2025

FORREST FIRES GUIDELINES

NATIONAL DISASTER MANAGEMENT AUTHORITY
PAKISTAN

Forest Fires in Pakistan: A Threat to Nature

Forest plays an important role in maintaining environmental balance by supporting biodiversity, regulating climate, and providing resources such as timber and non-timber products. Forest fires are among the main factors causing huge damage to forest ecosystem and in larger context climate change. Forest fires are anticipated to occur with increased frequency and severity due to global warming, posing greater threats to the atmosphere, terrestrial ecosystems, and human society. Pakistan has become increasingly vulnerable in recent years to the effects of climate change, which has made forest fire incidences worse. According to World Wide Fund (WWF) for Nature, Pakistan is classified as a forest deficient country with less than 6 percentage of its total area categorized as forested. The country climate is primarily shaped by its geographical location and topography resulting in diverse climatic conditions.

Majority of country falls within arid and semi-arid zones leading to extremely hot dry and prolonged summers. Forest Fires risk are increased during the summer season due to above-average temperature and declining precipitation pattern. May and June are considered as the driest and hottest months of Pakistan and made conducive environment for forest fires to occur. Distribution of forests varies by province and other administrative area; it is highest in Khyber Pakhtunkhwa, followed by Sindh, Punjab, Balochistan, Azad Jammu and Kashmir and Gilgit-Baltistan. These guidelines focused only on the natural forest fires hazard assessment which occur in the month of May and June. Meteorological parameters relevant to forest fires include temperature, windspeed, humidity. By addressing meteorological, climatological and socio-economic dimension, the guidelines aim to enhance country resilience to heat related disasters while advancing climate adaptation and mitigation objectives.

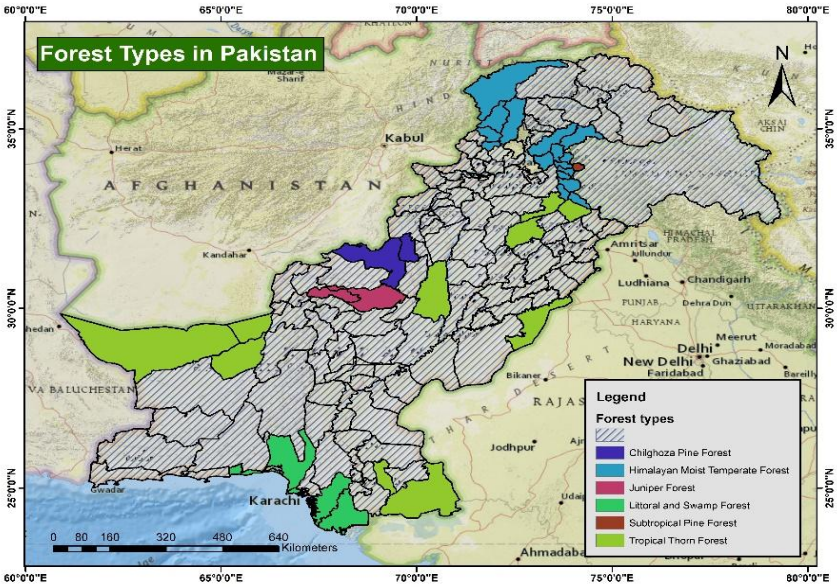

Figure: 1 Map of Different Forest types in Pakistan

From 2001 to 2024, Khyber Pakhtunkhwa had the highest rate of tree cover loss due to fires with an average of 244 ha lost per year.

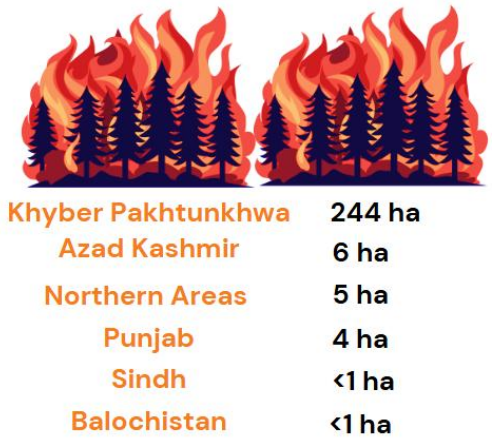

Figure: 2 Total tree Cover loss from fires in different provinces of Pakistan (2001-2024)

Forest fires are an ever-present hazard particularly in the Northern Mountains of Khyber Pakhtunkhwa, Pakistan due to several factors, including the dry climate, barren environment, human encroachment on forest land, and highly combustible crops like maize.

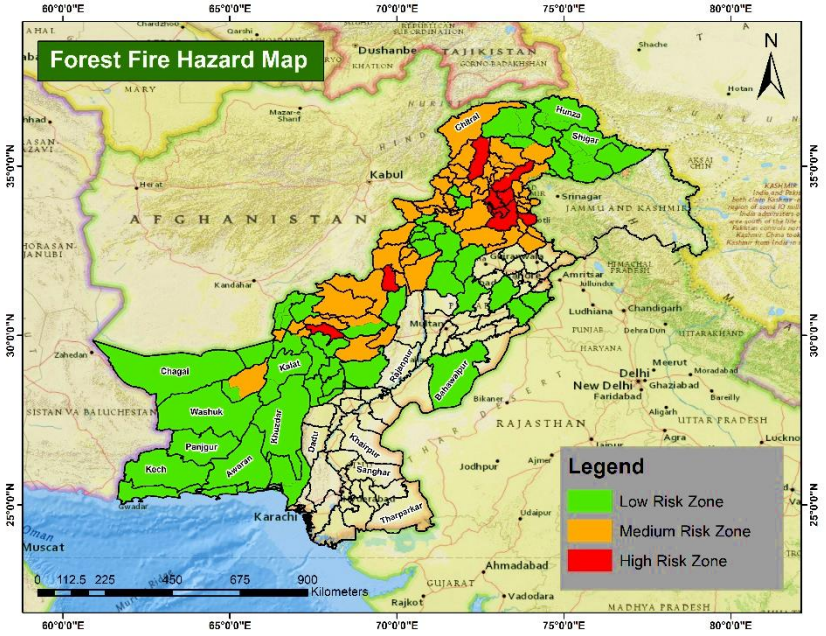

Figure: 3 Forest Fire Hazard Map

Below map highlights the distribution of shrubland and tree cover across various districts in Pakistan. The green-shaded regions indicate areas with significant vegetation, including forests and shrubland, which are crucial for biodiversity, climate regulation, and environmental sustainability

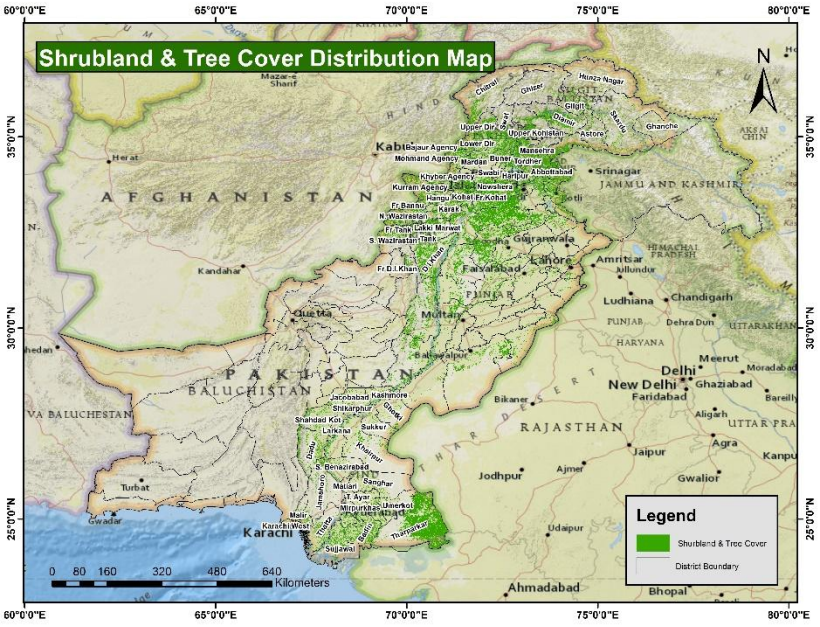

Figure: 4 Shrubland and Tree Cover Distribution Map

The northern regions, particularly Khyber Pakhtunkhwa (KP) and Gilgit-Baltistan, have extensive tree cover. Hazara Division (Abbottabad, Mansehra) and Malakand Division (Swat, Dir, Chitral, Shangla) show significant green areas. Upper Kohistan and Upper Dir also have a dense tree canopy. There are Forest Pockets in Punjab especially Murree, Rawalpindi, and Chakwal have notable vegetation cover (Margalla Hills and Murree Hills) Some tree cover is observed in Gujrat and Sialkot districts. There is limited tree cover in Sindh especially Thatta, Badin, and Tharparkar regions have sparse shrubland patches. Ziarat, Kalat, and Sherani have dense forest patches, particularly the Juniper forests in Ziarat. Some shrubland is present in the Quetta and Khuzdar regions. There is Sparse Vegetation in Southern Punjab area like Bahawalpur, Rahim Yar Khan, and Multan have minimal shrubland. The Cholistan Desert and Thar Desert have very little tree cover.

Climatic and Environmental Drivers of Forest Fires

Climatic (weather-related) and environmental (topography, human activity), both factors contribute in creating conducive environment for fires to ignite and spread. The dry period from April till the end of June is “fire season” in Pakistan’s forests.

Several weather factors significantly influence forest fire risk. These guidelines emphasize the following key factors.

- **Wind speed**

  High wind speed increases fire spreads by fanning flames and embers. A wind speed exceeding 25 mph is considered a trigger for increase fire hazard.
- **Relative Humidity**

  Low humidity dries vegetation, making it more flammable. A relative humidity below 15% indicates dry condition and increase fire risk
- **Precipitation**

  Precipitation reduces fire risk by saturating and dampening surface fuels. Low accumulated precipitation (0-10mm in the past week) suggests drier conditions and potential fire risk.
- **Temperature**

  High temperatures contribute to increased fire risk by drying fuels and creating conducive environment for ignition. A temperature above 35-degree Celsius is considered a potential factor for increased fire risk.

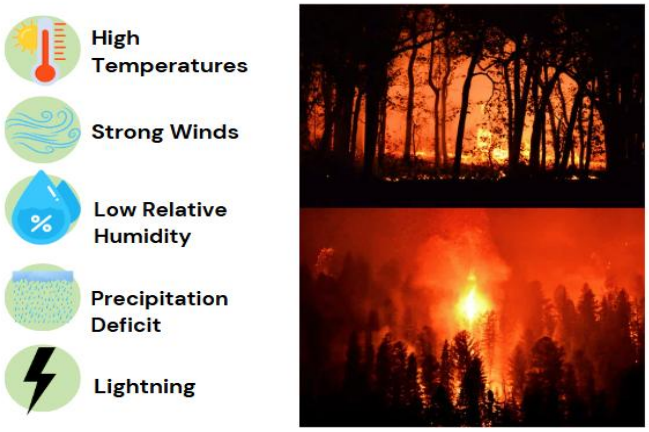

Figure: 5 Climatic Drivers of Forest Fires

Seasonal Outlook

The forest fire season typically occurs during the dry and hot months, primarily from April till end of June and sometimes extending into July or August, depending on the region and weather patterns.

Meteorological projections indicate that La Niña conditions are expected to persist through February-April 2025, with a transition to ENSO-neutral likely during March-May 2025. The

Indian Ocean Dipole (IOD) is expected to remain in a neutral phase, limiting its direct influence on regional climate. Below-normal rainfall and prolonged dry spells are projected. These conditions, combined with warmer-than-average land surface temperature will elevate heat stress and fire risks. Exceptionally low relative humidity (15–20%) and strong westerly winds (20–30 km/h, with gusts up to 50 km/h) will dominate from March to June, intensifying evaporation and dryness. These factors will amplify heat stress and support combustion in vegetative areas, increasing the likelihood and severity of forest fires, particularly in Sindh, Balochistan, and northern forests of Pakistan considered a potential factor for increased fire risk.

Temperature

Temperature plays a vital role in fire susceptibility mapping, significantly affecting various factors that heighten the risk of forest fires. Elevated temperatures increase the chances of vegetation drying out, creating optimal conditions for ignition. Additionally, warmer temperatures speed up evaporation, lowering soil moisture levels and making vegetation more prone to catching fire.

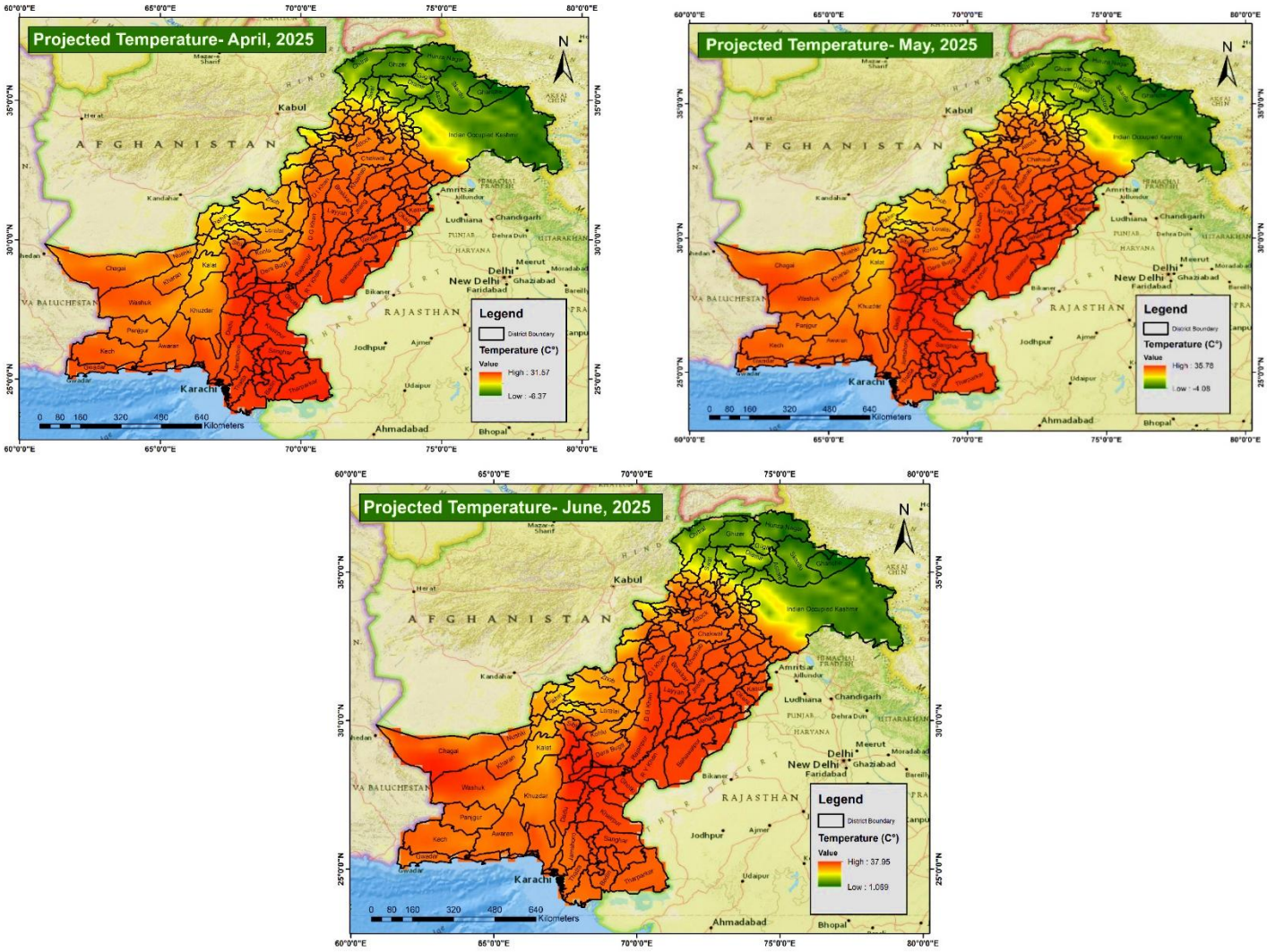

Figure: 6 Temperature Projection for the months of April, May and June 2025

According to the seasonal outlook 2025 based on the emerging patterns and multi-model ensemble projections above normal temperatures are likely to occur with high temperatures are anticipated in the month of May and June.

Precipitation

Precipitation plays a key role in fire susceptibility mapping by affecting fuel moisture levels and overall fire risk. Sufficient rainfall helps keep vegetation moist, serving as a natural barrier against wildfires. Conversely, extended periods of minimal precipitation led to drought conditions, heightening the risk of ignition and the spread of fires.

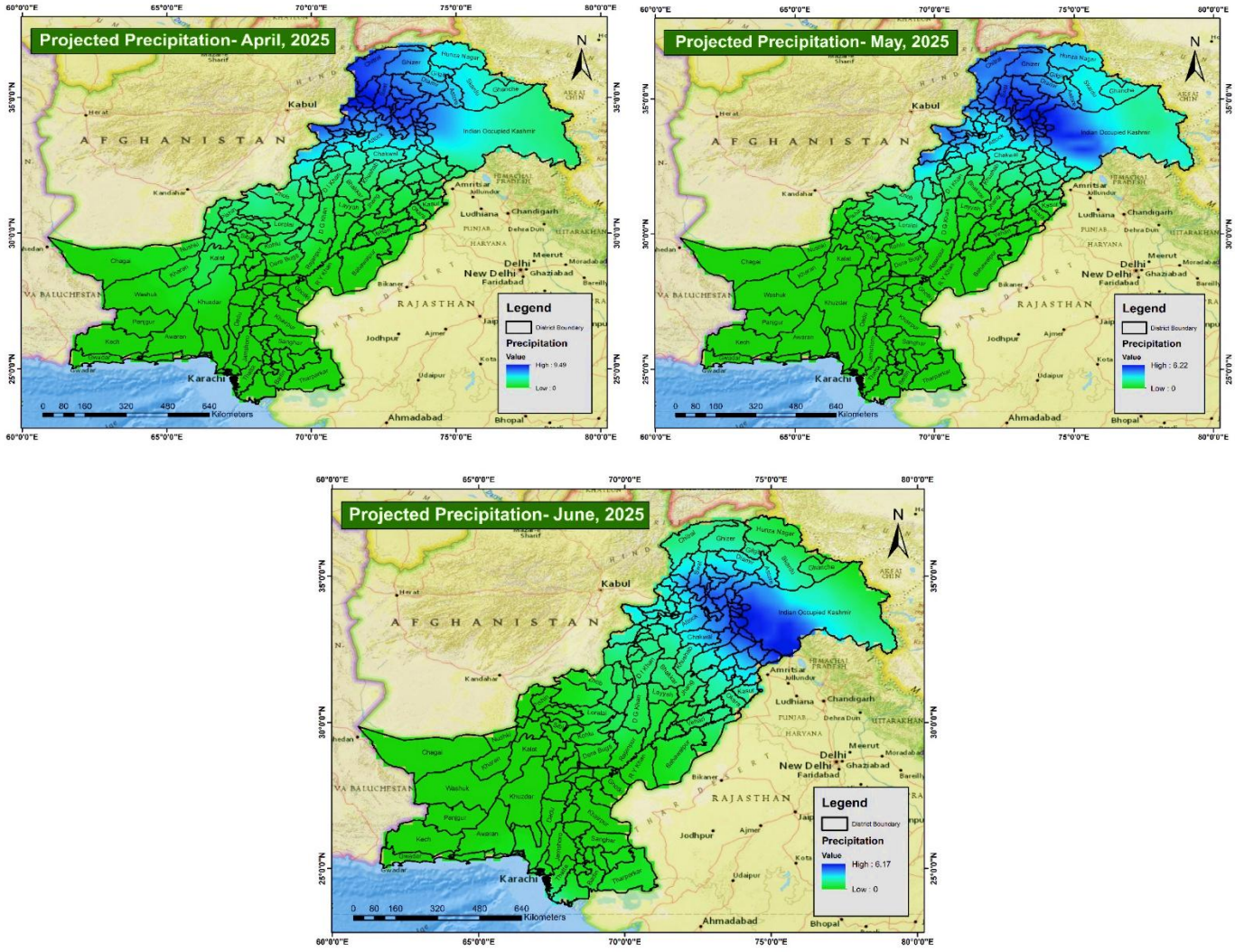

Figure: 7 Precipitation Projection for the months of April, May and June 2025

The weather forecast for April, May, and June 2025 predicts below-average rainfall with extended periods of dryness. High-pressure zones are expected to suppress cloud formation, which will heighten the likelihood of heatwaves and dry conditions. These

prolonged dry spells, combined with rising temperatures, will significantly increase the risk of forest fires, as dry vegetation becomes more susceptible to ignition.

Relative Humidity

Relative humidity influences wildfires by either moistening or drying out combustible materials. As relative humidity drops, fire activity intensifies because lightweight materials such as grass and pine needles dry out rapidly. Low humidity not only dries out vegetation temporarily but can also lead to a brief increase in fire risk. The relative humidity tends to be at its lowest when air temperatures are high.

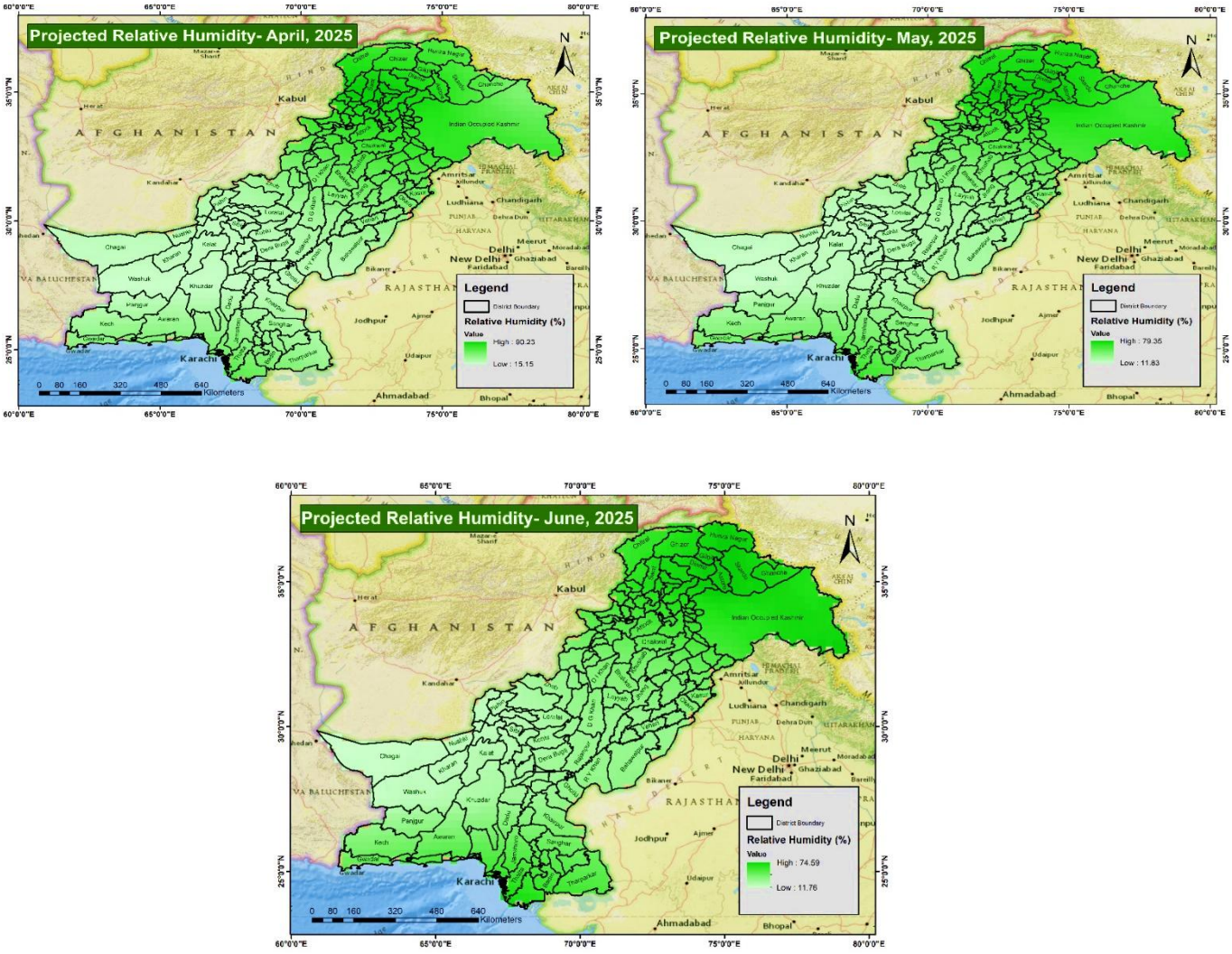

Figure: 8 Relative Humidity Projection for the months of April, May and June 2025

Low relative humidity levels (15–20%) will prevail in may and june , contributing to dryness and heightened fire risks. Dry atmospheric conditions will amplify heat stress and support combustion in vegetative areas.

Wind speed

Windy conditions supply wildfires with additional oxygen, helping them burn more fiercely. This can result in hotter flames, greater fuel consumption, and the creation of fire whirls or firestorms, which pose a significant threat to both property and lives.

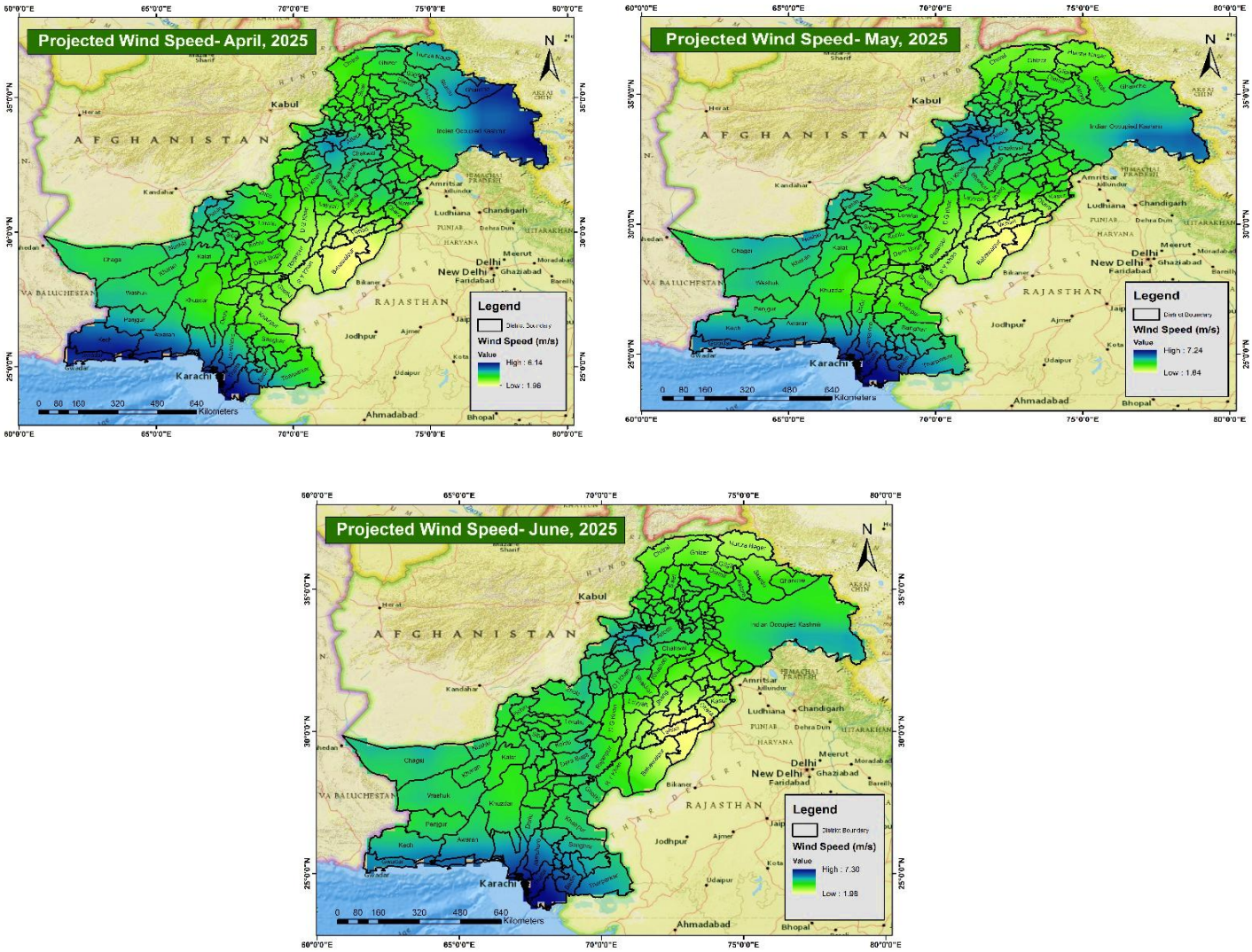

Figure: 9 Wind speed Projection for the months of April, May and June 2025

Strong westerly winds (20–30 km/h, with gusts up to 50 km/h) will dominate, particularly from March to June. These winds will intensify the spread of forest fires and increase the severity of

fire incidents. Lower relative humidity coupled with rising temperatures increases evapotranspiration, leading to drier vegetation and higher fire risk. Additionally stronger winds during this period can facilitate the spread of fires. Due to dry circumstances and strong winds, forest fires have increased in recent years. Under such conditions, grass ignites and spreads rapidly throughout the forest. It cannot be stated definitively that heat will ignite a fire. However, when a fire does start, hot summer weather might contribute to its rapid spread. Rising temperatures due to global warming have increased the frequency of forest fires, and improper forest management has exacerbated the situation. According to forest authorities, locals sometimes start fires, either intentionally or unintentionally, which can occasionally get out of control.

Forest Fire Vulnerability Analysis

To assess forest fire vulnerability in different provinces of Pakistan, analyze five critical parameters:

- **High Temperature** – Increases drying of vegetation, making it more flammable.
- **Low Relative Humidity** – Reduces moisture in the air, drying out vegetation.
- **Low Precipitation** – Leads to dry conditions, increasing fire risk.
- **High Wind Speed** – Spreads fire rapidly by carrying embers.
- **Vegetation Cover (Fuel Load)** – Provides fuel for fires in forested areas.

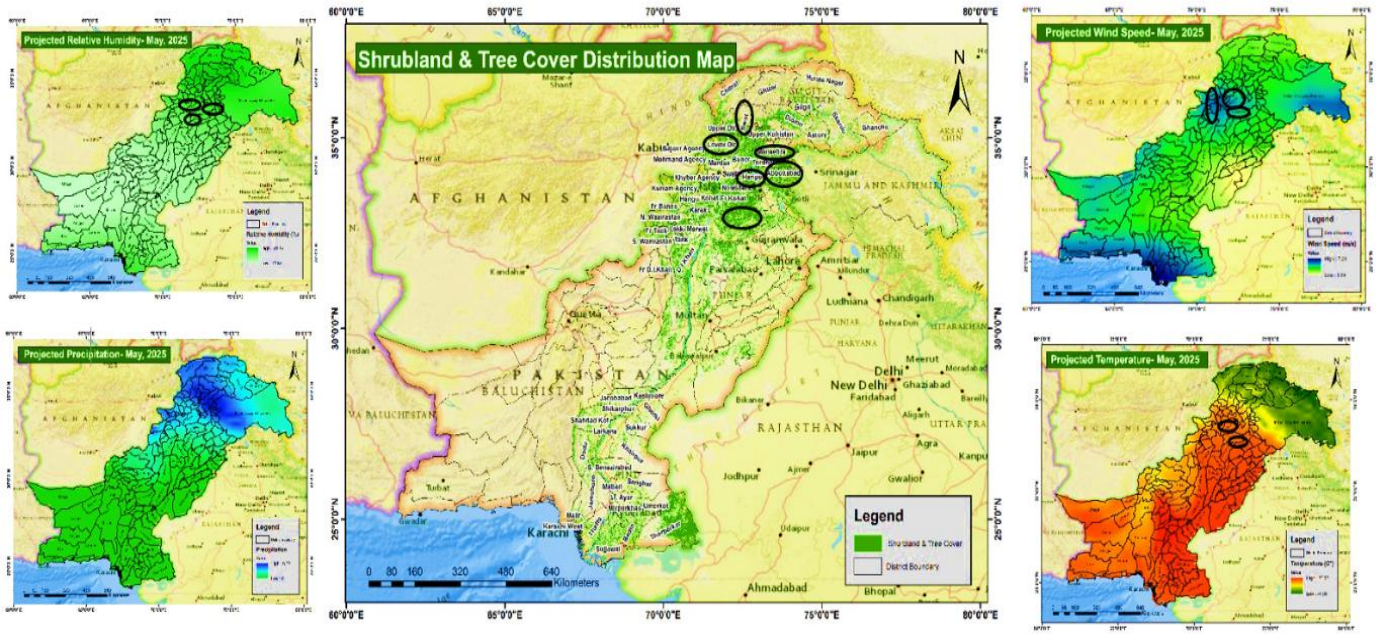

Figure: 10 Projected Climate Impact on Shrubland & Tree Cover (May 2025)

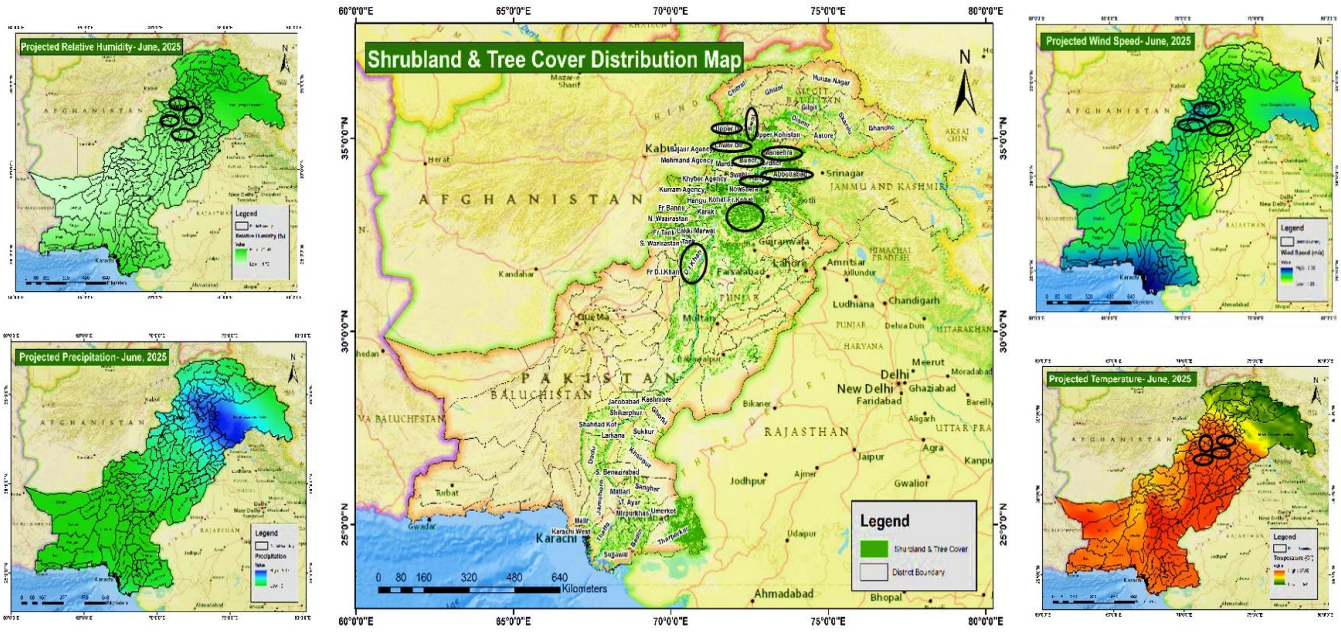

Figure: 11 Projected Climate Impact on Shrubland & Tree Cover (June 2025)

Khyber Pakhtunkhwa (KP) – Vulnerable Areas

Vulnerable areas in Khyber Pakhtunkhwa to forest fire is Swat, Dir, Chitral, Abbottabad, Mansehra, Haripur, Kohistan, Buner, Shangla, Kurram, Orakzai, Dera Ismail Khan

- High Vegetation Cover (Shrubland & tree cover in Swat, Dir, and Abbottabad) → Fuel for fires.
- Moderate-to-High Wind Speeds (North western KP) → Can spread fires quickly
- Moderate-to-High Temperatures (Southern KP & foothills) → Causes drying of vegetation.
- Fluctuating Humidity (Higher in valleys, but low in hills) → Can create dry spells.
- Precipitation Variability (Rainfall in some areas, but dry spells in others) → Potential for fire ignition during dry periods.

🔥 **Highest Risk:** Swat, Dir, Abbottabad, Mansehra, Haripur

🔥 **Moderate Risk:** Kohistan, Shangla, Orakzai, Buner, Kurram, DI Khan

Punjab –Vulnerable Areas

Vulnerable areas in Punjab to forest fire include Margalla Hills, Murree, Potohar Plateau, Chakwal, Rawalpindi, Jhelum, Southern Punjab (Cholistan)

- Dense Vegetation in Margalla Hills, Murree & Potohar Plateau → High fuel load.
- Moderate Wind Speeds in Potohar Plateau & Southern Punjab → Spreads fire easily.
- High Temperatures in Potohar & Southern Punjab (Cholistan) → Dries vegetation completely.
- Low Humidity in Potohar & Southern Punjab → Increases flammability.
- Low Precipitation in Southern Punjab → Dry conditions intensify fire risk.

🔥 **Highest Risk**: Margalla Hills, Murree, Potohar region

🔥 **Moderate Risk**: Chakwal, Jhelum, Southern Punjab

Balochistan – Vulnerable Areas

Vulnerable areas in Balochistan to forest fire include Ziarat, Quetta, Kalat, Zhob, Sherani, Bolan, Kolu, Barkhan, Musakhel, Harnai.

- Pine Forests in Ziarat & Sherani → High fire fuel (dry pine needles).
- Strong Wind Speeds in Central & Western Balochistan → Spreads fire rapidly.
- Extremely High Temperatures in Lower Balochistan → Creates dry conditions.
- Very Low Humidity in Most of Balochistan → Vegetation dries quickly**.**
- Minimal Precipitation in Most of Balochistan → Keeps conditions arid**.**

🔥 **Highest Risk:** Ziarat, Sherani, Kalat, Harnai, Musakhel, Kolu, Barkhan

🔥 **Moderate Risk:** Zhob, Quetta, Bolan

Forest Fire Risk and Exposure Dynamics

Forest fire risk assessment is conducted in some of the vulnerable areas that are particularly prone to the dangers of forest fires.

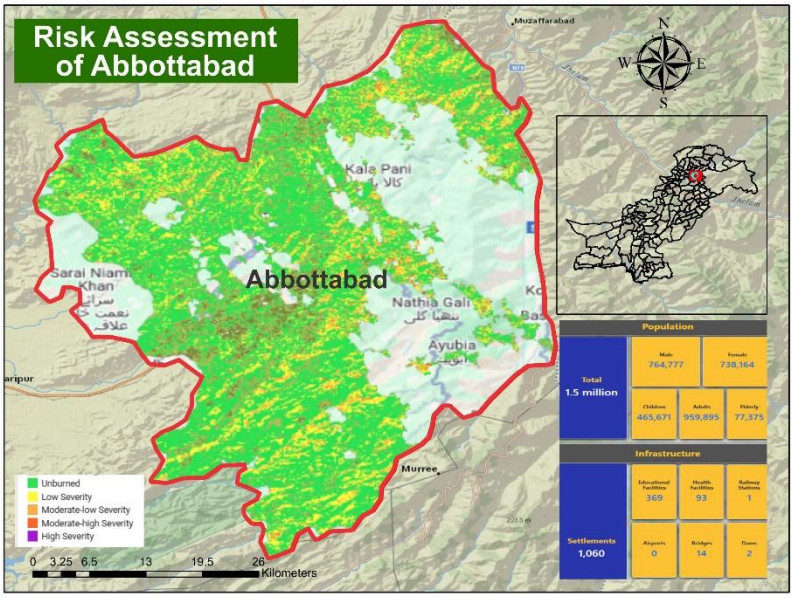

Figure: 12 Risk Assessment of Abbottabad District

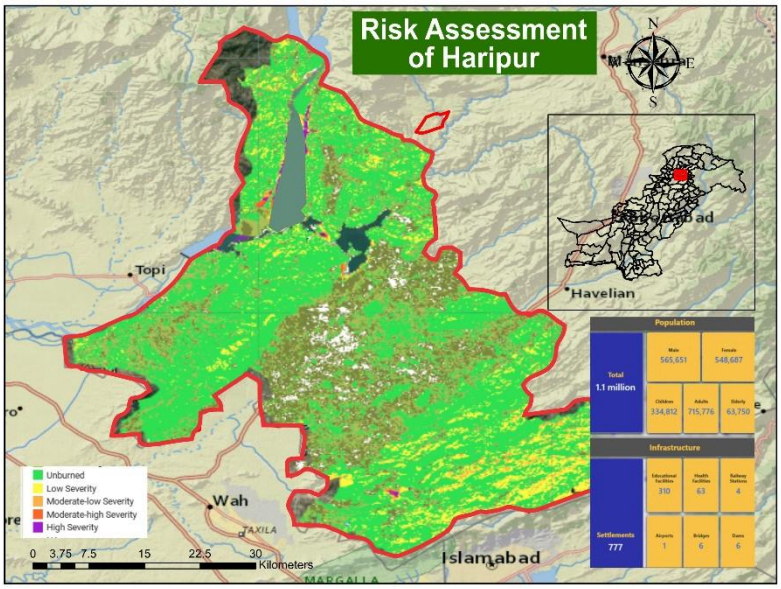

Figure: 13 Risk Assessment of Haripur District

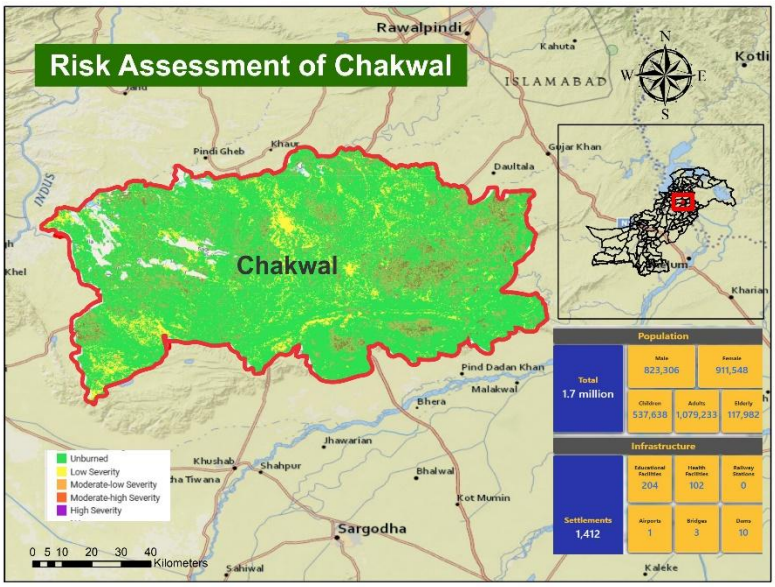

Figure: 14 Risk Assessment of Chakwal District

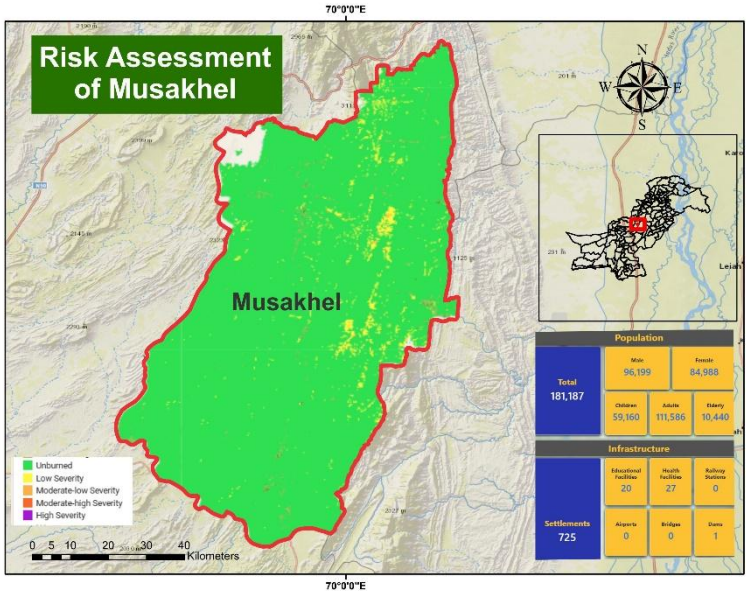

Figure: 15 Risk Assessment of Musakhel District

The assessment involves analysing various factors such as vegetation type, topography, climatic conditions and past forest fires events Additionally, exposure levels are calculated to determine the potential impact on local communities, infrastructure, and biodiversity. This comprehensive evaluation helps prioritize mitigation efforts and strengthen disaster preparedness in these high-risk regions.

Forest fires pose a significant threat to Pakistan's ecosystems, biodiversity, and local communities, particularly in vulnerable regions such as Sherani, Kotli Sattian, Swat,

Abbottabad, Haripur, Chakwal, Rawalpindi, Harnai, Kohlu, Zhob and Musakhel. Addressing this challenge requires a comprehensive approach that includes community involvement, robust monitoring systems, sustainable forest management, and strengthened institutional frameworks. By prioritizing prevention, preparedness, and mitigation measures, Pakistan can not only reduce the risk of forest fires but also protect its natural heritage and enhance the resilience of its people and environment.

National & Global Best Practices

Prevention Strategies

- Deploy satellite-based remote sensing and Geographic Information Systems (GIS) for real-time fire monitoring.
- Establish early warning systems to alert local communities and authorities.
- Launch campaigns to educate communities on fire prevention, such as safe agricultural practices and avoiding open fires during dry seasons.
- Promote community-based forest management programs.
- Strengthen laws against deforestation, illegal logging, and slash-and-burn practices. Implement zoning policies to reduce human activities in high-risk areas.

Response Strategies

- Form specialized firefighting units trained for forest fire management.
- Equip them with advanced fire suppression technologies, such as aerial firefighting tools.
- Adopt standardized systems like the Incident Command System (ICS) to coordinate firefighting efforts.
- Engage local, provincial, and national authorities in a unified response plan.
- Establish volunteer societies, fire brigades to act as first responders.
- Collaborate with international organizations for funding, expertise, research and technology transfer.

Post-Fire Recovery Measures

- Replantation of native and fire-resistant tree species in burned areas
- Use erosion control measures like check dams and contour trenching to prevent soil degradation.
- Create safe corridors and sanctuaries for wildlife affected by fires.
- Analyze historical fire data to predict and prevent future occurrences

- Develop public apps for real-time alerts and fire reporting.

Risk reduction practices

- Limit development and vehicular movement in high forest fire risk areas.
- Clear the vegetation surrounding homes and other structures.
- Build fire lanes and/ or fire breaks between homes and any forested or bush land areas, if a natural firebreak does not exist.
- Plant vegetation of low flammability.
- Use fire-resistant building materials.
- Use traditional and advanced methods of prescribed burning for sustainable agriculture and flora and fauna management.
- Enact legislation, policies and regulation at the appropriate jurisdictional levels.
- Conduct community-based fire risk minimization activities during all stages of fire management.
- Provide community alerts through fire danger rating systems.
- Educate the community and raise public awareness about the risks of wildfires.
- Develop firefighting capacities and public safety.
- Enhance the Integrated Forest Fire Management (IFFM) concept through increased community participation.
- Mandatory evacuation plans can help limit the number of people affected by forest fires in areas where they are more likely to occur.
- Conduct detailed assessments to determine which plant species are prone to igniting fires. Remove these plants from high-risk regions to lessen the likelihood of forest fires.
- Investment in fire suppression and efforts to avert forest fires, such as cutting fuel loads and re-establishing natural fire cycles in ecosystems.
- Implement the proven practices and tools such as fire monitoring watch towers and early detection, fire danger rating, and asset vulnerability management through buffer zones and the adoption of codes.
- Increasing the tree-to-person ratio in Pakistan.
- Use drones to track fire activity, computer models to forecast fire behavior, and infra-red satellite sensor data to identify flames and heat in smoke.

Case Studies of Best Practices

Australia

- Fuel Management: Australia uses prescribed burns and community awareness campaigns to mitigate fire risks.
- Emergency Response: The country has a well-established ICS and aerial firefighting units.

United States

- Forest Management: Focuses on thinning overgrown forests and reintroducing natural fire regimes.
- Public-Private Partnerships: Collaborates with NGOs and private companies for fire prevention programs

Canada

- Early Warning: Uses satellite monitoring and AI for early detection.
- Community Resilience: Implements Fire Smart programs to engage local communities in fire prevention.

Anticipatory Actions for Forest Fires

Disaster Type	Stakeholder	Anticipatory Actions
Forest Fires	**Federal Government**	• Implement policies to mitigate climate change-related risks. • Promote afforestation and land conservation programs. • Coordinate national response mechanisms for disasters.
	National Disaster Management Authority (NDMA)	• Issue timely warnings and situation reports to all stakeholders. • Formulate policies and guidelines for forest fire management. • Coordinate response efforts at national and provincial levels.
	Provincial Disaster Management Authority (PDMA)	• Conduct risk assessments and map high- risk forest areas. • Develop and implement firebreaks and controlled burning strategies. • Coordinate with local governments and emergency response teams.

Forest Fires	**Forest Department**	• Implement fire prevention policies, including restrictions on campfires and land clearing. • Establish rapid response teams for immediate action. • Maintain fire towers for monitoring.
	Area Military Formations	• Provide aerial support, including helicopters for fire suppression. • Deploy engineering units to create firebreaks and containment lines. • Assist in evacuations and logistical operations.
	Local Governments & Municipal Authorities	• Mobilize local firefighting units. • Ensure availability of water sources for firefighting purposes. • Conduct community awareness programs on fire prevention.
	Households & Individuals	• Stay informed about fire warnings. • Maintain defensible space around properties.

Risk Assessment and Mapping

- Use GIS and satellite data to create detailed fire risk maps highlighting areas prone to forest fires.
- Include factors like vegetation type, proximity to human activities, and historical fire data.

Climate Change Scenarios

- Model the impact of changing weather patterns (e.g., higher temperatures, reduced rainfall) to anticipate future fire risks.
- Identify seasonal windows of heightened vulnerability for targeted action.

Multi-Hazard Assessments

- Combine forest fire risks with other climate-related risks (e.g., floods and droughts) for integrated planning

Preparedness and Resource Mobilization

- Stockpile fire suppression equipment (e.g., water tanks, fire retardants) in regions identified as high-risk.
- Pre-position firefighting units near vulnerable forests during peak fire seasons.
- Conduct fire simulation exercises to train response teams and communities in fire suppression techniques.
- Provide capacity-building programs for forest department personnel and local volunteers.

Early Warning Systems

- Utilize AI and machine learning to analyze weather patterns and vegetation conditions for fire risk forecasting.
- Integrate systems like NASA's Fire Information for Resource Management System (FIRMS) for real-time monitoring.
- Collaborate with meteorological departments to monitor temperature, humidity, wind speeds, and lightning occurrences—critical factors for forest fire ignition.
- Develop community-specific alert mechanisms via SMS, mobile apps, and local radio broadcasts to warn residents in vulnerable areas.

Sustainable Forest Management

- Reduce the build up of dry leaves, deadwood, and undergrowth (fuel loads) through controlled grazing and manual clearing.
- Introduce agroforestry practices in surrounding areas to reduce dependence on forest resources

Infrastructure Development

- Build and maintain firebreaks—cleared or plowed strips in forests that prevent fire spread.
- Develop water storage facilities like reservoirs and ponds within or near forests for rapid access.