

Planetary Health - Forest Fires in Chongqing

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Abstract: The World Health Organization introduced planetary health concept. That is, the planet's health is inextricably linked to human health. The recent spate of forest fires is a warning to take action against climate warming. This study explores the relationship between forest fires and human health and summarizes health promotion's role in forest fires in Chongqing from the perspective of the Ottawa Charter.

Keywords: Health Promotion; Forest Fires; Ottawa Charter; China

Introduction

Planetary health is the state of the earth that humans need to achieve to survive on the planet sustainably. The close connection between humans and the planet requires that humans find a state of health that allows human civilization to coexist in harmony with natural systems at the highest standard. Health here includes social-psycho-physical health and is equitable and worldwide^[1].

Since the health of the earth is inextricably linked to human health, this requires humans to address issues facing the health of the earth, such as soil degradation, ocean acidification, and climate change. Only when the planetary health problems are solved can human beings survive on the earth in the long term^[2].

Forest fires are one of these challenges. Forest fires are influenced by complex interactions between vegetation, climate, topography, and humans that can affect fire characteristics^[3,4]. Regional climate variability has been a significant driver of change in fire characteristics^[5,6]. Moreover, land use/cover and topography can also influence fire frequency and burn size. Furthermore, human activities such as cultural burning, logging, and fire protection can alter fire frequency and burn size^[7]. In recent years, global warming has led to higher temperatures in many countries, causing forest fires to occur more frequently than in the past in many areas^[8]. For example, forest fires in Australia have increased significantly since 2000^[9]. As of August 26, 2022, the duration of hot weather above 40 degrees has reached 15 days, eight days more than in 2006^[10].

The planetary health theme of this report is the impact of forest fires in Chongqing on natural systems and human health. This year's forest fires in Chongqing, southwest China, were the worst since 1961 due to prolonged dry and hot weather^[11]. Southwest China is a humid and hot subtropical broadleaf evergreen forest characterized by small fire size and high frequency of occurrence^[7]. In the past, burned areas in southwest China were lower than elsewhere and generally occurred in the spring and winter^[7]. However, this year forest fires occurred in August and were more extensive than in previous years^[10]. A literature search reveals that this year's forest fire situation is like 2008. Both 2008 and 2022 forest fires were due to a freezing winter experienced, and then a large forest fire occurred in China the following year^[12]. Some studies mention that this is due to the La Niña phenomenon resulting in severe weather such as heavy rainfall, high winds, drought, and extreme high and low temperatures^[13].

The frequent occurrence of forest fires will cause casualties and loss of land and resources^[14], which requires health promoters to educate residents about first aid in the face of fire, develop response policies, and provide fire-fighting

equipment. At the same time, further attention should be paid to the issue of global warming. Analyzing this forest fire incident will make people aware of the seriousness of the problem and then take action. In addition to this, forest burning itself will lead to the production of more greenhouse gases which will increase global warming^[15].

The study of forest fires in Chongqing, southwest China, was conducted to understand the impact of forest fires on natural systems and human health in this region. In addition, the role of health promotion in this challenge and further measures will be explored.

Human activities cause forest fires

First, urban sprawl is causing forest fires. Since Chongqing became a municipality directly under the central government in 1997, it has undergone intense urban development with a continuous outward expansion of the city limits^[16]. Natural forests have been severely damaged by urban expansion during this time, with only a few patches remaining around some mountain tops^[16]. At the same time, the urbanization process removes native vegetation and introduces exotic weed species. This process has led to the homogenization of biota and the loss of biodiversity^[17,18]. Both deforestation and ecosystem destruction will lead to a warmer climate. Climate warming coupled with the urban heat island effect will promote forest fires at the drop of a hat^[8,19]. For example, Chongqing recently experienced multiple wildfires in about six of the 26 districts and two of the 12 counties because of twelve consecutive days of high temperatures^[20,21]. High temperatures have also led to power outages and drought in the southwest^[21]. Second, regional culture induces forest fires. China has many traditional festivals and cultures, some of which have the traditional custom of fire worship, like the many temples in the hills of Chongqing where people can burn incense and worship Buddha. In order to worship ancestors, people also used to burn paper in the mountains to worship^[22]. All these behaviors will induce the occurrence of forest fires. In the last few years, the country has started to promote the use of flowers instead of burning paper to protect the environment. However, people are still accustomed to burning paper, and it will take time for this mindset to change^[23].

Forest fires pose a threat to human health

Forest fires have a direct impact on the surrounding residents. Chongqing is a city built on mountains and densely populated with over 32 million people^[11,24,25]. Since forests are not far from the city, forest fires can easily seriously impact the lives of the surrounding residents and pose a threat to their lives. Some residents complained on social media that they smelled smoke in their apartments, and some published photos had the burning embers of the fire reaching their balconies^[11]. The loss of greenery after burning the trees has caused psychological trauma to the surrounding residents^[26]. In addition, forest fires require a lot of human and material resources to extinguish the fires. Since mid-August 2022, the city of Chongqing has been battling a burning wildfire^[27]. As of August 25, more than 14,000 rescue workers have been sent to control the fire, while more than 1,800 Chongqing residents have been relocated^[21]. Firefighters from Sichuan, Gansu, and Yunnan provinces joined forces with Chongqing to fight the Chongqing forest fires. Over 20,000 people participated in the operation, from professional rescue teams to community volunteers^[10]. Local fire departments sent firefighters equipped with helicopters to fight the blaze from the air and on the ground^[27]. Although no casualties were reported in this incident, it was exhausting and frightening, affecting many people's ordinary lives. Furthermore, whether extreme weather will be more frequent in the future is still unknown, and effective control of forest fires is a concern.

Forest fires damage planetary health and cause indirect effects on human health

First, forest fires exacerbate climate warming. Recent studies have shown that forest fire emissions significantly impact

global interannual variability in terrestrial ecosystem fluxes and atmospheric CO₂^[28,29]. China's recent increase in forest fires has already increased CO₂ emissions, and the average annual carbon emissions from forest fires are about 11.31 Tg^[15]. Second, forest fires cause landslides. The heavy monsoon rains after the fire season can bring the risk of soil erosion and even landslides in the fire area, leading to soil erosion and a sharp decline in biodiversity^[30]. Third, forest fires produce toxic gases such as dioxins. Dioxin-like compounds are toxic, carcinogenic, mutagenic, and persistent in the environment. Forest fires, agricultural burning, and bushfires are considered the primary natural sources of dioxins^[31]. Hence, human actions cause forest fires, and forest fires affect planetary health and human health. They interact with each other and are closely linked in a cause-and-effect cycle.

Health promotion plays a vital role in the prevention of forest fires

Strengthening community action

The government has a good relationship with the public, and the public is actively involved in fighting fires. Many residents who witnessed the fire joined the local volunteer team to fight with the firefighters. Residents volunteered to form motorcycle teams, and volunteers rode mountain bikes to carry supplies to the top of the mountain^[32]. These young volunteers said, "We work mainly to deliver supplies to the supply center, and the front-line firefighters take the real risk^[21]." Some firefighters recalled that the motorcyclists were still delivering supplies to the mountain at 1 a.m., and some claimed that this was the first time he ate sorbet at the rescue site^[10,33]. All this stems from place identity and place-based pride of Chongqing people themselves. The rich nourishment of nature and the harsh environment have created their tenacious, brave, courageous character^[34]. They have a strong sense of responsibility for their homeland. In addition, the Chinese government has high prestige in the hearts of its people, a trust that has grown since the war and as China continues to grow stronger. Hence, this community culture should be valued by health promoters. It should be protected to form a guide among the population.

Developing personal skills

Local people and firefighters were given good health education in terms of developing personal skills. These educational measures include increasing public awareness of the impacts of wildfires and fire on ecosystems and human infrastructure to mitigate the effects of future wildfires. Firefighters also need ongoing professional training to improve their understanding and judgment of fire behavior to minimize incidents and reduce fatalities. Moreover, governments and firefighting agencies must emphasize to civilians not to extinguish rapidly spreading wildfires by themselves but to notify and wait for professional firefighting teams^[15]. Chongqing made significant progress this year with almost no casualties in any of these fire incidents, compared to the 200 people who lost their lives in the fires in Northeast China in 1987^[35]. Therefore, these fire education efforts are practical and need to be continued. The most recent fires in Chongqing have raised concerns about climate change among residents. Health promoters should hit the iron and further educate and encourage people to take action against global warming.

Reorienting health services

China has begun to focus on forest fire prevention. Over the past 30 years, China has developed meteorological and environmental satellite sensors to detect forest fires in and around the country. These satellites have created more accurate and efficient operational systems for fire detection, emission estimation, and risk prediction^[15]. The next step that needs to be advanced includes mapping a forest fire risk area to minimize fire frequency and avoid damage. Developing a new fire hazard and risk model to predict forest fires and accurately forecast El Niño events is critical^[15]. Estimating forest fire

emissions based on satellite sensors is significant and complex. More research should be conducted to detect forest burned areas, debris from burn scars, fuel loads, and biomass based on multiple sensors. Further investigation, analysis, and calculation of the proportion of fuels consumed by forest fires and emission factors for different vegetation types are necessary for future quantitative assessment and validation of forest fire emissions in China^[15]. These actions require health promoters to work with multiple sectors to ensure further improvement of the fire prevention system.

Creating a supportive environment

Creating a supportive environment includes a variety of aspects. The following will sort out and provide suggestions based on the issues mentioned in this report. In the face of urban sprawl, health promoters should work with environmental authorities to analyze the pros and cons of government urbanization plans and provide sound advice. Traditional ritual culture needs to be gradually changed through health education, and fines should sometimes be imposed. As people are traumatized by forest fires, health promoters need to provide post-disaster guidance and strengthen community ties so that people have a place to pour out what is on their minds and help rebuild after the disaster. In addition, health promoters need to actively communicate with the government to ensure adequate funding is available to support fire rescue and prevention efforts. Finally, health promotion should focus on forest reconstruction and strengthen the monitoring and prevention of gases released from forest burning. In summary, implementing these recommendations will help create a supportive environment that includes economic, service, physical, and social aspects.

Establishing healthy public policy

China already has many laws and regulations related to forest fires. China has a well-established fire protection law and forest law. Fire Protection Law of the People's Republic of China stipulates the legal responsibilities and provisions related to fire prevention, firefighting, and rescue^[36]. Forest Law of the People's Republic of China includes legal duties related to the management and administration, supervision, and inspection of forest protection, afforestation, and land greening^[37]. However, the changing climatic environment has created new requirements for forest fire protection. The current spate of forest fires calls for more policies to curb global warming. In response, China has proposed a green policy of energy saving and emission reduction^[38]. Through health communication, the Chongqing government has decided to accelerate the construction and production of high-quality new energy vehicle projects^[39]. Although some green policies have been introduced, it does not seem to have much effect. Therefore, health promoters still need to mediate with stakeholders and promote more emission reduction policies.

Conclusion

Human systems depend on planetary health, and planetary health is influenced by human behavior, forming a closed loop. In this concentric ring, health promotion works for both human health and planetary health. Health promotion can improve the inhabitants' quality of life and well-being and reduce environmental hazards to protect the planet. Hence, health promotion plays an essential role in the whole process of forest fire prevention. Although the current forest fires can be addressed appropriately, global warming has not yet stopped, and this will require more effort from health workers.

References

- [1] Whitmee S, Haines A, Beyrer C, Boltz F, Capon AG, Dias BF de S, et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The Lancet*. 2015 Nov 14;386(10007):1973–2028.
- [2] Horton R, Lo S. Planetary health: a new science for exceptional action. *The Lancet*. 2015 Nov 14;386(10 007):1921–2.

- [3] Rollins MG, Keane RE, Parsons RA. Mapping Fuels and Fire Regimes Using Remote Sensing, Ecosystem Simulation, and Gradient Modeling. *Ecol Appl*. 2004;14(1):75–95.
- [4] Perry DA, Hessburg PF, Skinner CN, Spies TA, Stephens SL, Taylor AH, et al. The ecology of mixed severity fire regimes in Washington, Oregon, and Northern California. *For Ecol Manag*. 2011 Sep 1;262(5):703–17.
- [5] Raymond CL, McKenzie D. Carbon dynamics of forests in Washington, USA: 21st century projections based on climate-driven changes in fire regimes. *Ecol Appl*. 2012;22(5):1589–611.
- [6] Sibold JS, Veblen TT, González ME. Spatial and temporal variation in historic fire regimes in subalpine forests across the Colorado Front Range in Rocky Mountain National Park, Colorado, USA. *J Biogeogr*. 2006;33(4):631–47.
- [7] Chang Y, Zhu Z, Bu R, Li Y, Hu Y. Environmental controls on the characteristics of mean number of forest fires and mean forest area burned (1987–2007) in China. *For Ecol Manag*. 2015 Nov 15;356:13–21.
- [8] Liu Y, Stanturf J, Goodrick S. Trends in global wildfire potential in a changing climate. *For Ecol Manag*. 2010 Feb 5;259(4):685–97.
- [9] Canadell JG, Meyer CPM, Cook GD, Dowdy A, Briggs PR, Knauer J, et al. Multi-decadal increase of forest burned area in Australia is linked to climate change. *Nat Commun*. 2021 Nov 26;12(1):6921.
- [10] Zheng R, Tan M. Over 20,000 People Devoted to Extinguishing Fires in Chongqing [Internet]. *iChongqing*. 2022 [cited 2022 Sep 14]. Available from: <https://www.ichongqing.info/2022/08/27/over-20000-people-devoted-to-extinguishing-fires-in-chongqing/>.
- [11] McCarthy SD. Wildfires rage as China's Chongqing suffers unrelenting record heat wave [Internet]. *CNN*. 2022 [cited 2022 Sep 14]. Available from: <https://www.cnn.com/2022/08/23/china/china-heat-wave-chongqing-wildfires-intl-hnk/index.html>.
- [12] Wu Z, Yan S, He L, Shan Y. Spatiotemporal changes in forest loss and its linkage to burned areas in China. *J For Res*. 2020 Dec 1;31(6):2525–36.
- [13] Tian XR, Zong XZ, Shu LF, Wang MY, Zhao FJ. [Impacts of ENSO events on forest fire weather of China]. *Ying Yong Sheng Tai Xue Bao J Appl Ecol*. 2020 May;31(5):1487–95.
- [14] Zong X, Tian X, Yao Q, Brown PM, Zong X, Tian X, et al. An analysis of fatalities from forest fires in China, 1951–2018. *Int J Wildland Fire*. 2022 Apr 4;31(5):507–17.
- [15] Zhang JH, Yao FM, Liu C, Yang LM, Boken VK. Detection, emission estimation and risk prediction of forest fires in China using satellite sensors and simulation models in the past three decades--an overview. *Int J Environ Res Public Health*. 2011 Aug;8(8):3156–78.
- [16] Yang Y, Yuan X, Li B, Sun R, Wang Q. Characteristics and significance of the remnant evergreen broad-leaved forest in the urban area of Chongqing, China. *Biodivers Sci*. 2007 May 20;15(3):247.
- [17] McKinney ML. Urbanization as a major cause of biotic homogenization. *Biol Conserv*. 2006 Jan 1;127(3):247–60.
- [18] McKinney ML. Urbanization, Biodiversity, and Conservation: The impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems. *BioScience*. 2002 Oct 1;52(10):883–90.
- [19] Wotton BM, Nock CA, Flannigan MD, Wotton BM, Nock CA, Flannigan MD. Forest fire occurrence and climate change in Canada. *Int J Wildland Fire*. 2010 May 13; 19(3): 253–71.
- [20] China battles forest fire in Chongqing region [Internet]. [cited 2022 Sep 17]. Available from: <https://news.yahoo.com/china-battles-forest-fire-chongqing-092053191.html>.
- [21] Tone S. Volunteers Band Together to Help Battle Wildfires in Chongqing [Internet]. *#SixthTone*. 2022 [cited 2022 Sep 17]. Available from: <https://www.sixthtone.com/news/1011076/https%3A%2F%2Fwww.sixthtone.com%2Fnews%2F1011076%2Fvolunteers-band-together-to-help-battle-wildfires-in-chongqing>.

- [22] Scott JL. For Gods, Ghosts and Ancestors: The Chinese Tradition of Paper Offerings [Internet]. Hong Kong: Hong Kong University Press, HKU; 2007 [cited 2022 Sep 17]. Available from: <http://muse.jhu.edu/book/5617>.
- [23] China moves to ban burning joss paper to cut pollution and help the environment, but many say it disrespects tradition | South China Morning Post [Internet]. [cited 2022 Sep 17]. Available from: <https://www.scmp.com/news/people-culture/article/3127005/china-moves-ban-burning-joss-paper-cut-pollution-and-help>
- [24] Guo J, Han G, Xie Y, Cai Z, Zhao Y. Exploring the relationships between urban spatial form factors and land surface temperature in mountainous area: A case study in Chongqing city, China. *Sustain Cities Soc.* 2020 Oct 1;61:102286.
- [25] Yang Y, Fujihara M, Li B, Yuan X, Hara K, Da L, et al. Structure and diversity of remnant natural evergreen broad-leaved forests at three sites affected by urbanization in Chongqing metropolis, Southwest China. *Landsc Ecol Eng.* 2014 Jan 1;10(1):137–49.
- [26] To P, Eboreime E, Agyapong VIO. The Impact of Wildfires on Mental Health: A Scoping Review. *Behav Sci Basel Switz.* 2021 Sep 21;11(9):126.
- [27] Chongqing Municipality battles wildfires amid extreme heat [Internet]. [cited 2022 Sep 17]. Available from: <https://news.cgtn.com/news/2022-08-25/Chongqing-Municipality-battles-wildfires-amid-extreme-heat-1cN5BUUTxVC/index.html>.
- [28] Patra PK, Ishizawa M, Maksyutov S, Nakazawa T, Inoue G. Role of biomass burning and climate anomalies for land-atmosphere carbon fluxes based on inverse modeling of atmospheric CO₂. *Glob Biogeochem Cycles* [Internet]. 2005 [cited 2022 Sep 18];19(3). Available from: <http://onlinelibrary.wiley.com/doi/abs/10.1029/2004GB002258>.
- [29] Boschetti L, Roy DP. Defining a fire year for reporting and analysis of global interannual fire variability. *J Geophys Res Biogeosciences* [Internet]. 2008 [cited 2022 Sep 18]; 113(G3). Available from: <http://onlinelibrary.wiley.com/doi/abs/10.1029/2008JG000686>.
- [30] Luo C, Shen Z, Li Y, Han J, Pausas JG, Xu Q, et al. Determinants of post-fire regeneration demography in a subtropical monsoon-climate forest in Southwest China. *Sci Total Environ.* 2021 Apr 20;766:142605.
- [31] Salamanca M, Chandía C, Hernández A. Impact of forest fires on the concentrations of polychlorinated dibenzo-p-dioxin and dibenzofurans in coastal waters of central Chile. *Sci Total Environ.* 2016 Dec 15;573:1397–405.
- [32] Chinese motorcyclists join wildfire battle. *BBC News* [Internet]. [cited 2022 Sep 18]; Available from: <https://www.bbc.com/news/av/world-asia-china-62770119>.
- [33] “True Heroes of the City”: Sparks of Patriotism as Firefighters Contain Chongqing Wildfire [Internet]. [cited 2022 Sep 18]; Available from: <https://www.chinaculturetour.com/chongqing/culture.htm>
- [34] Culture in Chongqing, Chongqing Local Culture. [Internet]. [cited 2022 Sep 18]. Available from: <https://www.chinaculturetour.com/chongqing/culture.htm>
- [35] Satellite analysis of the severe 1987 forest fires in northern China and southeastern Siberia - Cahoon - 1994 - Journal of Geophysical Research: Atmospheres - Wiley Online Library [Internet]. [cited 2022 Sep 18]. Available from: <https://agupubs.onlinelibrary-wiley-com.ezproxy.library.uq.edu.au/doi/abs/10.1029/94JD01024>.
- [36] Fire Protection Law of the People’s Republic of China. :14.
- [37] Forest Law of the People’s Republic of China [Internet]. [cited 2022 Sep 20]. Available from: https://english.mee.gov.cn/Resources/laws/envir_elatedlaws/202102/t20210207_820735.shtml.
- [38] Wang M, Feng C. How will the greening policy contribute to China’s greenhouse gas emission mitigation? A non-parametric forecast. *Environ Res.* 2021 Apr;195:110779.
- [39] Yan V, Tan M. To Develop More Quality New Energy Vehicles in 2022 | Chongqing Two Sessions [Internet]. iChongqing. 2022 [cited 2022 Sep 20]. Available from: <https://www.ichongqing.info/2022/01/20/to-develop-more-quality-new-energy-vehicles-in-2022%E4%B8%A8chongqing-two-sessions/>.