

# → E04SD – EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

**Agriculture and Rural Development | Morocco**

**The Atlas Mountains Rural Development Project (PDRMA)**

**The Green Morocco Plan (GMP)**



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**Cover image** shows the vegetation cover in the Atlas Mountains on as observed with Sentinel-2 on 24 September 2016 at 10 m spatial resolution. Sentinel-2 is the first optical Earth Observation mission of its kind to include three bands in the 'red edge', which provide key information on vegetation state. Here, the bands 8, 4, 3 are combined to a 'false colour image' that highlights active vegetation cover in red.

Credit: EO4SD Agriculture Cluster (GeoVille for ESA/IFAD, 2017).

## 1. INTRODUCTION

Agriculture is a strategic sector in Morocco, economically and socially. Agriculture production represents almost 15 percent of Morocco's GDP and as such, it plays a major role in terms of food security, employment, and stabilisation of livelihoods of rural residents, which makes up almost 40 percent of the total population. The poverty rate in rural areas has dropped in recent years, but remains four or five times higher than that of urban areas, with provinces in mountainous areas being among the poorest.

Economic growth in Morocco is particularly volatile due to changes in agricultural production, which depends on climate conditions, among other factors. Morocco is characterised by two types of agriculture, a modern, highly productive agriculture in irrigated areas covering about 20 percent of cultivated land, and a traditional food-producing agriculture for the remaining 80 percent, localised in disadvantaged, rain fed farmland, and mountain and oasis areas.

Food supply in Morocco, which is a major component of national food security, thus depends mainly on rainfall that displays large inter-annual variations. Most of the rainfall in Morocco comes between the months of October and April, which is a short period for crop growth and development. As at this moment only one fifth of the croplands are irrigated, weather risk mitigation as well as crop improvement opportunities are limited.

The Green Morocco Plan (Plan Maroc Vert, PMV) is dedicated to stimulating the agriculture sector based on two pillars, one for modern agro-industry (pillar I) and one for smallholder farmers (pillar II). The International Fund for Agricultural Development (IFAD) supports the implementation of the Green Morocco Plan in mountainous areas through the Atlas Mountains Rural Development Project (PDRMA), related to the second pillar (supporting smallholders through the so-called solidarity-based agriculture). PDRMA has a long-term agreement with the Mountain Area Rural Development Program (PDRZM) planned jointly by IFAD and the Government of Morocco. This program approach allows for better investment planning, and seeks to enhance investment effectiveness by better coordinating the various stakeholders at central, provincial and local levels and scaling up approaches that were successful.

The potential of EO-based geo-information products and services to contribute in an effective way to the consolidation of a sustainable agriculture sector in Morocco is presented in this document. The purpose is to raise awareness and demonstrate the added value of EO information products and services for implementation of their ongoing development projects.

### The Green Morocco Plan

Launched in 2008, the Green Morocco Plan (Plan Maroc Vert, PMV) is a government strategy designed to stimulate the national agricultural sector. Its goal is to reform agriculture and promote its integration in the international market, and develop sustainable growth. The PMV strategy follows a comprehensive approach, encompassing the specific objectives of all stakeholders, based on two main pillars: modern agriculture (pillar I) and solidarity-based agriculture (pillar II). Pillar II provides support to smallholder farming for: (i) modernising and integrating smallholder farming into product value chains as a means to reduce poverty through an integrated rural development strategy; and (ii) developing alternative sources of income.

## 2. OBJECTIVES

The Atlas Mountains Rural Development Project (*Projet de développement rural des montagnes de l'Atlas, PDRMA*) aims at reducing poverty in areas of the Atlas mountains and increasing agricultural production. The project covers three provinces of Ouarzazate, Tinghir and Beni Mellal.

Multiple problems account for the persistently high rural poverty rate in these areas. To understand the connections between rural communities and markets, a holistic view on the mountainous Atlas regions of Morocco is required. The specific objectives of the PDRMA project are to strengthen the target populations' abilities to improve their incomes by improving market access, managing natural resources in a sustainable manner, and diversifying their sources of revenues.

Earth Observation (EO) offers the opportunity to assess the status of natural and agricultural resources with a particular focus on agricultural areas evolution, land regeneration, and assessment of improved natural resources management and conservation, which would contribute to more sustainable income sources for local populations.

The EO4SD project aims to answer key development questions in relation to IFAD activities in Morocco:

- How well are the agricultural areas connected to markets?
- Have bare lands been transformed into agriculture?
- Can degradation in rangelands be halted?
- Which areas are most prone to soil erosion?
- How does the Green Morocco Plan affect the environment?

## 3. IMPLEMENTATION PLAN

The PDRMA project involves three technical components where geo-spatial applications are of key value: (i) agricultural value chain development and (ii) sustainable natural resource management, climate change adaptation and diversification, and (iii) project coordination, management and monitoring and evaluation (M&E) mechanism.

EO4SD defined a cluster of land information services that were delivered to IFAD and the national-level stakeholders of the Atlas Mountains Rural Development Project (PDRMA). These services are based on a combination of mapping and monitoring tools as well as training activities to address the key research questions and the technical components of PDRMA. This includes:

### **(1) Land cover change mapping** (EO-based products and services including agricultural production areas, rangeland and tree cover mapping)

This service enables monitoring the agricultural areas expansion by identifying the location and changes in agricultural areas (i.e. planting of fruit trees, which is financed through PDRMA). Furthermore, the service identifies the location, extent and changes in rangelands that stabilise erosion-prone slopes and feed ruminant livestock.

### **(2) Tools to assess land degradation and environmental conditions** (EO-based products and services including water-based soil erosion, vegetation dynamic analyses, land degradation assessments)

This service allows identifying degraded or degradation-prone areas that can become target priorities for land management investments. In particular, the two main problems in the PDRMA areas are soil erosion along the rivers and the loss of productive capacity (degradation, overgrazing) of rangelands. In this context, a long-term time series of vegetation trends provides insights in the historic evolution of vegetation cover to highlight areas with significant negative trends. Soil erosion maps combine information about the actual land cover with terrain, soil and rainfall information, indicating areas that are prone to water-based soil erosion, as well as those impacted by drought conditions and/or susceptible to drought.

**(3) Value chain assessment** (EO-based products and services as well as geo-information products to identify the distance from agricultural production zones to towns/markets)

Rural infrastructure mapping helps to implement policies and programs, which meet specific market development objectives. This service consists of maps of road networks as well as other transport and critical infrastructure elements. Corresponding land cover and use maps focus on agricultural production centers, rural settlements as well as inputs from data other sources resolving distance to markets (e.g. travel time from production or storage facilities) which are used for supply chain assessments.

The target partners are:

- **IFAD** as the implementing agency for the Atlas Mountains Rural Development Project (PDRMA) Pillar II of the PMV,
- **the Ministry of Agriculture and Maritime Fisheries (MAPF).**

Earth Observation data, information products and services, available at the appropriate scales and timeframes, were made accessible to the users through the EO4SD data and information delivery platform (EO4SD.lizard.net). The Lizard platform was used as a hub for data sharing and visualisation. The communication with Lizard was available both via the web-interface (where the services and data products will be shown for different regions and scales) and through direct communication via an Application Programming Interface (API) for continuous communication between the technical partners and the ESA consortium.

The ESA Sentinel-2 for Agriculture (Sen2-Agri) tool furthermore offers the IFAD user community validated algorithms to derive EO products for crop monitoring. Four key products were provided: monthly composites, dynamic cropland masks, crop type maps and leaf area index (LAI) products. Sen2-Agri test sites were piloted in Morocco (Tensift, Tadlat and Doukkala) by several local universities: Chouaib Doukkali University, Sultan Moulay Slimane University and Caddi Ayad University.

Service level	Data	Spatial coverage	Temporal coverage	Spatial resolution	Description
Regional to national	Land cover/ use and change	Ouarzazate, Tinghir and Béni Mellal	Baseline mapping 2016 and change for 2018 in Ouarzazate	10 m	Land cover/use map depicting - Water bodies - Non-vegetated - Trees - Agriculture - Rangeland
	Soil erosion mapping (water based)	Ouarzazate, Tinghir and Béni Mellal	One coverage, depending on input data	30 m	Identification of areas prone to water based soil erosion based on terrain, vegetation cover, and rainfall and soil type.
	Rural infrastructure and distance to markets	Ouarzazate, Tinghir and Béni Mellal	One coverage, depending on input data	Depending on input data	Distance of agricultural production zones to towns/ markets. This information can be refined with in situ information on storage facilities and other key parts of the supply chain.
	Vegetation dynamics (trend analysis)	Ouarzazate, Tinghir and Béni Mellal	2000-current	30-250 m	Large scale assessment of rangelands with 250m MODIS time series including distinction between annual and perennial vegetation; hotspot assessments of croplands along rivers with 30m Landsat time series and 10m Sentinel for the current status.
	Climate-normalised vegetation trend (vegetation dynamics not related to climate)	Ouarzazate, Tinghir and Béni Mellal	2000-current	250 m	For rangelands with 250m MODIS time series including distinction between annual and perennial vegetation

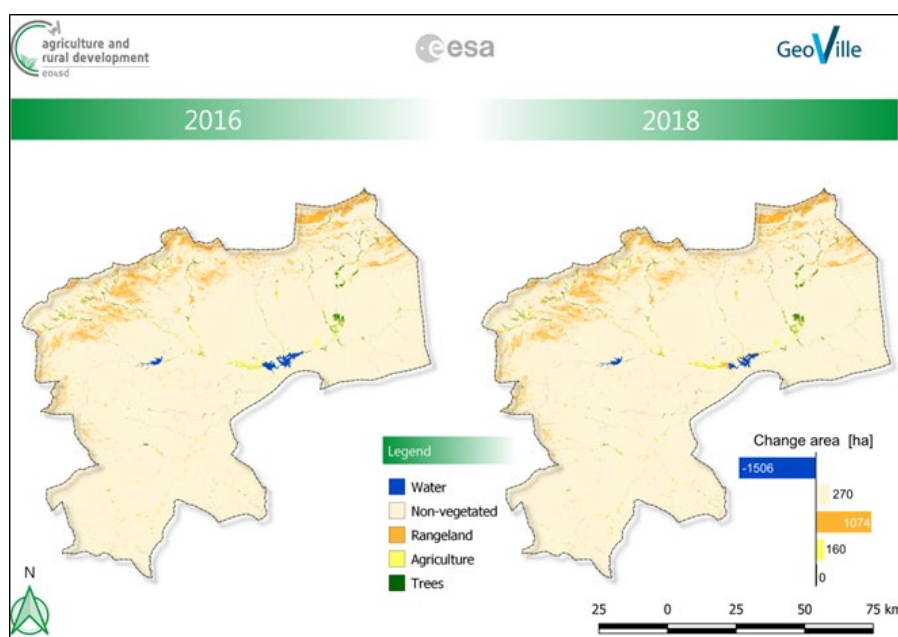
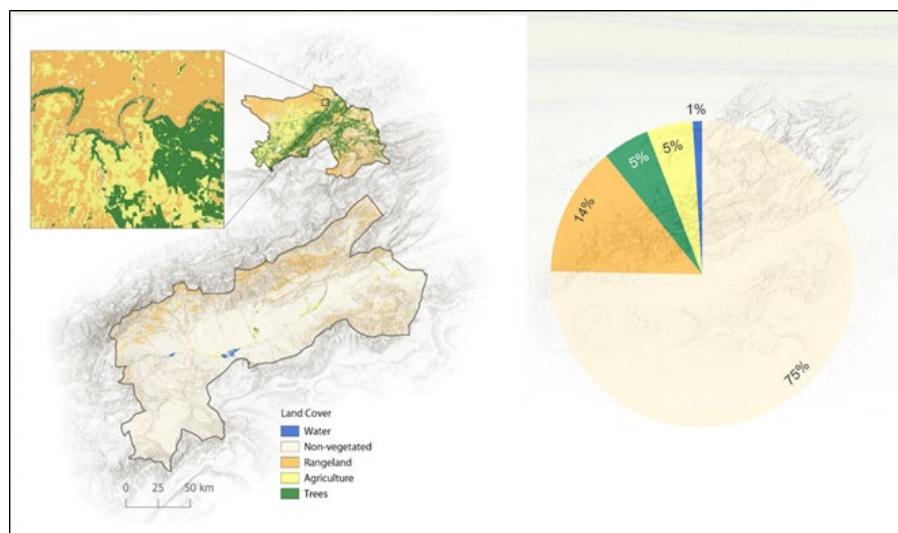
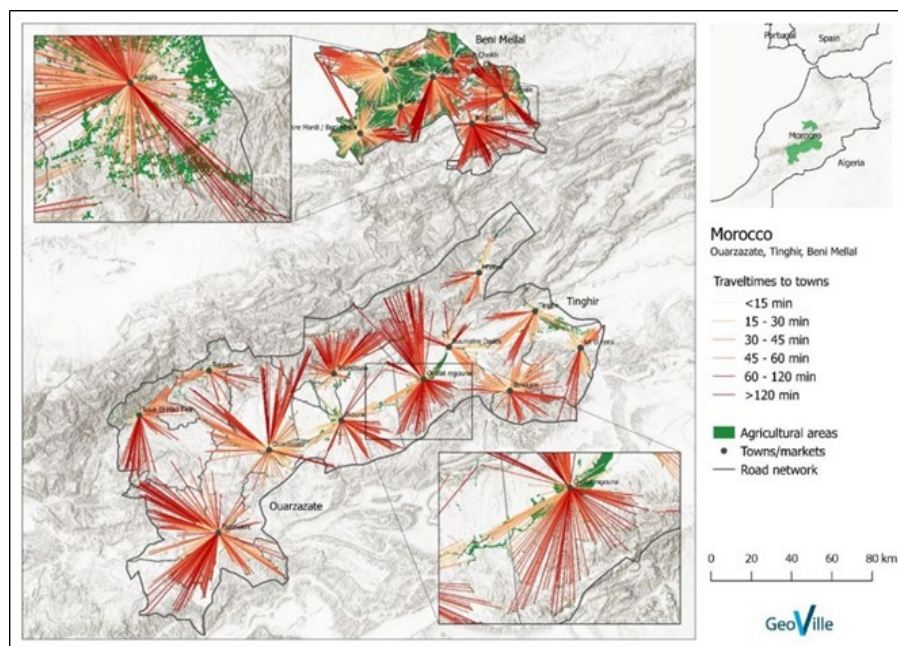


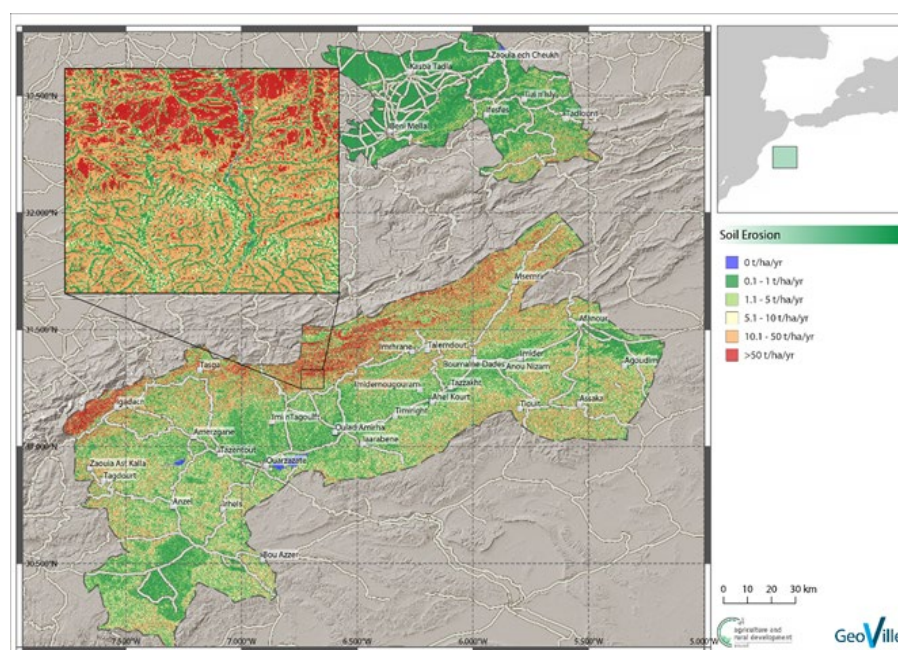
Figure 1 Detailed land cover/use mapping for 2016 and change of land use in the Quarzazate region between 2016 and 2018 based on Sentinel-2imagery.

Credit: EO4SD Agriculture Cluster (GeoVille for ESA/IFAD, 2019).



**Figure 2** Based on the road network, the distance and related travel time from agricultural production areas to towns and market centres can be assessed. Agricultural production areas were derived from Sentinel-2 data. Such information supports agricultural value chain development and value addition, and can be refined with further information e.g. storage locations.

Credit: EO4SD Agriculture Cluster (GeoVille for ESA/IFAD, 2019).



**Figure 3** Water based soil erosion potential is derived from satellite-based digital terrain information; rainfall and land cover data as well as a digital soil map. Areas prone to soil erosion can be identified and further assessed, supporting recovery activities.

Credit: EO4SD Agriculture Cluster (GeoVille for ESA/IFAD, 2019).

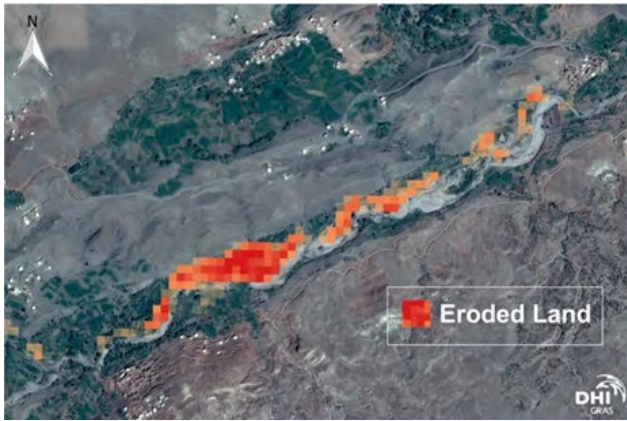
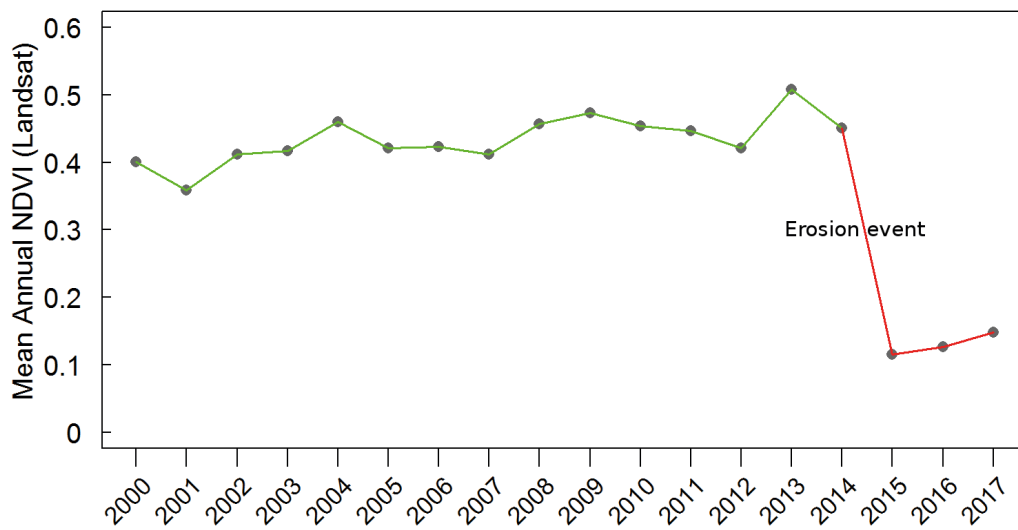


Figure 4 Disappearing agricultural lands due to river erosion near Ighrem N'Ougdal (Morocco). EO time series analyses can reveal magnitude and timing of historic soil erosion provide baseline information and serve as a tool for selecting intervention areas.

Credit: EO4SD Agriculture Cluster (DHI GRAS for ESA/World Bank, 2017).



## 4. CAPACITY BUILDING

The amount of free and open-access satellite data has increased dramatically with the commissioning of the Sentinel satellites. However, national GIS and remote sensing centres or user organisations often lack the capacity to develop and use the data for monitoring and reporting activities. Developing a portfolio of tailored information services and ad hoc capacity building activities would help them to sustainably build up their decision-making capabilities as well as knowledge in EO data exploitation.

The E04SD initiative included a capacity-building plan that aimed at demonstrating the opportunities and benefits of using EO-based information services so that they become an integral part of the planning, operational, monitoring and evaluation phases of projects. This plan was implemented with the technical support of the ITC Faculty of Geo-Information Science and Earth Observation of the University of Twente, a global leader in training and capacity building in the field of geo-information science, Earth Observation and GIS. It aimed at developing the skills set of the remote sensing professionals and the user organisations alike and include - as necessary - practical exercises concerning data application and use, lectures, and independent EO research by the participants. It also specifically leveraged free, open access Earth Observation data and programs.

This dedicated training component (see Figure 5) involved the organisation of awareness raising sessions with MDBs and other development partners and national training workshops organised for the French-speaking stakeholders in Marrakech, Morocco. The duration was 5 days and stakeholders from different targeted projects were gathered together.

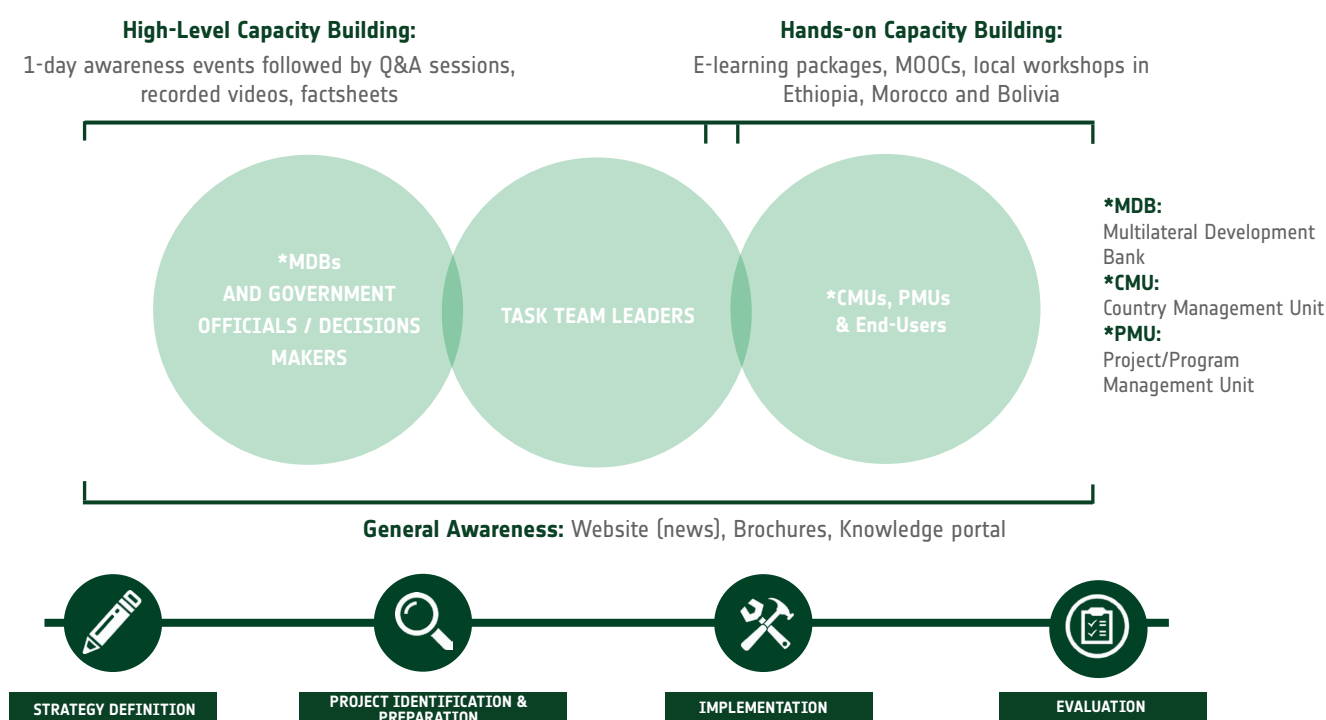


Figure 5 E04SD capacity building plan.

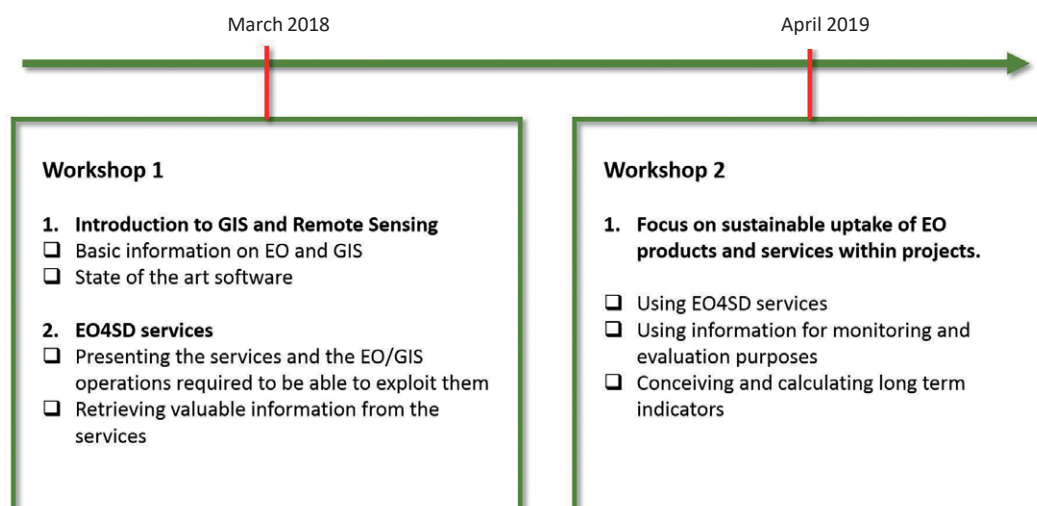


Figure 6 Outline of customised national training workshops.

Figure 6 outlines how national training workshops were organised aiming at supporting organisational capabilities to use EO data and services to fulfil their operational functions.

The Agriculture and Rural Development cluster organised the first local workshop in Marrakech (Morocco) at the Direction Regional de l'Agriculture (DRA) from 12 to 16 March 2018. For this event, attended by 20 participants from MDBs and governmental agencies, the focus was on projects implemented in Burkina Faso and Morocco and funded by the UN's International Fund for Agriculture Development (IFAD) and the World Bank (WB). This training did not only present the state-of-art EO capabilities for the agriculture and rural development sector to local stakeholders but it also provided the project implementation teams with a refresher training on GIS and EO technology and data.

Moreover, a roadmap towards an integrated approach to the development of EO-based indicators for Monitoring and Evaluation purposes was discussed during the workshop. Attendants from different backgrounds and with different roles in regional projects, organisations, and ministries benefited from the various components of the training, showed keen interest for the next round of local workshops, and proposed topics and areas of interest to be covered in future EO4SD capacity building events.

A second workshop was held in Marrakech (Morocco) from 23 to 26 April 2019 that aimed at French-speaking stakeholders in the frame of the EO4SD initiative. While the first workshop targeted the first interaction and use of the products and services this second workshop had the aim to see how these services are used in the projects and to formulate a roadmap with each of the stakeholders.

## Partners of the Agriculture Cluster

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