A WORLD OF INNOVATION

THOMAS MASCHLER AND ASA STRONG EXPLAIN HOW THEIR NEW OPEN SOURCE FORESTRY MONITORING APPLICATION HAS ALREADY BEEN USED TO CREATE FOREST ATLASES IN COUNTRIES ACROSS THE CONGO BASIN

Open data enables citizens and communities around the world to engage in important societal and environmental issues. Besides stimulating innovation, entrepreneurship and scientific discovery, open data democratises decision-making by increasing transparency. It enables citizens to comprehend their leaders' actions and hold them accountable when the information doesn't add up.

But simply making data 'open', or freely available to everyone, doesn't guarantee accountability. To make data actionable for the average user, it needs to be put into context and packaged into the right tools.

Global Forest Watch (GFW) aims to turn big data into action. One of the go-to platforms for the most up-to-date forest information, it enables users to perform complex analyses with a few simple clicks, monitor deforestation globally in near-real time, calculate carbon emissions from land conversion or even evaluate the impact of companies' supply chains on forests to measure their progress toward zero-deforestation commitments.

National forest agencies in the Congo Basin have used GFW perhaps better than anyone. The Congo Basin is home to some of the largest undisturbed tropical rainforest on the planet, with thousands of tropical plant species and hundreds of endangered mammals. Approximately 75 million people live there, many of whom directly depend on resources provided by forests such as food, water, fuel wood and income.

The Congo Basin Forest Atlases, first released in 2005, were created in partnership between World Resources Institute (WRI) and the forest ministries of Cameroon, Central African Republic, Congo, Democratic Republic of Congo, Equatorial Guinea and Gabon. These atlases were made using data and analysis featured on GFW, customised to include local data and fit the needs of the ministries responsible for managing their national forest estates. They contain information on land allocation, management practices and logging statistics, as well as a collection of official documents such as decrees, by-laws and management plans.

Before the Forest Atlases, this information was scattered across various departments and agencies, so was often inaccessible for officers deciding about land-use, resulting in double allocation of land, insufficient assessment of cases or conflicts of authority. Making everything available through the Forest Atlases helped the ministries to streamline their internal processes to avoid mistakes, and to implement and better communicate their sectoral programs.

The atlases also opened access to national forest data to the broader public. For the first time, forest stakeholders could validate the information they got from the ministries and draw their own conclusion. Suddenly, maps and spatial statistics on forest- and land-use found their way into reports and publications across the entire community of forest stakeholders, including national agencies, development organisations, NGOs and private companies.
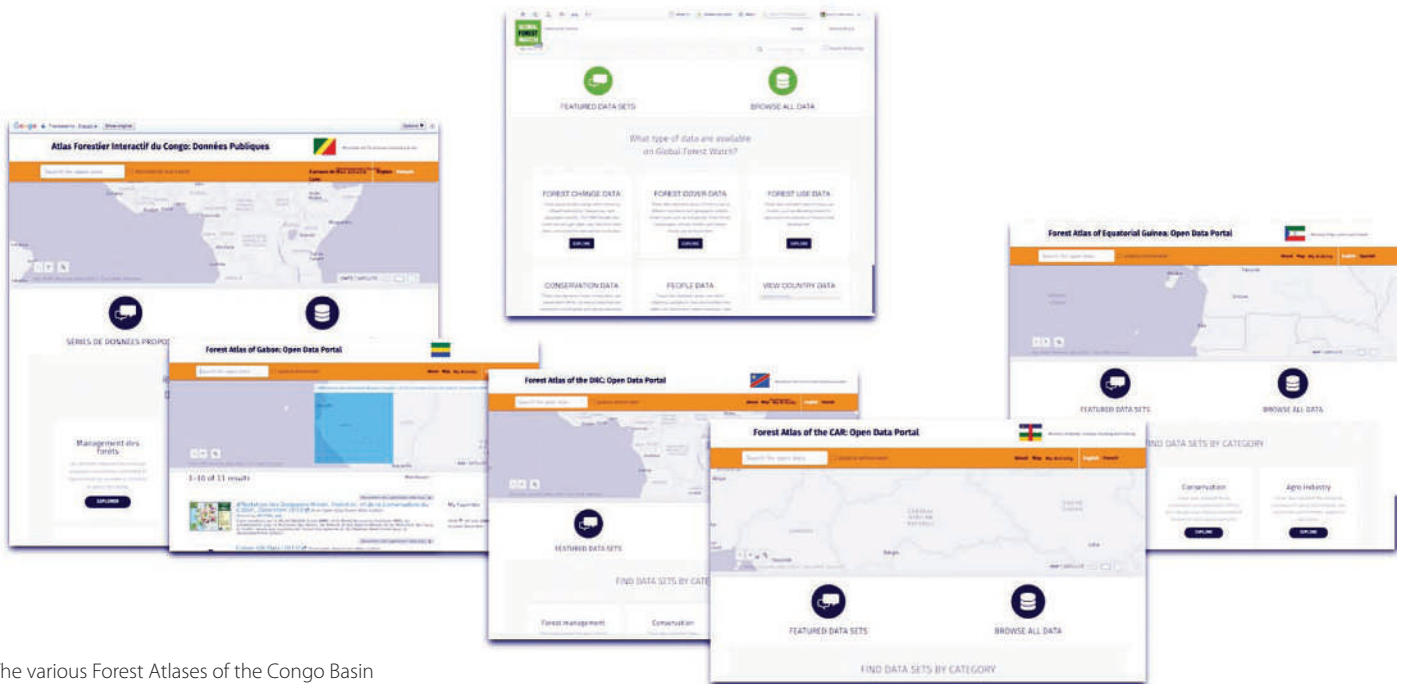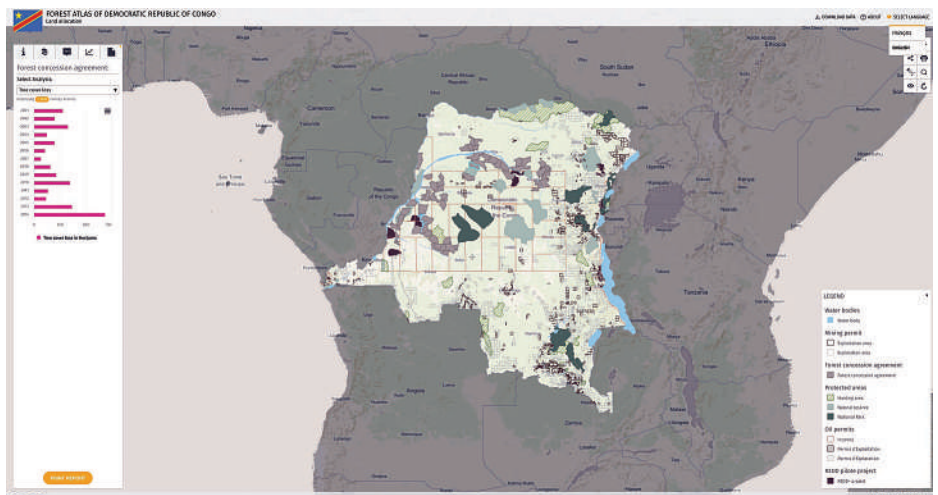
The various Forest Atlases of the Congo Basin

Better management of estates

The atlases have made tangible improvements in the management of Congo Basin forests. For example, Cameroon's Ministry of Forestry and Wildlife (MINFOF) used its Forest Atlas to pinpoint potential illegal logging activity, by overlaying maps of logging roads with logging and mining permit boundaries to reveal activity that extended beyond what was legally permitted.

The Democratic Republic of Congo's Ministry of Environment and Sustainable Development used its Forest Atlas to evaluate forest concession contracts for renewal, and ultimately suspended 91 permits covering 12.7m ha for violating legal requirements.

MINFOF has also established a community and council forest in central, based on forest loss detected using data and recommendations from GFW.
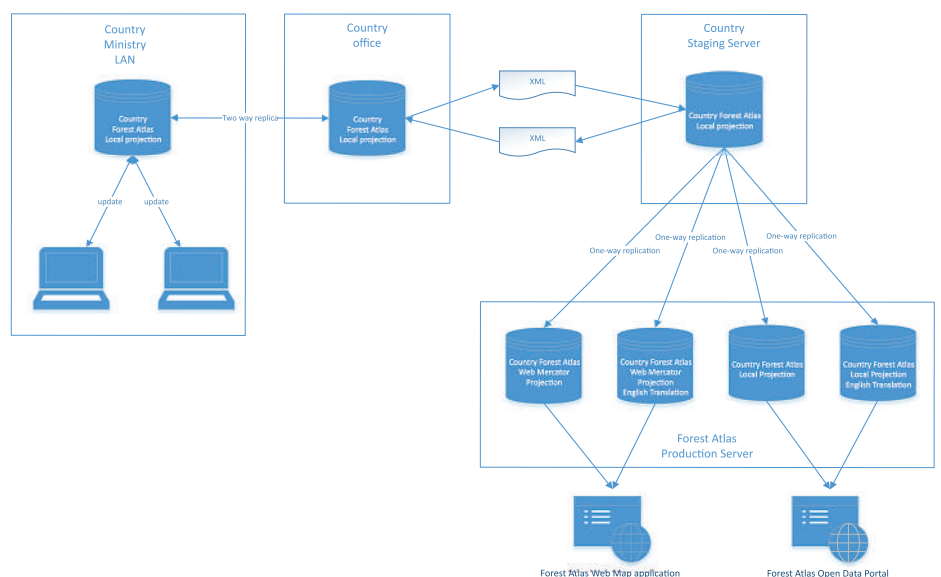
Forest Atlas features

The Forest Atlases contain some key features that have improved forest management in the Congo Basin.

GIS tools help decision-makers to work with maps that highlight different aspects of forest-and land-use management, including logging, mining, agriculture and conservation. With one click, users can run complex analyses on land-cover composition and above-ground biomass as well as forest-cover dynamics such as loss, gain and bushfires. Near real-time forest cover monitoring systems such as weekly GLAD and monthly Terra-i alerts are available through Global Forest Watch's Open Data Portal.

Users can also browse through the attributes of every feature on the map to learn more about what they represent. For example, users can learn when and how conservation areas were created, as well as who manages them and how. They can also download

The Democratic Republic of Congo's Forest Atlas. Like most of the Forest Atlases, it is available in both French and English

The Forest Atlas application architecture

PDFs of any relevant documents, such as management plans, decrees or by-laws.

In addition to the web-map tools, the Atlases enable the public to access more forest sector information. Each Atlas has a corresponding Open Data Portal where anyone can find and download data they see on the platform. The data is maintained in both English and French, the official language spoken in most Congo Basin countries. Since data are published directly by each government agency, they are considered an authoritative source. An additional module providing in-depth analysis for key indicators has just been released for the different atlases.

Under the hood

Deploying and managing the different Forest Atlases, each in multiple languages, requires strong technical architecture and capabilities.

To ensure that data on each Forest Atlas could help influence national decision making, we introduced spatial planning and spatial thinking across the ministries. To familiarise the officials with spatial data and analysis, existing forest and land-use titles for each country were digitised and published as both printed and interactive maps. The maps showcased the current land allocation, change in land cover as well as interdependencies between the two, and helped staff to understand the power of these types of analytics. The staff were then further trained in GIS and data management, allowing them to produce maps and analyses themselves.

With increased capacity, more complex systems were introduced using central servers, enterprise geodatabases and online geodata portals. While ministry staff now manage and update data on their own, in-country WRI staff still support the cartography units and provide training on the job to assure continuity and a stable system.

However, designing a robust system that enables an entire organisation to share its data in the context of the Congo Basin countries is challenging. Things that are taken as granted in the western world, such as a stable electricity network and broadband internet, are not a given in Central Africa. Although there are many champions, overall computer literacy is still very low.

ArcGIS provides solutions that work even in this challenging environment. Cartography units in the ministries are equipped with a central ArcSDE database. Technicians replicate the geodatabase onto their local machines and can access and edit the data even when the network is down or they are working off side. Versioning enables projects to remain isolated until they are ready for publication. Distinct topology rules help the team to quickly identify inconsistencies in the data. Regular synchronisation with the central database ensures that everyone on the team always has the latest data.

To give non-technical staff access to the maps and other information, data layers of the geodatabase are registered with an ArcGIS Server instance and shared across the ministry using ArcGIS Portal for Server. This is configured for disconnected environments and works independently of an internet connection. Forest Atlas applications are hosted on ArcGIS Portal for use within the ministry. Field offices out of the network receive regular delta file updates of data by email or USB stick.

The public version is hosted on Amazon Web Services and ArcGIS Online to assure high availability. The technicians keep the system up-to-date using delta files to synchronise the online replica of the central geodatabase. Once in the cloud, data are further replicated into live geodatabases that hold copies of the geodatabase in different projections and languages.

By translating domains and subtypes within ArcSDE, the Forest Atlases can display layers in different language (usually French and English) without needing to alter the underlying data. The data used in web applications is re-projected during the synchronisation and directly stored in Web Mercator projection to render faster and reduce the load on the server, while a separate copy in the local projection is kept for distribution via the Open Data Portal.

To distribute Forest Atlas data publicly, forest ministries rely on ArcGIS Open Data. Each ministry using a Forest Atlas has its own Open Data Portal where it publishes its geospatial data for public access as well as additional resources such as forestry

contracts, reports and other publications. Data distributed through the Open Data Portals are published in their original projections together with comprehensive metadata. Data in English and French are curated using separate open data portals. Users can search data by keyword, full text or location and download the desired dataset. Web developers can find the necessary API endpoints for use in their applications. If not specified differently, all data is licensed under the CC-by-4.0 license, allowing users to use and redistribute the data.

The success of each Congo Basin Forest Atlas demonstrates how capacity-building coupled with powerful GIS analysis can improve the management of forests at the national scale. With open source tools like GFW Map Builder (see Box), these applications can be scaled faster and easier than ever. So what's the wait? Get started building your own GFW today!

GIS ANALYSIS CAN IMPROVE THE MANAGEMENT OF FORESTS AT THE NATIONAL SCALE

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GFW MAP BUILDER

Forest Atlases are published using Map Builder, a tool that GFW recently released publicly. It enables anyone to create their own forest monitoring website using their own data, coupled with geospatial analysis features from GFW. GFW worked with Blue Raster to develop this web application template based on ArcGIS Online, and it is published under the MIT licence, so any organisation can create its own forest monitoring platform with custom data, at any geographic scale, for free. Users can use Map Builder with both ArcGIS Online and ArcGIS Portal for Server.

Users can customise the web applications by changing logo and branding, plugging in custom data, focusing the map on a unique area of interest or styling data for a specific topic. Different apps can be linked between each other to form a comprehensive atlas.

To view the application, visit http://my.gfw-mapbuilder.org/v1.latest/. To learn more about how to use GFW Map Builder, visit www.globalforestwatch.org/howto/tags/map-builder/. The source code is available https://github.com/wri/gfw-mapbuilder.

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