

BioTopic

Fire Monitoring to support Sustainable Forest and Pasture Management in the Republic of Armenia

To combat pasture, agricultural, and forest fires, consequent action by political and community leaders as well as individuals is essential.



Background

Forests play a key role in protecting ecosystems and biodiversity. They prevent erosion and are central for carbon storage. So far, fires in Armenia are often associated with pasture or agriculture. Yet, they also pose a risk to forests. Especially in the dry season fires can jump from pasture or agricultural land onto forests, and, hence, can degrade large areas within a short period of time. In Armenia, little is yet known about the spatial-temporal dynamics of fires, their main causes and affected areas, the extent of their impact on biodiversity and livelihoods, as well as associated losses on carbon storage and greenhouse gas emissions. Hence, nationwide fire monitoring based on objective data is central to guarantee sustainable forest and pasture management in Armenia.

Aim and Objectives

In order to gain better understanding about the occurrence of fires on pastures, agricultural land and forests in Armenia, baseline information on fire occurrence and spatial distribution is required. In this respect, GIZ-Sustainable Management of Biodiversity (SMB) Programme supports the Government of Armenia in conducting a nationwide fire assessment. Using remote sensing (RS) data from the years 2013 and 2014, this work aims to detect burned areas in Armenia, and analyse their spatial and temporal

dynamics, causes and risks. Obtained burned area data are fed into the evolving National Forest Management and Information System (NFMIS) of Armenia, thus serving as a tool for implementing sustainable forest management in the country. In addition, trainings on the methodology of burned areas are offered to relevant stakeholders by international experts. For the first time, a quantitative assessment of burned areas has been conducted allowing an analysis of the spatial distribution of fires and their possible threats to the environment in Armenia. This is briefly presented in this leaflet.

Dataset

Landsat-8 OLI data have been used to detect burned areas. Five frames which are covering Armenia have been downloaded for 2013 and 2014 with a total number of 60 scenes. The Optical Line Imager (OLI) multispectral bands have a spatial resolution of 30 m. Landsat 8 data are free and open data, and are available after registration through the EarthExplorer website of the US Geological Survey. For re-checking burned areas, detections of actively burning fires with the MODIS sensor have been used- available four times daily. It consists of a list of pixel coordinates with ancillary information such as fire radiative power (FRP) and a fire mask indicating the location of active fire detections, clouds, clear land and water.



Figure 1: Pre-Processing: Cloud Masking.

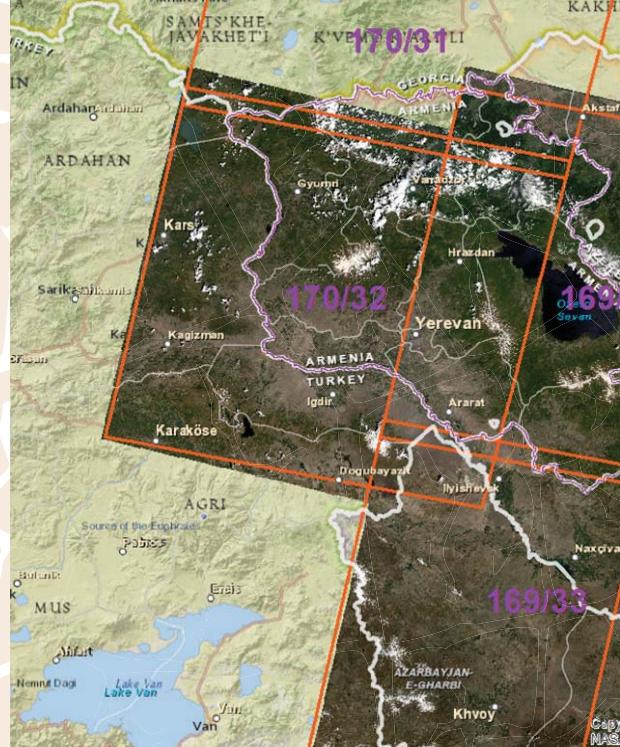


Figure 2: Landsat Frames covering Armenia.

Methodology

To detect burned areas, a change detection approach based on pairs of Landsat images is applied. This approach takes advantage of the different spectral properties of living vegetation, senescent vegetation, soil, and charcoal: recently burned areas are characterized by a strong decrease in near infrared reflectance and a slight increase of shortwave infrared reflectance. This change is mainly caused by the removal of vegetation on the burned areas (thus exposing more soil), and deposition of charcoal. Spectral indices and their difference products are being used – the Normalized Burn Ratio (NBR) and the Normalized Difference Burn Raito (dNBR), as well as the Normalized Vegetation Index (NDVI) and the Normalized Difference Vegetation Index (dNDVI). For a correct derivation of these indices several pre-processing steps of satellite

images are necessary, including calibration to Top-of-the-Atmosphere (ToA) Reflectance, correction of atmospheric effects, as well as cloud, shadow, snow and water removal. The two indices are being calculated for each time step and the difference product for each pairing. As a next step, a rule-based classification set of burned and unburned areas is being defined based on the calculated difference product. During post-processing, areas associated with spurious change are being removed. Also, a plausibility assessment of (non-) identified burned areas is being conducted by using the MODIS instrument on-board of the Terra and Aqua satellite for active fire detection.

In Armenia, 26,761 ha of burned areas have been identified in 2013, and 10,433 ha in 2014.

The Landsat-8 Satellite provides unbiased information for detecting burned areas in Armenia.



Figure 3:
Landsat 8 picture from 13/09/2014 highlighting burned areas (dark red).



In Armenia, most fires occur on pastures and agricultural land.

Results

The results of this assessment within the Republic of Armenia revealed that a total of 26,700 ha were burned in 2013, and 10,500 ha in 2014. The data show that most fires occur on pasture land in mountainous areas, and on agricultural land. Pasture fires – causing soil degradation – can lead to a loss of biodiversity, and a substantial reduction in the productivity of the land. The most fire affected regions in Armenia are Ghegarkunik, Shirak and

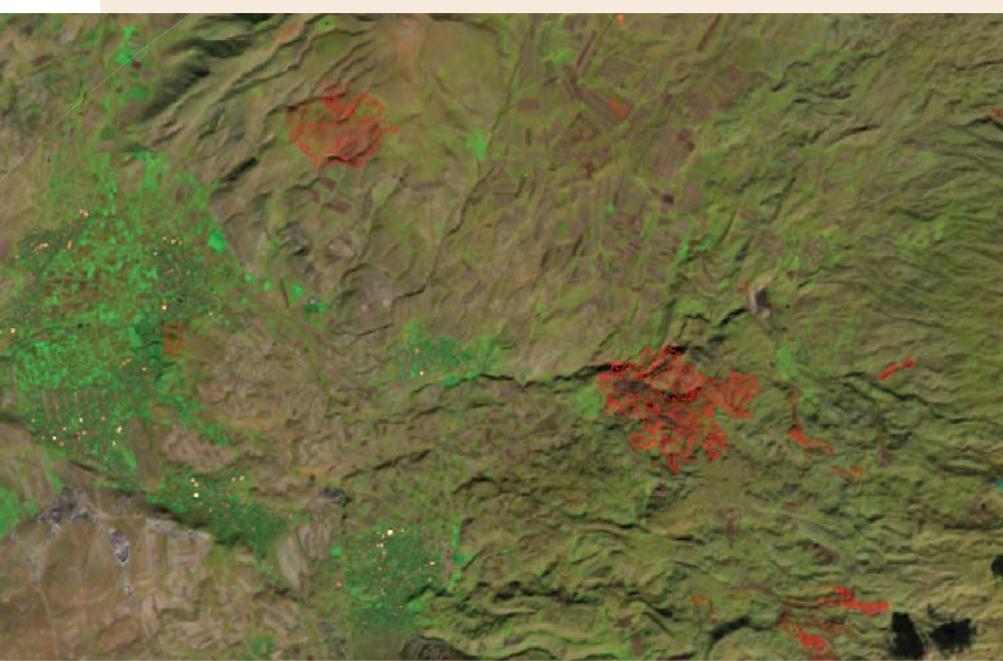
Syunik, each indicating over 1000 ha of burned areas both in 2013 and 2014. Fires within the boundaries of State Forest Enterprises (SFEs) affected 90 ha in 2013, and 120 ha in 2014. Field visits by experts to the SFEs show that those fires mostly affected the edge of the SFE and often belonged to a larger fire. Although SFEs have not been directly affected by fires in 2013 and 2014, the analysis shows a risk of fire spreading from pasture and agricultural land into SFEs and, thus, indicating a threat to forests.

Table 1: Regional Distribution of Burned Areas in 2013 and 2014.

Region	Area 2013 [ha]	Area 2014 [ha]
Aragatsotn	1609	789
Ararat	641	127
Armavir	36	50
Gegharkunik	10576	1846
Kotayk	1326	853
Lori	1373	464
Shirak	3340	1306
Syunik	6840	2828
Tavush	169	1841
Vayots Dzor	850	319
Yerevan	1	11
Total	26762	10433

Figure 4:

Landsat 8 picture from 24/10/2014 overlaid with classification results.



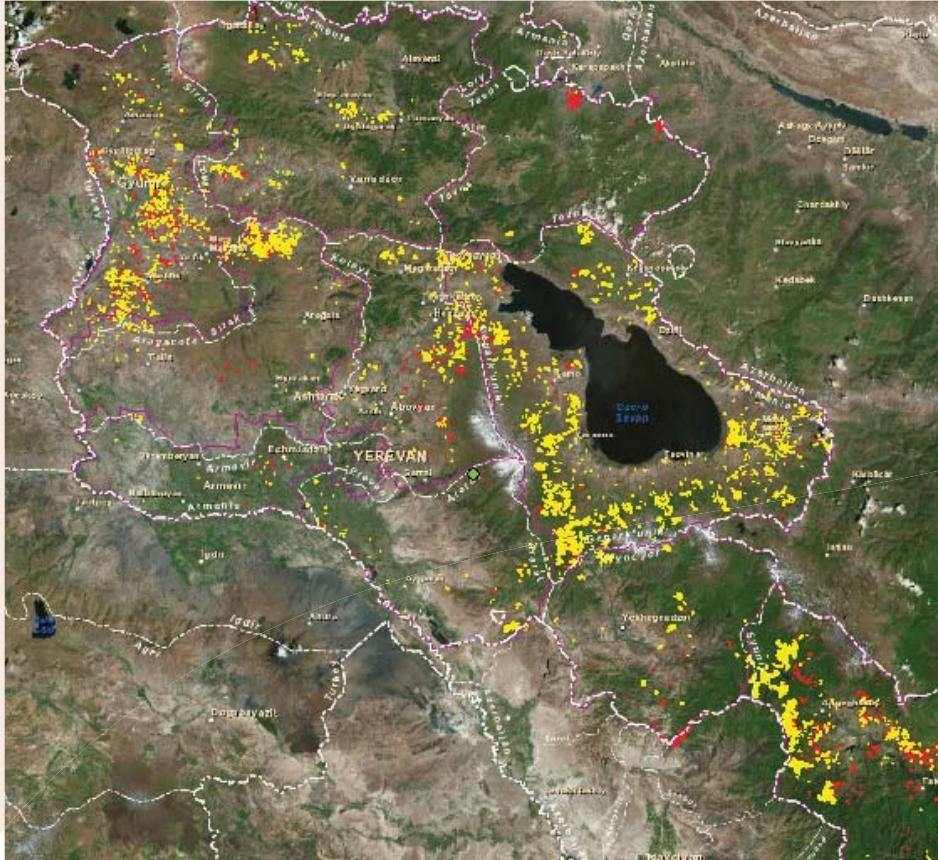


Figure 5: Armenia Burned Areas 2013/2014.

Future Steps

In order to reduce adverse impacts of pasture, agricultural, and forest fires, alertness and consequent action by political and community leaders as well as individuals is essential – especially within the regions Ghegarkunik, Shirak and Syunik. A legal basis already exists in Armenia: the RA law on 'Protection of Atmospheric Air'. It announces the ban 'to burn stubble, plant residues and dry vegetation areas, vegetation of pastures and meadows in the agricultural, forest neighbouring, forest and specially protected area lands' ¹. However, to guarantee compliance, its practical enforcement needs to be further strengthened, and information needs to be disseminated to community leaders. Likewise, principal causes of pasture, agricultural and forest fires need to be addressed by

effective awareness raising events. Mass-media campaigns, school visits or teachers' training events constitute appropriate measures to effectively inform rural communities about existing risks and negative impacts of fires on biodiversity and livelihoods. Regions that are most severely affected by fire should be in the centre of attention in terms of educational work and preventive activities. With respect to pasture, and forest fire activities, these measures will contribute to an informed generation, a change in existing attitudes and, most importantly, they will lead the communities and individuals to comply with rules and regulations as well as legal practices. A better understanding about prevalent risks and negative impacts of fire on biodiversity and livelihoods represents an important step towards sustainable pasture and forest management in Armenia.

¹ Non-official translation. Armenian Version can be found on: www.parliament.am

Legend

World Boundaries and Places

Marzes

Burned Areas 2013

Burned Areas 2014



0 10 20 40 60 80 Kilometers

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Address: Sustainable Management of Biodiversity South Caucasus
4/1 Baghramyan Avenue, 0019
Yerevan, Republic of Armenia
Tel.: (+37410) 581877
Email: thomas.eberherr@giz.de
Webpage: www.giz.de

RA Ministry of Territorial Administration and Emergency Situations

Address: Government House 2
Republic Square, 0010 Yerevan
Tel.: (+37410) 511362
Email: info@mta.gov.am
Webpage: www.mta.gov.am

RA Ministry of Agriculture

Address: Government Building 3
Republic Square, 0010 Yerevan
Tel.: (+37410) 524641
Email: agro@minagro.am
Webpage: www.minagro.am

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Author: Kathrin Winterscheid

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