Table 2. Underlying Causes of Forest Fire in AFoCO Member Countries

Activities	Member Countries
1. Carelessness (e.g., accidental human activities or negligence)	Bhutan, Brunei Darussalam, Cambodia, Lao PDR, Myanmar, Singapore, Thailand
2. Human activities for daily livelihood and recreation (e.g., hunting, honey harvesting, resin collection, etc.)	Bhutan, Cambodia, Indonesia, Lao PDR, Myanmar, Thailand, Viet Nam
3. Poor agricultural practices (e.g., open burning for land preparation, agricultural debris burning, etc.)	Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Viet Nam
4. Shifting cultivation or slash-and-burn	Cambodia, Lao PDR, Myanmar, Viet Nam
5. Arson	Indonesia, Malaysia, Philippines, Thailand
6. Land conversion for new settlements, agriculture, concession, etc.	Brunei Darussalam, Cambodia, Myanmar
7. Limited capacity on addressing forest fire problems (e.g., human resource, technology, financial, etc.)	Cambodia, Indonesia, Myanmar, Philippines
8. Conflicts (e.g., policy conflict, human-wildlife conflict, etc.)	Bhutan, Philippines, Thailand
9. Land encroachment	Cambodia, Thailand, Myanmar
10. Limited awareness and experience on fire prevention	Cambodia, Indonesia, Myanmar
11. Natural causes (e.g., lightning)	Bhutan, Kazakhstan, Mongolia

Source: Country reports from the Member Countries at the AFoCO Short-Term Training Course on Forest Fire Management Information System, 1-5 November, 2021

THE WAY FORWARD

Wildfires, in a way, are an inevitable part of the environment. Some are necessary for fire-dependent ecological systems, but lately due to climate change, an increasing number of destructive fires have occurred worldwide. It is expected that the frequency, severity, and intensity of wildfires will increase with longer fire seasons because of higher temperatures and drier fuels associated with climate change. The global commitment to limit global warming to by 1.5℃ after Paris Agreement 2015 is closely linked to forest fire management strategies.

The 26th UN Climate Change Conference of the Parties (COP26) in Glasgow in November 2021 reconfirmed that the climate crisis is real and requires a joint global response. Post-COVID-19 economic recovery plans of Member Countries will also affect how well each country can play a part in reducing the effects of climate change. Therefore, understanding the trend of fire regimes, including their history, current situation, and future projections, is important. The following interventions are recommended for a holistic and integrated approach to forest fire prevention, control, and management and to ensure the involvement of all stakeholders:

1. Develop an effective management system with rules, regulations, and restrictions to ensure effective prevention and minimize damage and loss from fire and smoke haze.
2. Build a network to share knowledge, lessons learned, problems, best practices, and find solutions in FFMIS. In addition, study more on fire, smoke haze behaviors.
3. Find an easier and simpler communication schema to deliver scientific information to decision-makers and policy-makers to ensure their support for effective fire prevention and management at all administrative levels.
4. Raise public awareness and inform the public about fire prevention and control in all possible ways such as campaigns, training or personal visits, etc.
5. Implement community-based fire management with a holistic ethical approach to sustainability. It is imperative to combine modern knowledge of fire management with deep local wisdom.
6. Try to understand the nature and timing of burning and find solutions that need to be adapted to the local and regional context.
7. Try to approach human behaviors underlined in causes of forest fire, considering underlying socio-economic and conflict factors.
8. Strengthen all kinds of regional and international cooperation through real commitments made by the respective countries to effectively address and resolve the problems of fire and smoke haze.

Asian Forest Cooperation Organization (AFoCO)

AFoCO is a treaty-based intergovernmental organization that is committed to strengthening forest cooperation and taking concrete actions to promote sustainable forest management and address the impacts of climate change.

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Envisioning an Integrated Information System for Forest Fire Management

Current Status and the Way Forward

BACKGROUND

Wildfires — also called forest fires or bush fires — are the uncontrolled burning of plants and vegetation in an area due to physical, biological, ecological, and environmental circumstances, including weather conditions. Generally, the majority of wildfires are the result of human activities driven by demographic pressure, the expansion of agricultural land, and the conversion of forest land into other land uses.

Wildfires have beneficial effects on some ecosystems, such as by rejuvenating forests for some species, and are important for land management and the functioning of ecological processes. But wildfires also pose risks to people, wildlife, and property when poorly managed and cause drastic environmental damage in most cases. According to the European Space Agency (ESA), fire affects an estimated 4 million square kilometers of Earth's land each year[1]. According to the Centre for Research on the Epidemiology of Disasters, there have been at least 470 wildfire accidents worldwide since 1911, resulting in at least $120 billion in damage[2].

The faster a fire is detected, the more rapid the response and the less the damage and impact to ecosystems. Accordingly, early warning systems, which can conduct near-real-time or real-time fire detection and monitoring, are emerging as important components in effective forest fire control and management. Therefore, to understand the technology application trend for forest fire information and management, AFoCO Regional Education and Training Center organized the training course entitled "Forest Fire Management Information System" from 1 to 5 November 2021

Key Messages

1. Forest fire needs to be understood as part of a climate change regime, based on a data science-based forest fire management information system.
2. Solutions should be explored in line with a holistic understanding of the challenges and obstacles in order to ensure the participation of all stakeholders.
3. It is essential to invest in activities to raise public awareness about wildfires to increase the nationwide forest fire prevention level.

AFoCO regular training on community-based forest fire management ©AFoCO

[1] ESA Climate Office, 2021. Multi-Decade Global Fire Dataset To Support Trend Analysis. Available at: https://climate.esa.int/de/news-events/multi-decade-global-fire-dataset-set-support-trend-analysis/

[2] (Secondary data) Mapping wildfires around the world, 2021, August 19. Available at: https://www.aljazeera.com/news/2021/8/19/mapping-wildfires-around-the-world-interactive

POLICY HIGHLIGHTS ON FOREST FIRE MANAGEMENT INFORMATION SYSTEMS IN AFoCO REGION

Based on the problem statements outlined by each country, the core problem at the regional level was identified as "The risk of forest fires in the absence of an integrated operating system for effective forest fire management," wherein three main issues were raised as main causes (Figure 1).

1. *There is a lack of holistic readiness for the forest fire management information systems.*

Forest fire management is a complicated issue correlated with human behaviors and natural and environmental consequences.

The management of fire, smoke, and haze can be effectively broken down into seven fundamental steps: (1) prevention, (2) monitoring, (3) prediction, (4) warning, (5) response, (6) recovery/mitigation & after-action-review/mitigation & after-action-review/assessment, and (7) identify advantages/disadvantages, ways out & improvement. Among these steps, PREVENTION is the most fundamental one, with the saying, "Prevention is better than a cure." Also, in operating forest fire management information systems conducting monitoring, prediction, and warning, the faster a fire is detected, the lesser the damage and impact to ecosystems. For those purposes, fire early warning information plays an essential role in the forest fire control planning process and daily operation, such as the Fire Danger Rating System (FDRS), Wildland Fire Decision Support System (WFDSS), etc.

However, most Member Countries are not ready to access a holistic fire management scheme with advanced tools and technologies. Some countries have responded that they are operating their national preparedness activities for fire management, as shown in Table 1. Despite a level of technological development in some countries' fire management systems, most participants shared the view that machinery and equipment for firefighting are still deficient at the regional and local level in most Member Countries. The provision of forest fire equipment is one aspect of setting up nationwide forest fire prevention systems.

Smoke and haze are difficult to manage and measure, as they are transboundary issues. Likewise, while satellite-based open-source monitoring systems are globally and regionally operated (e.g., Global Fire Assimilation System (GFAS)-Copernicus Atmosphere Monitoring Service (CAMS), SERVIR Mekong, ASEAN Specialised Meteorological Centre), air quality measurement stations to reflect the real smoke haze situation are still limited within the countries. Based on the joint milestones of partner organizations (e.g., Peace Forest Initiative of UNCCD), it is also critical to develop capacity-building platforms as part of its control, management, and planning to utilize proper and effective knowledge and proven technologies.

Table 1. National Wildfire Information Systems

Country	National Wildfire Information System
Bhutan	No system at the national level
Brunei Darussalam	No system at the national level
Cambodia	No system at the national level, Open-source FDRS provided by Thailand, officially requested in 2016
Indonesia	1.National forest and land fire early warning system (SiPONGi+) 2.National fire danger rating system (FDRS) (SIPANDORA)
Kazakhstan	No system at the national level
Kyrgyzstan	No system at the national level
Lao PDR	No system at the national level, Open-source FDRS provided by Thailand, officially requested in 2016
Malaysia	Malaysia Observation Fire Danger Rating System
Mongolia	No system at the national level
Myanmar	No system at the national level, Open-source FDRS provided by Thailand
Philippines	No system at the national level
Singapore	Forest Fire Detection and Monitoring System (FFDMS)
Thailand	1.National FDRS at Department of National Park Wildlife and Plants Conservation 2.National FDRS at Royal Forest Department (Open source FDRS)
Viet Nam	National FDRS

Source: Country reports from participating Member Countries at the AFoCO Short-Term Training Course on Forest Fire Management Information System, 1-5 November, 2021

2. *Socio-economic factors must be considered as a key driver of forest fires.*

In order to maximize the beneficial effects of advanced tools and technology, it is critical to recognize human behaviors as a vital factor. With reference to the country reports, human activities are widely embedded as major causes of forest fire in the region, including land clearing for agricultural activities, slash-and-burn or shifting cultivation, settlement, concession, non-timber forest product harvesting, logging, carelessness, conflicts, and hunting (Table 2).

Among these, poverty is observed as a key driver for the frequency of forest fires. For example, to migrant farmers, shifting cultivation is still prevalent, and burning is the easiest and cheapest preparation method for land clearance. Therefore, in line with public awareness activities, long-term approaches to developing alternative land management methods and income sources are necessary to change people's fire ignition habits and cultivation methods.

Land conversion using fire for the concession is another socio-economic phenomenon as it is the least expensive method for clearing forest and preparing land for agriculture and other purposes. Not only indigenous communities or poor migrants but also land speculators and forest estate companies widely use fire for land conversion. Naturally, arson commonly occurs from conflicts surrounding these matters, which can sometimes cause devastating fires.

Last but not least, it is necessary to understand the behavior patterns of people who use fire as a tool for effective and efficient fire prevention. In Mongolia, for example, people typically play an important role in fire suppression and management using traditional tools and means of transport.

Indeed, fire prevention measures should consist of awareness-raising programs or campaigns that demonstrate simple and safe fire suppression methods to educate people on ways to control forest fires. There should also be public health programs to inform people of the consequences of fire — how it affects weather and climate, results in air pollution, causes a range of health issues such as respiratory and cardiovascular problems, and even impacts mental health and psychosocial well-being, according to a recent report from UN World Health Organization (WHO).

3. *Forest fire needs to be understood as part of a climate change regime.*

The fire triangle consisting of oxygen, heat, and fuel provides a visual guide of the core elements needed for a fire to ignite. In a fire regime, this triangle is interpreted as climate, human activities, and vegetation, respectively. Among the three, the factor "climate" has shown a dramatic change as detected in global data from the last half-century. Changing temperature and precipitation patterns due to climate change result in longer fire seasons and are expected to increase how frequently forest fires occur and how much area they burn. Warmer temperatures are likely to cause rapid evapotranspiration and desiccation of wildland vegetation, and the resulting drier conditions increase the frequency and number of fires. Accordingly, increased temperatures imply longer fire seasons as a result. Eventually, drastic changes in fire seasons and patterns can raise global temperatures[3], further impacting and changing the fire regime.

Additionally, lightning-induced fire is one of the natural factors observed in Central Asian Countries such as Kazakhstan and Kyrgyzstan. The frequency of lightning ignition is relatively high, owing to the countries' continental climate and the regular occurrence of thunderstorms during Kazakhstan's fire season between April and September . Kazakhstan's country report states that about 32.5% of its forest fires are caused by lightning. Yet in addition to the identified causes, both Kazakhstan and Kyrgyzstan have high rates of forest fires with unknown causes, at 48.5% and 78.5%, respectively, according to their country reports.

BOX 1. Training Summary

The training course entitled 'Forest Fire Management Information System' was virtually organized from November 1 to 5, 2021, and welcomed 47 participants from 14 AFoCO Member Countries: Bhutan, Brunei Darussalam, Cambodia, Indonesia, Kazakhstan, Kyrgyzstan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Thailand, Singapore, and Viet Nam. A total of eight sessions were led by the trainers of Kasetsart University, Thailand, Food and Agriculture Organization of the UN, National Research and Innovation Agency, President Office of Indonesia, Planning, Directorate of Forest and Land Fire Management of Indonesia, and Kyungpook National University of the Republic of Korea.

The course aimed to:

- describe and enhance the understanding of integrated forest fire management;
- explore the available forest fire detection and monitoring systems and relevant forest technology; and
- share the knowledge and experience of the best practices of forest fire management in AFoCO.

[3] Flannigan, M., A.S. Cantin, W.J. de Groot, M. Wotton, A. Newbery, and L.M. Gowman.2013. Global wildland fire season severity in the 21st century. Forest Ecology and Management 294: 54–61. Available at: http://dx.doi.org/10.1016/j.foreco.2012.10.022