
**República de Moçambique**
**Ministério da Terra, Ambiente e Desenvolvimento Rural**

# M & MRV Unit design in Mozambique: Equipment of Data Management Systems, Hardware, Software, and Equipment to improve MRV Data

**Governo de Moçambique**

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# M & MRV Unit design in Mozambique: Equipment of Data Management Systems, Hardware, Software, and Equipment to improve MRV Data Collection, Management, Storage, Analysis and Dissemination

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## 1. Background

The Government of Mozambique aims to ensure as a priority in its 2015-2019 five-year plan, the sustainable and transparent management of natural resources and the environment, as the basis for the country to accelerate their economic development efforts.
Mozambique as a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) decided to join the initiative to reduce emissions from deforestation and forest degradation (REDD+), having prepared and submitted to the World Bank, the Readiness Preparation Proposal for REDD (R-PP) to be financed through the Forest Carbon Partnership Facility (FCPF). Under this program, the country should develop a forest monitoring system (M& MRV) efficient, accurate and transparent.

The proposal of development of a M&MRV system in Mozambique was discussed and agreed on 11.02.2016 at the World Bank headquarters in Maputo attended by the main stakeholders: MITADER (UT-REDD+ and DIRN), UEM, JICA and WB. Two main components were considered in order to establish the M&MRV System; (i) the development of a baseline or Forest Reference (Emissions) Level (FRL/FREL) from the historical analysis (during the reference period) of the emissions due to deforestation, forest degradation, etc., and (ii) the design and implementation of the National Forest Monitoring System that will allow to measure the reduction in future emissions compared to the 'business as usual' scenario (baseline projection), due to the implementation of the REDD + program.

Under the second component there comes a time to design and implement one of the keys activities*: Procurement of Equipment of Data Management Systems, Hardware, Software, and Equipment to improve MRV Data Collection, Management, Storage, Analysis and Dissemination*.

This is one of the priority activities for the implementation of the M & MRV system and it basically consists in creating an advanced laboratory of geospatial techniques (GIS & RS) to service the National Forest Monitoring System (NFMS) (National Forest Inventory and MRV REDD+ activities) at MITADER (UT-REDD+/DIRN).

The future contracting services as specified in this ToR should offer a complete solution for integrated forest monitoring in Moçambique under the NFI and REDD + projects. Using together the pieces of a complete analysis platform of GIS and Remote Sensing with the most advanced technologies in the market and from different devices (laptops, smartphones, tablets and desktops), and with a guarantee of evolution, and future support services to create an advanced laboratory of geospatial techniques at MITADER (UT-REDD+/ DIRN).

## 2. Objectives of the Assignment

The overall objective of the assignment is to design and develop an advanced laboratory of geospatial tools at MITADER (UT-REDD+/FNDS), to provide services for a NFMS that monitors, measures, reports and verifies the data and activities related to REDD+.

The specific objectives of the assignment include:

**1. To design and implement a satellite land monitoring system to spatially track forest and land cover/land use changes;**

**2. To design and implement a geo information system to support the National Forest Inventory (NFI) that is compliant with IPCC requirements for REDD+;**

**3. To design and implement an advanced technological solution for greenhouse gas inventory for forestry sector but also coherent and consistent with agriculture and other land-use sectors (AFOLU).**

**4. To design and implement a Web Portal for MRV REDD+ in Moçambique with data and applications gathered throughout MRV project.**

**5. To train and build GIS/RS capacity of MITADER staff (UT-REDD+/DIRN) to monitor, measure, report and verify REDD+ activities.**

**6. To support technically the MRV Unit during the project implementation.**

## 3. Justification

The MRV system will be, as required, a robust and transparent national forest monitoring system for the monitoring and reporting REDD+ activities, providing estimates that must be transparent, consistent and accurate (taking into account national capabilities and capacities). It will use a combination of remote sensing and ground-based forest carbon inventory – National Forest Inventory - approaches for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes.

The implementation of MRV is being coordinated by the UT-REDD+, with support from the DIRN and a number of national and international partners.

Given the lack of infrastructure and technical equipment and trained technical staff at UT-REDD+ to carry out the tasks associated with monitoring, measuring, reporting and verifying for estimating anthropogenic forest-related greenhouse gas emissions and removals, forest carbon stocks and forest area changes, it is necessary to design and purchase a complete geospatial laboratory and to train the human resources needed to perform the required tasks.

Under the second component (2. Monitoring Systems for Forests) of the MRV Road Map, we consider the design and implementation of the National Forest Monitoring System that will allow to measure the reduction in future emissions compared to the 'business as usual' scenario (baseline projection), due to the implementation of the REDD + program. The activity *2.2. Acquisition of equipment and others* will support the purchase of all furniture, material and equipment necessary to prepare the MRV Unit under the UT-REDD+ (and DIRN).

## 4. Service scope and description

These are the most relevant requirements of this proposal, which however could be modified with provided justification of technical and economic advantages to the project.

The bidder/company should design and implement a:

**Geospatial information architecture in three levels: Integrated Web GIS Platform:**

- **DATA:** Geographic Database in which geospatial data is stored; **Database, Online content and services, Server extensions.**

- **ACCESS AND SERVICES:** Geospatial Server, where GIS services (mapping, analysis, data management) are created and where the web site (MRV web site) will be hosted; **Portal.**

- **APPS:** Tools for creating maps, templates and administration, together with customers' desktop applications, web and mobile devices, including additional modules required for the project: **Desktop apps (GIS & RS), Web, Devices.**

**Architecture Components:**

- **GIS Server**: should provide the client with the GIS capacity in a service-based architecture. It will be possible to deploy geospatial data and features, images, geoprocessing models, geolocators and route optimization services through web services that can be shared throughout MITADER or the Web. Users will access these web services from any web client or device. The GIS Services will be deployed and scaled using either servers on site (MITADER), either in the cloud or both. Types of Services: map service, feature service, geoprocessing service, image and mobile.

- **Geodatabase**: the platform will provide the necessary tools to storage effectively and efficiently geographic information in centralized repositories accessible by GIS professionals and other users through services. The information is stored either in files within a file system or a collection of tables in a Database Management System of (e.g.) Microsoft SQL Server. Storing all information in a Geodatabase will constitute a common and centralized data repository for all geographic data of MITADER. The data model of the Geodatabase will be scalable and can grow with the organization since small-scale single-user systems, through departmental systems to corporate systems serving an unlimited number of users.

- **Portal Web**: It is a collaborative platform based on the cloud that will allow MITADER members to create, share and access maps, applications and data; managing organizational geospatial content in a secure environment, publishing maps and data as services hosted on the secure cloud, configuring the online website, creating web maps, creating maps and apps with APIs, templates and tools, collaborating across and beyond the organization, finding relevant and useful basemaps, data and configurable GIS resources, Accessing Online, etc. The GIS Portal should be designed using SOA (Service Oriented Architecture) that leverages web services making it ready for integration with future MITADER portal, UT-REDD+ website and other internal or external applications.

- **Desktop GIS**: This level platform will provide MITADER with the tools needed by GIS professionals to create, edit, manage and analyze geographic information within their own environment. It will include full professional applications that support the different GIS tasks such as mapping, data visualization, analysis, management of geospatial data and images and dissemination of geographic information. Furthermore, the platform will seek to obtain the layer having a single, synchronized information that will enable users to view and manage data in their moment (using event monitoring tools, updating spatial information through tablet or smartphone, etc…).

- **Desktop for image processing**: this level platform will include the tools that provide expert-level results in analysis and image processing (data explorer, pre-processing tools, analysis tools, batch classification procedures, change detection, accuracy assessment, harmonization of maps and statistic generation).

**Architecture implementation:**

- **Development Environment**: Pre-Production or Test environment, it will be tested for deploying applications, connections to databases, data model definitions and cache tests. A single server with all installed components will be set up.

- **Production Environment**: two servers will be set up; one server to install and store the database management system (hereinafter DBS) (e.g. Microsoft SQL Server or PostgreSQL), and another to install and configure the GIS Server (hereinafter GISS). Depending on the type of GIS/RS software solution, an additional Desktop License Server (hereinafter DLS) could be located in any of the two servers (DBS or GISS) or in any other environment within the network. From this server (DLS) floating licenses will be served to all workstations.

**User profile and numbers**

- **Generic Web User:** Consumer of disseminate information published with open public privileges. Unlimited users but performance depending on MITADER hardware and network.

**Observations:** The information published for these users should not be of restricted diffusion and demand security policies, as may be seen by those with knowledge of the URL services, maps and applications offered.

- **Nominal Web User:** Consumer of disseminate information published with different privileges (administrator, publisher, displayer, etc.). Approx. 50 users.

**Observations:** At Front-end (Portal / Viewers) it could be created a group of users with generic (viewer) user role of generic accessing to pre-generated viewers with the information necessary. At Back-end (GISS) it would have to size the resources (servers and geoservices) properly to absorb spikes from service requests.

- **GIS Editor User:** Information Generator. Approx. 5 floating users.

**Observations:** GIS Desktop (complete functionality) should allow concurrent connection of 5 users from unlimited product installations that are made, the limitation is given by the number of available licenses on the license server (DLS).

- **RS Editor User:** Information Generator. Approx. 2 floating users.

**Observations**: RS Desktop (complete functionality) should allow concurrent connection of 2 users from unlimited product installations that are made; the limitation is given by the number of available licenses on the license server (DLS).

- **Database Administrator (DBA) (DBS and GISS).** DB designer and maintainer. 1 user (DB Manager)

**Observations:** minimum redundancy, concurrency control by locking techniques or closing of accessed data, logical and physical independence of data spatial distribution, data integrity (security measures that prevent bad data entering), audit system to maintain the control of access to the database (right of access to the data contained in the database by individuals and organizations: who, what, time), backup and recovery (database system must regain its status in a pre-time data loss).

**Hardware**

For the proposed architecture implementation, the following hardware recommendations should be considered:

- For the development environment a dedicated computer will be configured installing all the software required for the project (GIS and RS Desktop apps and DB) with identical characteristics to that used in production environment.

- For the production environment, the proposed workstations (5), servers (2), printers (2), external hard disks (6) and extendable electric sockets with current stabilizers (7) will be considered:

- **Workstations (5)**

| Hardware Platform | Memory | Video Card | HD | Monitor |
|---|---|---|---|---|
| XeonE5- 1650v3/6core/3500 MHz / 15 Mb cache ó XeonE5- 2643v3/6core/3400 MHz / 15 Mb cache | 32 GB | 8 GB NVIDIA Quadro M4000 Graphics (or similar), supporting OpenGL 2.0. or later | 512 Gb SATA SSD | Dual screen HR, refresh rate > 100 Hz screen size >21 inch |

Intel (I210/I217) Ethernet Controller. Wireless networking built-in. OS Windows 10 Pro 64 bit

Response times will be evaluated in the Technical proposal: access to geographic database, client/server communication network, client workstation. Simulation conditions: 10 DC in Local Network of 1Mbps.

- **Servers (GISS/DBS) (2)**

**GISS**

| Hardware Platform | Memory | Video Card | HD | Monitor |
|---|---|---|---|---|
| 1 Quad Core XeonE5-2637v3/4core/3500 MHz / 15 Mb cache | 32 GB | 4 GB supporting OpenGL 2.0. or later | 2 x 300 Gb 15000 rpm Serial Attached SCSI (SAS) 12 Gbps 2.5-inch disk drives with RAID 1 | HR screen, refresh rate > 100 Hz screen size >21 inch |

**DBS**

| Hardware Platform | Memory | Video Card | HD | Monitor |
|---|---|---|---|---|
| 1 Quad Core XeonE5-2637v3/4core/3500 MHz / 15 Mb cache | 32 GB | 4 GB supporting OpenGL 2.0. or later | 4x900 Gb 10000 rpm Serial Attached SCSI (SAS) 12 Gbps 2.5-inch disk drives with RAID 5 | HR screen, refresh rate > 100 Hz screen size >21 inch |

OS Windows Server 2012R2 Standard

Response times (local client and remote access client) will be evaluated in the Technical proposal: client workstation, access to Web services, network latency, queuing network traffic and network utilization. Simulation conditions: 10 DC in Local Network of 1Mbps and 25 RC in External Network of 10ms network latency and 6 Mbps.

- **Plotter/Printer (2)**

Plotter: 36-inch (914-mm) web-connected ePrinter. Prints up to E/A0-size. 128Gb virtual memory or above (1)

Laser Color Printer Multifunction (print, copy, scan). Print speed up 21 ppm (or above). Automatic two sided printing, Hi-speed USB 2.0, Ethernet 10/100Base-TX, Wireless 802.11b/g/n (1).

- **External hard disks 1 TB (6)**

- **Extendable electric sockets with current stabilizers (7)**

**JumpStart Service Platform**

This service refers to the installation, launching and basic training service and management tools. It will last 7 days, 5 at the customer installations and two remotely.

The main contents of each of the phases / blocks are:

1. **FIRST PHASE**. Installation, training, working with spatial data and registering Geoservices.

   - **Block 1**. Coordination of the JumpStart service: Initial Coordination Company/Customer. Starting the Service: Definition and Planning.
   - **Block 2**. Installing the Products: Desktop apps, Server and Spatial Database Engine on a single server. Verifying the installation. Basic and Management Training on the products.
   - **Block 3**. Loading Data. Geoservices Generation: Basic training in operation. Loading sets of data on the Geodatabase. Generation of examples of Geoservices and publishing with Server app.

2. **SECOND PHASE**. Disseminating information from GIS Online and Web Templates.

   - **Block 4**. GIS Online for Organizations: Basic training in GIS Online. Configuring WebMaps with customer data.
   - **Block 5**. Configuring Web Templates and Mobiles apps using JavaScript and Web App Builder.
   - **Block 6**. Closing JumpStart Service: Delivery of documentation with links to the Help on the topics covered in the JumpStart Service. Close and Termination of Service.

**Training on GIS and Remotes Sensing analysis**

This service aims to strengthen MRV Unit capabilities in acquiring, storing, processing and analyzing GIS and Remote Sensing data required for REDD+ activities, using open-source and commercial software solutions.

GIS Desktop Training Course will last 5 days, 35 hours at the customer installations. It will include complete training documentation and remote training support for 24 months.

RS Desktop Training Course will last 5 days, 35 hours at the customer installations. It will include complete training documentation and remote training support for 24 months.

**Training on design and elaboration of a MRV web-portal**

This service aims to strengthen MRV Unit capabilities in designing and elaborating a MRV web-portal and a set of apps that will allow MITADER members to create, share and access maps, applications and data regarding MRV project.

Developer Network and Server Enterprise Training Course will last 5 days, 35 hours at the customer installations. It will include complete training documentation and remote training support for 24 months.

## 5. Deliverables

- **Workstations and Servers (GISS/DBS)**

| Hardware Platform | Number of items |
|---|---|
| XeonE5- 1650v3/6core/3500 MHz / 15 Mb cache or<br>XeonE5- 2643v3/6core/3400 MHz / 15 Mb<br>cache | 5 |
| 1 Quad Core XeonE5- 2637v3/4core/3500 MHz / 15 Mb cache | 2 |

Other technical specifications in hardware description.

- **Plotter/Printer (2)**

Plotter: 36-inch (914-mm) web-connected ePrinter. Prints up to E/A0-size. 128Gb virtual memory or above (1).
Laser Color Printer Multifunction (print, copy, scan). Print speed up 21 ppm (or above). Automatic two sided printing, Hi-speed USB 2.0, Ethernet 10/100Base-TX, Wireless 802.11b/g/n (1).

- **External hard disks 1 TB (6)**

- **Extendable electric sockets with current stabilizers (7)**

- **Licenses**

| **Licenses (functionality).** Including licenses maintenance during project implementation period (24 months) | **Number of items** |
|---|---|
| **Developer Network:** providing software developers with the resources needed to build a wide range of custom GIS solutions; standalone desktop applications, mobile, web, and enterprise solutions. | 1 |
| **Server Enterprise:** supporting for Spatially Enabled Databases, Geodatabase Management, GIS Web Services, Geodata Service, Image Services, Web Mapping Applications, Smartphone and Tablet Applications, Web Editing, Geoprocessing, etc. | 1 |
| **GIS Desktop floating licenses:** supporting for the basic and advanced Spatial Analysis capabilities, considering at least one license for geostatistical analysis, 3d analysis and data interoperability capability. | 5 |
| **Remote Sensing Desktop floating licenses:** supporting for the basic and advanced Image analysis capabilities including at least one atmospheric correction module, one feature extraction module and one orthorectification extension | 2 |