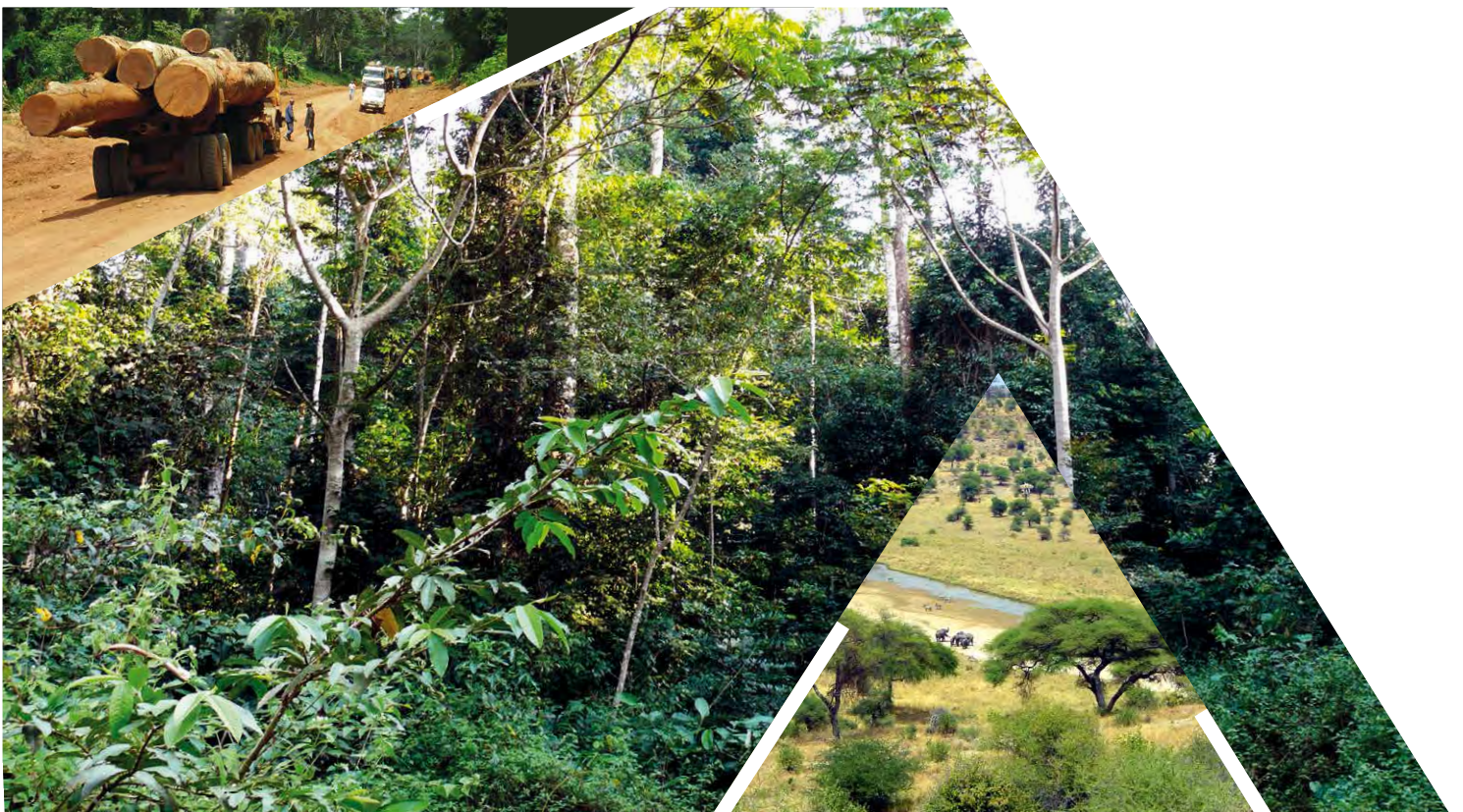REDD+

NATIONAL
FOREST
MONITORING
SYSTEMS

REDUCING GLOBAL CO$_2$ EMISSIONS

Reduction of greenhouse gas emissions is central to the United Nations Framework Convention on Climate Change (UNFCCC). Tropical deforestation and degradation are estimated to contribute about 20% of the total greenhouse gas emissions.

The UNFCCC mechanism for reducing emissions from deforestation and degradation (REDD) has gained momentum since its inception in 2005, and since this time, countries have been encouraged to develop National Forest Monitoring Systems (NFMS) as part of the REDD+ process. In this context GAF AG has been actively supporting several African countries in developing operational REDD+ Monitoring, Reporting and Verification (MRV) projects in Africa based on scientifically robust and IPCC compliant methodologies. The methods are applicable to both the humid and dry tropical forest regions in the world.

Our Services /Our Expertise

► Facilitate the national institutional arrangements and stakeholder awareness required to implement NFMS and REDD+

► Design and implement national and regional IPCC compliant Monitoring, Reporting and Verification (MRV) systems for REDD+

► Design and implement biomass inventories for carbon accounting

► Earth Observation based operational monitoring of deforestation/degradation and biomass

► Assessment of CO$_2$ Emission Factors

► Capacity building and technology transfer on REDD+

► Project Management and implementation of REDD+ Pilot initiatives and projects

REDD (2008-2011)

Pilot Project Cameroon

The Government of Cameroon has been actively supporting REDD since its inception in 2005. Under the auspices of the European Space Agency (ESA) GMES Service Element on Forest Monitoring, a pilot project to develop a national forest monitoring systems for REDD+ in Cameroon was implemented with user consultation and endorsement in 2007. The project was later supported by the German development bank (KfW) and the GIZ Support Project to COMIFAC.

The overall objective of the project was to establish a pre-operational framework for deforestation/degradation assessment and carbon monitoring/accounting for the national REDD+ process. The project addressed methodological issues for the REDD policy formulation with special focus on application of Earth Observation (EO) technologies with ground-based Carbon accounting.
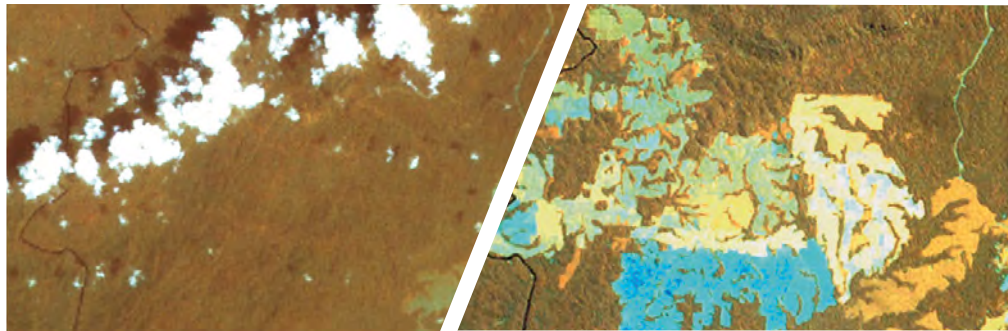
Landsat TM-4 satellite image showing intact forest land in Cameroon in the year 1989 (left); Large deforestation areas of the same are shown in Landsat ETM-7 in the year 2001 (right).

Project Achievements:

► Stakeholder Analysis and Institutional Arrangements:

- Identification of stakeholder needs for MRV in the REDD+ process
- Establishment of a REDD+ stakeholder platform

► Emission Accounting:

- Design and implementation of a comprehensive IPCC compliant biomass inventory
- Development of land use change policy scenarios and projections of future deforestation and degradation

► Estimating forest cover and change:

- Establishment of a national framework for wall-to-wall mapping of historical deforestation in the REDD+ process
- EO-based annual tracking of forest degradation within forest concessions

► Capacity Building and Technology Transfer:

- Training workshops on EO-based monitoring of forest cover change, spatial and econometric modelling
- On-the-job training on biomass inventory
- Seminars on REDD+ sensitization, REDD+ MRV and Reference Scenario establishment

► The project implemented an effective south-south co-operation by applying experiences obtained in deforestation monitoring and carbon stock accounting in Bolivia in the Congo Basin.

(2009-2014)

Mapping of Tropical Humid Forests in the Republic of the Congo and the Gabonese Republic

The Republic of the Congo (RoC) and the Gabonese Republic have actively pursued the development of National Forest Monitoring Systems (NFMS). The ESA supported GMES Service Element Forest Monitoring (GSE FM) REDD Programme implemented by a consortium led by GAF AG supported both these countries in the geo-spatial monitoring aspect of a REDD MRV system. The GSE FM REDD Project was implemented in close collaboration with the Ministry of Sustainable Development, Forest Economy and Environment (MDDEFE) in RoC and the Gabonese Agency for Space Studies and Observations (AGEOS) in the Gabonese Republic. Historic forest mapping for both countries provided quantitative figures on deforestation rates required for setting up a national Reference Emission Level.

The main objective of the GSE FM REDD Extension in both the Republic of the Congo and the Gabonese Republic was to set up a pre-operational system for monitoring forest cover and forest cover changes within the REDD framework.
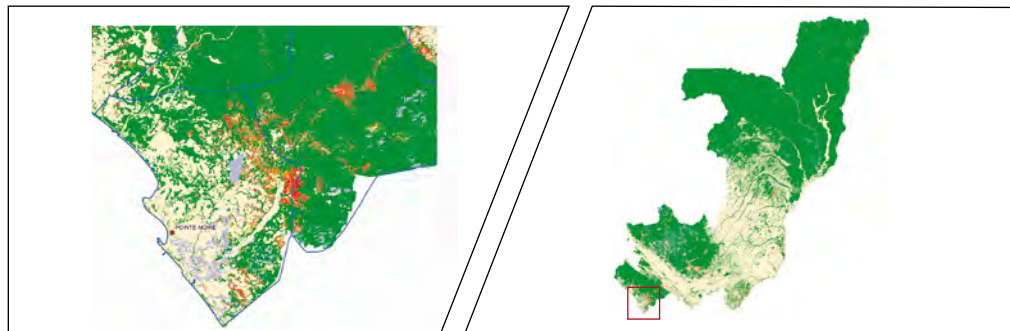
Satellite-based mapping of forest land and land cover change within the years 1990, 2000 and 2010 in the Republic of the Congo. Right image: national coverage; Left image: subset of the area of Point Noire showing the increase of deforestation (orange and red).

Project Achievements:

Support for NFMS:

► Technical Support to the national institutions responsible for MRV REDD+

► Provision of REDD Awareness Workshops to various stakeholders

► Supporting the countries in the negotiation process at COPs

Technical Results:

► Wall-to-wall mapping of forest area and forest area change for 1990-2000-2010 using IPCC compliant land cover classes for changed areas: agriculture land, grassland, settlement, wetland and other land

► Methodological steps and outputs provided feasible components for the Activity Data assessment for the REDD+ process and the NFMS.

► The results of the GSE FM REDD services provided the countries with both the technical steps and empirical information to support their negotiations during the COP meetings of the UNFCCC

Capacity Building:

► Local counterparts received training on the technical/methodological steps employed in production of the REDD services

Methodological Developments for Forest Cover Change Mapping of Tropical Humid Forests

In the European Union Framework Programme 7 research project entitled "REDD for Africa" REDDAF, GAF AG and its consortium of partners addressed technical challenges related to Earth Observation (EO)-based activity data assessment in Cameroon and the Central African Republic (CAR). Methodological issues such as persistent cloud cover in tropical countries, as well as the complex phenomenon of degradation mapping were dealt with using improved processes based on multi-temporal and multi-sensor sensor satellite data.

The main objective of the REDDAF project was to test and provide improved methodologies using both optical and radar EO data for deforestation/degradation assessment in both Cameroon and CAR; additionally methods for assessing above ground biomass for monitoring carbon stock changes in these countries was undertaken.
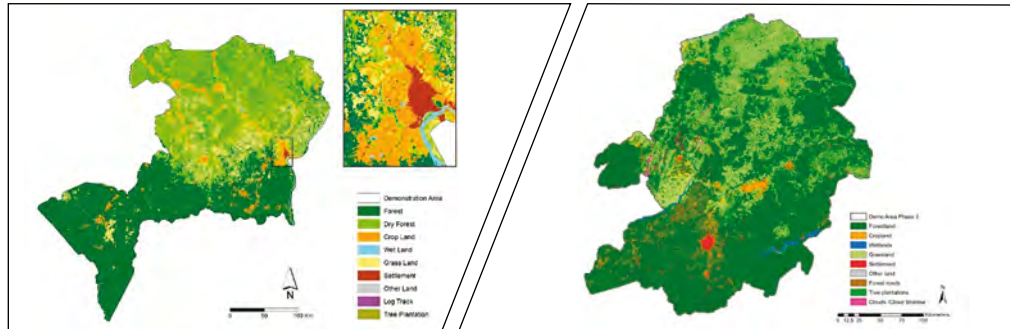
IPCC compliant land cover maps (2010) for demonstration areas in Central African Republic (right) and Cameroon (left) based on optical satellite data (Landsat TM4/ TM5/ ETM, RapidEye, Deimos).

Project Achievements:

► Processing chains for deforestation and degradation assessment as well as direct EO-based biomass mapping were improved in different test conditions; methods can be used for large area mapping

► The improved methodologies contributed to the overall efforts for developing National Forest Monitoring Systems (NFMS) in both Cameroon/CAR

► Historic analysis of deforestation provided a basis for an analysis of drivers of deforestation and spatial modelling of future trends in deforestation

► Counterparts received training on the technical/methodological steps employed for developing a NFMS using remote sensing.

GEOFORAFRI (2014-2015)

Strengthening Technical Competencies for EO-Based Forest Monitoring

The GEOFORAFRI programme aims to facilitate the adoption of Earth Observation (EO) techniques and methodologies via technology transfer to Central and West African countries in order that local institutions undertake forest monitoring according to international guidelines required in the REDD+ process. The GEOFORAFRI programme is divided into several components; the components that GAF AG has focussed on include the strengthening of the in-country capacity for EO data acquisition and processing for forest monitoring. Capacity building efforts are primarily aimed at governments and technical services in charge of forest monitoring particularly MRV units and REDD+ thematic working groups.

The overarching objective of the GEOFORAFRI Project is to strengthen the technical competencies in EO based forest monitoring of regional and national institutions involved in the REDD+ process in Benin, Republic of Congo and Togo.

Project Achievements:

► Installation of computer hard- and software for archiving and processing remote sensing data in the beneficiary institutions

► Provision of different remote sensing training modules for vegetation/forest monitoring to local partners:

- Module 1 - Fundamentals of remote sensing
- Module 2 - Practical exercises for satellite-based forest monitoring
- Module 3 - Object-oriented classification

Envisaged Achievements:

► Improved access to and processing/storage capacity of satellite imagery (telecommunications, workstation and storage device) in selected institutions of Benin, Republic of Congo and Togo

► Improved skills on the application of satellite data for forest monitoring as recommended within REDD+

Pilot Project for the Development of Integrated MRV Systems in the SADC Region

The Southern African Development Community (SADC) which comprises 15 Member States in the region is covered by an estimated 357 million hectares of natural forests or 75% of the total land area. The region contributes about 31% to the total deforested area in Africa, with the main causes of deforestation being agricultural expansion, timber exploitation, and population growth. In order to better manage these forest reserves, SADC required a regional REDD+ MRV (Monitoring, Reporting and Verification) system using an ecosystem approach with the aim to harmonise methods for the Member States. A pilot project with the support of GIZ (Germany) was implemented from 2012-2015 to prototype and test methods for geo-spatial monitoring and terrestrial inventories within a regional MRV.

The main objective of the project was to develop an IPCC compliant forest monitoring system for a regional REDD+ MRV that can be used by the SADC Member States to quantify emissions from deforestation and forest degradation.
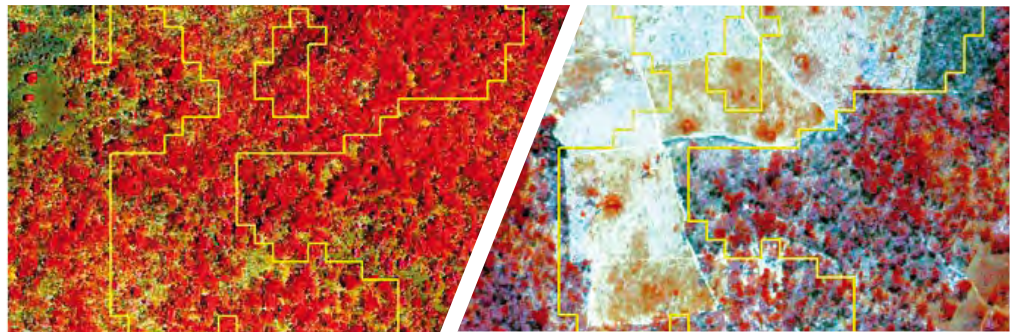
Intact forest land shown in Ikonos satellite image in the year 2000 (left); Changes of forest land into crop land shown in WorldView-2 satellite image in the year 2010 (right). © DigitalGlobe Inc., all rights reserved.

Project Achievements:

► Design of an audited and compliant IPCC regional MRV REDD+ document for remote sensing based Activity Data (AD) assessment, biomass inventory, and Emission Factor (EF) assessment

► Estimating Forest Cover and Change:

- Establishment of a national methodology for wall-to-wall mapping of historical deforestation in the REDD+ process for 1990-2000-2010

- Earth Observation (EO) based assessment of forest degradation

► Capacity Building and Technology Transfer:

- Training on EO-based monitoring of forest cover change (deforestation and degradation mapping)

- Training on terrestrial inventory for REDD

- Emission Accounting

► Emission Accounting:

- Provision of emission estimates (CO_2) based on the activity data and biomass data for pilot sites

(2014–2015)

Mapping of Tropical Dry Forests in Africa

The dry forests in the southern African region cover approximately 2.4 million sq.km and have some of the highest deforestation rates in Africa as well as globally. The area is home to a vastly rural population who rely on the ecosystems for their livelihoods. The main driver of deforestation and degradation in this region is agricultural expansion and the extraction of timber for fuelwood. The need for improved forest monitoring of these dry forests is therefore imperative for supporting the countries in the development of their REDD+ MRV systems and improved forest management. ESA is supporting the improvement of Earth Observation (EO) based methodologies for dry forest monitoring with a view to the utilisation of the future Sentinel-2 satellite data which would resolve some of the challenges in mapping these ecosystems.

The main objective of this project was to develop improved methodologies for monitoring dry forest ecosystems as well as the assessment of deforestation/degradation in these biomes. The main forest type that was studied was the Miombo ecosystem in Malawi and Zimbabwe.

Charcoal production
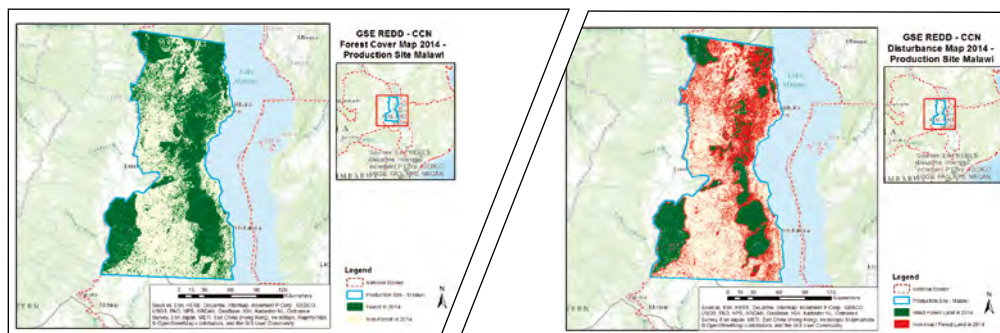
Satellite-based mapping of forest cover (left) and non-intact (degraded) forest land (right) in Malawi; both from the year 2014.

Project Achievements:

► Development of automated, multi-temporal image processing chains for improved mapping of dry forests

- Assessment of historical deforestation in test sites for 2000-2014

- Assessment of forest degradation in test sites for 2000-2014 using Intact/Non-Intact forest mapping concepts

► More robust and more automated, cost efficient processing chains for dry forest monitoring

► More reliable statistics for REDD reporting (for Tier 2 reporting) for these ecosystems

► Awareness raising of user community in Southern Africa for the utility and benefits of Sentinel 2

► Technology transfer to counterparts (i.e. capacity building) in Malawi and Zimbabwe

EOMonDis (2016-2019)

Bringing Earth Observation Services for Monitoring Dynamic Forest Disturbances to the Users

The EOMonDis Project aims to offer operational Earth Observation (EO) based tropical forest monitoring services to support countries and a wide range of users with accurate relevant forest information data for their reporting requirements. The project especially is supporting countries implementing the REDD+ policy process as well as stakeholders involved in implementing Zero Deforestation commitments. An investigation into the funding mechanisms supporting the forest monitoring for the REDD+ and ZD as well as a user feedback mechanism will assure the sustainability of project developments.

The main objective of EOMonDis is to develop innovative methods to overcome existing challenges of tropical forest monitoring by integrating dense time-series from optical and radar sensor systems, especially from the suite of the newly launched Sentinels. The methods developed are tested and demonstrated on selected sites in Cameroon, Gabon, Malawi and Peru in order to take account of the phenological variety of tropical biomes.
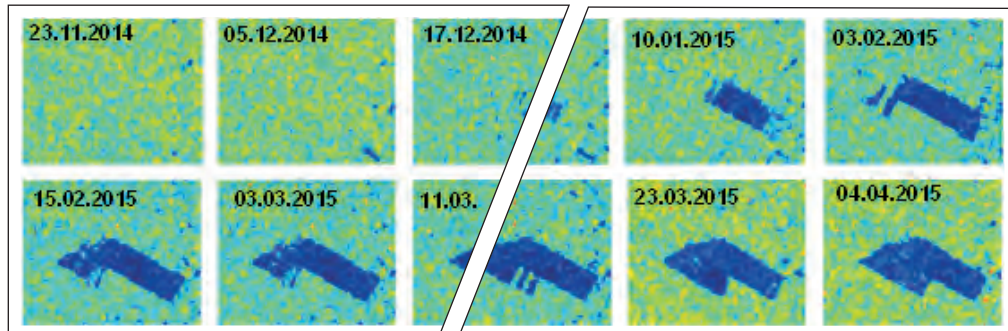
Example of the radar backscatter behavior during the evolvement of a forest clearing (*images by CESBIO*). Dense time series data allows the monitoring of gradual forest degradation and deforestation. Blue colour represents cleared forest areas.

Project Activities:

The implementation of the project is comprised of four main tasks:

► **Requirements Assessment**
  The EOMonDis developments are based on the collection of functional requirements, building an optimal trade-off between environmental and climate policy requirements, the related potential markets, operational User needs and technological constraints.

► **Innovation and Development**
  The mapping of forest disturbances and forest degradation is based on methodological improvements of processing chains for dense time series of optical and radar satellite data. The Users access to the products will be improved through a web based service platform.

► **Demonstration and Validation**
  The experiences and feedback acquired during the demonstration and validation phase is the basis for further improvements and customisations of the products and the service platform.

► **Service Provision**
  The project will be ready to provide user-tailored forest monitoring products for roll out, such as Forest Cover Maps, near real-time Forest Disturbance Maps, Above-Ground Biomass Maps and respective change products.
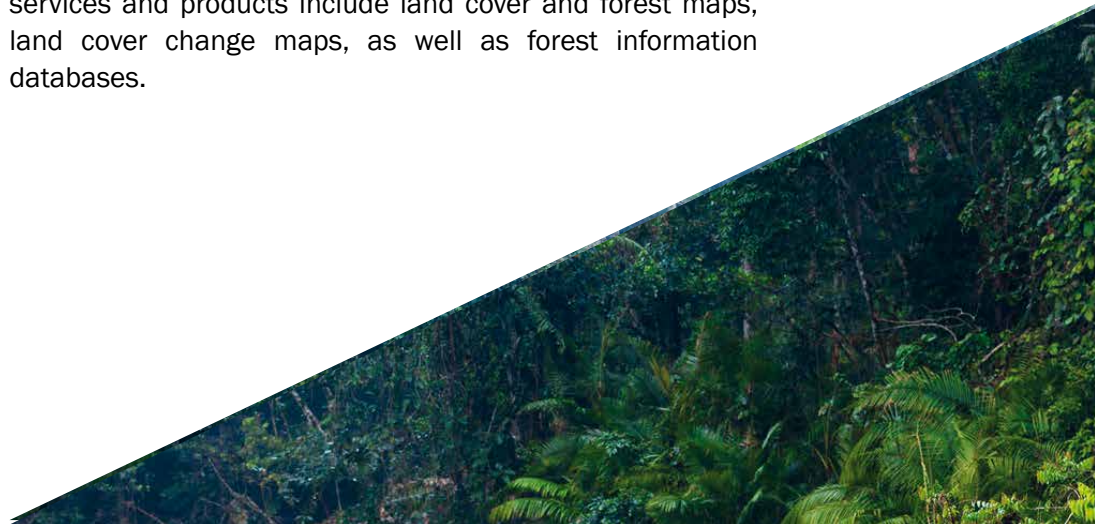
TECHNICAL CAPACITY

APPLIED EXPERTISE

GAF AG offers a comprehensive portfolio of proven products, services that cost-effectively meet the diverse requirements of forest and environmental professionals, practitioners, policy and decision makers worldwide.

The solutions offered are continuously evolving to meet the demands of a dynamic sector that confront complex challenges. GAF addresses these challenges with a unique combination of technical capacity, human skills and applied expertise which are adapted and focused on the future.

GAF AG has successfully managed a variety of international forest and environmental projects. Project design is customised to address local, regional, national and international user requirements from both public and private sector. Key services and products include land cover and forest maps, land cover change maps, as well as forest information databases.