

Wildfire analyses in Iraqi Kurdistan

December 2024

The Kurdistan Region of Iraq (KRI) has faced a concerning rise in wildfires in recent years. These fires pose both acute and long-term threats to communities, livelihoods, and the region's unique biodiversity. The fires are primarily caused by a combination of natural and human-made factors, including hot and dry weather conditions, accidents, and increasingly military activities: fighting between the Turkish Armed Forces and the Kurdistan Workers Party (PKK) insurgent group. Beyond direct environmental degradation, this fighting has also led to the displacement of communities and the destruction of infrastructure. There are also indications that these developments are compounded by larger concerns over climate change in the KRI that are impacting weather patterns and environmental conditions. The rapid increase in temperatures, winds and dry vegetation all make the region more prone to wildfires, which in turn affects livelihoods and engenders displacement.

As part of PAX's work on [Climate and Environment Action](#) in Iraq, this Environmental Action Alert presents a brief analysis of fires in KRI during the period of May to August 2024, building on remote sensing analysis, open-source data collection and collaboration with partners. Satellite analysis of burned territory is conducted using European Space Agency (ESA) Sentinel-2 and Planet satellite imagery to visualize and identify land that has been damaged by the fires, while wider NASA [MODIS](#) data is used to quantify the total area of fire damage. The open-source information used in the report is drawn from various sources, including local news reports, social media posts, official statements, and interviews with local civil society organizations (CSOs) working on environmental issues in the region.

Biodiversity in the Kurdistan Mountains

The Zagros mountain range in KRI provides most of Iraq's natural forest cover, which in turn provides local communities with natural resources used for construction, crafts and firewood. The unique forest ecosystem also provides several advantages to the region, such as soil protection, water purification and

biodiversity conservation. Various species of oak, including *Quercus aegilops*, make up nearly 90% of the forest cover, depending on altitude of the so-called “open forest zone”. Other species that grow in the area include walnut (*Juglans regia*), the oriental plane (*Platanus orientalis*), the willow (*Salix* sp), a species of pine (*Pinus brutia*), black poplar (*Populus nigra* s.l.), and pistachio trees (*Pistacia* sp).

The mountainous, green and arid areas of the Kurdistan region combine to host a rich and unique ecosystem, which is part of the Irano-Anatolian biodiversity hotspot. The area is host to over 6,000 plant species, 2,500 of which are endemic. The region also has a rich wildlife population, including globally endangered species such as the Persian leopard (*Panthera pardus tulliana*), the goitered gazelle (*Gazella subgutturosa*), the striped hyena (*Hyaena hyaena*), the Syrian brown bear (*Ursus arctos syriacus*), the Eurasian lynx (*Lynx lynx*), the bezoar ibex (*Capra aegagrus aegagrus*), and endemic amphibians and reptiles, including the Kurdistan newt (*Neurergus derjugini*).



▲ The Kurdistan newt, an endangered species of reptiles. Mawat, Zagros Mountains in Iraq, September 2021. Soran Ahmed.

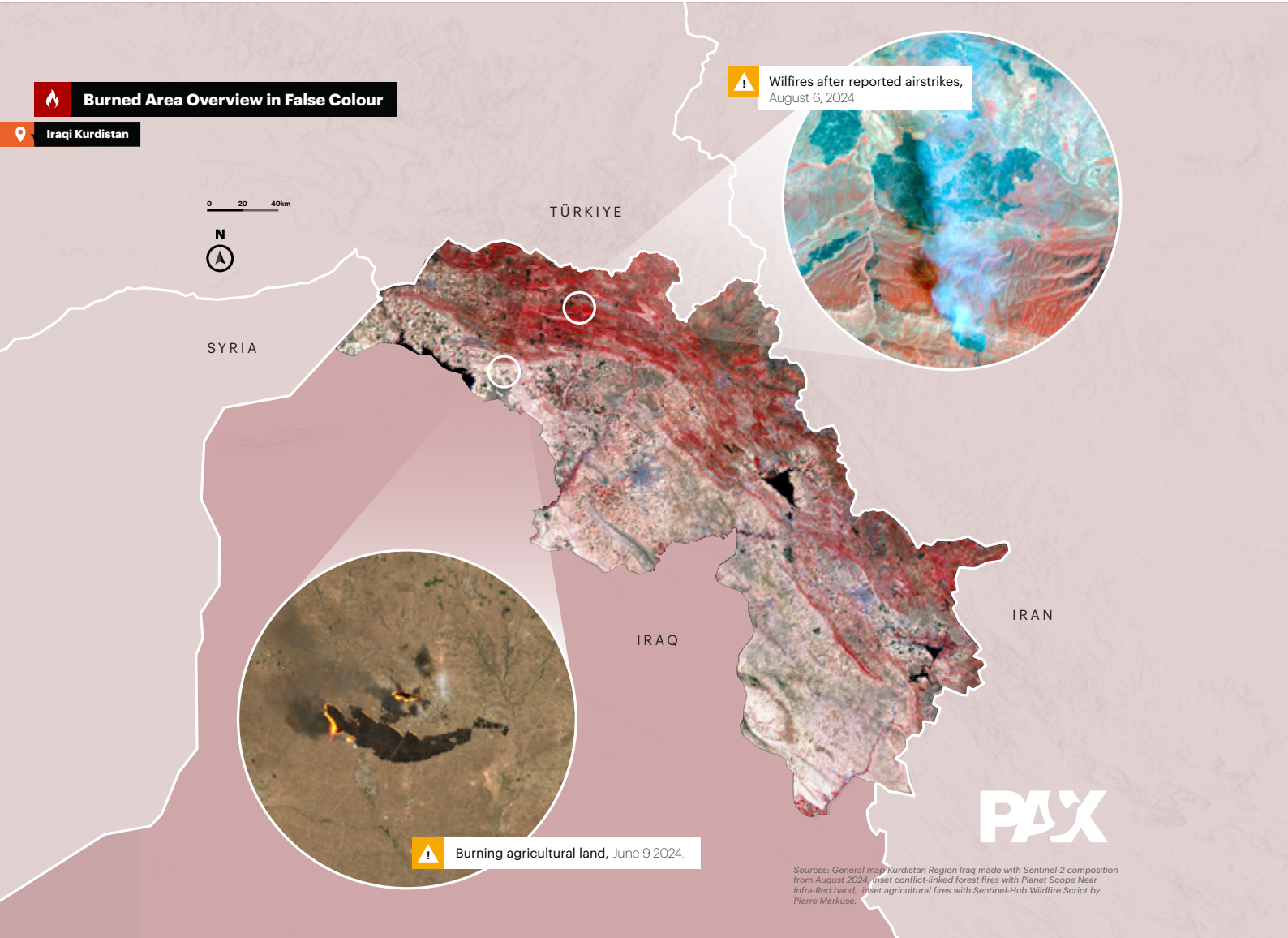
The region has experienced massive forest loss over the past decade, shrinking from 1.4 million hectares of forest in 1920 to 300,000 hectares in 2003, driven by (illegal) logging, conflict and the region's oil-driven economic boom. Since 2010, another 290,000 hectares of forest have burned down, according to the Kurdistan Ministry of Agriculture. Some studies even claim a 20% loss of forest in the KRI between 2000 and 2016. These various figures underscore the need for a thorough and consistent environmental monitoring presence in the region to track land usage and land change, including climate variables.

Wildfires in the Kurdistan Region

Kurdistan's hot and dry summers mean that wildfires can easily start and rapidly spread by wind amidst the dry vegetation. This is both naturally occurring, primarily by lightning strikes, but also from human activities such as sparks from machinery, barbecues, cigarettes, stub burning of harvested lands or fires during picnics. A substantial part of the wildfires are also linked with conflict, though clear data to make a strong correlation between military activities and increase of fires is **lacking**. Data from NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) demonstrates that using thermal sensors to detect heat sources is helpful in demonstrating the number of fires throughout the KRI, though likely all of the fire reports in the south of the region are linked with agricultural activities. **Research** by PAX in 2020 also linked military activity with large swaths of burnt forest, with an estimated 300,000 hectares being affected.

Increasingly, these fires are affecting the livelihoods of local farmers, as fruit and nut trees are damaged. Other times, farmers cannot reach their agroforestry areas due to ongoing military activity, leading to land abandonment and degradation.

As of 2024, the KRI continues to experience a trend of wildfire incidents during the summer, many of which are linked with military activity. Incidents of fires increased notably from late May to late August, correlated with high summer temperatures in the region and the accompanying dry weather and wind, especially in lowland areas. The Eid al-Adha holidays in June 2024 also marked another spike in fires. According to local sources, out of a total of 404 fire incidents reported during those four days, **348** fires were caused by the burning of weeds and bushes, resulted in damaged forests and agricultural lands. Heightened human activity due to the Eid celebrations was a significant factor in these fires.



Methodology

The area of interest (AOI) for this research is the territory currently administered by the Kurdistan Regional Government, which extends beyond the official administrative boundaries of the Kurdistan Region of Iraq. This choice was based upon effective control of land by the KRG and the implications for dealing with all issues related to environmental change in the region, including wildfires.

The remote sensing analysis was conducted for the AOI using both Sentinel-2 [Burned Area Index](#) and [MODIS](#) products. As MODIS uses low-resolution imagery (250m) for its burned area analysis, additional remote sensing analysis of the region was conducted using Sentinel-2 imagery with 20m resolution for improved results. This approach is based on 275 Sentinel-2 images with 0% cloud cover, collected for the time period of 01.05.2024 – 31.08.2024. The Burned Area Index used for the Sentinel-2 (BAIS2) calculation was based on methodology from [Filipponi \(2018\)](#). BAIS2 gives each pixel a value from -1 to 2, in which higher values have a high probability of representing a burned area. A threshold has to be manually selected. To allow for greater flexibility, five different thresholds were used, representing different levels of confidence. After all 275 images were reclassified according to the confidence thresholds, they were combined into one large raster covering the entire AOI. Because of the possibility of overlapping layers, the highest pixel value from each location was used for the combined raster. Since the BAIS2 is also very sensitive to detecting water, water bodies have to be removed from the results. Water bodies were extracted from OpenStreetMap data and then subtracted from the BAIS2 layer, with additional steps taken to clean up the results and remove false positives. The final BAIS2 result was converted into a vector file, which was used to calculate the sizes of the burned areas according to their BAIS2 level of confidence. Due to time constraints, the results of this analysis are not conclusive, and would require more fine-tuning to get a full picture of all burned areas. Another disclaimer is that significant parts of the burned areas were not positively identified in this analysis after the results were manually cross-checked with near-infrared imagery of burned areas. The full methodology is available upon request.

Data from the [Armed Conflict Location & Event Data Project \(ACLED\)](#) and [Christian Peacemaker Teams \(CPT\)](#) was also used to find areas that were reported as the site of military activity. These sources provided essential insight into the frequency and scale of airstrikes, drone attacks, and other conflict-related incidents that contributed to the fires in the region. There were 1845 incidents reported in the selected time period, with many on the same locations, either on the same day or different days, meaning there is overlap of reported incidents.

To find a link between the strike sites and burned areas, a five-kilometer area buffer was placed around each strike, and the burned area that fell within this distance was linked with the strike and with the reported date of the strike. This range is based on audio and visual evidence shared by eyewitnesses. A few selected incidents were used as a test to measure if the range of burned area at the time of the reported strikes, with positive results. The range is an estimated average as there are instances in which the fires occurred either further away or closer to the strike in question; as such, the range should not be treated as definitive. The primary aim of this research is to demonstrate the increased risks and likelihood of a spatial-temporal link between conflict events and wildfires, and is not a proven correlation in all cases.

▼ Burning vegetation after Turkish airstrikes in the Amadiyah region, Monday, 8 July 2024. Via ANF News.



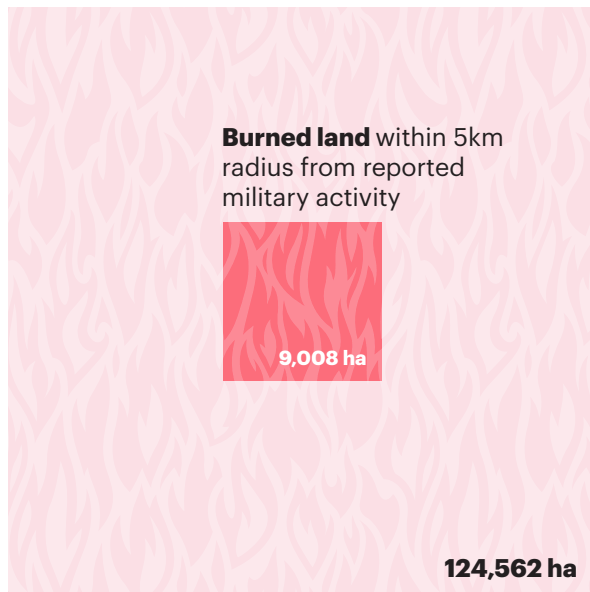
What the data and satellite imagery tells us about wildfires in 2024

Analyzing fires in the monitored period provides insight on their locations, with a substantial number that can be linked to military activities. Reported fires and burned land detection range from the mountainous border regions in the north and east to agricultural areas in the central and southern parts of KRI. The geographical location, combined with the type of vegetation involved, can both influence the intensity of the fires, as some locations are more difficult to reach for firefighters or are contaminated with unexploded ordnance.

Based on the remote sensing data from Sentinel-2 and MODIS imagery, the following conclusion can be drawn. In total, over 124,562 hectares of burned land were detected in the AOI for this research. Below are the figures based on two different sets of sensor data (from the manual Sentinel-2 analysis and the MODIS data-set).

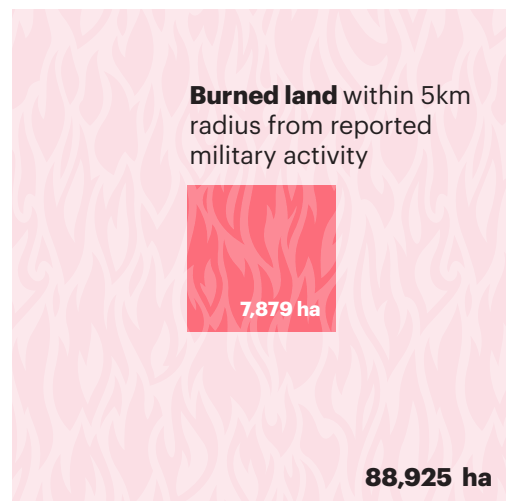
Data from satellite analysis shows that the majority of the burned land in KRI is found in agricultural land and around urban areas, often caused by farmers burning off post-harvest stubs or villagers burning shrubs to clear the land. These fires can spiral out of control and affect areas where crops are still growing. There are also sporadic reports of wildfires caused by lightning strikes in various areas of the region, such as Daratu, the Pirmam road, and Prde.

Total burned land



 Sentinel-2 data

Total burned land



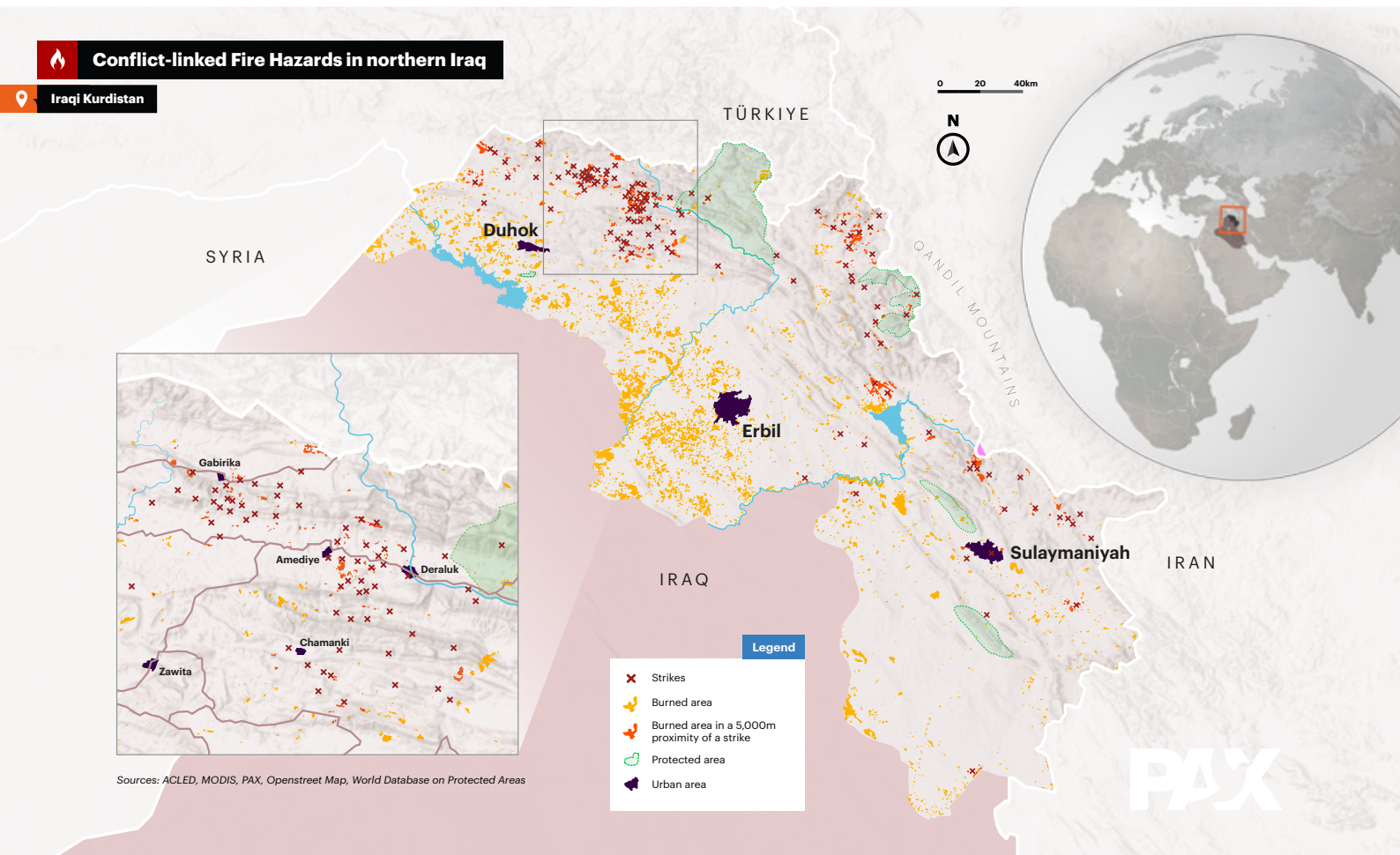
 MODIS data

Conflict-Linked Fires

Military activity has been another driver of human-made fires in KRI's mountainous areas. Airstrikes by drones, fighter jets and helicopters, shelling with artillery and mortars and the direct fighting between Turkey and the PKK causes dry vegetation in the area to burn. Even a small spark is enough to set

shrubbery and trees alight, let alone the widespread usage of bombs, grenades, and tracer munitions in these areas. There are also indications of the deliberate use of flares dropped by helicopters to start fires to burn vegetation allegedly used as cover by militants.

Analysis shows that the main regions affected by military activity are Amadiya (in Dohuk), Bradost and Choman (in Erbil), and Sulaimani. Turkish forces intensified their activities in July 2024, advancing into northern Iraq and engaging in frequent clashes with PKK militants. According to a report by the Community Peacebuilding Teams, a local NGO, Turkey conducted 381 airstrikes and drone attacks in KRI between 15 June 2024 and 15 July 2024. Of these, 289 attacks occurred in Duhok, 48 in Erbil, 42 in Sulaimani, and one in Sinjar.



The Amadiya district in Dohuk has experienced numerous fires due to armed clashes. Fires have occurred in villages including Barwari Bala, Alkishke, and Merga Qasre, where fires resulted from Turkish artillery shelling and drone strikes, affecting agricultural land and forested areas and causing displacement. In one specific incident in Barwari Bala, fires burned approximately 971 hectares of land. In other regions, the fires affected agroforestry, particularly orchards.

Districts of Erbil in the Bradost and Balakayati areas have also experienced regular shelling from across the Turkish border. According to PAX local partners, shelling was heard from Choman during the bombardment of Gomi Fellaw, a popular tourist spot, though there have been no media reports or other notions of this incident.

Sulaimani governorate has also seen conflict-linked fires, as it has regularly been targeted by Turkish airstrikes (and sometimes Iranian shelling) due to the presence of the PKK and its Iranian off-shoot, PJAK. For example, the village of Gallala in the Qandil Mountains has been regularly targeted by Turkish airstrikes, with the resulting fires burning down vineyards and orchards.

In sum, a substantial amount of fires have been directly caused by the armed conflict taking place in northern Iraq. In this analysis, PAX has used ACLED data for reported incidents, including both video footage and eyewitness statements. The 5km buffer used in the analysis is based on the potential visual line of sight and audio range of eyewitness reports. The total number mentioned here is likely an undercount as not all airstrikes have been reported.



▲ Villager fighting forest fires, Blava village in Iraqi Kurdistan. June 2024, 23. Karvan Guherzi.

Our analysis found over 120,000 hectares of burned land throughout KRI. Through analysis of remote sensing and open-source data, we found 126 locations where military activities were reported could be linked to burned areas. Not only have these fires led to displacement of thousands of people, they also have wide-reaching consequences for local nature. Bakhtyar Bahjat, head of the Halgurd-Sakran National Park near the border with Iran in 2018, stated the following about conflict-linked wildfires in 2018: “in this dispute between humans, it is wildlife and vegetation that are the victims,” a statement that still holds true today.

How fires lead to forced displacement

The fighting between Turkey and the PKK is contributing to the displacement of communities caught in the crossfire and affected by the conflict-linked wildfires. 602 villages are under the threat of displacement, while the populations of at least 170 villages have already been displaced.

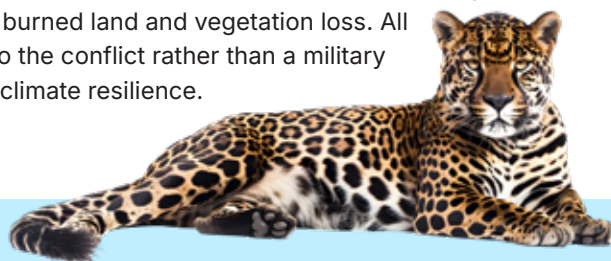
According to a local news report, the PKK claimed that Turkish forces are putting pressure on civilians to leave the combat zone; Turkish forces retorted that the PKK is using local villagers as human shields and accuse the PKK of setting fire to the forests so that their locations cannot be determined. Locals in the village of Dergale Musa Bage told researchers that Turkish forces had forced them to leave their village. The head of Miske village, in Amadiya, also stated that a wave of local civilians fled their homes due to the armed clashes in the nearby villages of Teshmabi and Jamalki. CPT has reported that 26 families from Miske village have fled their homes, while local sources state that civilians from Amadiya district usually flee to Duhok city. The evacuations extend beyond Sidakan, including 65 villages in Mergasur town, 13 villages in Choman district, and four villages in Warte district. Clashes between Turkish forces and the PKK near the village of Sargale have also resulted in the displacement of local communities and the burning of 55% of local agricultural land.

The destructive consequences of (conflict-linked) wildfires on nature and people

Though the majority of the detected wildfires occur in agricultural areas, the burning of forests in mountainous areas is leading to tree-cover loss and degraded biodiversity. Forests are important carbon sinks, and research indicates that the worldwide increase of wildfires is decreasing nature's capacity to store carbon monoxide. The increase of forest fires in northern Iraq would contribute to global tree loss, while the smoke from burning trees also contributes to carbon emissions. The burning also results in habitat loss for wildlife, leading to protected species becoming more vulnerable to poaching.

Besides these environmental consequences, conflict-linked wildfires also have an impact on community livelihoods in the affected areas, with fires affecting locals' agricultural land and other assets, leading to a loss of livelihoods and posing a serious human safety risk. While no reports of casualties due to wildfires have been recorded, the amount of agricultural land affected, and the number of communities displaced, gives an idea of the socioeconomic impact of these fires. Rising temperatures and increasingly unpredictable weather patterns also make the region more prone to wildfires. Human activity, in particular military operations, seriously increases the risk of large-scale outbreaks of fires, often difficult to control and with serious risks to human life, livelihoods and ecosystems.

The findings of this report underscore the linkage between military activity, wildfires and burned land, with their ensuing acute and long-term humanitarian and ecological consequences. In a time when Iraq is increasingly facing the impacts of the climate crisis, the clashes between Turkey and the PKK are having a compounding effect, driving yet more conflict emissions from burned land and vegetation loss. All actors involved should therefore strive for a political solution to the conflict rather than a military one in order to build peace, protect nature, and work towards climate resilience.



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Cover photo: Burning forest after Turkish air strikes at night in Dohuk governorate. July 17, 2024. Karvan Goherzi