Contents lists available at GrowingScience

Journal of Future Sustainability

homepage: www.GrowingScience.com/jfs

The role of wildfires in a sustainable future

Ebrahim Sharifi[a*]

[a]*Department of Mechanical & Industrial Engineering, Toronto Metropolitan University, Canada*

C H R O N I C L E

Article history:
Received: January 2, 2022
Received in revised format: June 18, 2022
Accepted: August 10, 2022
Available online:
August 22, 2022

Keywords:
Global warming
Wildfire
Forest fire
Climate change
Natural disasters

A B S T R A C T

Climate change and global warming have led to many risks and changes for the Earth, including the increase in natural fires, floods, air pollution, unusual seasons, etc. The increase in the trend of global warming may bring many countries underwater. For instance, the populous Asian nation of Bangladesh is most vulnerable to rising sea levels. It is estimated that a rise of just one meter in sea level is enough to submerge 30,000 square kilometres of the coastal areas of Bangladesh and displace 15 million people. Therefore, it is crucial to determine the effects of different factors on global warming and take possible actions to reduce the damage. Among various factors, natural fires are believed to be responsible for up to 20% of greenhouse gas production in the world. The source of 80% of fresh water in the United States is believed to be forest lands, which means the effect of natural fires can be disastrous not only for drinking water but also for aquatic habitats. In this paper, we present a survey on the impacts of forest fires on global warming.

1. Introduction

Climate change and global warming have led to many risks and changes for the Earth, including the increase in natural fires (Bowman et al., 2009). Natural fires all over the world put animal and plant species, landscapes and natural resources at risk (Pausas & Keeley, 2009). In turn, natural fires have many risks for the planet, humans, plant and animal species, and the environment (Mutch, 1970). Natural fires are responsible for up to 20% of global greenhouse gas production (Bowman et al., 2009). Fires can travel at speeds of up to 22 kilometres per hour, which means they can quickly destroy large areas of land (Neary et al., 2005).

Researchers' studies show that the general increase in the Earth's temperature, which is much more reported in the regions near the North Pole, has caused the heating season to become longer, the pattern of lightning in the region has changed, and the number of natural fires has increased (Moore, 2016). Only during the first nine months of 2022, a total of 3,121 wildfires have been recorded in Canada, burning 1,106,771 hectares of area (Canadian Interagency Forest Fire Center). Wildfires seem to be more in western regions of Canada (Tymstra et al., 2020). Wotton et al. (2017) investigated potential climate change effects on fire intensity and key wildfire suppression thresholds in Canada and concluded that Canadian agencies ought to strengthen their wildfire management capacity and capability more effectively. This implies better horizontal collaboration, more efficient resource sharing, financing to develop innovative decision support tools, and an increased concentration on prevention and mitigation (Wotton et al., 2017).

This study investigates the effects of wildfire effects on the sustainability of those regions. The study tries to briefly review some important and highly cited articles devoted to this topic.

* Corresponding author.
E-mail address: ebrahim.sharifi@ryerson.ca (E. Sharifi)

ISSN 2816-8151 (Online) - ISSN 2816-8143 (Print)

doi: 10.5267/j.jfs.2022.8.003

2. The effects of different factors on wildfire

2.1 The effect of moisture

Girardin and Wotton (2009) investigated the effect of summer moisture and wildfire risks across Canada. They reported that 63% of the variance in the Canada-wide annual area burned over the period 1959-1999 was described by summer moisture availability. Wildfires have had some undesirable impacts on people who live close to forests. Some people may be forced to evacuate their homes and lose their jobs.

2.2 The effect of wildfire on residence dislocation

Beverly and Bothwell (2011) are believed to be who considered the first national evaluation of wildfire-related evacuations in Canada and reported the loss of homes that coincided with evacuation incidents. They reported that in spite of the intensity and plentiful of wildfires in Canada, wildfires had displaced a small number of residents. From 1980 to 2007, the median number of evacuees and home losses per year in Canada were 3,590 and 2, respectively, according to their survey. Evacuees' homes survived in 99.3% of cases. They also reported that most evacuations happened in boreal areas, which represented somewhat low population densities. However, evacuations were less prevalent in southern regions, where most people in Canada resided, but individual wildfires in these areas maintained substantial effects. Interactions between wildfire and Canadian residents provided a uniform regional pattern, and they could be considered 'low-probability, high-consequence events. This Canadian context is basically different from regions such as California, where concentrations of fires and people overlap across large areas and therefore calls for a different fire management response (Beverly & Bothwell, 2011). Fig. 1 shows the distribution of wildfires in Canada.

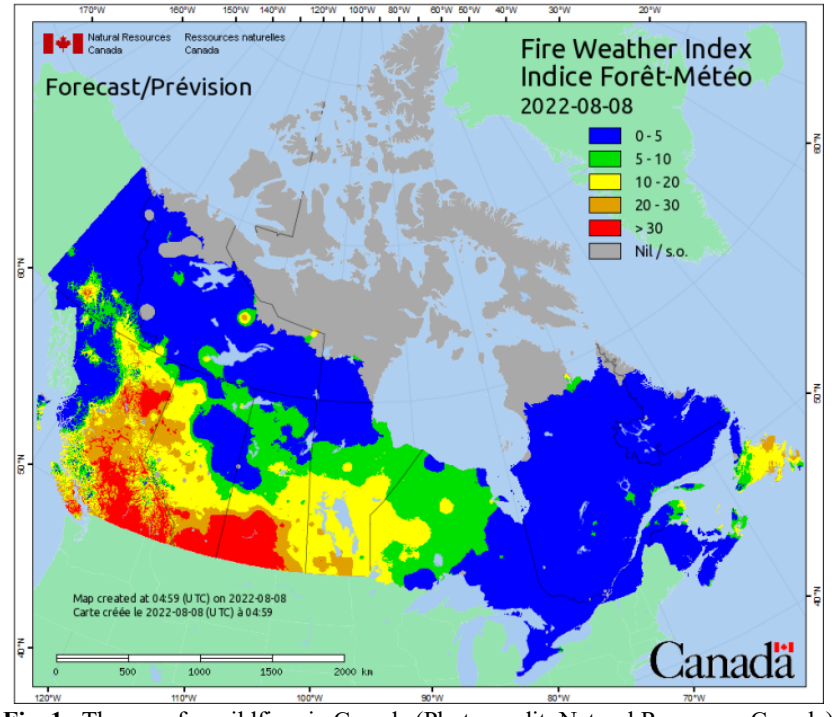

Fig. 1. The map for wildfires in Canada (Photo credit: Natural Resources Canada)

McCaffrey et al. (2014) investigated the effects of wildfire on residents in the United States. They reported some issues by interviewing four communities in the United States where some alternative to mass evacuation during a wildfire was being considered. In each community, emergency responders and community members were requested to respond to the challenges of their evacuation. Their report indicated that opinions were mixed on whether evacuation or an alternative method was more appropriate. The results showed the complicated nature of developing evacuation strategies which were beneficial to all parties involved. Moritz et al. (2014) explained how to cope with the consequences of wildfire in the world.

2.3 The risk involved with wildfire

Wildfire creates several risk factors for the economy and people who live close to the forest. According to Burke et al. (2021), the recent tremendous increases in wildfire activities have brought interest to the causes of wildfires, the consequences, and how risk from a wildfire could be mitigated. Burke et al. (2021) collected some data on the changing risk of wildfire in the United States. Based on their survey, Burke et al. (2021) believed that approximately 50 million homes are

located in the wildland-urban in the United States, and this number could go up by 1 million houses every 3 years. To find out how changes in wildfire activity could possibly influence air pollution and associated health outcomes, they proposed a statistical model which was associated with satellite-based fire and smoke data to date from pollution monitoring stations. They forecasted that wildfires could be blamed for up to 25% of $PM_{2.5}$ (particulate matter with diameter <2.5 μm) in recent years. Dmitrenko et al. (2022) studied the development of preventive measures to eliminate wildfires using transport and other services.

McLennan et al. (2019) discussed whether residential and industries located near wildfires should leave the region for good or not. They reviewed North American and Australian research into wildfire evacuation behavior released by officials from January 2005 to June 2017. Wildfire evacuation policies varied across the two regions where in North America, mandatory evacuations were popular, while in Australia, most were advisory. The survey also showed that following a wildfire evacuation warning, some threatened residents could wish to stay on their properties to keep them safe. At the same time, many residences delayed evacuating, and some who were not on their properties when an evacuation warning was issued could look to return. A mandatory evacuation was likely to yield greater compliance, and enforcement policies were also likely to be useful. A self-delayed evacuation was likely when warnings were not substantially informative: residents were likely to engage in information search rather than initiating evacuation actions. The wildfire warning and threat histories of a location may have some effects on residents' decisions and actions. They reported that evacuees and public safety officials had various concerns about evacuation. They derived some lessons learned from the cases to use for planning future wildfire evacuations. O'Donnell et al. (2014) investigated whether or not wildfire management resources in the United States are efficiently allocated to protect resources at risk. They reported that with United States federal land management agencies under pressure to reduce wildfire suppression expenses, it is necessary to study social preferences for wildfire management to forecast suppression benefits. The issue of wildfire has been investigated in other countries, for instance, the United Kingdom (McMorrow, 2011), Japan and India (Arce et al., 2017).

3. Wildfire and global warming

Many scientific studies show that an astonishing number of fires in many parts of the Earth are becoming a daily and normal thing, and this is due to climate changes because of the warming of our blue planet (Flannigan et al., 1998; Piñol, 1998; Baker, 2022; Running, 2006). The fire these days in the forests of Australia is the most obvious and biggest example of this warning; A stunning fire that has brought together the fire and rescue forces of such a country with hundreds of specialists, but it is still burning huge parts of the lungs of the Earth. So far, the fire has consumed more than 100 million hectares of Australian forests, an area larger than the country of Portugal, and according to a new study by the University of Sydney, Australia, it has burned more than a billion animals; Animals that have been a symbol of animal diversity in this continental country. It is unfortunate that, contrary to popular belief, the statistics of more than one billion animals lost, according to the studies of the Australian Environmental Centers and the report of the "ABC News" network only belong to mammals, birds and reptiles, and include insects, bats and frogs are not possible because it is difficult to count these species of animals. Even if the remaining animals are saved, the scorched Earth left over from the man-made hell will not allow them to live. Australia is one of the biggest producers of coil, which is blamed for green gas emissions and global warming (Chang et al., 2015). Nevertheless, other reasons are also given for wildfires, such as lightning, volcanic eruptions, sparks from falling rocks and spontaneous combustion (Scott, 2000). Nevertheless, heat waves, droughts, periodic climate changes such as El Niño, and regional weather patterns at the edge of high-pressure air can increase the risk of forest fires and fundamentally change how they occur (Mckenzie et al., 2021).

4. Wildfire and human health

Fire smoke contains important particles that can cause side effects on the respiratory system. Inhalation of smoke from a fire can be a health hazard. Fire smoke is composed of combustion products, including Carbon dioxide, carbon monoxide, water vapor, suspended particles, organic chemicals, nitrogen oxide and other compounds. Inhalation of suspended particles and carbon monoxide causes major health problems (Cannon & Gartner, 2005; Black et al., 2017; Liu et al., 2015). Fire smoke can cause health problems for a group of people, especially children and those with breathing problems (Holm et al., 2021). Air pollution is one of the causes of allergic diseases such as asthma. In particular, some people with asthma overuse cold medicines (Henry et al., 2021). In particular, some people with asthma overuse cold medicines (Haikerwal et al., 2016; Kiser et al., 2020; Shen et al., 2018). Colorless and odorless gas that is found in the highest concentration near the fire. For this reason, carbon monoxide inhalation is a serious health hazard for firefighters (Navarro, 2020). Fire smoke can enter the lungs, where it absorbs into the blood and reduces oxygen delivery to vital organs (Reinhardt & Ottmar, 2004; Semmens et al., 2021).

5. Conclusion

Wildfire is believed to be one of the most important issues that must be considered in an open study. Wildfires may change the nature of the world and create severe circumstances in people's lives. Forests are the primary source of oxygen, and the lack of sufficient oxygen could jeopardize nature's life cycle. Today, we see severe changes in seasons, rising ocean water

levels and severe weather in many regions worldwide. Such changes could become more serious in future, and there is a need for some actions to prevent global warming. We hope this short survey could shed light on the importance of caring for our planet.

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