→ EO4SD - EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Climate Resilience | Central Asia

Earth Observation in Kyrgyzstan and Tajikistan

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1. INTRODUCTION

Earth Observation (EO) data has significant potential to support climate resilience planning, design and implementation. Since 2019, The European Space Agency's Earth Observation for Sustainable Development Climate Resilience (EO4SD CR) cluster has worked with several International Finance Institutions (IFIs) to apply EO-derived data and services to support real-world climate resilience projects.

One such collaboration is with the International Fund of Agricultural Development (IFAD), where EO data and climate risk information have been provided to help build pastoral communities' climate resilience across Kyrgyzstan and Tajikistan. Through its Regional Resilient Pastoral Communities Project (RRPCP) in Kyrgyzstan and Community-based Agricultural Support Project II (CASP-2) in Tajikistan, IFAD supports rural poverty alleviation and the economic growth of rural farming communities. The EO4SD CR cluster provided IFAD with climate data and information to help it to unlock climate finance to support these projects and continues to provide technical assistance through service provision and capacity building.

About ESA's EO4SD Climate Resilience Cluster

Since 2008, the European Space Agency (ESA) has worked closely with International Financing Institutions (IFIs) and their client countries to harness the benefits of EO in their operations and resources management. Earth Observation for Sustainable Development (EO4SD) is an ESA initiative that has increased the uptake of EO-based information in regular development operations at the national and international level.

The ESA EO4SD Climate Resilience Cluster has provided insight into EO's potential to support climate-resilient decision making at the regional and national scale. In collaboration with several IFIs, the EO4SD CR cluster has developed EO-based integrated climate screening and risk management products and services to help manage climate-related risks and capitalise on the opportunities that climate resilience can create. The EO4SD CR cluster is also working to build the capacity of IFI staff and IFI client states, allowing stakeholders to autonomously use EO-based information for climate resilience decision making.

2. USING EARTH OBSERVATION TO LEVERAGE CLIMATE FINANCE

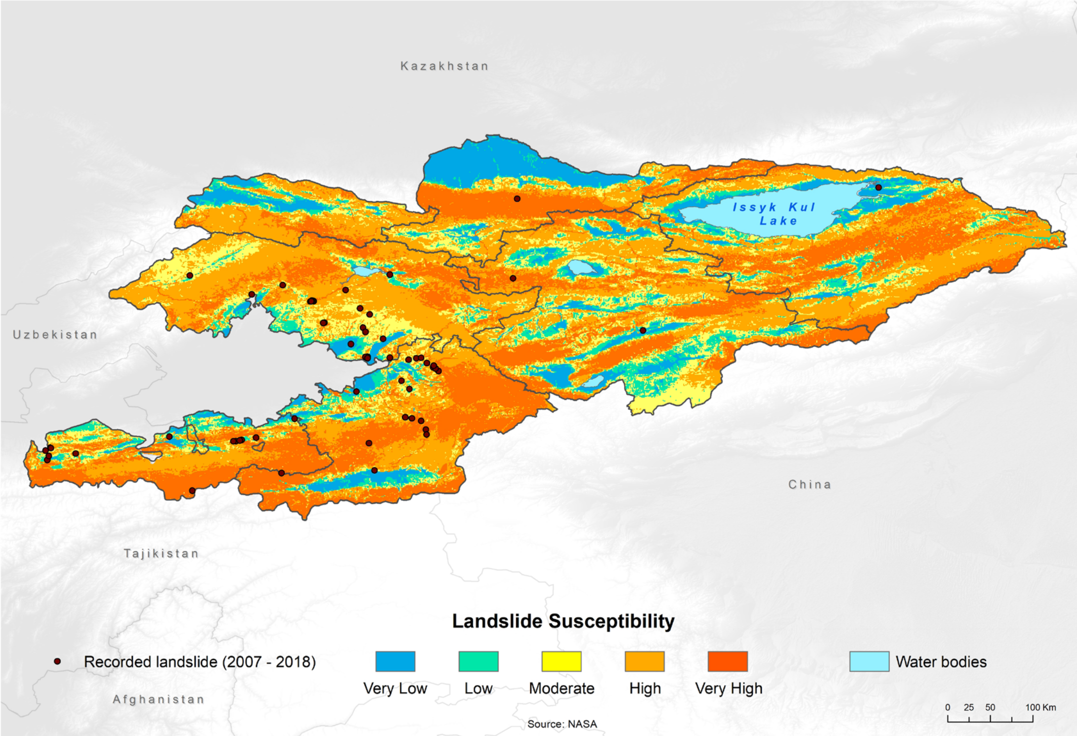
Chronic vulnerabilities in pastoral communities across Central Asia, such as poor infrastructure and high rural poverty, are exacerbated by the impacts of climate change and sub-optimal land management practices. In response, IFAD is spearheading the design of new pastoral resilience programmes in Tajikistan and Kyrgyzstan to improve land management and bolster the sustainability of the rural agricultural economy.

In Kyrgyzstan, IFAD's Regional Resilient Pastoral Communities Project (RRPCP) aims to contribute to rural poverty alleviation through increased resilience, incomes, and enhanced economic growth in rural farming communities.

Kyrgyzstan hosts a population of 6.4 million, 66 per cent of which live in rural areas and depend predominantly on agriculture and livestock for their livelihood[1]. In Kyrgyzstan, the livestock-rangeland system is trapped in a vicious cycle, whereby many decades of overgrazing have contributed to extensive land degradation, resulting in soil erosion and landslides, and a reduction in livestock productivity. To compensate for the economic loss, households often purchase additional livestock, further intensifying the rate of land degradation. In addition to the degradation of natural resources due to unsustainable agricultural practices, forests, pastures, and other sensitive resources are also under stress from anthropogenic-induced climate change. Climate change, therefore, presents an additional threat to natural resources and may cause both further damage to forests and pasturelands and shocks to the broader rural economy.

The RRPCP aims to tackle these issues and strengthen Kyrgyzstan's rural economy to climate impacts through improved livestock and pasture health and productivity, and the enhanced climate resilience of pastoral communities. If funded, the project will be executed through three components, one of which, 'Sustainable community-based integrated forest-rangeland ecosystem management', is particularly well-placed to benefit from the technical capabilities of the EO4SD CR cluster (for example, see Image 1).

1 National Statistical Committee of the Kyrgyz Republic. (2019). Accessed: October 2019. Available from: http://stat.kg/en/.



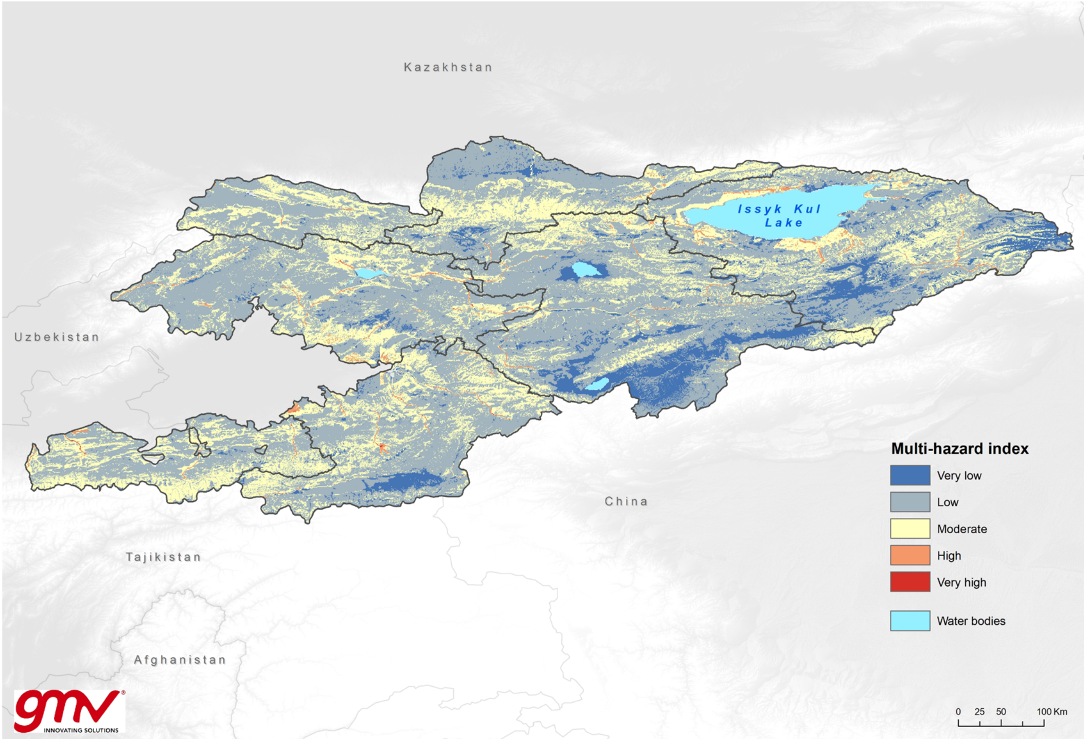


Image 1 **Landslide susceptibility map (top) and multi-hazard index map (bottom) that combines landslide, vegetation damage, flood and soil erosion (Kyrgyzstan). Source: GMV.**

In Tajikistan, the Community-based Agricultural Support Project II (CASP-2) aims to spur inclusive growth and drive poverty reduction among highly vulnerable, rural poor communities.

Tajikistan has a population of 9.126 million in 2018, of which 73 per cent live in rural areas. Agriculture makes up 18.7 per cent of its GDP. While Tajikistan has seen progress in reducing poverty, the country remains in 129th place in the Environmental Performance Index (EPI), with one-fifth of the population affected by food insecurity[2]. Irrigation is critical for the development of Tajikistan's agricultural sector. In 2018, more than 67 per cent of its arable land (563,000 ha) was irrigated[3]. However, the irrigated area is decreasing due to deteriorating irrigation and drainage infrastructure, salinisation, waterlogged soils and unreliable electricity to pump stations. Decreased irrigation presents hardships for rural, poor communities and puts these communities at risk of being further pushed into poverty.

Research shows that involving vulnerable communities when developing adaptation approaches is essential for success and helps to ensure that actions being taken solve the root of the problem[4]. A crucial element of CASP-2 is to integrate climate adaptation needs into new Community Action Plans (CAPs). CAPs implement community change by identifying and specifying what will be done, who will do it and how it will be achieved. Pasture User Unions (PUUs) will use the CAPs to specify and justify community-level needs for climate resilience investment from the national fund.

Unlocking Climate Finance

The EO4SD CR cluster is working with IFAD to address the information and skills that place structural constraints on both Tajikistan's and Kyrgyzstan's ability to unlock climate finance. Through the tailored provision of EO climate information in support of two applications for climate finance, the EO4SD CR cluster enables both countries to present the required high-quality climate information.

To maximise the impact of both projects, IFAD is applying for funding through the Green Climate Fund for its project in Tajikistan, and from the Adaptation Fund in Kyrgyzstan. The EO4SD CR cluster assisted IFAD to build evidence base and rationale to support its application to each fund. Accessing climate finance can be a technically complex, time-intensive process that requires prospective beneficiaries to furnish detailed evidence in support of their applications. This requirement remains a barrier for many of the countries that would benefit most from such financial support. Providing high quality, credible EO data in support of climate finance applications can therefore help developing countries unlock climate finance, and ultimately enable them to access the resources to advance toward their climate resilience goals.

For IFAD, the EO4SD CR Cluster assembled a bespoke selection of EO-derived climate and natural hazard information, such as related to extreme rainfall, flood hazard, vegetation health, and soil erosion. This included information about patterns and trends related to a range of climate variable across both countries (Image 2) and climate-related multi-hazard maps. Together, these data help project sponsors and beneficiaries to identify degraded land and prioritise areas suitable for afforestation or pasture. Restoration efforts can then be directed at those areas with the greatest potential to benefit from climate resilience investments.

2 IFAD Country Profile – Tajikistan. Available from: https://www.ifad.org/en/web/operations/country/id/tajikistan
3 Country Partnership Strategy: Tajikistan, 2016–2020. Available from: https://www.adb.org/sites/default/files/linked-documents/cps-taj-2016-2020-ssa-03.pdf
4 IIED,2015. Vulnerable communities: climate adaptation that works for the poor

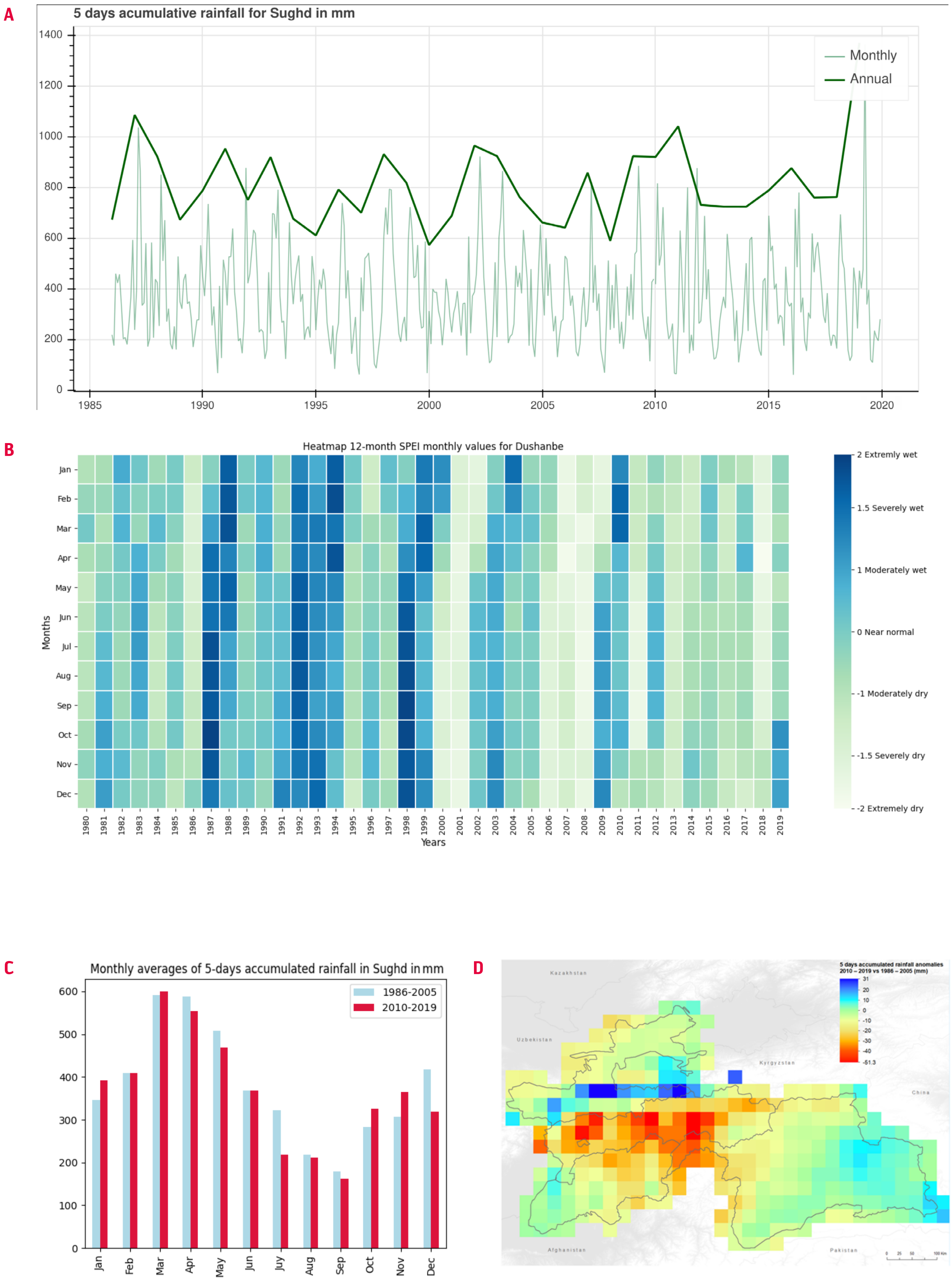


Image 2 A comprehensive portfolio of climate and natural hazard data were analysed and presented in each technical report, including province-level trends presented as time-series plots (A) and heatmaps (B), and climate normals presented as column plots (C). Spatial patterns and trends are presented as maps (D). Source: GMV and Sistema.

Regional capacity in GIS tools and EO geospatial data is limited to a small set of poorly resourced institutions. Therefore, the formats used to provide the data was crucial. Information - presented in the form of maps, heatmaps, and time-series plots - was delivered in standard-format technical reports, along with accompanying data descriptions and summaries (Image 3). This enables a wide range of users to access and use the data, and for it to be easily integrated into climate finance proposals.

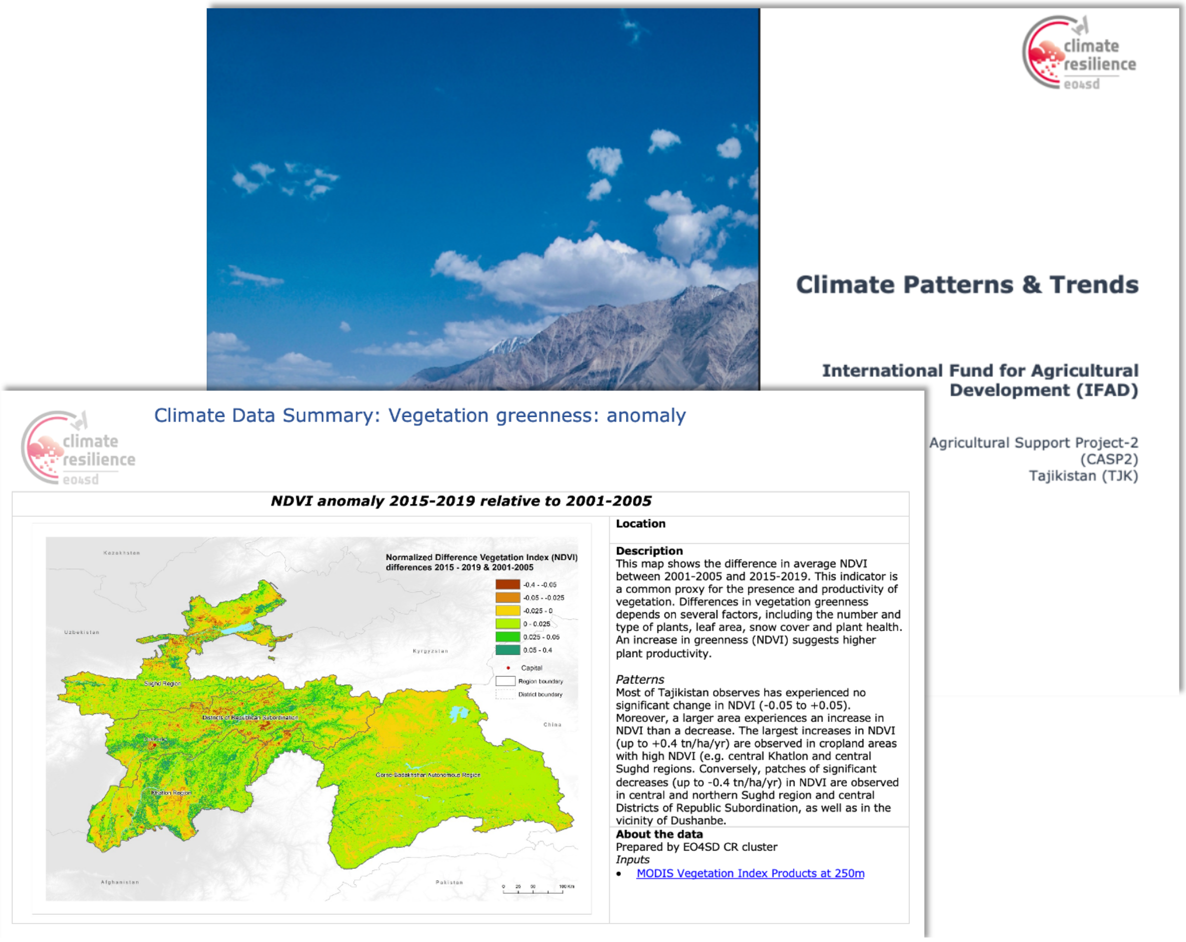


Image 3 The EO4SD Climate Resilience Cluster supplied data as a comprehensive technical report (Word and PDF document), enabling critical information to be accessed and extracted with minimal technical effort. Source: GMV and Acclimatise.

By providing credible, comparable, and high-quality evidence regarding climate trends and climate risks to pasturelands, the EO4SD CR cluster helped IFAD to reduce its data deficit. At the same time, IFAD brings valuable 'on-the-ground' expertise to validate EO-based products and provide added insight regarding community vulnerability.

3. MULTI-HAZARD ASSESSMENT USING EARTH OBSERVATION: PORTFOLIO

As mentioned in the previous section, the EO4SD CR cluster provided IFAD with a range of EO-derived climate and natural hazard information to enable project sponsors and beneficiaries identify patterns and trends in climate hazards to rangelands and identify areas suitable for rehabilitation or reforestation investments.

Table 1 presents a summary of the EO-derived products provided to IFAD in each technical summary document. These products range from climate data and soil erosion maps, to vegetable degradation and multi-hazard indices. Collectively, they help furnish evidence that enables IFAD to establish a robust climate resilience rationale for climate finance in its funding applications to the Green Climate Fund and Adaptation Fund.

Table 1 Summary of products provided in each technical report in accordance with IFAD's requirements.

Product	Description
Climate data	Graphs and maps present observed monthly and annual patterns, trends, and anomalies for a range of climate-related indicators, including surface air temperature, soil moisture, and extreme rainfall.
Soil erosion rate	Soil erosion is a severe challenge in Kyrgyzstan and Tajikistan and both affects and is affected by, rangeland condition. Maps show the rate of soil erosion over two baseline time periods and the change in soil erosion rate between these two periods. The rate of soil erosion is estimated using the Revised Universal Soil Loss Equation (RUSLE) method.
Vegetation degradation	An economically resilient pastoral economy relies on healthy vegetation. Vegetation indices are processed and mapped to show changes in vegetation health over time and space.
Vegetation heat stress	Change in average and extreme temperature can expose vegetation to more severe heat stress. Maps show where vegetation is most exposed to heat stress and how this has changed over time.
Rangeland identification and pastureland degradation	Building the resilience of pastoral economies requires, (1) identifying the location of rangelands and pasturelands, and (2) identifying hotspots of pastureland degradation. Based on a composite vegetation index, maps show where rangelands and seasonal pasturelands are located and how their condition has evolved over time.
Multi-hazard index	A multi-hazard index combines a portfolio of climate-related hazards, such as the rate of soil erosion, landslide susceptibility, vegetation heat stress. The index is mapped to show the severity of hazard areas are exposed to and the types of hazard that present the highest levels of threat.

Table 2 enclosed at the end of this brochure contains additional technical information related to these projects. The soil erosion and rangeland identification products are detailed in the sections below.

3.1 Example 1: Monitoring the soil erosion rate

Severe rates of soil erosion across Kyrgyzstan and Tajikistan can be both a cause and an effect of rangeland and pastureland degradation and are high by global standards. Sub-optimal rangeland and pastureland management, over-stocking, changing land cover, and evolving rainfall patterns can precipitate increases in the rate of soil erosion, heightening the potential severity of secondary hazards such as fluvial flooding (owing to sedimentation of channels) and mudflows.

The EO4SD CR cluster developed national soil loss maps using the RUSLE method (Image 4) and EO data to help IFAD and its beneficiaries understand the severity of soil loss across Kyrgyzstan and Tajikistan and how the hazard has changed over time. In Tajikistan, the results of this analysis show a small amount of change in the rate of soil loss (+/- 10 tn/ha/yr) overall, with a larger area experiencing lower rates of soil loss than higher rates of soil loss. The largest increase in soil loss rate was recorded in central Tajikistan (+25 to +67 tn/ha/yr) and in northwest Gorno-Badakhshan.

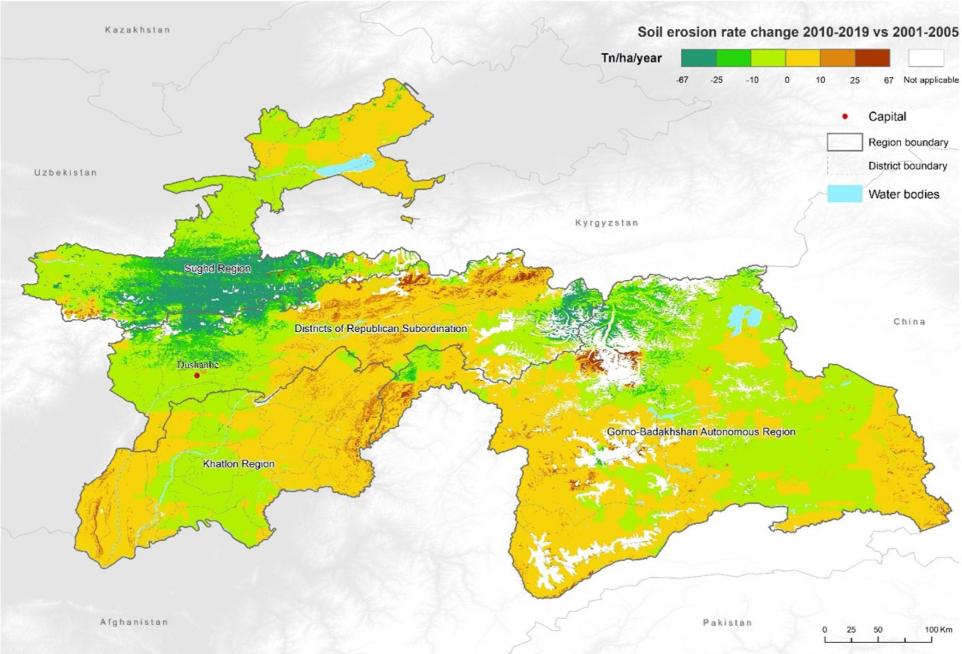


Image 4 **Estimated soil erosion rate change (tonnes per hectare per year) driven by rainfall patterns across Tajikistan between 2001 to 2005 and 2015 to 2019. The rate of erosion is calculated using the RUSLE methodology at 100m resolution. Source: GMV.**

3.2 Example 2: Rangeland identification and pastureland evolution

The EO4SD CR cluster was requested by IFAD, together with the Food and Agricultural Organisation (FAO), to assess the degradation of pasturelands in rangelands (Image 5). The 'pasture evolution' product help fill two significant knowledge gaps, namely (1.) the location of rangelands and pasturelands, and (2.) the evolution of pastureland condition.

The products provided by the Cluster mobilise a composite vegetation index to determine PUUs pasturelands' health, considering factors additional such as seasonal grazing periods, altitude, and the phenology of palatable and non-palatable vegetation. Ultimately, this product can be used to identify the location of utilised or under-utilised pastures in each PUU, study seasonal changes in rangelands, and inform pasture use management (e.g. by controlling stocking

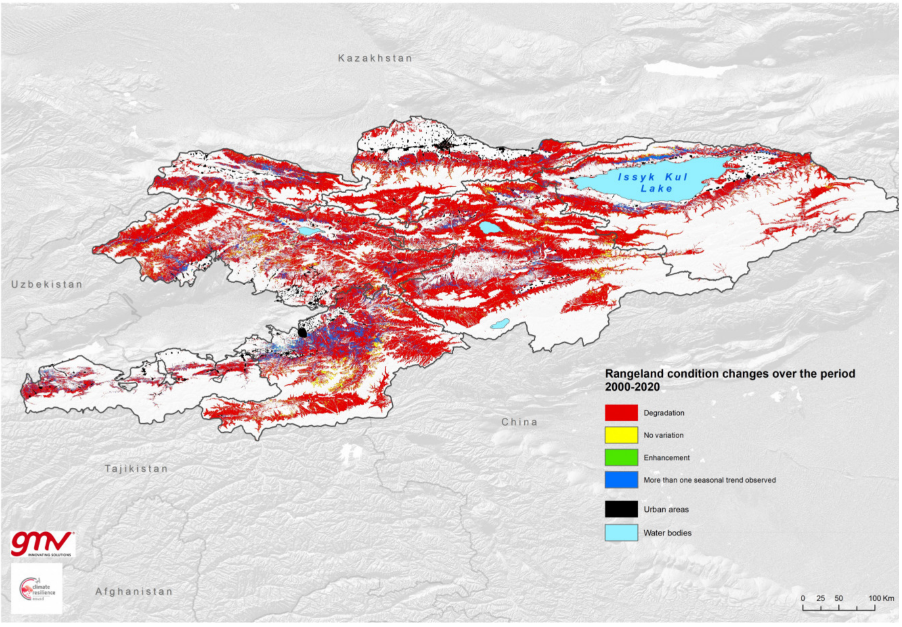


Image 5 **Changes in seasonal pastures condition in Kyrgyzstan over the period 2000-2020 developed using a composite of Landsat-based indexes, AI-improved LULC map, IPCC pastures degradation thresholds, and local information on grazing seasonal periods, grazing altitudes, grazing on slopes, pastures distance to villages in winter provided by Camp Alatoo Public Foundation. Source: GMV**

4. CAPACITY BUILDING

The Cluster's engagement with IFAD includes a capacity building (CB) element. This aims to build the capacity of the beneficiaries of the investment projects mentioned above to access and use Earth Observation data. CB will take the form of an independent CB programme or be integrated with existing activities planned by IFAD.

These CB activities will consist of introductory webinars and online workshops open to a range of regional stakeholders. Pre- and post-event blogs will increase awareness of capacity building activities by capturing learning and sharing information more widely.

The Cluster has delivered:

1. An introductory webinar on Earth Observation to IFAD personnel providing information regarding the EO4SD framework, Climate Resilience cluster activities, portfolio of sectoral services, prototypes and the selected projects/services;

2. A showcase of how Earth Observation data can be used to monitor climate impacts pastureland degradation, for a webinar organised by UNDP, GIZ, and IFAD ('Using remote sensing for the NDC update (Kyrgyzstan)'). The Cluster demonstrated how such data might inform decision-making regarding climate resilience investment and help drive carbon soil stock models used in NDC assessments.

In future, the Cluster has proposed:

1. Regional webinars providing guidance on the use of GIS platforms and the interpretation of EO data to build the climate resilience of pasturelands and forestry (during project implementation).

2. Guidance and templates for presenting key climate risk information for climate finance applications.

The National Observatory of Athens' Centre of Excellence BEYOND leads the capacity building activities with support from EO4SD Climate Resilience Cluster partners GMV and Acclimatise.

Table 2 Earth Observation climate and natural hazard indicators provided to IFAD in each technical report.

Indicator	Data source
Extreme rainfall (maximum 1-day, 5-day accumulated, 1–20-year return period)	• Copernicus Climate Change Service ERA5 reanalysis
Drought index (SPEI 6, 9, 12)	• Copernicus Climate Change Service ERA5 reanalysis
Soil erosion (RUSLE)	• Climate Hazard InfraRed Precipitation with Station data (CHIRPS) (5km) • SoilGrids data: sand, silt and clay, organic carbon stock content (250m) • Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) (90m) • Fraction of green Vegetation Cover (Fcover) from Copernicus programme (1km) • NASA's Global Food Security-support Analysis Data (GFSAD) (1km) • ESA's Climate Change Initiative (CCI) Land Cover products (300m)
Vegetation greenness	• MODIS Vegetation Index Products (0.05 deg.)
Degradation of natural vegetation	• ESA Climate Change Initiative Land Cover (300m) • MODIS Vegetation Index Products (250m) • MODIS Surface reflectance (bands 01, 02 and 06) (250m) • LAI Copernicus (300m)
Riverine flood	• Flood hazard map of the World - 100-year return period. European Commission, Joint Research Centre (JRC) • Aqueduct flood hazard map of the World - 100-year return period. World Resources Institute (WRI)
Temperature (mean, maximum, minimum, frost)	• Copernicus Climate Change Service ERA5 reanalysis
Landslide susceptibility	• Global susceptibility map from the modelled Global Landslide Hazard Assessment for Situational Awareness model (LHASA) by NASA • Landslides events from the Cooperative Open Online Landslide Repository
Land cover/land use	• ESA Climate Change Initiative (CCI) Land Cover products (300m) • Moderate Dynamic Land Cover (100m)
Vegetation vulnerability to temperature	• MODIS Enhanced Vegetation Index (MOD13Q1 v006 and MYD13Q1 v006) (250m) • MODIS Land Surface Temperature (MOD11A2 v006 and MYD11A2 v006) (1km)
Natural vegetation biomass	• ESA Climate Change Initiative Biomass (100m)
Soil moisture	• ESA Climate Change Initiative Soil Moisture
Rangeland and pasture degradation	• Monthly averages of spectral bands used to generate: normalised difference vegetation index (NDVI), soil-adjusted vegetation index (SAVI), modified soil adjusted vegetation index (MSAVI) and enhanced vegetation index (EVI). • Landsat-5 and Landsat-8 (30m) • Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) (90m) • Land cover GlobeLand30 (2000 and 2020) (30m)

Partners of the Climate Resilience Cluster

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