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# Interactive Forestry Atlas of Cameroon

Version 1.0

*An Overview*

A GLOBAL FOREST WATCH REPORT

# **Interactive Forestry Atlas of Cameroon**

(version 1.0)

## **An Overview**



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**A Global Forest Watch Report 2005**

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Africa (*Conservation et Utilisation Rationnelle des Ecosystèmes Forestiers d’Afrique Centrale* - ECOFAC), the Jane Goodall Institute (JGI), the Integrated Forest Monitoring System for Central Africa project of the U.S. National Aeronautics and Space Administration (NASA-INFORMS), the National Institute of Cartography of Cameroon (*Institut National de Cartographie* - INC), Nature Plus, the International subsidiary of the National Office of Forests (*Office National des Forêts International* - ONFI), the Dutch Development Organization (SNV), the Tropenbos Cameroon Programme (TCP), the Wildlife Conservation Society (WCS), and the World Wide Fund for Nature (WWF).

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## FOREWORD

As the institutional, regulatory, and administrative reforms initiated since the 1990s have shown, Cameroon is resolutely engaged in a process of sustainable forestry management, adopting—among other measures—a zoning plan for the southern forestry region; reinforcing community participation in the management of forestry resources; improving allocation procedures for forestry operation titles; reinforcing monitoring and control of forest use, and participating in regional processes (e.g. CEFDHAC, Yaoundé Summit, COMIFAC, and AFLEG).

To further transparency in the forestry sector and battle illegal practices, the Ministry of the Environment and Forests (MINEF) has chosen to develop multiple partnerships, particularly in the area of control and monitoring of the forestry sector. To this end, a cooperation agreement was signed on June 6, 2002, between MINEF and Global Forest Watch (GFW), aiming to support MINEF's forest monitoring functions. The agreement focuses on utilizing remote sensing (RS) and geographic information systems (GIS) technologies to develop a cartographic and statistical database for users and managers of forest resources of the Republic of Cameroon. This database will serve as a reference tool for MINEF in order to facilitate monitoring for sustainable forest management.

GFW was well positioned to engage in this collaboration as evidenced by its publication in 2000 of a document entitled “An Overview of Logging in Cameroon (*Aperçu sur la situation de l'exploitation forestière au Cameroun*),” produced in collaboration

with nongovernmental organizations, experts, and the governmental authorities of the forest sector.

In 2004, GFW's interest in Cameroon and its continued presence in this country has been demonstrated in a much more meaningful manner with the production of this *Interactive Forestry Atlas of Cameroon*. This first version of the interactive atlas is the product of a close collaboration between GFW, forest management authorities, and all the stakeholders seeking sustainable forest management in the country.

The current initiative is unique in that it gathers forestry data and information, presents them in a visual manner, and combines data and information that have heretofore not been connected nor easily accessible. The improvement in quality and accessibility of information pertaining to the forestry sector through the use of modern tools such as RS and GIS may contribute significantly to the improvement of the management and rational, sustainable, and responsible use of forests.

By contributing to this atlas, the Government of Cameroon confirms its commitment to increased transparency and good governance. The Government of Cameroon hopes that the information produced by the partnership with GFW will be made available to the greater public via the Internet websites of the GFW and the current Ministry of Forests and Wildlife (MINFOF). All of the parties involved recognize that this version of the atlas constitutes a first step. Subsequent efforts will be focused on keeping this tool up to date as well as

training key practitioners in its use and integration in decision-making processes. These efforts will continue within the MINFOF-GFW collaborative framework.

For all of these efforts and the significant outcomes they have produced, I would like to thank WRI, GFW, and their network of partners, as well as the international donor agencies that have supported this work, in particular the United States Agency for International Development's Central Africa Regional Program for the Environment program (USAID-CARPE) for their constant support, along with the World Bank, the John D. and Catherine T. MacArthur Foundation, the European Union (EU), and GTZ (German agency for technical cooperation). On behalf of the Government of Cameroon, I invite these partners to continue their collaboration with the Government of Cameroon concerning the challenge of sustainable management of Cameroon's forestry resources.

**Yaoundé, January 20, 2005**  
**The Minister of Forests and Wildlife**



## ABBREVIATIONS

AAC	Annual Allowable Cut ( <i>Assiette Annuelle de Coupe</i> )	FMU	Forest Management Unit (see UFA)	RS	Remote sensing
AFLEG	Africa Forest Law Enforcement and Governance	GFW	Global Forest Watch	SDIAF	Sub-Department of Inventories and Forest Management Management ( <i>Sous Direction des Inventaires et Aménagements Forestiers</i> )
ATO	Africa Timber Organization	GIS	Geographic Information System	SFID	Forestry and Industrial Society of Doumé ( <i>Société Forestière et Industrielle de la Doumé</i> )
AVHRR	Advanced Very High Resolution Radiometer	GLC	Global Land Cover	SIBAF	Industrial Society of African Timber ( <i>Société Industrielle des Bois Africains</i> )
BCTF	Bushmeat Crisis Task Force	GPS	Global Positioning System	SIGIF	Automated Forestry Information Management System ( <i>Système Informatisé de Gestion des Informations Forestières</i> )
CARPE	Central Africa Regional Program for the Environment	GTZ	German Technical Cooperation ( <i>Gesellschaft für Technische Zusammenarbeit</i> )	SLC	Scan Line Corrector
CBFP	Congo Basin Forest Partnership	Ha	Hectares	SNV	Dutch Development Organization
CEFDHAC	Conference of Humid and Dense Forest of Central Africa ( <i>Conférence sur les Ecosystèmes de Forêts Denses et Humides d'Afrique Centrale</i> )	IFIA	InterAfrican Forest Industries Association	SSV	Sales of Standing Volume (see VC)
CEW	Cameroon Environmental Watch	INC	National Institute of Cartography ( <i>Institut National de Cartographie</i> )	TCP	Tropenbos Cameroon Programme
CFC	Community Forestry Unit ( <i>Cellule de Foresterie Communautaire</i> )	IRS	Indian Remote Sensing	TREES	Tropical Ecosystem Environment observations by Satellite
CIDA	Canadian International Development Agency	ITTO	International Tropical Timber Organization	UCC	Central Control Unit ( <i>Unité Centrale de Contrôle</i> )
COMIFAC	Central Africa Forests Commission ( <i>Commission des Forêts d'Afrique Centrale</i> ) - formerly known as the Conference of Forests Ministers of Central Africa ( <i>Conférence des Ministres en Charge des Forêts de l'Afrique Centrale</i> )	IUCN-	World Conservation Union - Regional ROCA Office for Central Africa	UCECAF	Central Forestry Cartographic Unit ( <i>Unité Centrale de la Cartographie Forestière</i> )
DCP	Division of Cooperation and Projects	JGI	Jane Goodall Institute	UFA	<i>Unité Forestière d'Aménagement</i> (see FMU)
DF	Department of Forests	JRC	Joint Research Centre	USAID	United States Agency for International Development
DFAP	Department of Wildlife and Protected Areas	LBZG	Limbe Botanical and Zoological Garden	VC	<i>Ventes de Coupe</i> (see SSV)
ECOFAC	Conservation and Rational Use of Forest Ecosystems in Central Africa ( <i>Conservation et Utilisation Rationnelle des Ecosystèmes Forestiers d'Afrique Centrale</i> )	MINEF	Ministry of Environment and Forests	WCS	Wildlife Conservation Society
ERDAS	Leica Geosystems	MINEP	Ministry of Environment and Protection of Nature	WRI	World Resources Institute
ESRI	Environmental Systems Research Institute	MINFOF	Ministry of Forests and Wildlife	WWF	World Wide Fund for Nature
ETM	Enhanced Thematic Mapper	NASA-	National Aeronautics and Space Administration - Integrated Forest Monitoring System for Central Africa	ZIC	Safari Hunting Zones ( <i>Zone d'intérêt cynégétique</i> )
EU	European Union	INFORMS	National Geospatial-Intelligence Agency	ZICGC	Community Hunting Zones ( <i>Zone d'intérêt cynégétique à gestion communautaire</i> )
		NGA	non governmental organization		
		NGO	International subsidiary of the National Office of Forests ( <i>Office National des Forêts International</i> )		
		ONFI	Forest Environment Sector Program ( <i>Programme Sectoriel Forêts Environnement</i> )		
		PSFE	Forestry Revenue Enhancement Program ( <i>Programme de Sécurisation des Recettes Forestières</i> )		
		PSRF			

## EXECUTIVE SUMMARY

The tropical forests of Cameroon generate important economic, social, and environmental benefits for the country. Given the vast, remote nature of these forests, the Government of Cameroon has made significant commitments and notable strides in monitoring forest-based activities to strengthen planning and management for sustainable forest use. This commitment has spawned many programs aimed at producing and/or compiling forest-monitoring data, creating an opportunity to bring relevant datasets together in a single GIS-based decision-support tool that integrates satellite imagery and other spatial data from various sources. As part of a series of efforts aimed at improving forest monitoring, the Ministry of Environment and Forests of Cameroon (MINEF) and the Global Forest Watch (GFW) initiative of the World Resources Institute have formally partnered to create such a tool.

Within the framework of Cameroon's Forest Environment Sector Program (*Programme Sectoriel Forêts Environnement* - PSFE), the MINEF-GFW collaboration aims to enable better decision-making by improving the quality and availability of geographic information relevant to the forest sector. Through this *Interactive Forestry Atlas of Cameroon* (Version 1.0) and related data products (listed below), these partners seek to provide relevant spatial data and information on the forest sector in accessible forms for use by government, industry, and the public.

Six specific products are contained in the *Interactive Forestry Atlas of Cameroon* CD-ROM:

1. The welcome and users guide – provides instructions on the installation and viewing of the atlas and its content.
2. The *Interactive Forestry Atlas of Cameroon* – includes a map-viewing application that allows users to view maps in detail, pan and zoom to areas of interest, view data layers individually or in combination, query datasets, and print maps of their choice. Free and easy-to-use map-viewing software (ESRI ArcReader) is also included.
3. The GIS data and metadata – includes original shape files and attributes, including information on how the datasets were created. See Appendix 1 for a list of datasets found in this atlas.
4. This overview report – provides an overview of the purpose, content, and methodology of the atlas, including examples of useful potential applications for key decision-makers and technicians in government, industry, and civil society organizations.
5. The technical roads report – provides a detailed technical description of the methodology utilized to create the roads dataset.
6. Poster – presents the overall situation concerning forest exploitation in Cameroon.

By using this interactive atlas, key decision-makers and all stakeholders are able to easily access and manipulate the most current and critical information for forest monitoring in order to produce and view maps. Through the MINEF-GFW collaboration, this atlas contains the most up-to-date, verified information on the forest sector, including the boundaries of timber extraction areas and useful data on their attributes, such as the status of management plans, the year in which logging titles were allocated, and annual timber-production volumes. Information is also presented on biodiversity and wildlife protection areas, and a dataset of digitized roads information was developed especially for this atlas.

Examples of potential uses of the atlas discussed in the following report include:

- Supporting the prioritization of field missions for monitoring and enforcement of forest laws and regulations;
- Helping to determine whether road construction is taking place within the boundaries of legally attributed logging areas and/or in compliance with approved management plans;
- Helping to resolve conflicts by providing a source of objective information on the boundaries of various forest zones, such as Forest Management Units (FMU), Sales of Standing Volume (SSV), Council Forests, Community Forests, protected areas, etc;

- Informing the application process for new logging titles, including by assisting local communities in their efforts to identify areas available for establishing and harvesting timber from Community Forests, thus minimizing the confusion that has previously plagued this process;
- Supporting the key local authorities (e.g., the Ministry of Agriculture, the Ministry of Public Works, local councils, and members of parliament) in their land use and regional planning activities, including the identification of roads critical to the travel and market access of some remote rural communities; and
- Supporting the relevant authorities and partners in the design of new protected areas and conservation corridors.

The *Interactive Forestry Atlas of Cameroon* also supports ongoing efforts of non-governmental organizations (NGOs), donors, inter-governmental organizations, research institutes, and progressive companies towards improved forest governance and management. Training sessions tailored to the needs of various target user groups are being undertaken in order to ensure maximum awareness of the atlas and its potential applications. More specifically, the atlas and related products can provide support to many regional programs and

processes, most notably the Africa Forest Law Enforcement and Governance (AFLEG) process, execution of the Plan of Convergence of the Central Africa Forests Commission (COMIFAC), the Conference on Humid and Dense Forest Ecosystems of Central Africa (CEFDHAC), the efforts of the International Tropical Timber Organization (ITTO) and the Africa Timber Organization (ATO) to promote sustainable forest management, and the activities of the Congo Basin Forest Partnership (CBFP).

While this atlas presents all the latest data concerning the forest sector that could be located, created, and/or provided by MINEF, it does have certain limitations. It should be understood as a work in progress that will evolve and improve with periodic updates and/or the expansion of the scope of data. Evidence drawn from this atlas should not be considered sufficient for a definitive judgment of legality or illegality of specific activities, which can only be determined with further field investigation by MINEF.

The atlas is available on line (at [www.globalforestwatch.org](http://www.globalforestwatch.org) and [www.minef.cm](http://www.minef.cm)) to promote transparency and make information accessible to all stakeholders with Internet capabilities. Likewise, CD-ROMs are disseminated to key decision-makers and other forest sector stakeholders.

# 1 INTRODUCTION

## 1.1 Current Situation

With more than 20 million hectares of moist tropical forest, the forest sector of Cameroon contributes significantly to its national and local economies, providing employment and associated roads, schools, and health clinics as well as important environmental services.<sup>1</sup> The challenging task of guiding and monitoring the forest sector falls on the Government of Cameroon, which, along with its donor partners, has committed significant resources to forest sector monitoring.<sup>2</sup> Some of its most notable achievements and efforts are:

- Adopting and implementing the forest code (Law Number 94/01 of 20 January 1994) to improve sustainable forest management;
- Creating the Automated Forestry Information Management System (*Système Informatisé de Gestion des Informations Forestières* - SIGIF) database;
- Operationalizing the Forestry Revenue Enhancement Program (*Programme de Sécurisation des Recettes Forestières* - PSRF);
- Inviting and cooperating with an independent observer (the UK-based non-governmental organization, NGO, Global Witness); and
- Launching of the Forest Environment Sector Program (*Programme Sectoriel Forêts Environnement* - PSFE).

These programs and collaborations signal Cameroon's serious commitment to strong forest governance and management.

The forest industry plays an important role in forest management and in generating economic benefits from the forest. However, the specific contributions of private-sector forest operators to national economic growth—and to the conservation and responsible use of the forest resources allocated to them—vary considerably. These operators can be characterized along a spectrum, ranging from progressive forest concessionaires fully committed to sustainable forest management and value-added wood processing, to short-sighted operators with limited regard and respect for the well-being of local populations, forest resources, and national laws and regulations. This situation has led to—and continues to produce—a number of serious problems, such as illegal logging, unsustainable use of forest resources, reduced fiscal revenues, and limited benefits for local populations.

Given the vast and remote nature of much of Cameroon's forest, combined with the Government's limited financial resources and skilled personnel, there is a clear need for advanced information technologies and decision-support tools to strengthen planning for field monitoring and control missions. As previously noted, Cameroon has already placed significant effort into improving its capacity for forest governance and management. However, the integration of remote sensing (RS) and geographic information systems (GIS) technologies provides an important opportunity to strengthen the coordination of these initiatives

as well as to improve their functionality. Decision-support tools that integrate RS and GIS approaches can provide a comprehensive source of accurate, objective, up-to-date, and timely information that is spatially linked to the site of forest operations. Such monitoring tools are essential to enable sound decision-making and consequently better governance and management in the forest sector.

## 1.2 MINEF-GFW Memorandum of Understanding

Responding to the previously described situation, and with the facilitation of the World Bank, the Ministry of Environment and Forests (MINEF)<sup>3</sup> of Cameroon and the Global Forest Watch (GFW) initiative of the World Resources Institute signed a Memorandum of Understanding (MOU) in June 2002, which formalized their respective responsibilities in collaborating on an effort to improve the quality and availability of geographic information relevant to the forest sector.<sup>4</sup> MINEF agreed to provide GFW with data on forest sector activities in Cameroon, while the Cameroonian institutions partnering with GFW would create and compile further data necessary to produce map-based tools. (See Section 1.5 for more details on how this collaboration has been operationalized, including validation methodology.) The collaboration was designed to support MINEF in its effort to improve forest governance, while promoting transparency and access to information among diverse stakeholders concerned with conservation and use of forest resources in Cameroon.

## 1.3 Products and Purpose

This *Interactive Forestry Atlas of Cameroon* is one of the principal outputs of the ongoing MINEF-GFW collaboration. Six specific products are contained in the *Interactive Forestry Atlas of Cameroon* CD-ROM:

1. The Welcome and User's Guide – provides instructions on the installation and viewing of the atlas and its content.
2. The *Interactive Forestry Atlas of Cameroon* – includes a map-viewing application that allows users to view maps in detail, pan and zoom to areas of interest, view data layers individually or in combination, query datasets, and print maps of their choice. Free and easy-to-use map-viewing software (ESRI ArcReader) is also included.
3. The GIS data and metadata – includes original shape files and attributes, with information on how the datasets were created. See Appendix 1 for a list of datasets found in this atlas.
4. This overview report – provides an overview of the purpose, content, and methodology of the atlas, including examples of useful potential applications for key decision-makers and technicians in government, industry, and civil society organizations.
5. The technical roads report – provides a detailed technical description of the methodology utilized to create the roads dataset.

6. Poster – presents the overall situation concerning forest exploitation in Cameroon.

The atlas is designed to support MINEF and the Forest Environment Sector Program (PSFE) by identifying problem areas, facilitating discussions with stakeholders, and improving the decision-making process with regard to forest management and governance. There are a wealth of potential applications of the atlas, some of which are highlighted in Section 2.

For example, the atlas will support MINEF in identifying areas where logging has taken place and locating where questionable practices might be occurring. This information could assist MINEF in its planning for field monitoring and control missions. Training programs, for MINEF and other key users, on how to best use the atlas to support decision-making are underway through a Cameroonian GFW expert in GIS/RS. To ensure continued usefulness for such purposes, updated versions of the atlas will be prepared and distributed on a regular basis.

Via the MINEF and GFW websites, this *Interactive Forestry Atlas of Cameroon* will be accessible to all interested stakeholders. It will also support ongoing efforts of NGOs, donors, inter-governmental organizations, research institutes, and progressive companies towards improved forest governance and management. More specifically, the atlas and related products can provide strong support to many regional programs and processes, most notably the Africa Forest Law Enforcement and Governance

(AFLEG) process, execution of the Plan of Convergence of the Central Africa Forests Commission (COMIFAC), the Conference on Humid and Dense Forest Ecosystems of Central Africa (CEFDHAC), the efforts of the International Tropical Timber Organization (ITTO) and the Africa Timber Organization (ATO) to promote sustainable forest management, and the activities of the Congo Basin Forest Partnership (CBFP).

Moreover, the atlas could be used as a model tool for forest monitoring in other forested regions. GFW has provided leadership in the elaboration of a similar interactive atlas product in Russia, which is available on the GFW interactive map server ([www.globalforestwatch.org](http://www.globalforestwatch.org)).<sup>5</sup> Similar initiatives are underway in Canada and Alaska and are being developed in Republic of Congo and Indonesia. These atlases will also be available on the GFW website.

## 1.4 Atlas Overview

This interactive atlas brings together for the first time, in a user-friendly, accessible format, key datasets on forest governance and management in Cameroon. It encompasses data from various sources, including new data, older and/or updated data that had not previously been made publicly available, and pertinent previously released data. The major data layers included in the atlas are listed in Table 1, and the corresponding datasets and their sources are outlined in Appendix 1.

The atlas is organized according to several themes:

- The roads theme is based on a new dataset on logging roads, created specifically for this atlas through the interpretation of satellite imagery, which was incorporated with existing data on public roads. The integrated roads dataset was then overlaid within the other themes.
- Newly released data from MINEF, not previously made public in this format, are presented in five themes, including timber extraction zoning, year of title allocation, volume of wood harvested, status of management plan for specific Forest Management Units (FMU), and biodiversity protection and wildlife management zoning plan. (Key terminology related to logging titles in Cameroon is summarized in Box 1.)
- Previously released data are assembled in two themes — vegetation and basic map features (e.g., settlements, water bodies, etc.) — and are included to make the atlas a comprehensive source of currently available information on the forest sector in Cameroon.

### Box 1. Summary of Logging Titles in Cameroon

- **FMU – Forest Management Unit:** Created under the 1994 forest code, FMUs are forest management units zoned within the Permanent Forest Domain (i.e., forests that are zoned for biodiversity conservation and sustainable management). They are allocated by a competitive bidding process for a 15-year period and require a forest management plan approved by the relevant administrative authority. (The corresponding term in French for FMU is *Unité Forestière d'Aménagement* - UFA).
- **Forest Concessions:** Singly managed units, which may include one or more FMUs, not to exceed 200,000 hectares (ha).
- **SSV – Sales of Standing Volume:** SSVs are zoned within the Non-Permanent Forest Domain (i.e., communal, community, and private forests zoned for timber extraction, agricultural, mining, and other uses) or can also be allocated to nationals within the Permanent Forest Domain. SSVs are allocated by a competitive bidding process for a maximum of three years, are not to exceed 2,500 ha, and do not require a management plan. (The corresponding term in French for SSV is *Ventes de coupe* - VC).
- **Community Forests:** Established under the 1994 forest code, community forests are areas within the Non-Permanent Forest Domain zoned for use by village communities. With technical assistance from MINEF's Community Forestry Unit (*Cellule de Foresterie Communautaire* - CFC), a village community seeking a forest title identifies a zone not exceeding 5,000 ha and drafts a simple management plan for approval by MINEF. Proceeds from community forest management are used for community development projects.
- **Council Forests:** Areas zoned within the Permanent Forest Domain and managed according to an approved management plan. The objectives of the Council Forest, along with its final boundaries, are established during the official classification process. Once allocated, these forests become the private property of a council; however, the commune must abide by the management plan in order to retain title to the forest area.
- **Licenses (*Licences*):** Allocated prior to implementation of the 1994 forest code, Licenses were in effect a type of concession that did not include some of the more advanced forest management requirements (e.g. management plan) put in place by the 1994 code and supporting regulations. As of 1998, all of these Licenses had expired.

**Sources:** Bikié, H., J. G. Collomb, L. Djomo, S. Minnemeyer, R. Ngoufo, and S. Nguiffo. 2000. An Overview of Logging in Cameroon. Global Forest Watch / World Resources Institute. Washington DC.; Law 94/01 of January 20, 1994; and Decree 94/436 of August 23, 1994.

Table 1. Atlas Themes and Contents		
Heading	Data Layers	Scale
Roads	<ul style="list-style-type: none"> <li>Public roads</li> <li>Logging roads (for logging seasons 1999–2000, 2000–2001, 2001–2002, and 2002–2003) — characterized by date of origin, type, and use intensity</li> </ul>	1:200,000 1:200,000
Zoning plan - Timber extraction*	<ul style="list-style-type: none"> <li>Forest Management Unit (FMU) <ul style="list-style-type: none"> <li>– allocation status</li> <li>– year of permit allocation</li> <li>– annual volume harvested (m<sup>3</sup>)</li> <li>– management plan status</li> <li>– classification status</li> </ul> </li> <li>Sales of Standing Volume (SSV) <ul style="list-style-type: none"> <li>– allocation status</li> <li>– year of permit allocation</li> <li>– annual volume harvested (m<sup>3</sup>)</li> </ul> </li> <li>License (historical concessions)</li> <li>Community forests</li> <li>Council forests</li> </ul>	1:200,000 1:200,000 1:200,000 1:200,000 1:200,000 1:200,000 1:200,000 1:1,000,000 1:200,000 1:200,000
Zoning plan - Biodiversity protection and wildlife management	<ul style="list-style-type: none"> <li>Protected Areas</li> <li>Areas for Managed Hunting</li> </ul>	1:200,000 1:200,000
Vegetation	<ul style="list-style-type: none"> <li>Forest stratification - MINEF vegetation type classification</li> <li>Global Land Cover 2000 Database</li> </ul>	1:200,000 1:1,000,000
Basic map features	<ul style="list-style-type: none"> <li>Settlements (national, provincial, and district capitals, and villages)</li> <li>Map pages — demographic grids</li> <li>Administrative boundaries</li> <li>Water bodies (coastline, national, regional, and detailed rivers, and other water surfaces)</li> </ul>	1:200,000 1:200,000 1:200,000 1:200,000
*Refer to Box 1 for further description of terms used		

## 1.5 Overall Methodology and Baseline Validation of Boundaries

As stipulated in the MINEF-GFW MOU, MINEF provided GFW with officially approved documents, information, and statistics on the management and use of forest resources in Cameroon, including information on boundaries, allocation and classification status, and management status, as well as annual wood production statistics for the various forest territories.<sup>6</sup> GFW and its local partners, Cameroon Environmental Watch (CEW) and Limbe Botanical and Zoological Garden (LBZG, a Technical Operational Unit under MINEF), provided technical support to MINEF by creating new datasets (e.g., on roads), updating existing spatial data, and integrating datasets to produce map-based tools, such as this atlas.

To operationalize the agreement between MINEF and GFW, a steering committee was established to identify specific activities and corresponding leads, and develop a workplan.<sup>7</sup> To build the GIS database, GFW in collaboration with MINEF developed the database structure, defined its content, and harmonized the codes with SIGIF to simplify integration of datasets. GFW systematically reviewed the existing spatial data provided by MINEF to ensure that it followed pre-defined standards.<sup>8</sup> CEW digitized the boundaries of newly attributed timber extraction areas as described on the final public notice documents (*avis au public*) or classification decrees (for FMUs), where applicable.<sup>9</sup> All the boundaries were digitized with reference to National Institute of Cartography's

(INC) topographic maps (see Appendix 1 for full references to the datasets utilized). LBZG digitized the road network using satellite imagery and following the procedures developed by GFW and summarized in Section 2.1.<sup>10</sup> GFW assembled these datasets and systematically reviewed, verified, and made corrections where necessary, to ensure agreement with public/legal documents and topographic base maps prior to integration into the GIS database for the atlas.

Validation of the GIS database required input from multiple partners, including MINEF, logging companies, bilateral and multilateral agencies, and NGOs. GFW, its partners, and the technical staff of MINEF held working sessions during which criteria were elaborated for incorporating forest territory boundaries into the GIS and for modifications to these boundaries as needed.

For example, in the case of FMU boundaries, if the boundaries of different exploitation areas were found to overlap, then the boundary specified by the more advanced stage of the classification process was given priority. If the overlapping boundaries emerged from the same stage of the classification process, then the boundary with the earlier date of allocation is given priority. For any other overlaps, MINEF resolved the discrepancy on a case-by-case basis. Particular attention was paid to validating that the boundaries for timber extraction areas depicted in this atlas were the best available and where possible were based on the finalized classification decrees as of August 2004. Thus, the MINEF-GFW collaboration ensured that this atlas presents the most up-to-date, revised, and verified information on boundaries.

## 1.6 Scope and Limitations

Following the previously described protocol, this atlas includes all the up-to-date boundary and attribute information released by MINEF. This version of the atlas focuses on the roads dataset, timber extraction areas (specifically FMUs, SSVs, and Community Forests), and related attribute information. The information on protected areas and wildlife management areas is based on the best data available from GFW partners at the time of publication. However, incorporating additional attribute information and further boundary refinements will significantly improve this theme in subsequent versions of the atlas.

While this atlas reflects the latest forest-sector data that could be located, created, and/or provided by MINEF, it does have certain limitations. For example, the datasets included in this atlas are based on official 1:200,000 topographic maps, which themselves are dated and known to contain certain inaccuracies, thus significantly limiting the spatial accuracy of these datasets. Therefore the atlas should be considered a work in progress, which will evolve and improve with periodic updates and/or expansion of the scope of data.

Consequently, evidence drawn from this atlas should not be considered sufficient for a final judgment on the legality or illegality of activities detected in specific forest areas. For example, overlaying datasets on logging area boundaries with the roads dataset can help identify irregular activities occurring in specific locations; however, further field investigation by MINEF would be needed to properly determine whether any irregular activity was indeed illegal.



## 2 ATLAS THEMES

This section provides a detailed description of each of the themes composing the atlas. It includes summary data tables and examples illustrating potential uses of the atlas as a decision-support tool for targeted groups of users. Particular attention is given to the overlay of the newly created roads dataset with datasets composing other atlas themes (e.g., timber extraction, biodiversity conservation and wildlife management, etc.).

### 2.1 Roads

The existence and location of logging roads is important evidence of the extent of historic and current industrial logging activities. Satellite imagery can be used relatively easily and effectively to identify logging roads and infrastructure, and thus facilitate the monitoring of industrial forest activities.<sup>11</sup>

For this atlas, GFW partner LBZG created a roads dataset. This dataset can support monitoring of compliance of with forest laws, specifically concerning the geographic location of forest exploitation, when combined with other datasets on forest management.<sup>12</sup>

#### Data Sources and Methods

The roads dataset includes information on the date of origin, road type, and intensity of use for each road by logging season on an annual basis from 1999 to 2003.<sup>13</sup> Using satellite imagery from

Landsat 7 Enhanced Thematic Mapper (ETM+), LBZG mapped roads throughout the forested zone of Cameroon (see Map 1 for an example). Satellite images were enhanced to improve the visibility of older, fainter, and more infrequently used logging roads (see details in Box 2).

Road type could not be identified from satellite imagery alone. Instead, road type was assigned by overlaying the digitized road data on georeferenced 1:200,000 topographic maps produced by the National Institute of Cartography of Cameroon. This allowed the identification of national, provincial, and departmental roads as well as most airstrips.

Logging roads were primarily identified by their presence within the boundaries of FMUs or SSVs, combined with their distinctive appearance on satellite images (i.e., a network of many small roads in a forested area as distinguished from single roads connecting settlements or other roads). However, some roads that appear to be logging roads were detected outside the boundaries of valid permit areas. In this atlas, the term “forest road” is used to denote such possible logging roads located outside valid permit areas.

To validate the spatial accuracy of the roads dataset created for this atlas and confirm the identification of road types, GFW and partners drove and tracked a sample (seven percent) of the mapped roads using a GPS. Comparison of field-tracked roads with those mapped from satellite imagery determined the average accuracy to be plus or minus 41.7 meters.

The resulting roads dataset includes over 40,000 kilometers (km) of roads. Of these, about 10,000 km are primary or secondary logging roads located inside valid logging areas (see Table 2 for details). Nearly 2,000 km are roads in forest areas outside the boundaries of known valid logging titles.<sup>14</sup>

(For a more detailed treatment of the methodology used to create and validate the roads dataset, please refer to the technical report.)

#### Useful Applications and Recommendations

- *Prioritize field monitoring missions.* The roads dataset developed for this atlas could help MINEF determine whether logging roads are located within legally attributed logging areas and/or in compliance with approved management plans. Field monitoring is a costly but critically important exercise. Given the limited budget at MINEF’s disposal for this purpose, use of this roads dataset could provide valuable guidance as to where to spend limited field time. For instance, this atlas identifies about 1,900 km of active forest roads outside known authorized logging areas (see Table 2). MINEF could consider conducting field checks on some or all of these roads to determine whether they were used for logging purposes and if this logging was legal or not. Similarly, MINEF could consider monitoring priority areas within the more than 6,600 km of abandoned logging roads identified in this atlas, to ensure that these roads are not being used for poaching and other illegal activities

## Box 2. The Roads Dataset: Methodological Details, including Specifications and Limitations of Landsat 7 ETM+ Imagery

To create the roads dataset used in this atlas, a total of 46 medium- to high-resolution (28.5 m) orthorectified Landsat 7 (ETM+) satellite images were used. A list of these images, along with a map of the available Landsat images for the Forest Zone of Cameroon, is presented in Appendix 2.

Landsat imagery has been the most desirable platform to date for digitizing logging roads. It is relatively inexpensive, of medium to high resolution, and free of copyright constraints, allowing imagery to be shared among organizations. Landsat ETM+ satellite imagery has a spatial resolution of 28.5 meters per pixel (bands 1-5 and 7) and 14.5 meters per pixel (panchromatic band) and a view range of 183 km x 170 km.

Bands were selectively combined to form color composite images to enhance the contrast between vegetation and bare ground, making the roads more visible. Different band combinations were used to maximize the visibility of roads under a range of conditions and ages; the prominent band combinations used included 7-5-3, 7-5-4, and 5-4-3. To

improve the detection of narrow roads, the panchromatic band (14.5 m resolution) was merged with the other bands (28.5 m resolution) to create a “pan-sharpened” image. This image enhancement especially improved the visibility of older, fainter, and more infrequently used logging roads.

Unfortunately, the Landsat satellite’s scan line corrector (SLC) malfunctioned in May 2003, creating data gaps. SLC-off Landsat images are being made available, but these images have been corrected using previously captured data, rendering them unsuitable for detecting and monitoring roads over time. Since this malfunction, the scientific community has been searching for a replacement. Other types of imagery, including ASTER and the IRS (Indian Remote Sensing) satellite, are being investigated as possible alternatives. High-resolution imagery, such as IKONOS or Quickbird, can be useful tools for verifying datasets derived from Landsat TM 7 (or other medium- to high-resolution imagery), but the high cost of this imagery is a limiting factor.

that could degrade forest ecosystems. Since MINEF can realistically conduct field checks on only a portion of these thousands of km of roads, the use of this dataset to determine priorities in the field should prove valuable.

- *Identify roads critical to remote rural communities.* This dataset could also provide needed information to support MINEF in

working with the Ministry of Public Works, local councils, and members of parliament to identify roads critical to travel and market access for remote rural communities.

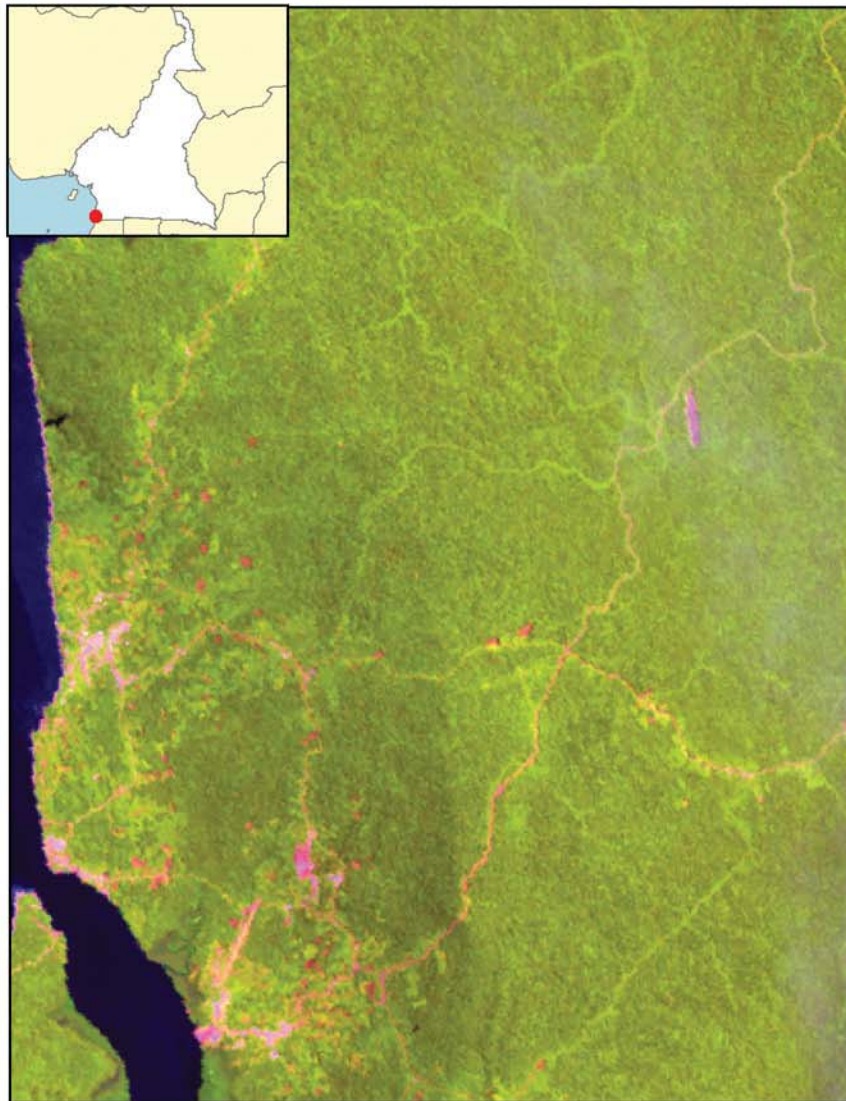
- *Assist development planning.* The roads dataset could also be of interest to government ministries charged with development planning functions (e.g., Ministries of Transport, Trade

**Table 2. Road Categories and the Total Number of Roads Digitized (1999–2003)**

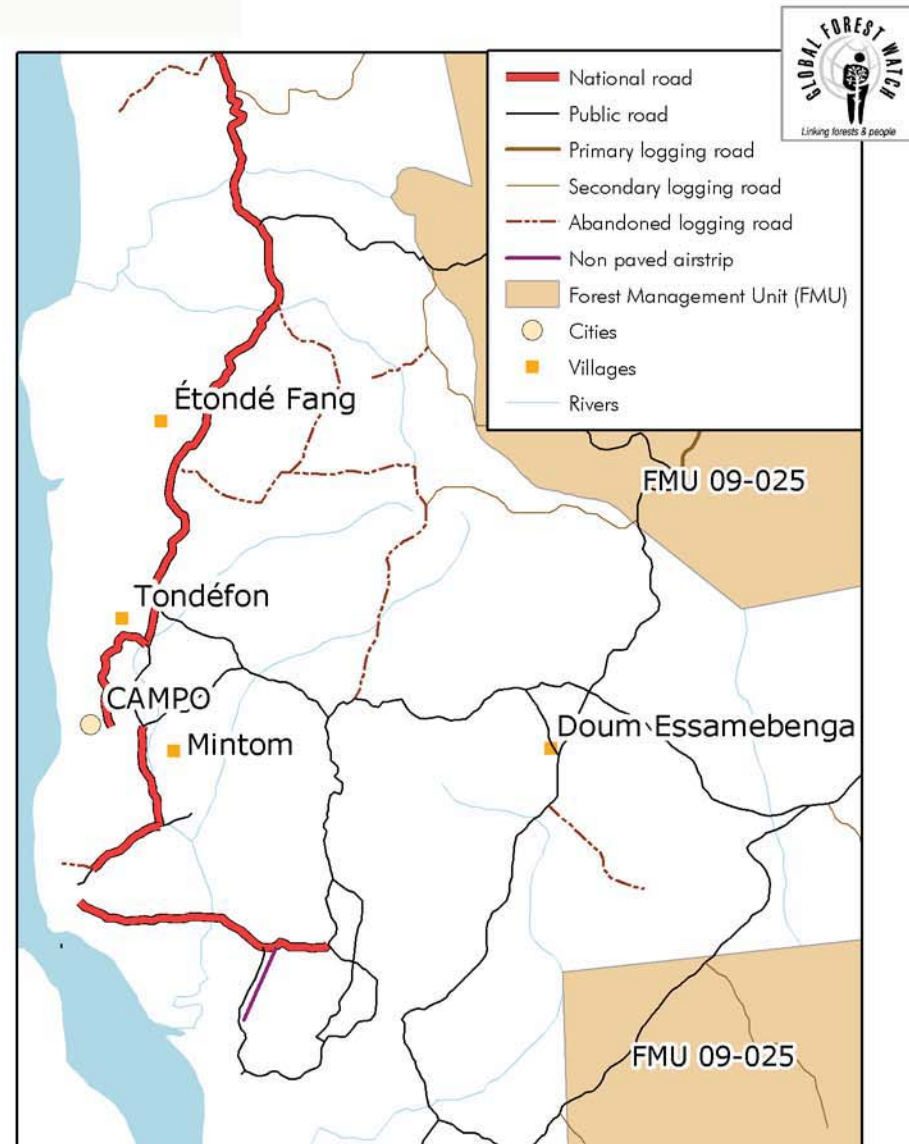
Explanation	Length (km)
National roads	4,437
Provincial roads	2,355
Divisional roads	1,753
Other public roads	14,265
Railways	486
Plantation roads	491
Primary logging roads (within FMUs)	2,278
Secondary logging roads (within any legally attributed logging area)	8,052
Abandoned logging roads (in old Licenses)	5,234
Abandoned forest roads (outside old Licenses)	1,419
Forest roads (active roads outside valid FMU and SSV)*	1,901
Paved airstrips	16
Airstrips	41
<b>TOTAL</b>	<b>42,728</b>

\*Forest roads are of unknown origin and are outside known valid logging areas. They may include roads inside unallocated FMUs, roads inside valid logging areas for which boundaries were not available (SSVs, community forests, or council forests for which data are incomplete), or roads associated with villages. In most cases, additional information is required to determine whether these roads are of legal origin.

## Map 1. Comparison of Satellite Imagery with Atlas Map Features



a. View of Landsat image used for road interpretation (Campo region, Southern Province).



b. View of corresponding roads digitized from Landsat imagery, with atlas data, including FMU concessions.

& Industrial Development, Economic Affairs, Planning, & Territorial Development, Public Works, Agriculture, etc.).

- *Advance understanding of the ecological and social impacts of forest exploitation.* Another possible use of the atlas and the roads dataset developed for it is to further ecologists' understanding of the dynamics and impact of forest exploitation on forest ecosystems. Social scientists could also use the roads dataset to gain insight on the relationship between human wellbeing and forest exploitation.
- *Minimize costs and environmental impacts of new road construction.* Private-sector forest operators could use this atlas to identify ways to benefit from existing road infrastructure depicted in the roads dataset. Such uses of the atlas would help limit infrastructure costs and minimize the environmental impacts of road construction.

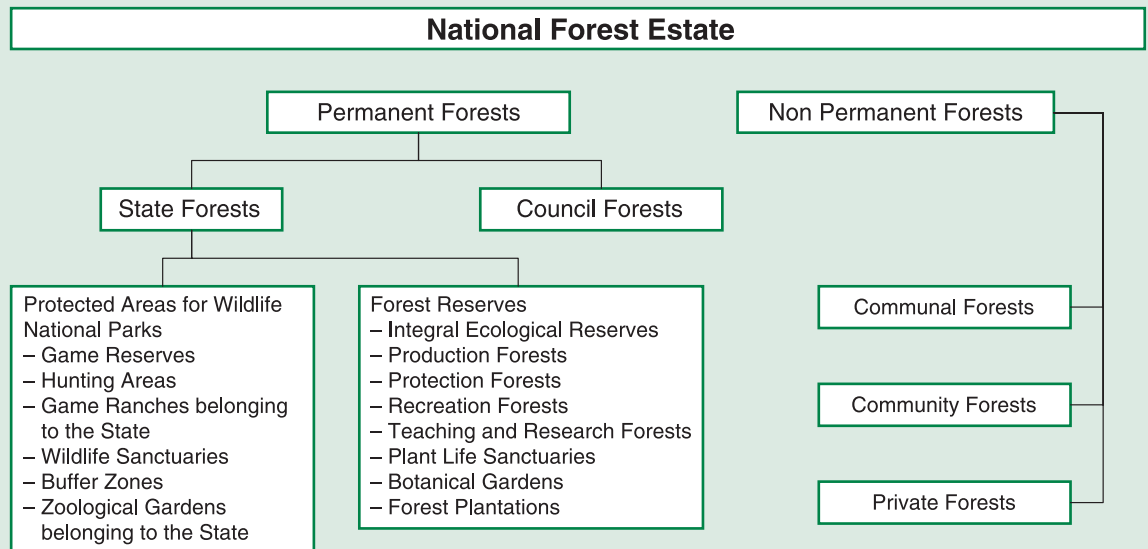
## 2.2 Timber Extraction Areas

### Timber Extraction Zoning

This theme focuses on Cameroon's system of forest zoning, particularly as it relates to logging titles. Following adoption of the forest code of 1994, MINEF began to authorize new types of titles for timber extraction activities and phased out the previously utilized system of Licenses.<sup>15</sup> The architecture of the forest zoning system in Cameroon, including a summary of classification procedures for the national forest estate of Cameroon, is described in Box 3.

### Box 3. Forest Zoning and FMU Classification in Cameroon

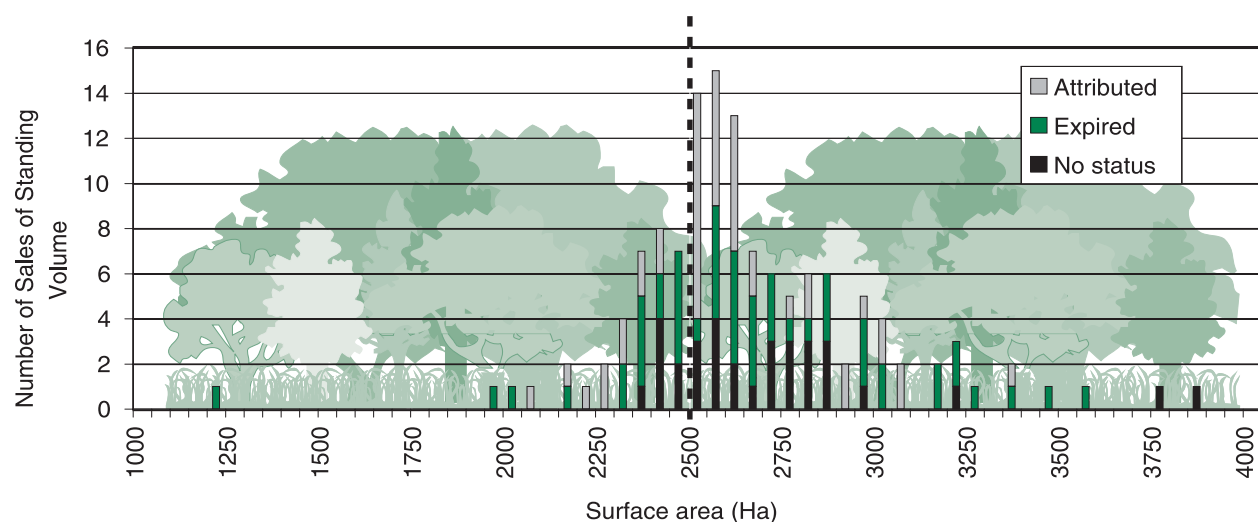
The diagram below describes the architecture of the forest zoning system in Cameroon as articulated in the forest code, developed by Tecsuit Inc., and utilized in this atlas. Article 22 of the forest code requires that the Permanent Domain cover at least 30 percent of the national territory, represent ecological diversity, and be managed sustainably according to management plans approved by the relevant administrative authority. The Non-Permanent Domain—including the Communal, Community Forests, and Private Forests—is zoned for other purposes/uses.



FMUs are allocated by public auction and under a selection process summarized in Box 4. Prior to the auction, public notices (*avis au public*) are issued to invite offers. These notices include, among other details, the initial boundary and area descriptions. The classification process should be completed prior to allocation; however, that is not normally the case. For most FMUs, after allocation the classification process begins, during which MINEF provides the technical information necessary for a commission directed by the Prime Minister (*Première Ministre*) to make the final classification decision. This decision may result in final FMU boundaries that differ from the public notice (*avis au public*).

**Source:** Forest Code 94/01 of January 20, 1994.

**Figure 1. Surface Area Distribution of SSVs Allocated Since 1999\***



\* The dotted line indicates the maximum allowable size of SSVs, as specified by the 1994 forest code.

Of particular interest for this theme are the FMUs contained within Cameroon's Permanent Forest Domain (see Box 3) and the SSVs and Community Forests zoned within the Non-Permanent Domain. This atlas includes all of the most recent information released by MINEF on forest territory attributes and boundaries.<sup>16</sup>

However, in some cases, data were incomplete or missing altogether, including data on 179 SSVs (out of a total of 311) and 12 allocated Community Forests (out of a total of 67).<sup>17</sup> Likewise, data on several important logging zones were not yet available for this edition of the atlas, including the 5-year operational blocks (*blocs quinquennaux*) and their annual allowable-cut areas (*Assiette Annuelle de Coupe - AAC*).<sup>18</sup>

FMUs, protected areas, SSVs, and Community Forests are the most important forest titles allocated in the southern forested zone of Cameroon (see Map 2). Map 3 displays a zoomed-in view of this same area, in which logging roads are clearly visible.

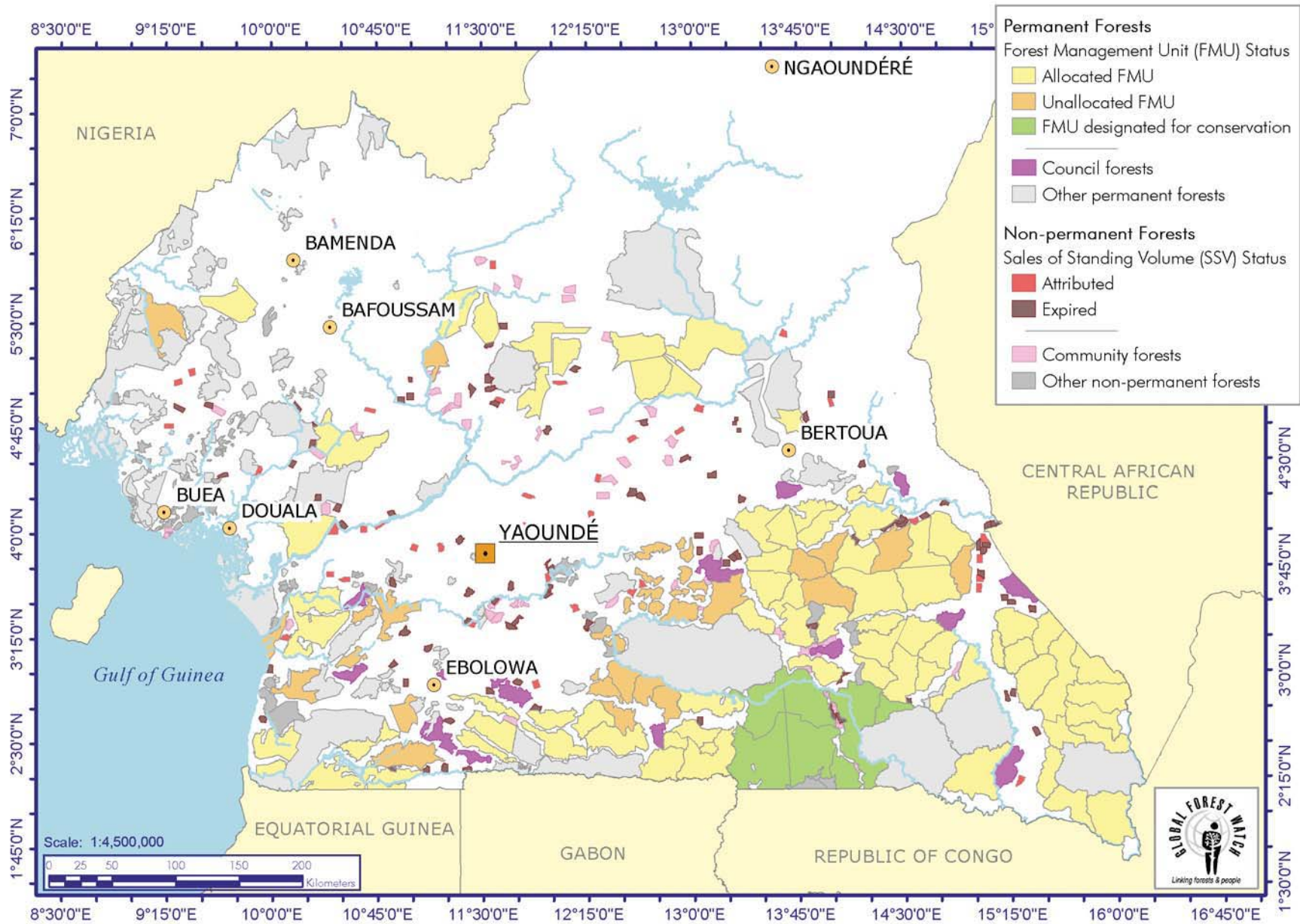
Table 3 presents information on the number and total surface area of various types of forest zones with the national forest estate of Cameroon. FMUs account for approximately 7 million ha, or about half of the land area within the Permanent Domain, with another 3.8 million ha (about one third of total land area) contained in protected areas. Active FMUs cover more than eight times as much surface area as SSVs and Community Forests combined. Note that the

statistics presented in Table 3 indicate that the total land area of the Permanent Domain (12.7 million ha) makes up 27 percent of the national territory of Cameroon (46.9 million ha), which is less than the 30 percent minimum required by the 1994 forest code.<sup>19</sup>

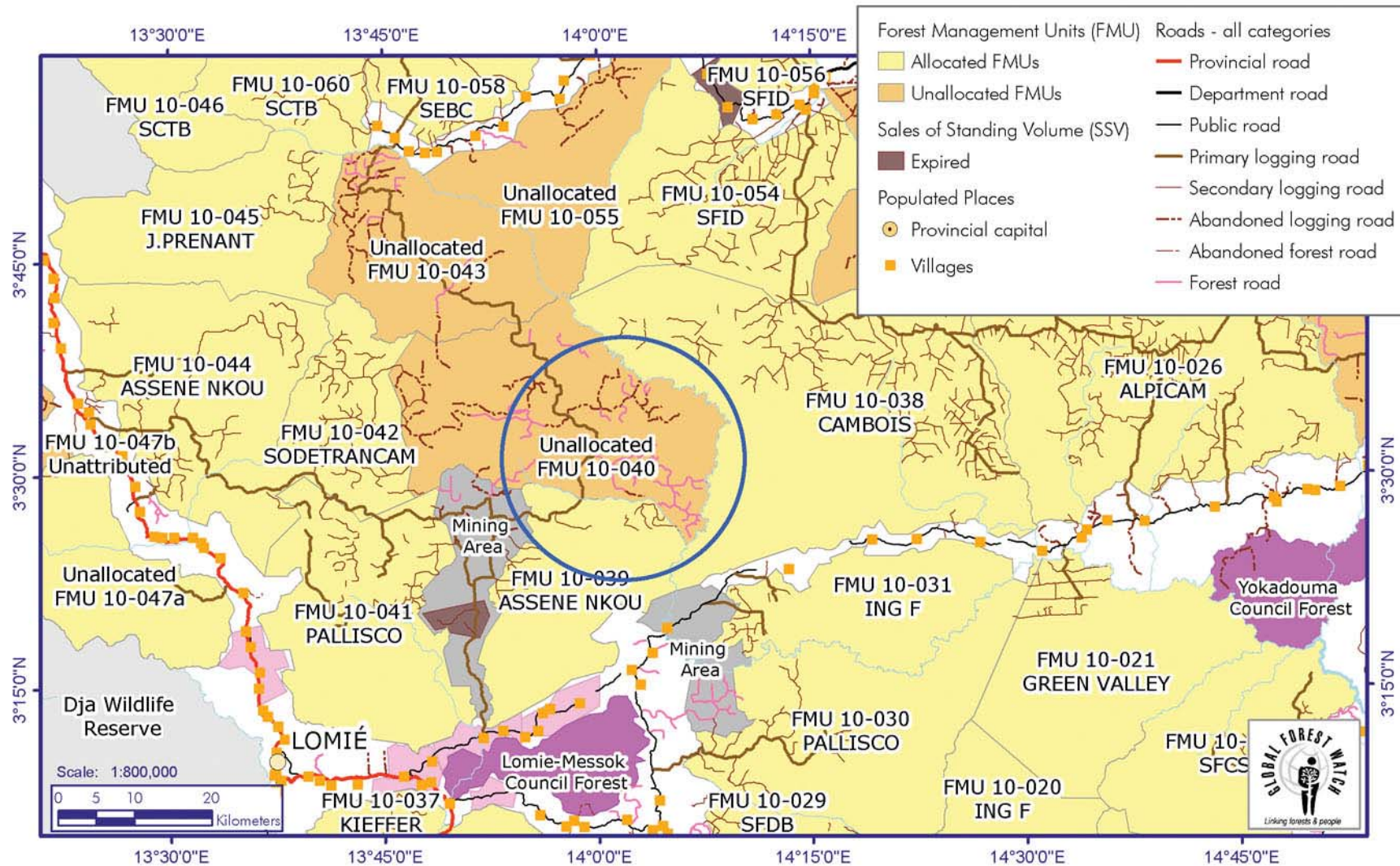
Figure 1 depicts the size distribution of SSVs allocated since 1999. Note that the surface area of a significant number of SSVs surpasses the legal maximum of 2,500 ha.<sup>20</sup>

Table 4 presents information on logging concessionaires by total land area held. These statistics indicate a high degree of consolidation in the forest industry sector of Cameroon. In 2003, nine groups of concession holders (multinational corporations) collectively held more than 60 percent of active FMUs by land area. Thus, it may be possible to achieve significant improvements in the management of the forest territory of Cameroon by engaging these key groups.<sup>21</sup>

## Map 2. Status of Logging Concessions



### Map 3: Roads Visible at Finer Map Scales (Abong Mbang Area)



Interactive atlas users may zoom into areas of interest or use preset bookmarks based on the national 1:200,000 topographic maps. This view of the Abong Mbang area shows concession status (see Map 2 for an overview) and roads digitized from Landsat imagery (described in Section 2.1). Primary and secondary logging roads are visible inside concessions; abandoned logging roads are shown with a dashed line. Note the forest roads designation (pink) for roads outside valid logging concessions. FMU 10-040, which is unallocated, contains many roads (circled in blue) that were built outside permitted areas. Much of this area was previously allocated within License 1812 (which expired in 1998); however, new roads were identified in 2003.

<b>Table 3. Summary of Forest Management Zones (2004)</b>			
<b>Domain</b>	<b>Category</b>	<b>Number</b>	<b>Area (ha) <sup>(1)</sup></b>
<b>Permanent</b>	<b>Forest Resources</b>		
	• Allocated FMU	72	4,946,900
	• Unallocated FMU	24	1,147,800
	• FMU for Conservation	9	867,000
	• Other Production Forest (not FMU)	30	632,400
	• Other Forest Reserves <sup>(2)</sup>	57	920,000
	<b>Protected Areas – Wildlife <sup>(3)</sup></b>		
	• National Parks	17	2,910,382
	• Wildlife Reserves	6	738,995
	• Wildlife Sanctuaries	4	246,368
	• Zoological Gardens	3	6.7
	• Hunting zones	57	<sup>(4)</sup>
	• Other Protected Area		<sup>(5)</sup>
	<b>Council Forest</b>	13	325,500
<b>Total <sup>(6)</sup></b>		12,735,400	
<b>Non Permanent</b>	Communal Forest (SSV etc.)	132	345,300
	Community Forest <sup>(7)</sup>	67	241,466
	Private Forest		<sup>(8)</sup>

<sup>(1)</sup> Unless otherwise indicated, surface areas were rounded to the nearest 100 ha.  
<sup>(2)</sup> Integral Ecological Reserves, Protection Forest, Recreation Forest, Teaching and Research Forest, Plant Life Sanctuaries, Botanical Gardens and Forest Plantations.  
<sup>(3)</sup> These data are from DFAP (2004).  
<sup>(4)</sup> Some ZIC/ZICGC zones overlap with other management zones, thus giving statistics for their area may be misleading.  
<sup>(5)</sup> "Other protected areas" include State owned game-ranches and buffer zones; however surface area statistics were not available.  
<sup>(6)</sup> The total Permanent Forest Domain surface area presented here is a combination of GIS data from the atlas and other MINEF data and therefore should only be considered as an estimate based on the best available data.  
<sup>(7)</sup> These data are from the Community Forestry Unit (CFC).  
<sup>(8)</sup> No data were available.

### Useful Applications and Recommendations

- *Resolve conflicts over boundaries.* Many stakeholder disputes continue to result from a lack of clarity in the actual boundaries of various forest titles. The information contained in this atlas concerning the boundaries of specific forest-use zones (e.g., FMUs, SSVs, Community Forests, protected areas, etc.) could help resolve potential conflicts over the boundaries of timber exploitation, mineral extraction, biodiversity conservation, and agro-industrial land uses. Via the MINEF-GFW collaboration, this atlas presents the most up-to-date, revised, and verified timber extraction area boundaries as of May 2004, which in certain cases were found to be overlapping.<sup>22</sup> The atlas provides an objective reference and decision-support tool that could be valuable for informing participatory boundary-negotiation processes involving all relevant stakeholders prior to the classification and gazettelement of the different land use zones.
- *Enhance the usefulness of future versions of this atlas.* The atlas's future utility for helping to resolve conflicts over forest-zone boundaries depends on its regular updating and proven accuracy. MINEF could continue to make data publicly available according to the MOU for the MINEF-GFW collaboration—specifically, information on AAC and 5-year parcels, as well as more complete information on Community Forest boundaries and attributes. These missing data would greatly strengthen the utility of the next edition of the atlas and ensure its value



**Table 4. Largest Holders of Logging Concessions by Surface Area (2004)**

Group (Concession Holder) <sup>(1)</sup>	Nationality	Area (ha) <sup>(2)</sup>	Percentage of Total Area <sup>(3)</sup>	Number of FMUs
THANRY/VICWOOD (CIBC, CFC, SAB, SEBC, J.Prenant, Kieffer) <sup>(4)</sup>	China / Cameroon	663,300	13	10
ROUGIER (Lorema, SFID, SOCIB, Cambois)	France	474,200	10	7
SEFAC (Filière Bois, SEFAC)	Italy	411,900	8	5
KHOURY (EFMK, SABM, SN COCAM, RC CORON)	Lebanon / Cameroon	338,100	7	5
ALPI (ALPICAM, STBK, GRUMCAM)	Italy	305,000	6	3
PASQUET (Pallisco, Assene Nkou, Sodetrancam)	France / Cameroon	301,400	6	5
WIJMA (Wijma, CFK)	Netherlands / Cameroon	242,000	5	4
BOLLORE (SIBAF, Bubinga) <sup>(5)</sup>	France	209,500	4	3
PATRICE BOIS (COFA, SFF)	Italy / France / Cameroon	206,900	4	3
OTHERS <sup>(6)</sup>		1,794,600	36	27
TOTAL		4,946,900	100%	72

<sup>(1)</sup> According to MINEF officials, most of these Groups have no legal status and therefore the statistics presented in Table 4 should not be taken to indicate a discrepancy with the maximum surface area (200,000 ha) allocated to a particular private forest operator, as specified by the forest code (article 49 - 1, 2).

<sup>(2)</sup> Surface areas are based on GIS statistics, and were rounded to the nearest 100 ha. These statistics could therefore be significantly different than the official surface areas.

<sup>(3)</sup> Due to rounding, percentages do not add to 100.

<sup>(4)</sup> Propalm-Bois (124,500 ha) belonged to THANRY/VICWOOD in 2002–2003, but was transferred in 2004 to TRC.

<sup>(5)</sup> HFC (Forestière de Campo) (163,500 ha) belonged to BOLLORE in 2002–2003. It was recently divided and transferred to SCEB and WIJMA.

<sup>(6)</sup> “Others” correspond to groups whose concessionaires hold less than a total of 200,000 ha.

as a tool for discussion and resolution of conflicts.<sup>23</sup>

- *Investigate irregularities.* Map-based tools concerning forest-zone boundaries could help direct attention to irregularities that might merit further investigation by MINEF. For instance, MINEF could investigate situations, such as that identified in Map 3, to uncover the cause of road construction outside an authorized logging area and identify solutions to prevent such activities in the future. Likewise, MINEF could clarify why a significant number of SSVs surpass the maximum area permitted under the forest code.
- *Support planning for protected areas.* The information contained in this atlas theme could also be of interest to the Department of Wildlife and Protected Areas (DFAP), research institutes, and biodiversity conservation NGOs to support planning and management of wildlife habitat as well as design of corridors within the larger landscape of production forests.
- *Inform the application process for new logging titles.* With its integrated historic logging information drawn from multiple sources, this dataset on forest-zone boundaries could inform forest companies seeking newly advertised forest exploitation titles (FMUs, SSVs, etc.). Moreover, communities seeking to establish and exploit Community Forests could use this particular dataset to identify areas within the Non-Permanent Domain that are free of current legal title,

thus minimizing the confusion that has plagued this process in the past.<sup>24</sup> The Community Forest Unit within MINEF could use this dataset to provide guidance to interested parties in accordance with their mandate to provide free assistance to interested communities (Article 37-1 of the forest code).

### **Year of Title Allocation**

This theme highlights a specific attribute—the year in which forest titles (FMUs, SSVs) were allocated. Box 4 provides a synopsis of the allocation process in Cameroon. The atlas contains data on the allocation of FMUs and SSVs since 1996 (see Table 5 for a summary of yearly allocations). (For further information on the availability of data, refer to the Timber Extraction Zoning in Section 2.2.)

Maps created by overlaying this dataset on the year of title allocation with the roads dataset can provide information on questionable forest activities in specific forest areas. For instance, Map 4 reveals an extensive network of recent, intensively used roads within a currently unallocated FMU.

Although the forest code (Article 55-1) requires that SSVs remain open for exploitation for a maximum of three years, 32 of the 132 SSVs listed in Table 5 are known to have been allocated more than three years ago, that is in 1999 (6) or 2000 (26). Of these 32 SSVs, only 28 are listed expired, leaving four SSVs that might be operating beyond the allowed period.

(Map 6, discussed in the Annual Wood Volume Production section below, incorporates information on the year of title allocation to analyze trends in wood production.)

### **Useful Applications and Recommendations:**

- *Prioritize field monitoring missions.* MINEF and its Central Control Unit (*Unité Centrale de Contrôle - UCC*) can use this atlas to prioritize their field monitoring and control missions, specifically in areas such as those identified in Maps 3 and 4 as well as other such areas with potentially questionable activities. Moreover, this dataset together with logging roads data can be used to monitor and control compliance with the management plan elaboration requirements.
- *Identify SSVs remaining open for exploitation in violation of Article 55-1 of the forest code.* In order to monitor compliance with the forest code (Article 55-1), MINEF could also verify and take appropriate action concerning SSVs that may still be active beyond the legally mandated maximum of three years.

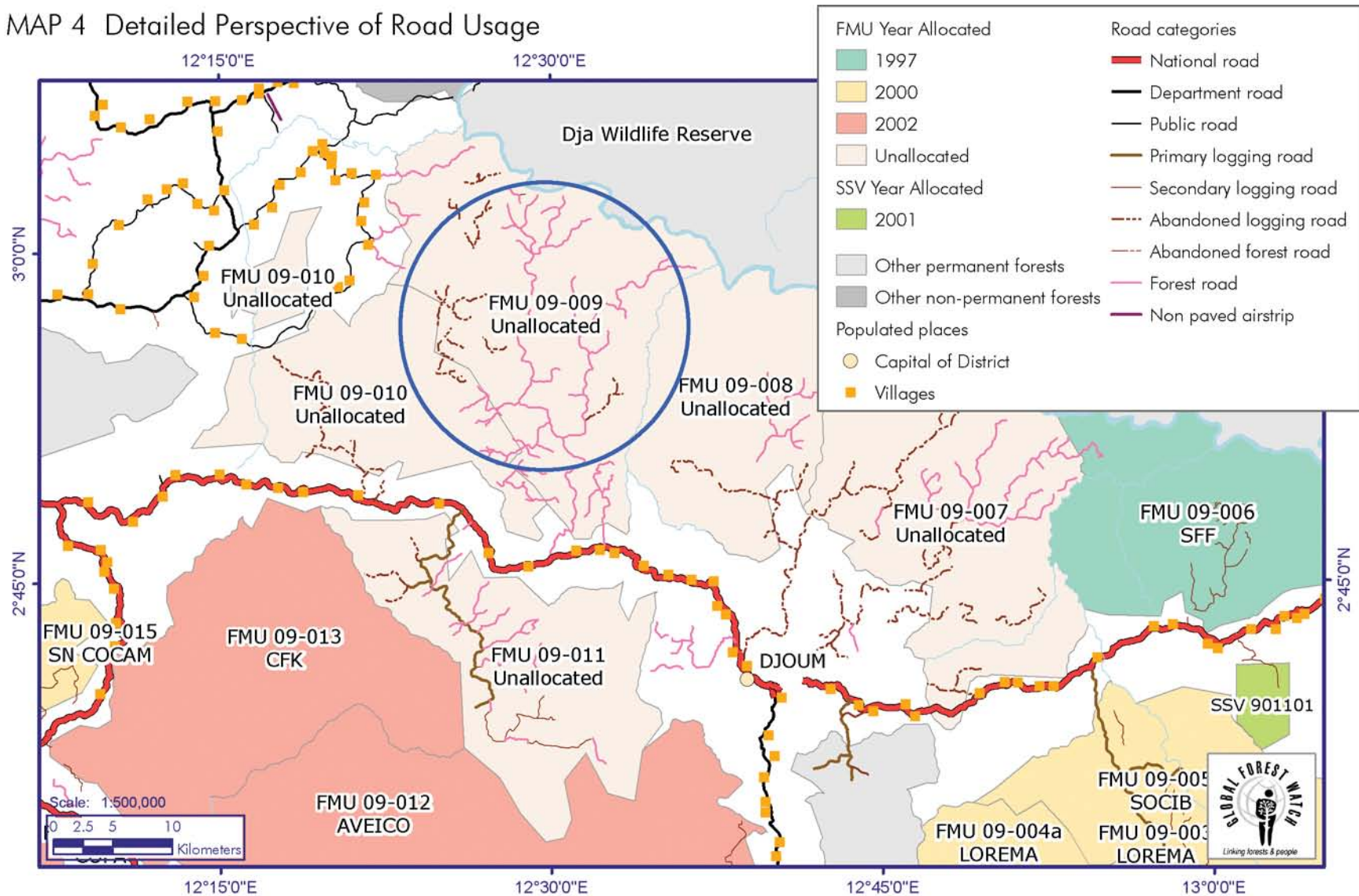
### **Box 4. Logging Permit Allocation Process in Cameroon**

The allocation of SSVs and FMUs is determined by a governmental body called the Inter-Ministerial Commission for Forest Concession Allocation (*Commission interministerielle d'attribution des concessions forestières*). It includes representatives from different ministries (e.g., MINEF, Economy and Finance), specific departments of MINEF, unions, experts called on an individual basis, and an independent observer. The selection criteria and procedures are ruled by an order (*Arrêté*) that is circulated whenever the annual allocations occur (i.e., 0293/MINEF dated March 21, 2000). These criteria considered the following: investments, financial capacity, technical capacity, and respect for both prior commitments and the environmental legislation. A technical score and a financial score were given. The financial score was calculated by the following formula: financial bid x 100 / highest financial bid offered for that particular FMU or SSV.

Updated excerpt from: Collomb, J.G. & H. Bikie. 2001. 1999 - 2000 Allocation of Logging Permits in Cameroon: Fine-Tuning Central Africa's First Auction System. Global Forest Watch-Cameroon.

## Map 4. Detailed Perspective of Road Usage

MAP 4 Detailed Perspective of Road Usage



This view provides a detailed perspective of road usage, a proxy for logging activity, compared with the year of forest title allocation. Note that FMUs 09-009 and 09-010 (circled in blue) are listed as unallocated. However, it is clear that there is an extensive network of recently constructed forest roads (most observed in the 2000-01 and 2001-02 seasons) throughout these FMUs and approaching the Dja Wildlife Reserve. Much of this area was previously allocated within Licenses 1579 and 1791 (which expired in 1998); however, new roads were identified in 2003.

**Table 5. Distribution of FMU and SSV Allocations by Year (1996–2004)**

Zoning Type	Year	Number (expired) <sup>(1)</sup>	Area (ha) <sup>(2)</sup>	Percentage of Total Area
FMU	2002	7	432,300	6
	2001	15	968,600	13
	2000	23	1,704,600	23
	1997	20	1,428,100	20
	1996	7	413,400	6
	Unallocated	33	2,014,800	28
	TOTAL	105	6,961,800	96
SSV	2004	39 (0)	100,100	1
	2002	1 (0)	2,500	<sup>(3)</sup>
	2001	32 (25)	79,600	1
	2000	26 (25)	67,700	1
	1999	6 (3)	15,900	<sup>(3)</sup>
	Unknown <sup>(4)</sup>	28 (1)	79,500	1
	TOTAL <sup>(5)</sup>	132	345,300	4

<sup>(1)</sup> SSV figures in parentheses indicate the number of SSVs expired in a given year.  
<sup>(2)</sup> Surface areas were rounded to the nearest 100 ha.  
<sup>(3)</sup> Less than 0.5%.  
<sup>(4)</sup> Refers to SSVs for which information on the year of allocation is not available.  
<sup>(5)</sup> Refers to the SSVs included in this atlas.

### FMU Management Status

This theme highlights the current status of the management plan process (drafting, submission, and approval) for each allocated FMU. (The management plan process, as stipulated in the forest code and supporting decrees, is summarized in Box 5.)

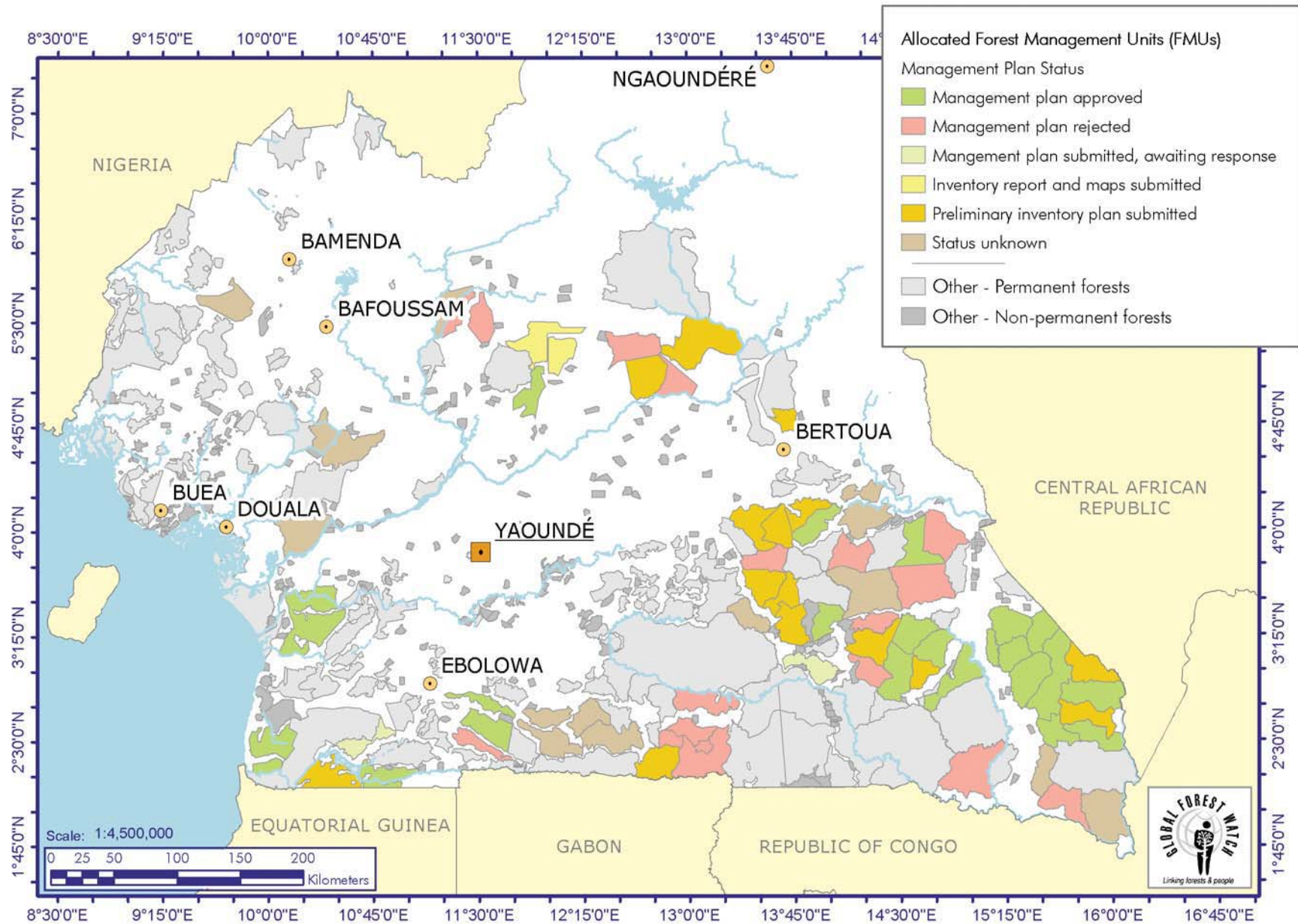
Map 5 displays the forest management status of FMUs as of May 14, 2004, with related data summarized numerically in Table 6. About one third (15 of 49, or 31 percent) of FMUs allocated in or before 2000 has an approved management plan.<sup>25</sup>

Therefore, the majority of active FMUs continue to be managed under the provisions of the temporary agreement (*convention provisoire*).

### Useful Applications and Recommendations

- *Provide an overview of the management status of allocated logging areas.* Information on the management status of allocated logging areas is often difficult to find and/or interpret. The map-based information provided in this atlas is likely to be of interest to MINEF, members of parliament (and their constituents), and private forest-sector operators, who often find it difficult to obtain such information, especially in an accessible format.
- *Support development of solutions to delays in the management planning process.* As indicated in Table 6, less than one third of allocated FMUs has an approved management plan in place. While there are many possible explanations for this delay, it is a

## Map 5. Management Plan Status of FMU Logging Concessions



### Box 5. Timeline and Requirements for Preparation of Forest Management Plans

After selection through the public bidding process, a concessionaire chosen for allocation of a FMU signs a temporary agreement (*convention provisoire*) with MINEF. This agreement allows the concessionaire limited exploitation over a maximum of three years (one AAC per year). During this 3-year period, the company must:

- Complete the pre-inventory/sampling phase (*sondage*), including Sampling Plan (cartography and pre-inventory, with sampling rate)
- Complete the inventories and study phase, including reports on
  - Management inventory and forest maps (*Rapport d'inventaire d'aménagement et cartographie forestières*), with identification and mapping of 5-year operational blocks (*blocs quinquennaux*) and the annual allowable cut (AAC) areas
  - Socio-economic studies (*Rapport d'études socio-économiques*)

- Consultations with local populations on usage rights (*Rapport de consultation avec les populations locales sur le droit d'usage*)
- Wildlife and biodiversity studies (*Rapport d'études sur la faune et la biodiversité*)
- Environmental impact study (*Rapport d'étude d'impact environnemental*)
- Prepare a draft management plan, incorporating all relevant information
- Submit draft management plan to MINEF for approval.

MINEF then accepts or rejects (requests modifications) the draft management plan. If MINEF accepts, the concessionaire can sign a 15-year renewable forest concession agreement (*convention définitive*) with MINEF. The forest management plan is reviewed every five years, when the boundaries of the FMU and its subdivisions may be adjusted as necessary.

**Source:** Order (*Arrêté*) n° 0222/A/MINEF/25mai2002

clear sign that an improvement to the process is needed. This dataset informs key decision-makers and their constituents as to the management status of various logging areas, and could support the development of solutions to these delays.

- *Identify specific locations of logging company operations.* The information presented under this theme could assist the Department of Wildlife and Protected Areas (DFAP), conservation NGOs, and research institutes by identifying the companies operating in specific locations—information that these entities could use to support joint implementation of projects and activities as well as conflict resolution and other purposes.

**Table 6. Summary of Management Status of Allocated FMUs, as of May 14, 2004**

FMU Management Status	Number	Area (ha)*	Percentage of Total Area
Management plan approved	22	1,538,300	31
Management plan rejected	17	1,127,600	23
Management plan submitted, awaiting response	2	96,200	2
Inventory report submitted	2	127,700	3
Preliminary inventory plan submitted	15	1,008,500	20
Status unknown	14	1,048,500	21
<b>TOTAL</b>	<b>72</b>	<b>4,946,900</b>	<b>100%</b>

\* Surface areas were rounded to the nearest 100 ha. To avoid confusion the actual total was included in this table rather than the sum of the rounded values.

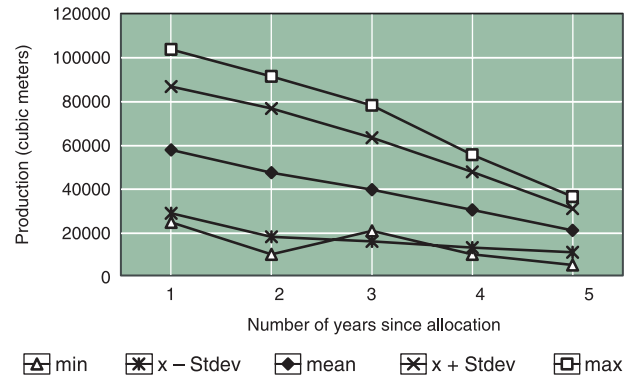
## Annual Wood Volume Production

Based on the Automated Forestry Information Management System (*Système Informatisé de Gestion des Informations Forestières - SIGIF*) database, this theme includes annual production data by volume (m<sup>3</sup>) for five logging seasons (1998-2003).

Map 6 depicts a zoomed-in view of forest exploitation areas (FMUs and SSVs), with wood production figures superimposed with the roads dataset. This juxtaposition reveals correlations of production levels with intensity of road use.<sup>26</sup> However, the map also shows areas of significant road development with little reported wood production, as well as areas with considerable wood production but few observable roads. The former could represent under-reporting of production, while the latter could indicate timber “laundering,” that is, improper reporting of timber harvested elsewhere as originating from the forest territory in question. Again, the data presented in the atlas can inform the necessary investigations, but should not be considered definitive proof of irregular activities.

Examining wood volume production levels by FMU over time reveals distinctive trends. As shown in Figure 2, many companies tend to harvest more wood during the first and second years following FMU allocation than in subsequent years. (Note, however, that the analysis is based on only eight FMUs for which five consecutive years of production data were available.)<sup>27</sup> Several factors could explain such an observation. One potential reason for the observed trend is that companies might harvest

**Figure 2. Trends in FMU Wood Production by Year Following Allocation\***



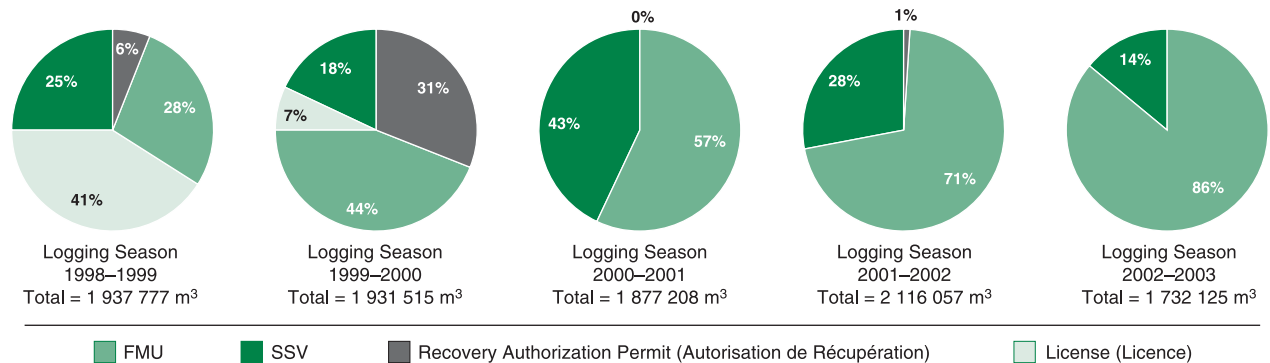
\* Based on data from SIGIF, 1998-2003 (n=8).

intensively in the early years of the FMU agreement in order to recoup their initial investments. Another plausible explanation is that the final, approved versions of forest management plans might stipulate lower production levels than originally anticipated under provisional forest agreements (*convention provisoire*).

In contrast, SSVs exhibit less regular trends in production levels over time than do FMUs.<sup>28</sup> For SSVs, it appears that the second year of production is the highest of the three years during which a company in principle could harvest. Among the possible explanations for this observed pattern is delays that cause companies to begin harvesting a year or two later than the SSV was allocated. Such delays might be due to difficulties in obtaining the necessary papers to begin logging or other start-up challenges (e.g., financing, road construction, etc.).

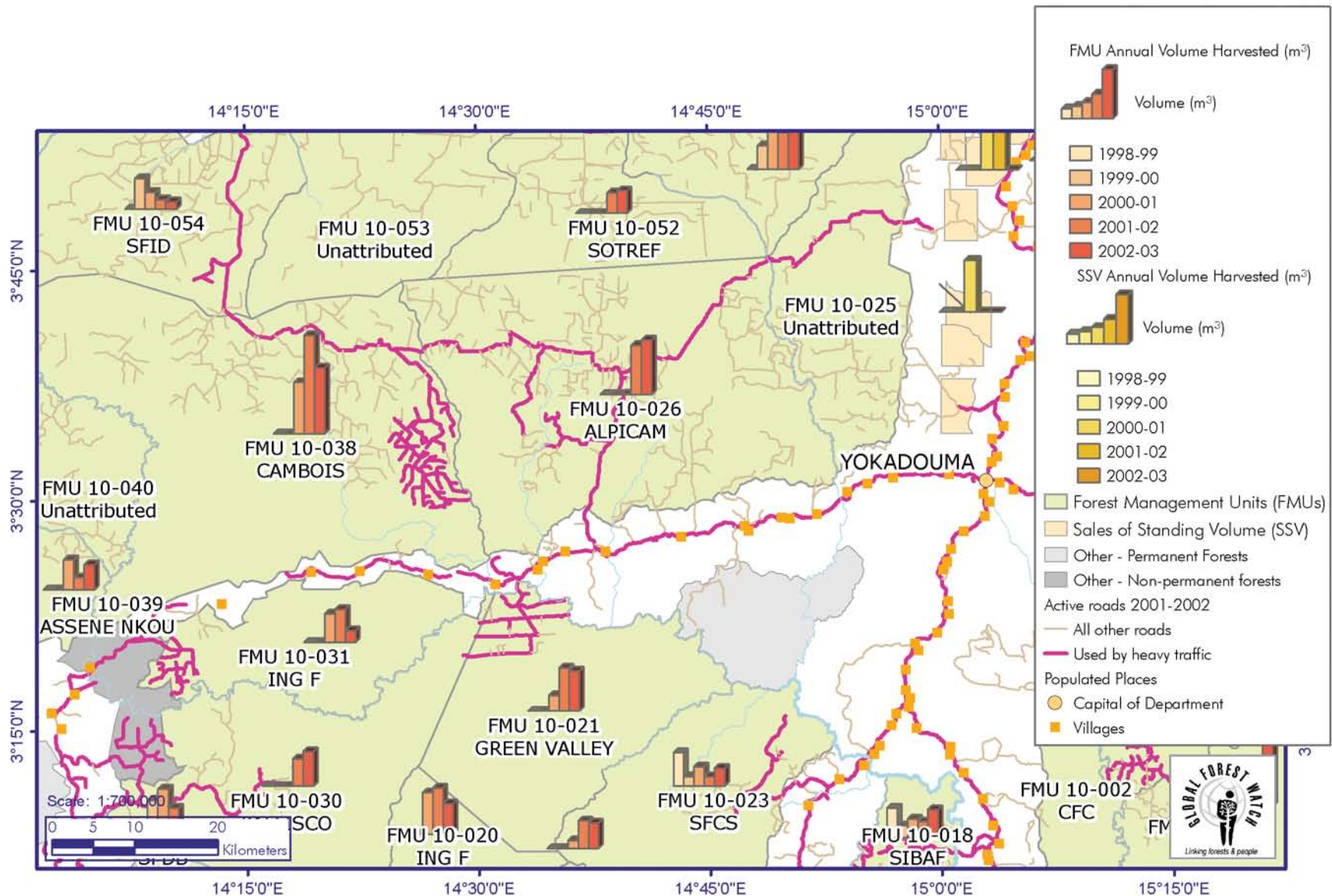
Figure 3 shows relative levels of annual wood production by type of logging title since 1998. Note that output from the former system of Licenses finally faded out in 2000. For the 5-year period from 1998 to 2003, about one third of total wood production (34 percent) originated in “unmanaged areas”—that is, SSVs and volume-based permits (Wood Recovery Authorization Permit (*Autorisation de Récupération de Bois*)).<sup>29</sup> Even as late as 2003, such areas accounted for a significant share (14 percent) of

**Figure 3. Annual Wood Production by Type of Logging Title (1998–2003)\***



\*Source: SIGIF

## Map 6. Fine-Scale Map of Wood Production Levels by Forest Management Unit (1998–2003)



In this view, production levels for SSVs as well as FMUs can be seen. Comparisons can be made by superimposing data layers on intensity of road use, or the year roads were first observed, and the wood volume production reported.



wood production. It should be noted, however, that these areas are by definition zoned within the Non-Permanent Domain and thus are not expected to be managed for long-term productivity and/or sustainability. Rather, by virtue of their zoning, they are ultimately slated for land uses other than standing forest.

### Useful Applications and Recommendations

- *Investigate questionable reporting of wood production levels.* MINEF and other relevant stakeholders could use the atlas for general monitoring of wood production on a spatially explicit basis. Such monitoring could be useful for detecting discrepancies between the reported volume of wood production in a given area and the level of road network development in that area, which would assist MINEF in making decisions about where to commit its limited resources for field-level investigations.
- *Support forest management planning.* As discussed above, this dataset indicates that a significant portion of total wood production still derives from unmanaged areas, including SSVs and other volume-based titles. The spatially explicit data on wood production volumes contained in this could help inform discussions about the long-term sustainability of production in the forestry sector. MINEF and interested private-sector operators could further investigate this matter and take these time-series data into consideration in planning for future timber production and wood processing.
- *Monitor tax revenues for discrepancies.* Of particular interest to the Government, donor

agencies, and other policy analysts are forestry tax data. If tax data from SIGIF are made available as part of the ongoing MINEF-GFW collaboration, they will be incorporated in future versions of the atlas, enabling users to identify discrepancies between timber volume harvested and corresponding taxes and to prompt corrective action to avoid loss of state revenue.

## 2.3 Biodiversity Protection and Wildlife Management Areas

This theme presents the most up-to-date information available on the boundaries of various forest zones reserved for biodiversity protection and wildlife management. Box 6 provides background on selected provisions on biodiversity protection and wildlife management zones in Cameroon’s forest code.

Table 7 presents information on the number and geographic extent of various types of biodiversity protection and wildlife management areas, including national parks, wildlife reserves, wildlife sanctuaries, hunting zones, community hunting zones, etc. Map 7 provides a visual overview of the size and location of various protection and hunting zones in Cameroon.

Superimposing the roads dataset with these data on protected area boundaries can show where new roads are penetrating into these zones. Specifically, Map 8 depicts intrusion of logging roads from a neighboring FMU into the eastern-most sectors of a protected area.

**Table 7. Summary of Protected and Wildlife Management Areas in Cameroon<sup>(1)</sup>**

Purpose	Category	Number	Area (ha)
Biodiversity Protection	National Parks	17	2,910,382
	Wildlife Reserves	6	738,995
	Wildlife Sanctuaries	4	246,368
	Zoological Gardens	3	6.7
	Other Protected Area <sup>(2)</sup>		3,895,751
Wildlife Management	Hunting Zones (ZIC)	41	<sup>(3)</sup>
	Community Hunting Zones (ZICGC)	16	<sup>(3)</sup>

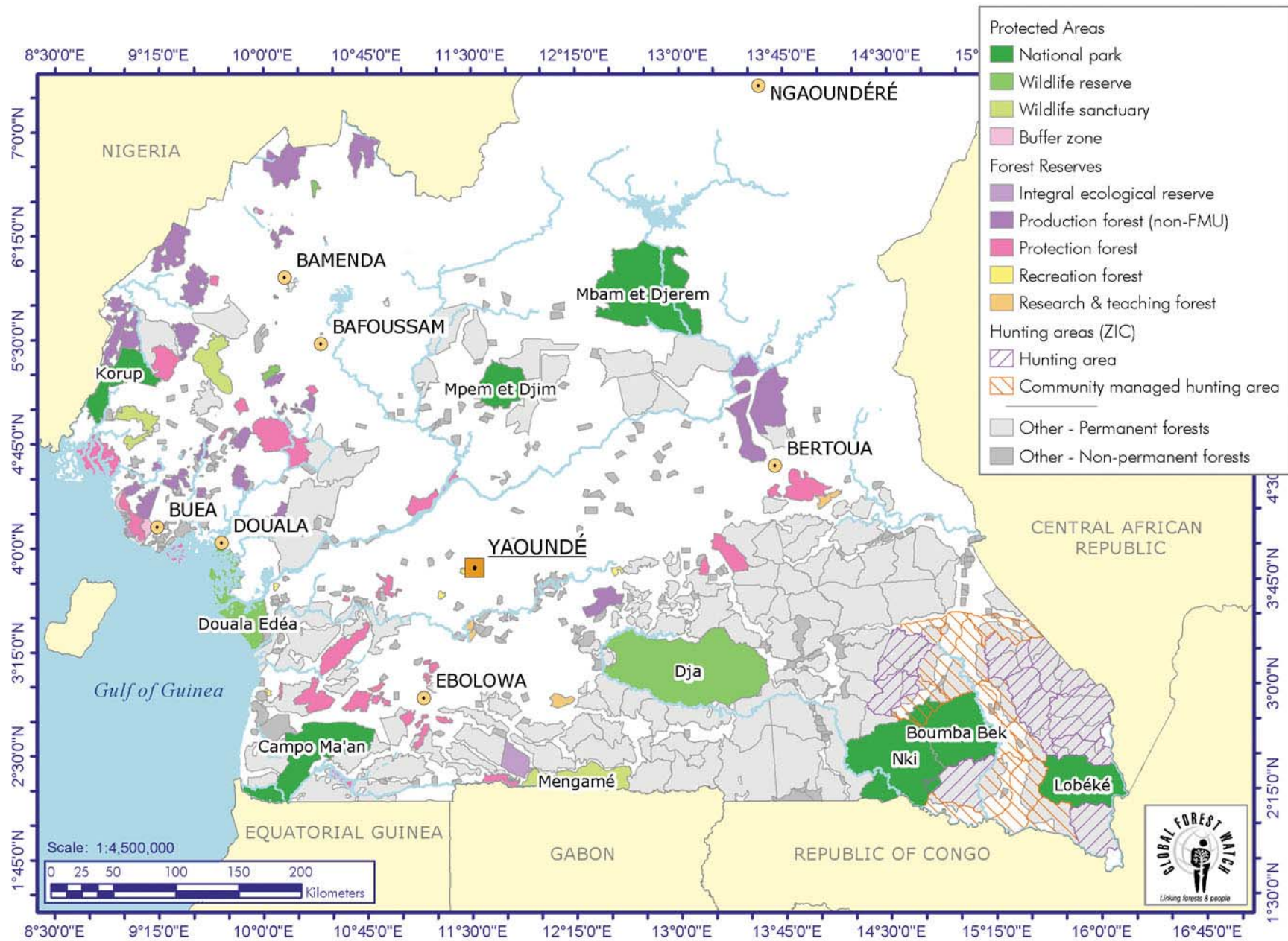
<sup>(1)</sup> These data are from DFAP (2004).

<sup>(2)</sup> “Other protected areas” include State owned game-ranches and buffer zones however surface area statistics were not available.

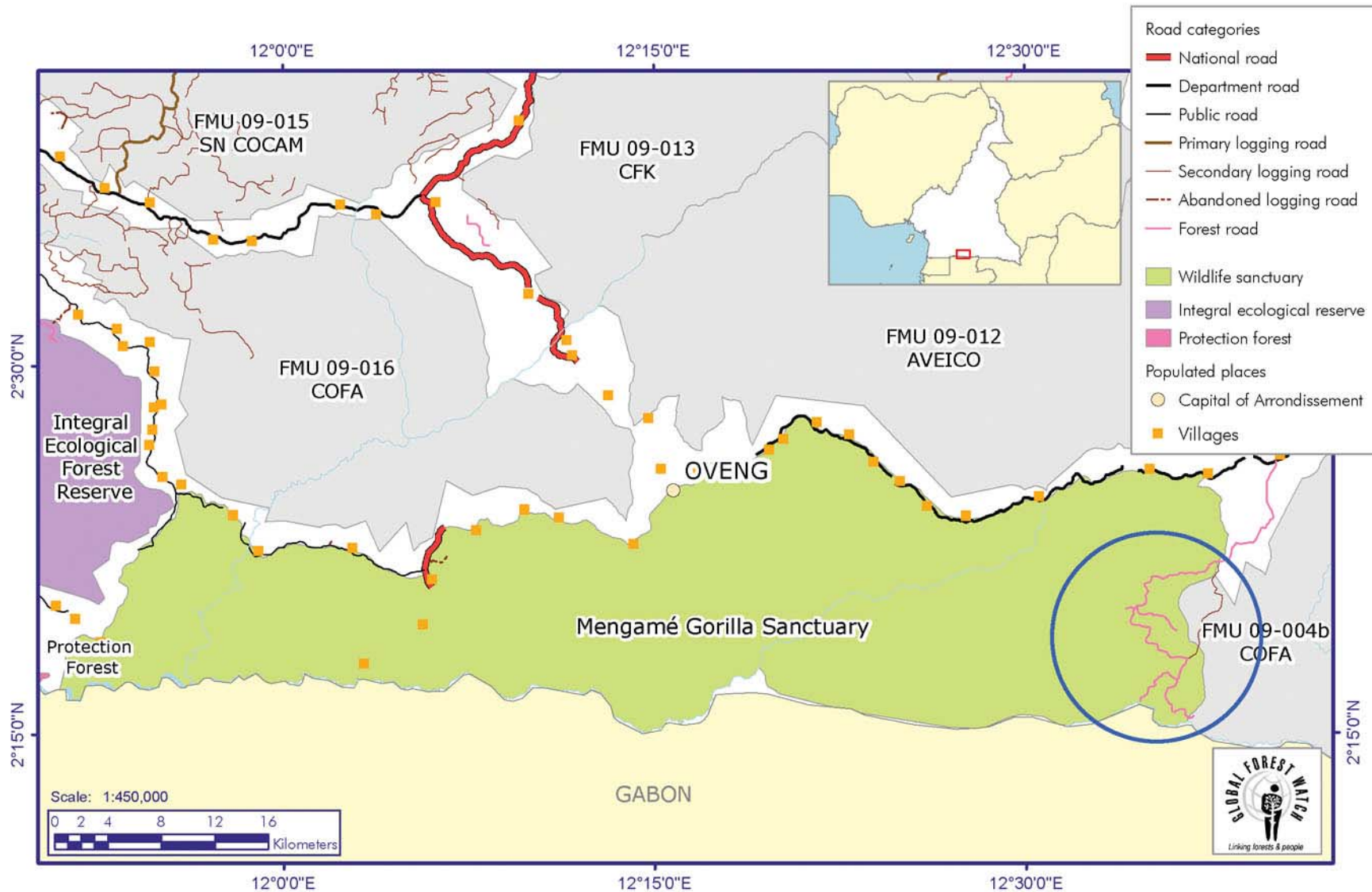
<sup>(3)</sup> Some ZIC / ZICGC zones overlap with other management zones, thus giving statistics for their area may be mis-leading.

In nine still unallocated FMUs, new projects may be launched on biodiversity conservation and the creation of trans-boundary conservation networks (between Cameroon, Gabon, and the Republic of Congo). Studies and discussions are ongoing concerning how much of these areas will remain production forest and how much will be re-zoned to become protected areas. Subsequent versions of this atlas will provide further information on these and other developments.

## Map 7. Biodiversity Protection and Wildlife Management



## Map 8. Identification of Road Building Outside Permitted Areas



This view identifies roads (circled in blue) observed within a protected area in both 1999-2000 and 2001-2002. This problem has been broadly discussed and was resolved by MINEF declaring that the original limits of the protected area are to be respected. This logging activity resulted from confusion about the boundaries of the protected area and the neighboring FMU. While this particular case predates the production of this atlas, it provides an example of the type of application for which the information provided in the atlas can be used.

## Box 6. Selected Legislative Provisions on Biodiversity Protection and Wildlife Management Zones in Cameroon's Forest Code

The 1994 forest code broadly describes several biodiversity protection and wildlife management zones and their purposes. Certain zones were created well before the forest code (Dja Wildlife Reserve – 1950) while others (ZICGC – 2000) are more recent. Article 78 of the forest codes divides the fauna of Cameroon into three protection groups (Classes A, B, and C) according to their protection status, which is reviewed every five years.

The hunting decree (Decree Nr. 95/446/PM) authorizes traditional hunting everywhere except in private domains and in protected areas. Legally hunted bushmeat is solely for individual consumption and therefore the commercial trade in bushmeat is strictly prohibited (Article 24). Hunting in the national domain can be prohibited during certain periods. Moreover, the use of certain techniques (Article 80) and some arms (Article 106 - 108) is forbidden for any hunting activity in Cameroon.

### Useful Applications and Recommendations

- *Focus monitoring and enforcement on road construction within or near protected areas.* The information and map-based tools included in this atlas could be used to focus future monitoring investigations and enforcement actions on areas where roads have been constructed within or near protected areas. Such a focus would help MINEF effectively deploy its limited resources for monitoring to ensure that the appropriate activities are occurring in the appropriate places.
- *Conflict resolution.* MINEF could use the atlas as a neutral and objective tool to support its data-driven decision-making and, where necessary, to help resolve conflicts among the Administration, private-sector operators, NGOs, and local communities.

- *Support for land-use decision-making affecting protected areas.* MINEF, together with other Ministries, traditional authorities, and members of parliament, could use the data in this theme of the atlas to support land use decisions that may have an impact on biodiversity protection and/or wildlife management zones, for example, through the establishment of buffer zones or new agriculture developments.

## 2.4 Vegetation

This atlas also contains basic information on forest cover from both the Global Land Cover (GLC) 2000 dataset and the MINEF forest stratification dataset.<sup>30</sup>

The GLC 2000 dataset was produced by an international partnership of research organizations coordinated by the European Commission's Joint Research Centre (JRC) in 2003. The land cover maps are based on daily data collected in 1999–2000 from the VEGETATION sensor on board the SPOT 4 satellite.

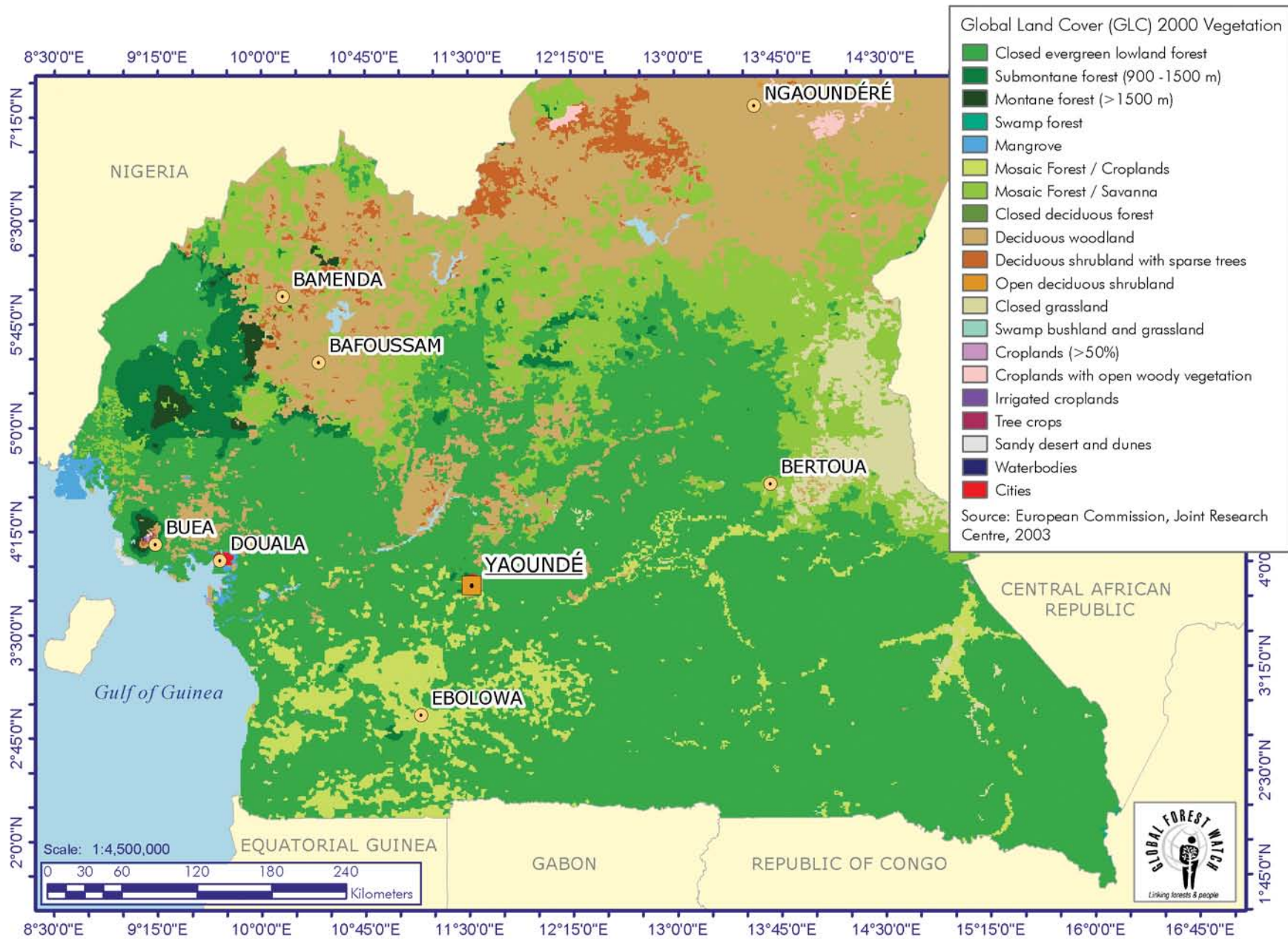
The MINEF forest stratification dataset is used by forestry companies in their concession management planning, among other purposes. This data layer is based on aerial photographs from the 1980s.

Maps 9 and 10 depict forest cover using data from GLC 2000 and the MINEF forest stratification dataset, respectively.

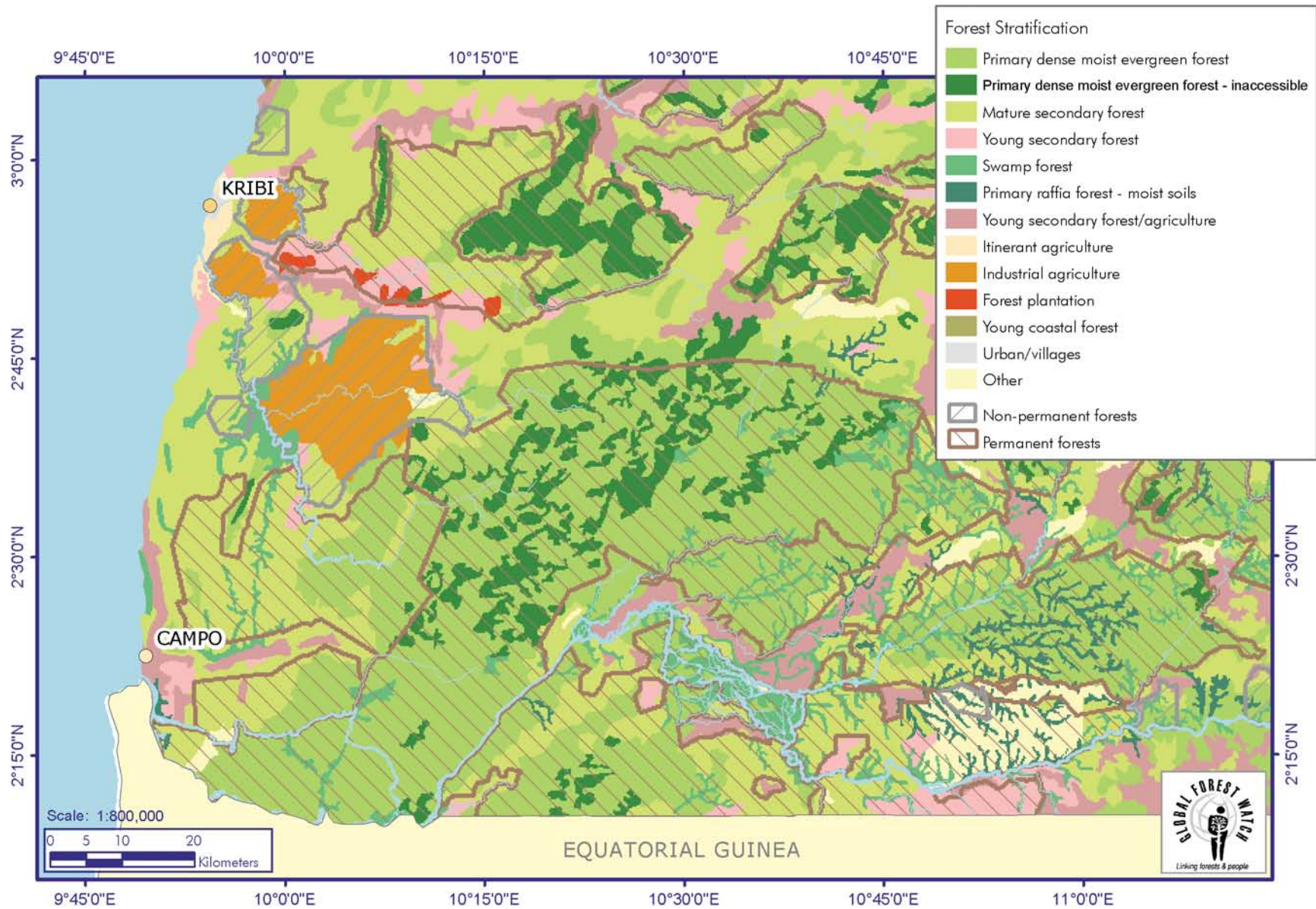
### Useful Applications and Recommendations

- *Update forest-cover layer with data from CARPE.* An effort funded by the Central Africa Regional Program for the Environment (CARPE) is already underway to update mapping of forest cover across Central Africa. To improve forest management planning, MINEF is interested in updating the forest stratification layer with these data as they become available.

## Map 9. GLC 2000 Vegetation for Cameroon (1 km resolution)



## Map 10. MINEF Forest Stratification



This view is a zoom into the Kribi area, showing forest stratification data overlaid with data on the boundaries of FMUs and protected areas.

### 3 CONCLUSION AND NEXT STEPS

This report has provided an overview of the *Interactive Forestry Atlas of Cameroon* (Version 1.0), including its purpose, content, methodology, and examples of potential applications.

Created through a partnership forged between MINEF, GFW, and other collaborating institutions, the atlas presents in one user-friendly source much of the relevant, spatially explicit data on forest management and governance in Cameroon. This initial version of the atlas has focused primarily on the forest exploitation zones together with a roads dataset created from satellite imagery. Using this atlas, decision-makers and stakeholders will be able to easily access and manipulate the most up-to-date, revised, and verified information to view maps on the boundaries of timber extraction areas (as of May 2004) as well as the most complete interactive map of Cameroon's extensive road network.

The atlas will enable users to view and produce maps based on current and critical information for forest monitoring and to support informed decision-making. As discussed above, examples of potential uses of the atlas include:

- Prioritizing field monitoring and control missions; helping to determine whether logging operations are occurring in legally attributed areas;
- Providing an objective reference to help resolve conflicts related to boundaries of forest use zones;
- Informing interested parties of historical forest exploitation activities in a given zone;
- Supporting local authorities in their land use and regional planning activities; and
- Providing data to support the design of new protected areas and conservation corridors.

#### Distribution

To promote transparency and accessibility of information, the data included in this atlas will be made available on line at [www.globalforestwatch.org](http://www.globalforestwatch.org) and [www.minef.cm](http://www.minef.cm). Likewise, CD-ROMs will be disseminated to decision-makers and other forest sector stakeholders. The CD-ROM will also be available to any interested parties upon request to WRI.

#### Training

Several extension/training activities are planned in order to ensure maximum understanding of the contents of this atlas and their potential uses. Training sessions led by a GIS-RS trainer currently based in Yaoundé will be undertaken with various user groups. Specifically, key decision-makers within the ministries as well as parliament will be offered hands-on training in order to maximize their awareness of the atlas and the ways it can be used to monitor forest practices and promote sustainable forest management. Technical training will also be provided to MINEF technicians in order to build capacity in GIS and mapping.

## Updating

We expect that this initial edition of the atlas will be improved in subsequent versions. Specific improvements will include updating the current datasets as new information is made available as well as adding new datasets. Annual updating will be undertaken by MINEF with support from GFW and its partners CEW and LBZG (a Technical Operational Unit under MINEF).

Critical to the success of future editions is continued and reasonably priced access to satellite imagery needed to update the roads dataset. Due to the malfunctioning of Landsat, the core partners are exploring replacement RS platforms, such as ASTER, IRS, etc. Continued updating will create longer-term time-series data and thus permit additional analysis, some of which is identified in this document. Future updates and improvements to all the atlas datasets are crucial to maintaining the comprehensive and timely nature as well as the accuracy of the data found in this atlas.

To further improve the functionality and utility of the atlas, other attribute information found in SIGIF (i.e., tax and other financial data) could

be merged with the atlas database. Anticipating this merger, we have structured the atlas database using the same coding system as SIGIF. This link, once operationalized, will also prove useful to the inter-ministerial PSRF efforts to formalize connections between MINEF and the Finance Ministry of Cameroon.

It is also possible that this expanded database could link with the UCC to support the planning and execution of their control missions. These integrations would transform this atlas into an even more powerful management information system to guide forest sector decision-making.

Lastly, linkages are envisioned between this atlas and a voluntary monitoring system under development for logging companies throughout Central Africa. This voluntary monitoring system will provide complementary information from certain concessionaires—to be audited by a third party—concerning their efforts to demonstrate legality and progress towards sustainable forest management (including the certification of forest products). GFW, IFIA, IUCN and other partners are leading the development of this system.



## NOTES

1. Bikié, H., J. G. Collomb, L. Djomo, S. Minnemeyer, R. Ngoufo, and S. Nguiffo. 2000. An Overview of Logging in Cameroon. Global Forest Watch / World Resources Institute. Washington DC.
2. MINEF. 2003. *Présentation des composantes du programme sectoriel forêt et environnement* (PSFE). Yaoundé.
3. In December 2004, following the presidential elections in October, the Ministry of Environment and Forests (MINEF) was replaced by the Ministry of Forests and Wildlife (MINFOF) and the Ministry of Environment and the Protection of Nature (MINEP).
4. The complete MOU is available at the following hyperlink: [http://www.globalforestwatch.org/english/centralafrica/pdfs/GFW\\_Convention.pdf](http://www.globalforestwatch.org/english/centralafrica/pdfs/GFW_Convention.pdf).
5. IKEA, Stora Enso, and more than 10 other forest product companies are using GFW's Russia Atlas for making responsible sourcing decisions in Russia. GFW's *Atlas of Russia's Intact Forest Landscapes* has become the Russian forest industry standard for implementing commitments to avoid sourcing from intact forests. It is the only publication of its kind available in Russia and is available at the following hyperlink: <http://www.forest.ru/eng/publications/intact/>.
6. Under the MINEF-GFW MOU, MINEF operates primarily through the following departments and divisions: Department of Forest (DF) technically assisted by the Sub-Department of Inventories and Forest Management (SDIAF), Department of Wildlife and Protected Areas (DFAP), and the Division of Cooperation and Projects (DCP).
7. The steering committee included representatives of MINEF, GFW, INC, donors, and other experts.
8. MINEF decision #0301 about cartographic standards was issued on April 04, 2001 and based on the following report commissioned by CIDA for MINEF and executed by TECSULT (Bélanger, L. Juin 2001. *Gestion durable des forêts Camerounaises*. Normes de cartographie forestière numérique, saisie et structuration des données, Edition 2. TECSULT). Also, in the same way, MINEF decision #0342 was taken on April 19, 2001 to make official the GIS database from the Central Forestry Cartographic Unit of MINEF (*Unité Centrale de la Cartographie Forestière* - UCECAF) that is the core of this atlas' GIS database.
9. These boundaries may eventually be modified as the classification process progresses (see Box 3 for further details).
10. Refer to the *Technical Report: Mapping Historic and Current Logging Roads in Cameroon*.
11. Laporte N., S.J. Goetz, C.O. Justice, and M. Heinicke. 1998. A New Land Cover Map of Central Africa Derived from Multi-resolution, Multi-temporal AVHRR Data. *International Journal of Remote Sensing*, 19(18): 3537-3550.; Laporte N.T. and T.S. Lin. 2003. Monitoring Logging in the Tropical Forest of Republic of Congo with Landsat Imagery. *Proceedings of the International Geoscience and Remote Sensing Symposium (IGARSS)*, 21-25 July 2003, Toulouse, France, Vol. IV:2565-2567.; Matricardi, E. 2003. Multi-temporal Assessment of Selective Logging Using Remotely Sensed Data in the Brazilian Amazon. M. A Thesis. Michigan State University, U.S.A.; de Wasseige, C. and P. Defourny. 2004. Remote Sensing of Selective Logging Impact for Tropical Forest Management. *Forest Ecology and Management* 188: 161-173.
12. In certain cases, cloud and/or canopy cover could limit the ability to detect all roads. Moreover, the detection of roads outside the boundaries of legally titled logging areas does not necessarily imply that illegal logging is occurring, only that it is an area of concern and should be explored further. Indeed, there may be a valid reason for a road's existence.
13. For this atlas, "date of origin" is defined as the date of the image in which the road was first observed.
14. As noted in Sections 1 and 2, not all of the active SSV and Community Forest data were available for this version of the atlas. Therefore, it is possible that a small portion of these forests roads identified to be outside the borders of legally approved logging areas may be located in these missing but legally allocated areas.
15. See Bikié et al. (2000) for a more detailed treatment of the forest code of Cameroon.
16. Key attribute information includes: allocation status and year, classification status, and annual wood volume production.
17. Data on 132 of 311 SSVs are included in this atlas. Data for 55 of the 67 community forest concessions have been digitized and included in the Atlas. According to MINEF partners, as of July 2004, some 60 community forest concessions have an approved "simple management plan" and may soon be attributed. Since the forest code created the opportunity for the establishment of community forests, over 300 official requests have been submitted to MINEF.

18. A FMU is divided into six 5-year operational blocks—each containing five annual allowable cut areas (AACs) of equal volumes—for a total rotation of 30 years. In the preparation of the forest management plan, the forest concessionaire has to provide the first detailed 5-year operational plan indicating the location of the first five AACs.
19. This figure (27 percent) was calculated by adding data (see Table 3) on the land area of the various zones making up the Permanent Forest Domain (12,735,400 ha) and dividing by the total land area of Cameroon (46,944,000 ha), as cited in the Central Intelligence Agency records of the U.S. Government <http://www.cia.gov/cia/publications/factbook/geos/cm.html#Geo>.
20. This could likely be due to the automatic calculation methods used, which yield different results from those obtained by the planimeter. This shows the need to harmonize and upgrade the standard of surface areas calculations used by the National Institute of Cartography (INC).
21. Along this line of thinking, GFW is partnering with the InterAfrican Forest Industries Association (IFIA), World Conservation Union (IUCN), and other NGOs and institutes to set up a voluntary monitoring system for forest concessions across the entire sub-region. This system will further enhance the transparency of this sector while providing a platform from which private-sector operators in central Africa can demonstrate to the international tropical timber market that certain actions have been taken to ensure the legality of their operations as well as voluntary commitments made toward sustainable forest management.
22. See Map 8 for an example of a conflict regarding the overlapping or unclear demarcation of forest territory boundaries.
23. A specific application was recently (June 2004) suggested by a Greenpeace press release claiming that a subsidiary company of Danzer in southwestern Cameroon was harvesting within their concession but outside of the appropriate AAC. Future editions of this atlas could help resolve this particular conflict once the AAC boundaries are made available.
24. The best available data suggests that at least 12 Community Forest requests have been denied solely because they were requested within an area already zoned for the Permanent Domain. According to the forest code, Community Forests are allocated solely in the Non-Permanent Domain.
25. Management status statistics for the FMUs allocated in or before 2000 were selected in order to identify which FMUs had complied with the forest code provision allowing three years for the preparation, submission, and approval of the management plan. Further explanation of the management plan process is provided in Box 5.
26. While there may indeed be a correlation between timber production levels and the extent of intensively used forest roads, a time-series analysis was not done. The variability of cloud cover from year to year might render such a multi-temporal analysis useless.
27. Future versions of this atlas are expected to contain longer and more complete time-series data, enabling a more robust trend analysis of wood production levels in FMUs.
28. Insufficient comparable time-series data were available to present informative statistics on SSV wood production over time. Future versions of this atlas will include more longitudinal data and thus provide additional insights on SSV production trends.
29. This figure (34 percent) was calculated by adding the total production since 1998 (3,210,507 m<sup>3</sup>) reported in SIGIF for SSVs and the Authorized Recovery of Wood permits (*Autorisation de Récupération de Bois*) and then dividing by the total production reported for all types of logging permits (9,594,682 m<sup>3</sup>). The Authorized Recovery of Wood permits are reserved for nationals and allocated by the provincial representative of MINEF. It can be given for timber located in the Non-Permanent forest domain, can be allocated for up to 3 months, and may not exceed 30 m<sup>3</sup> in volume. See Bikié et al. (2000) for a more detailed treatment of the types of logging titles permitted according to the forest code of Cameroon.
30. Mayaux, P., E. Bartholomé, M. Massart, C. Van Cutsem, A. Cabral, A. Nonguierma, O. Diallo, C. Pretorius, M. Thompson, M. Cherlet, J-F. Pekel, P. Defourny, M. Vasconcelos, A. Di Gregorio, S. Fritz, G. De Grandi, C. Elvidge, P. Vogt, and A. Belward. 2003. A Land Cover Map of Africa (*Carte de l'occupation du sol de l'Afrique*). European Commission, Joint Research Centre.

## Appendix 1. Table A. Atlas Datasets and Sources<sup>(1)</sup>

Dataset (name)	Description	Data Source
<b>Basic map features</b>		
Roads - Forested Zone of Cameroon (voie-com)	Roads digitized from satellite imagery	Original data created by GFW and LBZG (see Appendix 2) <sup>(2)</sup>
Country Boundaries Outline (Ctrl_Africa)	Country boundaries for Central African countries	National Geospatial Intelligence Agency's (NGA) Digital Chart of the World
Cameroon Administrative Boundaries (LIM_ADM)	Terrestrial national, provincial, and divisional boundaries for Cameroon	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
Cameroon Coastline (Shapefile/HYDR_SUR_Coastline)	Part of the Atlantic Ocean and Estuaries along Cameroon Coastline	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
Settlements-Southern Cameroon (Shapefile/ELEM_HAB)	The different settlements of Cameroon	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
Boundaries for Topographic Map Sheets-Southern Cameroon (Shapefile/INCMAP Sheets)	Boundary outline of the Topographical Based Map of Cameroon	Scanned 1:200,000 INC topographical maps of Cameroon and compiled by GFW <sup>(3)</sup>
River and Streams-Forested Zones of Cameroon (Shapefile/HYDR_LIN)	Hydrological Network (rivers and streams) for the forested zones of Cameroon	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
Cameroon Major Rivers, Lakes, and Oceans (Shapefile/HYDR_SUR)	Major Rivers, Lakes and the Atlantic Ocean for Cameroon	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
<p>(1) GIS users should refer to the metadata of each shapefile for more detailed information.</p> <p>(2) Certain areas of the Atlas roads dataset were cross-checked with similar datasets produced by the GTZ Southeast Cameroon project and TCP for their respective project areas</p> <p>(3) Original layer prepared for MINEF on behalf of CIDA by Tecsuit Inc.</p> <p>(4) Hunting zone data from the Southeast was provided by the GTZ Southeast Cameroon project.</p>		

## Appendix 1. Table A. continued<sup>(1)</sup>

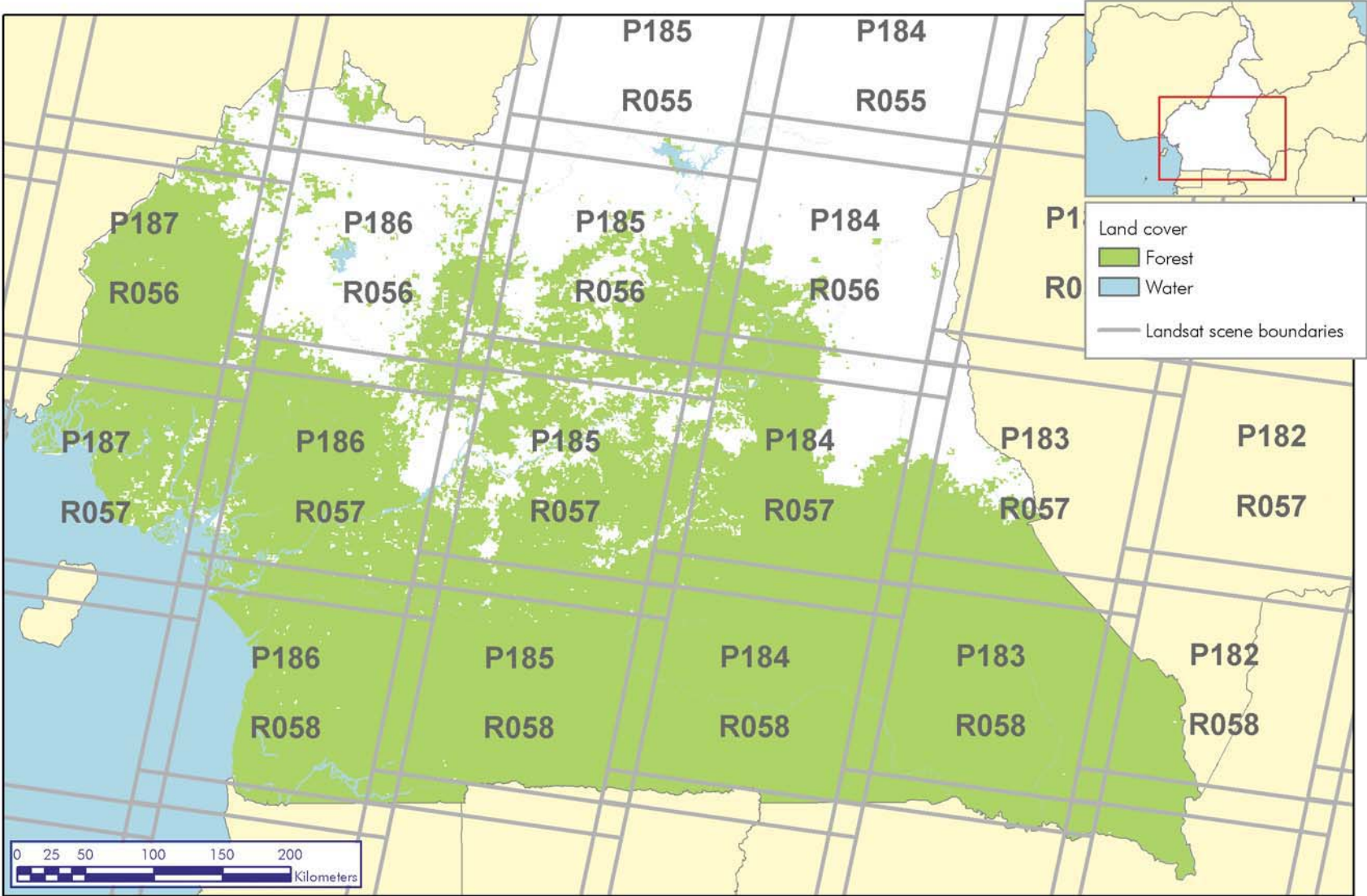
Dataset (name)	Description	Data Source
<b>Forest management</b>		
Permanent Forest Domain (Shapefile/DOM_PER)	Permanent Forest Domain in Cameroon (see Box 3 - Forest Zoning and FMU Classification in Cameroon)	Layer updated by GFW from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3,4)</sup>
Licenses (Shapefile/Licences)	Old logging concessions formerly referred to as Licenses	Layer based on national 1:200,000 INC topographical maps <sup>(3)</sup>
Non permanent Forest Domain-Cameroon Forest Zoning Plan (Shapefile/DOM_NAT)	Non permanent Forest Domain in Cameroon (see Box 3 - Forest Zoning and FMU Classification in Cameroon)	Layer updated by GFW (using official attributions documents) from data digitized on the national 1:200,000 INC topographical map sheets <sup>(3)</sup>
<b>Vegetation</b>		
Land Use and Land Cover Types for the Southern Parts of Cameroon (Shapefile/STR_FOR)	Land use and Land cover Types for Southern Cameroon	Layer based on national 1:200,000 INC topographical maps <sup>(3)</sup>
Vegetation Map of Africa	1 km resolution land-cover map of Cameroon	Global Land Cover 2000 database European Commission, Joint Research Centre, 2003
<b>FMU Attribution and Production Statistics</b>		
Years of Attribution (MS Access file)	The year of allocation for the various forest extraction zone titles	Official public notice of attribution documents ( <i>Avis au Public</i> )
Wood Volume Produced (MS Access file)	Annual wood volume produced per forest extraction zone titles	Obtained from SIGIF and compiled by GFW and CEW
<p>(1) GIS users should refer to the metadata of each shapefile for more detailed information.</p> <p>(2) Certain areas of the Atlas roads dataset were cross-checked with similar datasets produced by the GTZ Southeast Cameroon project and TCP for their respective project areas</p> <p>(3) Original layer prepared for MINEF on behalf of CIDA by Tecstart Inc.</p> <p>(4) Hunting zone data from the Southeast was provided by the GTZ Southeast Cameroon project.</p>		

## Appendix 2. Table B. Landsat Satellite Images Used to Digitize Roads

PathRow	1999	2000	2001	2002	2003
p182r058		26-Mar**	9-Feb**	1-Apr*	15-Feb**
p182r059		18-Sep**	9-Feb**	1-Apr*	15-Feb**
p183r057		14-Dec**		2-Jan*	5-Feb**
p183r058		1-Mar** 14-Dec**	7-May**	2-Jan*	5-Feb**
p183r059			7-May**	2-Jan*	5-Feb**
p184r056			7-Feb**	30-Mar*	
p184r057			7-Feb**	25-Jan* 27-Dec**	
p184r058		24-Mar**		31-Mar* 27-Dec**	
p185r056			14-Feb** 31-Dec*		
p185r057			14-Feb**	16-Jan*	
p185r058			18-Mar**	1-Feb*	
p186r056			5-Feb**	15-May*	
p186r057			26-Apr** 19-Oct*		
p186r058			26-Apr** 21-Feb**		27-Feb**
p187r056	12-Aug**	10-Dec**		30-Jan*	
p187r057	12-Aug**	10-Dec**		30-Jan*	

\* These images were purchased and donated by the NASA-INFORMS project (<http://www.whrc.org/africa>).  
 \*\* "All images were orthorectified by the Earth Satellite Corporation (Rockville, MD USA) to their Geocover dataset (<http://www.geocover.com>). All images regardless of source are available online at the University of Maryland Global Land Cover Facility - UMD GLCF (<http://glcf.umiacs.umd.edu>), and the University of Michigan's Landsat.org project ([http://www.Landsat.org/dataservices/GFW\\_WRI](http://www.Landsat.org/dataservices/GFW_WRI)). Images are also available on CDrom through partners in Cameroon (MINEF and LBZG)."  
 The yearly variability of satellite coverage can be attributed to variation in cloud cover.

# Map A. Landsat Images Available for the Forest Zone of Cameroon



**Ministry of Environment and Forests of Cameroon**  
**Global Forest Watch**  
**World Resources Institute**



**MINEF**

[www.minef.cm](http://www.minef.cm)



[www.globalforestwatch.org](http://www.globalforestwatch.org)



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[www.wri.org](http://www.wri.org)

