

Space based
Services for
Africa's
Agriculture



Global
Monitoring
for Food
Security





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Objectives

Global Monitoring for Food Security (GMFS) provides Earth Observation based services and encourages partnerships in monitoring agriculture and related environmental processes in Africa.

GMFS aims to establish operational services for crop monitoring in support of Food Security Monitoring Systems to serve policy makers and operational users, by ensuring sustainable integration and application of those solutions into a well-nodded stakeholder's network in Africa.

The GMFS partnership brings together data and information providers in order to assist stakeholders, nations and international organisations in better implementing their policies towards sustainable development and food security.

GMFS further contributes to the development and provision of operational service chains and improved access to satellite data. In this sense the services are designed to operate with ESA Sentinel satellite missions, which will ensure data availability starting from 2013 until 2020.

The ultimate goal is to identify food-insecure areas and affected populations. Innovative and robust data services and processing chains are only part of what is required. Assessing information needs, developing a technological solution, and providing services is a first step. Ensuring know-how transfer, following up the integration of the services into day-to-day workflows, and becoming fully involved in institutional networks is the second step that really brings these solutions to the users and their institutions.



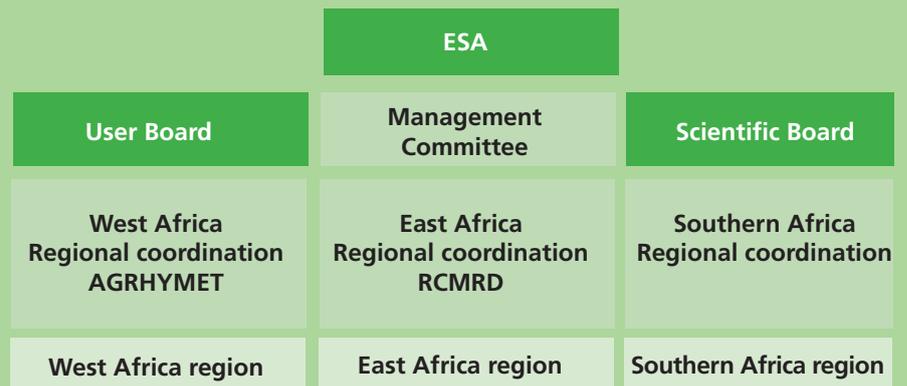
Currently more than a billion people on earth are affected by hunger and more than 30 countries are experiencing food emergencies. Most of these countries are in Africa [FAO World Summit on Food Security, 2009]. Advanced Earth Observation technologies can contribute to effectively identifying food crises and help to define early responses.



Service Network

GMFS is part of the European Space Agency's (ESA) contribution to the European Union / ESA Global Monitoring for Environment and Security (GMES) programme. It is the core European service element in support of established food security monitoring systems at various political scales.

The GMFS partnership started in 2003 and currently consists of seven European institutions with different fields of expertise: VITO, C-ITA, EARS, EFTAS, SARMAP, ULg and GeoVille. In addition to the European partners, two regional African institutions are key partners: The Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET) centre in Niger and the Regional Centre for Mapping Resources for Development (RCMRD) in Kenya.



Service Type	Service	Senegal CSE	Mali LaboSEP	Sudan FMoA	Ethopia MoA	Malawi MoAFS	Mozambique INAM	Zimbabwe MoA
Early Warning	Crop Yield and Vegetation Monitoring Service	● VITO ULG	● VITO		● VITO	● VITO ULG		● VITO
	FAST Service		● EARS					
	Soil Moisture Monitoring Service		● GeoVille					
Agricultural Monitoring	Support to the Optimisation of the National Agricultural Survey Service			● EFTAS			● C-ITA	
	Agricultural Mapping Service			● EFTAS				
	SAR Knowledge Transfer Service				● sarmap		● sarmap	
CFSAM Support	Support to Crop and Food Security Assessment Mission Service		● VITO					● VITO

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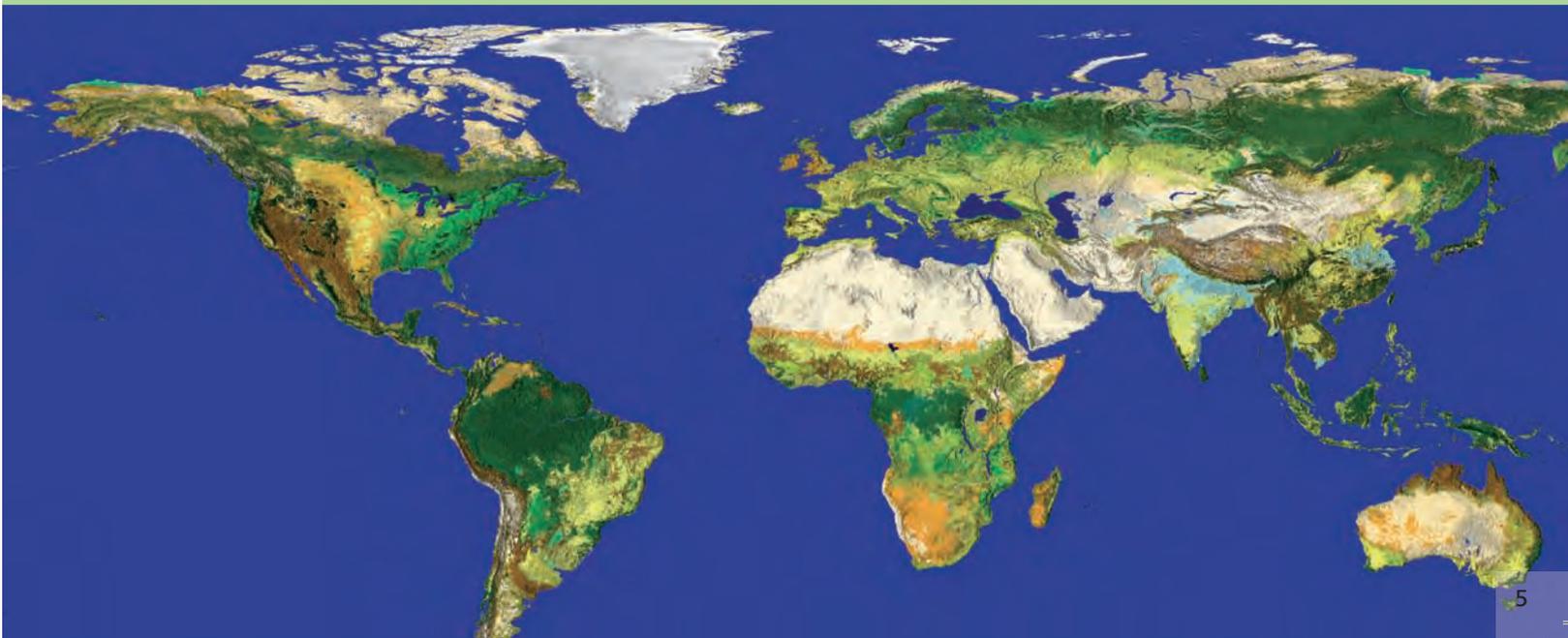


GMFS users are the driving force behind the implementation of the GMFS activities. The service network within Africa is coordinated through the two regional centres AGRHYMET and RCMRD as well as through numerous government authorities and public institutions at the national level of an increasing number of participating countries. Consultation is undertaken through the scientific advisory group and the user board.

The user board consist of representatives from all the GMFS user organisations and regularly connects with members of the scientific advisory group in order to ensure collaboration and knowledge exchange between end users and the international experts.

The scientific advisory group critically reviews the value of the services provided by GMFS and makes recommendations on methodological improvements. The group is made up of members from the European Commission's Joint Research Centre, the United Nations Food and Agriculture Organization, the United States Geological Survey and the University of Bonn, Germany.

User contacts and involvement have grown continuously since the beginning of GMFS. The GMFS partnership has established excellent relations at regional level with the AGRHYMET centre in Niamey and RCMRD in Nairobi. At national level, close working relations have been established with ministries and public authorities in Senegal, Ethiopia, Mozambique, Malawi, Sudan, Mali and Zimbabwe. These relations have been strengthened by involving local experts as national GMFS representatives to support the group in its user liaison and implementation of the GMFS services.





Achievements

Since GMFS services were launched in 2003, the value of remote sensing information from local to continental scale for crop monitoring and food security has been demonstrated. Good working relationships have been established with the stakeholder network in Africa, thanks to the user oriented multi-scale GMFS services. The GMFS services have provided access to reliable early warning data sets and fostered capacity building, supporting decision makers and staff of various early warning units. In addition to the continuous production and provision of the Early Warning Services, GMFS has established an extensive data-cataloguing and dissemination infrastructure through GeoNetwork, the internet, FTP transmission and the ESA Data Dissemination System.

Since 2003 the GMFS partnership has established multi-scale agricultural monitoring services by providing spatial information on key variables at different spatial and temporal resolutions and at different thematic levels of details affecting food security.

At national level GMFS has contributed to stakeholder frameworks through the introduction and integration of the Agricultural Mapping Services into daily workflows. GMFS has delivered demonstration cases and identified bottlenecks and weaknesses in the use of remote sensing for agricultural applications. In this respect GMFS has also provided advanced training for field work, handling of GMFS products and original satellite data, and the integration of those products into the daily work of various local experts.

A summary of the results achieved during the first six years (2003 – 2009) can be found on the GMFS website (www.gmfs.info). In short:

- The Early Warning services have covered an area of approximately 30 million km² to provide indicators at ten daily temporal resolution, serving eight regions of interest and 11 user organisations.
- Agricultural Mapping products have been provided to Senegal, Ethiopia, Sudan, Malawi and Zimbabwe, addressing the needs of the respective ministries of agriculture. During the first six years of GMFS operations, Malawi and Senegal were mapped five times and Ethiopia and Sudan were mapped twice. 4.1 million km² was mapped at medium spatial resolution (about 250-300 m ground resolution) and about 1 million km² was mapped based on high spatial resolution satellite images (15-20 m ground resolution).
- Validation of these maps was undertaken through extensive field work. In collaboration with local experts and through integration in pre-existing national surveys, a total of nine field work campaigns were carried out in Senegal, Malawi, Sudan, Zimbabwe and Ethiopia.



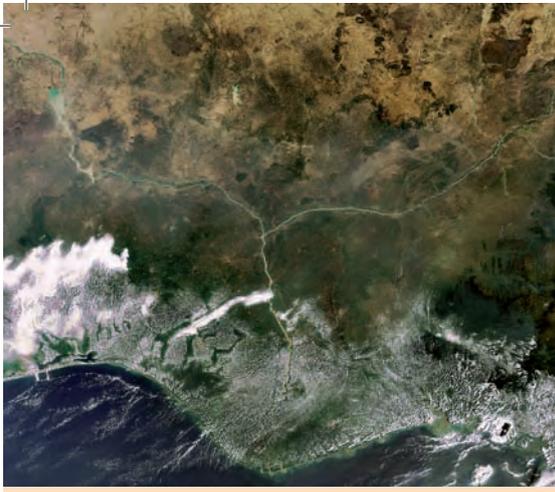
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- Agro-meteorological departments in Senegal and Malawi were provided with satellite-based yield estimates twice a year covering the most important regions of these countries.
- Inputs were provided to the Crop and Food Security Assessment Missions (CF-SAM) undertaken by the Food and Agriculture Organization (FAO) and the World Food Program (WFP) to support their missions in Senegal, Niger, Zimbabwe, Ethiopia, Sudan and Malawi.
- During the first six years the GMFS partnership provided 30 training sessions to a total of around 200 national, regional and international experts. Training sessions covered all aspects of GMFS:
 - Field data collection;
 - Validation procedures;
 - Early Warning indicators;
 - High resolution Synthetic Aperture Radar (SAR) data and medium resolution optical data for agricultural mapping;
 - The methodology for GMFS support to Crop and Food Security Assessment Missions (CFSAM);
 - Agro-meteorological yield forecasting;
 - Using ESA's Data Dissemination Service (DDS) for raw satellite data acquisition.





Service Portfolio

Policy makers and operational users at all levels need reliable and continuous information sources. Advanced agricultural information derived from Earth Observation data contributes to their need for clear information about the extent and distribution of agricultural production. This is an essential information for assessing food availability and is a crucial aspect of food security assessment.

GMFS provides multi-scale information on Early Warning, Agricultural Monitoring, and Support to Crop and Food Security Assessment Missions.

The GMFS Service Portfolio is structured into three top-level service types. The service types consist of different service packages each targeting a different key challenge in assessing food security and agricultural production.

The three service types can be summarised as:

- Continuous monitoring of growing conditions throughout the growing season and variability in crop yield and rangeland biomass for the Early Warning component;
- Assessment of total planted crop land and variability from one year to another for the Agricultural Monitoring component;
- Quick assessment of production levels on an ad hoc basis for the Crop and Food Security Assessment Mission support service.

The services address the needs of users at different political scales by providing information relevant to food security: (i) international users, interested in the assessment of food aid needs, mainly at a continental level; (ii) regional-level users, interested in the needs of their member states and in a regionalised approach and (iii) national-level users, interested in supporting national-level policy and decision makers.

The GMFS Service users are:

International-level:

- United Nations Food and Agriculture Organization - Global Information and Early Warning System (UN FAO-GIEWS)
- United Nations World Food Programme - Vulnerability Analysis and Mapping (UN WFP-VAM)

Regional-level:

- Regional Centre for Mapping Resources for Development (RCMRD), Kenya
- Application en Agrométéorologie et Hydrologie Opérationnelle (AGRHYMET), Niger

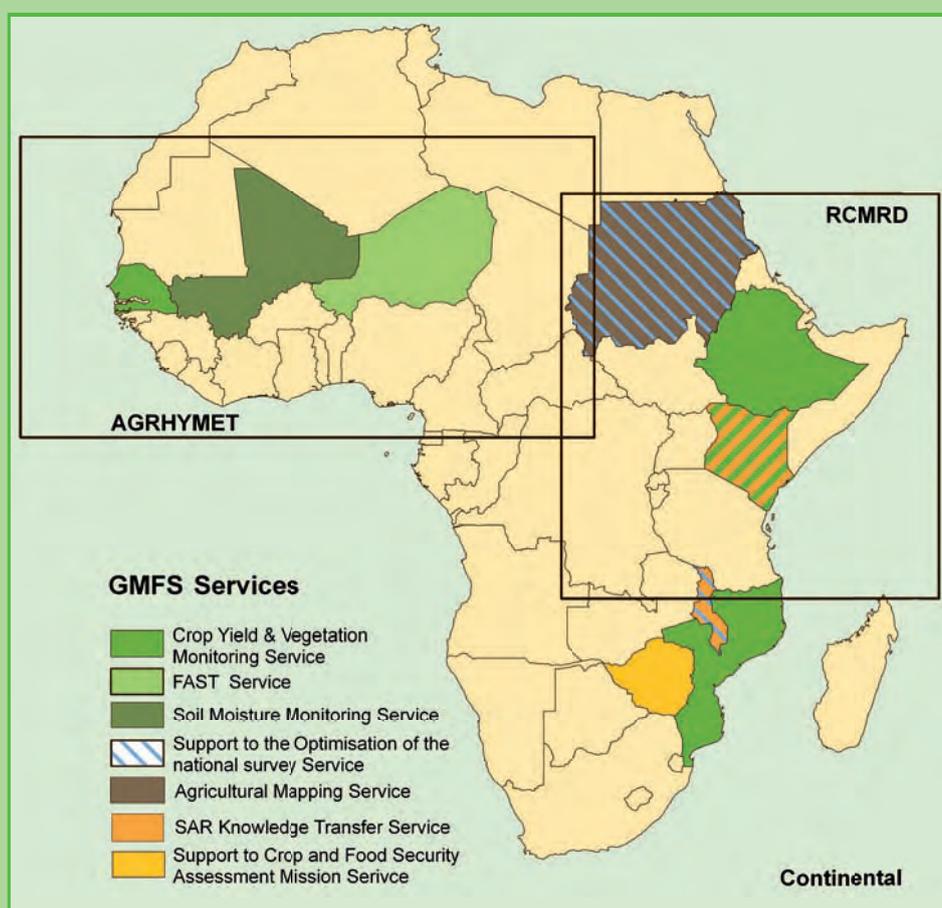
National-level:

- Ethiopia, Ministry of Agriculture (MoA)
- Malawi, Ministry of Agriculture and Food Security (MoAFS)
- Mali, Laboratoire Sol - Eau - Plante (LaboSEP), Institut d'Economie Rurale (IER)
- Mozambique, Instituto Nacional de Meteorologia (INAM), Ministry of Agriculture (MINAG)
- Niger, Ministry of Agriculture (MoA)
- Senegal, Centre de Suivi Ecologique (CSE)
- Sudan, Federal Ministry of Agriculture (FMoA)
- Zimbabwe, FAO-Harare, Agricultural Research And Extension Services, Ministry of Agriculture (MoA)

Overview of GMFS service types and services

Service Type	Key challenge	Service	Description
Early Warning	Continuous monitoring of overall growing conditions throughout the growing season and variability in crop yield and rangeland biomass	Crop Yield and Vegetation Monitoring	A variety of low-resolution vegetation indicators (new and existing) and yield estimates at ten daily intervals are produced and disseminated. The service includes a significant capacity-building component to allow users to integrate these indicators into normal operations.
		FAST (Food Assessment by Satellite Technology)	Low resolution evapotranspiration, rainfall and yield estimates at ten daily intervals are produced and distributed. Reports analysing the indicators are also prepared and training and workshops are provided.
		Soil Moisture Monitoring	Low spatial resolution Soil Water Index (SWI) data based on Synthetic Aperture Radar (SAR) and Soil Moisture Indicators derived from this (both at ten daily intervals) are produced and distributed. Training and workshops are also provided.
Agricultural Monitoring	Assessment of total crop area and variability from one year to another	Support to the Optimisation of National Agricultural Surveys	The service takes the form of a consultancy service to optimize existing national agricultural surveys conducted by the Ministry of Agriculture, introducing an area frame approach and making use of ground surveys and remote sensing at different levels.
		Agricultural Mapping	Maps of cultivated area based on high to medium resolution optical and SAR data are produced and distributed for the selected area. The service includes a significant capacity-building component to integrate the process chain into the user's day-to-day operations.
		SAR Knowledge Transfer	Knowledge transfer of the use of SAR images for agricultural monitoring, training of experts, and research on the production and utility of SAR-based agricultural area maps.
Support to Crop and Food Security Assessment Mission	Quick assessment of production levels on an ad hoc basis	Support to Crop and Food Security Assessment Mission	This service focuses on support of the joint FAO/WFP Crop and Food Security Assessment Missions (CFSAMs) through the provision of summary reports based on available data.

The map below shows the GMFS services, their geographical extent, and the two regional subcontractors.



Note: Final boundaries of Sudan are not yet available.

Detailed information about the GMFS services is available in the "Service Portfolio Specifications" document in the publications section of www.gmfs.info.

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Early Warning

The institutes currently receiving GMFS Early Warning services are:

- UN FAO-GIEWS
- UN WFP-VAM
- RCMRD, Kenya
- AGRHYMET, Niger
- MoA-DRMFSS, Ethiopia
- CSE, Senegal
- INAM & MINAG, Mozambique
- LaboSEP, Mali

GMFS Early Warning services provide seasonal low and medium resolution satellite image based indicators for crop and agricultural monitoring on ten daily basis.

Vegetation and crop conditions are assessed throughout the growing season using low resolution satellite imagery with approx. 1 km ground resolution or more and a high temporal frequency in order to monitor the overall growing conditions and identify areas with crop development anomalies that could affect final crop and livestock production. The added value of GMFS for Early Warning systems is the introduction of new information sources and methods in addition to the currently-used tools that are commonly based on vegetation indices, rainfall estimates and similar evaluation methods. GMFS introduces three different services, namely:

- Low resolution indicators (based on MERIS, Meteosat and ERS/ASCAT) with a very high temporal frequency of ten days;
- Crop Yield and Rangeland Biomass forecasts;
- Data Dissemination Systems.

These services include training on how to use and interpret the provided data sources in existing Early Warning Systems.

Users and partners

The main GMFS Early Warning users are institutions providing early warning information at regional and international level (cross-boundary), as well as a number of national institutes.

Services

The GMFS Early Warning service type consists of three components, which are based on soil moisture information extracted from radar satellites (ASCAT), yield forecasts extracted from evapotranspiration data from meteorological satellites (METEOSAT), and vegetation indicators based on near infrared and visible light reflection from optical sensors (ENVISAT MERIS). The data from these components is enhanced through advanced modelling and data dissemination systems.





The GMFS Early Warning services provide meteorological, vegetation and soil moisture indicators on a high temporal frequency of 10 days. This enables the user to identify areas with anomalies and potential risk of crop failure on a near real time basis.



Low resolution satellite data available at frequent time intervals helps users to follow the evolution of the crop season and to identify the location of food crises before they happen.

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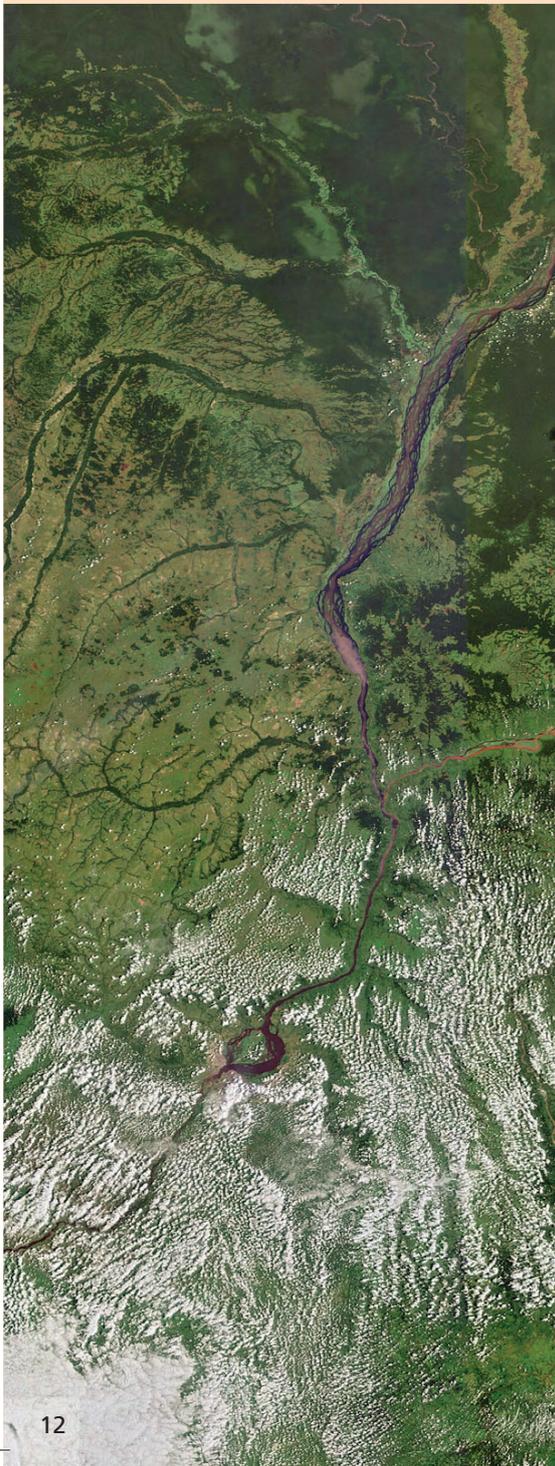
For qualitative monitoring of the crop growing season GMFS has introduced the **Crop Yield and Vegetation Monitoring Service**. This service consists of the production of MERIS Reduced Resolution indicators and Crop and Biomass Yield Forecasts, and the exploitation of the ESA Data Dissemination System (DDS).

Vegetation indicators provide regional and continent-wide information on the crop and vegetation conditions throughout the season. This data is produced from spectral reflectances captured with optical satellite sensors. The data is processed against a historical archive in order to place the seasonal values in a statistical probability context and highlight vegetation growth anomalies to users.

The Crop and Biomass Yield Forecasts provide the users with a yield forecast / estimate before or after harvest time and a rangeland biomass assessment during the growing period. These parameters are important factors in assessing crop and livestock production and as such are crucial in identifying potential surpluses or deficits. Both products combine remote sensing data with official statistics and field observations in sophisticated forecast models.

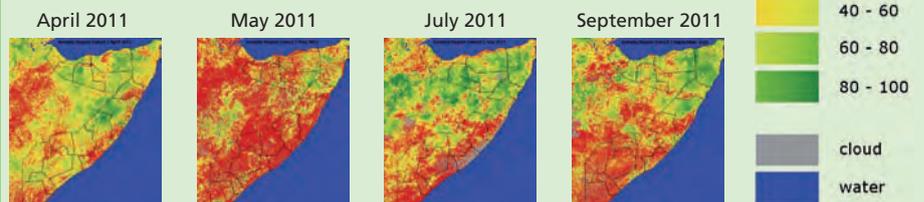
The ESA Data Dissemination System is a network providing raw satellite data to end users within three hours to three days after sensing. Use of this system strengthens infrastructure and improves data flow between the GMFS institutions in Europe and Africa, and also improves processing chains in Africa.

A second source of independent information covering West Africa is the **Food Assessment by Satellite Technology (FAST) Service**, which is produced from Meteosat-derived radiation and evapotranspiration data with a 0.04 degree spatial resolution. The FAST Service helps the user to locate areas of anomalous low or high rainfall and soil moisture.



Monitoring plant growth conditions

Satellite images allow monitoring of vegetation changes on a large scale, from continental level down to the national level, and can help to identify developing crises. The pictures below illustrate the developing crisis in southern Somalia and neighbouring countries in East Africa from April to September 2011, which culminated in severe droughts, putting more than 4 million people at risk as reported by WFP. The pictures illustrate the effects of the failing rains, and hence the lower than normal vegetation development (in red) during the April – September period, leading to the severe drought crisis.





This enables the user to forecast agricultural drought and contributes to Early Warning for crop failure on a timely basis. A third component of the FAST Service provides the user with yield forecasts. The data is compared to a five-year average for reference and combined with land use and crop maps and administrative boundaries to provide forecasts at different administrative levels.

In parallel with vegetation monitoring, the novel **Soil Moisture Monitoring Service** is being designed. Based on a reliable, long-term time series of soil moisture measurements derived from the ERS and ASCAT sensors, soil moisture indicators for the start of the growing season as well as drought/wet season monitoring will be developed. Depending on the maturity of these novel indicators, they will be used as complementary sources of information on the availability of water to vegetation and on drought or wet spells.



Agricultural Monitoring



Agricultural production is an important factor to be monitored in order to assess food security and the potential impacts on vulnerable populations. To specifically assess crop production it is important to know how much land is cultivated, where this land is located, how much is actually cropped and finally harvested. Spatial representation of this information is needed for food security analysis and actions that support sustainable, long term development.

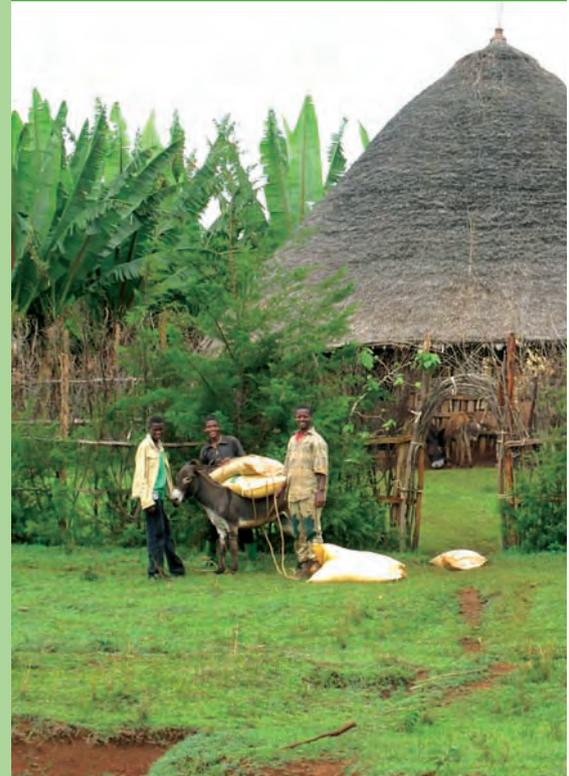
In many African countries, information on the annually cultivated land is not available. Mapping of the main cultivated areas is therefore a first step towards a better understanding of agriculture in these countries and an important input for generating statistics on crop areas.





To monitor crop production, the cropped area must be known. The total cropped area in any given growing season can differ significantly from previous growing seasons. This can result in large differences in crop production from season to season. The optimal way of estimating crop areas in Africa is still the subject of worldwide debate and recognised as a very challenging task. While several efforts have been made in the past to map “aggregated” cultivated areas, crop-specific mapping is still at the experimental stage and restricted to certain crops. In some African contexts, crop area estimates obtained via area frame approaches which combine remote sensing and ground surveys are already operational, but need to be extended to small subsistence farming.

GMFS contributes to this effort to monitor cropped area in the following ways: i) by integrating remote sensing data from different sensors into the mapping of the cropped area at the local scale and extending mapping of general vegetation growth dynamical to the national scale; ii) by improving crop area statistics through setting up area frame surveys combining ground surveys and the use of remote sensing at various levels (sampling frame construction, stratification, localisation of points to be surveyed, and final improvement of the crop area estimates).





The institutes currently receiving GMFS Agricultural Monitoring services are:

- RCMRD, Kenya
- FMoA, Sudan
- MoAFS, Malawi

Users and partners

The products within the Agricultural Monitoring service are produced covering specific areas. Where possible this is at a national level, but can otherwise be limited to the main agricultural areas, depending on the size of a country and the level of detail required. Therefore, GMFS users and partners also include institutes at the national level.

Services

The GMFS Agricultural Monitoring service type consists of three components.

Both the **Agricultural Mapping Service** and the **SAR Knowledge Transfer Service** aim to contribute to the production of up-to-date and accurate high resolution maps of the cultivated or cropped area, but exact acreage estimations cannot be extracted from these maps.

However, remote sensing can make an important contribution to area frame approaches at several levels, and this is addressed with the **Support to the Optimisation of National Agricultural Surveys Service**. The aim of this service is to develop operational workflows and processing routines in order to integrate remote sensing, modern agricultural field survey methods and statistical models into an integrated framework at user institutions.



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The Support to the Optimisation of National Agricultural Surveys Service takes the form of a consultancy service supporting national ministries of agriculture in generating more efficient and robust crop area estimates at the national, regional and departmental level and increasing the cost-effectiveness of statistical data acquisition. This is achieved through developing operational workflows and processing routines, to be applied by the user organisations and integrated into their on-going procedures.

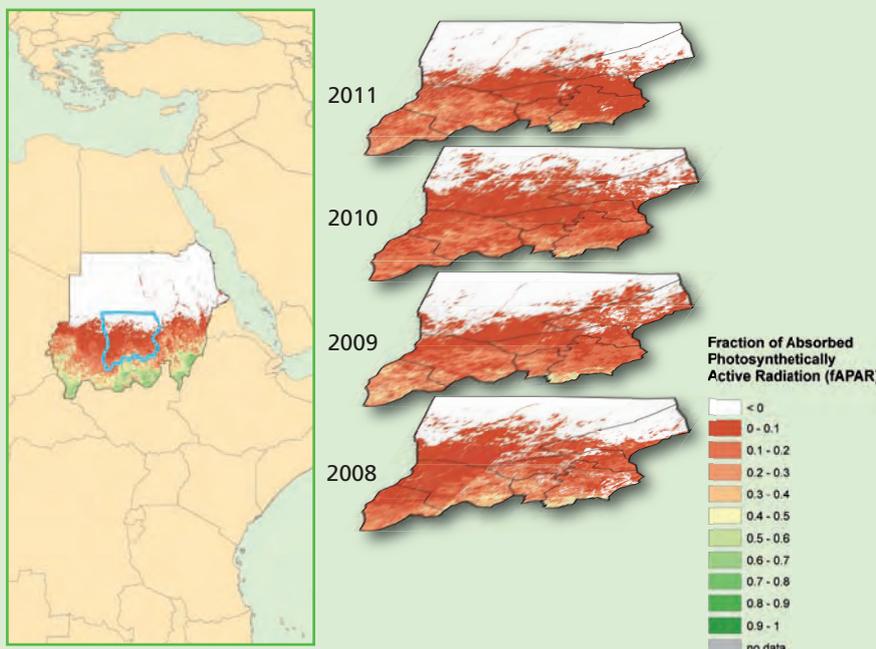
The **Agricultural Mapping Service** products are twofold:

- High resolution cultivated area maps based on multi-temporal high and medium resolution optical and radar data;
- Medium resolution indicative inter-seasonal maps of the recent spatial distribution of growth activities before the harvest. This can vary significantly from one year to another and as such affect the total production significantly.

The Agricultural Mapping Service includes the entire map processing chain as a capacity building feature, which transfers methodology and knowledge to the end users.



Extent of vegetation growth North Kordofan, Sudan Growing Season 2008 - 2011



High and medium resolution satellite images enable monitoring of the extent and growth dynamic of vegetation and help to indicate zones with potential low or high agricultural production levels.

The extent of the vegetation growth at the beginning of the growing season can highlight developing crises, in particular in the Sahel where agriculture is affected by high inter-seasonal variability due to climatic conditions.

The images clearly show the seasonal change in vegetation extent (potential rain-fed agriculture) for North Kordofan in Sudan. The maps are based on fAPAR values, an indicator for vegetation productivity. Red colour indicates sparse vegetation or low productivity, green indicates dense vegetation and high productivity, and white indicates areas without vegetation cover.

Note: Final boundaries of Sudan are not yet available.



Scientists and officials in the agricultural field agree that the use of SAR images for monitoring agriculture has a proven technological advantage. The all-weather and whole-day-long monitoring capabilities of SAR sensors allow monitoring of crops during the crucial main growing season, when cloud cover can be a daily phenomenon. However, using SAR data for agricultural applications like crop area mapping is a significantly different approach from using data from optical sensors. This problem is addressed by GMFS through the **SAR Knowledge Transfer Service**. This service provides users with:

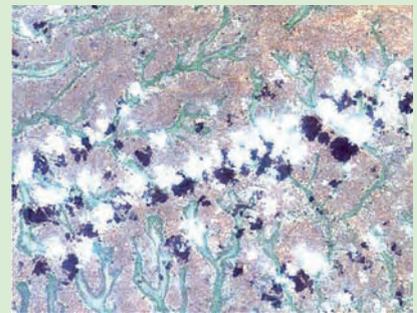
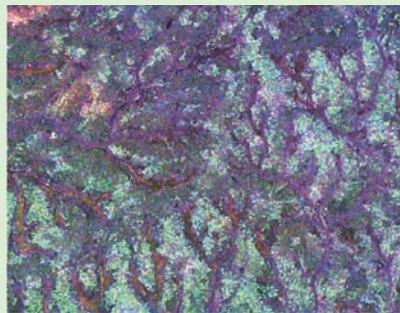
- A solid understanding of SAR and its use, particularly targeted to agriculture;
- A dedicated operational processing chain, in order that SAR data can be processed at the user site and distributed to key national agricultural institutions;
- The software FOODSECURITYscape®, a dedicated, operational SAR processing chain based on the most common SAR sensors, for the generation of crop products relevant to food security.

Currently the RCMRD in Kenya acts as GMFS partner for SAR Knowledge Transfer.



Synthetic Aperture Radar (SAR) sensors actively scan the surface of the earth with cloud penetrating ability and independent of night or day, allowing year-round monitoring of agriculture.

Optical sensors capture perfectly the spectral reflections of objects on the earth's surface in parts of the electromagnetic spectrum, which are sensitive to vegetation and agriculture, but are affected by cloud coverage.



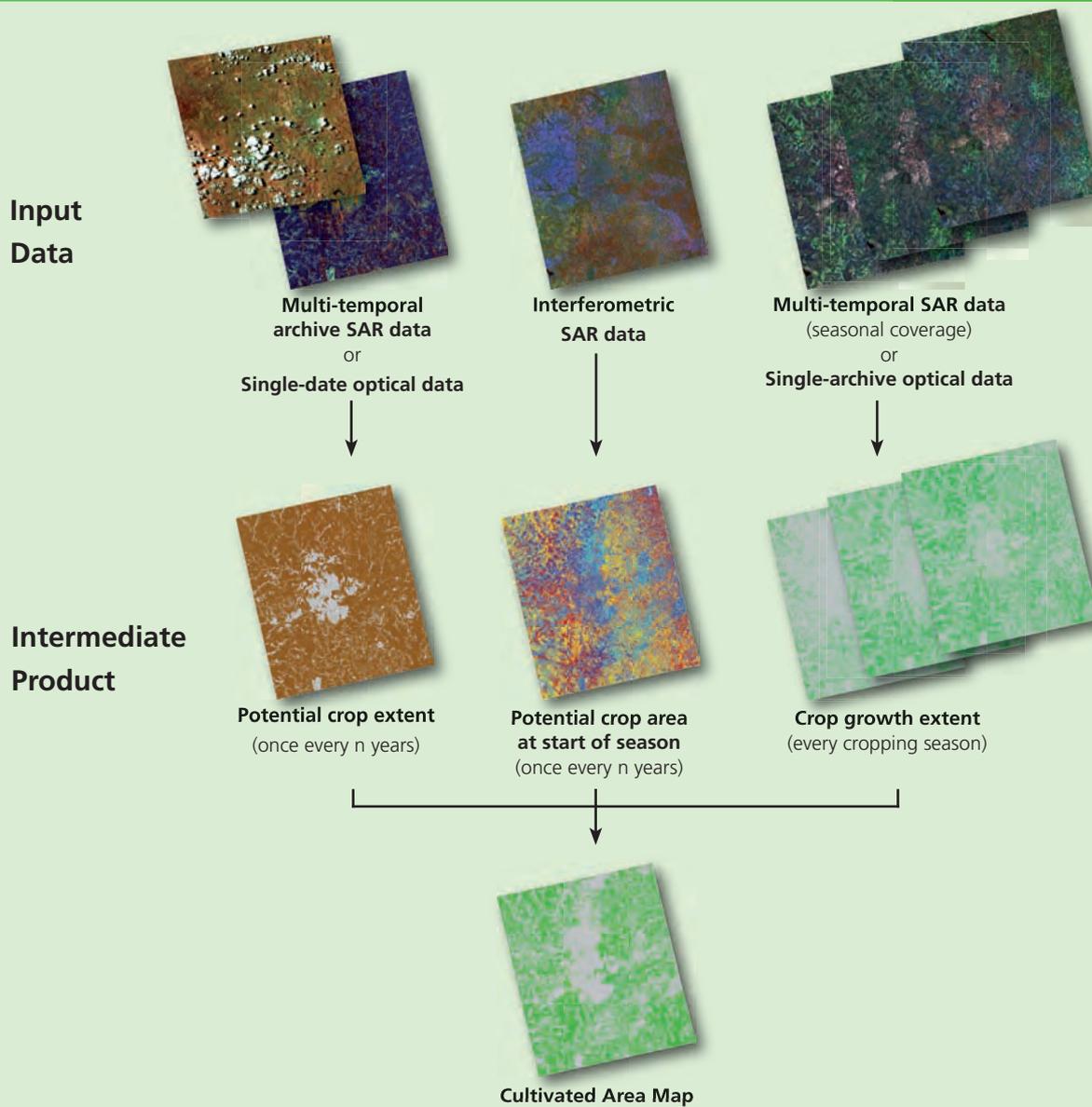
SAR image

versus

Optical image



Cultivated area mapping with optical and radar satellite data



The image shows the process chain and intermediate products of the generation of high resolution cultivated area maps. A number of the most common optical and SAR satellite datasets are suitable as input data. The crop growth extent is mapped every season and processed against the potential crop extent and the potential crop area at the start of the season. This process chain is integrated in the FOODSECURITYscape® software which is part of the SAR Knowledge Transfer Service.





Crop and Food Security Assessment Mission Support

In addition to service chains and data products, GMFS provides systematic support to strengthen users' food security frameworks. In this respect the GMFS partnership provides support to the joint FAO/WFP Crop and Food Security Assessment Missions (CFSAM) through the provision of compiled summary reports based on available data and information, either ground-based or space-borne.

The primary purpose of CFSAM is to provide accurate, timely and reliable information on imminent food security problems in a country or region so that appropriate action can be taken by governments, the international community or others in order to minimise the impact of man-made or natural disasters on the affected populations.

The CFSAM teams consist of national and international experts from FAO and WFP or other collaborating agencies. Experts from donor organisations usually join the missions as observers. For a given country a mission typically takes about 2-3 weeks and activities include, among others:

- Interviewing staff of relevant governmental departments;
- Collecting data on weather conditions/crop forecasts, food shortages, etc.;
- Cross-checking information with extension officers, farmers, remote sensing data, etc.;
- Conducting field visits.

Users and partners

Support for CFSAMs, which are jointly implemented by WFP and FAO, is aimed at the UN institutions and the related country offices. The geographic extent of the information provided is limited to the countries covered by the CFSAMs in Sub-Saharan Africa.



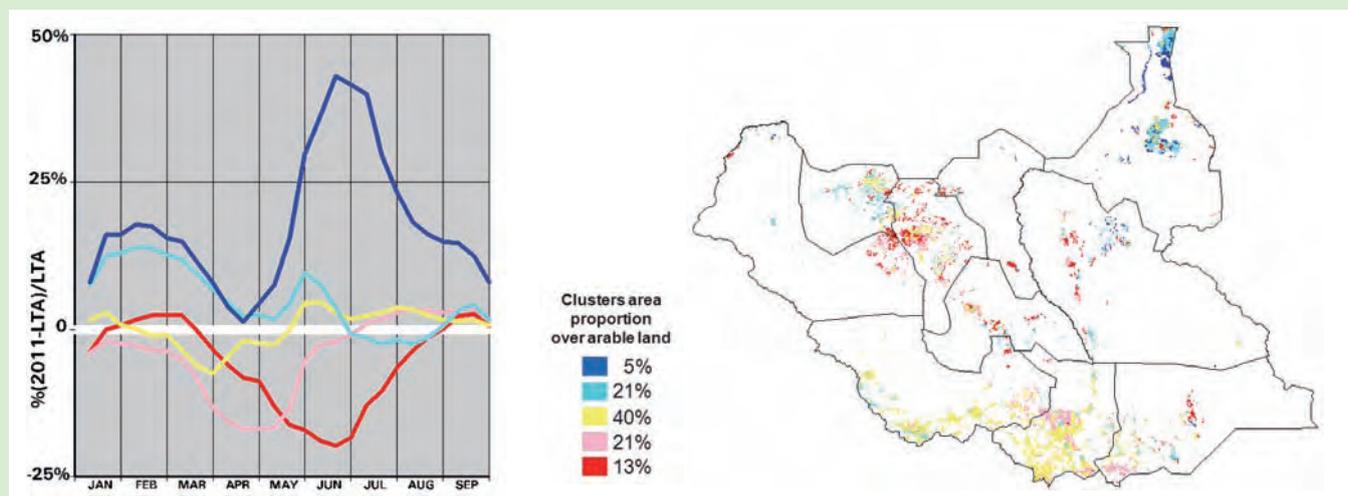
The institutes currently receiving CFSAM Support services are:

- FAO, Zimbabwe
- FAO, Rome
- WFP, Rome



Mapping and analysing vegetation status over arable land is part of the GMFS CFSAM Support Service

The image shows a cluster analysis for the vegetation status over arable land which was part of the GMFS CFSAM Support for South Sudan in 2011. The cluster analysis is applied on the percentage of difference of 2011 NDVI with the NDVI Long Time Average (LTA). The coloured clusters into the map are characterised by the corresponding colours of the profiles. The anomalies impact can be analysed according to their duration and the distance to the average (zero into the graph). The surface percentage of each profile/cluster is calculated to evaluate the extension of the anomalies. Such information can be used to define the location to visit during the field campaign.



Clusters profiles characteristics

Clusters distribution over arable land

Note: Final boundaries of South Sudan are not yet available.

Services

The CFSAM Support Service provides ad hoc assessment reports in support of the CFSAM. On the request of national governments, FAO/GIEWS and WFP conduct yearly Food Security Assessment Missions for those countries facing widespread and serious food emergencies. About 20 to 25 countries across the world are covered by these missions each year. Most of these missions take place in Sub-Saharan Africa, this being the part of Africa with the most widespread and long term history of food insecurity.

Satellite imagery is one source of data for crop production estimation. However, availability of geographic information based on remote sensing or other data sources is limited and the data generic. Crop production estimates are based on the concept of "convergence of evidence", combining a variety of data sources. GMFS provides supplementary Earth Observation-based information on overall crop growth conditions, plus production forecasts for the main crop and/or yield forecasts as per best availability. The purposes of the information provided by GMFS are: (i) to help plan and carry out the CFSAM by identifying priority areas to visit; (ii) to provide a yield estimate for the key crop based on Earth Observation data sources.



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Service Sustainability

The ultimate success of GMFS is the transfer of operational services to user institutions such that satellite-derived technologies can add value to food security monitoring frameworks in the long term. As such, the reliability and sustainability of the services is an utmost priority of the GMFS partnership.

The technical reliability and usability of the services provided, the secure long-term availability of the data sources, and sustainable knowledge transfer are all important factors in making sure that the GMFS services become widely used.

To achieve sustainability for each of the GMFS Services the partnership aims at achieving the following goals:

- The **methodology** needs to be mature and validated;
- The **capacity** to handle and analyse data needs to exist at the users' premises;
- **Data** needs to be available and access guaranteed;
- Operational **funding** mechanisms need to be in place.

Currently the services itself are under various stages of maturity and sustainability. While the Early Warning services are relatively mature, the Agricultural Monitoring and CFSAM part needs to become more mature. It is further recognized that significant effort will need to be done on the part of the GMFS partnership members to reach maturity of the offered services and consequently reach sustainability. To that effect the GMFS partners are organized themselves in the GMFS partnership which is governed by a management committee dedicated to sustainability.





In addition to this, reliable quality and high accuracy are crucial. As an important common principle of the GMFS partnership, all service providers are committed to a dedicated quality assurance mechanism and thorough validation of all GMFS services. Those principles are laid down in a service quality plan and a validation protocol.

The service quality plan describes the quality assurance procedures and conventions necessary for the production and generation of products and the execution of services of the GMFS service portfolio. It aims to outline quality assurance and quality control procedures in reference to the European Cooperation on Space Standardisation standards and is applicable to the GMFS partnership.

The key elements of the quality assurance procedures are common mechanisms for collecting and documenting the quality records and quality measurements produced by each GMFS partner.

The validation protocol establishes universal principles applicable to all the services and products generated in GMFS. Given the wide variety of products and services, these general validation principles are defined as specific validation procedures for each type of service and product. The protocol describes the general criteria related to the different validation approaches, provides detailed description of the relevant validation datasets for the services and products, and is aimed at ensuring a high standard of accuracy and transparency.

You can find more information about GMFS at www.gmfs.info.

More information about Validation and Quality Assurance is available in the validation section at www.gmfs.info.



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