Geo-ICT Technology for Efficient Management of Forests and Sustainable Provision of Biomass Energy in Rwanda

Raisa Sell

AfricaGiS conference  18-22 Nov 2019
Arbonaut around the world

• Founded in 1994
• International staff of 45 people and 15 different nationalities
• Headquarters in Joensuu, Finland
• Close cooperation with universities and research organisations
• Variety of in-house experts (e.g. foresters, mathematicians, computer scientists, geographers)
Arbonaut’s services

**Forest Information Systems**
- Collect, analyze, plan, share, report
- Web, desktop and mobile GIS solutions
- Operational forest management
- Water quality monitoring tools

**Forest Inventory**
- Remote sensing based inventories
- LiDAR and satellite image
- For private and public sector
- Methodology development
- Trainings and technology transfer

**REDD+ and Sustainable Forestry**
- REDD+ Strategy Development
- Definition of Forest Reference Level
- Land use and land cover mapping
- MRV – Measuring, Monitoring, Verification systems
Context - Forests in Rwanda

- Forests and tree resources have strategic position in the Rwandan development agenda as primary energy source to a large portion of population, supporting agriculture and ensuring equilibrium of the ecosystem
  - Estimated 86% of Rwanda’s energy is provided by biomass
  - Growing population, shrinking land availability
    → Forest resources under high pressure

- Meeting the growing demand of woody biomass with sustainable supply is of key importance for environmental protection (SDG15), adaptation to climate change (SDG13) and securing energy for all (SDG7)

- Target to increase forest cover to 30% of the total country land area by 2020
  - Natural forest 12%
  - Areas allocated to plantations 18%
Introduction on the DFMPs

• To improve the management of forest resources, an essential step was taken to develop District Forest Management Plan (DFMP) for each district

• DFMP is a mandatory tool for each district to guide and monitor forest resources management according to:
  ▪ Forestry Law (2013)
  ▪ National Forest Policy (2018)
  ▪ Forestry Sector Strategic Plan (FSSP 2018-2022)

• From 2014, 27 DFMPs designed (with support of PAREF.Be2, PAREF.NL, PAGREF, UICN and FMBE)

• Each DFMP has to be updated regularly to integrate changes
Example of main data constituting the basis of each DFMP
Attribute data management and calculations in Excel

<table>
<thead>
<tr>
<th>Forest ID</th>
<th>Previous Forest Names</th>
<th>Sector</th>
<th>Forest stand area ha</th>
<th>Species for conversion or management</th>
<th>Recommend Treatment Regime</th>
<th>Soil Condition</th>
<th>Subgroup in FMU</th>
<th>Year of FMU contracting</th>
<th>Final year of starting planning</th>
<th>Period of Full Cycle Management years</th>
<th>Tree planting density nbr stem per ha</th>
<th>Rotation CD in years</th>
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<th>CC2</th>
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</table>

**Graph:**

Standing stock (m3) projection for all public forests in the District

- **District owned forests**
- **State owned forests**
Challenges in the Excel based system

- Complex and not user-friendly heavy Excel files
  - => Very difficult for officers to master it and to easily update/change when necessary
  - => No validation rules for data entry, easy to make mistakes
- Shapefiles for spatial data not automatically linked to the Excel files
- Districts might have different Excel file format/structure => Need of harmonization to allow consolidation and centralisation in one unique database
- No connection to GPS/tablet system => Not efficient for using at field level
- No integration to other existing databases like LAIS (Land Administration Information System)
- Forest inventory campaigns use different database structure, without automatic linkages with DFMP forest stand Excel files => Need of harmonisation, need of keeping raw data from each inventory to make further comparative analysis
- Several components & functionalities missing in Excel files: Actor register, monitoring of DFMP implementation, managing cut permits, agroforestry planting activities
From Excel files to a modern GIS system

A project was started on developing a User-Friendly and Customized District Forest Managements Plans (DFMP) system

- Key actors in the project
  - Rwanda Water and Forest Authority (RWFA)
  - Belgian Development Agency (Enabel)
  - Arbonaut Ltd, Finland
  - kartECO, Greece

- On-going project, started in Sept 2018

- Concentrates in 3 pilot districts in Rwanda: Rwamagana, Gasabo, Gakenke
DFMP system

• Purpose of the new DFMP system is to provide a user-friendly web and mobile application for managing (creating, updating, monitoring) District Forest Management Plans
• Modern GIS system managing spatial and attribute data
• Nationwide database
• System developed entirely using Free and Open Source Software (FOSS)

• Users:
  ▪ RWFA officers (state level)
  ▪ District officers
  ▪ Private contractors implementing DFMP silvicultural activities
DFMP architecture

DFMP: District Forest Management Plans tool for state and district users
SFMP: Simplified Forest Management Plans tool for contractors (private operators)
LAIS: Land Administration Information System
DFMP Web application

• Key functionalities
  ▪ Viewing, creating and editing forest stand data (boundaries + attribute data)
  ▪ Producing silvicultural activity chains for forest stands incl. financial calculations
  ▪ Allocation of silvicultural activities implementation to private operators
  ▪ Monitoring of implemented activities
  ▪ DFMP reports

• Technology
  ▪ PostgreSQL + PostGIS
  ▪ Geoserver
  ▪ React
  ▪ OpenLayers
  ▪ Java
  ▪ Knowage (reporting tool)
DFMP Mobile application

• Key functionalities
  ▪ Viewing and editing existing data on forest stands
  ▪ Stand demarcation & collecting data for new forest stands (e.g. newly planted areas), recording boundaries by GPS
  ▪ Collecting sample plot level data
  ▪ Offline functionality

• Technology:
  ▪ React Native
  ▪ Mapbox
  ▪ Offline-First
Thank you!

raisasellt@arbonaut.com, +358 40 835 6467

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