

Milestone 4: Data Report

Introduction:

Wildfire is an important ecological process contributing to forest ecosystem health in Canada. On average from 1970 to 2017, 8000 wildfires occurred and burned 2.25 million ha across Canada annually [1]. Not all wildland fires should (or can) be controlled. Forest agencies work to harness the force of natural fire to take advantage of its ecological benefits while at the same time limiting its potential damage and costs. This makes fire control strategies a vital component of forest management and emergency management in Canada [2]

Forest fires being a major issue in Canada motivated our group to perform analysis and hence, the dataset used for analysis pertains to the forest fire incidents and area affected in various jurisdictions of Canada between 1990 and 2020 and was obtained from National Forestry Database.

Intended Audience:

About 6% of the forest lands in Canada is privately owned; management of the remaining 94% is the responsibility of the provinces and territories (90%), and federal institutions (4%) (national parks, First Nations reserves, and the Department of National Defence lands). Although the provincial and territorial governments are responsible for wildfire management on the lands they own, not all their forested areas are actively managed. [1]

Therefore, the intended audience of our analysis is anyone who is concerned with the issues related to forest fires mainly caused due to human activity and lightening as a result of the climate change. To be specific, the analysis provided through the presentation can be used by the Canadian Council of Forest Ministers, other government and non-government bodies like United Nations Framework Convention on Climate Change who can make use of the analysis for decision making.

Analysis:

Forest Fires in Canada

Number of forest fires and area affected for different jurisdictions (1990 - 2020)

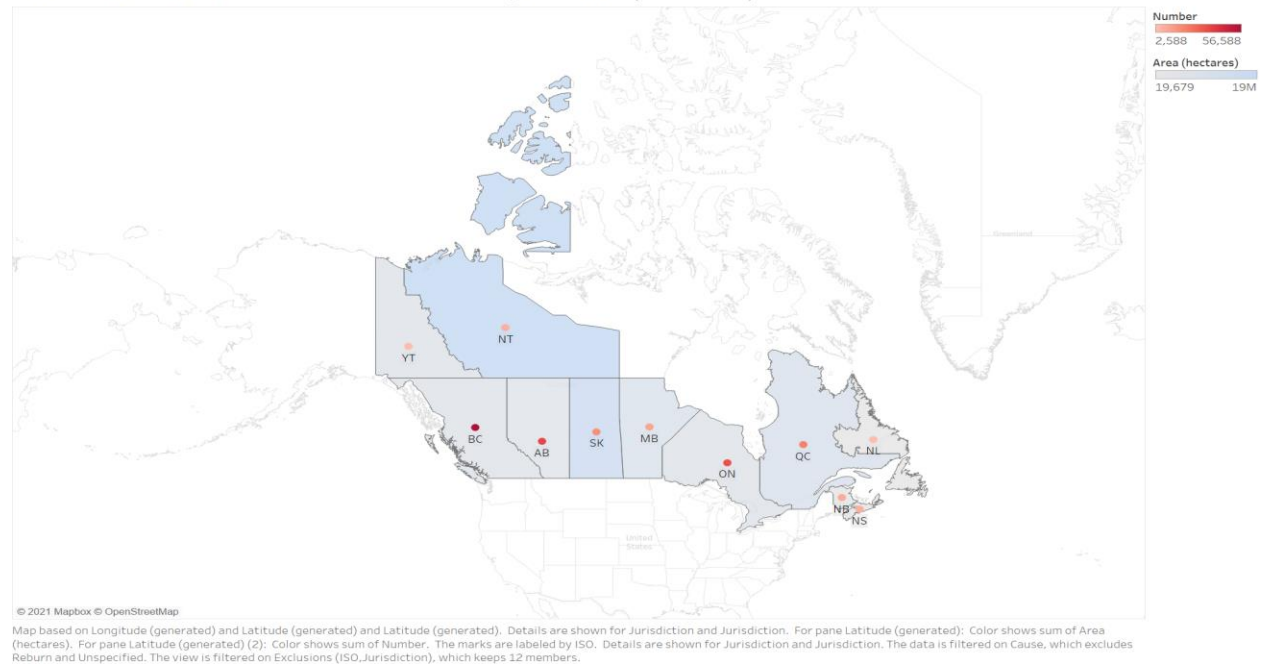


Figure 1

Figure 1 gives an overview of the forest fire situation in Canada for the period under consideration. The map illustrates the number of fire incidents that have taken place in respective jurisdictions of Canada along with the area affected due various causes of fire. The circles represent the number of forest fires in each jurisdiction and the area affected is shown using the blue light colour scheme

i.e. grey tones represent areas which were less affected due to forest fires whereas blue tones represent areas which were highly affected for the period from 1990 and 2020. It can be seen that the most fire incidents have occurred in BC (British Columbia) whereas in terms of area affected NT (Northwest Territories) stands ahead of all other jurisdictions.

Number of fire incidents and area affected for each jurisdiction

The number of fire incidents are not proportional to the areas affected (1990 - 2020)

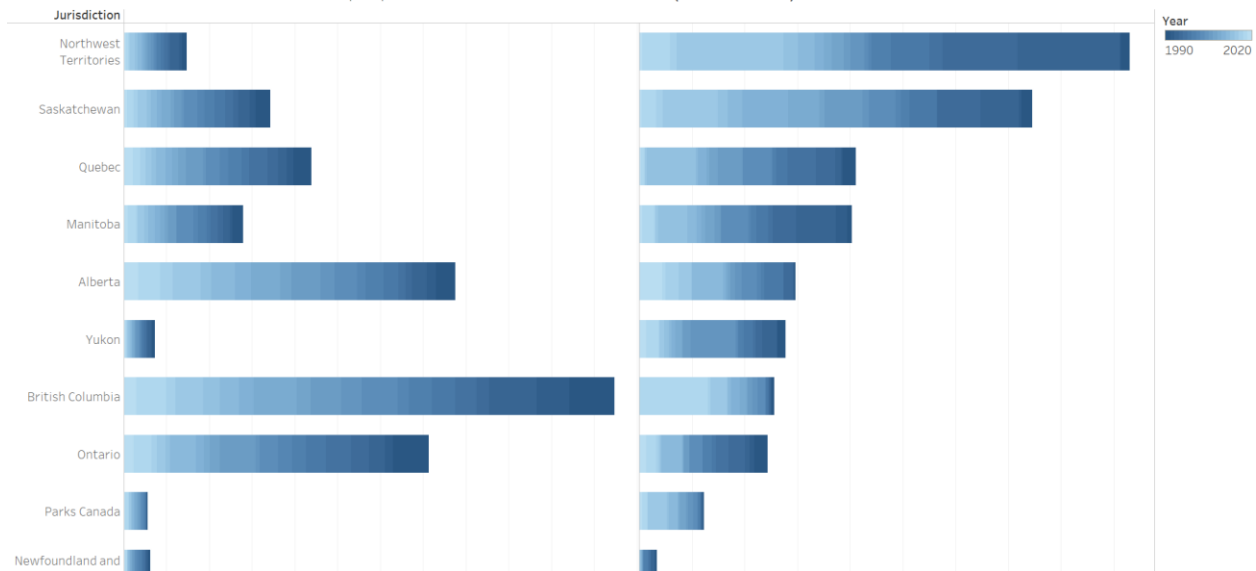


Figure 2

Figure 2 shows the relationship between number of fire incidents and area affected for each jurisdiction for the period under consideration. It can be seen that the number of fire incidents is not proportional to the area affected. For example, the number of forest fires in Northwest Territories is quite low; however, the area affected is the most. Similarly, British Columbia experienced the highest number of forest fires; however, the area affected was comparatively less. The graph also shows which jurisdictions need the utmost attention of the authorities who are concerned with forest fires as it can be seen that for some jurisdictions like Newfoundland and

Parks Canada, the proportionate number of forest fires and the area affected is significantly low when compared to the other jurisdictions. It can be observed from the trends that the number of fire incidents are not proportional to the areas affected for the given jurisdictions between specified periods.

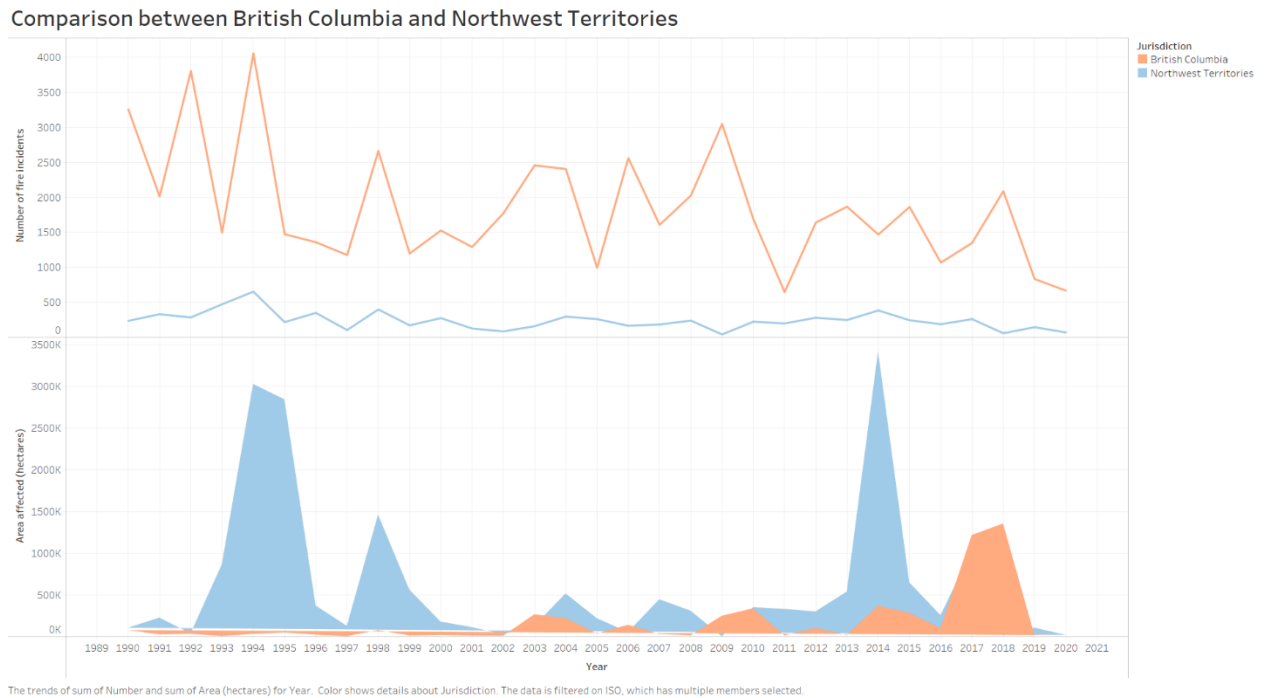


Figure 3

Figure 3 presents the comparison between the number forest fires and area affected for Northwest Territories and British Columbia. The visualization affirms that there is no relation between number of fire incidents and area affected as you can see that the area affected in Northwest Territories represented by the polygon is significantly high compared to the number of fire incidents represented by the line graph. A reverse trend is observed in case of British Columbia.

Year-wise comparison of top two forest fire causes

Although number of incidents due to the two causes are relatively same, the area affected due to lightening is significantly more

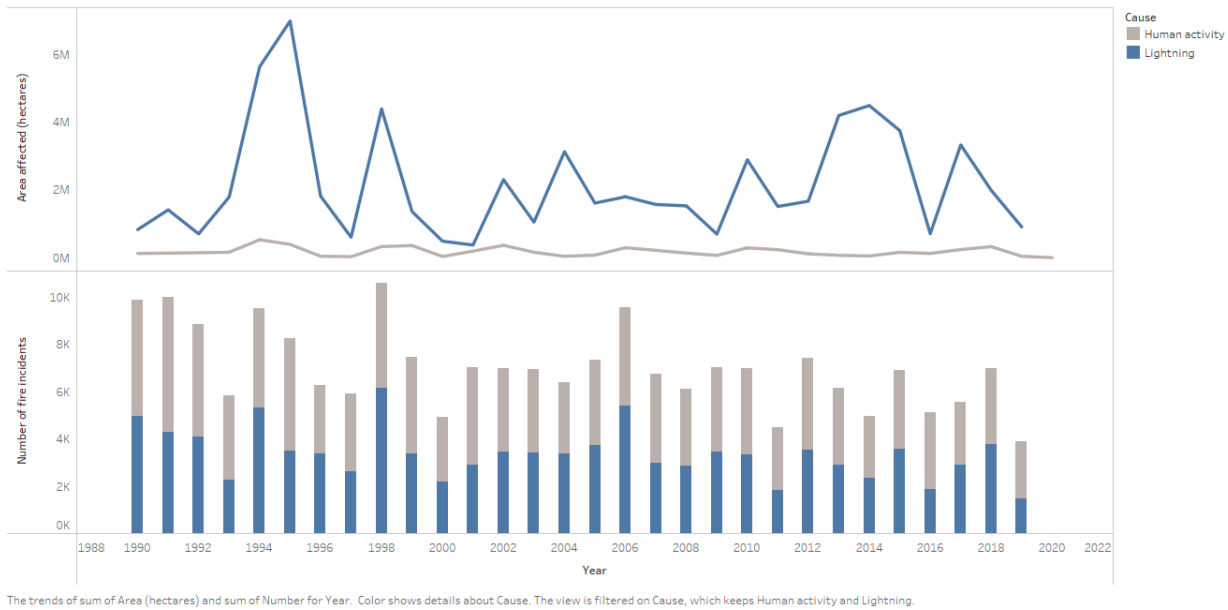


Figure 4

Figure 4 depicts the year-wise comparison of top two forest fire causes viz. lightning and human activity. The line graph represents the area affected in hectares due to the said causes and the bar chart represents the number of forest fires between 1990 and 2020. The main highlight of the graph is that the number of fire incidents due to the two causes are relatively same, but the area affected due to lightning is significantly more. Area affected by human activity had been almost constant all through the given time period whereas a lot of variation can be seen in case of lightning. The year with the highest area burned was 2014, with about 4.5 million hectares (ha) and the year with the smallest area burned was 2009, with about 800,000 ha. In terms of number of fire incidents, numbers are relatively same for both human activities and lightning. In terms of number of fire incidents, in 2019, there were about 4,000 forest fires, the smallest annual number of fires since 2009 and the highest number of wild land fires occurred in 2012, with about 8,000 fires.

It can be concluded from this figure that although there was no relation between number of forest fires and area affected. But area affected depends on the cause of forest fires.

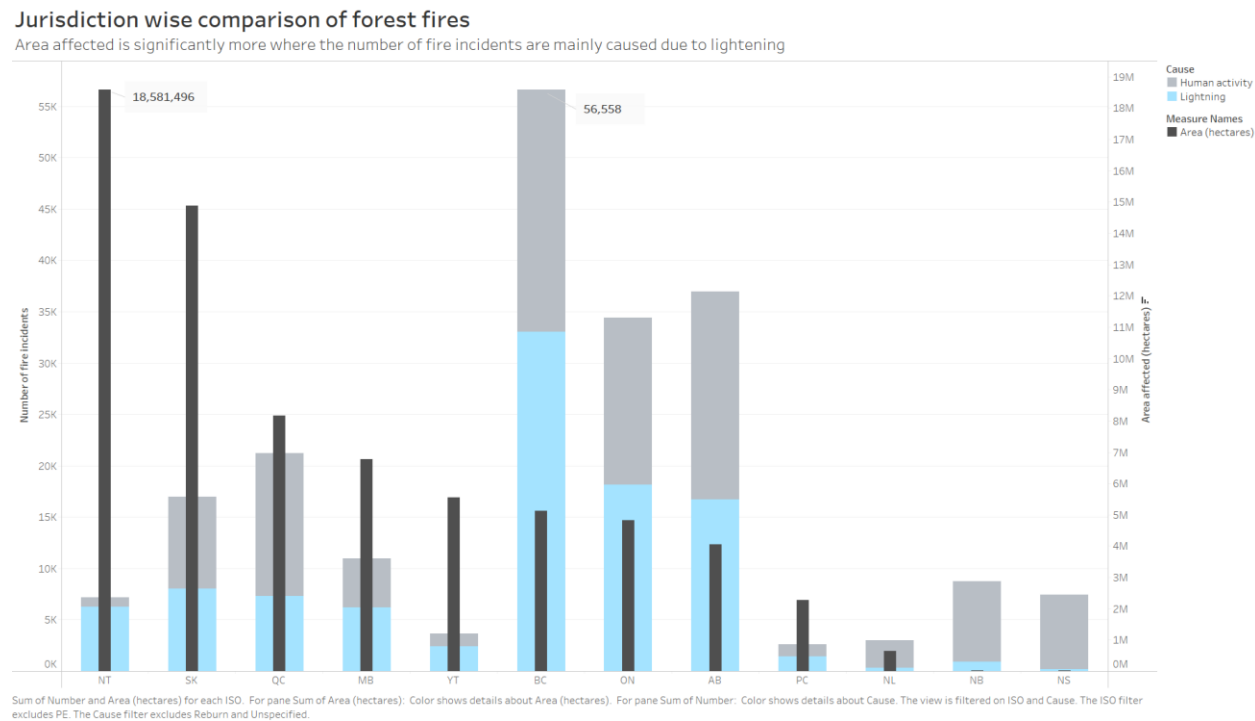


Figure 5

Figure 5 provides a jurisdiction wise comparison and affirms the previous conclusion that forest fires caused by lightening affects the area the most. The black coloured narrow-width bars represent the area affected in hectares for the given jurisdictions. We can see that area affected due to fire incidents between 1990 and 2020 is greatest for Northwest territories and least for New Brunswick and Nova Scotia. The wider bars behind the first bars represent the number of forest fires due to the two causes where blue shade represents lightening and grey shade represents human activity.

As it can be seen from the visualization, majority of fire incidents in Northwest Territories jurisdiction between 1990 and 2020 were due to lightening. Major proportion of forest fires in Nova Scotia and New Brunswick between 1990 and 2020 were result of human activities. For any given jurisdiction, the area affected due to forest fires is not proportional to the number of fire incidents but depends on the cause of forest fires. Area affected is greater for provinces where proportion of forest fires due to lightening is more than fire incidents due to human activity.

Conclusion:

Number of Fire Incidents due to various causes

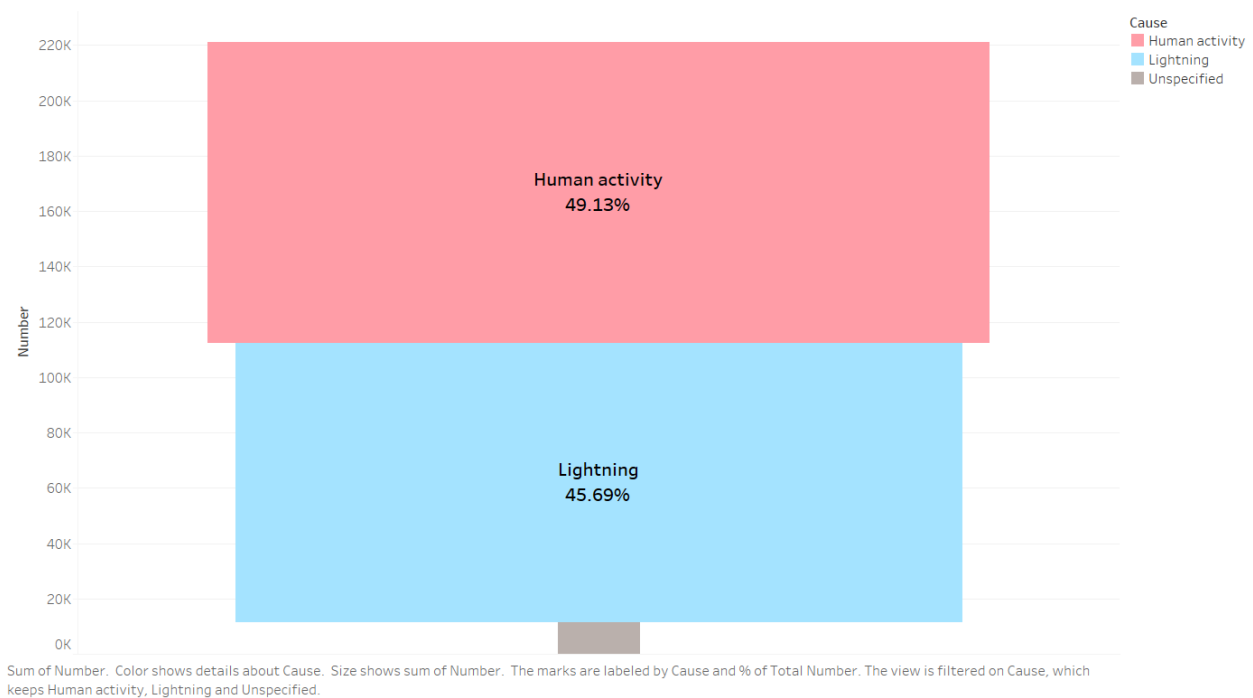


Figure 6

From the funnel graph (Fi), it can be inferred that number of forest fires caused by human activities and lightening are approximately the same. The percentage of number of forest fires caused by human activities is 49.13% and due to lightening is 45.69% which are almost similar.

Area affected due to various cases

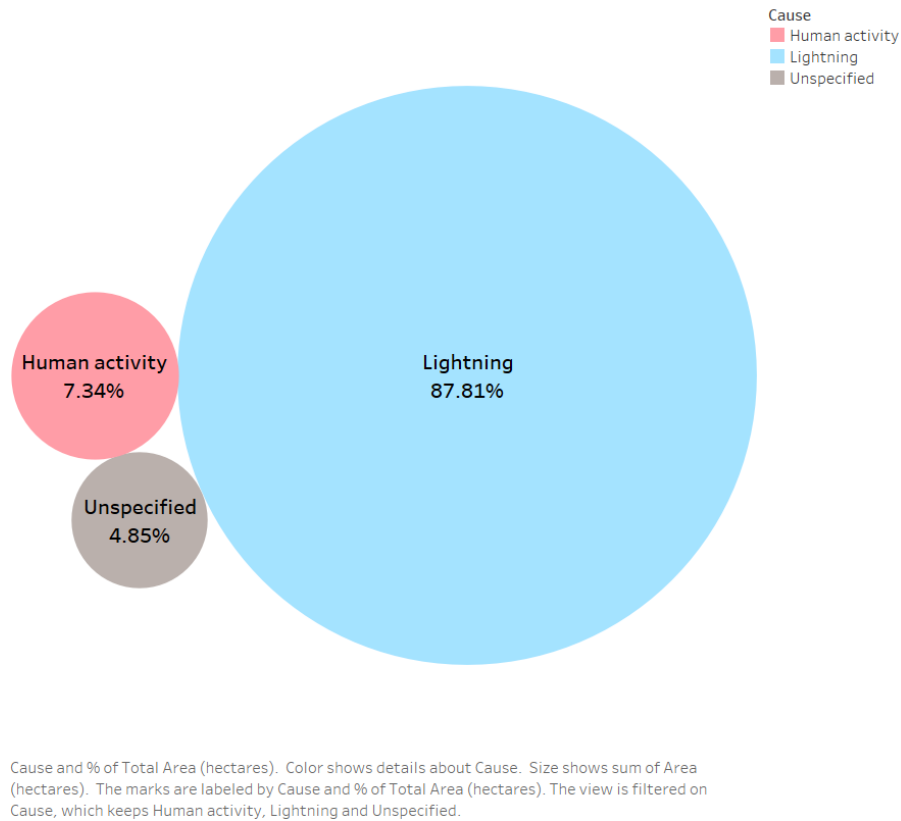


Figure 7

The bubble graph (Figure 7) shows the impact caused by lightening is significantly more as the area affected is the most. As it can be seen the percentage of area affected by human activity is only 7.34% while that of lightening is 87.81% which is notably high.

As lightening causes the most damage, climate change should be considered as a major threat and be taken seriously. Climate change may be sparking more lightning across the world, and there is an increasing scientific evidence pointing to the trend. An increase of one degree Celsius would increase the frequency of lightning strikes by 12 per cent, warned California University in

a study published 2015. A study published in Geophysical Research Letters in March 2021, too, has established links between climate change and rising incidences of lightning in the Arctic region. [3] Also, the number of lightning strikes recorded during the summer months between 2010 and 2020 shot up from around 18,000 at the start of the decade to more than 150,000 by 2020. Monitoring of lightning for climate science and services was limited. Hence, lightning was added to the Global Climate Observing System's list of Essential Climate Variables in 2016. [4]

In conclusion, the number of incidents due to the two causes are relatively same, but the area affected due to lightening is significantly more and number of forest fires are not proportional to the areas affected compared in various jurisdictions.

Recommendations:

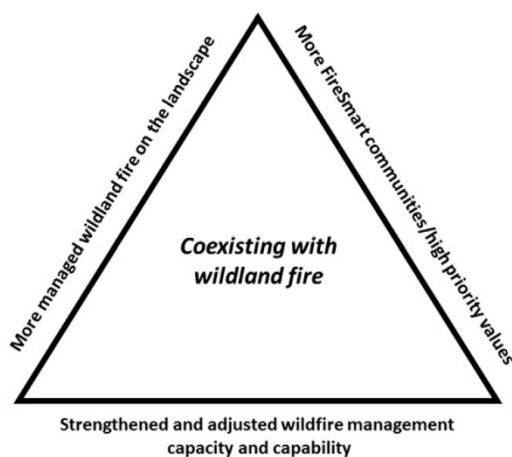
Wildfire impacts are likely to intensify as Canada's climate continues to warm at twice the global warming rate. Agencies therefore need to move from short-term fixes to transformational change to address the long-term picture.

In 2016, a review and renewed call to action of the Canadian Wildland Fire Strategy identified the need to increase preparedness capacity by

- 1) Enhancing firefighting capacity including the training and employment of Indigenous Peoples.
- 2) Renewing critical assets (e.g. aircraft, equipment and also highly qualified wildfire management personnel);

- 3) Maintaining or replacing critical infrastructure (e.g. communication and weather station networks, initial attack and air tanker bases);
- 4) Developing innovative solutions to overcome human resource challenges (e.g. staff recruitment and retention, skills upgrading). [1]

Initiatives can be taken by agencies to engage concerned departments to combine efforts to attain shared goals. This includes the further development of national standards, guidelines, terminology, decision support tools, and preparedness strategies. Further gains can also be made by enhancing data-sharing and integration, obtaining support, and leveraged funding to address operational wildfire research gaps, and developing innovative, integrated solutions



The given figure highlights the need of a paradigm shift in the approach to address the issue of wildfires due to climate change. It illustrates three approaches coexisting with wildfires. [1]

Most resource mobilization in Canada supports the response phase. Since the highest return on investment is at the preparedness phase, agencies should also consider the mobilization of resources to support both response and readiness. Transformational change within wildfire management to confront a rapidly changing world necessitates new skills upgrading. As wildfire events become more complex, and more decision support tools become available, enhanced training and education will be required to strengthen wildfire management capability. This

includes understanding the authorized roles and responsibilities of local, provincial, territory and federal agencies during a complex, multi-agency wildfire emergency. This component of wildfire preparedness requires agencies to foster and support a partnership culture before rather than during a disaster. As emergencies other than wildfire also increase in frequency and intensity, governments should consider the adoption of a single public safety agency under one ministry as a viable solution to improve internal coordination and cooperation. Although restructuring allows for a single point of contact it may not necessarily resolve organizational edge issues. The Canadian Wildland Fire Strategy ('CWFS') addresses the need for increased preparedness capacity but also identifies the need to enhance prevention and mitigation and support resilient communities through Fire Smart initiatives.

In order to move forward with the strategic objectives of the CWFS, the Wildland Fire Management Working Group ('WFMWG') has identified the following specific actions as critical:

1. Recommit to the strategy
2. Enhance horizontal collaboration and integration
3. Increase investment in innovation
4. Enhance prevention and mitigation capability
5. Enhance commitment to FireSmart and increase preparedness capacity [5]

The urgency is upon government, non-government agencies and the community to begin to act, as the consequences of inaction will only grow larger as time passes.

References:

1. <https://www.sciencedirect.com/science/article/pii/S2590061719300456>

[Research document on Wildfire Management in Canada and was used for facts and recommendations]

2. <https://www.nrcan.gc.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/forest-fires/13143>

[The webpage is about forest fires in Canada and its management and was used to obtain information regarding fire management]

3. <https://www.downtoearth.org.in/news/climate-change/lightning-strikes-linked-to-climate-change-1-697-killed-in-a-year-in-india-77897>

[The article talks about relation of lightning to climate change and was used to study the impact of climate change on lightning]

4. <https://www.canada.ca/en/environment-climate-change/services/lightning.html>

[The webpage gives information about forest fires in Canada caused due to lightning and was used for obtaining required statistics]

5. <https://d1ied5g1xfgpx8.cloudfront.net/pdfs/37108.pdf>

[The document pertains to Canadian Wildland Fire Strategy and was used to obtain information regarding the same]