort (i.e. the number of fire-fighters, fire trucks, and other resources deployed for each fire) is assumed to remain constant over time if the current scheme continues to be implemented.

In the South-West case study area, only two strategies generate positive net benefits: increased fuel reduction in DPaW managed land and increased fuel reduction in DPaW and Shire managed land simultaneously. For other strategies (i.e. land use planning, fuel management in private land and increased fuel reduction in Shire managed land only) the benefits generated are smaller than the costs (i.e. BCR < 1, see Table 2).

It is important to note that the benefits generated by the different strategies in the Bridgetown case study area are of a different order of magnitude compared to the benefits obtained in the Perth Hills area. In the Bridgetown area the benefits are of the order of AU$20,000 to AU$570,000 (Table 2); whereas in the Perth Hills they are of the order of AU$350,000 to AU$9.1 million (Table 1). The main reason for this is the

difference in the number of high value assets. In the Perth Hills area, which has a total area of approximately 169,000 hectares, there are more than 106,000 residential buildings and 5,300 industrial/commercial buildings. In contrast, in the Bridgetown area, for a similar size area (134,000 hectares), there are about 4,500 residential buildings and 300 industrial/commercial buildings (16).

TABLE 2. IMPACT IN THE BRIDGETOWN AREA FROM THE IMPLEMENTATION OF EACH STRATEGY

Result	Strategy				
	Increased fuel reduction (DPaW only)	Land-use planning	Fuel management (private landowners)	Increased fuel reduction (Shire only)	Increased fuel reduction (DPaW and Shire)
Proportion of area treated (fuel reduction)	5.15%	3.18%	3.38%	3.21%	5.18%
Cost of strategy	$243,000	$150,000	$54,000	$46,000	$288,000
Savings in asset losses	$380,000	$20,000	$18,000	$20,000	$427,000
Savings in suppression costs	$129,000	$0	$4,000	$6,000	$144,000
Total expected benefit of strategy	$509,000	$320,000	$22,000	$27,000	$571,000
Benefit : Cost ratio	2.09	0.13	0.41	0.59	1.98

CONCLUSION

The analysis shows that the strategies evaluated have different impacts in each case study area and the strategy that generates the highest benefit per dollar invested is different for each location. In the Perth Hills area, the strategy that generates the highest benefits per dollar invested is the land use policy, whereas in the Bridgetown area it is additional fuel reductions in DPaW managed land. In the Perth Hills, because of the large number of high value assets at risk in the area and the large number of fire incidents per year, the strategy that reduces the number of asset at risk generates the greatest benefits. In contrast, the Bridgetown area has a much lower number of high value assets, lower numbers of fire incidents per year, and a large proportion of natural and conservation areas; thus the strategy that reduces the chances of large, intense and costly bushfires occurring generates the greatest benefits.

The results from this study seem to indicate a tendency: in areas where there are high numbers of people, dwellings, commercial buildings and infrastructure (i.e. high value human assets), the highest value for money for additional investments in fire management is obtained from land use planning; while in areas where there is an abundance of natural areas, high values for biodiversity and a smaller concentration of high value human assets, the highest value for money for additional investments is obtained from fuel management. However, this observation is to be appreciated with caution. Each area is unique in its context and the results cannot be generalised to the whole State, even for similar areas. When the bushfire management context changes, the source of the costs and benefits also changes and the results between two seemingly similar areas can differ.

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