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Research article

Landowner response to wildfire risk: Adaptation, mitigation or doing nothing

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ABSTRACT

Wildfire has brought about ecological, economic, and social consequences that engender human responses in many parts of the world. How to respond to wildfire risk is a common challenge across the globe particularly in areas where lands are controlled by many small private owners because effective wildfire prevention and protection require coordinated efforts of neighboring stakeholders. We explore (i) wildfire response strategies adopted by family forestland owners in the southern United States, one of the most important and productive forest regions in the world, through a landowner survey; and (ii) linkages between the responses of these landowners and their characteristics via multinomial logistic regression. We find that landowners used diverse strategies to respond to wildfire risk, with the most popular responses being "doing nothing" and combined adaptation and mitigation, followed by adaptation or mitigation alone. Landowners who had lost properties to wildfire, lived on their forestlands, had a forest management plan, and were better educated were more likely to proactively respond to wildfire risk. Our results indicate the possibility to enhance the effectiveness of collective action of wildfire risk response by private forestland owners and to coordinate wildfire response with forest conservation and certification efforts. These findings shed new light on engaging private landowners in wildfire management in the study region and beyond.

1. Introduction

Wildfire, though an integrative part of terrestrial ecosystems, has become a contentious issue in recent decades in the United States (US) and many other parts of the world, as it posts threat to properties and human life as well as ecosystems (Food and Agriculture Organization of the United Nations, 2007; Bracmort, 2012). Driven by human and natural forces such as climate change, human population growth, and vegetation change, this threat is anticipated to intensify in the future (Pechony and Shindell, 2010). Alleviating the threat calls for new or modified human interventions, which generally include mitigation (to reduce wildfire risk) and adaptation (to reduce wildfire-caused loss and impact when it occurs). Such interventions, however, are challenging, particularly in areas where coordination of actions by many diverse individuals with different interests is inevitable, because effective wildfire prevention and protection require collective actions of spatially adjacent stakeholders (Kittredge, 2005). Additionally, because wildfire prevention and protection are more like a public good, potential free riding on the benefits generated from wildfire interventions implemented by others adds to the complexity of coordinating collective responses to wildfire risk (Ostrom, 1990; Reddy, 2000).

To enhance the effectiveness of collective wildfire responses, it is imperative to understand how and why individuals respond to wildfire risk. Drawing on the behavior of non-industrial private or family forestland owners in their response to wildfire, this study is intended to shed light on this quest. Specifically, we aim to identify (i) wildfire response options adopted by family forestland owners in the southern United States and (ii) factors influencing their adoption of wildfire response options. The southern United Station is one of the most important and productive forest regions in the world (Food and Agriculture Organization of the United Nations, 2014). The region's forestlands are primarily owned by family landowners of diverse attributes (Butler et al., 2004; Smith et al., 2009). Hence, it is an ideal region to study wildfire risk response

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by private forestland owners.

A common wildfire response in recent decades, particularly in developed countries has been fire suppression carried out primarily by national and state or provincial government agencies (Food and Agriculture Organization of the United Nations, 2007). Wildfire suppression is costly, and it alone may not be effective in wildfire management. In the US, for instance, wildfire suppression costs incurred by US federal agencies alone have skyrocketed over the past few years, averaging almost US$1.5 billion annually since 2000 (National Interagency Fire Center, 2014). Fire suppression can meet, to some degree, the immediate or short-term need to protect properties, lives, and natural resources. Yet, excessive wildfire suppression could cause a greater accumulation of vegetation fuels on the ground, thus increasing fire intensity and damage when it occurs (US Department of Agriculture (USDA) and US Department of Interior, 2000; Schoennagel et al., 2004). Hence, other wildfire response options besides suppression should also be part of the solution (Food and Agriculture Organization of the United Nations, 2007). These other responses range from wildfire mitigation measures such as fuel treatments (mechanical or prescribed burning) to adaptation activities such as wildfire insurance and to combined adaptation and mitigation efforts. These efforts are typically carried out by landowners, private and public alike.

A considerable amount of research has been done on wildfire responses on public lands in the US and elsewhere. Among these responses are vegetation fuel treatments, which use mechanical means or prescribed burning to reduce fuel loads on the land, thus decreasing wildfire hazards and intensity when it occurs (Graham et al., 2004; Agee and Skinner, 2005; Reinhardt et al., 2008; Fernandes et al., 2014). However, studies aimed at understanding how and why private individuals/households respond to wildfire risk and enhancing the effectiveness of their collective responses are rare, although wildfire prevention and protection are more complex and challenging on private lands than on public lands. For instance, the concept of fuel treatments appears applicable to private landowners, yet the high cost of mechanical treatments (Rummer, 2008) may discourage private landowners from adopting them. Fuel treatments can be much more easily implemented and coordinated on public land than on private land held by many diverse small owners (Busby and Albers, 2010; Fischer and Charnley, 2012).

Among the few existing studies on the responses of private landowners to wildfire risk, the focus has been on a specific response type (e.g., fuel reduction) instead of a wide spectrum of response options including doing nothing, mechanic fuel reduction treatments, prescribed burning, fire line construction, and insurance. In terms of wildfire mitigation activities, Fischer (2011) examined factors influencing the decisions of non-industrial private forestland owners to implement fuel reduction treatments in the western US. Kaval et al. (2007) and Walker et al. (2007) estimated willingness-to-pay of landowners for vegetation fuel treatments. Comparisons of the willingness-to-pay with fuel treatment costs could reveal whether these landowners would adopt fuel treatments on their lands and/or support fuel treatments on neighboring public or private lands in a financial perspective. A study in Australia found that the owners of private conservation lands did take some action to reduce vegetation fuel hazards, but directed much greater efforts to other conservation management than to wildfire management (Halliday et al., 2012).

Insurance has long been considered a wildfire adaptation option for private landowners (Yatagai, 1933; Shepard, 1935, 1937). Participation of private landowners in wildfire insurance markets could be influenced by gender, education, ownership type, and previous property damage caused by fire and other disturbances (Gan et al., 2014). Also, lower income households are less able to afford fire insurance and protection services than their richer neighbors, leading to poor households bearing a disproportionate amount of wildfire losses (Collins, 2008).

In this paper, we intend to examine a wide spectrum of wildfire response options ranging from “doing nothing” to adaption or mitigation alone and to combined adaption and mitigation. This will enable us to investigate how and why private landowners may adopt a specific wildfire response from a complete set of responses available to them. It not only better reflects the reality of wildfire responses by private landowners, but also provides a more comprehensive figure of landowners' preferences over different wildfire response options. Our findings provide insights into the behavior of these landowners in response to wildfire risk and the driving forces of their behavior, contributing to the literature and informing policy to engage private landowners in addressing the pressing and complex wildfire issue.

2. Methods

2.1. Landowner survey and wildfire response classification

A landowner survey was conducted to identify the responses of family forestland owners to wildfire risk in the southern US. This region consists of 13 states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. It is considered one of the most productive and important forest regions nationally and globally. Forests in this region supply approximately 60% of roundwood in the US market and over 14% of industrial roundwood in the world (Smith et al., 2009; Food and Agriculture Organization of the United Nations, 2014), in addition to non-timber benefits ranging from carbon storage to water regulation (USDA Forest Service, 2012).

Family forestland owners possess approximately 60% of timberlands in the region (Smith et al., 2009). These landowners have diverse ownership objectives, forest tract sizes, and socioeconomic characteristics (Butler et al., 2004). Although the region differs from other US regions in terms of biophysical conditions, forest type, and forest ownership structure, it faces a similar wildfire threat. Wildfire has recently become an increasing concern for forestland owners and local residents in the region, despite the fact that it has played an important role in ecosystem dynamics and human history (Stanturf et al., 2002; Fowler and Konopik, 2007).

Our survey targeted the population of family forestland owners who owned 10 acres or more of forestland in Alabama, Florida, Georgia, Mississippi, and South Carolina. We drew the survey sample of 2500 landowners from the population via cluster sampling (500 from each state). We employed a mail survey, which was designed and administrated following the standard approach proposed by Dillman et al. (2009). We received 585 surveys, yielding a response rate of 24.7% after excluding 127 undeliverable mails. The response rate is typical for this kind of surveys in the region (Molnar et al., 2007), and the key characteristics of the survey respondents resemble those of the study population (Jarrett et al., 2009). Of the 585 surveys received, 37 survey participants provided inconsistent or missing answers to the questions about how they responded to wildfire risk. One example of inconsistent answers was when a landowner simultaneously selected “doing nothing” and a mitigation or adaptation option. These inconsistent answers were removed; the remaining 548 observations were used in this analysis.

The survey instrument consisted of 30 questions pertinent to landowners' experience with wildfire, perception of wildfire risk, wildfire response strategies, awareness of wildfire assistance programs, forest tract features, ownership objectives, and