THE FORESTS OF THE CONGO BASIN

State of the Forest 2013

The Forests of the Congo Basin – State of the Forest 2013

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ACRONYMS

ADB	African development bank
AFD	French Development Agency
AGDRF	Agency for the sustainable management of forestry resources
AGEDUFOR	Appui à la Gestion Durable des Forêts de la RDC
AGEOS	Gabonese Spatial Study and Observation Agency
ALUFR	Albert-Ludwigs-Universität Freiburg
ANAFOR	National Agency for the Support of the Development of the Forest
ANPN	National Parks Agency
ANR	Assisted Natural Regeneration
APTs	Trans-boundary protected areas
ATIBT	Association technique internationale des Bois tropicaux
AWF	African Wildlife Foundation
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action under the Convention
AZE	Alliance for Zero Extinction
BAU	Business-as-usual
BMU	German Federal Ministry for the Environment
BTC	Belgian Technical Cooperation
CAR	Central African Republic
CARPE	Central African Regional Program for the Environment
CAT	Management and processing agreement
CBD	Convention on Biological Diversity
CBFF	Congo Basin Forest Fund
CBFP	Congo Basin Forest Partnership
CBNRM	Community-Managed Natural Resource Management
CCBA	The Climate, Community and Biodiversity Alliance
CCC	Congo Conservation Company
CCN	National Coordination Unit
CCPM	The coordinating circle of MINFOF/ MINEPDED partners
CDAE	Convention définitive d›aménagement et d›exploitation
CDC	Cameroon Development Cooperation
CDF	Forest Data Center
CEFDHAC	Conference on Central African Moist Forest Ecosystems
CESBIO	Center for the study of the biosphere from space
CFA	African Financial Community Franc (CFA franc)
CFAD	Forest Concession under Sustainable Management
CGIAR	Consultative Group on International Agricultural Research
CGIS	Geographic Information Systems & Remote Sensing Research and Training Center
CIB	Congolaise industrielle des Bois
CICOS	International Commission for the Congo-Oubangui-Sangha Basin
CIEDD	Centre d' information Environnementale et de Développement Durable
CIFOR	Center for International Forestry Research
CIRAD	Center for International Agricultural research for development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNIAF	Centre national d'Inventaire et d'Aménagement des Ressources forestières et fauniques
CO2M&M	Carbon Map and Model project
COBAM	Climate Change and Forests in the Congo Basin
CoC	Chain of Custody
CoFCCA	Congo Basin Forests and Climate Change Adaptation
COI	Canopy Opening Indicators
COMIFAC	Central African Forests Commission
COP	Conference of the Parties
COVAREF	Committees for the Valorization of Wildlife Resources
CPAET	Provisional Convention of Management, Exploitation and Processing
CR	Critically Endangered

C-R	Capture-recapture
CRDPI	Centre de Recherche sur la Durabilité et la Productivité des Plantations industrielles
CSC	Climate Service center
CSO	Civil society organizations
CTFC	Technical Centre for Communal Forests in Cameroon
CTFT	Centre technique forestier tropical
CTI	Industrial processing agreement
DACEFI	Development of community alternative to illegal forest exploitation
DCESP	Domestic Cannabis Eradication/Suppression Program
DFGFI	Dian Fossey Gorilla Fund International.
DFID	Department for International Development
DFS	Deutsche Forstservice GmbH
DGEF	Direction générale des Eaux et Forêts
DGIS	Dutch Ministry of Foreign Affairs
DHR	Horticulture and Reforestation Authority
DIAF	Direction des Inventaires et Aménagements Forestiers
DMC (Chap 1)	Disaster Monitoring Constellation
DNA	DesoxyriboNucleic Acid
DPGT	Peasant development and land management
DRC	Democratic Republic of Congo
EBA	Ecosystem-Based Adaptation
ECCAS	Economic Community of Central African States
ECOFAC	Conservation and Sustainable Use of the Central Africa Forest Program
ECOFORAF	Eco-certification of forest concessions in central Africa
EDF	European Development Fund
EF	Emission factors
EFC	Eucalyptus and Fibres of Congo
EFI	European Forest Institute
EIA	Environmental impact assessment
EITI	Extractive Industries Transparency Initiative
EN	Endangered
ENI	Italian national oil company
ESA (Chap 1)	European Space Agency
ESMF	Environmental and Social Management Frameworks
ESMP	Environmental and Social Management Plan
ETIS	Elephant Trade Information System
ETM	Enhanced Thematic Mapper
EU	European Union
EUTR	European Union Timber Regulation
F/NF	Forest/non forest
FACET	Forêts d'Afrique centrale évaluées par Télédétection
FAN	Fundacion Amigos de la Naturaleza
FAO	Food and Agriculture Organization
FAOSTAT	FAO Statistics Division
FCCC	Framework Convention on Climate Change
FCPF	Forest Carbon Partnership Facility
FFEM	French Fund for World Environment
FIP	Forest Investment Program
FLEGT	Forest Law Enforcement, Governance and Trade
FMI	International monetary fund
FOB	Free On Board
FPIC	Free Prior and Informed Consents
FRA	Forest Resources Assessment
FRM	Forêt Ressources Management
FSC	Forest Stewardship Council
FUNCATE	Brazilian foundation charged with the technical development of methods and tools for the Amazon forest monitoring system
GCM	Global Climate Models
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIC	Guaranteed Investment Certificate
GIS	Geographic information system
GIS	Geographic Information System
GIZ	German Agency for International Cooperation
GLAS	Geoscience Laser Altimeter System
GLOBE	Global Legislators Organisation for a Balanced Environment
GLOBIOM	Global Biosphere Management Model

GMG	Global Manufacturing Group
GPS	Global Positioning System
GRASP	Great Apes Survival Partnership
GRUMCAM	Company logs from Cameroon
GSEaf	Group of African elephant specialists
GSE-FM	GMES Service Elements - Forest Monitoring
GSPC	Global Strategy for Plant Conservation
GTBAC	Groupe de travail biodiversité d'Afrique centrale
GTCR	Climate and REDD+ Working Group
GTG	Geospatial Technology Group SARL (Cameroun)
GTI	Global Taxonomy Initiative
GVTC	Great Virunga Transboundary Collaboration
HH	Horizontal horizontal polarization
HIMO	High-intensity Labor
HIV	Human immunodeficiency virus
HV	Horizontal vertical polarization
HVC	High conservation value
ICA	International Consultation and Analysis
ICCN	Congo Institute for the Conservation of Nature
ICCWC	International Consortium on Combating Wildlife Crime
ICESat	Ice, Cloud, and land Elevation Satellite
ICRAF	International Centre for Research in Agroforestry
IEC	Information, education and communication
IEEE	Institute of Electrical and Electronics Engineers
IFAD	International Fund for Agricultural Development
IFB	Forest industries of batalimo
IFDC	International Fertilizer Development Center
IFO	Forest industries of Ouesso
IGNFI	National Geographic Institute France International
IIASA	International Institute for Applied Systems Analysis
INDEFOR-AP	National Institute of Forestry Development and Protected Areas
INECN	The National Environment and Nature Conservation Institute
INERA	National Institute for the Agronomic study and research
INPE	National Institute for Space Research
INTERPOL	International Criminal Police Organization
IP	Indigenous peoples
IPC	Inter-Prefectorial committees
IPCC	Intergovernmental Panel on Climate Change
IRAD	Institute of Agricultural Research for Development
IRD	Institute of research for development
IRST	Institute of Scientific and Technological Research
ITC	Faculty of Geo-Information Science and Earth Observation
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organisation
JCU	James Cook University
JR	Joanneum Resarch
JRC	Joint Research Centre
KfW	German Development Bank
KIT	Royal Tropical Institute
LACCEG	Climatology, Mapping, and Geographic Studies Laboratory
LAGA	Last Great Ape Organization
LAMEPA	Laboratory for Environmental Modelling and Atmospheric Physics
LCBC	Lake chad basin commission
LEDS	Low Emissions Development Strategy
LEM	Law Enforcement Monitoring
LIDAR	Light Detection and Ranging
LULUCF	Land Use, Land Use Change and Forestry
MAAF	Ministère de l'agriculture, de l'agroalimentaire et de la forêt
MAB	Man and the Biosphere
MDDEFE	Ministère du Développement durable, de l'Économie forestière et de l'Environnement
MDP	Clean Development Mechanism

MECNT	Ministry of the Environment, Nature Conservation and Tourism
MEEATU	Ministère de l'Eau, de l'Environnement, de l'Aménagement du Territoire et de l'Urbanisme
MEEDD	Ministère de l'Economie, de l'Emploi, et du Développement Durable
MEF	Ministère de l'Économie forestière
MEFCPEE	Ministère des Eaux, Forets, Chasse et Pêche, de l'Environnement et de l'Ecologie (RCA)
MEFDD	Ministry of Forest Economy and Sustainable Development
MERH	Department of Environment and fishery Resources
METEOSAT	Meteorological Satellite
MIFACIG	Mixed Farming Common Initiative Group
MIKE	Monitoring the Illegal Killing of Elephants
MINEF	Ministry of the Environment and Forests
MINEP	Ministère de l'Environnement, de la Protection de la Nature
MINEPDED	Ministère de l'Environnement, de la Protection de la Nature et du Développement Durable (Cameroun)
MINFOF	Ministry of Forestry and Wildlife
MIST	Management Information System
MNHN	National Museum of Natural History
MODIS	Moderate Resolution Imaging Spectroradiometer
MPATIEN	Ministry of Planning, Territorial Management, Economic Integration
MPMA	Ministry of Fisheries and the Environment
MPTF	Multi-partner trust fund services
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National adaptation programs of action
NASA	National Aeronautics and Space Administration
NBGB	National Botanic Garden of Belgium
NCCO	National Climate Change Observatory
NDVI	Normalized Difference Vegetation Index
NEPAD	The new partnership for Africa's development
NFI	National forest inventory
NFMS	National Forest Monitoring System

NGO	Non Governmental Organization
NR	Natural Reserve
NRF	National Redd+ Fund
NTFP	Non-Timber Forest Product
NUR	National University of Rwanda
ODI	Overseas Development Institute
OFAC	Observatory for the Forests of Central Africa
OLB	Origin and Legality of Timber
ONFi	Office national des Forêts International
OSFAC	Observatoire satellital des Forêts d'Afrique centrale
OSFT	Tropical Forest Spatial Observation
PA	Protected Area
PACEBCo	Congo Basin Ecosystems Conservation Programme
PACO	West and Central Africa Programme,
PAGEF	Projet d'Appui à la Gestion durable des Forêts du Congo
PALSAR	Phased Array type L-band Synthetic Aperture Radar
PAM	Policies and measures
PAPAFPA	Participatory program to support family farming and artisanal fisheries
PAPECALF	Enforcement of national legislation on wild fauna
PAPPFG	Gabonese project for development of small forestry permits
PAR	Parcipatory Action Research
PAREF	Programme d'Appui à la Reforestation
PARPAF	Project to support the relization of forest concession management plan
PASR-LCD	Sub-Regional Action Programme to Combat Land Degradation and Desertification
PBF	Forest and Biodiversity Programme
PEA	Exploitation and Management Permit
PEI	University of Prince Edward Island Charlottetown
PES	Payment for Environmental Services
PEXULAB	Extreme Emergency Anti- Poaching Plan
PFM	Mvoum Forest Plantation Company
PHC	Plantations and oil factories of Congo
PIKE	Proportion of Illegally Killed Elephants

PIN	Project Idea Note
PNOK	National parc of Odzala-Kokoua
PNS	Salonga National Park
PNSA	National Food Security Plan
PNVi	Virunga National Park
PRM	Périmètre de Reboisement de la Mvoum
ProNAR	National Afforestation and Reforestation Development Program
PSG	Simple management plans
PSGE	Emerging Gabon's Strategic Plan
PVC	Polyvinyl chloride
RAPAC	Central Africa Protected Areas Network
RARC	Agroforestry Resource Center
REDD	Reducing Emissions from Deforestation and Degradation
REDDAF	Reducing Emissions from Deforestation and Degradation in Africa
REL	Reference emission levels
RL	Reference levels
RNRA	Rwanda Natural Resources Authority
R-PIN	Readiness Plan Idea Note
RRC	Rural resource centres
RRI	Rights and Resources Initiative
RSPO	Roundtable on Sustainable Palm Oil
SAR	Synthetic aperture radar
SARIS	Société Agricole et de Raffinage Industriel du Sucre
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDSU	South Dakota State University
SEC	Suitable Environmental Conditions
SECR	Spatially explicit capture-recapture
SEP	Participative monitoring evaluation system
SES	Socio-ecosystem
SESA	Strategic Environmental and Social Assessment
SFM	Sustainable Forest Management
SGSOC	SG Sustainable Oils Cameroon PLC
SGTFAP	Sub-Group on Wildlife and Protected Areas
SIRS	Systèmes d'Information à Référence Spatiale
SLMS	Satellite land monitoring system
SMART	Spatial Monitoring and Reporting Tool
SNAT	National Territorial Management Plan
SNR	National Reforestation Service
SOCAPALM	Cameroonian Palmeraies Company
SOF	State of the Forest
SOFOKAD	Société Forestière de la Kadéi
SPOT-VGT	SPOT - Vegetation
SRTM	Shuttle radar topography mission
SSC	Species Survival Commission
STBK	Société de Transformation de Bois de la Kadey
TC	Teechnical coordination
TLTV	Timber Legality and Traceability Verification
TNS	Trinational Sangha Area
TRAFFIC	The wildlife trade monitoring network
TRIDOM	Trinational Dja-Odzala-Minkebe Area
UCL	Catholic University of Louvain
UFA	Forest management unit
UFE	Forest Exploitation Units
UK	United Kingdom
ULB	Brussels Free University
ULg	University of Liège
UMD	University of Maryland
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNODC	United Nations Office on Drugs and Crime
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
USA	United States of America
USAID	United States Agency for International Development

USDA	United States Department of Agriculture
USFS	United States Forest Service
VAT	Value Added Tax
VCF	Vegetation Continuous Fields
VCS	Verified Carbon Standard
VHR	Very High Resolution
VICA	Vicwood Centrafrique
VPA	Voluntary Partnership Agreement
VU	Vulnerable
WB	World Bank
WCMC	World Conservation Monitoring Centre
WCO	World Customs Organization
WCS	Wildlife Conservation Society
WIST	Wildlife Incident Support Teams
WRI	World Resources Institute
WWF	World Wide Fund for Nature
ZCV	Community Hunting Zone
ZIC	Zones d'Intérêt cynégétique
ZICGC	Zones d'Intérêt cynégétique à Gestion communautaire

PREFACE

We have said before that Central African forests are of global importance, and this is more true now than ever. Adding to climate change concerns, issues such as increased wildlife trafficking, manifested by devastating elephant poaching and increasingly scarce fauna resources available for local populations, land pressures from new forms of industrial farming and mining concessions, and major infrastructure projects. With the dual pressures of population increase and globalization, pressures on forest ecosystems is growing, while management efforts on the ground cannot always effectively keep pace with change.

Thankfully, global awareness of the plight of tropical forests - and Central African tropical forest issues in particular - is growing. International negotiations are searching for better mechanisms to preserve the forests, agreements for protection have been adopted by States, improved forest management standards are being decreed, regional and national institutions are being strengthened. Powerful examples of progress and success stories, are emerging, such as:

- forest and commodity concessions that are legally certified as sustainably managed,
- community rights agreements are increasingly organized and adopted as policy,
- conservation concessions that are created and protected areas that are strengthened.

The differences among COMIFAC countries are more marked than in the past. Some have committed themselves to ground-breaking and results-oriented policies and reforms while learning from other member States. While in other countries governance shows little sign of improvement, which diminishes their international credibility.

It is therefore too early for celebration, but now more than ever we must pursue efforts among all partners to meet the challenges before us.

This new edition of the "State of the Forest" could not have seen the light of day without the contributions of numerous authors and readers who have devoted considerable time and energy to refining it. We thank them immensely. Our sincere thanks also go to the countries and institutions which have supported publication of this work: the European Union, Norway, the United States of America, Germany, France, Canada and the FAO.

Raymond Mbitikon

Executive Secretary of the COMIFAC

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Facilitator of the Congo Basin Forest Partnership

INTRODUCTION

2013 STATE OF THE FOREST: An important participatory undertaking in Central Africa

Participants at the Validation Workshop on the "2013 State of the Forest – 21-22 March 2013"

The 2013 State of the Forest Report is the fruit of a long participatory process of information gathering, exchanges between experts, debates and the building of consensus to provide elements for the improved management of the Central African ecosystems. This vital undertaking responds to a groundswell request from diverse stakeholders for consolidated information in a joint report. The process of creating the report comprises many stages, wherein many actors are involved over a period of more than two years. The production of this new edition began in March 2011 on the occasion of the closure of the workshop to validate the 2010 Report, which was attended by about 65 participants.

As with previous editions, participants were asked to suggest topics of interest for the Report. More than 40 topics were proposed for the 2013 Report. A discussion then began on the prioritization of the various topics. This process resulted in certain topics being reorganized, culminating in the proposal for 10 chapters, which now constitute the bulk of this "State of the Forests".

At the editors' request, the drafting of each chapter is led by a "chapter coordinator". He/she:

(i) Proposes a structure for the chapter, based on the topics proposed,
(ii) Stimulates the group of co-authors to generate their respective contributions,
(iii) Formats the various contributions as well as possible, and
(iv) Prepares the first version of the chapter for the validation workshop and the final chapter based on feedback received from the workshop.

The validation workshop held in Douala on 21st and 22nd March 2013 constituted a key step in the production of this publication. The principal goal of the workshop was to encourage the actors and partners of the Congo Basin forest sector to examine, amend and validate the texts proposed for publication. In total, around 100 persons participated in this meeting, including public administration officials and representatives of environmental NGOs, the private sector and development projects. First, each draft chapter, including its themes and key elements, was presented, thus enabling each participant to identify the topics to which they could best contribute. Secondly, the participants were divided into working groups so as to make suggestions and contributions towards improving chapter content. During these discussions, there was a high degree of participation, and participants helped to make available to the authors better and more accessible information. The authors then proceeded to work on these texts. This work can take several months depending on the information and new analyses proposed at the validation workshop.

Once the texts – often drafted partly in French and partly in English – have been finalized, a proofreading committee works on improving their coherence and presentation in order to reach as wide an audience as possible. The translation, formatting, proofreading, printing and dissemination of the document are the final stages in this adventure, but they are nonetheless intensive and time-consuming and involve substantial human resources.

In terms of content, this new edition pays primary attention to forests other than dense rainforests. Hence three out of the ten chapters are devoted to (i) the forest areas of savannas and steppes, (ii) agroforestry and domestication of trees in Central Africa, and (iii) forest plantations.

Two chapters focus on topics related to climate. The first analyzes the Central African climate, concentrating in particular on (i) the way in which this climate could change in years to come, (ii) the changing impacts and (iii) possibilities of adaptation. The second reviews international negotiations and progress of REDD+ in the region.

Two other chapters address the important issue of allocation and utilization of forest land. The first addresses it from the standpoint of past trends leading to current problems and prospects at a time when the potential of Central African soil and subsoil is being prospected in many ways. Contrary to this first chapter with a somewhat "macro" perspective and a survey of new economic operators, the second chapter tackles the same subject, but from the standpoint of rural societies facing current and foreseeable impacts from emerging multiple land uses.

Finally, three chapters address recurring topics: the changes in forest cover, the forestry industry value chain and biodiversity status. Compared with previous editions, we note a multiplication of research projects on forest cover change using increasingly numerous and detailed satellite data. These studies all demonstrate a faster regional forest cover loss than natural regrowth of the canopy.

Biodiversity is also constantly diminishing. Fauna is under more pressure than ever. In addition to traditional hunting and commercial hunting of bush meat for towns and urban markets, we have witnessed for some years now large-scale poaching and trafficking in species of all kinds. Strengthening the law - the leitmotif of the action plans - is not yet producing the desired results. Among flora or fauna, the only species which expand are the invasive species, and among the keystone species, the mountain gorilla. The logging industry is also experiencing changes; new regulations and new markets (mainly Asian), changing production methods and, here again, differences between the courses followed by the various countries, notably concerning the implementation of sustainable management procedures.

PART 1

THE CENTRAL AFRICAN FORESTS : REGIONAL SYNTHESIS OF MONITORING INDICATORS

CHAPTER 1

Evolution of forest cover at a national and regional scale and drivers of change

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With contributions from : Peter Potapov, Svetlana Turubanova, Alice Altstatt, Louis-Vincent Fichet, Gernot Ramminger, Sharon Gomez, Guillaume Cornu, Lucas Bourbier, Quentin Jungers, Pierre Defourny, Thuy LeToan, Manuela Hirschmugl, Gabriel Jaffrain, Camille Pinet, Cédric Lardeux, Anoumou Kemavo, Philippe Dorelon, Donata Pedrazzani, Fabian Enßle, Joerg Seifert-Granzin, Landing Mane, Ludovic Nkok Banak, Anton Vrieling, Stéphane Mermoz

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1. Introduction

Tropical forests lie at the heart of international challenges of climate change and biodiversity conservation. As the second largest tropical forest ecosystem in the world after the Amazon rain forest, the Congo Basin forest plays a key role in the continental climate system. These African forests provide livelihoods (food, medicinal products, fuel, fiber, non-timber forest products) to 60 million people living within or near them, as well as fulfilling social and cultural functions. These forests contribute indirectly to feeding an additional 40 million people who inhabit regional urban centers (Nasi *et al.*, 2011).

Mapping forests and monitoring forest change is critically important. The state of forests affects the well-being of millions of people, the regional and global environment, and biodiversity status. Precise knowledge about a forest's surface area, botanical composition and dynamics provides information essential for implementing and monitoring environmental and economic policies. The essential roles played by forests are central to multilateral environmental agreements such as the United Nations Framework Convention on Climate Change (UNFCCC), specifically Reducing Emissions from Deforestation and Forest Degradation (REDD+) policies which recognize the role of forests in the carbon cycle, and the Convention on Biological Diversity (CBD), which considers the loss of forest habitats a leading cause of decreased biodiversity. The European FLEGT policy (Forest Law Enforcement, Governance and Trade) requires information on the traceability of timber products and the legality of logging.

Photo 1.1 : Gombé (Didelotia sp) in a mature forest, south-west Gabon

This chapter provides a partial overview of initiatives underway to monitor Central African forests using satellite imagery. The scale of analysis ranges from local to national and to the whole of Central Africa. Most of the studies identify areas affected by deforestation but more recent efforts attempt to monitor more finite changes in forest cover such as forest degradation and biomass reduction.

Photo 1.2: Mixed forest canopy in northern Gabon

2. National forest cover monitoring initiatives

Several countries including Gabon, Cameroon, the Congo, the Central African Republic (CAR) and the Democratic Republic of Congo (DRC), have officially committed to the REDD+ process (see Chapter 5). These countries are required to set up an integrated Measurement, Reporting and Verification (MRV) system to monitor changes in deforestation and/or forest degradation as well as improved forest cover. Mapping areas of forest cover change is indispensable to develop strategies adapted to local conditions to better monitor these dynamics. Highly detailed national maps are required only every three to five years, but changes in forest cover must be monitored more frequently. This MRV approach requires that national standards be established (such as the definition of the forest in terms of forest cover) and the involvement of national experts in mapping and validation processes.

Table 1.1: *Partial list of projects supporting national and local forest cover change mapping initiatives..*

Name (*)	Country	Leader	Institutional Partners / Countries	Technical Partners	Donors	Duration	Period of analysis	Coverage	Application IPCC recommendations
GSE-FM	Cameroon	GAF	MINFOF, MINEP	FAN	ESA, KFW	2008-2010	1990-2000-2005	Country	No
	Congo	GAF	MDDEFE	SIRS, JR	ESA, FFEM	2010-2014	1990-2000-2010	Country	Yes
	Gabon	SIRS	AGEOS	GAF, JR	ESA, FFEM	2010-2014	1990-2000-2010	Country	Yes
OSFT	CAR	Astrium	MEEDD	IGNFI	AFD	2010-2014	1990-2000-2010	33 Sub prefectures (55 % Country)	Yes
REDDAF	CAR	SIRS	MEEDD	GAF, CESBIO, JR, LACCEG	EU	2010-2013	1990-2000-2010	South-West Region	Yes
	Cameroon	GAF	MINEPDED	SIRS, CESBIO, JR, GTG	EU	2010-2013	1990-2000-2010	Center Province	Yes
FACET	Congo and DRC	OSFAC	-	SDSU, UMD, WRI	CARPE/ USAID, NASA, CBFF/ADB	2009-2013	2000-2005-2010	Country	No
ReCover	DRC	Norut	OSFAC	ALUFR, GMV	EU	2010-2013	1990-2000-2005-2010	West Region	No
REDDiness	Congo, Gabon	Eurosense	MEF (Gabon), CNIAF (Congo)	ITC, IRD	EU	2011-2013	2007-2012	South Congo, South-East Gabon	No

(*) Refer to the list of acronyms at the beginning of the report for the meaning of the abbreviations used in the table

Mapping methodologies may differ from one country to another because of different conditions and national standards. National and local forest cover change mapping initiatives are presented in Table 1.1. This section will then provide details on the national mapping initiatives for only Gabon, Cameroon, the Congo, and the CAR as the mapping of the DRC (FACET) was published previously in the State of the Forest 2010.

2.1 Gabon

Gabon has complete forest cover maps for the years 1990, 2000 and 2010. This mapping was performed under the framework of the GSE-FM Gabon project by processing Landsat satellite images for 1990 and 2000, and a combination of Landsat and Aster images for 2010. To cover the entire territory of Gabon, 300 satellite images were used because of permanent cloud cover, where without cloud cover, only fifteen Landsat images would be required.

Detailed mapping was conducted first for the reference year 2000. Each image from 2000 was processed and classified separately to extract forest cover. Detailed quality control was applied to each image and the results were "mosaicked" to create the Forest/Non Forest (F/NF) national layer for the year 2000. This F/NF map then was superimposed on images from 1990 and 2010 to extract the changes observed and classify them using a nomenclature compatible with that used

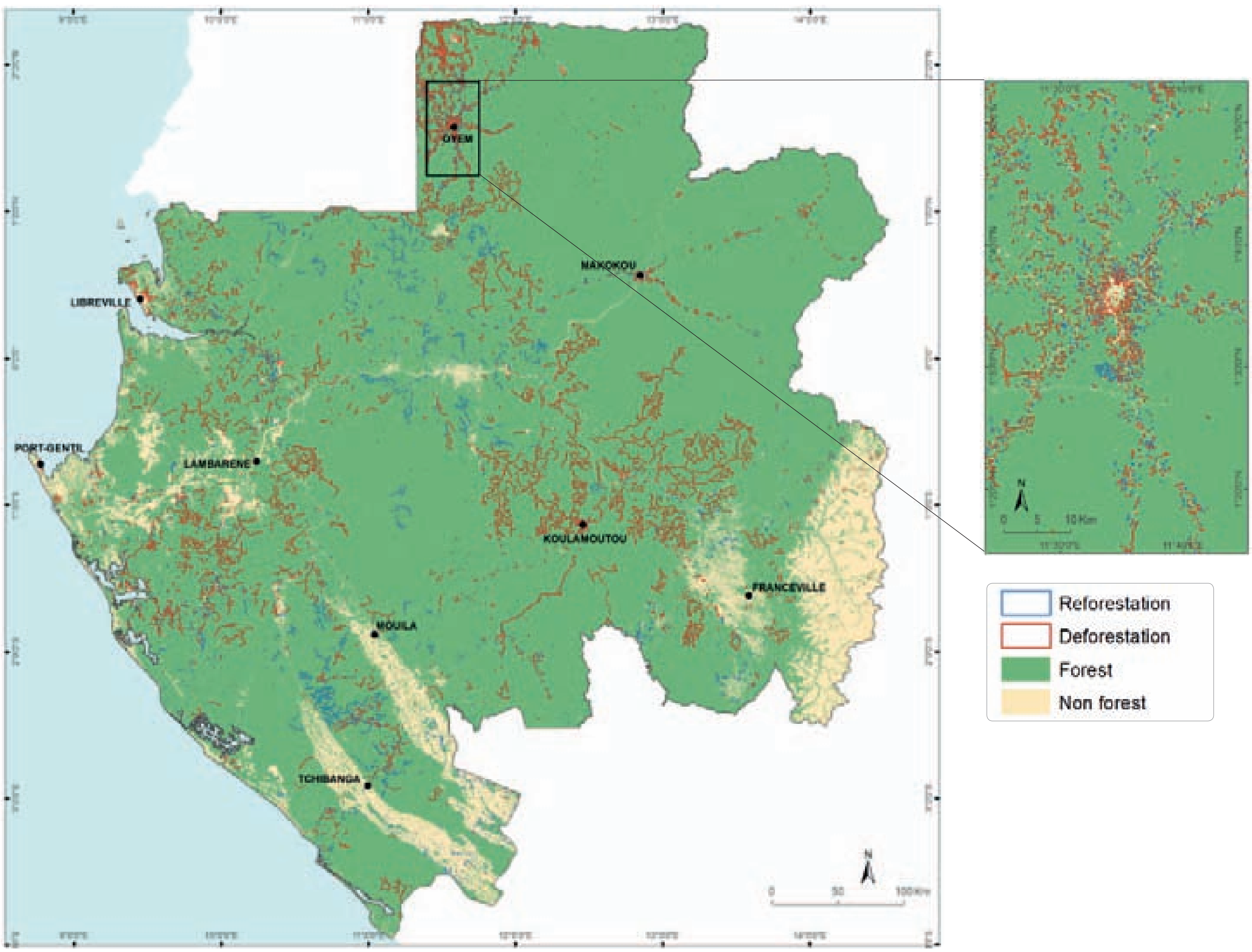

Figure 1.1 : Map of forest cover and change in Gabon between 1990 and 2000
Source : GSE-FM Gabon

by the IPCC. Accuracy of the derived F/NF maps was assessed at approximately 98 % for the three periods. The methodology used is described in detail by Fichet *et al.* (2012 and 2013). To improve the forest change estimate, the F/NF maps were combined with a photo-interpreted systematic sampling covering 1 % of Gabon (Sannier *et al.*, 2014). The results for all of Gabon are presented in Table 1.2. Forest covers more than 88 % of the territory, or about 236 000 km².

Table 1.2: *Forest cover change estimation in Gabon between 1990, 2000 and 2010*

	Unit	1990	2000	2010	1990-2000	2000-2010
Gabon	km²	267 667			Net deforestation	
Forest cover	km²	237 380	236 570	236 335	810	235
	%	88.68	88.38	88.29	0.34	0.10
Uncertainty (95 % CI)	km²	±664	±711	±698	±293	±259
	%	±0.25	±0.27	±0.26	±0.13	±0.11

Source: GSE-FM Gabon

The net deforestation rate between 1990 and 2000 is 0.34 %, representing a nearly 800 km² reduction in forest cover. Gross deforestation is estimated at slightly over 1 200 km². Almost half of the deforestation is due to logging and the opening of roads while nearly a third is from the conversion of forest into crop land, prairies and savannas. Slash-and-burn agriculture merges with the savanna on the satellite images. Nearly 400 km² have been reforested, 60 % by conversion of savannas/prairies into forest and 25 % from the reforestation of logging roads.

A clear slowing of deforestation occurred between 2000 and 2010 with an observed deforestation rate of 0.10 %, a value which is not significantly different from zero. This reduced deforestation rate may be related to the low rural population density, weaker agricultural dynamics and institutional measures taken by Gabon regarding national parks and the forest code. Thirteen national parks are located over the entire territory and the forest code has required operators to develop forest management plans. Another possible explanation may be found in ecological conditions broadly favorable to rapid forest regeneration, notably very good rainfall and a good dissemination of seeds by a wide range of animal species (Doucet, 2003). The ruggedness of the terrain also hinders the permanent logging of forests. Reasons for the reduced deforestation rates must be confirmed by studies underway in Gabon on the causes of deforestation and reforestation.

Photo 1.3: Peri-urban areas are less and less forested

2.2 Cameroon

Full national satellite image coverage based on Landsat data for 1990 and 2000, and DMC data for 2005/06 were acquired and analyzed to complete the forest cover assessment for Cameroon. The forest and non-forest areas were mapped for these years with a Minimum Mapping Unit (MMU) of 5 ha. Two separate projects (GSE-FM Cameroon and REDDAF) have undertaken mapping activities in the country, but budgetary constraints limited most work to the Eastern Province and Central Provinces.

Based on the production of forest/non-forest (F/NF) maps of the Eastern Province, change maps were generated for the periods of 1990-2000 and 2000-2005 (figure 1.2). The changed areas were then classified into the five IPCC-compliant categories: cropland, grassland, wetland, settlement land and other land. Training data necessary for the F/NF classification was derived from Very High Resolution (VHR) imageries and from data acquired during field campaigns.

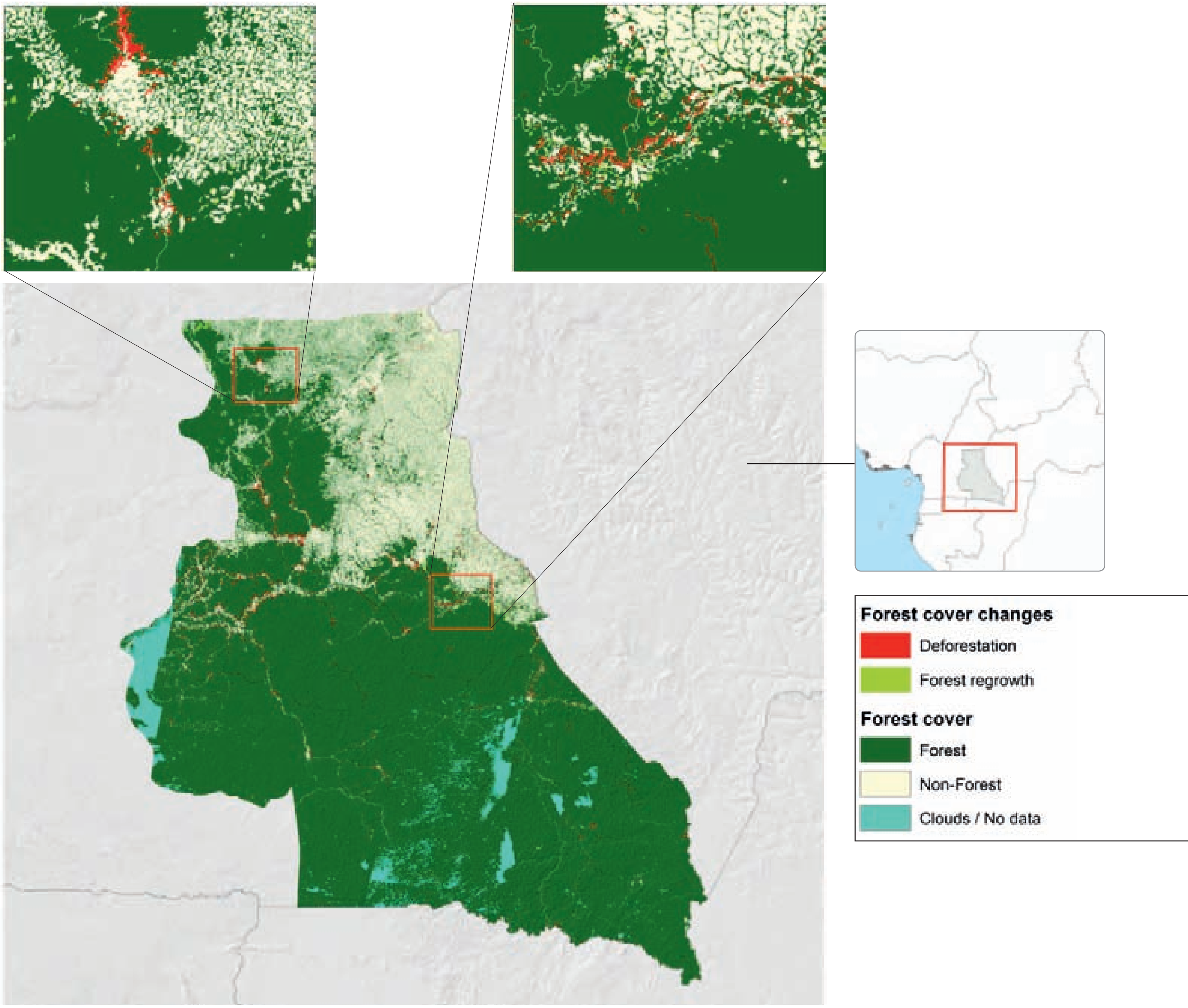

Figure 1.2: Forest cover change (in red) in the Eastern Province of Cameroon for the periods 1990-2000 and 2000-2005
Source: GSE-FM Cameroon

Table 1.3 presents forest cover change for the three reference years, (1990, 2000 and 2005). Because of cloud cover, the mapped area represents about 96-98 % of the 112 950 km² of the Eastern Province. Therefore, this mapped area (and corresponding forest cover areas) differs slightly between the two periods (*). The gross deforestation rate for the 1990-2000 period was estimated at 0.86 %. There was significant regrowth (0.21 %) during this period, leading to a net deforestation rate of 0.65 %. For the period 2000-2005, the gross deforestation rate was 0.07 %. Given the high rate of regrowth (0.10 %), the net deforestation rate over the 2000-2005 period is estimated at -0.03 %.

***Table 1.3**: Forest cover change estimations in the Eastern Province of Cameroon over the period 1990-2000-2005*

Eastern Province		1990	2000 (a)*	2000 (b)*	2005	1990-2000	2000-2005
Mapped area	km²	108 854		110 781		Net Deforestation	
Forest cover	km²	87 991	87 424	89 187	89 209	567.7	-22.9
	%	80.83 %	80.31 %	80.51 %	80.53 %	0.65 %	-0.03 %

(*) see in the text for explanation
Source: GSE-FM Cameroon

2.3 Republic of Congo

Photo 1.4: Relic forest protected by villagers in Bas-Congo, DRC

A forest cover and change mapping exercise for the years 1990-2000-2010 was performed within the framework of the GSE-FM Congo project. While the project goal is to cover the whole country to build a National REDD Strategy with the involvement of the Cameroonian government (MINFOF and MINEP), first analyses were only performed for the Northern Congo (Likouala and Sangha Provinces). To overcome the problem of heavy cloud cover in some parts of the country, different satellite sensors were used (Landsat-4, -5, -7, Aster, DMC, RapidEye and SPOT). Areas where forest cover change occurred were classified into the IPCC-compliant land cover classes. Preliminary results over Northern Congo indicate net deforestation rates of approximately 0.21 % for the period 1990-2000 and 0.03 % for the period 2000-2010 (table 1.4). Between 1990 and 2000, the gross deforestation rate was 0.35 % whereas the regrowth accounted for 0.14 %. For the second period (2000-2010), the gross deforestation rate was 0.27 % and the regrowth rate increased up to 0.23 %.

***Table 1.4**: Forest cover change areas Northern Congo (Likouala and Sangha Provinces) over the period 1990-2000-2010*

Likouala & Sangha		1990	2000	2010	1990-2000	2000-2010
Average Mapped area	km²	124 774			Net Deforestation	
Forest cover	km²	120 422	120 171	120 131	251.1	40.4
	%	96.5	96.3	96.3	0.21 %	0.03 %

Source: GSE-FM Congo

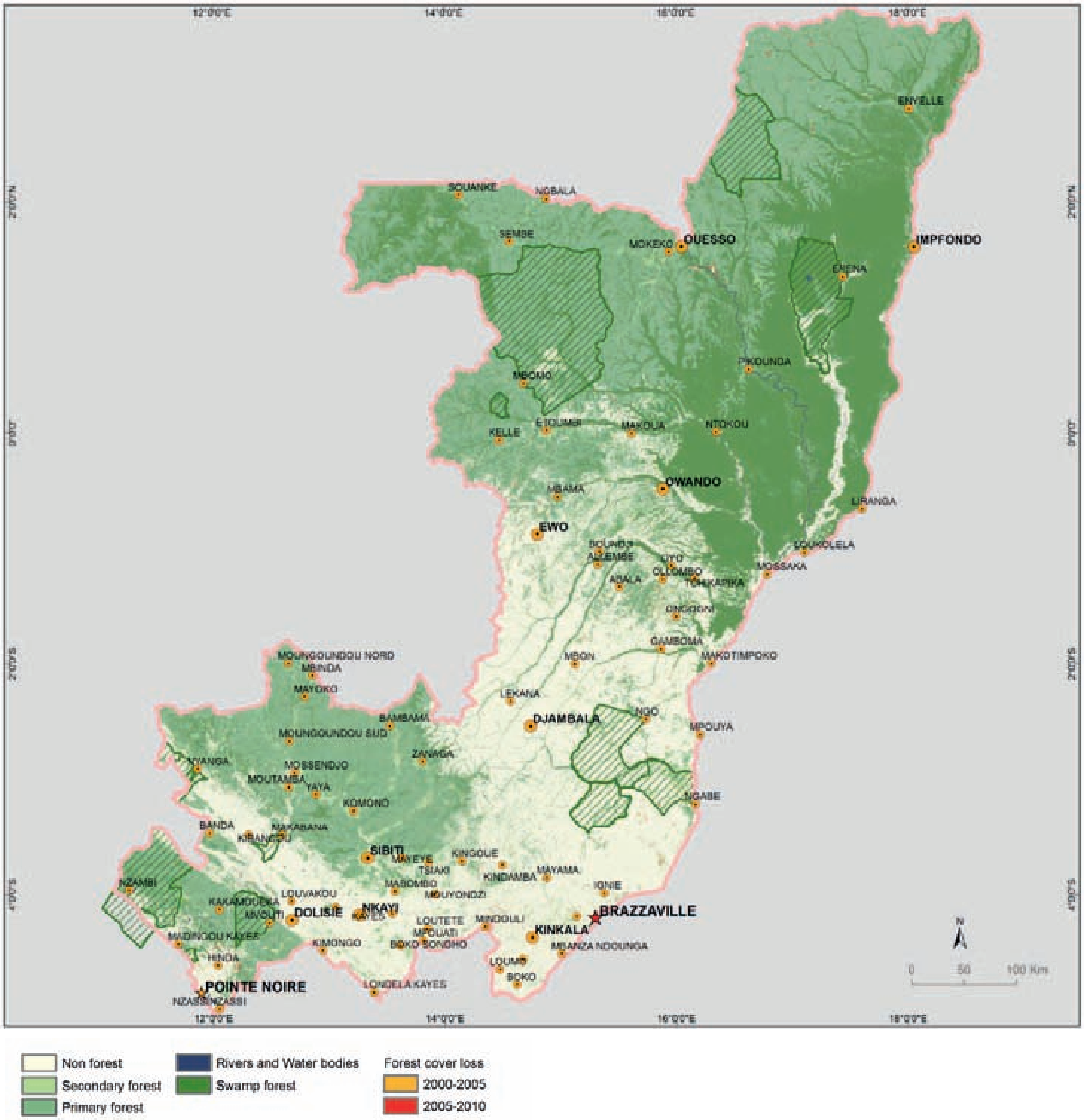

Figure 1.3 : Forest cover loss map of the Republic of Congo for the period 2000-2005-2010
Source : FACET Congo

Another mapping initiative over the Republic of Congo is the FACET atlas, a wall-to-wall mapping exercise performed over the entire national territory. FACET (*Forêts d'Afrique Centrale Évaluées par Télédétection*), quantitatively evaluates the spatiotemporal dynamics of forest change in Central Africa through the use of multi-temporal satellite data. FACET is a joint project of the *Observatoire Satellital des Forêts d'Afrique Centrale* (OSFAC) and the University of Maryland. The approach used for the Congo FACET atlas is similar to that used to produce the FACET atlas for the DRC (Potapov *et al.*, 2012), which was presented in the 2010 SOF Report (de Wasseige *et al.*, 2012). An exhaustive exploration of the Landsat ETM+ satellite archive was carried out in order to map the extent and loss of forest cover in the Congo from 2000 to 2010. A total of 1788 ETM+ images were processed to achieve the final map. This method is an evolution of the approach used by Hansen *et al.* (2008), where MODIS data are used to pre-process time series Landsat images, which are in turn used to characterize the extent and loss of forest cover. Forest cover has been mapped for 2000, and forest cover loss has been analyzed from 2000 to 2005 and from 2005 to 2010 (figure 1.3).

Forest cover change was analyzed across the entire national territory, with 99.9% of the land area covered by cloud-free Landsat observations. The total forest cover in 2000 was estimated at 229 385 km² (table 1.5). *Terra firme* primary forests comprise 52% of the total forest area, whereas secondary forest and swamp forest cover 4% and 44% of the total forest area, respectively. The area of gross forest cover loss between 2000 and 2010 was estimated at 1700 km² or 0.7% of the total 2000 forest area. For the total loss of forest cover, 51% occurred in *terra firme* primary forest, 34% in secondary forest, and 16% in swamp forest. The forest cover loss rates varied by forest type: the highest rate occurred in secondary forest (6.7%) and the lowest rate occurred in swamp forest (0.3%). The forest cover loss rate for primary forest was 0.7%. Most of the forest cover loss in primary forests is attributed to the expansion of agriculture and logging in pristine forests, which could potentially change plant and animal species composition as well as ecosystem dynamics. The total forest cover loss nearly doubled from the 2000-2005 to the 2005-2010 intervals. The greatest rate of increase occurred in swamp forest, where the loss increased nearly three-fold (284%), while *terra firme* primary forest loss increased by 182%.

Table 1.5: *Forest cover loss for the Republic of Congo over the period 2000-2005-2010 (area reported in square kilometers)*

		2000	2005	2010	Forest Loss	
					2000-2005	2005-2010
Congo	km²	339118				
Primary Forest	km²	117 708	117 403	116 846	305.4	557.2
Secondary Forest	km²	8 534	8 310	7 962	224.6	347.4
Swamp Forest	km²	101 443	101 374	101 178	68.9	195.9
Total Forest	km²	229 385	228 786	227 685	598.8	1 100.5
	%	67.6%	67.5%	67.1%	0.26%	0.48%

Source: FACET Congo

Box 1.1: Monitoring deforestation in the DRC – the TerraCongo project

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The *TerraCongo* project, initiated in 2011, stems from a collaboration between the Brazilian Space Agency INPE, and FUNCATE (a Brazilian foundation charged with the technical development of methods and tools for the Amazon forest monitoring system), the FAO, and a number of countries participating in the UN-REDD program (www.un-redd.org), notably the DRC, Paraguay and Papua New Guinea. The collaboration aims to build national capacity for tropical forest Monitoring and Measurement, Reporting and Verification (M and MRV) based on (mostly) freely available technology and data. Other goals of the project include reinforcing the technical and professional capacities of national experts during the implemen tation phase, as well as incorporating existing national data and methods into the TerraCongo system. FAO serves as a catalyst for the south-south transfer of technology and technical capacity building (notably, the Brazilian *TerraAmazon* software) and to promote and generate freely available, open-source remote sensing tools.

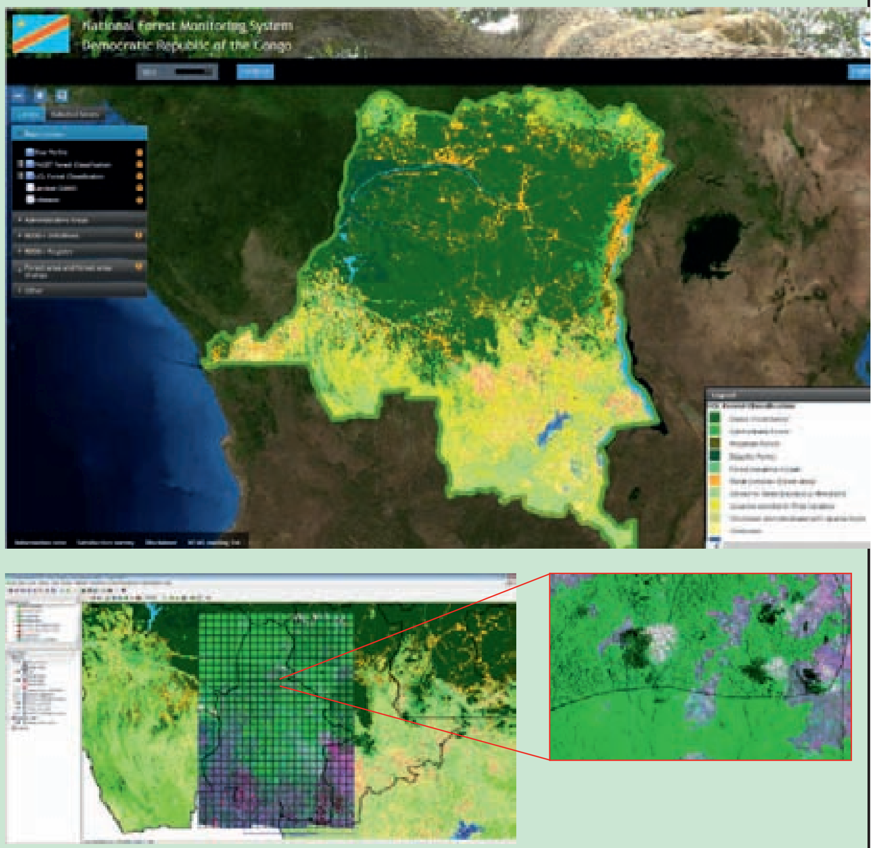


Figure 1.4: Presentation of the DRC forest monitoring initiative

DRC's *TerraCongo* is the first country implementing this initiative. The first phase of the project focuses on forest monitoring and data dissemination through the internet, which together form the DRC's official National Forest Monitoring System (NFMS). Currently the project only encompasses the Kasai-Occidental province, which has about 96 000 km^2 of forest. Kasai-Occidental province was chosen to start because it received the highest feasibility rank in an assessment that considered several criteria (surface area, deforestation rates, REDD+ activity, cloudiness, data availability, topography, forest plots, and forest types). This initial phase will be followed by the successive inclusion of all of the DRC's provinces, each which will each be stored in separate databases.

The measurement of the forest area for the TerraCongo project is based on freely available Landsat satellite data, free tools for image processing (e.g. http://km.fao.org/OFwiki/index.php/Open_Foris_Geospatial_Toolkit), and the free-of-charge *TerraAmazon* software (www.terraamazon.org) that facilitates multi-user editions of land cover maps. All satellite imagery used in the project is corrected and segmented. The data processing occurs in two main stages: the delineation of forest area for the year of reference and the detection of changes to the delineated forest area in subsequent years. Data pre-processing for the first stage makes use of the officially-adopted forest map, the DRC FACET map, which provides training data for image segment classification. The resulting initial forest map is estimated to be about 85% accurate (based on comparisons with high-resolution imagery in Google Earth, and not accounting for time differences). Data pre-processing for the second stage involves the automatic detection of change in forest cover between images from different dates.

In both data processing phases, a group of five national experts from DIAF (Department of Forest Inventory and Management), who received training in Brazil, Italy, and the DRC, post-process and validate the information derived though automated data processing to ensure that the forest areas conform to the DRC's official definition of a forest as submitted to the UNFCCC secretariat. This is done using a dedicated workspace in the *TerraAmazon* software, with two separate projects (implemented in the same database); one for the finalization of forest mask, and one for the periodic assessment of forest area change. Recent efforts focus on gathering high-resolution imagery to aid Landsat data interpretation and project validation, and on the handling of all data pre- and post-processing into the open and free software.

Results from the above-described work are published through the official NFMS web-portal of DRC (www.rdc-snsf.org), which was officially launched in December 2011 (COP), and is available to import, process, and disseminate any data related to forest Monitoring and MRV.

2.4 The Central African Republic (CAR)

The forest mapping exercise in the CAR, undertaken under the framework of the REDDAF and OSFT projects, covers about 345 000 km² in the southern part of the country, or 55 % of the national territory spread over 12 prefectures of the main rainforests area. Dense rainforest areas are in the south, while gallery forests and areas of more open and drier woodland formations are found in the north. The forest maps were produced from the classification of Landsat satellite images for the earliest periods, and SPOT 4/5 and RapidEye for the more recent ones.

For the three prefectures in the southwest (Sangha Mbaéré, Lobaye and Ombella-Mpoko), the methodology is identical to that used in Gabon (F/NF maps of the pivotal years 1990, 2000 and 2010 : see paragraph 2.1). For the nine other pre-

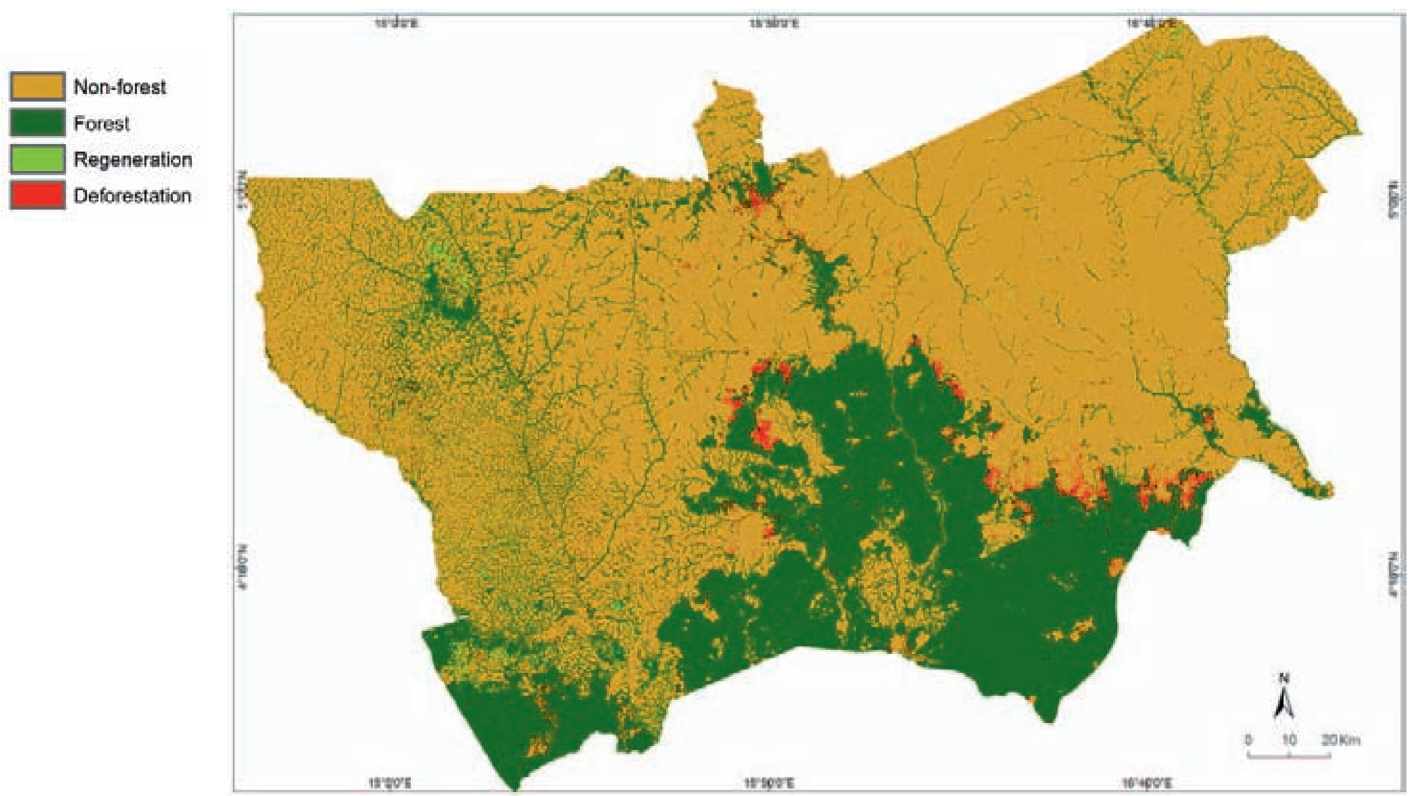


Figure 1.5 : Map of forest change between 2000 and 2010 in Mambéré Kadei province (Lot 1), CAR
Source : OSFT

Table 1.6: *Historical evolution (1990-2000-2010) of dense rainforest area in CAR, per prefecture*

Prefecture	Total area (km²)	1990		Changes 1990-2000 in dense rainforest		Changes 2000-2010 in dense rainforest	
		Dense rainforest area		***Deforestation***	***Regrowth***	***Deforestation***	***Regrowth***
		(km²)	***(%)***	***(km²)***	***(km²)***	***(km²)***	***(km²)***
Mambere-Kadei	30 100	9 845	32.7 %	694	59	436	151
Nana-Mambere	27 400	3 342	12.2 %	251	17	244	19
Ouham-Pende	23 300	1 093	4.7 %	105	25	99	7
Ouham	27 300	3 733	13.7 %	200	27	187	28
Kemo-Gribingui	16 800	4 582	27.3 %	318	32	347	15
Ouaka	49 200	5 246	10.7 %	263	112	188	120
Haute Kotto	16 200	4 174	25.8 %	182	23	254	27
Basse Kotto	17 200	2 750	16.0 %	54	102	53	160
Mbomou	60 400	23 668	39.2 %	362	141	364	116
Haut Mbomou	24 000	5 731	23.9 %	117	139	74	144
Sangha Mbaéré	18 700	17 713	94.7 %	124	34	118	55
Lobaye	18 400	10 223	55.6 %	119	7	128	64
Ombella-Mpoko	32 100	6 536	20.4 %	308	1	115	14
Total	**361 100**	**98 636**	**27.3 %**	**3 097**	**718**	**2 607**	**919**
Net deforestation			(km²)	2379		1688	
			(%)	2.41 %		1.75 %	

Source: OSFT and REDDAF-CAR

fectures, a detailed map of the year 2010 was produced using 10 m resolution SPOT images. Forest cover changes over the periods 2000-2010 and 1990-2000 were analyzed through comparisons with lower resolution Landsat images. The detailed map for 2010 was made with 6 land cover classes: dense forest, wooded savanna, savanna, settled area, wetland, and crop land. Figure 1.5 illustrates the changes in Mambéré Kadei province.

Forest change was assessed by comparing the 1990, 2000, and 2010 maps. These changes are presented by prefecture in Table 1.6.

The deforestation rate is relatively low in the rainforests of the CAR, at about 2 % over 10 years, with the exception of certain prefectures such as Nana-Mambere and Kemo-Gribingui, which have higher deforestation rates (reaching up to 7 % over 10 years). The dense rainforest in the CAR lost 4 % of its total area (4 067km²) in 20 years, or an average of 0.20 % per year.

3. Regional assessment of forest cover change

Photo 1.5: Conversion of primary forest into manioc fields

Efforts to harmonize forest cover monitoring at the regional scale complements various national initiatives (table 1.7). As certain criteria, including the definition of forest mapping can differ from one country to another; it is difficult to make comparisons between countries. Regional approaches permit a coherent overall assessment of the Central Africa forests. Two types of regional analyses are being conducted, each with its own advantages and disadvantages. The first, designed for a regional or even national but not local scale is a sampling approach that enables a better understanding of forest change because it covers the period 1990 to 2010. The second is wall-to-wall mapping, which is indispensable for the implementation of national and local policies but requires the processing of extensive satellite imagery using sophisticated tools.

***Table 1.7:** The different approaches used to monitor forest cover in Central Africa between 1990 and 2000, and between 2000 and 2010*

	1990-2000		2000-2010		
Country	**National mapping**	**Mapping by sampling**	**National mapping**	**Mapping by sampling**	**Atlas FACET**
Cameroon	X(East)	X	X(East)	X	X*
Congo	X(North)	X	X(North)	X	X
Gabon	X	X	X	X	X*
Eq. Guinea		X		X	X*
CAR	X(South)	X	X(South)	X	X*
DRC		X		X	X
Chad		X		X	
Regional		X		X	X*

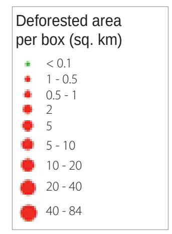
(work in progress)*

Under the framework of the TREES project, launched in 1992 by the European Commission, a new assessment of deforestation was carried out using the 1990-2000-2010 time series covering the Congo Basin. Maps were developed based on satellite images using updated image processing techniques. The maps were compared to determine the deforestation rate for each country of the Congo Basin. This study contributed to the FAO's 2010 Global Forest Resources Assessment (FRA) (FAO, 2012).

Photo 1.6: Munaya River, Cameroon

The TREES/FRA approach uses extracts from satellite images of 10 x 10 km plots dating from 1990, 2000, and 2010. The images were selected through a systematic sampling on each half degree of latitude/longitude (and even a quarter of a degree for Gabon and Equatorial Guinea, frequently covered by clouds), resulting in a potential total sample of 510 points systematically distributed over the rainforests of Central Africa. However, only 311 sites had good quality images for these three periods. Although the target years were 1990, 2000, and 2010, some images used were for years near these dates because of persistent cloud cover and the low number of images available. Most of the missing samples for these dates were in coastal areas of Gabon, Equatorial Guinea and Cameroon. The Landsat satellites that provided the data for 1990 and 2000 samples encountered technical difficulties in 2010. Therefore, the 2010 data set was built by combining data from several different satellites with similar spectral resolution: DMC (short revisit period and 22 to 32 m resolution), SPOT-4 and -5 (20 and 10 m resolutions). In all, 43 % of the images used for the 2010 analysis were DMC, 22 % SPOT, and 34 % Landsat TM.

Forest cover changes over the 1990-2000-2010 period were estimated based on an original image processing chain: visual selection of the best images available, recalibration, calibration, masking clouds and shadows, segmentation, detection and classification of change (Raši *et al.*, 2013). The processing chain was adapted for the DMC and SPOT samples (Desclée *et al.*, 2013). The automatically produced land use maps were verified and detected errors were recoded. The comparison of pairs of maps validated between 1990 and 2000, and between 2000 and 2010, enabled forest cover changes to be measured at the level of each sampling point (Mayaux *et al.*, 2013). Changing deforestation over the entire Congo Basin is presented in Figure 1.6.



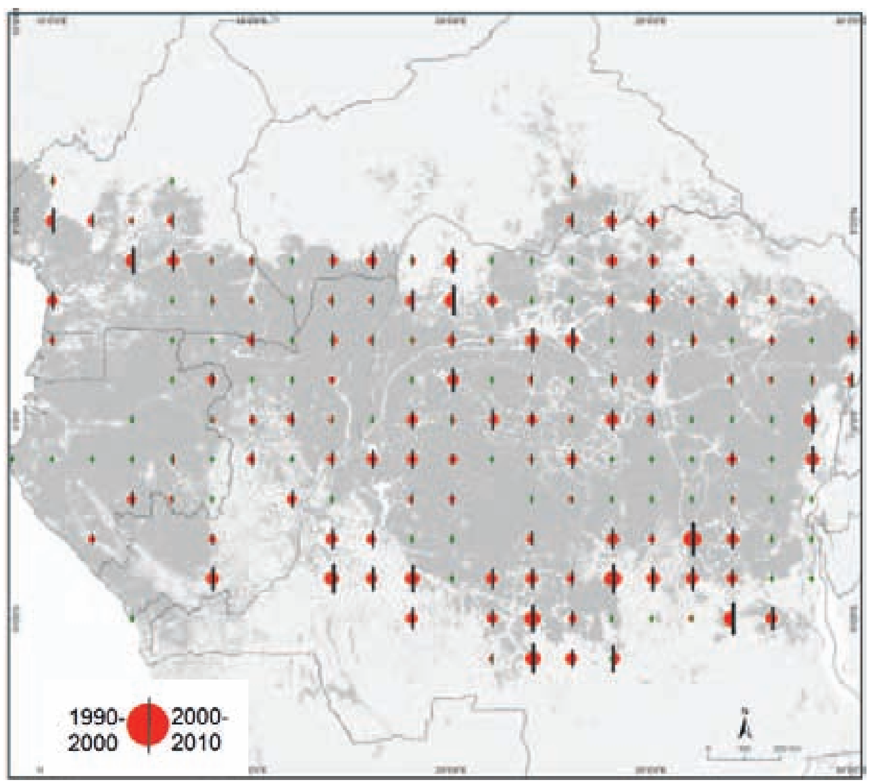


Figure 1.6: Gross deforestation in the Congo Basin standardized at the level of each point sampled between 1990 and 2000, and between 2000 and 2010
Source: JRC

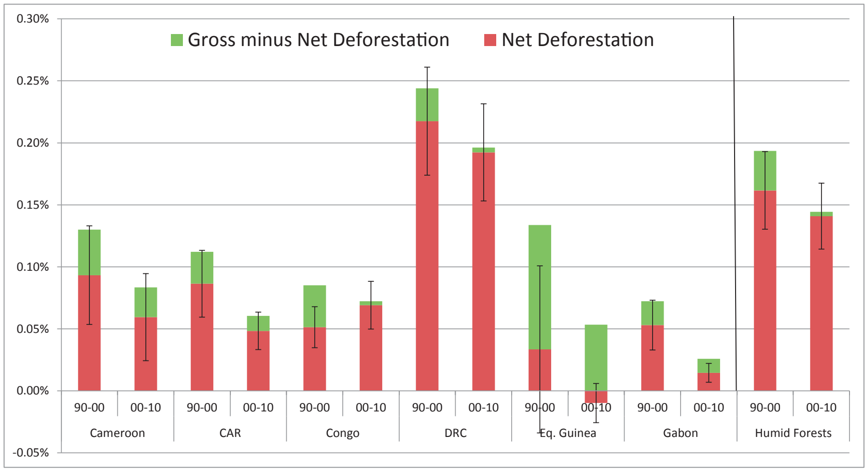


Figure 1.7 : Annual deforestation rates (gross and net) of Central African rainforests between 1990 and 2000, and between 2000 and 2010 (with standard error bar). The numbers are presented in Annex 1A.*

*Sources : UCL (1990-2000) and JRC (2000-2010) *Preliminary results*

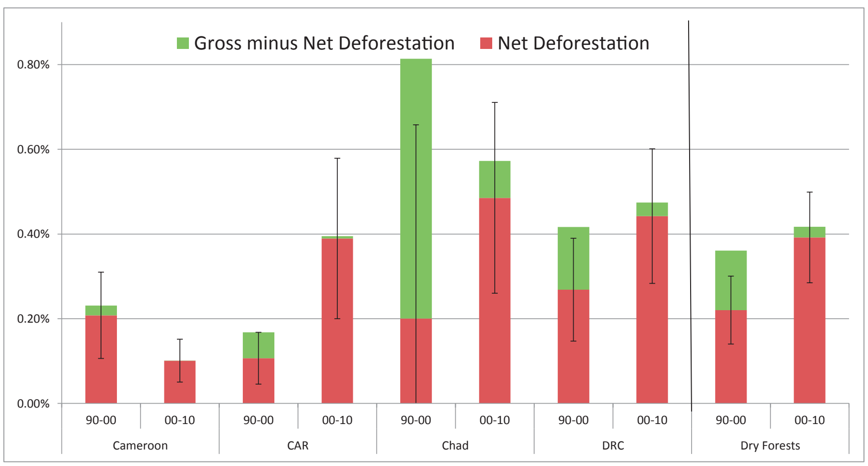


Figure 1.8 : Annual deforestation rates (gross and net) of Central African dry forests between 1990 and 2000 and between 2000 and 2010 (with standard error bar). The numbers are presented in Annex 1B.*

*Source : JRC *Preliminary results*

Figure 1.7 indicates the estimated deforestation rates per country and for all of the rainforests of Central Africa between 1990 and 2000, and between 2000 and 2010. The overall trend is a reduction in the deforestation rate, which drops from 0.19 % to 0.14 % for all of the Congo Basin rainforests. Reforestation also is decreasing and remains negligible.

A similar analysis was carried out for Central African dry forests. These dry forests are located outside the Guinea-Congo rainforest ecoregion. The approach described for the 1990-2000 period by Bodart *et al.* (2013) was extended over the 2000-2010 period for the COMIFAC countries. The main countries concerned are Cameroon, the CAR, the DRC, and above all Chad. The data for 1990 and 2000 were provided by Landsat and for 2010 by DMC (62 %) and Landsat TM (38 %). The results of this study are presented in Figure 1.8. While the gross deforestation rate is similar between 1990 and 2000 and between 2000 and 2010 (0.36 % vs. 0.42 %), reforestation decreases, dropping from 0.14 % to 0.03 % between these two periods.

3.2 Regional Landsat-scale forest extent and disturbance FACET map

A set of map products has been generated as part of the FACET program. These products, delivered as hard and soft-copy atlases of forest type, extent and loss at national scales, represent the first medium spatial resolution maps of their kind. We report here an addition to the FACET product suite, which to date consists of national scale products for the DRC (presented in SOF 2010) and the Republic of Congo (presented in Section 2.3). These mapping methods have now been extended to the regional scale, characterizing the following countries of Central Africa : Cameroon, the CAR, Congo, the DRC, Equatorial Guinea and Gabon.

Medium spatial resolution Landsat imagery is the data of choice in quantifying forest extent and change over large areas. The Landsat program meets several requirements for operational monitoring including a formal data acquisition strategy, an open data policy (data are provided free of charge and are readily accessible through the Glovis facilities ; http ://glovis.usgs.gov), and radiometric and geometric correction of the data, which obviates the need for onerous pre-processing by users. The successful launch of Landsat 8 in February 2013 assures the continuation of the program.

Methods for mass-processing the Landsat archive in support of land monitoring programs are now being implemented. Data-intensive computational methods allow for the querying of every Landsat pixel, enabling researchers to overcome the primary limitation of optical earth observation data sets for tropical Africa : cloud cover. FACET processing of Landsat data includes per pixel quality assessment in order to retain only viable land surface observations for forest characterization. Technical methods for processing and characterizing Landsat data in this manner are presented by Potapov *et al.* (2012). For this first regional product, data from 1999 through 2012 were included. To date, FACET products include two maps : a forest extent reference at time 1 and a forest cover loss estimate between time 1 and time 2 (Hansen *et al.*, 2013).

Regional-scale Landsat-derived forest extent and loss map products were derived and are displayed together in Figure 1.9 : a percent tree cover map for 2000 and a forest cover loss estimate map for the period of 2000 to 2012. Forest cover loss (in red) includes areas with tree cover greater than 30 % of surface area that experienced stand-replacement disturbance between 2000 and 2012.

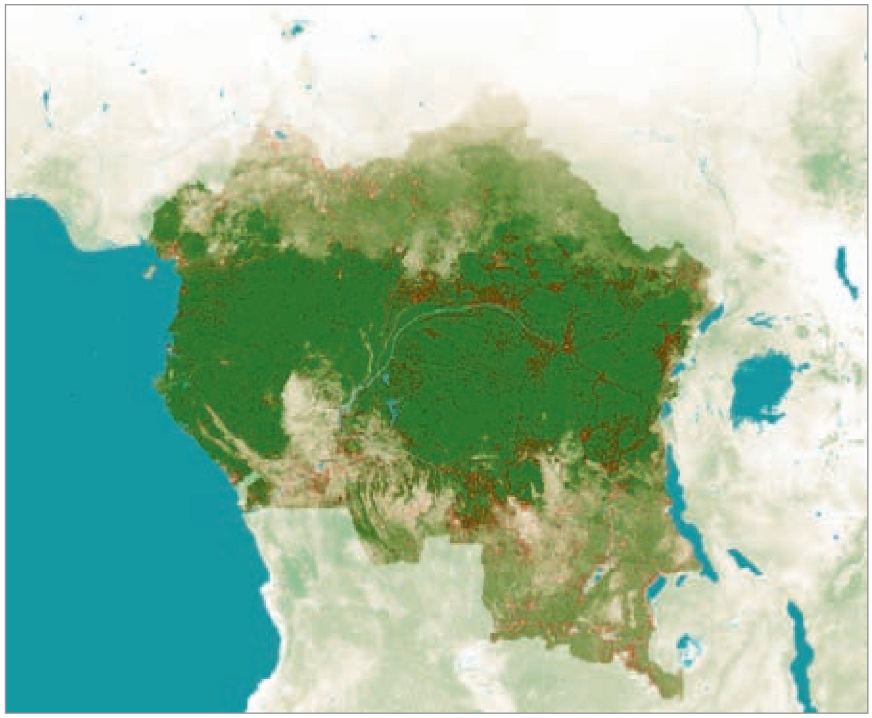


Figure 1.9 : Landsat-derived regional percent tree cover and forest cover loss for tree cover ≥ 30 % canopy cover

Source : FACET

Photo 1.7 : Village and Landscape of South Kivu

A regional subset is shown in Figure 1.10, illustrating the variation in forest disturbance between countries along the northern fringe of the Congo Basin rainforest. The background image captures the high data quality of the input Landsat data and the lack of cloud or haze contamination, which was possible because of the mass-processing of the Landsat archive.

Such regional maps demonstrate capabilities that could be adopted by national agencies responsible for forest monitoring. As an example, FACET data have been incorporated into UN-REDD activities, including the use of FACET as the primary thematic layer for forest cover extent and loss for the DRC's National Forest Monitoring System (NFMS). National monitoring tasks in support of the REDD+ initiative will require such data in establishing baseline carbon emissions estimates. Forest definitions used in REDD+ may vary based on tree height and cover density. For this regional map, the percent canopy cover of 5 meter or taller trees was estimated per pixel. Percent tree cover maps allow users to vary the definition of a forest based on canopy cover and enable the disaggregation of forest loss by canopy density strata. The mapped forest cover loss is for stand-replacement disturbances only, and it does not include an assessment of forest degradation due to selective logging. Additionally, to properly model carbon emissions for REDD+ monitoring objectives, it is necessary to label forest loss events by antecedent forest type and identify the change dynamic (mechanical clearing, fire, storm damage). The regional product will be made freely available at the CARPE and OSFAC websites (carpe.umd.edu and osfac.net).

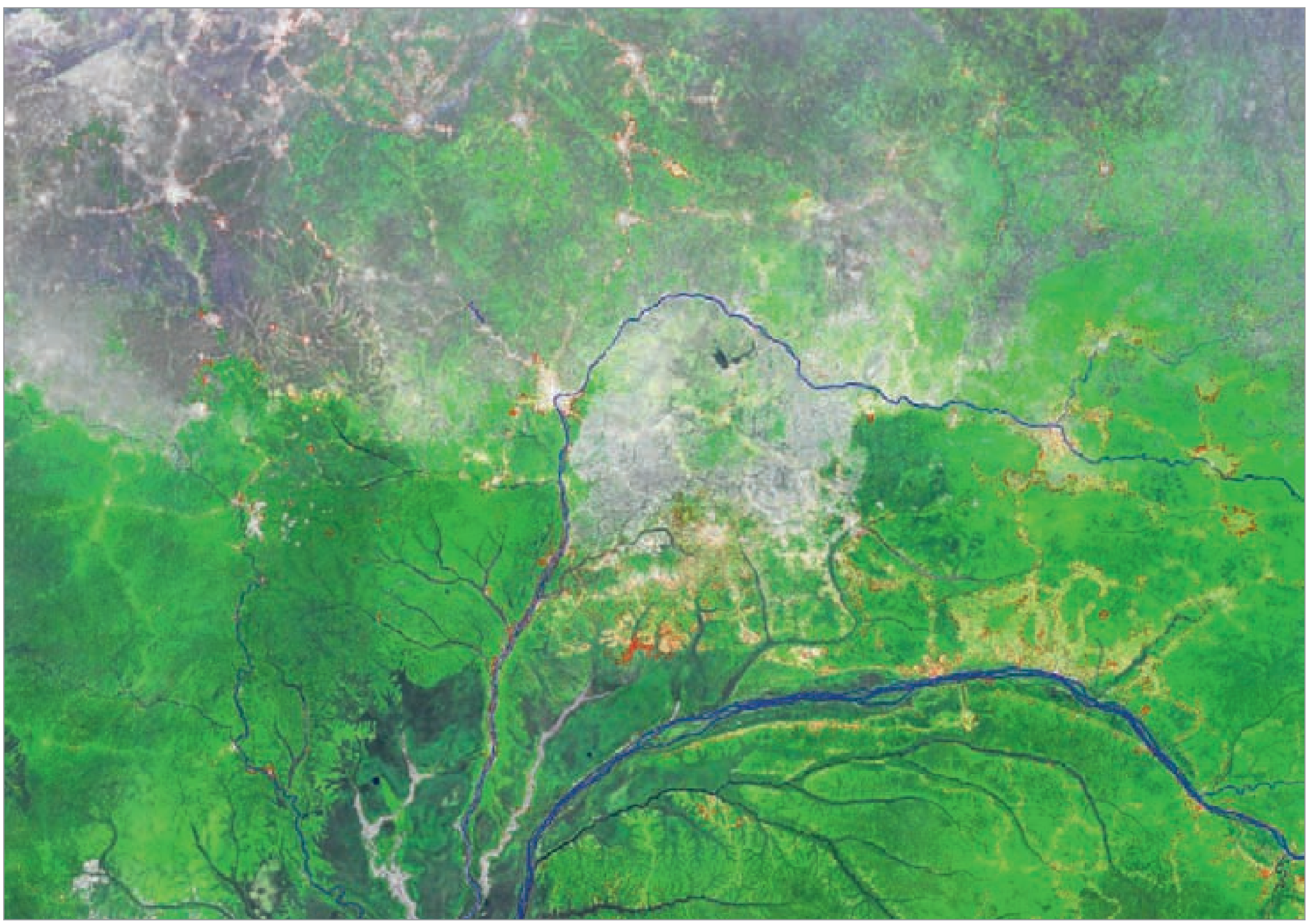


Figure 1.10 : Regional subset of Figure 1.9, with forest cover loss from 2000 to 2012 in red and a background composite image of Landsat in 5-4-3 false color

Source : FACET

4. Advances in forest degradation and biomass mapping: Case studies

Within the framework of sustainable forest management and the UN-REDD program, new tools are required to provide reliable and continuous information on changes in forest carbon stocks. Forest monitoring focuses not only on deforestation processes (conversion of forests into other land uses), but also on forest degradation, meaning the reduction of carbon stocks within degraded forest areas. By using remote sensing, numerous activities contributing to carbon stock reduction can be monitored, from selective logging to fire wood harvesting. Although deforestation estimation methods are robust, reliably assessing forest degradation remains a challenging task which requires advanced satellite image analysis technologies.

Photo 1.8: Forest remnants in the Bateke Plateau are most often found in the valleys or on the hills – Bateke Plateau, DRC

4.1 Evaluation of forest degradation

To exploit forest resources, access roads to reach trees and extract logs are required. The roads are organized into networks with heavily used main roads, secondary roads leading to timber harvest areas, and lastly skid trails that provide access to each tree selected for harvest.

A preliminary study developed a prototype tool to annually estimate the extension of logging roads based on Landsat image time series data. This tool was then used in a study conducted in southeast Cameroon, southern CAR, and the north of the Republic of Congo where forests are semi deciduous and where population densities are low. The majority of logging operations in these areas are managed by private companies.

Box 1.2: Improvement of forest-type mapping using MODIS

Valéry Gond, Adeline Fayolle, Alexandre Pennec, Sylvie Gourlet-Fleury
CIRAD

Generally speaking, it is impossible to distinguish between different types of forests on satellite image maps of Central African tropical rainforests because forests are shown as a big tinted green area. Yet studies carried out on the ground prove that a wide diversity of forest types exist. Within the CoForChange (www.coforchange.edu) project, the study of a chronological dynamic of satellite images and their underlying data have produced a map detailing forest types in the Sangha corridor (0°-5° north latitude and 13°-19° east longitude). The data from the MODIS satellite, which provide indices of EVI vegetation over 16 days at a resolution of 500 m, were used for the period 2000-2009. The spatial dynamic of rains was analyzed using monthly meteorological averages at a resolution of 8 km (http://earlywarning.usgs.gov/fews/africa/index.php). Inventory data from 37 898 forest plots were used to validate the map. Finally, the Cameroon vegetation map by Letouzey (1985) was used for validation (Gond *et al.*, 2013).

Figure 1.11 shows an excerpt of the map made. In the legend, the colored histograms represent average monthly precipitation, the thick line shows variation of photosynthetic activity throughout the year compared with the dotted lines which represent average photosynthetic activity of the study zone. In the north of the map, the brown and yellow colors highlight the transition between the savannas and the forest edge. The shades of green differentiate the types of tropical rainforests identified via analysis of satellite data: the darker the shade of green, the greater the proportion of evergreen trees; conversely, the lighter shade of green indicates an increase in semi-deciduous trees. The pink-shaded areas indicate agro-forestry zones close to transportation routes and urbanized areas. Finally, orange-shaded areas show southern savannas, which are clearly distinguishable from northern savannahs through their different vegetative cycle revealed by their photosynthetic activity.

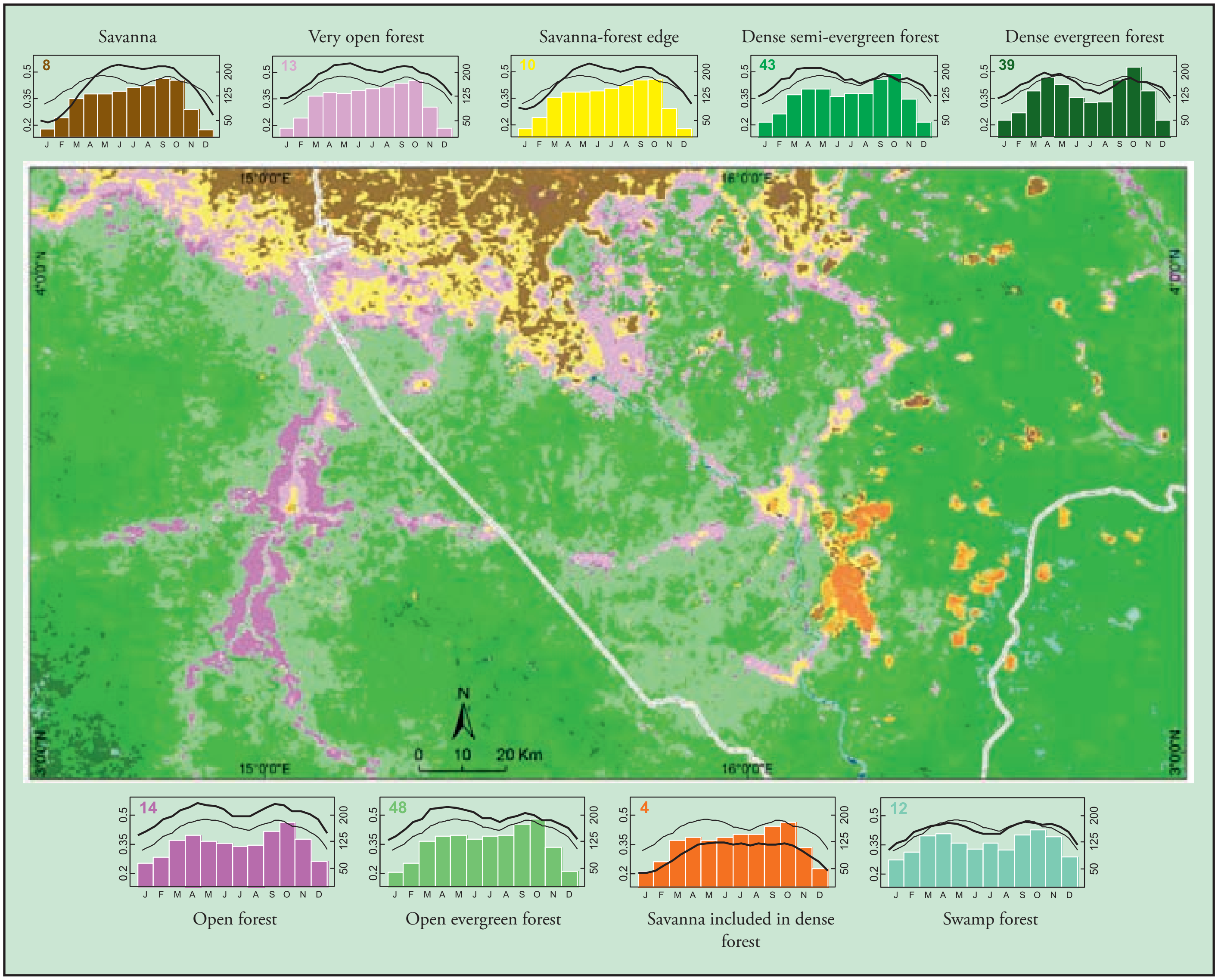


Figure 1.11 : Excerpt of map of the Sangha interval showing the northern borders of the Yokadouma (Cameroon) to the west, Nola to the east (Central African Republic) up to the sandstones of Carnot on the Republic of border

Based on Landsat images, several indices were calculated after increasing the contrast between forest areas and roads which are generally associated with bare soil, by applying a spatial filter (Gond *et al.*, 2004). Threshold values were adjusted to identify bare soil (Bourbier *et al.*, 2013). The results were produced on the scale of a 500 m grid in order to be compatible with MODIS sensor data. To estimate the development of logging roads (figure 1.12), the percentage of pixels of bare soil was calculated based on an annual composite of MODIS images on each 500 m-sided cell. These percentages were considered to be Canopy Opening Indicators (COI). By analysing COI time series, the evolution of road networks can be monitored and the impact of forestry operations can be assessed.

COI were calculated for the period 1999 to 2003 using Landsat images. The changes in COI provide information regarding changes in the opening and closure of forest cover. This technique permits an assessment of logging road networks and potentially of degraded forests in Central Africa.

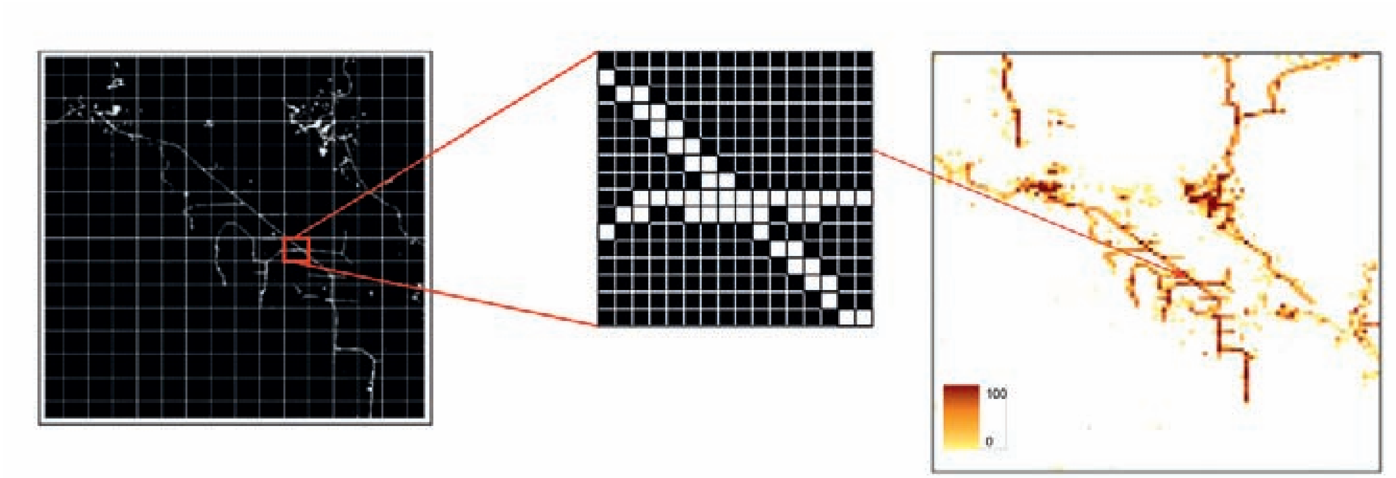


Figure 1.12 : The canopy opening indicator from Landsat (left) is aggregated on a 500 m sided grid (center) to estimate the ratio of bare ground area (right)

Source : Bourbier et al., 2013

Box 1.3 : Regional map of tree cover percentage obtained from radar data

Alexandre Bouvet

JRC

A new wall-to-wall map of the percent tree cover has been created for Sub-Saharan Africa. The map is the result of a supervised classification applied on a mosaic of double-polarization data (HH and HV) from PALSAR, the Japanese L-band synthetic aperture radar (Bouvet *et al.*, 2011). The mosaic covers the African continent at a spatial resolution of about 100 m. The Vegetation Continuous Fields (VCF) product from MODIS, which gives the percentage of the surface covered by trees in each 0.25 km^2 pixel, is used as training data for the classification. The following tree cover classes are retained: 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, and >60% (the PALSAR signal saturates for tree cover higher than 60%). Compared to VCF and other vegetation maps available at large scales, the improved spatial resolution allows the detection of fine structures (e.g. gallery forests) and the reduction of the number of mixed pixels, as shown on Figure 1.13. High-resolution samples of classified optical data from the Global Forest Resources Assessment 2010 (FRA 2010) Remote Sensing Survey, available at each square degree, have been used for the validation of these results. The accuracy of the forest/non-forest classification is estimated to be around 89% over the whole of Sub-Saharan Africa.

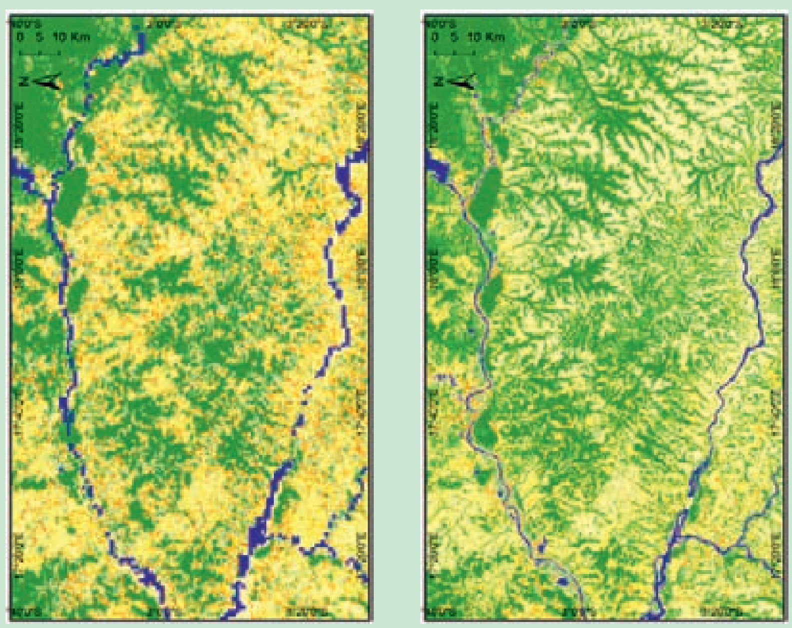


Figure 1.13 : Comparison of VCF percent tree cover (left) and classified PALSAR maps (right) (subset centered on -2.5°S, 15.5°E)

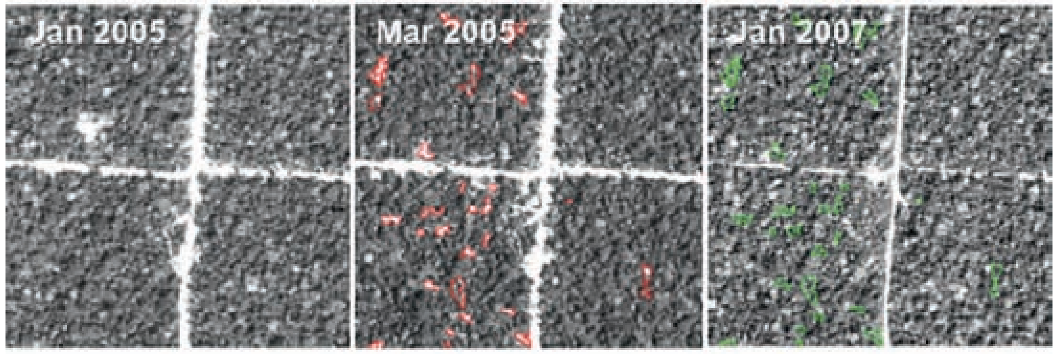


Figure 1.14 : Monitoring selective logging clearings based on SPOT temporal series imagery between January 2005 and January 2007 (Desclée et al., 2011)

A second study based on SPOT images permitted an assessment of forest cover change on a certified forest concession in the Republic of Congo (Desclée *et al.*, 2011). Forest disturbances were detected through changes in satellite images between 2005 and 2007. For example, on a 20 000 ha felling area, a 7 % loss of forest cover in the area logged was observed between January and March 2005 (figure 1.14). Sixty percent of this loss was caused by logging gaps and 40 % by logging roads. The 2007 analysis shows that the logging gaps had closed and only the main roads remain (figure 1.14). These forest cover monitoring maps can then be compared with information provided by the logging company. The precise monitoring of logging gaps requires annual fine spatial resolution satellite images.

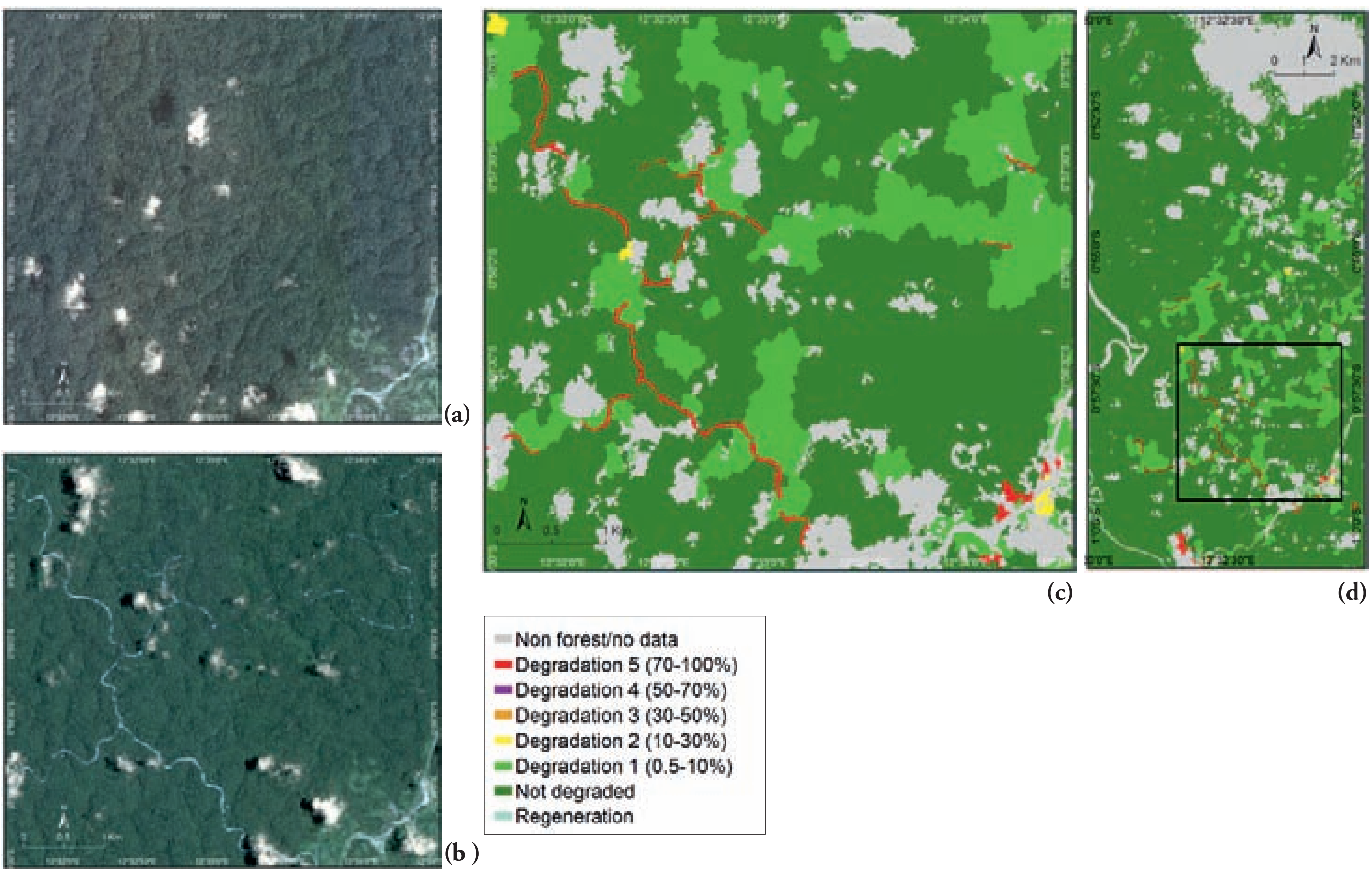


Figure 1.15 : Degradation mapping in central Gabon derived from Quickbird images acquired in (a) December 2010 and (b) March 2012. The degradation map (in c) shows the percentage area difference of small patches of bare soil for the period 2010-2012, d) the whole 20x10 km study area with black box indicating the location of the figures a, b and c.

Source : REDDiness

The potential of optical and radar satellite imagery to detect and monitor forest degradation was evaluated within the framework of the REDDiness project. Degradation mapping was performed over a test site of 20 x 10 km in central Gabon with multispectral, high-resolution Quickbird imagery (2.4 m) acquired between 2010 and 2012. The mapping was based on semi-automatic, object-based classification. First, large objects that have similar image characteristics were identified for both dates. Within these large objects, smaller patches that contain bare soil in one of the images (e.g. canopy gaps, logging roads) were detected. Five levels of forest degradation were then defined based on the percentage area difference of bare soil within each large object between both years. Forest degradation level 5 is considered deforestation when the threshold of tree cover falls below the definition of forest (figure 1.15).

The persistent cloud cover in large areas of the Congo Basin hampers effective multi-temporal analysis of forest degradation. To overcome this problem, radar imagery was used to detect forest degradation signs, although the processing and interpretation of these data for small-scale degradation features is complex and requires expertise in radar signal analysis.

Photo 1.9: Caesalpinaceae Forest, south-west Gabon

Box 1.4: Different approaches to mapping forests in response to persistent cloud cover

Baudouin Desclée and Philippe Mayaux
JRC

It is possible to map large tropical forest areas such as Central Africa with remote sensing. The techniques in use are, however, highly variable. The quality of results depends on several parameters, such as the images used, the pre-processing undertaken, the classification method, and the training data. Wall-to-wall mapping is referred to when a map covers a complete region, while sampling analysis is conducted on a representative sample of the area under study. The advantage of the first technique is that it provides exhaustive information on the entire region of interest, but it requires considerable image processing to combine many different images. The sampling approach focuses the analysis on a more limited area but allows a rapid picture of forest change over larger areas. The classification techniques used are either pixel (all of a satellite image's pixels are classified) or object (the image is divided into homogeneous polygons and assigned a land use category) methods. The advantage of the pixel approach is that information is obtained at a more precise spatial level (the scale of a pixel), while the object approach allows more coherent cartographic information (group of pixels with similar behavior). The challenge of the latter approach involves determining the relevant level of aggregation, often defined by the minimum mapping unit.

A major constraint on mapping tropical forests, particularly in Central Africa, is persistent dense cloud cover. This poses problems when analyzing optical images and suitable methods are needed to circumvent this difficulty. There are several options: (1) multi-sensor analysis, (2) image composition, and (3) use of radar images.

The first approach uses satellite images from different sensors to cover a large region with an adequate number of cloudless images. However, it is limited by the availability of images and access to these data. For example, access to Landsat images, which are widely used to monitor forests, was problematic in Central Africa between 2003 and 2013 because of a problem with the Landsat-7 ETM+ sensor in 2003 and the loss of Landsat-5 image reception over the area since 2001. Images acquired by other sensors (for example, SPOT, Aster, DMC and RapidEye) are therefore added to the multi-sensor analysis to cover the area of interest. Image compositing is a more recent approach which combines parts of many images to obtain a composite image without clouds. The advantage of this technique is that a cloudless image is obtained, but given that information from different dates are combined, it is more difficult to identify when a change in forest cover has occurred. The third option to address the issue of cloud cover is to use radar images with a signal undisturbed by clouds. However, this signal is influenced by other parameters (such as topography, soil humidity etc.) which renders it more complex to interpret. It is therefore useful to combine radar data with other information sources, for example, optical images.

These different forest mapping approaches each involve advantages and disadvantages in responding to an important challenge: mapping forests in a very cloudy region. The hunt for new solutions to produce more precise maps is constantly changing with the availability of new satellites.

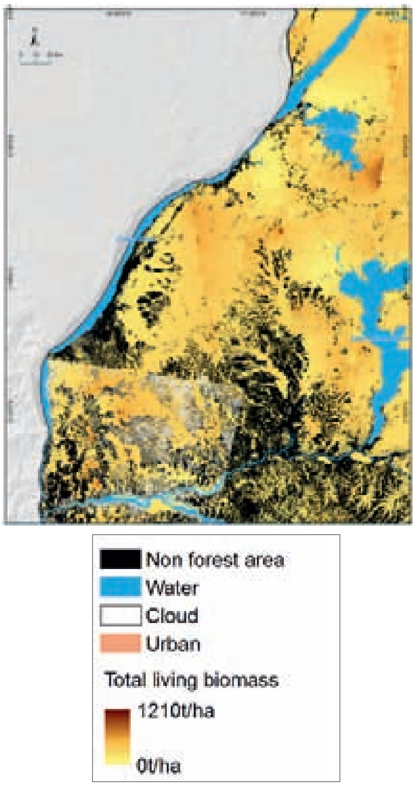


Figure 1.16 : Biomass map in forested areas over Eastern DRC derived from a combination of forest/non-forest and tree height maps

Source : ReCover.

4.2 Mapping forest biomass

As tropical regions have persistent cloud cover, satellite-based monitoring with cloud-penetrating sensors combined with optical images will play a crucial role in future MRV systems. As part of the ReCover project (Häme *et al.*, 2012 ; Haarpaintner *et al.*, 2012), a biomass map was produced over a 68 000 km² region in western DRC based on space-borne LiDAR data from ICESat/GLAS sensor over the period 2003-2009 (figure 1.16). Biomass was estimated by an interpolation and conversion of ICESat/GLAS based on tree heights at 1 km² resolution. For this first map, the allometric equation provided by Saatchi *et al.* (2011) was used. Additional input was a Forest/Non-Forest (F/NF) map derived from Landsat data and combined with both optical at higher resolution (Pedrazzani *et al.*, 2012) and cloud-penetrating radar data (Einzmann *et al.*, 2012). The resulting F/NF maps were produced for the years 1990, 2000, 2005 and 2010 at 30 m resolution.

Two methods for the direct assessment of forest degradation have been tested in Cameroon in the framework of the REDDAF project : (1) a NDVI-based approach, which compares the values of this vegetation index derived from RapidEye satellite data between 2009 and 2011 ; and, (2) the application of Cosmo-Skymed stereo satellite data to compute 3D models illustrating logging gaps and logging roads. Finally, a transferable model to estimate above ground biomass for low carbon forests using SAR data has been developed (Mernoz *et al.*, 2014). Figure 1.17 presents the results of this model, a biomass map for the Adamawa region in Cameroon covering about 15 000 km². Extensive (21 plots) biomass field measurements were carried out in 2012 and used for the calibration and validation of the inversion model using SAR data. This model could offer a cost-effective approach for estimating above-ground biomass in a low-carbon forest, requiring stronger validation and replication over other regions.

The Emission Factor assessment, measuring changes in carbon stocks of different forest carbon pools, focused on planned selective logging, one of the main agents of forest degradation in Cameroon.

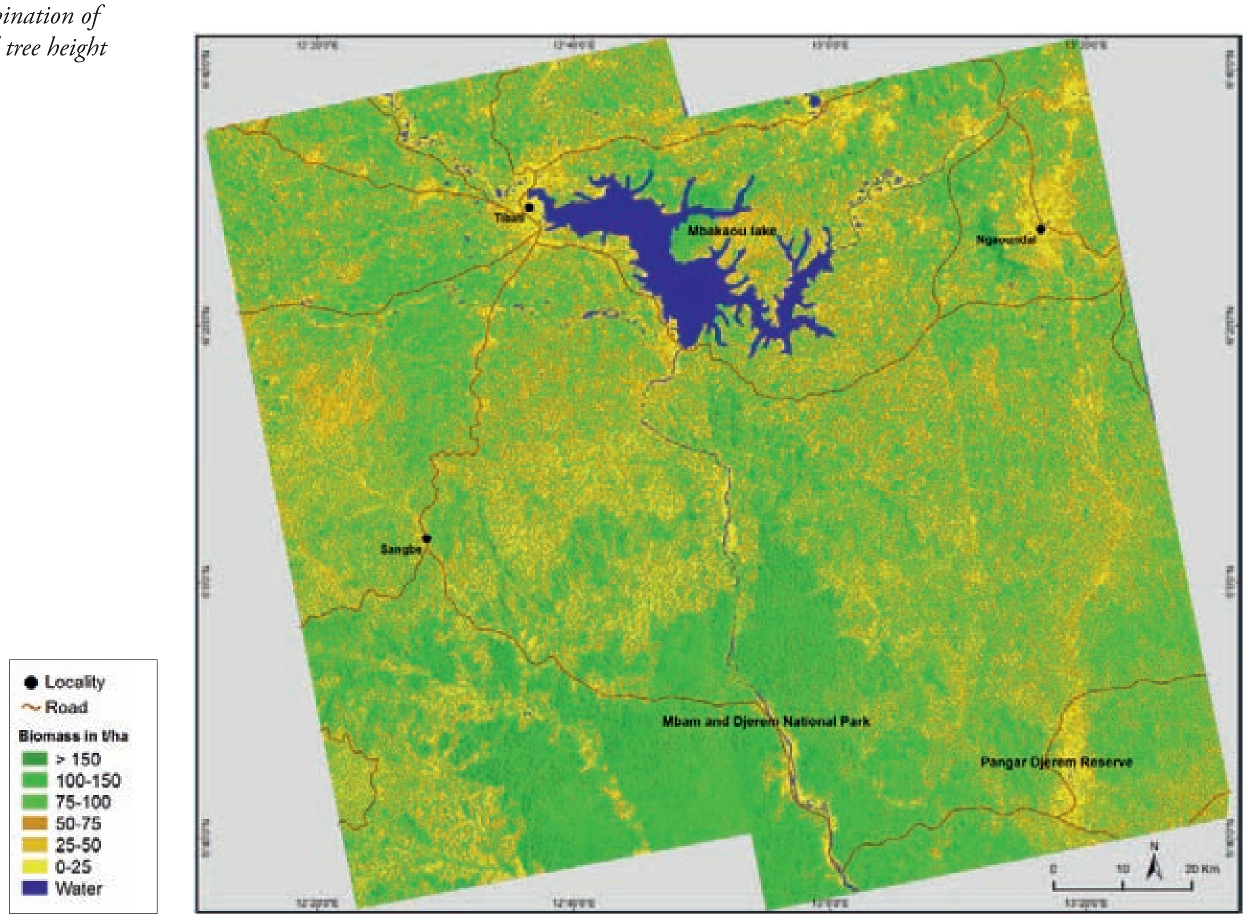


Figure 1.17 : Biomass mapping results for the Adamawa region, Cameroon

Source : REDDAF-Cameroon

Two field inventories assessed biomass and carbon impacts from selective logging in a FSC-certified forest concession as well as in a non-certified concession. The sampling design was based on Carbon Impact Zone (CIZ) plots in the logging gaps with an additional plot 50 m from the CIZ plot. The additional plot measures carbon stocks in intact forest. The size of the CIZ plots depends on the size of the damaged area caused by the fallen timber tree which is determined by the damaged and survivor trees around the logging gap. The results of the inventory of 67 plots indicated a total biomass including soil of 326 t/ha, with the above ground biomass accounting for 285 t/ha. A comparison of the CIZs with the intact plots indicated that in non-certified logging concessions, 1.97 tons (± 0.41) of carbon were removed per ton of extracted timber while on certified concessions the same factor was 1.34 tons (± 0.22).

These results demonstrated that improved forest management and logging practices can lead to a substantial reduction of emissions. This study also illustrated that it is possible to track degradation signals from selective logging using remote sensing imagery; however, it is important to note that having a high temporal frequency of satellite data is necessary for degradation assessment.

Based on these case studies, satellite imagery has a high potential to detect forest degradation, but it requires good-quality remote sensing imagery at frequent intervals (at least once per year) and at high spatial resolutions (<10 m). This has implications for the costs of a national monitoring system, and a sampling approach may be required to reduce costs. Persistent cloud cover is the main problem for optical image acquisition in the Congo Basin, but radar has its own intrinsic difficulties. The limited availability of optical and radar archive imagery makes it currently difficult to set proper baselines for forest degradation. Systematic observation strategies where a satellite sensor frequently covers the territory using the same observation characteristics are needed to help overcome these problems.

Photo 1.10: Secondary track for transporting timber – Bandundu Province, DRC

Box 1.5: Using the latest airborne technology for assessing forest biomass in DRC

Aurélie C. Shapiro[1], Mina Lee[2], Johannes Kirchgatter[1], Sassan Saatchi[3]
[1]WWF – Germany ; [2]WWF – DRC; [3]University of California, Los Angeles

Following the announcement of national forest biomass mapping in DRC (see box 8.3 in SOF 2010), the *Carbon Map and Model* project (CO2M&M[1]) launched in 2012 is now collecting airborne laser scanner data (LiDAR, for Light Detection and Ranging) to complement field and satellite data for estimating carbon stored in DRC forests. This strategic data collection for biomass assessment is being conducted through a sampling approach that mimics field forest inventory techniques. As national LiDAR coverage is not affordable, a stratified random sampling strategy will create the most unbiased dataset possible (i.e. widely and evenly distributed) while consistently representing the various forest types over the entire country. To that end, 212 plots covering about 400 000 ha in total area are being flown between 2013 and 2014 to acquire simultaneous LiDAR data and high resolution color aerial photos, providing one of the most comprehensive airborne forest inventories ever achieved in DRC.

LiDAR scanners are active sensors which use an altimetry approach to very accurately estimate the land surface elevation (<10 cm) as well as the forest height (figure 1.18). LiDAR pulse also provides information about the forest structure in dense forests (canopy, density). Existing and new "classical" field plots are being used to regionally calibrate LiDAR data, which will create an extensive data set to validate the methodology. LiDAR data, calibrated by field inventories, will then be scaled-up to satellite imagery and with other data to estimate biomass throughout the whole country.

1 http://www.wwf.de/themen-projekte/waelder/wald-und-klima/carbon-map-and-model-project.

In addition to estimating carbon stocks, this LiDAR data can be used in a variety of applications including forest health, biodiversity and conservation research. The LiDAR campaign will also provide information about forest disturbances such as logging in forest concessions, the extent of forest degradation and the regenerating capacity of tropical forests. According to Zhuravleva, *et al.* (2013), forest degradation can represent a significant component of carbon emissions in the Congo Basin. Therefore, by the end of 2015, this project will provide essential information on DRC's forest carbon stocks and emissions related to forest management, conservation and deforestation.

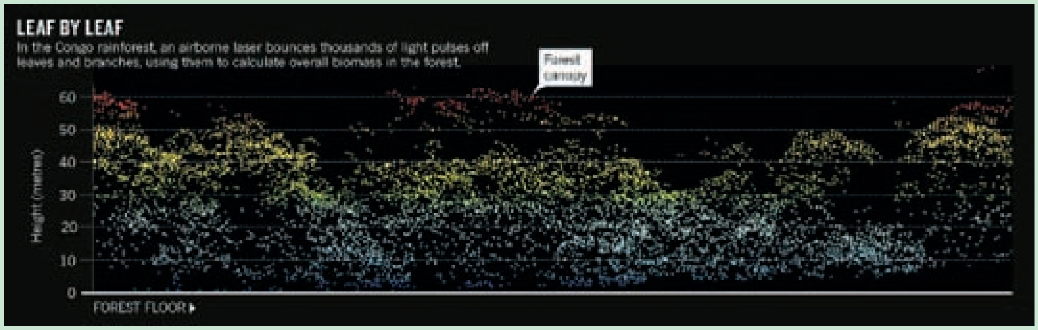


Figure 1.18 : Schematic showing the combination of airborne LiDAR estimating forest height and ground elevation which combined with auxiliary data result in a biomass map at 1 hectare resolution.

5. Analysis of deforestation drivers

5.1 Deforestation drivers and underlying factors

Numerous recent studies (Defourny *et al.*, 2011 ; Ernst *et al.*, 2013 ; Mayaux *et al.*, 2013 ; Megevand, 2013) have identified the direct factors and underlying causes of deforestation in the Congo Basin. In this region, small scale deforestation phenomena are observed, corresponding to increasing slash-and-burn agricultural activities, artisanal timber logging, artisanal charcoal production, and firewood harvesting.

Photo 1.11 : Canopy in the mist – Monts de Cristal, Gabon

Artisanal charcoal production is mainly to supply urban centers which create a circle of degradation around major cities in the region (Kinshasa, Douala, Yaoundé…). In the future, increased use of fossil fuels which are the focus of increasing exploration in the Congo Basin, could diminish wood's part of the energy mix in the region, but wood will likely continue to predominate.

The expansion of crop areas is linked to village agriculture, which mainly supplies local markets and nearby urban centers. To date, industrial agriculture has had limited impact on forest cover with the exception of oil palm and rubber plantations set up near large transportation axes. Some public policies whose impacts should be studied (notably regarding biofuel) and large agro-industrial projects certainly will influence deforestation.

Industrial logging has not yet been determined to be an important direct factor in deforestation because of low logging densities concentrated on a few high-value species. However, the concurrence of high human population densities with the opening of logging roads promotes substantial local forest cover degradation.

Mining and oil sectors do not cause important deforestation, at least in terms of surface area, but the local air and river pollution generated from these activities impacts the condition of forests. Numerous new projects are being considered in these sectors (for example, oil exploration in Virunga National Park) that will have a more pronounced impact on forests.

The consensus for the main underlying causes of forest degradation are rural and urban demographic pressure, rural poverty, the development of new infrastructure, and inadequate control over the governance of the forest sector. Deforestation remains low when the rural population density remains below a threshold of 8 inhabitants per square kilometer, and increases rapidly once this threshold is passed. The proximity of towns in terms of transport time strongly influences forest ecosystem degradation. The absence of quality road infrastructure hinders the development of agricultural and fuel wood activities. When transportation times exceed 16 hours, the influence of urban centers becomes statistically negligible (Mayaux *et al.*, 2013) except along waterways. Studies have shown that poor governance at the local and national level is also an underlying factor favoring deforestation, in particular in areas where poor or nonexistent spatial planning allows illegal activities to continue unchecked (Rudel, 2013).

5.2 Simulation of forest cover loss in the DRC through 2035

A simulation of the risks of forest cover loss in the DRC through 2035 was undertaken by UCL in collaboration with the FAO under the REDD+ initiative. The national DRC REDD+ strategy continues through 2035.

This study was based on forest cover change in the DRC between 2000 and 2010 described in the FACET atlas (Potapov *et al.*, 2012). The deforestation and forest degradation drivers identified by Defourny *et al.* (2011) in the DRC were used in a simulation of forest cover loss at a spatial resolution of one square kilometer. The distribution of the human population and the time required to reach markets in urban areas are the two variables that spatially explain forest cover change dynamics in the DRC (Kibambe and Defourny, 2010; Kibambe *et al.*, 2013).

The calibration of the simulation model used FACET atlas land use maps made in 2000 and 2005. The 2010 forest cover map in this atlas served to validate the model. Two scenarios allowed a comparison of the simulations made: a business-as-usual (BAU) scenario predicting a doubling of the population in 2035, and a conservative scenario envisioning an annual forest cover loss similar to that observed between 2000 and 2005.

While the forest cover loss observed between 2005 and 2010 was estimated to be 19 759 km² (Potapov *et al.*, 2012), or 14 % more than in the 2000-2005 period, the conservative simulation (2nd scenario) underestimated it by about 13 %. According to the conservative simulation, the annual forest cover loss rate is 0.19 %, an unrealistic figure given observed trends. Ernst *et al.* (2013) observed a doubling of gross deforestation rates, passing from 0.11 % per year between 1990 and 2000 to 0.22 % per year between 2000 and 2005. Potapov *et al.* (2012) indicate that the gross forest cover loss (all types of forests considered together) rose from 0.22 % to 0.25 % per year between the periods 2000-2005 and 2005-2010.

Based on scenario 1 (BAU), the annual forest cover loss rate was estimated to be 0.31 % with the hypotheses of demographic growth of 2 % to 3 % in rural areas, a maximum population density of 6 inhabitants/km² in forest areas (Kibambe and Defourny, 2010), and a demand for forest land per rural household of 0.25 hectares (Tollens, 2010). This rate of 0.31 % is four times less than the estimate by Zhang *et al.* (2002).

The simulations nonetheless showed that the conservative hypothesis could be a good indicator of short term forest cover change (about 5 years) because the forest areas converted into non-forest areas are small in DRC forests. In contrast, the simulation based on demographic growth shows that forest cover losses could be higher if the Congolese population doubles between now and 2035 over the life of the DRC REDD+ national strategy.

6. Perspectives for monitoring tropical forests

The different mapping and forest monitoring initiatives in Central Africa demonstrate the great international interest in tropical forests. The trend is towards more wall-to-wall mapping of forests because increasing amounts of satellite imagery are available (notably with the arrival of new Landsat-8 and Sentinel-2 satellites) and the resolution of images is increasingly fine. To be able to compare these different maps, it is critical to harmonize the methods and definition of land use classes, as well as to provide more information on the quality and accuracy of information, which is currently rarely the case. The mapping of certain countries such as Rwanda, Burundi and Sao Tome and Príncipe also is crucial to obtain an overall picture of the ensemble of COMIFAC countries.

Aerial studies of forest degradation and biomass are still under development. They will require better integration of field data, particularly for biomass, through the development of a field data collection and archiving network. It also is important to reinforce regional capacities to collect, process and analyze forest monitoring data in order for this to be conducted by experts from the region. The Libreville SPOT receiving station project may act as a springboard.

Photo 1.12: Typical vegetation in the dense humid rainforests, Cameroon

CHAPTER 2

The logging industry and management of natural forests: Tropical timber and the forests of Central Africa in the face of market trends

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1. Introduction: Markets and the value chain

Trends in Central Africa logging are largely dependent on market requirements. This is particularly true for international markets which demand high quality products. Strict market requirements create an obstacle for the optimum use of forest resources. International markets are increasingly concerned with production conditions and compliance with national regulations and international standards of sustainable management. At the same time, the internal Congo Basin market is growing rapidly, but because of low domestic purchasing power and buyers' indifference to forest management concerns, the domestic market is mainly supplied by informal and/or illegal operations.

This chapter concerns recent logging developments in Central Africa: it first reviews trends in demand for tropical timber, then gives an account of producers and their outlets, and lastly addresses the management of natural forests.

Photo 2.1: Logs from Okoumé being transported by sea, Gabon

2. Demand for tropical timber

2.1 International markets for tropical timber

2.1.1 Trends in timber volumes, prices and flows. The Congo Basin within world production

The world rough lumber (logs) harvest (excluding wood fuel) is estimated at 1 578 million m^3 (FAO, 2011).

The extraction of timber from the natural forests of all the COMIFAC countries, again according to FAO, amounts to approximately 16 million m^3, or just 1 % of world production[2]. Of this volume, 5 million m^3 of rough-lumber equivalent are exported (taking all products together), which represents just 0.3 % of world rough lumber production.

Volumes exported and destinations

Asia – essentially China – accounts for over 50 % of rough lumber equivalent[3] volumes exported. The European and Asian markets are mainly supplied by Cameroon and Gabon.

The inter-African market accounts for less than 10 % of the volume exported (about 0.4 million m^3 of rough-lumber equivalent by Gabon and Cameroon). Informal sawn wood, estimated at more than an additional 0.2 million m^3 per annum, constitutes a substantial share of supplies to neighboring countries in the subregion.

Evolution of volumes

The ban of rough lumber wood exports, which was ordered by Gabon in 2009 (almost 2 million m^3 of rough lumber was exported in 2007), came into force in 2010. In 2009, Gabon alone exported as much rough lumber as the rest of the sub-region but in 2010 all exports were stopped. The decrease in Gabonese rough lumber exports between 2009 and 2010 was partly offset by an increase of 500 000 m^3 in exports of rough lumber from other countries of the region, essentially Cameroon and the Republic of Congo. The profitability of Gabonese concessions declined following the imposition of this strict and unexpected ban.

The effects of the 2008 world economic crisis on volumes of sawn wood imported into the European market (whose market collapsed in 2009 and is still in recession) continue to be felt. Cameroon, the leading exporter and producer of sawn wood in the region, saw its exports recover in 2010 to a level which exceeded that of 2006 (close to 600 000 m^3). Gabon increased its sawn wood exports threefold between 2007 and 2011, reaching 470 000 m^3 after putting additional industrial equipment into service following the 2009 cessation of rough lumber exports. Gabon has also prohibited the felling of five species: Afo (*Poga oleosa),* Andok (*Irvingia gabonensis*), Douka (*Tieghemella sp.*), Moabi (*Baillonella toxisperma)*

2 Formal production in recent years has been between 6 and 8 million m^3; the FAO figure probably includes a proportion of informal production.

3 The rough lumber equivalent volume is the volume of rough lumber which has been necessary to produce 1 m^3 of finished products.

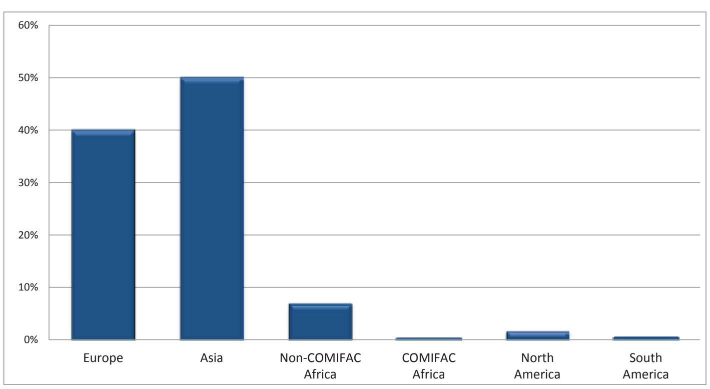


Figure 2.1: Volumes exported in 2012 (as percentages of exports of rough lumber equivalent) by the COMIFAC countries according to destination (OFAC data, Ministries in charge of forests in the countries concerned)

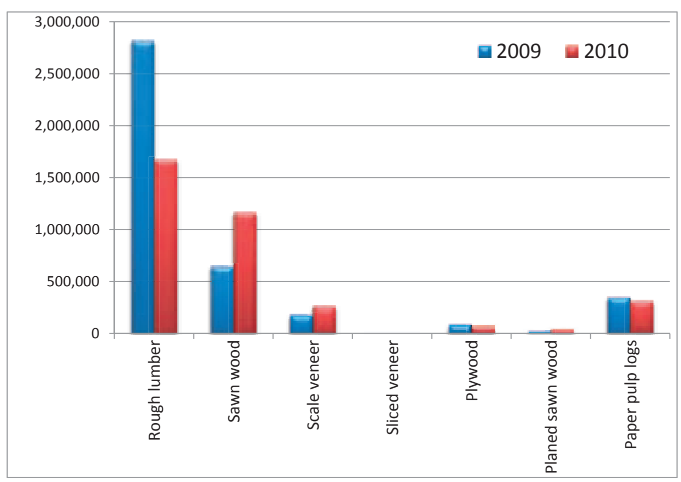


Figure 2.2: COMIFAC countries – volumes exported in 2009-2010 (actual m^3 of products)

and Ozigo (*Dacryodes buettneri*)[4]. Although these species account for only relatively small volumes (13 % of rough lumber exported in 2007[5]), this restriction has weakened the economic viability of certain concessions and has had a knock-on effect in neighboring countries.

Exports of planed sawn wood (flooring, terrace decking, moldings, etc.) remain very low (2 % of exports in rough lumber equivalent), dominated by far by Cameroon, which is again approaching its 2008 export level (41 000 m³ of planed sawn wood in 2010). Gabonese exports of plywood fell sharply, while scale veneer exports grew rapidly (an indirect effect of the as of yet unsigned economic partnership agreements between Gabon and the European Union, which triggered differentiated increases in customs tariffs according to product; which are particularly high for plywood).

Exports of processed manufactured products (e.g. doors, furniture) remain negligible.

At the regional level, exports of new species (known as secondary species) are growing, albeit slowly. These species include: Tali (*Erythophleum sp.*), Padouk (*Pterocarpus sp.*), Okan (*Cylicodiscus gabunensis),* Eyoum (*Dialium sp.*), Anzem (*Copaifera sp.*), Kotibé (*Nesogordonia papaverifera*), Red Longhi (*Chrysophyllum sp.*), Mukulungu (*Autranella congolensis*), Gheombi (*Sindoropsis letestui*), etc. Their marketing has been jeopardized by the difficulty in making up sufficient homogeneous consignments in volume and ensuring a stable supply over time. These species also suffer from low price levels which in most cases prevent them from becoming profitable, especially for remote concessions where transport costs greatly affect cost/price.

Furthermore, prospects for tropical timber on the European market are limited by competition from temperate timber and the very strong competition from materials other than wood (PVC and aluminum in external joinery, wood-polymers, etc.).

The supply of Forest Stewardship Council (FSC) certified tropical timber, although substantial, is not significantly modifying consumer behavior vis-à-vis tropical timber. The effects on the competitiveness of certified products by the entry into force of the European Union Timber Regulation (EUTR) on 3 March 2013 and the first Forest Law Enforcement, Governance and Trade (FLEGT) licenses expected in 2014 are hard to predict.

Photo 2.2: Logs for export from Owendo port, Gabon

Movement of prices

During the crisis, the changes in currency exchange rates tended to make exports more expensive.

The various logistical constraints (bridges, ports, roads) also increase transport costs and thus harm prospects for the development of exports.

The decline in demand linked to the 2008/2009 crisis has caused prices to fall. This decrease was greater for sawn wood (almost 25 % in 2009 and 2010) than for rough lumber (only in 2009).

Timber flows

Rough lumber (Cameroon, Congo), which accounts for more than half of regional exports, is mainly exported to China, followed by India as a distant second but where demand is increasing.

4 Only Moabi, Douka and Ozigo accounted for significant volumes.
5 Source: SEPBG statistics.

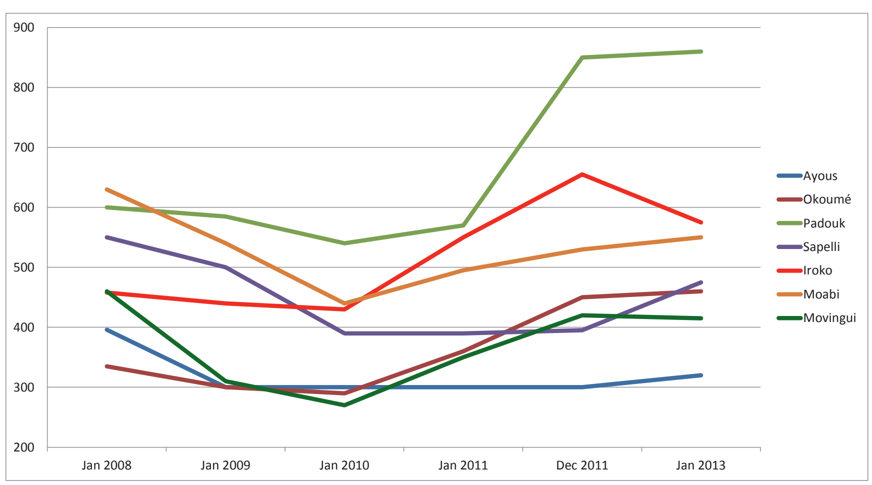
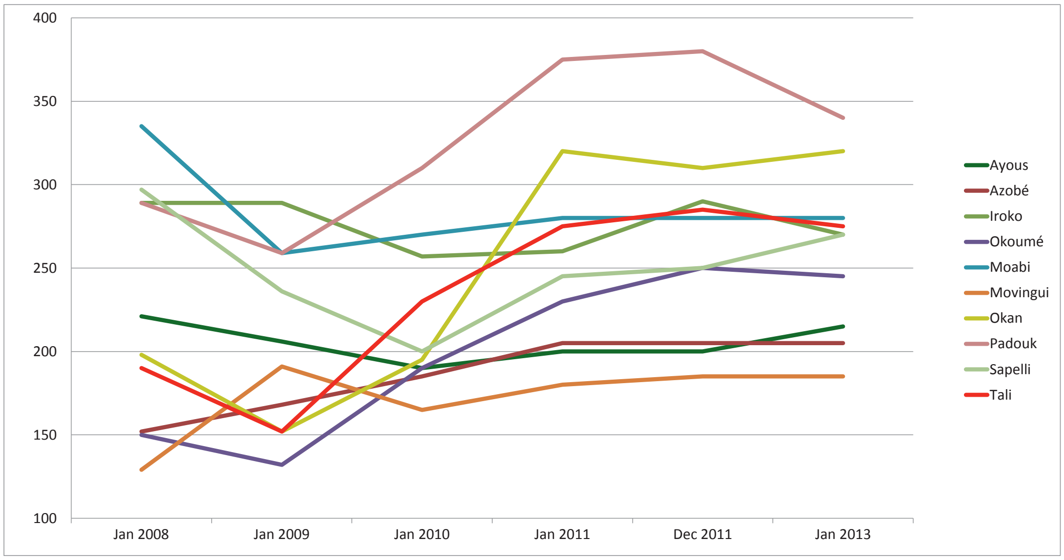


Figure 2.3: FOB prices of African sawn wood (€/m³)
Source: OIBT



Ayous (Triplochiton scleroxylon); Azobe (Lophira alata); Iroko (Cholorophora regia); Okoumé (Aucoumea klaineana); Moabi (Baillonella toxisperma); Movingui (Distemonanthus benthamianus); Okan (Cylicodiscus gabunensis); Padouk (Pterocarpus soyauxii); Sapelli (Entandrophragma cylendricum); Tali (Erythrophleum sp.)

Figure 2.4: Movement of FOB prices of African rough lumber (€/m³)
Source: OIBT

Sawn wood, which until recently came principally from Cameroon, is mainly exported to the traditional European customers (Spain, France, Italy, Netherlands), where demand is, however, falling. Asia is taking up the slack from this diminishing market (*Carte examen annuel 2010, ITTO, p.45*).

Scale veneer is exported essentially to Europe (France, Italy), but it is suffering from both the loss of interest in plywood and competition from temperate timber.

The requirements of international consumer markets for timber originating in Central Africa vary widely. The Asian market continues to pay little heed to questions relating to the sustainable management of forests and harvest legality. But since the Asian market is partly oriented towards the re-exportation of processed products, it too has to comply with requirements of other consuming countries including the European, American and Australian markets, notably for the traceability of products. The latter markets are becoming increasingly concerned about the production conditions of the timber they buy. The particular case of the European market is spelled out below because of its importance and the current interest in the execution of the FLEGT action plan. Indeed, although Asia has become the leading importer of African timber, Central African producers cannot afford to cut themselves off from the European market, to whose requirements they must adapt.

Table 2.1: *Quantity and types of products exported (formal sector) from Central African countries in 2010*

Exports 2010 (m³ of real product)	Cameroon	Congo	DRC	CAR	Equatorial Guinea(*)	Gabon	Total
Rough lumber	607 647	798 954	124 037	147 893	23 385	-	1 678 531
Sawn wood	696 166	132 187	25 838	36 657	3 375	278 236	1 169 084
Scale veneer	52 548	18 038	-	-	8 388	196 804	267 390
Sliced veneer	78	-	-	-		-	78
Plywood	17 084	167	-	-		54 707	71 958
Planed sawn wood	40 945	-	225	-		971	42 141
Paper pulp logs	-	318 492					318 492
Rough lumber equivalent	2 616 104	1 493 343	189 195	239 536	52 793	1 299 442	5 837 618

Source: Statistics from the forestry authorities in the countries concerned, volume in rough lumber equivalent estimated by the authors. (*) data of 2009

2.1.2. Voluntary Partnership Agreement and European Union Timber Regulation: legal requirements for access to the European market

The European Union (EU) established new requirements concerning trade in timber and its derivatives in 2003. These requirements were specified in the FLEGT action plan; its demonstrated objective is to ban illegal timber and trade in such timber with the EU. Some tropical timber-producing countries have begun negotiations with the EU on a Voluntary Partnership Agreement (VPA). The aims of such an agreement are to give concrete form to this mutual desire to combat illegal logging and to improve governance and control of the forestry sector. And lastly, it ensures that European consumers receive legal timber.

With the FLEGT action plan of 2003, the EU demonstrated its intentions to combat illegal logging and establish sustainable forest management in the timber-producing countries engaged in sector reforms. The EU supports efforts to strengthen the capacity of states to implement forestry regulations, to promote a "virtuous" private sector and the emergence of a civil society which wants to see good management of their country's forestry resources. Among the tools available under the FLEGT process, the negotiation of the partnership agreements is certainly the best known.

The Voluntary Partnership Agreements

The countries of the Central Africa region have been among the first to engage in this process. As of today, three countries from the region have negotiated, signed and ratified VPAs which are now being implemented: Cameroon, Congo and CAR. Two countries are at the negotiation stage: DRC and Gabon. No country has yet set up the system for verification of legality which allows the issuance of FLEGT permits. When the VPA is considered operational by the two parties (the first permits are expected in 2014), the EU will institute control measures at its borders and will reject any timber not accompanied by a FLEGT permit.

At the end of 2012 the situation regarding the implementation of the VPAs was as follows:

The VPA with Cameroon entered into force at the beginning of 2012. This country, which has a large number of logging licenses (volumes and areas), has numerous actors which makes control very complex. An additional difficulty is that some of the timber intended for export originates from a large informal timber sector.

The VPA with Congo entered into force in March 2013, but this country is having difficulties with implementation of its Legality Verification System and its national traceability system, and also with the rigorous application of the law by many logging companies. The development of the legality verification procedures is well advanced but their effective implementation requires a permanent financing mechanism and strengthening of the capacity of the personnel who will be responsible for it.

The VPA with the Central African Republic entered into force in July 2012. There are practical difficulties with its implementation as the country is heavily dependent on external assistance. The fact that it is completely landlocked creates problems with regard to the transit of its timber exports through Cameroon and responsibility for their traceability.

The VPA with the Democratic Republic of Congo has been under negotiation since 2010. One difficulty lies in the desire for decentralization within the country. In addition, industrial logging, which has developed in recent years under cover of small-scale permits, does not provide sufficient guarantees on the origin of the timber or the sustainable management of forest resources.

Photo 2.3: Sawing of Afrormosia (Pericopsis elata), DRC

Photo 2.4: A well-deserved rest for these workers in a designated logging unit, Gabon

Photo 2.5: OLB labeling for export – Douala Port, Cameroon

Lastly, the VPA with Gabon has been under negotiation since 2010. The division of the logging sector between the large companies and small logging operators, together with a lack of commitment on the part of the authorities concerned has left negotiations dormant for a long time.

The European Union Timber Regulation

The European Union Timber Regulation (EUTR) forms part of the FLEGT action plan and has supplemented the VPAs since 2010. The EUTR does not constitute a border control measure but applies to exporters of timber to the European market regardless of its origin (tropical or temperate timber, timber imported or produced in EU territory). It requires exporters to establish a system of "due diligence" which will enable them to ensure that the timber they are placing on the market is of legal origin. It makes illegal trade in timber a punishable offence and it requires those who engage in the European timber trade to implement a traceability system.

The Regulation explicitly states that timber importers who have a FLEGT (or CITES) authorization have complied with the Regulation, which is undoubtedly an advantage for all countries capable of issuing such an authorization.

Promulgated in 2010, the EUTR entered into force on 3 March 2013, but all the countries engaged in a VPA have been slow to implement it. These countries are therefore not in a position to issue a FLEGT permit, which is causing concern among the private sector in the producer countries. Without FLEGT permits, importers will infer a risk that their supplier is selling them illegal timber. In the absence of a national legal verification system it is incumbent on each exporter to the EU to supply information that will reassure the purchaser of the legality of the timber and its derivatives and of the credibility of the supporting information. The voluntary certification schemes, already well developed within the region, will certainly play an important positive role in this regard.

In the long term, the FLEGT permits will enable European operators to import timber from countries where the VPA is in effect. They will thus be able to fulfill without difficulty their obligations as defined by the EUTR, which constitutes an incentive for making progress in the implementation of the VPAs.

The positive image conveyed by an operational VPA should also reassure private and institutional investors engaged in "deforestation avoided" projects in the context of the REDD+ mechanism (Reduction of emissions linked to deforestation and forest degradation).

Box 2.1: The European Union Timber Regulation

Nicolas Bayol
FRM

The European Union Timber Regulation[6] adopted a legality definition. Article 2 (subparagraph h) specifies the areas of current legislation in the countries of origin covered by the EUTR:
- rights to harvest timber within gazetted boundaries;
- payment of harvest and timber rights, including duties related to timber harvesting;
- timber harvesting conditions, including directly related environmental and forest legislation, notably regarding forest management and biodiversity conservation;
- third parties' legal rights concerning use and tenure that are affected by timber harvesting;
- trade and customs, in so far as the forest sector is concerned.

There is coherence, favored by European legislators, between the legality of timber as defined in the EUTR and that defined in the VPAs.

6 EU Council Regulation N° 955/2010 of the European Parliament and of the Council adopted on 20/10/2010 laying down the obligations of operators who place timber and timber products on the market.

Challenges to the EUTR as a supplement to the VPAs

The EUTR in practice embodies a transfer of the responsibility for forest regulatory compliance, normally the responsibility of sovereign states, to the operators initiating transactions. In Europe, the latter are required to exercise due diligence and to verify the legality of the timber with their suppliers. The certified companies, thanks to a recognized internal chain of control, are able to demonstrate more visibly the legality of their products. In order to obtain a certificate, the necessary voluntary action requires a company's time and remains expensive, and is subject to due diligence. Certification may therefore constitute a valid alternative to the FLEGT permit in countries which have not yet negotiated a VPA.

In the countries of the Congo Basin, a major question associated with the implementation of the EUTR is what effect this new process offered to European purchasers will have on VPA implementation. By implementing a VPA, states would in effect regain their control powers on the basis of a legitimate, operational and recognized system for verification of legality. The recent history of the VPAs negotiated in Central Africa has shown how far these agreements have gone beyond the mere desire to combat illegal logging to focus increased attention on the future of the Congo Basin forests.

2.1.3. Requirements of the other international markets

Other timber-consuming markets are not lagging behind Europe. The tools to combat illegal logging are increasing in number, with a range of requirements vis-à-vis timber-producing countries.

- The international scene is prompting consumers to be more demanding

Since the G8 of 1998 and the world summit on sustainable development in 2002, action to combat illegal logging has come to the fore in international discussions. Timber-producing countries, notably in Africa, are mobilizing on this issue. The World Bank publishes data on the financial losses caused by illegal logging. NGOs regularly denounce this phenomenon. Gradually, consumers are asking for assurance that they are not participating in a controversial trade and are therefore requiring more information concerning the origin of timber products.

- The voluntary development of responsible purchasing policies

Responsible purchasing policies are developing both in the private sector among companies wishing to burnish their image with consumers and among public- sector authorities and communities. By way of illustration, mention may be made of the public purchasing policies of the Netherlands and the United Kingdom and the Japanese policy (*Japan Goho* (=legal) *Wood)*.

However, these purchasing policies remain market tools based on voluntary action and concern only a quarter of the timber trade at best.

- A further step: Regulations in Australia and the USA

Like the EU, other timber-consuming countries have opted to legislate against the trade in illegal timber: the United States since May 2008 with the Lacey Act, and Australia, which in late 2012 adopted the Illegal Logging Prohibition Act, which will come into force at the end of 2014. Like the EUTR this legislation prohibits the marketing of illegal timber harvested in breach of the laws of the producing country.

The Lacey Act imposes a broad ban ranging from sale to barter and even to possession of illegally harvested timber. However, this Act does not impose any obligation on means used, even if the authority encourages "due care" as a practical response to the obligations set out in regulations. All timber products, from rough lumber to paper are covered by the Lacey Act.

The Australian Illegal Logging Prohibition Act adopts a similar approach to the EUTR, i.e. a prohibition of sales and the exercise of "due diligence". A list of "regulated" products, the only ones that will be affected by the obligation of due diligence will be compiled within a year.

Like the EUTR, these regulations do not set up new customs barriers; they apply above all to economic operators and require applicable declarations. Thus the Lacey Act requires a declaration by the country of origin with scientific identification of species along with the quantity and value of the product for customs purposes. In Australia, the declaration of the due diligence system will be obligatory at the time of importation (this will be spelt out in 2013).

It is still early to compare controls and penalties since only the Lacey Act has been in operation for any length of time. That said, the enforcement thinking behind this Act is based on action by the American Justice Department to identify symptomatic criminal acts followed, in the event of an

Photo 2.6: A stump is labeled to meet traceability standards

Photo 2.7: Plywood sign at Alpicam – Douala, Cameroon

offence, by rigorous judicial proceedings. On the other hand, the EUTR and the Illegal Logging Prohibition Act aim to gradually give the private sector responsibility through controls and regular state monitoring.

Even though the approaches adopted by these legal instruments are slightly different, the expectations are the same: namely, that operators should be responsible and discriminating as regards their supply chain(s). In practice, therefore, these instruments impose responsible purchasing policies on the whole sector.

- Reliable producers and increasingly responsible importers

This legislation is not without consequences for operators in the timber-producing countries. In order to avoid taking risks, American, European and Australian importers will *de facto* exclude timber of uncertain origin from their supplies. They want reliable products.

Producers must therefore be able to offer guarantees in order to keep their clients. Documentation, security and transparency must be the watchwords of the supply chain. Some firms in producing countries have already made commitments to this end, notably through voluntary certification (of legality or sustainable management).

On a national scale, this is a formidable challenge for export operations. Only the EU has planned to assist the timber-producing countries in meeting this challenge posed by the VPAs. Neither the Lacey Act nor the Illegal Logging Prohibition Act provides for such specific assistance.

The African producing-countries have certainly committed themselves to achieve a strong market position. They have relatively short – and therefore relatively transparent – supply chains. The exporting companies are very committed to certification. Lastly, when the VPAs now being developed become operational, the verification of legality which will be applied to all exports will bring the evidence of legality to the international scene which the market is seeking.

2.2 Regional markets and intra-regional trade

Because of the high price of timber on the international market, several Central African countries source timber directly from neighboring countries at competitive rates, almost always through informal transactions. The regional market is therefore growing and the timber "leaving" the producing-countries (Cameroon, CAR or DRC) is exported to Chad, Nigeria or Uganda. The chief variable influencing cross-border demand is the distance between a rapidly expanding city and the nearest sources of supply.

The economic growth and increasing urbanization of Central Africa countries are the drivers of the increasing demand for timber, both nationally and regionally. Transport infrastructures nevertheless remain a constraint on the development of these cross-border flows (such as, for example, the difficulties in exporting timber to Nigeria or from the DRC to the CAR). But new roads are being built (Cameroon-Nigeria, Cameroon-Congo) which will promote regional and intra-regional trade, as is already illustrated by timber exports from eastern DRC to countries in east and southern Africa (Uganda, Rwanda, Kenya, South Sudan, etc.). Efforts to facilitate trade are being made in the Great Lakes region, together with the establishment of economic zones, which may also become a factor in promoting the development of regional and intra-regional trade.

Photo 2.8: Stack of sawn wood ready for the international market – Douala Port, Cameroon

2.3 Requirements of national markets

The large proportion of illegal and informal sawn wood sold on the domestic markets of all the countries of the sub-region shows that consumers are paying little heed to the criterion of legality. The very great majority of purchasers simply want to buy products as cheaply as possible, which tends to promote informal production that does not have to bear the costs of forest management or conformity with legislation. Low prices also mean that mainly poor-quality products are found on the domestic markets.

Three approaches (probably in combination with each other) are feasible in order to increase the requirements of national markets for more legality and sustainability : (1) the influence of the VPA-FLEGT process ; (2) the public markets ; (3) technical and commercial standards.

Cameroon and Congo have included their domestic markets in their VPA and thus will have to endeavor to ensure the legality of all their national production. The CAR has initially excluded the domestic market from its VPA. The choices of Gabon and the DRC are as yet unknown.

In Congo and Cameroon, legal provisions have not yet included the "small permits" which are the most attractive to small-scale sawmill operators. Legislative reforms needed to incorporate the domestic market into the VPAs have not progressed. Therefore there is little chance that their "legality" can be verified by external auditors. The VPA under these circumstances could force actors on the domestic market to remain illegal. Such a situation could then create openings in the domestic market for certain formal loggers who would know how to adapt their "business model" to local conditions (prices, quality, etc.). It will be interesting to see to what extent they could enter into competition and in which niches with informal sawyers, as is the case today in the CAR.

Price remains a serious constraint on increasing the requirements in domestic markets : the formal legally- sawn wood products are three to four times more expensive than the informally-produced sawn wood. Legal timber, including that originating from sustainable logging, will have great difficulty competing in national markets if it is much more

Photo 2.9: Entering the Alpicam plywood production factory, Cameroon

expensive than informal sawn timber. The latter will not disappear overnight and will fight to keep its market share. Making legal timber attractive on domestic markets would therefore require major incentives such as reducing the charges imposed on legal timber.

It is unlikely that the local private demand for sawn wood will turn to more costly legal products. The state therefore will need to create this demand for legal sawn wood in its national market. However, there is still very little talk of increasing the standards for national public markets. Efforts to this end must be made. Furthermore, development partners could begin to ask for quality control of the timber used in projects which they sponsor : building of schools, hospitals, etc., or other infrastructure.

The standardization of technical and commercial legislation must also be developed to assist producers in adapting to markets more effectively.

3. The producers

3.1 Diversified operations

Logging operations in Central Africa may be described in several ways : formal or informal, industrial or small-scale, legal or illegal.

Informal production is that which escapes regulation, registration and taxation by the state ; it is generally undertaken on a small scale, with limited human, material and financial resources.

Illegal activities are those undertaken in breach of the laws and regulations in force.

Small-scale activities are undertaken without mechanical equipment or with rudimentary mechanical equipment.

Production may be small-scale and legal in origin, or it may be industrial and illegal in origin. Production is often informal because the regulatory framework is ill suited to operators working on a small scale or to their market. Although the definition of legality is clear enough, there is debate about the legality desired in timber markets.

For some, legality is limited to the right of access to the resource. A company in possession of valid legal felling permits for the forest and trees concerned would thus be legal, as would its production. In the context of industrial production (forest concessions), access to the resource (long-term concession contract and annual felling permits – relating to an "annual felling base") is generally well regulated and formalized, and the timber originating therefrom is in most cases legal in relation to this criterion for access to the resource.

But the work done within the private certification processes (SGS, BVQI and Rain Forest Alliance) has created a more global vision of the legality of timber and its derivatives. The FLEGT process has also encouraged the various participants to define more precisely and in a more consensual fashion what is entailed by the legality of a type of timber or derivative. On the basis of national regulations and legislation, legality encompasses, apart from the right of access to the resource ; regulations relating to land rights, the environment and the protection of biodiversity, forest management, taxation, the right to work, transport and processing of forestry products, respect for local communities and indigenous peoples, and commercial and export procedures.

As the result of the work done through negotiating the VPAs, the FLEGT is a set of legality tables defining criteria and indicators of the legality of a product on the basis of the laws and regulations of the producing country. In the context of the VPAs, the legality verification system will seek to verify whether all the various criteria, indicators and verifiers defined in these tables are fully respected, which will permit the issuance of a FLEGT authorization. The first analyses show that substantial progress is needed in order for all companies to respect all the criteria defined in the tables.

The small-scale sector is in most cases informal. The right of access to the resource in particular is ill defined and subject to little state control, the rights are often acquired on a customary basis within the local communities, which means that under existing regulations this "small-scale timber" is most often illegal. Substantial work is currently being done by the states of the region with the support of CIFOR to more effectively regulate the small-scale sector by adopting regulations which are more closely adapted to its specific characteristics. This approach also seeks to prevent this important sector of the local economy from being bypassed by industrial entrepreneurs seeking to evade compliance with the regulations imposed on concessions, as was shown in the DRC in 2012 (press conference and technical note by the National Coalition Against Illegal Logging in DRC concerning "artisanal-industrial" enterprises operating in an industrial manner with small-scale permits). In Central Africa, production by the small-scale sector dominates domestic markets. Volumes exported outside the subregion remain limited.

Photo 2.10: Construction of latrines for workers' camp, Gabon

Table 2.2: *Dominant characteristics of small-scale and industrial operations in Central Africa*

	Small-scale	Industrial
Logging permits	None or rarely, short-term permits by number of stands or area	Yes in most cases (cf. list of types below) Sometimes logging permits not valid or not compatible with industrial logging
Legality	Legal framework often incomplete or unsuited to small-scale activity and its actors. Limited compliance with laws and regulations	Legal framework often very complete. Very variable level of compliance with all laws and regulations.
Operators	Small or very small national enterprises. Segmented operations, multitude of small operators.	Large or medium-sized enterprises, in most cases with foreign capital. Very integrated operation, with forestry and industrial enterprises.
Felling	Chainsaws, sometimes axes, a few trees per producer.	Chainsaws. Larger worksite per producer (generally more than 1000 m^3 rough lumber per month).
Extraction and transport of products	Partly manual for processed timber and rough lumber. No heavy equipment used.	Extraction by means of tractors with tires or tracks.
Processing	Several examples: chainsaw at the felling site in forest (no transport of rough lumber), small sawing units, processing tools often rudimentary and obsolete. Low-quality sawing, generally wood not dried or second and third processing products.	In plants: sawn wood, veneer and plywood, slicing. If legislation permits, a proportion of rough lumber is exported as is and processed abroad.
Sales	National markets or in neighboring countries.	Sales essentially for exports outside the subregion.
Declaration of production	No declaration in most cases.	Declaration to ministries responsible for forests.
Taxation	Only partial taxation in most cases.	Taxation and partial taxation.

Adapted from Lescuyer et al., 2012

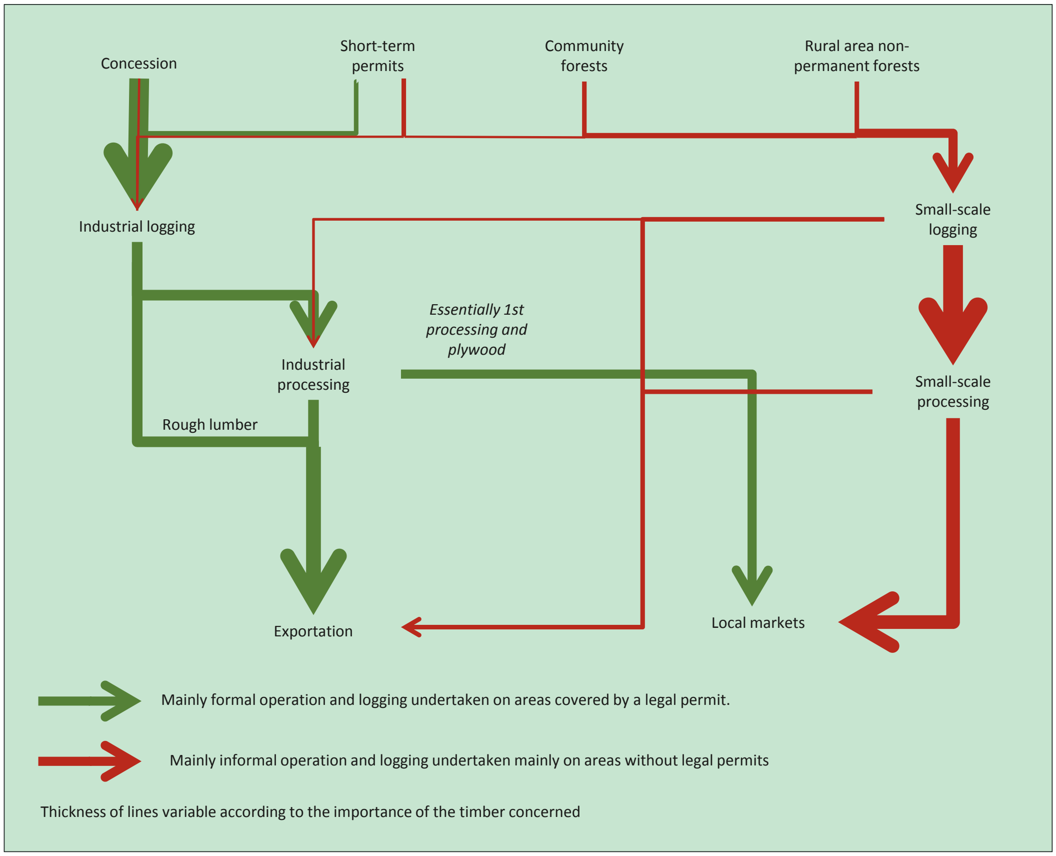


Figure 2.5: The main logging operations in Central Africa

3.2 Formal production and types of forestry permits (formal logging)

The formal regional production of rough lumber declined appreciably in 2010 to approximately 6 million cubic meters, the lowest production level recorded since 1993. This decline is the result of the combined effect of the economic crisis on the tropical timber market and the prohibition of Gabonese rough lumber exports in 2010.

This formal production originates from various logging permits, which we have endeavored to classify by type. The bulk of formal production (over 90 % in 2010) derives from long-term logging permits on concessions which permit-holders have an obligation to manage.

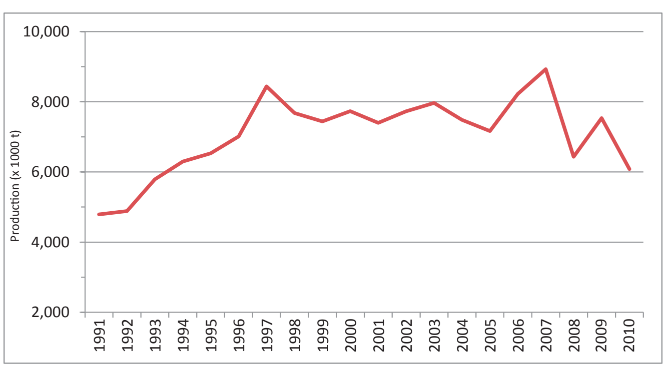


Figure 2.6: Rough lumber harvests in Central Africa 1991-2010

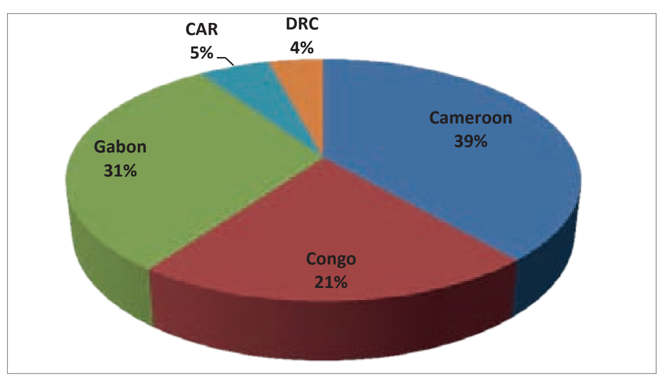


Figure 2.7: Distribution by countries of annual rough lumber harvest in Central Africa in 2010

Table 2.3 : *Types of logging permits in Central Africa for the harvest of timber originating from national forests*

	Cameroon	Congo	CAR	DRC	Gabon
Long-term permits covering an area of more than 15 000 ha Granted for a minimum of 15 years Management obligation on concession-holder	Logging agreement issued on a UFA	CAT or CCI issued on a UFA or UFE	PEA	Forestry concession contract	CPAET and CFAD which may integrate or combine associated forest permits
Community forests	Communal forests	Communal forests and forests of other local communities	Public community forests	Not provided for in Forestry Code	Not provided for in Forestry Code
Local community forests	Community forest	Community development series	Community forest	Local community forests	Not provided for in Forestry Code. Creation of community forests under study
Short-term permits by volume, number of stands or area Issued for a maximum of one year Covering not more than 50 stands, 2 500 ha or 500 m^3	Sale of felled lumber, authorization to recover timber, authorization to remove timber, personal authorization of felling, logging permit	Special permit	Small-scale logging permit	Small-scale felling permit	Permit by mutual agreement

Existence : Yes No

With : CAT : Management and processing agreement ; CFAD : Forest concession under sustainable management ; CPAET : Provisional management, logging and processing agreement ; CTI : Industrial processing agreement ; PEA : Logging and management permit ; UFA : Forest management unit ; UFE : Forest logging unit.

At the regional level, long-term forest concessions are dominant with formal operators in both area and volumes extracted.

The short-term permits are in theory intended for small-scale operators who sell their products to nearby towns or cities or countries in the subregion which do not produce timber. In practice, the complexity of access to this type of permit and the very low level of formal production recorded from these permits raise questions about their relevance, in that they do not seem to meet the specific requirements of small-scale operators.

3.3 Informal producers and production

In the countries of the Congo Basin, the latest estimates of volumes of timber sawn by small-scale operators (most without a valid logging permit) and sold in the large cities show that this type of production is very substantial compared with the production and exports of industrial sawn wood enterprises.

In the DRC, the latest estimates indicate that consumption in the cities of Kinshasa and Kisangani is about 290 000 m^3 of sawn wood, of which about 60 000 m^3 originates from industrial discards (CIFOR 2013, not published) ; about ten times the production (and export) of industrial sawn wood. In Cameroon and the CAR, local consumption exceeds the production of industrial sawn wood, whereas in Congo and especially Gabon, industrial production is greater than local consumption. Following the Gabonese government's decision to prohibit the export of rough lumber, which means that all felled wood has to be processed locally, a likely medium-term increase in the quantity of industrial discards will compete in the domestic market with small-scale sawn wood.

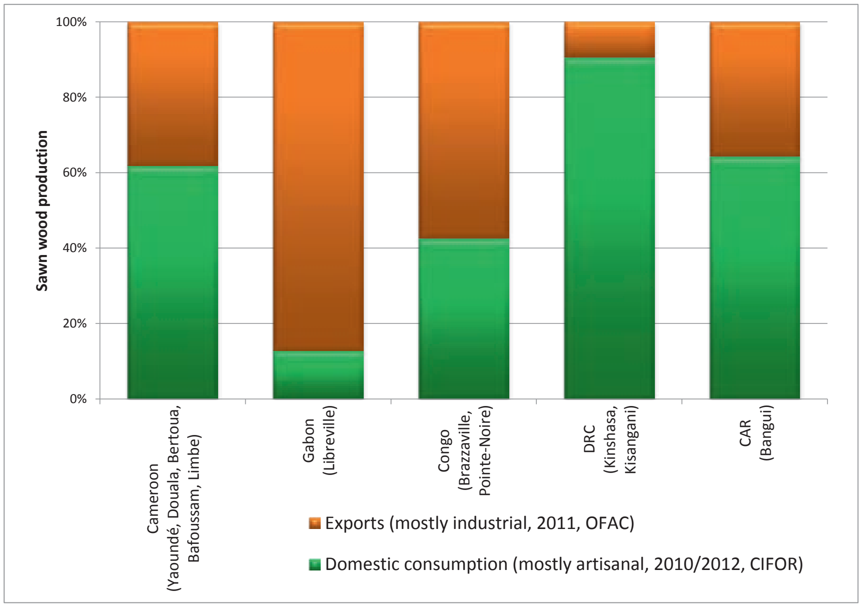


Figure 2.8 : Comparison (in %) of volumes of sawn wood exported and consumed locally in five Congo Basin countries

In all the countries of the region, demand continues to be sustained mainly by the construction industry and large public infrastructures. These markets are not yet concerned about the quality and legality of the products used. Their influence on the quality of domestic production therefore remains low.

The great majority of production for the internal market is based on small-scale sawn wood exploited with limited means by a majority of small entrepreneurs, which sometimes form syndicates, and rarely by medium-sized enterprises. The small-scale sawn wood operators may be divided into two main groups depending on whether they receive prior orders from residents of the large cities or they themselves decide to fell timber for the urban markets. In each case, the structure of costs and benefits may vary considerably. In general, sawn wood operators without prior orders do not manage to sell their products at the same price as operators filling orders. They are also more subject to roadside controls.

Small-scale operators who export to neighboring countries have the benefit of far more developed organization and support (commercial, financial and political) than sawn wood operators who only supply the domestic markets. This applies in Cameroon to small-scale sawn wood exported to Chad and in the DRC to sawn wood exported to Uganda.

Photo 2.11 : Artisanal sawing – Ovigui, Gabon

3.4 Changes in the industrialization of the value chain

Globally, the Central African timber industry remains underdeveloped, characterized by processing timber to a lesser extent than the other tropical regions of Africa, South America and Asia. This industry nevertheless is by no means an insignificant part in the economies of the countries concerned (between 4 % and 6 % of GDP, 15 % of export earnings in Gabon and 21 % of earnings in Cameroon).

To date, the legal minimum processing rates required for each logging operator are as follows :

- In Congo, 85 % of timber must be processed, but in 2012 some enterprises obtained extensions for reaching that quota or an exceptional temporary authorizations for certain species ;
- In Gabon, 100 % since the end of 2009 ;
- In Cameroon, 100 % with possible exceptions for secondary species ;
- In CAR, 70 % since 2008 ;
- In DRC, 70 % in at least over 10 years for owners of processing units and national operators (100 % for the others) ;
- In Equatorial Guinea, 100 % since 2008.

However, these rates are complied with only to a limited extent, as shown by Table 2.4.

Table 2.4: *Estimated actual processing rates*

	2009-2011	2005-2008	1993-1999
Cameroon	NA	88 %	57 %
Congo	NA	57 %	42 %
Gabon	67 % (1)	37 %	15 %
Equatorial Guinea	NA	11 %	NA
CAR	51 % (2)	59 %	77 %
DRC	NA	39 %	69 %
Central Africa	NA	54 %	42 %

Sources: 1993-1999: OIBT; 2005-2008: OFAC; 2009-2011: MEF-DCESP/SDV-CMA (Gabon), OFAC (CAR)
NA: data not available; (1) rate reaching 100 % in 2011; (2) period 2009-2010

Legitimately, the countries require logging operators to ensure improved use of the rough lumber extracted from the forest. In order to further this aim, in 2010 and 2011 four meetings entitled "Towards a strategy for promotion of the development of the logging industry in the Congo Basin" were organized by IFIA, OIBT, FAO and the RECAP WOOD INVEST project financed by the EU under the PROINVEST program. These meetings were held in Yaoundé (Cameroon, September 2010), in Brazzaville (Congo, March 2011), in Kinshasa (DRC, May 2011) and in Libreville (Gabon, June 2011). Their objective was to formulate and implement national strategies for the development of the logging industries. This effort is linked to the fifth strategic axis of COMIFAC's "Convergence Plan" on the sustainable evaluation of forestry resources.

The strategic axes adopted were:

- Support and promote investment in small enterprises in the sector;
- Propose products for financing adapted and accessible to industrial operators and small or very small enterprises;
- Place emphasis on training by creating technical and vocational training centers;
- Remove trade barriers in local and regional markets;
- Integrate the informal sector into national economies;
- Establish tax incentives for the development of timber processing operations.

Photo 2.12: Some planks from a small-scale logging operation drying in a Gabon village

4. The management of production forests

4.1. Logging concessions geared to industrial production

Work on the management of concessions in the Congo Basin has been under way for about 15 years. The first management plans were approved in the late 1990s and early 21st century. Up to 2009 the momentum for managing logging concessions was strong (cf. chap. 2 of State of the Forest 2010, de Wasseige *et al.*, 2012). In early 2013, concessions accompanied by a management plan covered approximately 19 million hectares – an increase of 35 % since 2009. This managed area accounts for 40 % of areas under concession in the subregion.

Since 2010, however, the area of managed forests has stagnated, a development which may be attributed to various factors including the effects of the world economic crisis which severely affected the African tropical timber sector in 2008-2009 creating conditions unfavorable for investing in management plans, which cost 3-5 €/ha (Cassagne and Nasi, 2007).

Progress in sustainable forest management varies very widely according to countries and geographic zones, but also according to types of actors:

Cameroon and Northern Congo continue to be models, with a majority of managed areas and numerous certifications attesting to compliance with implementation of management plans.

The CAR has completed the effort to manage all its forestry concessions granted, but must now meet the challenge of effectively implementing these management plans. The PARPAF project, the driver of management in this country, ended in 2011 and an agency for the sustainable management of forestry resources (AGDRF) was created in May 2012. The purpose of this agency is to implement the sectoral forest management policy of the Ministry for Water, Forests, Hunting and Fishing, taking into account the achievements of PARPAF and to pursue management activities for the logging permits not yet issued.

At the end of 2012, neither southern nor central Congo nor the DRC had a single approved management plan. Nevertheless, this fact hides the genuine progress made in recent years; the process is now under way for an inventory of resources prior to the drafting of the management plans. This process has been undertaken on over 1.8 million hectares in southern and central Congo and for 3.2 million hectares in DRC, covering 37 % and 30 % of concession areas respectively.

Over these two areas, the first relevant plans were completed in 2013. In addition, in the DRC, management plans approved in late 2012 for 4.3 million hectares (41 % of concessions) established the management standards for the first four-year period of the management plans.

It is also expected that the entry into force of the EUTR (cf. 2.1.2) will force action from operators who have hitherto been insensitive to the legal requirements of sustainable management.

The situation in Gabon is in contrast: in the first decade of the present century, Gabon was a driver in the initiative for sustainable management of forest concessions, with the strong commitment of enterprises preceding the establishment of a legal framework. The small producers who were lagging behind because of their low investment capacity and whose size was incompatible with application of the model developed for large areas are now committed to the process through support of the Gabonese project for development of small forestry permits (PAPPFG).

Photo 2.13: A raft of logs – Owendo, Gabon

Firms with European capital are at the forefront of sustainable management. The commitment of many of them to private certification has made possible great progress– environmentally, socially and economically. The consistent efforts made by companies to meet certification requirements have led to increasingly effective management tools and procedures for the protection of fauna and flora and to increasingly close cooperation with local communities, including investments in social capital (schools, dispensaries, direct and indirect employment, HIV campaign, training, etc.). At present there are over five million hectares of FSC-certified national forests in the Congo Basin.

Certification of legality in the Congo Basin has begun, with over three million hectares under Origin and Legality of Timber (OLB) and Timber Legality and Traceability Verification (TLTV) certificates.

This progress in the area of responsible development and management is, however, taking place in restrictive conditions which are affecting the environmental and economic viability of African operations. The logging companies (certified or otherwise) based in Africa are operating in an economic context that is often unattractive: difficult access to investments, lack of tax incentives, very limited locally available vocational training, few competitive qualified personnel, industrial equipment incapable of maintaining added value locally (low drying capacity, mediocre output, expensive petrol used for fuel), competition with informal local markets. Forestry research is insufficient to produce data on the ecology of species and forestry dynamics or to assist in the development of management tools, etc. The authorities lack the means to perform their role and make legislation operational. At a higher level, the lack of multisectoral vision is impeding the development of forest-timber operations, which is poorly integrated in the national development strategy (e.g. lack of planting to meet energy demand, employment market underestimated). In addition, the poor image of tropical timber in certain international markets means that maximum benefit is not derived from it.

Table 2.5: *Areas of long-term forestry concessions in Central Africa*

	Forest concessions			Managed concessions		Certified concessions	
	Area (ha)	Number	Average area (ha)	Area (ha)	%(1)	Area (ha)	%(2)
Cameroon	7 058 958	111	63 594	5 071 000	72 %	2 393 061	34 %
Congo	12 600 221	51	247 063	3 504 159	28 %	2 584 813	21 %
Northern Congo	5 822 597	14	415 900	3 504 159	60 %	2 584 813	44 %
Southern Congo	6 777 624	37	183 179	0	0 %	0	0 %
Gabon	14 272 630	150	95 151	7 181 420	50 %	2 435 511	17 %
Equatorial Guinea	0	0		0		0	
CAR	3 058 937	11	278 085	3 058 937	100 %	0	
DRC	12 184 130	80	152 302	0	0 %	828 033	7 %
Total	49 174 876	403	247 063	18 815 516	38 %	8 241 418	17 %

(1) FSC, OLB and TLTV certificates
(2) Percentage of area of concessions
Sources: WRI 2011 (Cameroon), Gally and Bayol 2013 (Congo), PAPPFG Project (Gabon), AGEDUFOR Project (DRC), ECOFORAF Project (CAR and certification)

In recent years, some of the first management plans in Gabon, the CAR and Cameroon have been revised in order to take account of new trends in an evolving context (notably new markets) or to update and spell out more clearly the basic data used for planning. It would now appear useful to review the execution of these planning documents. In Congo, the first management plans were the subject of a five-year evaluation which attested to the effective execution of the bulk of management requirements. The French Development Agency (AFD), a major actor in the management process, drew up a "Balance sheet of 20 years of AFD intervention in the Congo Basin" in 2011.

This balance sheet shows the success of the sustainable management plan as an "economic and ecological model for partial delegation of governance to logging companies". It also emphasizes the need to go still further in taking account of the social and environmental questions involved in sustainable forest management.

4.2. Communal forests – Situation in Cameroon

At present, Cameroon is the only country in the subregion with communal forests. Other countries are studying the advisability and procedures for creating forests managed by local communities.

Cameroonian legislation gives communes the right to manage forest resources with retrocession of land rights. Thus, a communal forest is classified a Permanent Forest Domain to the benefit of the commune concerned or which has been planted by it on communal land. The average area of communal forests (excluding plantings) is about 20 000 hectares or four times the maximum area of community forests.

According to Cuny (2011), communal forestry is facing three main challenges : (i) land classification and registration are complicated administrative operations and expensive (obligation to proceed via the Prime Minister's Office and secure the prior agreement of the Office of the President of the Republic since land is a highly political issue ; classification of some forests has thus taken several years) ; (ii) the environmental impact study, although expensive, becomes obligatory under the law ; (iii) the cost of the whole process is high : 50 million CFA francs (excluding demarcation) apart from subsequent operating costs resulting from logging, monitoring, review of the management plan, etc. The first classification agreement was signed in 2001 (Poissonnet and Lescuyer, 2005), i.e. seven years after the concept was created. Since then the number of classified communal forests has increased steadily. In 2012, 17 forests were classified as such covering an area of 381 834 hectares (table 2.6). Among these classified communal forests, 15 are under management (management plans approved) covering 318 613 hectares, nine are under exploitation (229 690 hectares) and in

Table 2.6 : *Situation of classified communal forests in Cameroon by region*

Region	Number of CFs classified, managed and under exploitation	Area (ha)	Number of CFs classified and managed	Area (ha)	Number of CFs classified under management	Area (ha)	Total area of CF per region (ha)
East	4	115 257	3	51 697.5	0	0	166 955
Centre	3	58 076	1	20 000	1	29 500	107 576
South	2	56 357	2	17 226	1	33 720.5	107 304
Total	9	229 690	6	88 923.5	2	63 220.5	381 834

Source : Database of the Technical Centre for Communal Forests in Cameroon (CTFC) two, management approval is pending (management plans under preparation – 63 221 hectares).

In addition to the 17 classified forests, 16 others are in the process of classification and their area is approximately 413 850 hectares. Forty seven communal forests have been created or are being created through planting (approx. 11 000 ha). In addition, the Minister of Forests and Wildlife has established the list and procedures for transfer of the management of certain forest reserves to the communes. Forth three reserves and reforestation areas are thus concerned by this decision (estimated area : 151 086 ha).

4.3. The community forests

COMIFAC's convergence plan advocates harmonization of legislative approaches concerning "community permits", the forestry licenses which grant local and indigenous communities the right to harvest and supply a timber market. Cameroon, the CAR and Gabon passed similar legislation which defines community forestry in the "classic" sense, binding the state and a community in the management of a part of the forest. However, these countries differ in their level of execution. Numerous community forests in Cameroon are beginning to supply a share of the national market estimated at 5-10 % (Malnoury, 2012), whereas no community forest has yet been allocated in Gabon or the CAR. In the DRC, the situation is comparable to that in Gabon : the few pilot experiments are not yet based on enacted legislation and are not making a significant contribution

Box 2.2 : Management of a pilot concession at Maniema (DRC)

Frédéric Sepulchre and Antoine Schmitt.
PBF/GIZ

A pilot concession of 42 000 hectares has been created through the support of the German-Congolese Cooperation Agency "Biodiversity and Forest Program" (PDF) near Kindu between the Congo and the Elila rivers. The objective is to test a simple model for managing forest resources and revenue. The project is being undertaken jointly by the local communities living near the concession and the applicable government institutions.

The Kailo forest concession is one of the national government's protected forests. The 18 villages surrounding it enjoy customary rights and are allowed to undertake logging within the protected forest. Only manual logging is taking place, mainly near roads and rivers. Almost all the timber is from three species: Iroko (*Milicia excelsa*), Kosipo or Tiama (*Entandrophragma sp.*) and Emien (*Alstonia sp.*). Fallen wood is shared through agreements between loggers and local communities, the loggers paying a "right for logging".

The forestry code provides that any timber harvest must be preceded by a forest management plan. The PBF has charged the German Forest Service (DFS) with drawing up this document. The management plan must be simple and must, *inter alia*, meet the following conditions :

- the majority of the community must benefit from the use of the forest;
- the forestry activities on village lands must be planned;
- the forest cover must be preserved and the regeneration of marketed species ensured.

In order to achieve these results, the following major constraints must be removed:

- difficulty within the communities in reaching a consensus on land questions and access to natural resources;
- transportation of forestry products is difficult because of poor road conditions ;
- government agencies do not effectively carry out their supervisory responsibilities ;
- the unclear process of forestry decentralization creates uncertainties making decentralization policies difficult to put into effect.

The preparation of a management plan has demonstrated the legal and technical vacuum which exists between small-scale and industrial logging. This vacuum must be quickly filled in order to be able to develop strategies needed to resolve problems in the DRC forest sector.

to the timber market. The experience of Congo Brazzaville is different : community development areas are defined within a logging concession, whose management plan is concluded between the private sector (and not a community) and the state. Various development options are possible under the plan, including small-scale logging.

It must therefore be concluded that, in Central Africa, despite some innovative and encouraging policies, social forestry in the broad sense is contributing only to a very marginal extent to the international and national timber markets. A substantial effort remains to be made for the execution of these policy options. Community forestry cannot originate solely from law, but in addition requires local support since the production know-how and potential are great. The experiences of Gabon and Cameroon show that communities can produce quality sharp-edged planks with chainsaws and mobile saws. This represents a unique opportunity to supply legal and equitable timber to meet the considerable demand of the domestic markets, even if the competitiveness of this timber remains threatened by the persistence of illegal production. This aspect is very important within the FLEGT context in the subregion, when the internal markets are integrated into the legality verification systems.

4.4. How are the areas intended for small-scale production to be managed?

Although the regulations provide for logging permits adapted to small-scale production (cf. Table 2.3), very small volumes are in fact produced with these permits. The bulk of small-scale production remains informal if not illegal.

Studies need to be undertaken to identify effective opportunities for legal small-scale production. Such production is possible ; this is already partly the case with informal production in the non-permanent forest domain and hence in degraded forests or areas intended over time for conversion to a non-forestry use.

An opportunistic association exists between small-scale logging and agricultural land uses, which is mostly a result of the abundance of valuable timber species in fallows and on cocoa farms, their easy accessibility and the low price of farmland timber. Farmers apply various strategies to the management of tree resources in fallows and cocoa agroforests with most felling authorized in fallows and most trees preserved on the cocoa farms. With current agricultural expansion and intensification trends associated with small-scale logging, timber resources on rural land are at risk of depletion with direct consequences for domestic timber supplies and the thousands of livelihoods it sustains. Marketing and regulatory changes – notably for forest tenure – are needed to encourage the integration of timber production in agricultural management systems.

Timber volumes produced on these agricultural areas will probably remain insufficient to supply small-scale production operations, therefore solutions to access the permanent forest domain need to be found. A major challenge will then be to determine procedures for the sustainable management of these forest areas in cooperation with local sawmill operators. This new model will differ from that of the large logging concession which is exploited solely by operators using industrial equipment and wage-earning employees. It will also be different from the current community forest approach, which offers only community management of the areas and resources, whereas small-scale logging is above all an individual enterprise.

Photo 2.14 : Raft of logs ready for transport – Sodefor Concession – Bandundu Province, DRC

CHAPTER 3

Biodiversity conservation and management

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1. Introduction

Since the first edition of the State of the Forest (SOF), the state and conservation of biodiversity have been a continuing concern. Every subsequent edition has reviewed the threats to the fauna and flora of the subregion. In 2010, the subject was presented in a chapter entitled "Biodiversity in the forests of Central Africa : panorama of knowledge, principal challenges and conservation measures" (Billand, 2012). By devoting a new chapter to this subject, the SOF 2013 reaffirms the importance of biodiversity and the protection of species for the sustainable development of the forests of Central Africa.

The present chapter is not a monograph of the current situation ; it makes no claim to be an exhaustive treatment of the biological diversity of Central Africa. Rather it follows the panorama drawn earlier while highlighting additional knowledge acquired and the tools available to follow the changes of the biodiversity and to facilitate its management. It also addresses some topical questions and recent experiences with the management/conservation of animal and plant biodiversity.

The first part of the chapter, which is particularly innovative, describes the available methods for estimating biodiversity in the forests of Central Africa. The first section concerns the large mammals, including most of the emblematic species ; it then presents methodologies for evaluating plant diversity.

The second part presents the status of a number of emblematic species. It provides the most recent information on the critical status of elephant and great ape populations. After reviewing the state of knowledge of plant diversity, this sec-

Photo 3.1 : INERA forest department herbarium – Yangambi, DRC

tion also describes the problems of invasive species through examples of the small fire-ant in Gabon and Cameroon, and the invasive plants in Sao Tomé. Surprisingly, this threat to the ecosystems of Central Africa has so far been given little attention by conservationists.

Several biodiversity tools and approaches are presented in the third and fourth parts. Attention is focused, *inter alia*, on the fundamental role of herbaria for the knowledge, conservation and management of plant biodiversity. A preliminary review of the trans-boundary protected area initiatives is presented, following the conservation measures described in SOF 2010. Lastly, Central Africa continues to be confronted with the extensive and indeed resurgent phenomenon of poaching and trafficking in animal species. Considerable attention is therefore given to the challenge to combat poaching. This question is addressed transversally in the last two chapters, which highlight concerted multiple action programs being developed in the region, including cross-border management

2. The methods of evaluating biodiversity in the forests of Central Africa

Box 3.1 : Assessment of the status of large mammals: some definitions

The terms "inventory" and "census" are often used equally in studies quantifying central Africa's large mammals. These exercises help document the abundance and distribution of living species in a given location at any given moment. Monitoring is a process which incorporates a time-related or temporal aspect ; the change in numbers over months and years, is examined. In general, the monitoring of fauna supports the management of the targeted species and of their habitat. The monitoring serves to evaluate management efficiency, identify zones confronted with conservation issues and to observe seasonal migrations or movements of species, etc.

2.1. Evaluation of large fauna

Monitoring wildlife is a fundamental requirement for guiding the management and conservation of species and their habitat. The presence of large-bodied mammal species with relatively slow reproduction rates combined with the intensity and distribution of human activities are two commonly used indicators for ecosystem health (Alstatt *et al.*, 2009 ; Atyi *et al.*, 2009). Generally, monitoring the status of large fauna first determines their population abundance and distribution, then identifies and prioritizes the factors which may impact their abundance and distribution in the future (generally threats). These factors are monitored for trends across space and time (IUCN/SSC, 2008).

2.1.1. The customary methods : distance sampling and reconnoitering

Distance sampling and reconnoitering on foot (recce) are the two most commonly used techniques to evaluate wildlife populations in the dense forests of Central Africa. Recces are based on the direct observation of the animals or, more generally, on monitoring the traces of their activity (footprints, droppings, nests, remains of meals, etc.). In distance sampling, only the droppings or nests (of great apes) are taken into account. We will give only a summary description of these two methods as they are described in detail in the reference work by White and Edwards (2000).

Customarily, distance sampling is applied along linear transects. One or more tracks are opened through the vegetation in a specific direction. Then, all observations of each dropping and each nest are counted along the track and the perpendicular distance of each observation in relation to the axis of progression is measured. The total number of animals present in the sample zone (known as absolute density) is then estimated on the basis of modeling the probability of detection of observations along the transects, the effective area covered (total length of transects x effective width of the transects), and the rate of production and degradation of the said observations (droppings or nests) according to site and season[7]. Distance sampling is considered by the scientific world as the reference method.

The theoretical basis for this method and some extremely useful field advice is described in detail in Buckland *et al.*, 2001 and 2004. The software program DISTANCE, which is available on the CREEM (Centre for Research into Ecological and Environmental Modelling) website (http://www.ruwpa.st-and.ac.uk/distance), is used both for the sampling design and for the analysis of the results (Thomas *et al.*, 2010).

Recce does not include the variability in detecting the animals. This method consists simply of noting the observations while travelling in an approximate direction on pre-existing tracks (footpaths, animal paths, etc.). The data collected are similar to those of data sampling but without measuring the perpendicular distance of the observation. These data are converted into an abundance index ("kilometric abundance index" or "encounter rate"), which may indicate temporal changes in a specific animal population.

2.1.2. Innovative methods: genetic estimation and camera trapping

New techniques for evaluating animal populations are in development; they include genetic estimation and camera trapping, which are adapted to rare, nocturnal or particularly discreet species. Genetic counting methods have been successfully used for small populations of forest elephants in Ghana (Eggert *et al.*, 2003), Asian elephants in Laos (Hedges *et al.*, 2013), great apes in Gabon (Arandjelovic *et al.*, 2010; Arandjelovic *et al.*, 2011) and gorillas in Uganda (Guschanski *et al.*, 2009) and in the Virunga mountains (Gray *et al.*, 2013). The method requires the prior establishment of the genetic profile of the animals on the basis of their DNA gathered on the ground (droppings or hairs). The results of the DNA analyses of the materials collected are then introduced into a mathematical capture-recapture (C-R) model which estimates absolute density. These results can also serve to construct accumulation curves for newly identified individuals.

Camera trapping consists of taking pictures of animals with cameras which are activated by infrared means (photo 3.2). A C-R model then makes it possible to calculate absolute densities for species which have characteristics enabling each individual to be identified, for example, the bongo in Congo (Elkan, 2003) and the Virungas National Park (Nixon and Lusenge, 2008), the leopard in Gabon (Henschel, 2008) or the elephants in the forests of Asia (Karanth and *et al.*, 2012). The development of spatially explicit capture-recapture techniques (SECR) now allows the robust estimation of animal density; this can also be used for unmarked animals (e.g. Chandler & Royle, 2011). For these unmarked animals, which are the majority of the species usually monitored in the Central Africa region (such as ungulates, apes and elephants), occupancy models (in which traps, transects, and surveys by independent observers can be treated as repeated observations for a local sample area) can also be used (O'Connell, 2011). Finally, a combination of remote video trapping, SECR and other methods has recently been successfully used for great ape and elephants in Gabon (Head *et al.*, 2013).

7. Given that it is impossible to count all the animals (or all traces of animals) of a given animal population or of an area, the census statistics (the number of animals or traces of animals actually recorded in a study) may be used to deduce an estimate of the population. The abundance of a particular species in a given area is then calculated by dividing the count statistic by the probability of detection of an animal or trace of an animal (for example, Nichols and Conroy, 1996) (MacKenzie *et al.*, 2006). The statistic count may also be determined from the number of animals captured, photographed or otherwise identified during capture-recapture studies (for example, Otis *et al.*, 1978), or the number of plots where an animal (or sign of an animal) has been detected through sampling of occupation of the plots (MacKenzie *et al.*, 2006).

Photo 3.2: Installation of a photo trap for the study of African golden cat (Caracal aurata), south of the Ivindo National Park, Gabon

2.1.3. Other available techniques

Other techniques exist within a context of more specific intervention. For example, counts by means of sweeps (complete coverage of a survey zone in order to detect all animals, or their signs, present there) (McNeilage *et al.*, 2006 ; Gray *et al.*, 2010) and the monitoring of animals accustomed to the presence of humans (Kalpers *et al.*, 2003 ; Gray and Kalpers, 2005) have been specially developed for great apes and a few other primates. The appeal technique (van Vliet *et al.*, 2009) or village surveys (van der Hoeven *et al.*, 2004 ; van Os, 2012) have tended to be used for the management of species of game in a hunting area. Interview surveys are also useful precursors for standardised field surveys (Meijaard *et al.*, 2011).

The range of counting methods is therefore broad (Maréchal, 2011). The choice of a suitable method depends on many factors : species targeted purposes of the study (management objectives, type of results anticipated, desired accuracy of estimates), field conditions (size of site, means available) (table 3.1). In a strict conservation context, this choice can be made using the decision tree proposed by proposed by Strindberg and O'Brien (2012).

Table 3.1 : *Counting methods according to species of large-bodied mammals, level of expertise required and scale of application*

Method	Species target	Level of expertise required (knowledge, skills, necessary practices)	Area of application
Linear transect	***	+++ Navigation in forests, reconnoitering of signs and species, statistics for preparation of regulations for the study, analysis and interpretation of results, distance sampling	# to ###
Recce	***	++ Navigation in forests, reconnoitering of signs and species, statistics for preparation of standards for the study, analysis and interpretation of results	# to ###
Genetic counting	*	+++ Navigation in forests, statistics for preparation of standards for the study, analysis and interpretation of results, precautions for the storage of DNA, genetic analyses, C-R analysis	# to ###
Camera trapping	* or **	++ to +++ Handling photos, statistics for preparation of standards for the study, analysis and interpretation of results, C-R analysis and SECR	# to ###
Sweeps	* or **	++ Navigation in Forest	#
Monitoring accustomed animals	*	++ Individual reconnoitering of animals	##
Calling technique	** (duikers)	++ Competence of the caller, statistics for preparation of standards for the study, analysis and interpretation of results	#
Village survey	***	++ to +++ Interview techniques, cartography, statistics for preparation of standards for the study, analysis and interpretation of results	## to ###

Species targeted : * : only one species ; ** : a taxa or group of species ; *** : all large-bodied mammals.
Level of expertise required : + : basic (basic knowledge of the forest) ; ++ : medium (a particular skill) ; +++ : confirmed expertise (several areas of knowledge/particular skills).
Scale of application : # : a few thousand hectares (a sector of a forest) ; ## : several tens of thousands of hectares (a forest concession, for example) ; ### : several hundreds of thousands of hectares (a massif).
Adapted from Maréchal, 2011

Box 3.2: Fauna censuses in forestry concessions

Corinne Maréchal
University of Liege

For 10 years or so now an increasing number of mammal censuses (large and medium-sized species) have been carried out in the logging forests of Central Africa. This is a result of the growing commitment of logging companies to the process of sustainable management, and also to the laws and regulations which now require them to take wild animals into account in the concessions allotted to them (Billand, 2010).

Under these laws, management standards and certification requirements, the animal population censuses in the concessions essentially serve (a) to provide the basis for the zoning plan delimiting sectors of protection and preservation, and (b) to evaluate, and thereby reduce the impact of logging (primarily from hunting) on animal species (Maréchal, 2012).

A 2011 study by the University of Liège, financed by CIFOR, reviewed the practices used to census wild animals in logging forests. To that end, 75 projects concerning some 60 forestry concessions were analyzed (Maréchal, 2011). The methods used to evaluate the fauna potential in logging forests are fairly similar to those used in forests intended for conservation. The most widely used methods are "distance sampling", "recces" on foot or a combination of the two (recce-transect). However, procedures appear to vary widely from one site to another, particularly regarding the collection of field data, the processing of results or the presentation of distribution maps.

This situation results from a lack of standardized operational procedures for evaluating the resource. In fact, even the most advanced management regulations say very little about the method of collecting and analyzing data on animal populations, while sustainable management procedures do not specify the variables to be measured on the ground for evaluating fauna.

It would therefore appear necessary to standardize the procedures for the evaluation and monitoring of large-mammal populations in forestry concessions management plans. Ideally, a new methodological framework should be developed, specially adapted to the particular context of industrial forestry, which should include the exploitation strategy, management objectives (including fauna), available skills, and the economic and logistical constraints particular to the concession. For this purpose, proposals have been made by Maréchal *et al.* (2011).

2.2. Evaluation of Flora

2.2.1. Contribution of forest inventories in concessions

One of the difficulties in studying the biodiversity of tropical forests, and hence defining priority areas for conservation, is obtaining good-quality field data at reasonable cost. In the context of the USAID/CARPE program (carpe.umd.edu), the Missouri Botanical Garden (MBG), the *Université Libre de Bruxelles* (ULB) and the Wildlife Conservation Society (WCS) have collaborated over four years to assist logging companies in identifying, within their concessions, suitable areas for conservation. The methodology which was evolved has subsequently been applied in several logging concessions in Gabon (Stévart and Dauby, 2011).

The forest inventory data are used to classify the principal habitats. However, these data are less precise than those collected by scientists, notably in terms of taxonomic identification, especially for rare species of trees and ground vegetation and,

Photo 3.3: Explosion of greenery in the understory of a Bas-Congo woodland – DRC

to a lesser extent, for non-commercial species. In order to minimize this bias, however, statistical methods that attach little weight to rare species (Rejou-Mechain *et al.*, 2010) make it possible to characterize the spatial variation of the various flora and to define a forest typology. This typology can be more precisely defined by targeted and more complete inventories, including additional data on flora, notably for endemic species.

Tested for the first time in Gabon on the Sylvafrica inventories in the concessions of the Rimbunan-Hijau – Bordamur group (Stévart and Dauby, 2009), this approach has enabled the identification of rare types of vegetation and other important requirements for large-bodied fauna. The recommendations subsequently issued were useful to Sylvafrica in formulating the development plan.

2.2.2. Example of permanent plots

A large complex of over 250 permanent plots with an area of between 0.2 and 50 ha and covering a total of approximately 500 ha has been established in tropical Africa in order to monitor and study vegetation (Picard and Gourlet-Fleury, 2008 ; African Tropical Rainforest Observation Network : afritron.org ; etc.). In these plots, all trees with a diameter of more than or equal to 10 cm (at 1.3 m above the ground or at 30 cm above the buttresses) were identified and georeferenced. In general, each tree is marked with paint or identified with a metal label to ensure their long-term monitoring.

These permanent plots are an essential tool in the study of the dynamics of forest stands. They also make it possible to study the processes at the origin of plant diversity and its probable past, present and future distribution, notably in the context of climate change. In addition, they help to answer questions about the impact of forest fragmentation on the distribution and abundance of plant species and the quantity of biomass stored in the various types of forest in forests with strong biodiversity or strong endemism. (see box 3.3 : Integrating ecological knowledge in management decisions : the contributions of the CoForChange project).

3. State of biodiversity in the forests of Central Africa

3.1. Current status of some emblematic mammals

Ideally, the protected areas should serve as cores of conservation and protection of large African fauna. They should be protected by effective teams and serve as a model for managing fauna over the long term. But numerous studies show the decline, even the collapse of large mammal populations (primates, elephants, antelopes, etc.), including within protected areas (Caro and Scholte, 2007 ; Craigie *et al.*, 2010 ; Bouché *et al.*, 2012).

The direct causes (proximate drivers) of this phenomenon are well known : poaching mainly and changes in land use (notably farming clearings). But among the deep-rooted causes (underlying drivers) will be found the ineffective management of the protected areas (Scholte, 2011).

3.1.1. Update on the illegal killing of elephants

Since 2002, the MIKE program (Monitoring the Illegal Killing of Elephants) of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) has been monitoring, in 15 protected sites in Central Africa[8], the illegal killing of elephants (a "vulnerable" species on IUCN's "red list", except for the forest elephant sub-population considered to be "in danger"). MIKE mainly collects data relating to elephant carcasses found in the field and calculates the PIKE index (Proportion of Illegally Killed Elephants), which is the number of illegally killed elephants as a proportion of the total number of carcasses counted (Burn *et al.*, 2011).

8 Boumba Bek and Waza in Cameroon, Bangassou, Dzanga Sangha and Sangba in CAR, Nouabalé Ndoki and Odzala-Kokoua in Congo, Lopé and Minkebé in Gabon, Garamba, Kahuzi Biega, Okapi Faunal Reserve, Salonga and Virunga in Democratic Republic of Congo and Zakouma in Chad.

Box 3.3 : Integrating ecological knowledge in management decisions : contributions from the CoForChange project

[1]Sylvie Gourlet-Fleury, [2]Adeline Fayolle
[1]CIRAD, [2]ULg

CoForChange is a project co-financed by the European Union, the National Research Agency (France) and the Natural Environment Research Council (UK).

A multidisciplinary team of researchers and forest engineers from eight public and private European institutions and four European countries in association with five African institutions, one international institution and 14 logging companies, (see list on http://www.coforchange.eu) collaborated from 2009-2012 on the GoForChange project. This multidisciplinary project set out to explain and predict possible future diversity of the humid tropical forests of the Congo Basin, and to propose tools to assist in decision-making for improved management of these forests which are subjected to increasing climatic and anthropogenic pressures. The project focused on a region of approximately 20 million hectares covering southwest RCA, south-east Cameroon and the northern Republic of Congo.

The project produced many results, some of which have major implications for forest planning and the conservation of forest ecosystems.

The integration of a large quantity of spatial information; geological maps, topographical SRTM data (Shuttle Radar Topography Mission), METEOSAT climate data, MODIS data (Moderate Resolution Imaging Spectroradiometer), vegetation activity, and zoning data supplied by partner forest companies has highlighted the influence of the geological substrate on the distribution of tree species and, more generally, on the floral and functional characteristics of forest populations (Fayolle *et al.,* 2012).

In particular, the sandstone substrates and to a lesser extent certain alluvial substrates upon which sandy soils have developed (RCA and north Congo) contain diversified forests composed of evergreen species that tolerate shade, grow slowly and are of dense wood. The pedologogical, anthracological (the study of conserved coal in sediments) and archeological findings demonstrated that these forests had not been disrupted by man and were probably ancient. Conversely, on the granite and schist substrates where richer soils have developed there are also diversified forests but composed of deciduous species whose canopies are prominently fast-growing heliophilic species, composed of average to low density wood. There are signs that these forests have been disturbed by man, especially where "ayous" (*Triplochiton scleroxylon*) species are observed. Most anthropogenic disturbance occurred in current *marantaceae* forests (Ouesso, north Congo region). The study of carbon isotopic profiles revealed that these forests, which are today very open, were not initially savannah but actually degraded forests that had been invaded by giant herbaceous plants, most likely because of a resurgence of human activity in the region beginning about 500 years ago.

A controlled environment study of the ecological requirements for principal tree species showed that these species were particularly resistant to drought at the "juvenile" stage, with the exception of certain pioneers such as the parasolier (*Musanga cecropioides*). This result is supported by studies carried out in the adult stages within the Mbaiki region in RCA.

The project proposed a new forest typology for the study region and completed an initial diagnosis of forest resilience to human and climatic (drought) impacts. These diagostic methods could be extended to other forests in the region, using the methodology suggested by CoForChange. This general assessment would be useful for planners who decide on priority zones for timber production and conservation. (it is better to produce where the soils are rich and the forests productive) and for logging managers (productive forest plantations can support a more dynamic silviculture than that currently practiced).

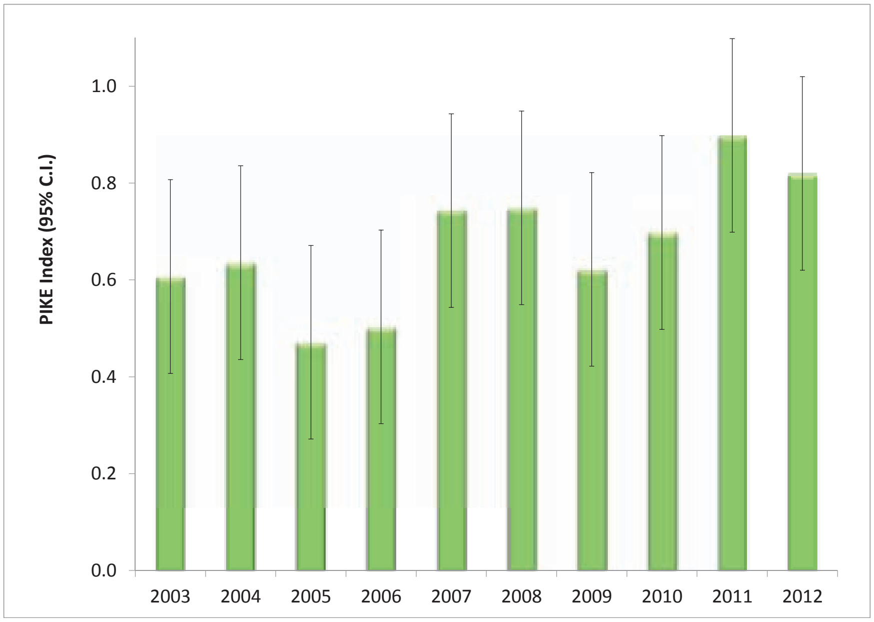

Figure 3.1 : Evolution of the PIKE index in Central Africa between 2003 and 2012 (confidence interval 95 %).

Source : CITES's MIKE program

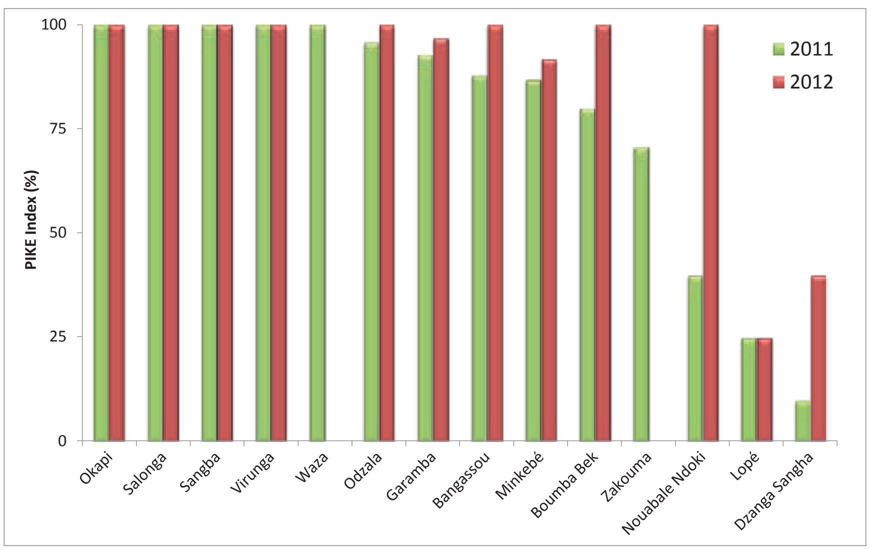

Figure 3.2 : PIKE values at the various MIKE sites in 2011 and 2012.

Source : MIKE's program Central Africa

Between January 2003 and June 2012, out of 2 175 carcasses counted, PIKE revealed two opposing trends : a decline in illegal killing between 2003 and 2006, and an increase up to 2011-2012 (figure 3.1).

Given that with a PIKE index of over 0.5 an elephant population is probably already in decline[9], it is apparent that the level of illegal killing was very high in the first half of 2012, with an average PIKE index of more than 0.7. In 2011, the situation was already serious as all the MIKE sites showed a PIKE index close to 100 %, except at Dzanga-Sangha, Lopé, Zakouma and Waza (figure 3.2).

Poaching is not confined to the MIKE sites, as was confirmed by the massacre in 2012 of 200 to 400 elephants, according to sources, in the Bouba Ndjda National Park in the north of Cameroon and of 30 more at Wonga Wongue in Gabon and in the region of Mayo-Lémié/Chari-Baguirmi in Chad.

These trends are confirmed by :

The ETIS program data (Elephant Trade Information System) run by CITES[10], which records ivory seizures in countries of destination ; these confirm the MIKE results over the period 2000 to 2012, with record ivory seizure levels between 2009 and 2011.

The GSEaf survey conducted by IUCN (Group of African elephant specialists in IUCN) in March 2012 among the network of researchers and elephant managers in 12 African countries showed a resurgence of poaching during the preceding 12 months in Cameroon, Gabon, Congo, Central African Republic and the Democratic Republic of Congo (DRC).

Details of the joint results of MIKE, ETIS and GSEaf are available at http ://www.cites.org/fra/com/SC/62/F62-46-01.pdf

The regular surveys conducted in West Africa show a decline in the elephant population of 76 % since 1980 (Bouché *et al.*, 2011). The same trend is apparent in the forests of Central Africa, with a decline of 62 % (Maisels *et al.*, 2013).

The resurgence of the illegal killing of African elephants can be linked to the economic boom in China and to the increase in the purchasing power of Chinese households (Martin and Vigne, 2011 ;

9 Monitoring the Illegal Killing of Elephants. CITES CoP 16 Doc. 53.1 available on http ://www.cites.org/fra/cop/16/doc/F-CoP16-53-01.pdf

10 http ://cites.org/eng/cop/16/doc/E-CoP16-53-02-02.pdf

Wittemyer *et al.*, 2011). Some experts consider that if poaching pressure remains at present levels, the species may disappear from Central Africa within 20 years (Maisels, personal comment). Strategic decisions were therefore taken at the CITES CoP16, in March 2013, to address this elephant poaching crisis (see 4.3. Recent CITES decisions on elephants).

3.1.2. Case of the great apes

There are four species of African great ape : bonobos, chimpanzees, eastern gorillas and western gorillas. The IUCN/SSC A.P.E.S. (Ape Populations, Environments and Surveys) Portal (http ://apesportal.eva.mpg.de/) and the Red List of Threatened Species (IUCN, 2012) provide up-to-date estimates of the geographic range, population size and the proportion of the populations located within protected areas for each of the nine great ape taxa (table 3.2). IUCN has published conservation action plans for eight of these taxa (IUCN and ICCN 2012 ; Kormos and Boesch, 2003 ; Maldonado *et al.*, 2012 ; Morgan *et al.*, 2011 ; Oates *et al.*, 2007 ; Plumptre *et al.*, 2010 ; Tutin *et al.*, 2005). These plans, together with survey results and vulnerability assessments, guide effort and resource allocation to priority conservation needs ; nonetheless, the only great ape taxon that is not in decline is the mountain gorilla (Robbins *et al.*, 2011 ; Gray *et al.*, 2013).

Great apes have very slow rates of reproduction, making their populations extremely vulnerable to any level of offtake. The main threats to great ape survival are poaching for the bushmeat trade, habitat destruction and infectious diseases. Additionally, the live trade in young great apes is reportedly on the rise (Stiles *et al.*, 2013). Despite having full legal protection status in all range states, laws are often not enforced. The proportion of great apes in the total catch or gross weight of bushmeat is small, but nevertheless constitutes a large number of animals (Dupain *et al.*, 2012 ; Foerster *et al.*, 2012 ; Hart, 2009).

Habitat destruction is likely to become a more significant threat as forests are converted to agro-industrial plantations to meet increasing international demands (Carrere, 2010). Although deforestation rates in Central Africa are low (Mayaux *et al.*, 2013), they could change rapidly if poorly planned agro-industrial conversion goes ahead as it has elsewhere (Malhi *et al.*, 2013). A relatively small proportion of great ape range is protected (except for mountain gorillas as the entire population is in national parks). While 11 % of Congo Basin forests have been gazetted as protected areas, about 15 % is designated for timber exploitation (Nasi *et al.*, 2012). The latter proportion increases to nearly 50 % of western lowland gorilla and central chimpanzee habitat (Morgan and Sanz, 2007). Therefore logging concessions and the adoption of wildlife-compatible management practices are very important for great apes (Morgan *et al.*, 2013). An assessment of change in "suitable environmental conditions" for great apes over a period of 20 years (Junker *et al.*, 2012) showed that high hunting pressure or habitat degradation have rendered large tracts of forest unsuitable for great apes. The same assessment showed that since the year 2000 the proportion of ape range within protected areas has been reduced to 18 % to 60 % depending on the taxon (mountain gorillas excepted ; Table 3.2).

Improved protected area management, especially law enforcement (Tranquilli *et al.*, 2012), and sound wildlife management in buffer zones are vital for ape conservation and for biodiversity in general (Laurance *et al.*, 2012). Furthermore, landscape-level conservation-focused land-use planning is essential to keep great apes from being reduced to isolated populations in forest fragments (Dupain *et al.*, 2010). Habitat fragmentation increases proximity between humans and apes and thus the likelihood of disease transmission from one to the other. The impacts of infectious diseases, such as the Ebola virus, Simian Immunodeficiency Virus and human respiratory viruses, are increasingly well documented, highlighting the need to consider interventions such as vaccination of apes (Ryan and Walsh, 2011). Recovery from disease outbreaks in slow reproducing species, such as apes, takes many years even under favourable conditions (Walsh *et al.*, 2003), and extinction risks are growing as ape populations become increasingly fragmented and isolated.

In the face of rapidly changing dynamics on the African continent (industrial agriculture, mining, infrastructure, human demographics, etc.), the survival of great apes will depend on evidence-based conservation strategies that have been tested empirically to demonstrate what works and what does not (e.g. Junker *et al.*, 2012 ; Tranquilli *et al.*, 2012).

3.1.3. Forest buffalo: a large grazer living in a forest landscape

The geographic range of the forest buffalo, *Syncerus caffer nanus*, is limited to the Congo Basin forest (Sinclair, 1977), but because of their elusive habits, few data exist for this subspecies of African buffalo (Blake, 2002; Melletti *et al.*, 2007a; Korte, 2008a). Although the forest buffalo inhabits forests and because it is the largest grazer in the rainforest ecosystem, it may play an important ecological role in maintaining clearings, using proportionally more open habitat than forest. The future of this subspecies depends on effectiveness of protected areas with special attention to forest clearings and mosaics of forest and savannas, where critical food resources are abundant. Habitat loss and poaching are major threats to forest buffalo populations (IUCN/SSC, 2008). Buffalo are hunted for their meat especially in rural areas, where human populations depend on bushmeat for protein increasing the hunting pressure on this subspecies.

Estimates of abundance are limited to a few sites where the open habitat allows for direct observation of buffalo. Forest buffalo population estimates range from 20 individuals at Campo-Ma'an National Park in Cameroon (Bekhuis *et al.*, 2008) to 500 at Odzala National Park in the Republic of Congo (Chamberlan *et al.*, 1998). Small numbers of buffalo are also reported in the Dzanga sector of the Dzanga-Ndoki National Park., Central African Republic, where the population is estimated at between 32 and 40 individuals (Melletti *et al.*, 2007b). At Lopé National Park in Gabon, the savanna and forest mosaic of the northeast portion of the park has an estimated population of 324 individuals (Korte, 2008b).

Given these low population estimates, their dependence on open habitat within the forest landscape and the stability of buffalo groups, open areas, which are large enough to support buffalo herds and have adequate protection from poaching, are crucial for maintaining forest buffalo populations in the Congo Forest Basin (Melletti *et al.*, 2007b; Korte, 2008b).

Table 3.2: *Summary of African great apes statistics*

Subspecies	Suitable environmental conditions – SEC (km²)	Total species range (km²)	Population estimate	IUCN category (population trend)	Percent of SEC in protected areas
Western lowland gorilla *Gorilla gorilla gorilla*	347 400	694 208	~150 000	CR (decreasing)	25.2
Cross River gorilla *Gorilla gorilla diehli*	2 975	3 648	200 – 300	CR (decreasing)	—
Grauer's gorilla *Gorilla beringei graueri*	10 900	21 600	2 000 – 10 000	EN (decreasing)	60.3
Mountain gorilla *Gorilla beringei beringei*	785	785	880	CR (increasing)	100
Bonobo *Pan paniscus*	97 975	418 803	15 000 – 20 000 (minimum)	EN (decreasing)	42.4
Central chimpanzee *Pan troglodytes troglodytes*	317 425	710 670	70 000–117 000	EN (decreasing)	25.5
Eastern chimpanzee *Pan troglodytes schweinfurthii*	816 450	961 232	200 000 – 250 000	EN (decreasing)	18.4
Western chimpanzee *Pan troglodytes verus*	555 450	660 337	23 000	EN (decreasing)	21.7
Nigeria-Cameroon chimpanzee *Pan troglodytes ellioti*	41 150	168 407	3 500 – 9 000	EN (decreasing)	—

CR: Critically Endangered, EN: Endangered

Sources: Campbell et al., 2012; Gray et al., 2013; IUCN Red List; IUCN/SSC A.P.E.S. Portal; IUCN and ICCN 2012; Maldonado et al., 2012 and Robbins et al., 2011

Photo 3.4: Forest buffalo in Bai Hokou – Dzanga-Ndoki National Park, CAR

The forest buffalo is declining across its geographic range (IUCN/SSC, 2008). Based on only a few population estimates, East (1999) estimated a total population of 60 000 forest buffalo with about 75 % of the population in protected areas. The future of this subspecies depends on well-managed protected areas as well as the strengthening of legislation governing hunting (IUCN/SSC, 2008 ; Cornélis *et al.*, in press). Thus, appropriate hunting regulations and enforcement of these regulations are also critical for maintaining forest buffalo populations.

3.1.4. The large carnivores

While the forests in the Congo Basin have long been an important stronghold for leopards, *Panthera pardus* (the apex predator in this habitat and an IUCN Red List near threatened species) (Nowell and Jackson, 1996), the forest-savanna mosaic habitat also once harbored important populations of lions, *Panthera leo* (Vulnerable), African wild dogs, *Lycaon pictus* (Endangered), and spotted hyenas, *Crocuta crocuta* (Malbrant and Maclatchy, 1949). Uncontrolled hunting by humans, however, has led to a dramatic decrease in wild ungulate populations (carnivore's prey), especially in the more accessible open habitats. Today, lions and African wild dogs are almost certainly extinct within the Congo Basin, while spotted hyenas have been reduced to one small and isolated population, surviving in the Odzala-Kokoua National Park in the Republic of Congo (Henschel, 2009). Vagrant hyenas have been detected in neighboring Gabon (Bout *et al.*, 2010), but no evidence exists for the occurrence of a second resident population within the Congo Basin.

In remote forest regions, wildlife populations (the prey of leopard), have been less severely affected by human activity, and consequently, leopards are still fairly widespread across intact core areas within the Congo Basin (Henschel, 2009). However, evidence is mounting that leopards have disappeared from a number of forest sites on the fringes of the Congo Basin (e.g. Andama, 2000 ; Angelici *et al.*, 1998 ; Maisels *et al.*, 2001 ; Willcox et Nambu, 2007), where human population density is higher. A recent study in central Gabon suggests that bushmeat hunting may precipitate the decline in leopard numbers through exploitative competition and that intensively hunted areas are unlikely to support resident leopard populations (Henschel *et al.*, 2011).

Photo 3.5: Male leopard prowling an abandoned logging trail in the NSG concession – East of the Lopé National Park, Gabon

Under these circumstances, land-uses that mitigate the effects of bushmeat hunting such as well-managed, large protected areas and similarly large and well-managed logging concessions, are essential for the effective conservation of leopards in the Congo Basin (Henschel *et al.*, 2011). Conservation efforts directed towards spotted hyenas should promote the rigorous protection of the remaining population in the Odzala-Kokoua National Park, and the establishment of a second population in the center of their former range, the Bateke Plateau (Henschel, 2009).

3.2. State of plant diversity

3.2.1. State of current knowledge on flora

Flowering plants (angiosperms)

Our knowledge of the vascular flora of Central Africa is incomplete. In the case of Rwanda, Burundi and DRC, the National Botanic Garden of Belgium is in the process of preparing a checklist of the vascular plants: the list can already be accessed online (http://dev.e-taxonomy.eu/dataportal/flore-afrique-centrale/). Table 3.3 shows recent estimates of the numbers of species in each country. In most cases, these are only rough estimates based upon the available data and in some cases the data are not available. The real botanical diversity is probably much higher than these estimates.

Lichens

The checklist of lichens and lichenicolous fungi (Feuerer, 2012) clearly demonstrates the fragmentary knowledge of this group of species in Central Africa (table 3.3). For more than half of the countries, no pertinent data are available. Countries for which more data are available still do not give a good picture of the total lichen diversity. The checklists are based on a small number of publications and the reported species belong to a rather small number of families. This indicates that research has so far mainly been driven by the interest of the individual investigators and their taxonomical knowledge at that moment. For instance, with the exception of São Tomé and Príncipe , not one species of one of the largest tropical families, the Graphidaceae, is mentioned. Lichens are generally very sensitive to changes in the habitat. So if the earth continues to warm all lichen species preferring cold conditions are threatened.

Algae

Algae are a group of aquatic photosynthetic organisms, which range in size from microscopically small to very large. Aquatic algae are responsible for more than half of the oxygen production on earth. The diatoms, one of the algae groups, are important bio-indicators of water quality, and they are used in paleolimnological studies to reconstruct past climate. Other algae include Cyanobacteria, which while more closely related to bacteria, are traditionally studied as part of the algae. Estimates of the species diversity of these two groups of algae in Central Africa can be found in Table 3.3.

Bryophytes and Pteridophytes

Bryophytes (hepatic, anthocerotes and mosses) and pteridophytes (lycopsides and ferns *sensu stricto*) have long been neglected in biodiversity inventories, particularly in tropical Africa. Even though some countries have been explored in depth, most of the data available for Central Africa are deficient, discoveries of new species are frequent and inventories are continuing (table 3.3).

Photo 3.6: Botanical garden – University of Kisangani, DRC

Table 3.3: *Botanical diversity in Central Africa*

<table>
<tr><th>Country</th><th>Angiosperms</th><th>Pteridophytes</th><th>Lichens</th><th>Algae</th><th>Bryophytes</th><th>Introduced</th></tr>
<tr><td>Burundi</td><td>3 413</td><td>174</td><td>21</td><td>690</td><td>152</td><td>288</td></tr>
<tr><td>Cameroon</td><td>8 500</td><td>279</td><td>101</td><td>n/a</td><td>585</td><td>410</td></tr>
<tr><td>DRC</td><td>8 203</td><td>378</td><td>183</td><td>487 (*)</td><td>893</td><td>364</td></tr>
<tr><td>Equ. Guinea (Annobon)</td><td rowspan="3">7 100</td><td>42</td><td>n/a</td><td rowspan="3">n/a</td><td>53</td><td rowspan="3">226</td></tr>
<tr><td>Equ. Guinea (Bioko)</td><td>204</td><td>1</td><td>352</td></tr>
<tr><td>Equ. Guinea (Rio Muni)</td><td>117</td><td>1</td><td>157</td></tr>
<tr><td>Gabon</td><td>4 710</td><td>179</td><td>2</td><td>n/a</td><td>316</td><td>n/a</td></tr>
<tr><td>Rep. of Congo</td><td>4 538</td><td>n/a</td><td>2</td><td>n/a</td><td>126</td><td>n/a</td></tr>
<tr><td>CAR</td><td>4 300</td><td>n/a</td><td>3</td><td>n/a</td><td>333</td><td>297</td></tr>
<tr><td>Rwanda</td><td>2 974</td><td>194</td><td>112</td><td>52</td><td>554</td><td>291</td></tr>
<tr><td>São Tomé</td><td rowspan="2">1 230</td><td>139</td><td rowspan="2">78</td><td>n/a</td><td>158</td><td rowspan="2">297</td></tr>
<tr><td>Príncipe</td><td>117</td><td>n/a</td><td>47</td></tr>
<tr><td>Chad</td><td>2 250</td><td>n/a</td><td>23</td><td>1 426</td><td>78</td><td>131</td></tr>
</table>

(n/a: no reliable data available or under review)
(*) For lake Tanganyika 956 species of algae have been recorded

Box 3.4 : Mushroom diversity of Central Africa

Jérôme Degreef & André De Kesel
National Botanic Garden of Belgium

Only 2 500 mushroom species have been described in Africa, 70% of which are native or endemic (Mueller *et al.,* 2007). This inventory is far from complete however because it is estimated that in an ecosystem there are four to six times more mushroom species than superior plants. The first official list of Congo (DRC) mushrooms, produced by Beeli in 1923, recorded 593 species. In 1948, Hendrickx reported that the number had increased to 1 163, including Rwanda and Burundi. No report has been produced since then.

Due to their seasonal nature, producing a complete inventory of mushrooms requires much more field work than for other living species. Moreover, Central African mycologists are poorly represented within the whole African mycologist community. Indeed, in 2012, only 10 out of 200 members of the African Mycological Association (http://www.africanmycology.org/) were represented by Central Africa (Gryzehnhout *et al.,* 2012).

In view of this situation, priorities must be made for further research. Edible mushrooms constitute a particularly interesting group within the more general framework of the development of non-timber forest products (NTFP).

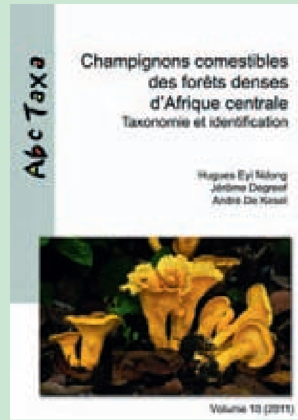

Figure 3.3 : Edible mushrooms of central Africa's dense forests

300 edible mushroom species were recorded in tropical Africa (Rammeloo and Walleyn, 1993 ; Boa, 2006), more than half of which are related to living trees via a symbiosis called "ectomycorrhizae".

These mushrooms play an important part in the ecosystem, but inevitably end up disappearing due to the disappearance of the associated trees. Abundance and diversity of these mushrooms may therefore be used as key indicators of the state of the forest.

In light of this, an illustrated training manual was recently published, enabling the identification of Central African dense forest's most consumed species (Eyi Ndong *et al.,* 2011) (figure 3.3). It aims to improve local knowledge on African mushrooms and their diversity. The manual is available electronically (www.abctaxa.be) but also as a free hard copy thanks to support from the GTI (Global Taxonomy Initiative), a Belgian focal group, and from the BTC (Belgian Development Cooperation).

3.2.2. Threats to biodiversity : the case of invasive species

Invasive plants in São Tomé

In São Tomé and Príncipe various introduced plant species have spread from the crop-growing areas where they had been planted and have acquired an invasive character (Figueiredo *et al.*, 2011). In a context of high endemism and insularity, the phenomenon is particularly threatening to the country's plant diversity.

Among these invasive plants are : *Cinchona* spp. (cinchona), *Rubus rosifolius* (Asian raspberry plant), *Tithonia diversifolia* (Mexican sunflower), *Bambusa* spp. (Stevart *et al.*, 2010). Cinchona is one of the 100 most invasive species in the world and its harmful impact on the biodiversity of invaded sites is recognized (http ://www.issg.org/database/welcome/). Originating from Latin America, it was planted from the mid-nineteenth century in many islands to treat cases of malaria (Galapagos, Hawaii, São Tomé, etc.). Rapidly becoming naturalized, cinchona forms dense stands preventing the regeneration of natural forests. In São Tomé in particular, in the mountain ecosystems in which it proliferates and which it degrades, it reduces local biodiversity and disrupts ecotourism activities (Lejoly, 1995).

It is estimated that in São Tomé about one third of imported local flora has become naturalized. It may therefore be assumed that many of these plants are potentially invasive, albeit not yet detected as such to date.

Although these invasive plants have already probably caused irreparable damage (loss of biodiversity, including endemic species), the most remarkable ecosystems can still be preserved. For example, it would appear possible to control biodiversity loss in the Obo National Park and its surrounding area through evaluation of the situation, the prediction of future invasion, the eradication and control of the invasive species, and the awareness-raising and education of the local people.

The small fire-ant (*Wasmannia auropunctata*) in Gabon and Cameroon

Wasmannia auropunctata is a tiny, biting, red ant native to the neotropics, which has colonised and dominated many tropical and sub-tropical areas worldwide. In Africa, *W. auropunctata* was first recorded in Libreville, Gabon around 1913. It is presumed to have arrived on boats importing goods from the Americas (Santschi, 1914). Since then, it has spread across Gabon and north to neighboring Cameroon (figure 3.4). Recent genetic analyses suggest a single clonal origin for the entire regional population (Mikheyev *et al.*, 2009 ; Foucaud *et al.*, 2010).

Although some earlier infestations were a result of deliberate introductions of *W. auropunctata* as a method of limiting insect pests in Cocoa plantations (de Miré, 1969), currently its primary means of dispersal is inadvertent and mediated by human activities, notably logging and oil drilling (Walsh *et al.*, 2004 ; Mikheyev *et al.*, 2008), building and road construction, and the transportation of goods and vegetation (Wetterer and Porter, 2003).

The impacts of *W. Auropunctata* on biodiversity could be dramatic. For example, in Gabon, a greater than 95 % decrease in native ant species diversity has been attributed to *W. auropunctata.* (Walker, 2006). There is growing evidence that

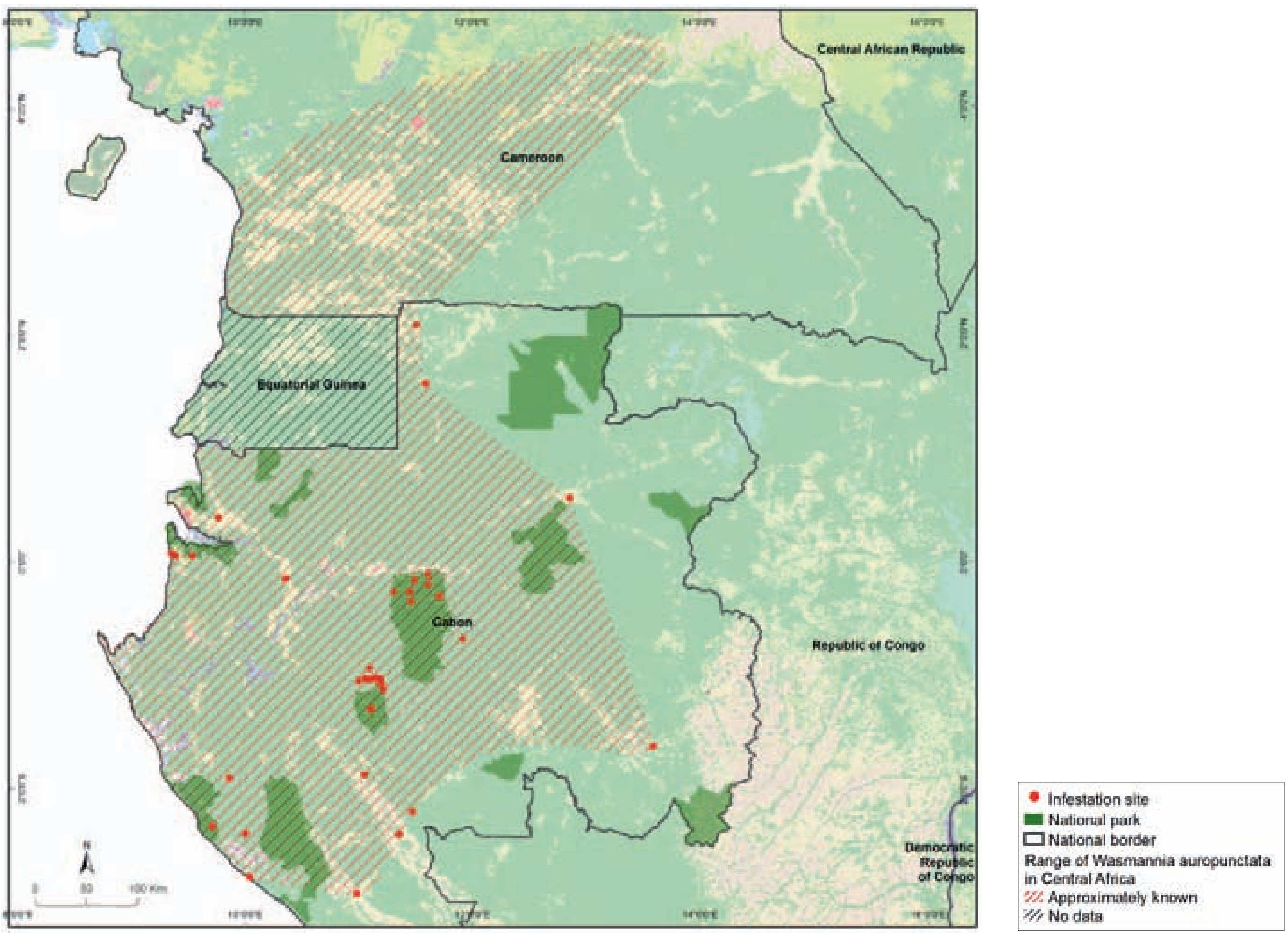

Figure 3.4 : Approximate known range of Wasmannia auropunctata in Central Africa (red hatching) ; red points indicate known infestation sites in Gabon. Black hatching : no data, although presence is likely.

Data sources : Wetterer et al., 1999 ; Walsh et al., 2004 ; Walker, 2006 ; Mikheyev, et al., 2008, 2009 ; Mikissa, 2010 ; Tindo et al., 2011 ; JP vande Weghe, O.Hymas, JB Mikissa, V. Mihindou and K. Jeffery, pers. obs.)

delicate ecosystem processes are being disturbed at different trophic scales, as populations of microbivore, detritivore, pollinating and mutualistic species are affected by the introduction of *W. auropunctata* (Dunham and Mikheyev, 2010; Mikissa, 2010). *W. auropunctata* has a mutualistic relationship with phloem-feeding insects, which cause damage to plants by sapping nutrients and increasing diseases (Smith, 1942; Delabie *et al.*, 1994; de Souza *et al.*, 1998; Fasi and Brodie, 2009). While long identified as a threat to crop species, its spread into protected areas and more undisturbed environments in Gabon is now causing concern for the conservation of native plant fauna.

Untreated *W. auropunctata* infestations can become unbearable to humans within a few years, due to the frequency of stings sustained in highly infested areas. Although not yet measured, the potential for damage to the economy of rural communities and to the development of tourism within Gabon is becoming increasingly apparent. Reports already exist of plantations, houses and villages being abandoned because of *W. auropunctata* infestations (J.B. Mikissa, pers. comm.). Appropriate fire-ant treatments and management programs have not yet been developed for Gabon, yet they are urgently required. While total eradication is now an unrealistic option, strategies should include public awareness, prevention of spread, monitoring, eradication of isolated infestations and treatment at advancing frontiers.

4. Tools for managing biodiversity in Central Africa

4.1. The legislation on traditional hunting and poaching

In Central Africa, all countries have included in their forestry codes provisions for local people to have access to faunal resources in their traditional lands. But this right of usage is limited and certain hunting practices are illegal. In the field, however, the dividing line is often difficult to establish between so-called traditional hunting and poaching (illegal hunting), between what is permitted and what is forbidden. These are defined in legislation but are difficult to reconcile with local practices. These distinctions are particularly relevant to hunting gear, the areas allocated to traditional hunting, the uses of bushmeat and the circulation of animal products. An examination of the legal provisions relating to the practice of hunting in Cameroon illustrates particularly well this situation on the ground and its contradictions (box 3.5).

Photo 3.7: Pygmy hunter and his game – UFA Bétou, Congo

Box 3.5: Hunting and poaching in Cameroon: What does the law say?

Roger Ngoufo
University of Yaoundé

Hunting in Cameroon requires, among other things, a hunting permit or license, which has been compulsory since 1981 (article 48 of the former Act No. 81-13 of 27 November 1981, and later article 87 of existing Act No. 94-01 of 20 January 1994 establishing regulations for forests, fauna and fisheries). The only derogation permitted concerns so-called "traditional" hunting defined as hunting carried out "with implements made from materials of plant origin" (Decree No. 95-466 of 20 July 1995 establishing the procedures for the application of the regulations relating to fauna). Under the Act of 1994, this traditional hunting "is authorized throughout the national territory except in state forests for the concession of fauna and on the property of third parties".

Again according to the relevant legislation, "products emanating from traditional hunting are exclusively intended as foodstuffs" (art. 24 of Decree No. 95-466 of 20 July 1995 establishing the procedures for the application of the regulations relating to fauna). This falls under the concept of the right of use defined as "the exploitation by local inhabitants of forest, fauna or fisheries products for personal use" (art. 4).

In Cameroon, poaching is defined as any act of hunting without a permit, in the closed season, in reserved places or with prohibited equipment or weapons" (art.3 of Decree No. 95-466 cited). Similarly, any traditional hunting procedure liable to jeopardize the conservation of certain animals may be restricted (art. 81 of Act No. 94-01 of 1994). By extension, "any person found, at any time or in any place, to be in possession of the whole or part of a protected class A or B animal, as defined in article 78 of the present Act, whether alive or dead, shall be deemed to have captured or killed it" (art. 101 of Act No. 94-01 of 1994).

Photo 3.8: Temporary poachers' camp

All these provisions *de facto* outlaw numerous widespread local practices, which thereby become acts of poaching. For example, the use of traditionally manufactured rifles, nets or steel cables is completely illegal, even though these practices are common at the local level. Certain ancestral practices using partially or fully protected species have thus become illegal, such as the killing of an elephant, which constitutes a rite of passage among the Bakas. Many people are also liable to fall under the ambit of the law through their involvement in any way in the traffic in animal products. In other words, it has to be acknowledged that the concept of "traditional hunting" provided by Cameroonian legislation does not tally with the facts on the ground.

4.2. The lists of threatened species

According to the IUCN Red List of Threatened Taxa (http ://www.iucnredlist.org/), about 6 000 species have been evaluated in Central African countries. For these species, the levels of threat are detailed by group in Figure 3.5. While the majority of evaluated species are not threatened, 0 to 34 % of the species are classified as Vulnerable (VU), Critically Endangered (CR) or Endangered (EN) by group per threat category (e.g. 34 % of plants are classified as VU ; 2 % of birds, EN). The high percentage of species for which there are no data available (DD – Data Deficient) is also worrisome.

The numerous species which remain unevaluated (and so unaccounted for in the statistics presented in Figure 3.5) are even more troubling. For example, of the approximately 8 000 plant species known from Central African forests (White, 1983), only 965 (12 %) have been assessed. For assessed mammals, most evaluations were conducted in 2008 ; of these, some 70 % are LC (Least Concern) while 12 % are VU, EN, or CR. Several of these threatened species are listed by CITES.

In general, evaluations of species are valid for approximately 10 years before they require updating (Schatz, 2009). Using this benchmark, as a whole, only 6 % of the Central African evaluations are out of date. However, in consulting the IUCN database, plants (particularly listed timber species) are clearly in the worst position, with 32 % of the evaluations requiring updating. Many groups were updated in 2012, with some 1 500 updates or additions, including all of the

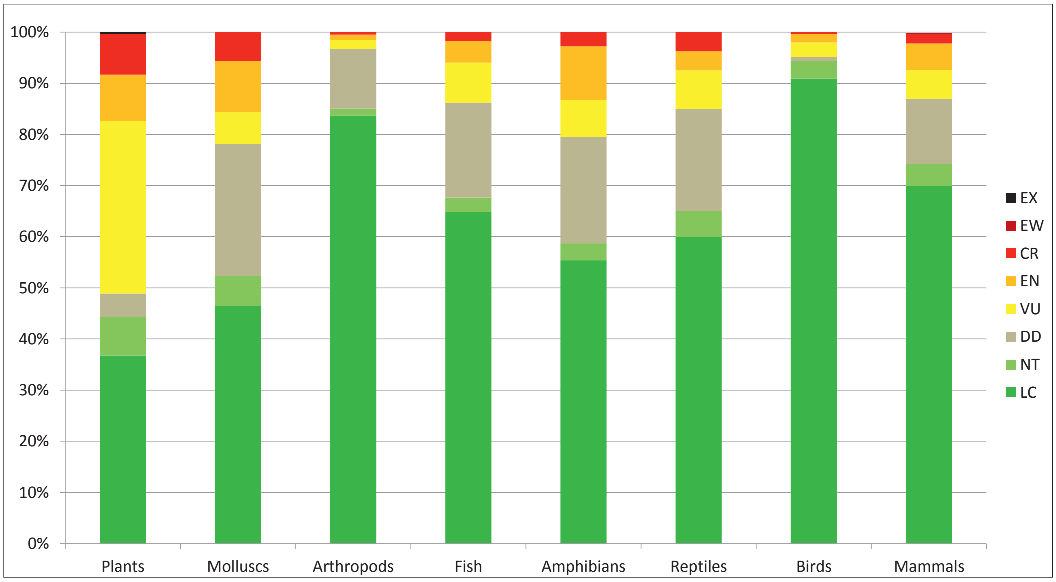

Figure 3.5 : Percentage of Central African threatened species by category of threat and species group (EX : Extinct ; EW : Extinct in the Wild ; DD : Data Deficient ; NT : Near Threatened ; LC : Least Concern ; CR : Critically Endangered ; EN : Endangered ; VU : Vulnerable)

listed birds and many mollusks, arthropods and fish.

Nonetheless, different cases show that a good understanding of the threat level is vital to help guide conservation action :

A number of Central African amphibians were assessed for the IUCN Red List in 2012. The IUCN Amphibian Specialist Group uses these assessments, in conjunction with priorities identified by the Alliance for Zero Extinction (AZE) and information provided by local partners, to identify the most critical habitats requiring conservation for the long term survival of some of the world's more threatened amphibians. Their priority sites include Cameroon's Mont Oku, Mont Manengouba, Mont Nganha, and the Bakossi Hills, each containing 35 to 85 species. These sites form part of the global set of priorities identified by the AZE, an effort to draw attention to habitat conservation of threatened species worldwide. In the Congo Basin, there are 15 AZE sites including those cited previously and the DRC's Itombwe Mountains, São Tomé's lowlands, Gabon's Mont Iboundji, and Rwanda's Nyungwe National Park (http://www.zeroextinction.org).

Another example of how the analysis of threat level informs conservation priorities is with the freshwater assessments of Central Africa conducted by IUCN, in which regionally threatened species of fishes, mollusks, odonates and crabs were mapped within river sub-watersheds (figure 3.6). The coastal equatorial regions (including Cameroon's crater lakes), the Lower Congo Rapids, and the Bangweulu-Mweru system in the Democratic Republic of Congo have the highest level of threatened freshwater species (Brooks *et al.*, 2011). Many of these areas qualify as Key Biodiversity Areas, areas which are globally important for biological conservation (Holland *et al.*, 2012). A related pan-African study on dragonflies found that the mountains of the Cameroon-Nigeria border had the most threatened species in the Congo Basin, while the highest number of DD species is found in north-eastern Gabon, a well-studied area in the 1960s and '70s which has not had subsequent field surveys (Clausnitzer *et al.*, 2012). Finally, a Red List of Cameroon's endemic plant species has given preliminary evaluations of more than 800 species (Onana & Cheek, 2011).

In Gabon, new surveys of poorly known, highly threatened and strictly endemic species in the Libreville area helped to inform the boundaries of the newly created Raponda-Walker Arboretum. The last remaining populations of *Psychotria wieringae* (EN), *Acricocarpus vestitus*, *Gaertnera spicata* amongst others are now guaranteed protection (Lachenaud *et al.*, 2013).

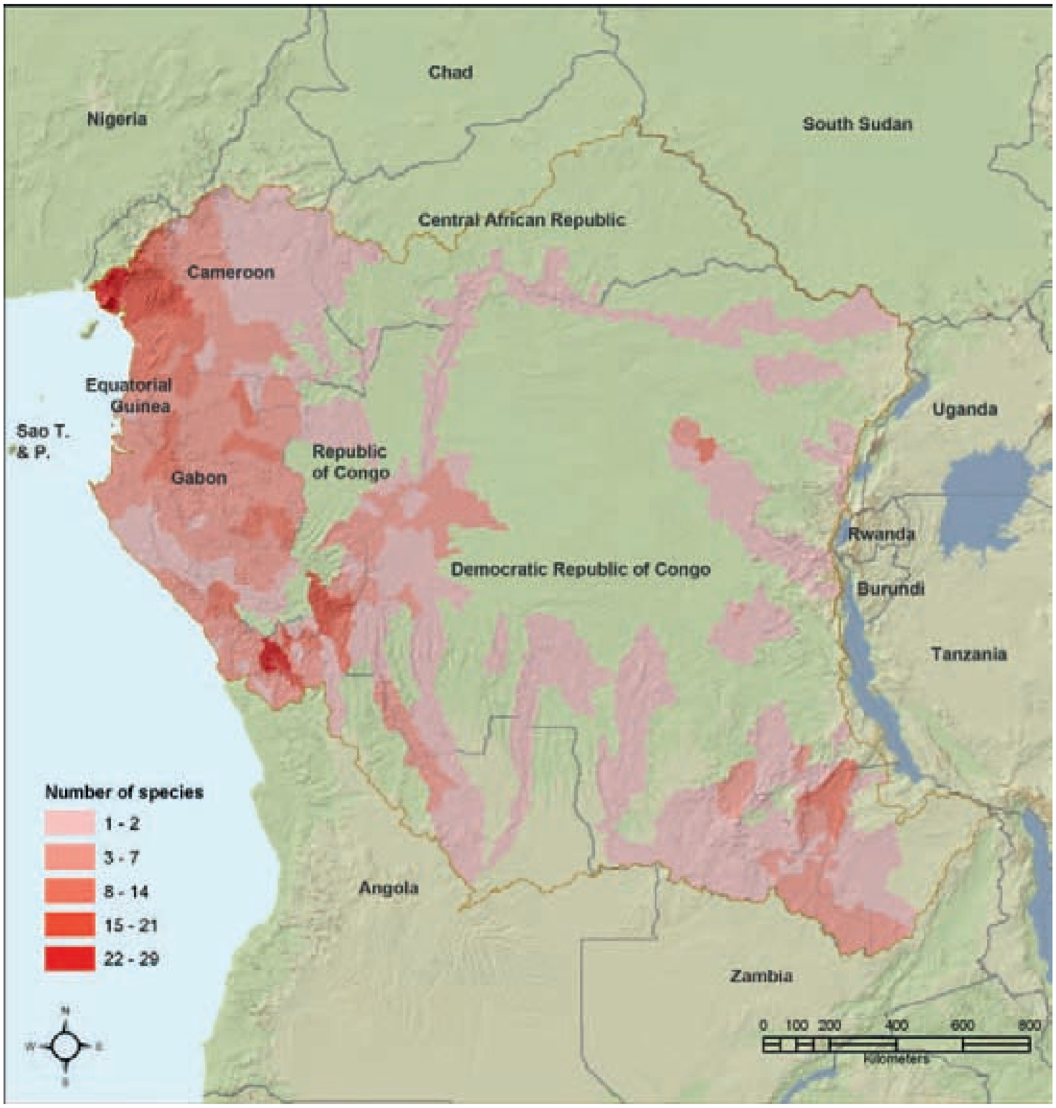

Figure 3.6: The distribution of regionally threatened species of fishes, molluscs, odonates and crabs within Central Africa, mapped to river sub-watersheds (Brooks et al., 2011)

Photo 3.9: Psychotria wieringae, one of several highly-threatened, rare and endemic species in the Libreville region of Gabon, which is now protected by the newly-created Raponda-Walker arboretum.

Finally, when species are threatened by commercial trade, they are often listed by the Convention on the International Trade of Endangered Species (CITES). Examples of large mammals on the list include the African elephant (VU) (for Central Africa this includes the forest elephant subpopulation (EN)), Western Lowland Gorilla (CR), Mountain Gorilla (EN), Chimpanzee (EN), Bonobo (EN), Mandrill (VU) and Drill (EN). Well known plants include *Prunus africana* (VU) and *Pericopsis elata* (EN), as well as many orchids (see box 3.6 for more information).

Box 3.6. IUCN's Red List and commercial trees: the case of Pericopsis elata (Harms) Meeuwen (assamela, afrormosia)

Jean-Louis Doucet and Nils Bourland
Gembloux Agro-Bio Tech / University of Liège

From the okoume (*Aucoumea klaineana*) to the sapelli (*Entandrophragma cylindricum*) many commercial tree species are included on IUCN's Red List (http://www.iucnredlist.org/). No less then half the species currently logged in Central Africa are considered threatened under the AIcd criterion. Among these species, those which have decreased in population by at least 50 percent over the last three generations are classified as vulnerable (VU), a reduction of at least 70 percent is classified as in danger of extinction (EN) or in critical danger of extinction (CR) if reduced by at least 90 percent.

However, the characteristics of these trees such as their longevity make the classification for the list unusually complicated. The duration of a generation defined by IUCN (2001), the average age of the parents of the cohort, is generally close to a century for most of the commercial species (Menga *et al.,* 2012). Furthermore, a poor understanding of the ecology of the commercial species underscoress the high priority for studying their autecology, particularly to evaluate threats so that forestry management can be improved in logging operations.

The assamela *(Pericopsis elata*), also known as the afrormosia or kokrodua, is classified as EN in IUCN's Red List and in annex II of CITES (species for which an export permit or re-export certificate is necessary). Its status was studied in Cameroon by Barland *et al.,* (2012a) in a forestry concession of about 120 000 ha. The population analyzed was suffering from a substantial regeneration deficit. The local abundance of this heliophilic species derives from old forest clearings, which enabled it to intitially regenerate (van Gemerden *et al.,* 2003; Brncic *et al.,* 2007). Because shifting agriculture was previously more common in these areas, conditions favoring its regeneration have diminished.

The assamela flowers regularly in the area studied starting at the age of about 120 years onwards while the average age of the reproducing adult trees is estimated to be about two centuries. In practice, it is impossible to determine the population reduction over three generations (i.e. 600 years) as called for by the IUCN. Moreover, the impact of commercial harvest on the assamela in Cameroon can be regarded as limited because the species may be felled only if its diameter is at least 90 cm, which would reduce the number of seed trees by only 12 percent in 30 years. If it is assumed that the population studied is representative of the Cameroonian population, the EN status would appear to be greatly exaggerated.

However, the situation may vary from one country to another. In the Republic of Congo and the Democratic Republic of Congo (DRC), the legal minimum diameter for harvest is only 60 cm, which threatens a greater proportion of seed trees and could adversely affect regeneration of the species.

Nevertheless, the assamela's distribution range in Central Africa coincides with some protected areas (Bowland *et al.,* 2012b). Thus, 7 percent of the assamela area in DRC appears to occur in protected areas, as opposed to 40 % in Congo and 46 percent in Cameroon.

Applying the IUCN criteria to timber species is therefore extremely delicate. It is even possible that today certain heliophilic species such as the assamela could be even more abundant than 600 years ago (see Brncic *et al.,* 2007).

Consequently, a more rigorous estimate of the status of species should take account of population dynamics considering future, and not past, anthropic impacts. Any simulation should necessarily consider the ecology of the species, the zoning plan of the countries included in its distribution area (including the proportion of distribution within protected areas), rates of deforestation, forestry legislation and the existence of reafforestation programs. Lastly, in light of national disparities, a regional approach appears essential.

In the case of heliophilic and anthropophilic species such assamela or okoume, conservation alone will not be sufficient to guarantee the maintenance of populations in the long term. Only rational management, integrating regeneration programs, will ensure their longlasting survival.

4.3. Recent CITES decisions on elephants

CITES is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Every two to three years, member states meet to review the implementation of the agreement. At the last conference of the parties to CITES, in March 2013 in Bangkok, strategic decisions were adopted for the first time about on-the-ground actions to collectively address the elephant poaching crisis and the escalating illegal trade in ivory (http://www.cites.org/common/cop/16/sum/E-CoP16-Com-II-Rec-13.pdf). The data illustrating the current elephant poaching crisis are outlined briefly in 3.1.1. "Update on the illegal killing of elephants" of this chapter.

Among other decisions, taking DNA samples on future ivory seizures greater than 500 kg is now mandated, and CITES parties are required to report annually on ivory stockpiles. Additionally, the discussion of the possibility of a CITES-sanctioned trade in ivory was postponed and the ban remains in place. Moreover, the CITES Secretary General will now cooperate with the UN Office of Drugs & Crime regarding illegal killing of elephants, illegal trade in ivory and the national security implications of ivory trafficking. Public awareness campaigns aimed at reducing the demand for ivory, which is the principal driver of the illegal killing of elephants, were endorsed by the CITES plenary. This endorsement further allows for the building of a coalition of individuals, scientists, NGOs, institutions and governments to take united international action to reduce demand for ivory. Finally, an agreement was adopted to strengthen the African Elephant Conservation Fund (http://www.fws.gov/international/wildlife-without-borders/african-elephant-conservation-fund.html) and the African Elephant Action Plan (http://www.bloodyivory.org/action-plan).

The Conference decided to establish Wildlife Incident Support Teams (WISTs), to be dispatched at the request of a country which has been affected by a significant poaching incident related to illegal trade or that has made a large-scale seizure of CITES listed specimens. The WISTs will assist and guide appropriate follow-up actions in the affected or intercepting country in the immediate aftermath of such an incident.

4.4. Herbaria, not only about naming plants

A herbarium is a collection of preserved plants for scientific research and education. Herbaria are a vital and irreplaceable taxonomic reference for plants, which identify thousands of plant names. Herbaria are complementary to the function of the Botanical Gardens as explained in the box 3.3 of State of the Forest 2010.: "Botanic gardens in Central Africa: roles and prospects".

Herbaria are essential to achieve the first objective of the Global Strategy for Plant Conservation (GSPC), which states that "Plant diversity is well understood, documented and recognized." (see: https://www.cbd.int/gspc). They are where new species are discovered, described and named. New species are often described many years after they were collected. Fontaine *et al.* (2012) estimated that the shelf life, between discovery and description, is on average 21 years for species of all kingdoms. Bebber *et al.* (2010) calculated that it takes between 23 to 25 years to describe half the new plant species collected in one year. This interval can be explained by the shortage of specialists, the tremendous amount of material available in herbaria (it estimated that the world's 2721 active herbaria together house 361 million specimens) and by the methodology of plant taxonomy itself.

Herbaria are also important for all types of research on plants such as genetics, palynology, wood anatomy, chemistry, pharmacognosy, inventories, etc. Vouchers specimens, which have all of the essential elements for identifying the specimen, including comprehensive labeling about the place, date, collector and habitat of collection, are crucial in many research domains.

Herbaria are not only a depository for dried herbarium specimens. They also hold associated materials such as liquid-preserved fruits and

Photo 3.10: Example of a restored herbarium in INERA – Yangambi, DRC

flowers, DNA samples, wood samples, drawings, watercolors, photographs, archives, literature, etc. The combined availability of these materials allows scientists to study the morphological and genetic variability of a species as well as its past and present distribution; calculate environmental parameters and potential distribution patterns; predict future distribution in the context of global change; document the distribution history of crops, pest and invasive species; evaluate the *in-situ* and *ex-situ* conservation of plants; and, provide a historical reference for carbon and nitrogen cycles.

The oldest herbaria in Central Africa date back to the early 20th century (e.g. the herbaria of Kisantu and Eala). From 1946 onwards, many local herbaria were founded. Many of these col-

Table 3.4: *Most important herbaria in the Congo Basin.*

Country	Name	Code	Institute	Number of specimens
Burundi	Herbarium of the Biology Department	BJA	University of Burundi	20 000
Cameroon	National Herbarium of Cameroon	YA	National Herbarium of Cameroon	96 000
	Herbarium Limbe Botanical & Zoological Gardens	SCA	Limbe Botanical & Zoological Gardens	30 000
	Herbarium of the school of Garoua wildlife	HEFG	Garoua wildlife school	11 000
Central African Republic	Herbarium faculty of sciences	BANG	Bangui university	10 000
	Herbarium Central Station of Boukoko	SCB	Central Station of Boukoko	3 600
Republic of Congo	Herbarium National of Congo	IEC	Study on plant resources center	40 300
Democratic Republic of Congo	Herbarium of the Centre for Training and Research Forest Conservation Epulu	EPU	Congolese Institute for the Conservation of Nature (ICCN)	8 000
	Herbarium of the university and INERA of Kinshasa	IUK	University of Kinshasa and INERA	29 000
	Herbarium of the Kisangani university	KIS	Kisangani university	10 000
	Herbarium of the Lubumbashi university	LSHI	Lubumbashi university	25 000
	Herbarium of the Kisantu botanical garden	KISA	Congolese institute for the conservation of nature (ICCN)	8 000
	Lwiro Herbarium	LWI	Research center in Natural Sciences Lwiro (CRSN)	15 000
	Kipopo Herbarium	KIP	National Institute for the Agronomic study and research (INERA)	25 000
	Luki Herbarium	LUKI	National Institute for the Agronomic study and research (INERA)	10 000
	Mulungu Herbarium	MLGU	National Institute for the Agronomic study and research (INERA)	10 000
	Yangambi Herbarium	YBI	National Institute for the Agronomic study and research (INERA)	150 000
Gabon	National herbarium of Gabon	LBV	CENAREST	40 000
Equatorial Guinea	National Herbarium and Documentation Centre	BATA	National Institute of Forest Desarollo	8 000
Rwanda	National Herbarium of Rwanda	NHR	Institute of Scientific and Technological Research (IRST)	16 700
São Tomé and Príncipe	Herbarium national of São Tomé and Príncipe	STPH	Directorate General of Environment, Ministry of Natural Resources and Environment	1 500
Chad	Herbarium of the Research Laboratory Veterinary and Zootechnical	-(*)	Livestock Ministry	8 000

(*) Not mentioned in Index Herbariorum

Source: Index Herbariorum: http://sciweb.nybg.org/science2/IndexHerbariorum.asp lections still exist and can be an important tool for the study of the biodiversity of the region. In addition to the collections in local herbaria, important collections from the regions can be found in European and North American herbaria (e.g. Kew, Meise, Missouri, Paris and Wageningen) (table 3.4).

In an effort to maintain historically important scientific collections, rehabilitation projects are underway in several herbaria with financial and technical support from international partners, including the Andrew W. Mellon Foundation (African Plants Initiative), the French Ministry of Foreign Affairs (Sud Expert Plantes), development cooperation agencies of several countries, the European Union, and several European botanical gardens and herbaria. These projects focus on the rehabilitation of institutions' infrastructure and collections, the training of technicians and researchers, as well as the digitization of collections. They provide support to local partners in the pest-control of herbaria, the mounting of herbarium samples, the classification and determination of herbarium specimens, and the digitization of collections, including the data-capture of botanical information. Scanned images of herbarium material from the Congo Basin, with their accompanying data, are made available via the internet (http ://plants.jstor.org/), and this is especially valuable to African researchers. These projects not only contribute to the development of local African institutions but also strengthen their scientific research both locally and internationally.

Photo 3.11 : Kaleidoscope of shape and color

5. Management of biodiversity in Central Africa

5.1. Lessons from Trans-boundary Protected Areas

In Central Africa, six trans-boundary protected areas (APTs) have been established since 2000 after cooperation agreements were completed ; (Kamdem Kamga, 2012), the Trinational Sangha Area (TNS : Cameroon, Congo and CAR), the Trinational Dja-Odzala-Minkebe Area (TRIDOM : Cameroon, Congo and Gabon), the Lake Télé-Lake Tumba Complex (Congo and CAR), the Binational Séna Oura-Bouba Ndjida Area (BSB Yamoussa : Cameroon and Chad), the Trans-boundary Mayumba-Conkouati Park (Gabon and Congo) and the Mayombe complex (Congo, DRC and Angola).

Two other trans-boundary complexes are in the process of being established : the Binational Campo Ma'an-Rio Campo Area (Cameroon and Equatorial Guinea) and the Monte-Alen-Monts de Cristal Area (Equatorial Guinea and Gabon). The expected accession of Gabon and the revision of the agreement on the Mayombe forest will make Mayombe the first quadpartite trans-boundary complex in Central Africa.

Photo 3.12 : River under a luxuriant forest, northern Gabon

In 2012 the Commission on Central African Forests (COMIFAC), with the financial support of the GIZ, commissioned a study to review the existing APTs and to propose a strategic orientation framework adapted to this type of conservation initiative (Ngoufo, 2013). The Great Virunga Trans-boundary Collaboration (GVTC), which comprises three countries, including one from outside the subregion (DRC, Rwanda and Uganda), was included in this study. The diagnosis has covered the processes of creating, managing, governing and financing these trans-boundary complexes.

The study concluded that the creation and management of trans-boundary complexes in Central Africa are technically feasible. However, their management and governance display shortcomings, even though their contribution to subregional integration and mutual cooperation in biodiversity conservation efforts is undeniable. Unfortunately, the financing of the protected areas very often falls short of actual needs and is too dependent on external financiers, which raises uncertainty about their sustainability.

A working group on the protected areas and wild fauna is being set up within the COMIFAC. It should serve as an interface between the subregional political bodies and actors on the ground and will promote greater capitalization on the lessons learned from the various APT initiatives. Other actions capable of significantly improving the functioning of the APTs may also be envisaged : overall planning on the basis of the management plans of the various protected areas concerned ; making the most of the tourism potential of the various sites (example of the Odzala-Kokoua National Park, see box 3.7) ; the mobilization of resources for the execution of the subregional Action Plan for the countries in the COMIFAC area for the strengthening of the enforcement of national legislation on wild fauna (PAPECALF – box 3.9), etc.

Box 3.7 : Ecotourism in the Odzala-Kokoua National Park

Robbert Bekker, Bourges Djoni Djimbi and Paul Noupa

TRIDOM

The Odzala-Kokoua National Park was created in 1935 and covers 1 354 600 hectares. It contains over 100 clearings where visitors can see a number of large mammals; plains gorillas, elephants, buffaloes, bongos and chimpanzees. These animals, as well as birds, reptiles and insects together with their exceptional habitats, give the park great ecotourism potential.

Photo 3.13 :Lango eco-lodge, Odzala-Kokoua national park, Congo

The sustainable financing and management of the park are guaranteed by the public-private partnership agreement of November 14, 2010 between the Government of Congo and the African Parks Network. The agreement is for a renewable period of 25 years. The park's development plan provides for complete protection of 60 % of its area with 40 % designated as transition and eco-development zones. In order to derive the greatest benefit from the park's natural and cultural riches and to contribute to local development, on April 29, 2011 the government signed a renewable 25-year partnership agreement with the Congo Conservation Company (CCC) for the rights to seven ecotourism and hunting concessions within and on the outskirts of the park. In return, it will make an annual payment of 5 % of its gross receipts to a village development fund.

The CCC has invested 5 million euros in the development of ecotourism. In 2012 it built three lodges (two top-of-the-range at Lango and Ndzéhi and one middle-range at Mboko) at a cost of 3.8 million euros, and it built two satellite camps in 2013. The three lodges employ about 100 people, 60 % from the area. All have been locally trained in hotel management.

The first 120 tourists arrived between August and September 2012. Starting in 2013, ecotourists are welcomed during the best visiting periods: January-February (lesser dry season) and June to mid-October (main dry season). The products offered include : discovery of the forest on foot, watching large wild animals from watchtowers, tracking groups of gorillas and sailing in dugout canoes.

In 2013, regulations to determine how village development funds are distributed were drawn up. Thus, of the 71 local villages direct and indirect beneficiaries are designated. Procedures for disbursement and management of the funds are also being established.

Box 3.8: Participative monitoring of the "Tri National de la Sangha"

[1]Dominique Endamana, [1]Kenneth Angu Angu, [2]Jeff Sayer, [3]Thomas Breuer, [4] Zacharie Nzooh, [1]Antoine Eyebe and [1]Léonard Usongo
[1]IUCN, [2] JCU, [3] WCS, [4] WWF

The "Sangha Group", starting in 2004 formed a group of the many actors involved in the management of the Tri National de la Sangha (TNS) forested landscape: managers of protected areas, research and conservation institutions, universities, loggers, local NGO's and civil servants.

This group has created a participative monitoring evaluation system (SEP) with the goal to analyze the impact of the actions taken to conserve biodiversity and to develop local communities at the landscape scale as well as to assess the results of these activities. This measure supplements the remote sensing monitoring of forest management initiated by the CARPE programme (Yanggen *et al.,* 2010).

These measures rely on the participative "bottom-up" approach which engages the local communities and indigenous populations according to the following steps : conceptualization of the tool, development and definition of the indicators and continuous monitoring of these indicators (Sayer *et al.,* 2007). The SEP has enabled a greater understanding of the dynamics within the TNS landscape as well as the identification of values ascribed to the landscape and has furthermore identified the avenues leading to environmental and socio-economic changes.

The indicators are grouped according to natural, physical, social and human benefits (table 3.5) (Department for International Development, 2001). The natural benefits have been divided into two categories; local resource importance (NTFP, subsistence game hunting, etc.) and global resource importance (large mammals: elephants, primates, etc.).

Table 3.5: *28 indicators used for TNS landscape monitoring (2006-2011)*

Local natural benefits	Global natural benefits	Human benefits	Social benefits	Physical benefits	Governance
Availability of four NTFP priorities	Illegally-killed elephants	Health care access	Running of the local committees on natural resources management	Manioc windmills	Application of the law
Availability of non-protected fauna	Bongo population	Standard of school attendance	Communal initiatives on natural resources management	Housing standard	Violation of rules on fauna
Commitment to sustainable management of forest process or certification		Ability of forest companies to employ local, qualified technicians	Perception of corruption (public and private sectors)	Number of drinkable water points	Sharing of eco-tourism and fauna benefits derived from forest management
			Level of associated activity	Access to nearest large urban center	Recurrence of local conflicts
			Progress in awarding of the Baka Community Forests	Level of tourism development	Re-establishment level of parliamentary committees
			Participation of the Baka in resolution of disputes in the court of the traditional chief	Wood transformation factory/workshop	Forest and fauna control
			Use of the forest license-fee	Market of the three products most in demand	

Monitoring of these 28 indicators started in 2006. Each indicator is assessed according to the Likert scale (ranging from 1 (worst-case situation of the indicator) to 5 (ideal indicator situation)). This process happens once a year during the annual Sangha group meeting, based on quantitative and qualitative data gathered by administrators of protected areas and by their partners, within their own proper

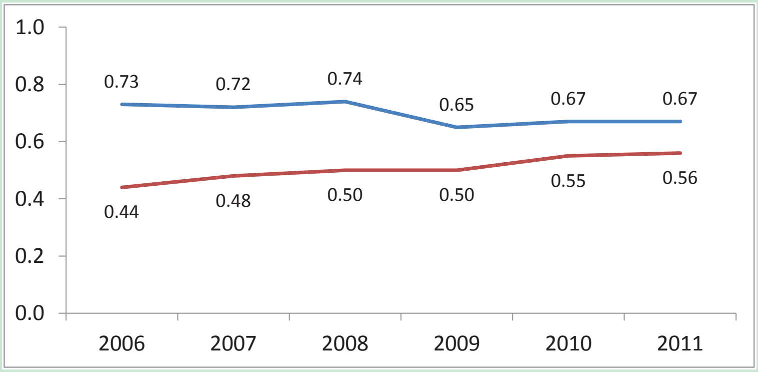

Figure 3.7 : Changes in conservation and development indices in the TNS 2006-2011

ecological and socio-economic monitoring evaluation system (figure 3.7).

The monitoring of these factors (Endamana *et al.*, 2010) has enabled the development of future conservation and development plans for the TNS (Sanker *et al.*, 2009) and has also increased the understanding of the landscape's resilience in facing external factors such as the 2008 international financial crisis (Sayer *et al.*, 2012). To achieve a consensus on the indicators, the landscape-level participative monitoring requires substantial time investment and patient involvement in monitoring from all the local actors, dialogue between all actors through an exchange platform, an adjustment of the indicators according to evolving stakeholder priorities and finally, the archiving of field data.

These benefits are applicable to other priority CBFP landscapes. The described approach will inspire the CGIAR institutions (CIFOR, ICRAF, Biodiversity International) long-term monitoring of "Referenced Landscapes" in their global research program on the changes of forest landscapes.

5.2. The management of wild fauna in Central Africa

5.2.1. The anti-poaching initiatives

In its previous edition, the State of the Forest outlined the multiple threats currently besetting the protected area systems in the subregion (Angu *et al.*, 2010). Among them poaching for ivory or bush-meat is considered likely to have the most serious impact on animal populations.

Photo 3.14 : Squirrel caught in a trap – UFA Bétou, Congo

This scourge has increased in recent years with the development of transnational criminal networks participating in the illegal traffic in fauna. The phenomenon is also having an impact in terms of public order and security as it has cost the lives of many trackers and ecoguards (Garamba in DRC, Zakouma in Chad, Bouba Ndjida in Cameroon).

A range of anti-poaching measures

At the present time a whole series of tools and initiatives are being deployed to combat poaching. They may be summarized as follows :

- Supply of equipment : vehicles and weapons for anti-poaching teams, construction of security posts, particularly in sensitive areas and along access routes (roads, tracks, rivers, etc) ;
- Making sites secure : setting-up of security patrols, organization of lightning raids, creation of elite paramilitary units or support for national armed forces ;
- Strengthening capacity : increase in numbers and training of ecoguards ;
- Development of a MIST-type database (Management Information SysTem, available

on http ://www.ecostats.com/software/mist/mist.htm) or SMART (Spatial Monitoring and Reporting Tool, available on http ://www.smart-conservationsoftware.org/) ;

- Work with local populations : development of income-generating alternatives to poaching (e.g. agriculture, fisheries, market-gardening) and execution of education and awareness-raising programs ;

- Increased law enforcement : strengthening and harmonization of legal and institutional frameworks regarding wildlife management, coordination of actions at the local, national and regional levels (see box 3.9 on PAPECALF).

Cross-border initiatives

The major anti-poaching innovation in Central Africa has been the move away from local or national initiatives to a cross-border approach. Coordination already exists in the TNS and TRIDOM (see section 5.1 and box 3.7). In late 2012, in order to respond to cross-border poaching, the tripartite plan involving Chad, Cameroon and CAR was approved by the COMIFAC Council of Ministers. In March 2013 an Extreme Emergency Anti-Poaching Plan (PEXULAB) was adopted as a supplement to PAPECALF in order to take urgent action against elephant poaching in Central Africa.

The cross-border anti-poaching actions are being set up in order to improve coordination of activities and involve the following principal participants : administrative authorities, protected-area conservationists, conservation project officials, etc. Cooperation takes the form of joint security operations in the border regions by multinational teams of ecoguards, sometimes supported by the armed forces. This strong cooperation between States needs to be further enhanced by the standardization of penalties and sanctions against poachers.

In October 2012, the Central Africa Protected Areas Network (RAPAC) initiated a study aimed at the harmonization of legislation relating to wildlife management. It will, *inter alia*, cover the various aspects of anti-poaching legislation in the subregion (procedures, penalties, etc.) and will propose common strategy actions.

Poaching unfortunately corresponds to the economic laws of supply and demand. Today it extends beyond non-compliance with the regulations relating to sustainable wildlife management in the various States. Poaching is becoming a question of national security and territorial integrity. More than in the past, the States responsible must take concerted action on poaching in order to guarantee the conservation of wildlife and its biodiversity.

Photo 3.15 : Land turtle in Gabon forest

Photo 3.16 : Gabon viper (Bitis gabonica) – Ndjolé region, Gabon

Box 3.9: Sub-regional action plan for the strengthening of the implementation of national laws on wildlife

Chouaïbou Nchoutpouen[1], Stephane Ringuet[2], Germain Ngandjui[2] and Marc Languy[3]
[1]COMIFAC, [2]TRAFFIC, [3]WWF

In February 2005, the Central African heads of state adopted a "Convergence Plan" outlining priorities for biodiversity management and for tackling poaching and the illegal exploitation of forest resources. Despite this political good will, the illegal poaching and trade, especially of ivory, have developed into extremely worrying proportions which pose a serious danger to vulnerable species such as elephants and great apes. Yet all these countries have signed and ratified several international conventions, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD). They have also all drawn up and adopted national laws in favor of sustainable wildlife management. Nonetheless, these laws are far from being implemented in the most efficient manner.

In June 2012, the COMIFAC Board of Ministers adopted a sub-regional Action Plan for the strengthening of the implementation of national laws on wildlife (PAPECALF). This groundbreaking plan, which will be implemented between 2012 and 2017, commits governments to reinforce the application of sub-regional national and international laws, conventions and agreements that regulate the management of wildlife in Central Africa. It aims to improve the implementation of the laws by introducing more efficient deterrent tactics against poaching and illegal trade. It also promises to aggressively increase the number of arrests and prosecutions of those implicated in poaching or illegal trade in the COMIFAC countries.

Specifically, the Action Plan's objectives are the following:

- strengthen cooperation and collaboration among the controlling and judicial authorities affected by the implementation of the laws on wildlife – both nationally and internationally - within the COMIFAC area;
- increase monitoring and checks, in particular in key transit areas or borders, internal markets and cross-border zones;
- introduce effective deterrents to tackle illegal wildlife poaching and trade; ensure prosecutions are carried out regularly and that they comply with respective national laws; ensure that the outcomes of investigations and prosecutions are closely monitored, published and widely broadcast;
- strengthen awareness of issues associated with illegal wildlife trade (Ringuet and Ngandjui, 2012; SC62 Doc. 30).

In order for PAPECALF to be effectively implemented, each country must allocate adequate financial and human resources to this end. The relevant government ministries must make everyone aware of this Action Plan though an effective communication process which results in implementation on a national level. Two bodies in charge of ensuring the Action Plan will be implemented have been created: a National Coordination Unit (CCN) which, in each country, will be embedded in the Ministry of Wildlife; and a Working Sub-Group on Wildlife and Protected Areas (SGTFAP), which will be embedded within the COMIFAC Working Group on Biodiversity.

The expected success of the implementation of the plan will rely on effective coordination and communication and sharing of information between the countries and the relevant organizations.

Box 3.10: Strengthening of cross-border surveillance in the TRIDOM area

Robbert Bekker, Bourges Djoni Djimbi and Paul Noupa
TRIDOM

TRIDOM is a cross-border tri-national complex of protected areas comprising the Dja wildlife reserve and the Odzala and Minkebe national parks. For two years now the TRIDOM partners have been taking a number of innovative actions to support the governments of the three concerned countries (Cameroon, Congo and Gabon) in their sovereign task of combating international poaching which is threatening elephants. These actions have taken the following forms:

Legal tools

As with the Sangha tri-national project, a cross-border protocol has been drawn up and will serve as a legal framework for joint surveillance operations along the common borders. In order to prosecute offenders of wildlife and environmental laws, three joint national committees have been established within the TRIDOM framework to monitor disputes and the application of laws (at Ouesso and Ewo in Congo, and at Makokou and Oyem in Gabon). Cross-border collaboration with Cameroon is being established. These committees operate under the aegis of the state prosecutors and comprise representatives of the ministries of forests and interior, the police, the *Gendarmerie* and armed forces, NGOs and economic partners.

The cross-border anti-poaching operation

The capacities of the surveillance teams on the ground have been strengthened. A common Management Information System (MIST) has been adopted in all the TRIDOM protected areas as a tool for monitoring anti-poaching activities. A total of 110 personnel have been trained to collect, analyze and interpret data (abundance of large mammals and human activities, size of fruit on the ground from the most important food plants). In addition, some 30 conservation workers (representatives of water and forests ministries, prefectures and sub-prefectures) have been trained in information techniques and the monitoring of wildlife. This training was given by national gendarmerie officers and by the state prosecutor attached to the Ewo Higher Court.

In Djoum (Cameroon), in Tala-Tala (Congo) and in Oyem (Gabon), the protected areas services, the brigades and the six frontier forestry posts were provided transportation equipment (vehicles, motorcycles, outboard motors), communications equipment (VHF radios, satellite telephones), and navigation and camping equipment.

These resources, valued at $ 530 000, have been financed by the Global Environment Fund. There are also plans to build a control post at the point where the frontiers of the three countries meet, close to the colonial marker near the village of Alati in Cameroon, and to base the future tri-national anti-poaching brigade there.

Lastly, TRIDOM conservation personnel have developed a joint cross-border anti-poaching action plan which was put into effect in 2013.

Example of a surveillance and anti-poaching unit in Congo

In order to contribute to the anti-poaching operation in the Forest Management Units (UFAs) at Tala-Tala (Sifeu) and Jua-Ikié (Sefyd) in the Department of Sangha in northern Congo, the TRIDOM project modeled its program on the WCS-supported experimental operation conducted in the Ngombé UFA (eastern part of the TRIDOM Congo segment). TRIDOM has supported a partnership between forest concession-holders, the government and WWF to create a surveillance and anti-poaching unit. In this context, the Forestry Department is making available the eco-guards responsible for conservation work, the forestry companies are financing operations on the ground in keeping with their concession commitments and WWF is providing its expertise in conservation and biodiversity. TRIDOM is supporting the initiative through the financing of equipment and training.

Community activities

Awareness-raising campaigns on community forests and conflicts between local people and elephants were conducted in order to remind these local people of the value of the natural resources within their environment. To date, 16 village communities on the edge of the Odzala-Kokua National Park have worked to reduce commercial hunting in exchange for the setting-up of income-generating activities (goat farming, aquaculture, beekeeping, development of a number of non-timber forest products, rehabilitation of coconut groves or intensive subsistence crops, etc.). Some communities want to participate in the surveillance of “strategic” clearings in order to reduce poaching and to facilitate the restoration of ecological corridors. Their objective, in the medium term, is to develop community-managed ecotourism.

Box 3.11 : An itinerant courthouse: the "mobile court" in the Salonga National Park (DRC)

Florence Palla
RAPAC

A mobile court now allows judges, prosecutors, defendants, witnesses and lawyers (around 20 people) to be transported right up into isolated areas. This had not been possible previously.

In November and December 2011, a *Chambre foraine* or mobile court was organized in Monkoto by the partners of the Salonga National Park (SNP), in support of the Congo Institute for the Conservation of Nature (ICCN). Ten poachers were tried for illegal possession of weapons and for poaching. By the end of the trial, seven life sentences had been handed out and the poachers were immediately transferred to Ndolo prison in Kinshasa. On this occasion, 12 weapons were seized and three (presumed) poachers were acquitted.

5.2.2. Action to combat trafficking of great apes

Several initiatives are specifically addressing the illegal trafficking of endangered great apes.

For example, the Last Great Ape Organization (LAGA, http ://www.laga-enforcement.org/) is providing technical and legal assistance to Forestry and Wildlife Administrations in arresting and prosecuting illegal wildlife dealers in Cameroon, Gabon, Congo and CAR. Also LAGA has developed measurable standards of the effectiveness of enforcement of illegal trafficking (i.e. number of major traffickers arrested, convicted and imprisoned per week).

Also, new formal collaborative agreements by international agencies such as the International Consortium on Combating Wildlife Crime (ICCWC), which includes CITES, INTERPOL, the United Nations Office on Drugs and Crime (UNODC), the World Customs Organization (WCO), and the World Bank works to craft a comprehensive and collaborative approach to prevent illegal trade (http ://www.cites.org/eng/prog/iccwc.php).

Other responses to great ape trafficking are described in "Stolen Apes", available for download on the GRASP website (http ://www.un-grasp.org/news/114-stolen-apes-counts-illegal-trade-toll). This report, published in 2013, is the first to analyse the scale and scope of the illegal great apes trade, and it highlights the growing links of sophisticated trans-boundary crime networks to wildlife trafficking.

At the sub-regional level, the COMIFAC Action Plan for the Strengthening of the Implementation of National Laws on Wildlife (PAPECALF 2012-2017) is another potentially effective instrument to shift the trend of great apes trafficking in Central Africa (Box 3.9).

PART 2

CLIMATE CHANGE IN CENTRAL AFRICA

CHAPTER 4

Climate change and adaptation in Central Africa: past, scenarios and options for the future

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1. Introduction

Evidence of human-induced climate change and its impacts on various sectors is steadily increasing, raising doubt whether limiting rising global average temperature to 2°C above pre-industrial levels is still a realistic goal. According to the 4^{th} Assessment Report (IPCC AR4) of the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2007), the African continent has an elevated susceptibility to the stress caused by climate change and relatively low capacity to adapt to the consequences. The sectors identified as the most vulnerable to climate change are: agriculture and food security, water supply, ecosystems, and health (Sonwa *et al.*, 2012). The vulnerability of these sectors requires that forest management and development strategies take climate change into account. Combating climate change requires two different approaches: reducing the rising concentrations of CO_2 and other greenhouse gasses in the atmosphere (mitigation) and preparing to live with the inevitable consequences of climate change (adaptation). Forests have played a crucial climate change mitigation role in the international negotiations on climate change since the concept of REDD (Reducing Emissions from Deforestation and Forest Degradation) arose in the middle of 2000^{th}. Forests sequester and store atmospheric carbon; avoided deforestation and reforestation may therefore have a positive effect on atmospheric CO_2 concentration.

This chapter aims to summarize the current state of knowledge of climate change and adaptation related to forests in the COMIFAC region. This synthesis aims to assist the Congo Basin countries in developing adaptation options and policies for forests and the local communities living in forest landscapes. It builds on information from the IPCC 2007 report and other published sources as well as unpublished information from the few climate change and adaptation studies in the region.

Photo 4.1: An imminent storm. Erosion risks are high in Rwanda

Mitigation

The role of forests in climate change mitigation is receiving increasing interest in the region, as reported in previous editions of the State of the Forest of the Congo Basin (Nasi *et al.*, 2009 ; Kasulu *et al.*, 2009 ; Tadoum *et al.*, 2012). COMIFAC and its member countries have put considerable effort into the international negotiations (i.e. their common positions on REDD, see chapter 5) and into the implementation of the REDD+ concept (e.g. the regional World Bank REDD+ project and the FAO project on MRV). Responses to climate change in Central Africa generally emphasize mitigation without prioritizing adaptation (Bele *et al.*, 2011 ; Somorin *et al.*, 2012).

Adaptation

The few initiatives on climate change adaptation in the COMIFAC region has focused mainly on the agricultural sector. Nevertheless, non-timber forest products (NTFP) play a crucial food security role, and timber is a major economic sector for regional national economies. Adaptation in the forest sector in order to maintain these and other crucial forest functions for the Congo Basin countries thus becomes increasingly important. Options to optimize tropical forest management with regard to climate change adaptation need to be further explored. Several studies have started to look into climate change scenarios and impacts (e.g. the study "Climate Change Scenarios for the Congo Basin", implemented by the German International Cooperation (GIZ)) and into forest adaptation options in the Congo Basin region (e.g. the projects "COBAM" and "CoFCCA", implemented by the Center for International Forestry Research (CIFOR) etc.). The "CoForchange" project developed by the Center for International Research on Agricultural Development (CIRAD) also sought to understand the linkage between forests, climate change, and climate variability.

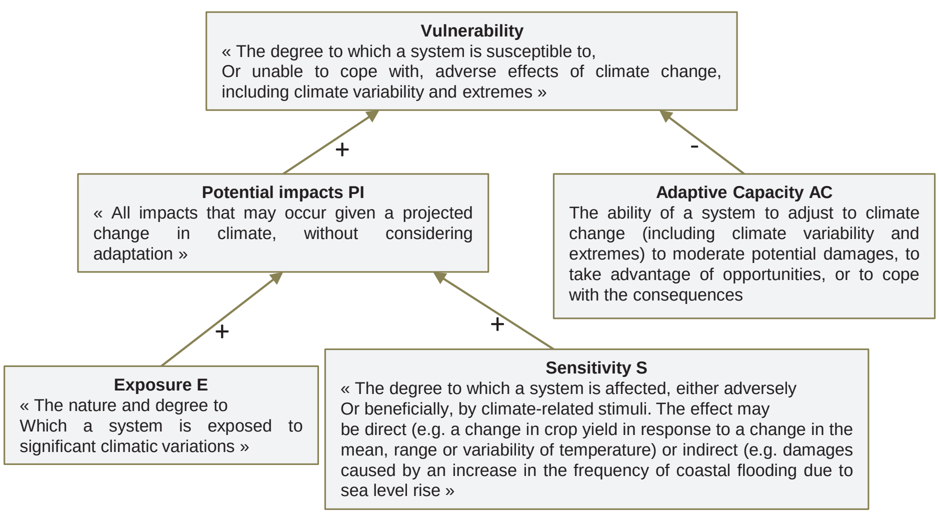

Figure 4.1 : The components of vulnerability (definitions are from IPCC : McCarthy et al., 2001). The signs under the arrows mean that high exposure, high sensitivity and low adaptive capacity induce high vulnerability.

Adapted from Locatelli et al., 2008.

Vulnerability framework

Vulnerability can be defined as "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC TAR WG II, 2003). The vulnerability framework [V= f (E, S, A)] considers vulnerability (V) as a function (f) of exposure (E), sensitivity (S), and adaptation (A). The function can also be applied to the forest sector (Locatelli *et al.*, 2008, see figure 4.1), and its principles underlie this chapter.

The **sensitivity** component in this chapter is broadly captured by the review on why forests and adaptation to climate change is needed in Central Africa. **Exposure** to climate change will be presented in the form of available information concerning observed climate change and projections of future climate change, based on the variables of precipitation and near surface air temperature. The effect of these changes in the past and the projections for future changes on different sectors, and thus on local communities, will be presented in the impact section. **Adaptation** will be covered by the section on possible responses to these impacts. As adaptation actions do not occur in a vacuum, and because joining efforts with previous initiatives can help, we will also explore the synergies with others activities.

Photo 4.2: Lekoni Circle – Bateke Plateaux, Gabon

2. Why "forests and adaptation" in Central Africa?

While the importance of the forestry sector, with its environmental, economic, and social benefits for the COMIFAC countries is widely recognized, the question of how to adapt to climate change remains largely unanswered. Currently, the focus is on REDD+, and few efforts have been made to mobilize adaptation funds (Ecosecurities, 2009). While Central Africa is not a highly polluted region, it nonetheless is vulnerable to the effects of climate change. The role of nature is increasingly acknowledged as playing an important role in the face of climate change. Adaptation to the impacts of climate change on the forestry sector will have repercussions on other development sectors, notably water, health, food security and energy (Sonwa *et al.*, 2012). All of these sectors are indeed interdependent and contribute to the development of Central African countries.

Biological diversity, which is the focus of much attention in Central Africa, is not immune from climate change. It is therefore necessary to examine how the climate affects biodiversity and what could be its responses (in other words, adaptation) to climate disturbances.

"Ecosystem-Based Adaptation" (EBA) is receiving increasing attention. Plans for the rational use of forest resources (from planting to sustainable harvesting to full preservation) will facilitate adaptation to the effects of climate change. "EBA" may, for example, be understood as the protection or restoration of mangroves to protect coastal areas from marine aggression, or as agroforestry practices to diversify crops and reduce vulnerability to climate variations. It also may be understood as using diversified genetic resources in forest plantations to facilitate adaptation to climate stress, or the effective management of watersheds to assure permanent supplies of water and hydro-electric energy. According to Collset *et al.* (2009), the success of EBA depends on reducing non-climatic stresses, the involvement of local communities and other actors and stakeholders, the use of sound natural resource management practices, an adaptive approach, and its integration in a comprehensive adaptation strategy. The successes of EBA should be the focus of intense communication to reach the maximum number of actors and decision-makers so that they may be widely reproduced.

While such actions can help the forest sector to adapt to climate change, the sectors putting direct or indirect pressure on the forests, such as agriculture, mining and urban settlements will play an important role in adapting to climate change in the greater Congo Basin region. Thus, forest adaptation goes far beyond the forest sector itself and incorporates all forms of competing land-use.

3. Climate parameters in the past and projection in the future

3.1 The climate and its observation in Central Africa

General characteristics

The climate of Central Africa is regulated by the annual migration cycle of the Intertropical Convergence Zone and the influence of the Atlantic and Indian Oceans. In January, the area of precipitation is located in the extreme south of the Congo Basin, while it is the dry season in the north (north Cameroon and the RCA). The area of precipitation then gradually migrates north, passing over the center of the basin in April. Rainfall occurs further north in July while it is minimal in the south (Hirst and Hasternrath, 1983). The area of precipitation starts to move south in September, re-crossing the center of the region in November. The annual rainfall cycle in the center of the region (between 5°S and 5°N) is consequently bimodal. Meanwhile, in the north and south of Central Africa, the annual rainfall cycle is monomodal, with maximum precipitation respectively in July-August and January-February. In addition to this north-south variability, climate characteristics vary from east to west. In the eastern part of the Congo Basin, maximum rainfall is recorded between March and May. In the western coastal area, rainfall is more abundant between September and November (Nicholson and Dezfuly, 2013). In addition to this spatial variation, climatic heterogeneity is observed with variations in the start and end of rainy seasons, the length of the seasons, and rainfall amounts (Guenang and Mkankam, 2012).

Photo 4.3: Sunset on the Congo River – Mbandaka, DRC

This strong spatial-temporal heterogeneity reflects the complexity of the Congo Basin's climate and the multitude of factors influencing it (Nicholson and Dezfuly, 2013). These factors include the flow of vapor in the lower troposphere coming from the Atlantic Ocean (McCollum, 2000). This flow of water vapor influences the annual cycle as much as the interannual variability of the water cycle in the sub-region (Pokam *et al.*, 2012). Medium and high altitude atmospheric jet streams moving across the African continent influence the sub-region's climate (Nicholson and Grist, 2003). They facilitate the supply of water vapor to the sub-region, as well as the upward movement of air masses. The topography of the Congo Basin moreover contributes to these upward movements (Vondou *et al.*, 2009) and to the heavy precipitation in western Cameroon and the eastern DRC (Nicholson and Dezfuli, 2013). Near-surface temperatures of the Atlantic, Pacific and Indian Oceans influence the interannual (Balas *et al.*, 2006) and seasonal variability (Nicholson and Dezfuli, 2013) of rainfall in the Congo Basin.

Observation network

There are 419 meteorological stations and 230 hydrological stations in the ten COMIFAC countries (CSC, 2013). Certain stations have produced data for well over a century. Regular climate measurements began in 1885 and 1889 at the Douala and Yaoundé stations in Cameroon (Nicholson *et al.*, 2012). The majority of the stations, however, only began their observations in the 1950s and 1960s (CSC, 2013). Since the 1980s, several stations have unfortunately stopped functioning regularly (figure 4.2), and time series are often interrupted, limiting the number of stations with reliable and complete time series data (Aguilar *et al.*, 2009).

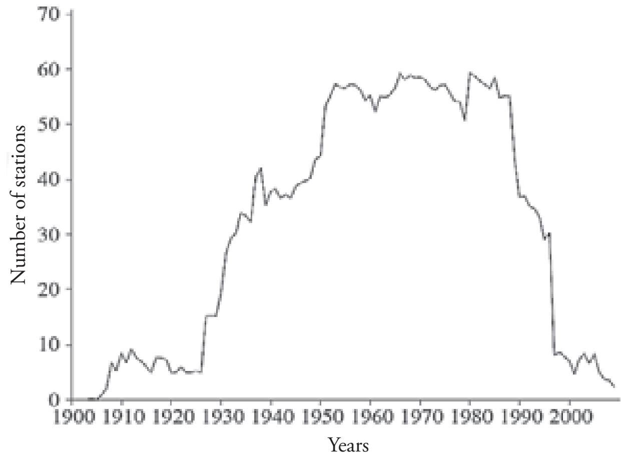

Figure 4.2: Number of rain gauges across the region 5°S-5°N, 12.5°E-30°E used per year in data of the "Climate Research Unit" at the University of East Anglia. According to Washington et al., (2013).

3.2. Past climate

Precipitation trends

A downward trend in total precipitation averages across Central Africa of 31 mm/decade was observed between 1955 and 2006 (Aguilar *et al.*, 2009). This drop in precipitation is associated with a drop in the number of extreme events by 0.67 days per decade. These reductions in precipitation vary in intensity across the region. In southern Cameroon and the Congo, the drop in rainfall persisted up to 1990 (figure 4.3). In Gabon and Central Africa, an increase was observed after 1980 and 1985 respectively (Olivry *et al.*, 1993).

Disparities exist at the local level: in the north of the Republic of Congo, the trend is marked by a drop in rainfall, while in the south of the country, rainfall levels are stable (figure 4.4) (Samba and Nganga, 2012). In the sub-region, drops in the number of consecutive days with at least 1 mm of precipitation, as well as in the number of days with precipitation above 10 mm, have been recorded (Aguilar *et al.*, 2009).

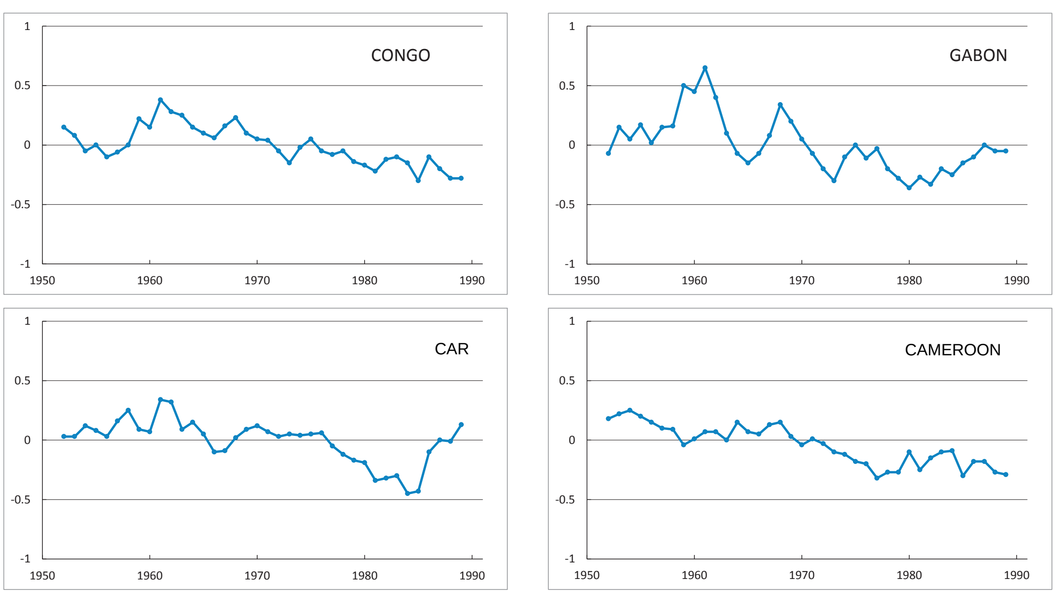

Figure 4.3: Change in annual precipitation indices since 1950 in different regions of Central Africa (according to Olivry et al., 1993). These indices are calculated using standardized annual precipitation anomalies .

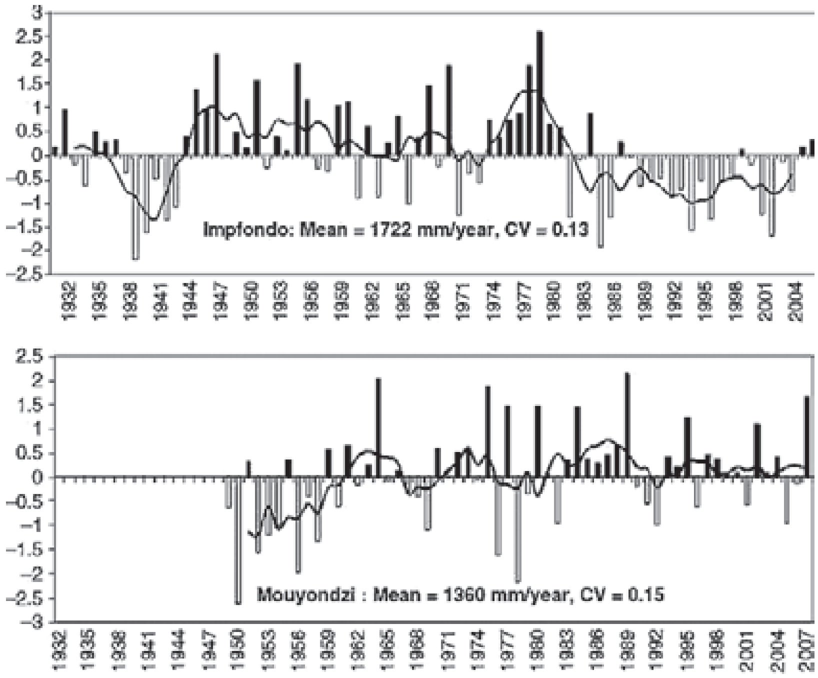

Figure 4.4 : Change in the annual precipitation indices since 1932 in two meteorological stations situated in the north (Imfondo) and south (Mouyondzi) of the Republic of Congo (according to Samba and Nganga, 2012). These indices are calculated using standardized annual precipitation anomalies.

Temperature trends

Temperatures indicate a warming trend. Between 1955 and 2006, warming has been observed across the region (table 4.1). It is important to note that the increase of heat-related parameters is about twice of the average statistics for the entire planet over the same period (Aguilar *et al.*, 2009). As for precipitation, the trend differs in amplitude across the region. In the Republic of Congo, temperatures increased by 0.5 to 1^0C during the decades of 1980s and 1990s (Samba *et al.*, 2007). At the local level, temperature increased by 0.3 to 0.5^0C in the north of the country while they remained stable in the south. Sanga-Ngoie and Fukuyama (1996) demonstrated a rise in temperatures of about 1^0C in Kinshasa, DRC over the 1960-1990 period, with values ranging from 0.6 to 1.6^0C across the rest of the country.

Table 4.1 : *Regional trends in temperature indices in Central Africa*

Index	Trend	Unit
Very hot days	+0.25	degrees Celsius per decade
Very hot nights	+0.21	degrees Celsius per decade
Frequency of hot days	+2.87	% of days in a year per decade
Frequency of hot nights	+3.24	% of days in a year per decade
Frequency of cold nights	-1.17	% of days in a year per decade
Frequency of cold days	-1.22	% of days in a year per decade

Hot day : day when the maximum temperature is above the 90^{th} percentile
Cold day : day where the maximum temperature is below the 10^{th} percentile
Cold night : night when the maximum temperature is below the 10^{th} percentile
Hot night : night when the maximum temperature is above the 90^{th} percentile
According to Aguilar et al., 2009

Global level assessments

Several COMIFAC countries in the framework of their national communications with the UNFCCC have assessed how precipitation and near surface air temperature, the most important climate parameters, might change over the course of the 21st century. These assessments, based on projections from Global Climate Models (GCM), have large confidence intervals due to their coarse spatial resolution (up to 500 km). As Table 4.2 shows, the projections differ substantially between the countries.

Table 4.2: *Overview of GCM projections used in the national communications to the UNFCCC for seven COMIFAC countries (adapted from GIZ/BMU 2011)*

Country	Number of communications to the UNFCCC	Simulated parameters	Reference period	Simulation time horizons	Trends
Burundi	2	Precipitation, temperature	1975-1990	2010, 2020, 2030, 2040, 2050	- precipitation: increase 2010-2030; decrease 2030-2040, then a new increase starting in 2050 - temperatures: 1° to 3°C increase 2010-2050
Cameroon	1 (the 2nd is being finalized)	Precipitation, temperature, marine level	1961-1990	2025, 2050, 2075, 2100	- precipitation: overall increase with strong variability in the Sudano-Sahelian region up to 2100 - temperatures: 3°C increase - rise in marine level
Congo	1	Precipitation, temperature	1961-1990	2050, 2100	-precipitation: +4 to 24 % in 2050; +6 to 27 % in 2100 - temperatures: +0.6 to 1.1°C in 2050; +2 to 3°C in 2100
Gabon	1	Precipitation, temperature	1961-1990	2050, 2100	-precipitation: +5 to 6 % in 2050; +3 to 18.5 % in 2100 - temperatures: +0.9°C in 2050; +2°C in 2100
DRC	2	Precipitation, temperature, and atmospheric pressure	1961-1990	2010, 2025, 2050, 2100	-precipitation: from +0.3 % in 2010 to +11.4 % in 2100 - temperatures: from +0.46°C in 2010 to +3.22°C in 2100 - atmospheric pressure: from 0.52 hPa in 2010 to -0.47 hPa in 2100
São Tomé and Príncipe	1	Precipitation, temperature, marine level	1961-1990	2100	- precipitation reducing - temperatures rising - rise in sea level
Chad	1	Precipitation, temperature	1961-1990	2023	-precipitation: +50 to 60 % in 2023 - temperatures: +0.6 to 1.7 °C

Sources: Initial communications on the UNFCCC, Burundi 2010, Cameroon 2004, Congo 2001, Gabon 2005, DRC 2009, São Tomé and Príncipe 2005, Chad 2001

Regional level

At the regional level, climate projection studies that cover at least a large portion of the Congo Basin are available, even though the region was not always the focus of these studies. An example are downscaling activities for the whole African continent (Mariotti, 2011) or a large portion of Africa (e.g. Paeth *et al.*, 2009 for northern Africa and the tropics; e.g. Hudson and Jones, 2002; Engelbrecht *et al.*, 2009 for subequatorial Africa). Most of these studies only date to the middle of the 21st century and use the input data of only one GCM-run model for one specific scenario. With a single GCM-run model for one specific scenario the sample size is extremely low, thus resulting in a very low confidence interval. Therefore, these studies can be classified as case studies rather than as comprehensive climate change projections. While these studies do agree on a basin-wide increase in temperature, the results differ for precipitation. Some studies project a decrease in rainfall over large parts of the basin by the middle (following the A1B scenario; Paeth *et al.*, 2009) and the end of the century (fol-

Photo 4.4: Typical village house in the forest, CAR

Photo 4.5: Central Africa is a region of intense, strong and sudden rains

lowing the A2 scenario, Engelbrecht *et al.*, 2009); other studies project constant rainfall amounts until the end of this century (following the A1B scenario; Mariotti, 2011).

Regional level assessments: CoFCCA-study

The Congo Basin Forests and Climate Change Adaptation (CoFCCA) project recently conducted a first attempt at modeling the climate in the region using the regional climate model PRECIS (Providing Regional Climates for Impacts Studies) to make the projections (Pokam *et al.*, 2011). The study projected changes in near-surface air temperature and precipitation for the period from 2071–2100 under the high emission scenario with a reference period spanning from 1961–1990. Broadly considered, PRECIS predicts an increase in precipitation in Central Africa, with the highest increase (around 14%) increase from September to October. However, this increase in precipitation will not occur over the whole region. The eastern part of the COMIFAC region will experience a decrease in precipitation. An overall increase of near-surface air temperature for the whole region compared to the reference period is predicted, with the largest value (around 4.3°C) during the season June-July-August.

Regional level assessments: Climate Change Scenarios Study

The German Federal Ministry for the Environment (BMU) funded a recent study from 2010-2012, "Climate change scenarios in the Congo Basin," a comprehensive regional climate change assessment for the greater Congo Basin region (CSC, 2013). Besides Chad, where only the southernmost third of its surface was covered because of technical reasons, the study covered the entire land-surface of all COMIFAC member countries (from 15°N to 15°S and from 7°E to 35°E). This assessment used 77 existing and additionally compiled global and regional climate change projections from 18 independent models (global and regional), the largest data set used so far, to analyze the impacts of high and low-emission scenarios (see: Annex 2 for methodological details). This analysis not only estimated the potential magnitudes of projected climate change signals, but also judged the reliability of the projected changes. Furthermore, within this project, a representative subset of the climate change projections have been used as input for subsequent impact assessments and the formulation of adaptation options (CSC, 2013).

We would like to caution the reader that the scope of this study was regional (the entire Congo Basin) and that it made projections for the middle and end of the 21st century. This makes it difficult to compare with presently observed changes, which are often at a local scale. It is also possible that these projections actually contradict the observed climate changes in the recent past, simply because of the much longer time horizon of the projections and because the climate in the region shows a distinct variability on the decadal time scale.

Near-surface air temperature

The Climate Change Scenarios study (CSC, 2013) revealed that all models, independent of season and emission scenario, show a warming of near-surface air temperature by at least 1°C towards the end of the 21st century. Temperature extremes, like the frequency of cold and hot days and nights, also decrease and increase respectively, independent from season and emission scenario (table 4.3). For these purposes, the frequency of cold days for example is defined as number of days with a daily maximum near-surface air temperature below the 10th percentile of the daily maximum near-surface air temperatures of the period 1961–1990. Since all models are projecting changes in the same direction, the likelihood of these changes occurring is very high. However, the range of possible changes is large, mainly because of a few outlier model projections. Therefore, a sub-range (the central 66% of projections) was defined as "likely changes." A projected climate change signal is considered to be robust if at least 66% of the model predictions agree in the direction of change (IPCC, 2007). For near-surface annual mean temperature, the sub-range ("likely changes") predicts between 3.5°C and 6°C increase in temperature for a high emission scenario and between 1.5°C and 3°C increase in temperature for a low emission scenario towards the end of the century. In general, the projected temperature increase is slightly higher (above average of the predicted changes for the entire study area) in the northern parts of the region and slightly lower (below average of the predicted changes for the entire study area) in the central parts.

Total Precipitation

The results of the different projections are not as robust for total precipitation as for near surface air temperature. Some models project an increase in the annual total precipitation in most parts of the greater Congo Basin region, whereas other models project a decrease over the same areas. However, towards the end of the 21st century a general tendency for a slight increase in annual total precipitation is projected for most parts of the Basin. The largest increase in annual total precipitation is projected for the generally dryer northern part of the region, which is related to the northward expansion of the tropical convection zone and to the relatively low total precipitation over this area. The "likely range" for changes in total annual precipitation is between -10 and +10 % (-10 and +30 % in the north) and between -5 and +10 % (-10 and +15 % in the north) for the high and low emission scenarios respectively. These results suggest that it is unlikely that drastic future changes in annual total rainfall will occur.

In contrast, substantial changes in the characteristics of rainfall are projected. The intensity of heavy rainfall events (95th percentile of daily precipitation amounts, but only wet days (days with daily rain amounts of at least 1 mm/day) are considered) is likely to increase in the future (the "likely range" is predominantly positive, up to +30 %). Also the frequency of dry spells (periods in the rainy season with at least six consecutive days with daily rain amounts of less than 1 mm/day) during the rainy season is projected to increase substantially for most parts of the region, indicating a more sporadic future rainfall distribution.

Table 4.3: *"Likely range" (centered on the median) of projected changes (in %) for the frequency of cold/hot days/nights averaged over the entire Congo Basin region.*

Projected Changes	Low emission scenario		High emission scenario	
	2036 - 2065	2071 - 2100	2036 - 2065	2071 - 2100
Cold Nights (in %)	- 9 to - 7	-10 to -7	-9 to -8	-10
Cold Days (in %)	-8 to -5	-9 to -6	-9 to -6	-10 to -9
Hot Nights (in %)	+27 to +43	+29 to + 56	+38 to +53	+64 to +75
Hot Days (in %)	+12 to +21	+13 to +29	+16 to +28	+31 to + 54

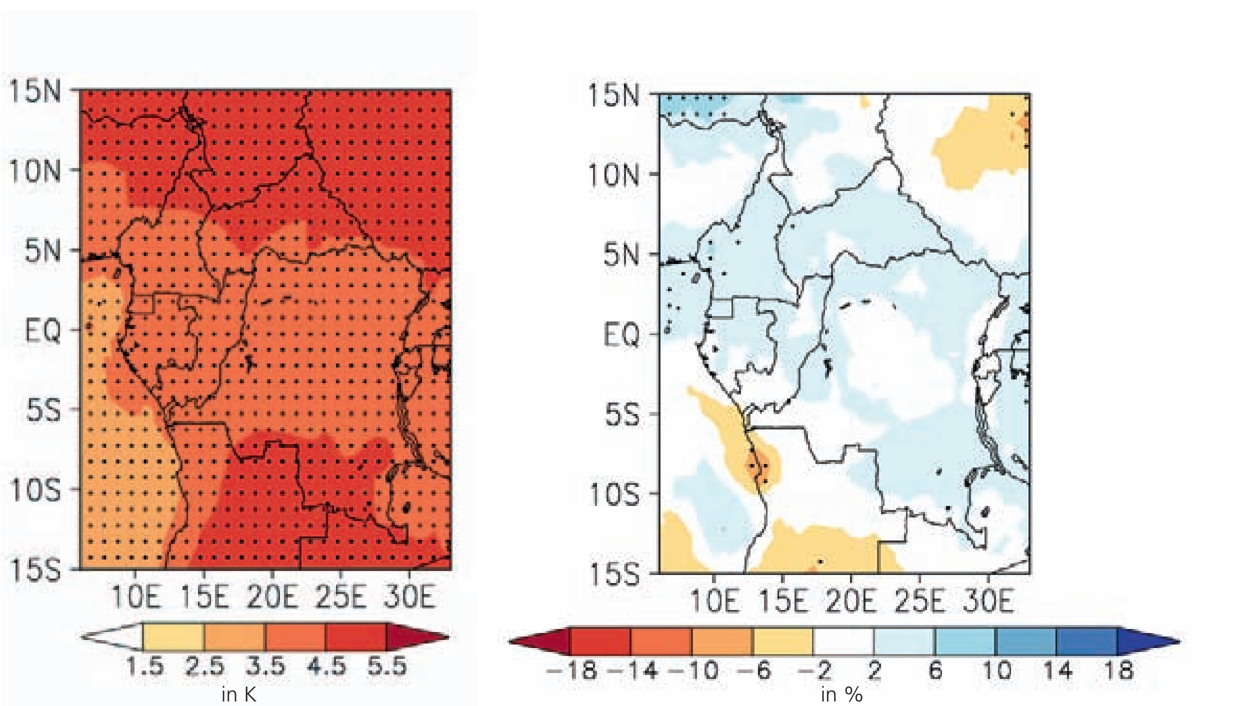

Figure 4.5: Projected change in annual mean temperature (left) and annual total precipitation (right) until the end of the 21st century (2071 to 2100) compared to the period 1961 to 1990 for a high emission scenario. The depicted change is the median change from a set of 31 different climate change projections from global and regional climate models. The black stipples highlight regions where the majority of the models agree in the direction of change. Projected changes in these regions are therefore more robust than over regions without stipples.

Source: CSC 2013

Photo 4.6: Abandoned laterite quarry, Gabon

In general, the study shows that projected rainfall changes will not lead to a general water shortage in the region. Some prolonged and more frequent dry periods might nevertheless become more likely in the future. While this finding is rather independent of the underlying emission scenario, near-surface air temperature is projected to increase substantially more under the high emission scenario. This conclusion is based on the results of the Climate Change Scenario study (CSC, 2013) which used a large ensemble of climate change projections from regional and global climate models. The models used do not take into account regional specific demographics, land use change, water extraction and other factors potentially having an impact on water availability, for example.

4. Climate change impacts

4.1 Past Impacts

Without entering into a discussion of whether changes in the recent past can be attributed to climate change or should be attributed to the impact of often overwhelming changes in land use, we present a number of observations focusing on the impact of climate variability or change on hydrology, vegetation and on society and economy.

Impacts of climate variation on watercourses

Land use and the climate can have both immediate and sustained effects on hydrology (Li *et al.*, 2007). We mainly present here climate-related impacts. The repercussions of past climate variations on watercourses are reflected in changes in their regimes. For example, Sircoulon (1990) showed that the average flow of all of the principle Sahelian rivers (Senegal, Niger and Chari), which was 136 km^3 per year prior to 1969, fell to 79 km^3 during the 1970-1988 period (a 43 % drop), and was just 36 km^3 in 1984 (a 74 % deficit). In humid tropical Africa, during the 1981-1990 period, there was a fall in river flow regimes marked by deficits assessed at 365 km^3 (or 32 % of the total flow of these rivers into the Atlantic Ocean). These deficits have led to numerous failures in the functioning of hydroelectric installations, notably in Cameroon. Table 4.4 presents the values of annual mean flow deficits calculated for several watersheds in Central Africa.

The decline in flows has repercussions on the quantity of water filling lakes, which are natural reservoirs. The example of Lake Chad well illustrates this point. During the 1955-1975 period, its surface area dropped from about 24 000 km^2 to about from 2 000 to 6 000 km^2 (Lemoalle *et al.*, 2012). In certain regions of the Congo Basin, an increase in precipitation was recorded beginning in the 1990s. This increase led to an increase in the flow of certain watercourses. This occurred in the Congo River where the flow started increasing in the early 1990s (Conway *et al.*, 2009).

Impact of climate variation on vegetation

The impact of climate change on water regimes has affected vegetation. Prior to the considerable drop in water levels of Lake Chad, vegetation in the north of the Congo Basin was mainly composed of *Phragmites*, *Cyperus papyrus*, *Vossia, Typha, Potamogeton* and *Ceratophyllum.* The drop in the lake's water level led to important vegetation changes and by 1976, the bulk of the vegetation no longer constituted *Vossia* and *Aeschynomene sp.* (Olivry, 1986). Changes in aquatic vegetation were observed in the Logone flood plain in northern Cameroon where flooding had declined in the 1970s following the upstream construction of a dam. Certain plant species characteristic of flood areas, such as *Vetiveria nigritana* and *Echinochloa pyramidalis,* were replaced by other species, notably *Sorghum arundinaceum* (Scholte *et al.,* 2000 ; Scholte, 2007).

Climate change also affects the reproduction and growth of trees, and it can cause their decline. However, the effects of climate change are often indirect, for example by affecting the frequency of fires or modifying the behavior of pests and diseases. During the "El Niño" years of 1983, 1987, and 1997, fires were particularly destructive in southeastern Cameroon. The effects of climate change can accelerate biodiversity loss through the disappearance of species or by reducing the resilience of severely disrupted ecosystems.

Socio-economic impacts

Climate change can have impacts on human populations : their energy and water supply, food security, health, etc. Certain changes can lead to significant social upheaval, ranging from a change in livelihood activities to the displacement of populations to more hospitable regions. For example, fishermen and livestock farmers have become crop farmers, leading to an escalating number of disputes over land and competition for the use of natural resources. High migration towards towns and areas with more favorable living conditions also has been observed (Sighomnou *et al.,* 2000). In addition, farmers in numerous places have adapted to drought by developing off-season crops on low-lying land and flood-recession cropping at the expense of natural biological diversity. In the Adamaoua region, for example, there has been a land rush on flood-recession plains, and competition over land has provoked numerous clashes between crop and livestock farmers (Boutrais, 1989). In northern Cameroon, the influx of agricultural laborers from Chad and Central Africa has led to the systematic cutting of woody plants to grow sorghum ; and in the western highlands, tapping springs for irrigating crops in higher altitude areas is causing shortages of potable water in the dry season on the plateaux.

Table 4.4 : *Deficits of mean values calculated in certain hydrometric stations before and after the abrupt change over the 1950-1989 period.*

Country	Station	Watershed	River	Change Date	Deficit
Cameroon	Eséka	Nyong	Nyong	1971	-18 %
Cameroon	Mbalmayo	Nyong	Nyong	none	Low deficit
Cameroon	Doume	Congo	Doume	none	Low deficit
CAR	Bangui	Congo	Oubangui	1970	-30 %
Congo		Congo	Sangha	1975	-22 %

Source : Servat et al., 1998

4.2 Future Climate Change Impacts

Photo 4.7: Forest fire in the dry forests on the plain, Gabon

As discussed above, we recommend the reader interpret the results presented with particular attention to their regional (entire Congo Basin) and temporal (towards the middle–end of the century) dimensions. Many changes in our environment, often at a local scale, are difficult to link with these projected changes, which will only be tangible for future generations, yet influenced by our present-day responses.

Impact on hydrology and energy

Some studies dealing with the future impacts of potential climate change on the water resources in the region have been compiled. An older study (Kamga *et al.*, 2001) showed a future change in annual river flow from -3 to +18 % for the upper Benoué River located in the sub-humid savannas of northern Cameroon. A regional-level study assessed the impact of climate change on the hydrology of the Oubangui and Sangha sub-basins of the Congo Basin (Tshimanga & Hughes, 2012). A decrease in total runoff of about 10 % is projected for the future, mainly caused by an increase in evapotranspiration, whereas no change is projected for rainfall.

The Climate Change Scenario Study (CSC, 2013) mentioned above showed that the projected changes in rainfall and temperature will result in substantial changes in the hydrology of the Congo Basin. Rising temperatures potentially lead to increased evaporation rates. For the hydrologic assessment within the Climate Change Scenario Study (CSC, 2013), a subset of 6 climate projections was used to analyze the potential impacts of the climate change described in paragraph 3.2. Such a subset of projections automatically has a smaller confidence interval and might sometimes lead to contradicting results compared to the more global results of the actual climate change scenarios. With that in mind, the impact studies showed that the increase in rainfall might exceed the increase in evaporation, and as a result, the run-off is projected to increase up to 50 % in some parts of the Basin. Run-off and stream flow will increase in the wet season especially, suggesting a significant increase in flood risks in the future, especially in the central and western parts of the Congo Basin. The scenarios predict conflicting results for the dry season : some scenarios indicate a drier dry season, while others show higher flows of water during the dry season. However, all of the models indicate that the difference between the wet and dry seasons will become larger compared to present day conditions ; the wet extremes, especially, will become more frequent and more intense, which is also related to the predicted higher frequency of heavy rainfall events.

In general, the analyses show that more water will be available in the future. In this regard, climate change may have a positive impact on potential electricity production. However, the variability of rainfall is also projected to increase, which means that in some years power production will be much lower compared to other years. Countries should therefore ensure they have other sources of electricity to cover the reduced hydropower production during dry periods.

Photo 4.8 : Wagenia fishery in the Congo River rapids – Kisangani, DRC

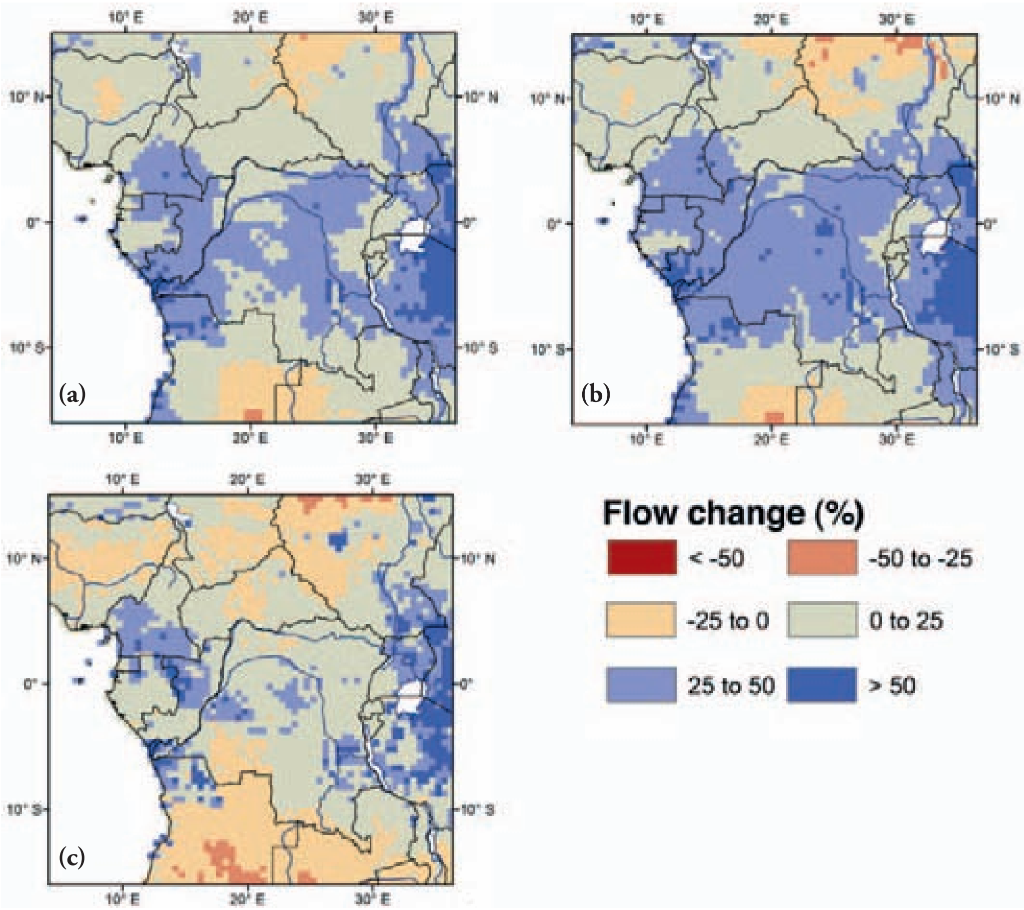

Figure 4.6. Maps show the projected mean of changes in mean flow (a), high flow (Q95) (b) and low flow (Q10) (c) for 2071-2100 relative to 1971-2000 for a high emission scenario. Flows are calculated using the Variable Infiltration Capacity (VIC) model in combination with three different climate models.
Source : CSC, 2013

Impacts on Forests

Climate change is expected to have a range of impacts on forest ecosystems. However, the effects of CO_2 and temperature on tropical forest growth are not yet fully understood. Generally it appears that higher atmospheric CO_2 concentrations might increase forest growth and carbon capture. Higher temperatures, however, might have negative impacts on forest growth and reduce the amount of carbon in the forests (Jupp *et al.*, 2010). The impact analyses show that the Congo Basin is unlikely to see a decline in forest growth as is sometimes predicted for the Amazon Basin as a result of climate change. Instead, there could be a moderate increase in ecosystem carbon, including vegetation and soil carbon (figure 4.7). Depending on how the climate will change, there could also be a shift in the ecosystems' land cover between forest and savanna. Based on the analysis, the most likely future scenario involves a moderate expansion of evergreen forests into savannas and grasslands to the North and the South of the current forest-savanna-transition zone. There is a large uncertainty range in the model assessments, highlighting the importance of collecting new data to further narrow the prediction ranges (e.g., biomass in the central Congo Basin and responses of forests to changing climate and CO_2 concentrations).

Impacts on Agriculture

Currently, it seems that other factors such as field management and nutrient availability are limiting agricultural production much more than climatic conditions. Only on the (drier) edges of the region is water availability limiting agricultural potential. In humid tropical climates, too much rainfall and high humidity limits agricultural production through nutrient leaching, fungal growth, and other factors potentially influenced by increased humidity such as insect pests, bacteria, weeds etc. In most of the Basin, water stress will increase slightly in the future (CSC, 2013). On the other hand, evapotranspiration (the process whereby liquid water is converted to water vapor) is projected to decrease between 2.5 and 7.5 % under the high emission scenario. The low emission scenario shows a general decrease in

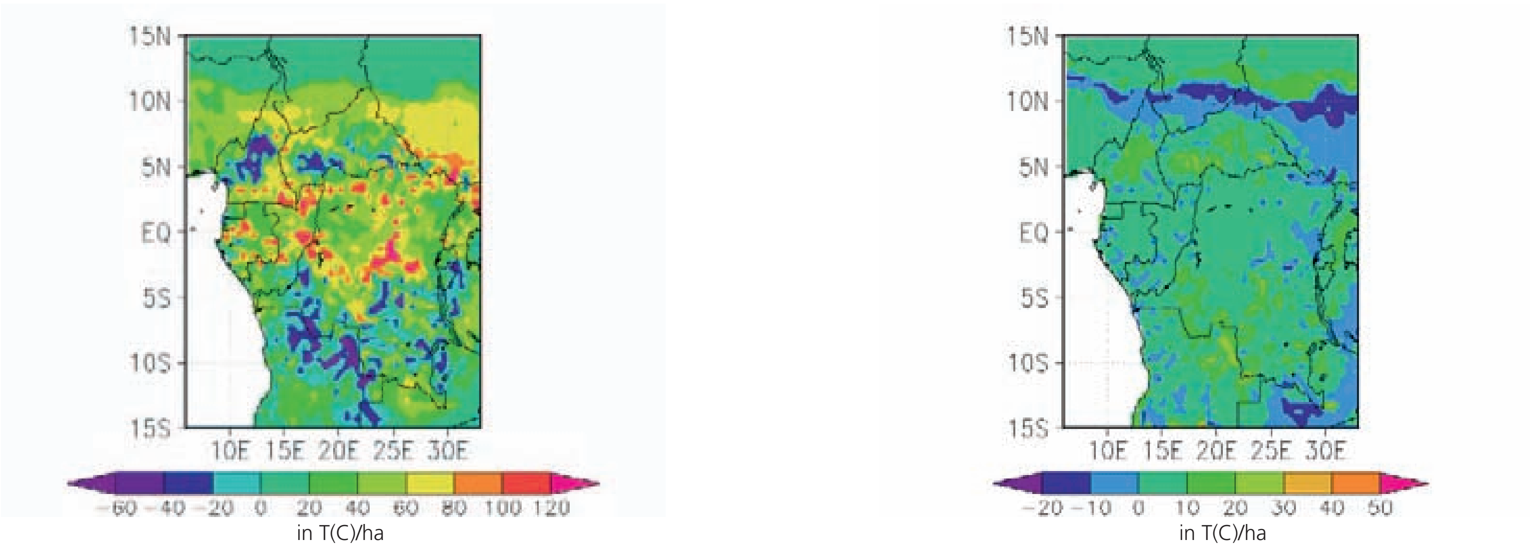

Figure 4.7 : The projection of change towards the end of this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under a high emission scenario. In the left panel, changes in potential vegetation carbon are shown, and in the right panel, changes in potential soil carbon are shown. The sum of these two panels indicates the changes in total ecosystem carbon. Changes in potential vegetation and soil carbon are calculated using the Lund-Potsdam-Jena-managed lands (LPJ-ml) model in combination with a single climate model (ECHAM5).

Source : CSC, 2013

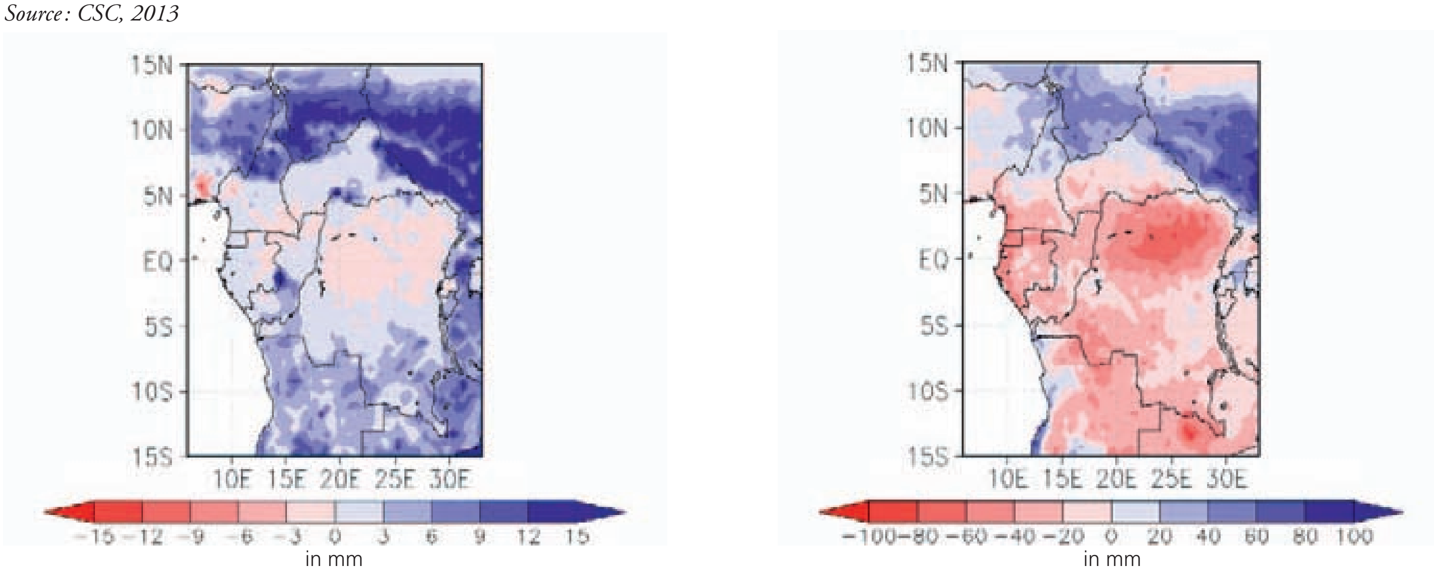

Figure 4.8 : The projection of change towards the end of this century (mean of the period 2071-2100 compared to the mean of the period 1961-1990) under a high emission scenario. The left panel shows changes in greenwater consumption (the total water amount evapotranspired by crops) and the right panel shows changes in evapotranspiration. Greenwater consumption and evapotranspiration are calculated using the LPJ-ml model in combination with a single climate model (ECHAM5).

Source : CSC, 2013

evapotranspiration as well, but toward the end of the century the trend becomes slightly positive. Only in the northern zone of the greater Congo Basin, belonging partly to the Sahel zone, is evapotranspiration projected to increase slightly. Therefore, the impact of future climate change on agricultural production will most likely be limited in the region, and agriculture will probably not suffer from structural water shortages. Only agriculture in the savanna regions surrounding the Congo Basin might potentially face water shortages in the future. In the southern savanna region, analyses indicate that more frequent droughts will affect agriculture production through water stress.

Impacts on Economic Growth

In several of the COMIFAC countries there is a clear correlation between annual rainfall and gross domestic product (GDP) growth. GDP and agricultural GDP growth rates tend to be higher in years with above-average rainfall than in the dry years (CSC, 2013). The impact of climate variability on GDP growth is most pronounced during dry years; during below-average-rainfall years growth is sometimes severely reduced. All above-average-rainfall years tend to exhibit relatively similar economic growth rates. The correlation between rainfall and GDP growth rates is stronger in countries with lower and more variable rainfall. In most countries, agricultural GDP growth rates are more affected by climate variability than the total GDP growth rates. For example, in the Democratic Republic of Congo during dry years, agricultural GDP growth was negative, while during average and above-average-rainfall years the economic output of the agricultural sector increased. In Chad, the situation is even more dramatic with large reductions in agricultural productivity during dry years and rapid growth during the years with near-average rainfall.

Photo 4.9: Central African urban populations are constantly growing – Bukavu, DRC

In terms of future climate change impacts on economic development, our analysis shows that COMIFAC countries are especially vulnerable to a reduction in rainfall and a significant increase in inter-annual rainfall variability. Some climate change scenarios show large increases in climate variability, which could have a negative impact on development.

In conclusion, Central Africa will face a more variable climate and a more variable hydrological regime. Also, the differences between seasons and between different years are likely to become greater. The region will experience more intense rainfall and probably more floods during the wet season. The dry season could become either wetter or drier. It is also clear that near-surface temperatures will increase in the future. Climate change adaptation should therefore focus on reducing the impacts of increased rainfall variability and higher temperatures.

5. Possible Adaptation Responses

According to the UNFCCC, adaptation responses are necessary and should be part of national transformation processes aimed at the vulnerabilities facing local stakeholders. To be effective, climate change adaptation should include a well-balanced mixture of approaches at local, national, and regional levels.

5.1 Local Level

Locally, forest communities suffer the effects of climate change (Bele *et al.*, 2010). In the absence of well-planned policy and institutional frameworks, communities appear unprepared to cope with climate change as shown by the vulnerability studies undertaken under CoFCCA (Congo Basin Forests and Climate Change Adaptation) (Bele *et al.*, 2011). By using Participatory Action Research (PAR), the CoFCCA project initiated pilot adaptation responses in the DRC, the CAR, and Cameroon. These initiatives involved the introduction or use of climate stress-resistant varieties (manioc, plantain), planting trees, adding value to non-timber forest products (NTFPs), and the development of apiculture to diversify peoples' income sources (see Bele *et al.*, 2013 for the pilot projects in Cameroon). Under the COBAM project, pilot projects also will be set up that take into account the synergy between adaptation and mitigation actions.

Since adaptation to climate change is highly local, institutions, particularly in rural areas, have an important role to play in fostering adaptation and resilience to climate change. Local institutions also play a role in mediating external interventions in a community (Agrawal, 2008, 2010). Research conducted as part of the CoFCCA project explored the types of institutions present within forest-dependent communities in three provinces of Cameroon (Brown, 2011). Results showed that diverse institutions, both formal and informal, exist within villages, including informal savings and loan groups, forest or agriculture groups, and forest or agriculture product marketing groups. While groups sometimes were gender specific, most often, this was not the case. Villagers are often members of several groups, and this may present opportunities for social learning. Social learning occurs when people engage with one another, sharing perspectives and experiences in order to address changing circumstances (Brown, 2011). This can be an opportunity for building resilience to climate change.

Photo 4.10: Oubangui, major tributary of the Congo River, at the beginning of the dry season, CAR

5.2 National level

The work of CoFCCA also illustrates national institutional responses to climate change (Brown *et al.*, 2010). The adaptive capacity or capability to adjust to and limit risk in the face of climate change is low for Cameroon, the CAR, and the DRC. This is because they lack key determinants of adaptive capacity such as economic wealth, technology, information, skills, and infrastructure. Vulnerability is exacerbated, particularly in the CAR and the DRC as a result of recent civil conflict and on-going insecurity in some parts of both countries (Brown, 2010 ; Brown *et al.*, 2010 ; Brown *et al.*, 2013). An analysis of policies and institutions in the CAR, Congo, and Equatorial Guinea indicates an absence of coordination between national agencies (Nguema & Pavageau, 2012 ; Gapia & Bele, 2012 ; Pongui & Kenfack, 2012), and weak intra-sectoral and multi-level coherence and complementarity in the planning and implementation of adaptation responses. Effective coordination is nonetheless crucial. An awareness of the threats posed by climate change exists in the respective countries, but this is not necessarily translated into the creation of institutions capable of coping with them. Several countries, such as the CAR and the DRC have developed national adaptation programs of action (NAPAs). The DRC received NAPA funding related to food security. Cameroon is developing a national adaptation plan (NAP). An analysis of these NAPAs and of other documents indicates that forest resources have not, or have only scarcely been considered in climate change adaptation planning (Bele *et al.*, 2011). While NAPA documents state the need for a gender-sensitive approach to climate change adaptation, there has not been broad participation in the development of the documents, with only vague strategies to address gender concerns (Brown, 2011).

Most of the COMIFAC member countries, which are characterized by generally low incomes and high poverty rates, face large development challenges. These immediate development needs may currently be more important priorities than climate change adaptation. However, planning for future development also creates opportunities for adaptation. To avoid making poor investment decisions and to reduce the future cost of adaptation, climate change adaptation strategies should be integrated into current development plans.

5.3 Regional level

In time COMIFAC, which is a federating platform for climate change response, should integrate scientific and operational initiatives for adapting to the effects of climate change. However, the region is not sufficiently mobilized to obtain funds for adaptation. Discussions and actions to reduce vulnerability in Central Africa have mainly focused on the issue of the fall in the water levels of Lake Chad and the rivers supplying it.

"Climate change" initiatives have come mainly from the research sector working with a few policy makers (Sonwa *et al.*, 2012). The positions taken by COMIFAC ministers regarding adaptation are much more mixed than those taken on REDD+. The same is true for CBFP international partners, conservation, and civil society stakeholders, which have not yet supported a regional level response to the problem of populations/communities and forest resources vulnerability to climate change. The Economic Community of Central African States (ECCAS) and COMIFAC have established a group of climate experts, a counterpart to IPCC at the Central African level, which has undertaken and is publishing a review of knowledge on the Central African climate.

At the conclusion of the climate change scenarios study, proposals were made for COMIFAC to deepen discussions and actions. There is a need to improve preparedness for extreme weather events, such as droughts and floods, because such events are likely to occur more often in future. In addition, the agricultural and energy

Photo 4.11 : Anything goes when setting yourself up in the forest – Bas-Congo, DRC

sector should spread risk through the diversification of activities. Farmers should grow different crops and also different varieties of the same crops to reduce the impact of climate variability. Countries should be careful not to become fully dependent on hydropower, because it makes them especially vulnerable to increased climate variability including droughts. Other sustainable energy sources, such as solar and biofuels could also be promoted. To prevent forest degeneration and erosion, there should be more attention on reforestation and agroforestry. Food and water security programs should develop strategies to manage climate variability so they are prepared for both dry and wet periods. The knowledge of climate change impacts and adaptation is still very limited in the region, and there is a need to build more capacity and raise awareness of the issues.

Besides COMIFAC, there are other regional organizations, widening the possibilities of regional adaptation options significantly. The economic drawbacks of not considering adaptation in national development strategies are obvious and clearly involve the ECCAS. In the hydrology sector, there are specialized regional organizations, like CICOS (International Commission for the Congo-Oubangui-Sangha Basin) and LCBC (Lake Chad Basin Commission), which work on watershed management and thus can take action related to the anticipated impacts on hydropower and flooding.

Neighboring countries to the north and south, which are expected to be severely affected by climate change, may also produce important indirect impacts on the Congo Basin countries. The increase in variability in agricultural production might lead to an increase in migration from these countries into the Congo Basin. Adaptation options that address such impacts should be considered.

Photo 4.12: Sea erosion along the Gabon coastline

6. **Synergies with other Initiatives**

The forest resources and rural communities targeted by climate change adaptation initiatives are already the focus of several biodiversity conservation and climate change mitigation projects and programs. The climate influences several sectors of national and rural economies and responses must be integrated and multi-institutional. The response to vulnerabilities cannot be made without considering existing initiatives. Synergy, particularly when it is well planned in advance, can help save time and resources.

6.1. Link between adaptation and REDD+ initiatives

Synergies with REDD+ and adaptation efforts in the forest sector could support an integrated response to climate change. Complementarities between REDD+ and adaptation are possible (Guariguata *et al.*, 2008 ; Locatelli *et al.*, 2010) because REDD+ activities can readily integrate adaptation actions into mitigation strategies making REDD+ activities more sustainable. Certain REDD+ activities could help rural communities cope with climate change, acting to serve both mitigation and adaption objectives simultaneously. For example, the restoration of mangroves captures CO_2 as the trees mature. Mature mangrove trees, in turn, will reduce the intensity of waves, which increases with climate change. On land, tree planting stores carbon but can also serve adaptation goals if these trees are resistant to climate change, act as windbreaks, and allow households to diversify their sources of income. Funding from REDD+ could also support poverty reduction which in turn would help people become more resilient to climate change (Somorin *et al.*, 2012**)**. However, for an activity to further both mitigation and adaptation goals, these synergies must be integrated from the outset in both planning and execution. The opportunities and potentials offered by this synergy is what the COBAM project seeks by exploring regional, national, and local policies and strategies needed to cope with the effect of climate change in the Congo Basin. The project is initiating pilot adaptation and mitigation- synergy activities in 5 of 12 biodiversity conservation landscapes of Central Africa. Preliminary national level studies in Equatorial Guinea, the CAR, and the Congo (Nguema & Pavageau, 2012 ; Gapia & Bele, 2012 ; Pongui & Kenfack, 2012) indicate that current policies do not encourage this synergy.

6.2. A need for coordination between regional structures

COMIFAC and the International Commission of the Congo-Oubangui-Sangha Basin (CICOS) group the regional states around forests and hydrology. However, these two initiatives have not yet focused on joint actions needed to respond to climate change. The link between forestry and hydrology at the watershed level is well established. A reduction in rainfall could lead to a reduction in hydroelectric energy supply. The cutting of wood could fill these energy deficits but soil erosion and silted reservoirs from forest clearing will act to reduce energy supply. The solution is to be found in institutional coordination at the watershed level. This must also be considered at the sub-regional level with effective coordination between COMIFAC and CICOS. The latter, which addresses one of the most sensitive sectors to the effects of climate change has not yet received the same degree of attention as COMIFAC. Also, the necessary partnerships between local communities and forest management is lacking in Central Africa (Sonwa *et al.*, 2012).

Synergy with the hydraulic sector would allow CICOS and COMIFAC to coordinate initiatives and eventually develop payments for environmental services (PES) mechanisms for electricity and water in adapting to climate change that henceforth could involve the private sector. Integrating climate change adaptation measures into other initiatives (like the example of the water and electricity sector given here) will make the region's natural resources more resilient to climate change.

Integrating climate change adaptation into biodiversity conservation, REDD+ and water management would also make these initiatives more resilient. Ecosystem-based adaptation (EBA) would further enable forest resources management techniques to support climate change adaptation in development sectors. However, this requires well-planned sub-regional structural coordination. Sustainable development that takes climate into account depends greatly on this coordination.

Photo 4.13: Typical straw hut – Monassao, CAR

7. Conclusions

Climate change mitigation measures have received considerable attention, especially with the development of REDD+, the subject of chapter 5 in this volume. Adaptation responses to future climate change at local, national, and regional levels are, with only few exceptions, still in their infancy. However, they are receiving increased attention and the results of the scenarios presented in this chapter provide important background information for initiatives presently under way.

The network of climate observation in Central Africa has been decreasing.

An increase in temperature (up to 1°C) and a reduction in average annual rainfall (e.g. 31 mm/decade) have been observed in the Congo Basin since the 1950s, albeit with considerable regional variation. Based on an extensive regional study, projections suggest the development of a more variable climate with substantial changes in the hydrology of the Congo Basin towards the middle to the end of the 21st century. Temperatures will increase by at least 2°C, and the difference between the wet and dry seasons will become larger compared to the current climate. The wet extremes, especially, will become more frequent and more intense. Run-off and stream flow will likely increase in the wet season, suggesting a significant future increase in flood risks, especially in the central and western parts of the Congo Basin. This will have major consequences for the use of hydropower, where infrastructure will have to take these changes into account.

Without taking into account changes in land use, a moderate expansion of evergreen forests into savannas to the North and South can be expected due to climate change, although considerable uncertainty with these predictions exists due to limited references to field conditions. The impact of climate change on agricultural production, as studied on a regional scale, will likely be limited to the northern and southern fringes of the Congo Basin. The semi-arid northern and southern flanks of the Basin are predicted to become much drier, with dramatic consequences for their human populations. Furthermore, the Congo Basin is not isolated, and people from neighboring areas will increasingly be induced to migrate into the Basin's relatively high-potential agricultural areas. Adaption for this, and other unexpected consequences of climate change, will require considerable attention.

Particular attention should be devoted to avoiding the fragmentation of institutions, as adaptation responses overarch the classical sectors of forest, agriculture, hydrology, infrastructure, etc. and require far more integration.

Photo 4.14: Fishing camp on the Lukenie River – Bandundu Province, DRC

CHAPTER 5

REDD+ : Progress and challenges

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[1]FAO, [2]COMIFAC, [3]World Bank, [4]UNDP, [5]UNEP-WCMC, [6]CIRAD, [7]EFI

1. Current status of climate negotiations

Member states of the Central African Forests Commission (COMIFAC) have been actively engaged in negotiations on the United Nations Framework Convention on Climate Change (UNFCCC) and on Reducing Emissions from Deforestation and Forest Degradation (REDD+) since 2005.

At the 11th Conference of the Parties (COP) in Montreal in 2005, Costa Rica and Papua New Guinea introduced a proposal to reduce greenhouse gas emissions originating from deforestation in developing countries.[11] This proposal was supported by numerous tropical forest countries, including those of the Congo Basin. In their view, the proposal would allow the climate change mitigation potential of forests to be developed and contribute to the UNFCCC objectives. Since then, the COMIFAC countries have spoken with a single voice at the UNFCCC discussions on REDD+.

Thus far, these negotiations have focused mainly on technical challenges (scale, measurement, reporting and verification (MRV) modalities, and reference levels) and REDD+ financing. The COMIFAC countries have adopted a common position on these issues. They have presented seven submissions to the UNFCCC (see table 5.1) and made ministerial level policy declarations. Their joint position notably contributed to broadening the scope of REDD+ by including reducing degradation and the conservation and sustainable management of forests.

In addition, numerous countries in the subregion have regularly supported and contributed to various submissions made by the Coalition for Rainforest Nations.[12]

11 See FCCC/CP/2005/MISC.1
12 See for example : FCCC/AWGLCA/2012/MISC.3 ; FCCC/SBSTA/2012/MISC.1/Add.1 ; FCCC/SBSTA/2011/MISC.7

Table 5.1: *COMIFAC country submissions to the UNFCCC*

Date of publication	REDD+ issues targeted	Participating countries	UNFCCC reference number
11 April 2006	· REDD+ scientific issues · Key principles · Policy and funding approaches · Methodological issues · Roadmap	Submission of Gabon, in the name of Cameroon, the Central African Republic, Chad, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Gabon.	FCCC/SBSTA/2006/MISC.5
2 March 2007	· Principles · Policy approaches, including scale of application · Funding: market and stabilization fund approaches · Levels of reference and adjustment factors	Submission of Gabon, in the name of Cameroon, the Central African Republic, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Gabon.	FCCC/SBSTA/2007/MISC.2
10 September 2007	· Consideration of degradation · National and subnational approaches · Reference scenarios · Market and stabilization fund approaches · Roadmap	Submission of the Democratic Republic of Congo, in the name of Cameroon, the Central African Republic, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Gabon.	FCCC/SBSTA/2007/MISC.14
22 April 2008	· Methodological issues related to the sustainable management of forests, degradation, and reference levels · Subnational approaches and leakages · Funding mechanisms, including markets and other options	Submission of Gabon, in the name of Cameroon, the Republic of Congo, Gabon, Equatorial Guinea, the Central African Republic and the Democratic Republic of Congo	FCCC/SBSTA/2008/MISC.4
10 March 2009	· Capacity building · REDD+ preparation fund · Inclusion of local communities to define methodological guidelines	Submission of the Democratic Republic of Congo, in the name of Cameroon, the Central African Republic, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Gabon.	FCCC/SBSTA/2009/MISC.2
21 May 2012	· Funding: public sources and REDD+ financing governance · Appropriate discussion forum for REDD+ financing · Consideration of multiple benefits of REDD+	Submission of the Democratic Republic of Congo, in the name of Burundi, Cameroon, the Central African Republic, the Republic of Congo, the Democratic Republic of Congo, Rwanda, Equatorial Guinea, Gabon, and São Tomé and Príncipe .	FCCC/AWGLCA/2012/MISC.3/Add.2
24 March 2013	· Governance and coordination of REDD+ funding · Non-market mechanisms and creation of new market mechanisms for REDD+ · Relations between REDD+ MRV modalities and those of NAMA	Submission of Chad, in the name of Burundi, Cameroon, the Central African Republic, the Democratic Republic of Congo, Equatorial Guinea, Gabon, the Republic of Congo, Rwanda, São Tomé and Príncipe , and Chad	Pending consideration during the 38th meeting of the SBSTA[13]

13 Available at: http://unfccc.int/files/documentation/submissions_from_parties/application/pdf/20130324_chad_subm_lulucf_sbsta38.pdf

Photo 5.1 : Forest north of Franceville, Gabon

1.1 On technical issues

In the UNFCCC negotiations, countries of the sub-region wanted all REDD+ activities to be treated equally, emphasizing the importance of rewarding virtuous behavior which reduces forest degradation and leads to forest conservation. This COMIFAC[14] position is quite rational given that the sub-region is more affected by forest degradation than deforestation, and that efforts to preserve the forest cover have been made despite limited financial resources.

1.1.1 Safeguard information systems

During the 36th meeting (Bonn, 2012) of the Subsidiary Body on Scientific and Technological Advice (SBSTA), countries of the sub-region maintained that safeguard information systems (see Section 2.2 for a definition of safeguards) must be based on principles of transparency, rigor, consistency, and comparability, and take into account country circumstances. In their view, these systems must be able to evolve, be consistent with the progress of national REDD+ strategies, and be based on existing communication channels such as official national communications and biennial reports.

1.1.2 Reference emission levels and reference levels

When drawing up forest reference levels (RL) and/or forest reference emission levels (REL) (see Section 2.3 for definitions of RL and REL), the COMIFAC countries deem it necessary[15] to take into account, using an adjustment factor, previous good forest ecosystem management practices and the specific situation of each country, including socio-economic development policies. The countries of the sub-region repeatedly noted that participating REDD+ countries must be able to develop their RELs/RLs in a gradual manner and according to national circumstances.

1.1.3 Measurement, reporting, and verification modalities

The countries of the sub-region did not discuss MRV (measurement, reporting, and verification) modalities at length at the UNFCCC. However, at the 36th session of SBSTA (2012), the COMIFAC countries maintained that REDD+ MRV modalities should be based on IPCC principles, namely completeness, consistency, transparency, comparability, and accuracy, and that they be coherent with and conform to the guidelines and modalities for REL and RL development. These modalities must be flexible and able to evolve to take into account national capacities and circumstances, and must be compatible with the reporting and verification guidelines for Nationally Appropriate Mitigation Actions (NAMA).

14 See FCCC/SBSTA/2007/MISC.14 and FCCC/SBST A/2008/MISC.4
15 See FCCC/SBSTA/2007/MISC.2, FCCC/SBSTA/2007/MISC.14 and FCCC/SBST A/2008/MISC.4

1.2. On REDD+ financing

For the COMIFAC, REDD+ financing should be both public and private (including market-based financing mechanisms). Different mechanisms and funds were suggested to finance REDD+ : the creation of a dedicated carbon market, setting up a stabilization fund, and the introduction of a tax on goods and services with a high carbon footprint.[16]

For the COMIFAC[17] countries, the choice of funding sources remains a sovereign exercise. Each country has the right to decide which funding sources are appropriate. The countries consider it essential that increased, new, additional, predictable, and sufficient financing be made available rapidly. They point out that the financial commitments made by developed countries must draw mainly from public sources supplemented by non-substitutable private sources.

The COMIFAC countries note the unique character of REDD+, which generates benefits from climate change mitigation and adaptation, and the numerous socio-economic and ecosystem co-benefits.

The COMIFAC countries are concerned about the future financing structure of REDD+ which, in phase three (full implementation), might only compensate reductions in greenhouse gas emissions and not forest conservation and sustainable management. Underlying this concern is the fact that many countries in the sub-region have low historic deforestation rates and their forest conservation and sustainable management behavior has been virtuous. In certain cases, this may be more a result of economic circumstances than national policy. Countries of the sub-region also supported the call for the creation of financing specifically dedicated to REDD+ within the Green Climate Fund to monetize the adaptation benefits generated by REDD+ activities.

1.3. The Warsaw Decisions : repercussions for COMIFAC countries

The Warsaw COP-19 (2013) allowed Parties to move forward on several contentious issues and to conclude certain discussions that had been left open in Doha (2012). In total, seven REDD+ related decisions were adopted. Notably, issues related to REDD+ financing, the governance and coordination of support, MRV modalities and forest monitoring systems, safeguard information systems, as well as those related to deforestation and degradation drivers were debated.

The Parties in particular redoubled their efforts to find a middle ground on the question of financing, notably using the report presented in Warsaw by a working group created in Doha. The objective was to increase REDD+ funding and improve effectiveness. On this issue, the Congo Basin countries repeatedly affirmed that efforts should not be limited to simply reducing forest-related emissions, but that they must also promote forest conservation and sustainable management. They noted that private REDD+ funding must not be a roundabout way to subsidize technology transfers from companies based in developed countries, but must generate concrete economic and social benefits for the host country.

In Warsaw, the Parties adopted a decision[18] in line with positions held by Congo Basin countries over the years. In particular, the Parties agreed that REDD+ funding be allocated in an equitable and balanced manner, taking into account a diversity of approaches, notably "alternative" ones. The decision also calls for the Standing Committee on Finance, under the framework of its work on coordination and coherence, to work on funding forests in the broad sense, not only within the framework of REDD+, but also within the framework of alternative approaches. Furthermore, the Parties agreed to link the receipt of "performance payments" to performance measurement, reporting, and verification directives during the REDD+ full implementation phase,

16 See FCCC/SBSTA/2007/MISC.2, FCCC/SBST A/2008/MISC.4 and FCCC/AWGLCA/2012/MISC.3/Add.2
17 See FCCC/AWGLCA/2012/MISC.3/Add.2
18 See the advance version of the Decision "Work programme on results-based finance to progress the full implementation of the activities referred to in decision 1/CP.16, paragraph 70". Available: http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_redd_finance.pdf

and to publish this information on the UNFCCC REDD+ website. Finally, the Parties reiterated the importance of providing incentives for non-carbon related benefits in order to ensure the sustainability of REDD+ activities.

Following a request made in Doha, the Parties meeting under the auspices of the Subsidiary Body for Implementation (SBI) and the SBSTA, considered different options to improve REDD+ coordination and governance, notably through the creation of an agency, a council or a committee. The COMIFAC countries supported the establishment of a REDD+ Council. In Warsaw, the Parties decided, however, to create instead a voluntary discussion platform to improve the coordination of support which will meet once a year during the first annual meeting of subsidiary bodies and which will be supported by the Secretariat.[19] To participate in this discussion, the Parties were invited to nominate a focal point at the UNFCCC who would be in charge of coordinating support. The Parties also were invited to identify national entities eligible to receive results-based funding. The first meeting of this discussion group will be held during the COP-20 in Lima (2014).

While good progress was made in Doha on REDD+ MRV modalities, the Parties did not succeed in coming to an agreement on verification, notably on the differences between the verification modalities for REDD+ and NAMA activities. In this regard, COMIFAC countries regularly upheld that NAMA methodological approaches should be defined separately from those of REDD+. During the COP-19 in Warsaw, Parties agreed on the verification procedure for REDD+ activities by specifying that the Parties seeking funding for REDD+ results must submit a technical annex with their biennial updated reports. The results presented in the annex in the form of tons of CO_2 equivalent will be analyzed by a team of technical experts appointed by the UNFCCC according to International Consultation and Analysis (ICA) modalities. This decision, which confirms that verification of REDD+ activities will be performed in a non-intrusive and non-punitive manner, is consistent with the position historically defended by Congo Basin countries.

Photo 5.2: REDD National Coordination communication campaign, DRC

Lastly, the Warsaw COP allowed the Parties to advance on other key issues, notably REL and RL submission modalities, national forest monitoring systems, drivers of deforestation and degradation, and submission modalities for summaries of information on safeguards. Details of these decisions, and their potential impacts, are presented in their respective sections below.

On the whole, the Warsaw COP clarified numerous issues which will enable COMIFAC countries to make progress implementing REDD+ and to benefit from its potential. During 2014, countries of the sub-region must nonetheless remain vigilant to ensure that their remaining concerns are considered at the COP-20, notably those concerning benefits unrelated to carbon and alternative, non-market funding approaches.

19 See the advanced version of the Decision "Coordination of support for the implementation of activities in relation to mitigation actions in the forest sector by developing countries, including institutional arrangements". Available: http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_mitigationactions_forest.pdf

2. REDD+ technical challenges

This section reviews four aspects of REDD+ : (i) a phased approach to REDD+ ; (ii) REDD+ safeguards ; (iii) reference levels ; and, (iv) MRV.

The gradual and cumulative nature of the international climate change negotiation process has resulted in a series of decisions relating to REDD+ activities that are a combination of principles, rules and modalities, including methodological guidance (e.g. Decisions 1/CP.13, 2/CP.13, 4/CP.15, 1/CP.16). The result of this process is a series of provisions including both institutional and technical recommendations and requirements. This section presents some of the background on the current recommendations and requirements for REDD+, especially key strategic components such as safeguards, reference levels and MRV. These requirements are discussed further in the Congo Basin context as experiences from the field, highlighted in section 4 below.

2.1 REDD+ in three phases

Given the technical and procedural complexity involved in implementing REDD+ activities, the Parties agreed that this process should be undertaken in three phases, as set out in Decision 1/CP.16, paragraph 73 :

Decides that the activities undertaken by Parties […] should be implemented in phases, beginning with the development of national strategies or action plans, policies and measures, and capacity-building, followed by the implementation of national policies and measures and national strategies or action plans that could involve further capacity-building, technology development and transfer and results-based demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified.

The importance of national circumstances for the implementation of REDD+ activities, in the context of the phased approach, is also recognized in Decision 1/CP.16, paragraph 74 :

Recognizes that the implementation of the [REDD+] activities… including the choice of a starting phase as referred to in paragraph 73 above, depends on the specific national circumstances, capacities and capabilities of each developing country Party and the level of support received.

2.1.1 Phase 1

Phase 1 includes all of the efforts required to define a national REDD+ strategy, including the policies and measures (PAMs)[20] and REDD+ activities that a country wishes to implement, and the consequent capacity building needs. This phase also includes the testing and selection of methodologies for reliable, robust and transparent national Monitoring (M) & MRV functions. Phase 1 is often referred to as "REDD+ Readiness". An important part of this phase is national capacity building, which is designed to give the Parties the knowledge and technical abilities necessary to enter Phase 2. This includes practical training on the pillars of the National Forest Monitoring System (NFMS) and development of the necessary systems and infrastructure to implement them.

2.1.2 Phase 2

Phase 2 entails implementing demonstration activities to test and refine the methodologies, action plans and PAMs defined during Phase 1. Demonstration activities should focus on establishing whether the PAMs can produce positive and measurable results in terms of greenhouse gas (GHG) emissions. They can focus on monitoring and reporting at the sub-national level as an interim measure, as specified in Decision 1/CP.16, paragraph 71(c). Phase 2 can also be considered a part of REDD+ Readiness, as it is still

20 Policies and Measures are often used to describe, in general terms, the variety of public policies, incentives, financial and fiscal instruments, regulations, laws, etc., used by a country to curb deforestation and degradation and/or incentivize REDD+ activities that may enhance carbon stocks. There is a wide variety of potential Policies and Measures relevant for REDD+, which may include, for example, increased forest enforcement, forest policies geared to improve land use planning, land tenure reforms, sustainable forest management guidance, fiscal incentives for the forestry sector, etc. Many other examples could form part of a country's Policy and Measures package.

part of a country's efforts to prepare for the full implementation of REDD+ activities.

Awareness raising, capacity building and technology transfer may continue throughout Phase 2, particularly for technical elements that do not need to be fully operational until Phase 3, such as the national forest inventory and satellite remote sensing system. However, it is desirable that the monitoring function of the NFMS be operational in Phase 2 in order to evaluate the outcomes of demonstration activities and to provide information on land use and land use changes to assess whether they are "results-based" (i.e. resulting in net positive outcomes), as required by Decision 1/CP.16, Appendix 1, paragraph 1(j). The forest monitoring system will generate feedback on the performance of the demonstration activities, allowing methodologies to be refined where necessary to improve performance.

Photo 5.3: Students departing fuel wood training field trip at the University of Kisangani

Photo 5.4: Farm clearing along the Ogooué River, Gabon

2.1.3 Phase 3

During Phase 3, "national implementation", the monitoring function should ultimately be extended to cover the entire national territory so that the country can assess the impacts of PAMs at the national level and to address the issue of displacement of emissions (leakage). Monitoring, in the context of REDD+, will allow countries to assess the performance of its PAMs and whether they are effective for reducing emissions and enhancing sequestration in the forestry sector. Monitoring for REDD+ could also support countries in the distribution of results-based payments, allowing them to assess where particular PAMs have resulted in net positive outcomes. The monitoring function could also provide additional geospatial data and information to help the countries improve their national communications and biennial update reports to the UNFCCC.

In Phase 3, the MRV function of the NFMS will be fully operational, resulting in national estimates of GHG emissions and removals from the forest sector, in line with Intergovernmental Panel on Climate Change (IPCC) and COP guidance (Decision 4/CP.15). This MRV function will allow countries to measure the aggregate mitigation performance of REDD+ activities at a national scale (in terms of tCO_2e/year), using a combination of remote sensing and ground-based forest carbon inventory data (Decision 4/CP.15, paragraph 1(d)). This performance will be reported to the UNFCCC Secretariat as part of the Parties' biennial update reports. Subsequently, reporting of GHG mitigation performance will be analyzed by an expert team of the UNFCCC for a technical assessment that follows the ICA modalities, allowing for an appraisal of the data, methods and assumptions used by countries that wish to claim results-based payments.

2.2 REDD+ Safeguards

Social and environmental safeguards for REDD+ implementation are key and not only needed to ensure "no harm" is caused to people and to the environment by REDD+ activities, but also to maximize the potential social and environmental co-benefits from REDD+. There are potential risks associated with REDD+ implementation, such as: potential conflicts over land and forest rights; inequitable benefit sharing of REDD+ revenues; violation of the traditional rights of indigenous peoples and of other forest-dependent communities on forest lands; and, potential negative impacts on natural habitats from fast-growing tree species. In the Congo Basin, where conflicts over use, access and benefit sharing by forest dependent-communities and other forest users are frequent (including within logging concessions and conservation areas), the application of these safeguards is particularly important.

The Cancun Agreements, resulting from the 2010 UNFCCC Conference of Parties (COP16), set out seven safeguards that should be promoted and supported during REDD+ implementation (box 5.1). The Durban Agreement (2011) elaborated on those requirements, requesting that countries engaged in REDD+ provide a summary of information on how safeguards are being addressed and respected throughout the implementation of the REDD+ activities. Finally, COP 19 in Warsaw confirmed that participating REDD+ countries are required to submit a summary of information on safeguards periodically in their national communications, following the initiation of REDD+ activities. On a voluntary basis, Parties may also submit the summary of information to the UNFCCC REDD+ information hub[21]. Finally, the recent Warsaw decision on REDD+ finance[22] links the reception of results-based payments to the prior submission of the most recent summary of information on how safeguards are being addressed and respected.

Box 5.1 : Safeguards in the Cancun Agreement (2010)

- Consistency with the objectives of national forest programs and relevant international conventions and agreements;
- Transparent and effective national forest governance structures;
- Respect for the knowledge and rights of indigenous peoples and members of local communities;
- Full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities;
- Conservation of natural forests and biological diversity and enhancement of other social and environmental benefits;
- Actions to address the risks of reversals; and,
- Actions to reduce the displacement of emissions.

Developing robust national systems to address safeguards is important for countries implementing REDD+ programs, not only because it allows them to comply with emerging guidance agreed to within the UNFCCC, but also because it increases the potential value of REDD+ investments, since safeguards can reduce the risk of social and environmental harm for both donors and private investors. Safeguards can also maximize the likelihood that social and environmental benefits will be achieved, which in turn enhances the sustainability of REDD+ achievements. Some of the Congo Basin countries, particularly those involved in the REDD+ Readiness process, have been actively seeking support to develop their national-level safeguards systems and to incorporate these into their systems for measurement, reporting and verification of results.

As discussed by Peskett and Todd (2012), a safeguards system at the national level can be composed of two main elements: (i) policies, laws and regulations (PLRs) that clarify the objectives and requirements necessary to address the specific risks and benefits of REDD+ in the country; and, (ii) a safeguard information system that collects and provides information on how safeguards are being addressed and respected.

21 See the advance version of the Decision "The timing and the frequency of presentations of the summary of information on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected". Available: http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_safeguards_1cp16a1.pdf

22 See the advance version of the Decision "Work programme on results-based finance to progress the full implementation of the activities referred to in decision 1/CP.16, paragraph 70". Available: http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_redd_finance.pdf

2.2.1 Instruments for safeguards design and implementation

In the Congo Basin, two international programs supporting REDD+ – the Forest Carbon Partnership Facility[23] (FCPF) and the UN-REDD Program[24] – have proposed a series of approaches and tools to build and implement REDD+ safeguards. These two programs are supporting capacity building at the national level towards REDD+ Readiness to ensure the Congo Basin countries meet the minimum requirements to access the results-based, positive incentives for REDD+ in the future. As illustrated in Box 5.2, building national systems that allow the country to comply with safeguards for the implementation of REDD+ is a key aspect of the REDD+ Readiness process.

Two of the main tools providing guidance for developing safeguards in the region are the FCPF's Strategic Environmental and Social Assessment (SESA) and UN-REDD's Social and Environment Principles and Criteria.

Box 5.2 : Defining REDD+ Readiness and Safeguards: The FCPF R-Package

The FCPF has developed a series of criteria to guide a country's assessment of its REDD+ Readiness level. Countries receiving funds from the FCPF are expected to report on progress towards Readiness through an "R-Package" that includes the following assessment criteria:

Social and Environmental Impacts:
a. SESA (Strategic Environmental and Social Assessment) coordination and integration arrangements;
b. Analysis of safeguard issues;
c. REDD+ strategy design with respect to impacts;
d. Development of the Environmental and Social Management Framework.

Information System for Multiple Benefits, Other Impacts, Governance, and Safeguards
a. Identification of non-carbon aspects;
b. Monitoring and reporting capabilities;
c. Information sharing.

The Strategic Environmental and Social Assessment approach to REDD+

The activities financed by the FCPF (Forest Carbon Partnership Facility) must comply with the World Bank's (WB) Operational Policies and Procedures (Box 5.3), taking into account, among other things, the need for effective participation of forest-dependent indigenous peoples and forest dwellers in decisions that may affect them and respecting their rights under national law and applicable international obligations. Given the multi-sectoral, programmatic nature of the REDD+ Readiness process, a strategic approach to address safeguards was deemed necessary by the WB rather than the standard, project-level environmental impact assessments.

The SESA combines both analytical and participatory approaches which integrate key environmental and social considerations relevant to REDD+ at the earliest stage of planning and decision-making. SESA is expected to provide specific policy, legal and regulatory reform recommendations guided by the safeguards policies, while fostering institutional strengthening and capacity building. Another output of SESA is national-level Environmental and Social Management Frameworks (ESMF) based on the WB's safeguards policies, which guide specific, future investments and programs, including carbon finance transactions (payments to emissions reductions).

The FCPF strongly emphasizes and supports countries' development of national-level grievance and redress mechanisms. A grievance and redress mechanism is a process for receiving and then facilitating the resolution of queries and grievances from affected communities or stakeholders related to REDD+ activities, policies or programs at the level of the community or country. Typically, these mechanisms focus on flexible problem-solving approaches to resolve disputes, such as through fact finding, dialogue, facilitation or mediation. If well-designed, a feedback and grievance mechanism should improve responsiveness to citizen concerns, help identify problems early, and foster greater confidence, trust and accountability among program stakeholders.

23 The FCPF currently supports the REDD+ Readiness process in Cameroon, the Central African Republic, the Democratic Republic of Congo and the Republic of Congo. Although a member of the FCPF, Gabon has not been active in the Partnership. Equatorial Guinea forfeited its membership as they failed to sign a formal Participation Agreement with the FCPF.

24 The UN-REDD currently supports the REDD+ Readiness process in the Democratic Republic of Congo and the Republic of Congo.

Photo 5.5: Social dialogue meeting – Ngounié Province, Gabon

REDD+ Social and Environmental Principles and Criteria

The objectives of the REDD+ Social and Environmental Principles and Criteria are: (i) to address social and environmental issues in UN-REDD National Programs and other UN-REDD Program-funded activities; and, (ii) to support countries in developing their national approaches to REDD+ safeguards in line with the UNFCCC requirements. The criteria and principles seek to be coherent with the guidance provided by the Cancun agreements and subsequent COP decisions. Within each of the broad principles, there is a list of criteria to be met by UN-REDD Program-funded activities.

The seven principles adopted are:

1. Apply the norms of democratic governance, as reflected in national commitments and multilateral agreements;
2. Respect and protect stakeholder rights in accordance with international obligations;
3. Promote sustainable livelihoods and poverty reduction;
4. Contribute to low-carbon, climate-resilient sustainable development policy consistent with national development strategies, national forest programs, and commitments under international conventions and agreements;
5. Protect natural forests from degradation and/or conversion;
6. Maintain and enhance the multiple functions of forests, including conservation of biodiversity and provision of ecosystem services;
7. Avoid or minimize adverse impacts on non-forest ecosystem services and biodiversity.

Box 5.3: The World Bank's (WB) Operational Safeguards Policies that apply to REDD+ initiatives

a. Environmental Assessment (OP/BP 4.01). The Environmental Assessment (EA) is an instrument to examine the specific environmental issues and impacts associated with the formulation of the REDD+ Strategy. It evaluates and compares the impacts against those of alternative options; assesses the legal and institutional aspects relevant to those issues and impacts; and, recommends broad measures to strengthen environmental management in the country with particular attention paid to the potential cumulative impacts of multiple activities.

b. Natural Habitats (OP/BP 4.04). The conservation of natural habitats should take into account the protection, maintenance and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The WB stresses the application of a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development..

c. *Forests* (OP/BP 4.36). This policy aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development.

d. *Physical Cultural Resources* (OP/BP 4.11). This policy aims to avoid, or mitigate, adverse impacts of development projects on cultural resources. Cultural resources are important as sources of valuable historical and scientific information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices.

***e. Indigenous Peoples* (OP/BP 4.10).** This policy aims to ensure that the development process fully respects the dignity, human rights, economies, and cultures of indigenous peoples. The WB requires the borrower to engage in a process of free, prior and informed consent for all projects proposed for WB financing and affecting indigenous peoples. Such WB-financed projects include measures to: (a) avoid potentially adverse effects on indigenous peoples' communities; or, (b) when avoidance is not feasible, to minimize, mitigate, or compensate for such effects. WB-financed projects are also designed to ensure that indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

***f. Involuntary Resettlement* (OP/BP 4.12).** This policy is triggered in situations involving the involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts when it cannot be avoided. For projects involving the restriction of access, the borrower provides the WB with a draft process framework that conforms to the relevant provisions of this policy as a condition of appraisal. In addition, during project implementation and before enforcing the restriction, the borrower prepares a plan of action, acceptable to the WB, describing the specific measures to assist the displaced persons and the arrangements for their implementation.

***g. Safety of Dams* (OP/BP 4.37).** The safe operation of dams has significant social, economic and environmental relevance. When the WB finances new dams, this policy requires that experienced and competent professionals design and supervise its construction and that the borrower adopts and implements dam safety measures throughout the project cycle.

***h. Projects on International Waterways* (OP/BP 7.50).** Projects on international waterways may affect the relations between the WB and its borrowers, and between riparian states. Therefore, the WB attaches great importance to making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard.

***i. Projects in Disputed Areas* (OP/BP 7.60).** Projects in disputed areas may affect the relations between the WB and its borrowers, and between the claimants to the disputed area. Therefore, the WB will only finance projects in disputed areas when either there is no objection from the claimants, or when the special circumstances of the case support WB financing, notwithstanding the objection.

Find more information on: www.worldbank.org/safeguards.

2.3 Reference emission levels and reference levels

To measure climate change mitigation efforts, it is important to establish a reference point. This benchmark is for measuring the performance of policies and forest measures taken. The results of actions undertaken must be measurable, reportable and verifiable. Decision 12/CP.17 specifies that, "*forest reference emission levels (REL) and/or forest reference levels (RL) expressed in tons of carbon dioxide equivalent per year are benchmarks for assessing each country's performance in implementing the activities referred to in Decision 1/CP.16, paragraph 70 (i.e. the five REDD+ activities)*."[25]

Negotiations on establishing RELs and RLs focused on five main points : (i) the scope ; (ii) the geographic scale ; (iii) methodological guidelines ; (iv) data required (and their quality) ; and (v) submission guidelines.

The analysis below of UNFCCC decisions concerning RELs and RLs and their implications allows an understanding of the positions taken by the Congo Basin countries.

The 15th Conference of Parties in Copenhagen (2009) clarified numerous methodological questions regarding the development of RELs and/or RLs. In particular, RELs and/or RLs must take into account historic data and be adjusted to national circumstances.[26] The Cancun Agreements (COP-16, 2010) permitted other methodological elements to be clarified, and called on Parties to define a national forest reference emission level and/or national forest reference level (REL and/or RL) or, as an interim measure, subnational RELs and/or RLs. It was also agreed that RELs and/or RLs must take into account national circumstances, the provisions of Decision 4/CP. 15 and eventual clarifications contributed by the COP.[27] This decision thus implies that the Parties can aggregate different RELs and/or RLs at the local level to build their national RELs and/or RLs.

The definitions of REL and RL are relatively imprecise. However, the Cancun COP accorded flexibility to countries with the opportunity to choose the scope of their REL and/or RL, namely the REDD+ activities that will constitute their "reference point". In general, the Parties suggest that RELs only consider greenhouse gas (GHG) emitting activities, namely deforestation and degradation. On the other hand, RLs imply the consideration of all REDD+ activities, meaning activities which emit GHG and those which sequester carbon. In other words, the RL represents the net atmospheric effect while the REL represents the gross effect.

The COP-17 in Durban (2011) furthermore provided some clarification on methodologies, the types of data required and REL and/or RL submission processes.[28,29]. Recently, the COP-19 in Warsaw further clarified the information that must be provided by Parties when submitting their RELs and/or RLs, and on REL and/or RL submission and technical analysis processes.[30]

Table 5.2 summarizes the different guidelines relevant to RELs and/or RLs adopted by the Parties at the Copenhagen to Doha COPs.

25 Paragraph 7, Decision 12/CP.17
26 Paragraph 7, Decision 4/CP.15
27 Paragraph 71(b), Addendum 1 of the Decision 1/CP.16
28 Decision 12/CP.17
29 See the annex of Decision 12/CP.17
30 See the advance version of the Decision "Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels". Available : http ://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_frl.pdf

Table 5.2: *Description of approaches to developing RELs and/or RLs*

Topic	Principle implications
1. Scope	• The Parties can choose to establish a REL and/or a RL and, according to national circumstances, the REDD+ activities to be considered; • The Parties must specify the REDD+ activities included, the sources, sinks, and gases, and must justify any exclusions.
2. Scale (geographic)	• The Parties may establish one or several subnational RELs and/or RLs as an interim measure toward developing a national REL and/or RL.
3. Methodological guidelines	• The REL and/or RL must take into account historical data and can be adjusted for national circumstances; • They must be established following the most recent IPCC guidelines; • They must be consistent with information provided in each country's GHG inventories; • The method used (approach, data, hypotheses, models, policies and plans) must be transparent; • The REL and/or RL must be developed gradually and be updated (new gas and reservoirs, activities…).
4. Data	• The data used must be exhaustive, accurate, complete, compliant, consistent and transparent; • The historic data used must be presented; • The definition of forests used must be precise; • The data set, approaches, methods, and models used must be presented; • The relevant policies and plans must be described, as must all changes made to the REL and/or RL over time.
5. Submission guidelines	• The REL and/or RL must be communicated on a voluntary basis following an annual call for submissions from the Secretariat; • They are periodically updated and must allow for improvement based on new findings; • Their technical evaluation will be based on the international analysis and consultation process as specified by the COP; • The technical evaluation will be coordinated by the Secretariat and conducted by a team of LULUCF sector experts; • The technical evaluation will result in an exchange of viewpoints between experts from the Secretariat and the submitting country, thereby enabling capacity building and, when required, revisions to the submission; • The technical evaluation will conclude with a public report by the expert team which will contain the REL and/or RL submitted, as well as information on possible improvements, opportunities for capacity building, and responses from submitting countries.

2.4 National Forest Monitoring Systems and MRV

Initial methodological MRV guidance for REDD+ was provided at COP 15, Copenhagen (2009). Decision 4/CP.15, paragraph 1(d) "*Requests*" Parties to:

…establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, subnational systems as part of national forest[31] *monitoring systems that:*

i) *Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes* **[Monitoring and Measurement]** *;*

ii) *Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities* **[Reporting] ;**

iii) *Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties;"* **[Verification]**.

31 "Taking note of, if appropriate, the guidance on consistent representation of land in the Intergovernmental Panel on Climate Change Good Practice Guidance for Land Use, Land-Use Change and Forestry."

In addition, a recent decision[32] from the COP 19 in Warsaw specifies that National Forest Monitoring Systems (NFMS) should:

- Be guided by the most recent IPCC guidance and guidelines, as adopted or encouraged by the COP;
- Provide data and information that are transparent, consistent over time, and are suitable for measuring, reporting and verifying emissions, removals as well as carbon stocks arising from the five REDD+ activities;
- Build upon existing systems, as appropriate;
- Enable the assessment of different forest types, including natural forests, as defined by the country;
- Reflect the phased-approach to REDD+, as appropriate;
- Be flexible and allow for improvement.

32 See the advanced version of the Decision “Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels”. Available: http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_fms.pdf

In addition, Parties have also recognized that NFMS may also provide, as appropriate, relevant information on safeguards.

In the IPCC’s Good Practice Guidance, the most common methodological approach is to combine information on the extent to which a human activity takes place in a given area (activity data, AD), with coefficients that quantify the emissions or removals per activity unit (emission factors, EF). These data together comprise the “Measurement” contingent of MRV (figure 5.1).

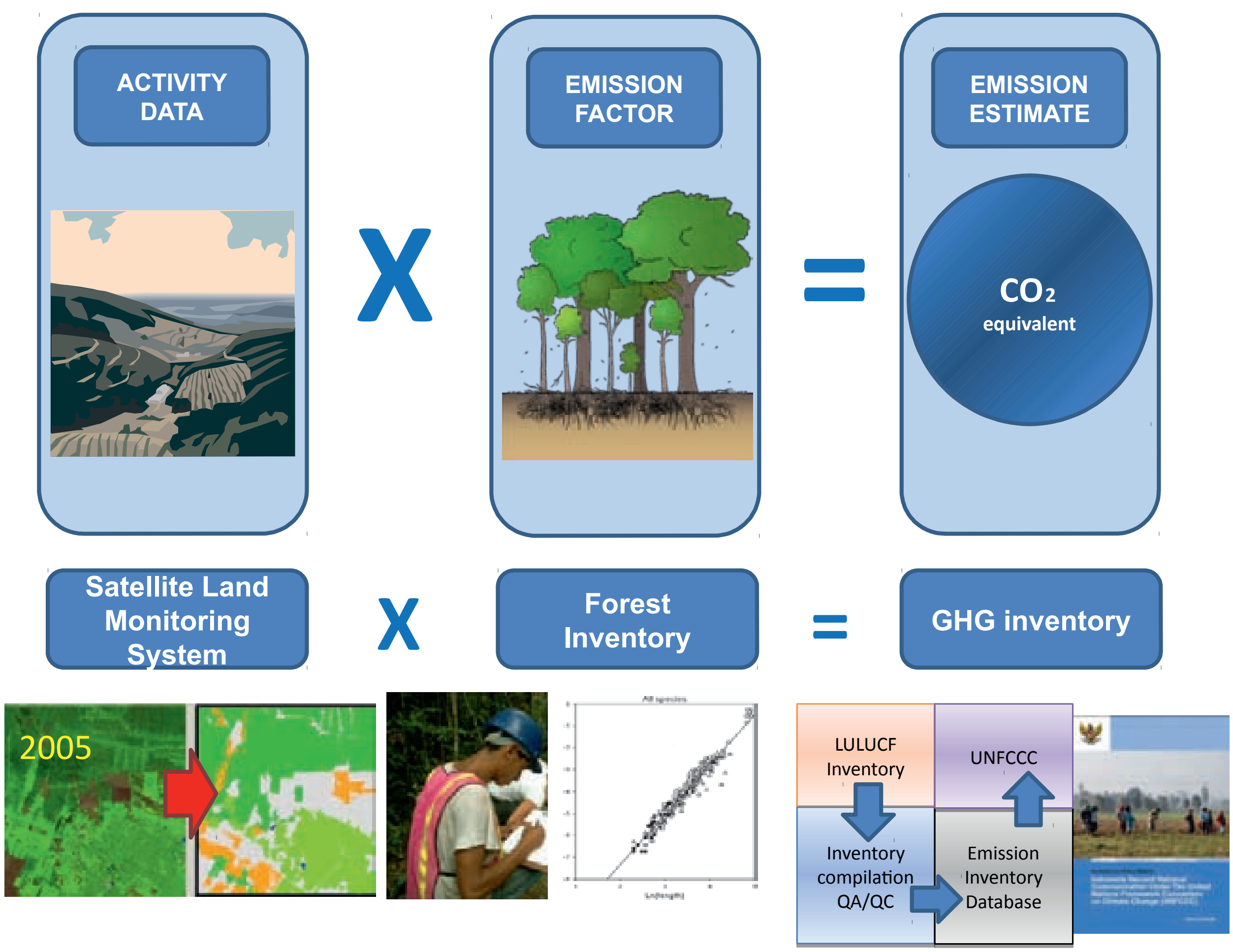

Figure 5.1: The IPCC’s methodological approach to calculate anthropogenic GHG emissions by sources and removals by sinks from forestland.

Photo 5.6: Transporting logs on the Lukenie – Bandundu, DRC

3. Political engagement in REDD+

This section presents how various Congo Basin countries are engaging politically in the REDD+ process.

3.1 REDD+ status in Congo Basin countries

COMIFAC countries share a common political will that is clearly visible at major international climate conferences. Nevertheless, the level of engagement differs from one country to another. There are three groups of countries: (i) countries where the R-PP (REDD+ Readiness Preparation Proposal) has already been drawn up and adopted (the Democratic Republic of Congo, the Republic of Congo, Cameroon, and the Central African Republic); (ii) Gabon, which opted for a National Climate Plan integrating all GHG emission sectors; and (iii) countries without an R-PP (Burundi, Equatorial Guinea, Rwanda, São Tomé & Príncipe, and Chad).

3.1.1 Countries with an R-PP

The Democratic Republic of Congo (DRC)

Thanks to a highly participative approach involving all stakeholders, and with the support of partners, the DRC has made remarkable progress in the implementation of its REDD+ process since 2009. In 2013, it started the gradual transition from the preparatory phase to the investment phase.

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Photo 5.7: Kinkosi: reforestation village, part of the Makala project

2009-2012: REDD+ process preparatory phase

Since 2009, the REDD+ process has been steered by the Ministry of the Environment, Nature Conservation and Tourism (MECNT), in partnership with the United Nations REDD program (UN-REDD) and the World Bank (FCPF program).

In January 2009, the first multi-lateral funding commitment was made in Kinshasa (0.2M$ from FCPF, 1.8M$ from UN-REDD) following a meeting between the MECNT, the international partners (FCPF, UN-REDD) and civil society organizations.

In May 2009, a National Committee, an Inter-Ministerial Committee, and a REDD+ National Coordination were created by decree of the Prime Minister.

In March 2010, the UN-REDD Policy Board and the FCPF (Forest Carbon Partnership Facility) Participants Committee approved supplementary funding for the implementation of the DRC's R-PP (3.4M$ from FCPF and 5.5M$ from UN-REDD).

Since then, the DRC has been recognized on the international stage as a major and credible REDD+ actor. Its achievements are as follows:

- First REDD+ Preparation Plan validated by UN-REDD and FCPF (World Bank);
- First Investment Plan validated by the Forest Investment Program (FIP) of the World Bank, securing a $ 60 million commitment in June 2011;
- First African country to establish in 2012 a regulatory framework for the approval of REDD+ projects and to establish a National REDD+ Registry;
- First country to establish a National Forest Monitoring System (www.rdc-snsf.org);
- In April 2012, obtained a national consensus on the drivers of deforestation based on numerous qualitative and quantitative studies;
- Implementation of six pilot REDD+ projects funded by the Congo Basin Forest Fund (CBFF) valued at $ 24 million;
- One of the first countries in the world to develop national REDD+ standards in conformance with UNFCCC principles (COP-16, Cancun) and an information system based on these standards;
- Implementation of a GLOBE Parliamentary Network in the DRC and a REDD+ legislative working group;
- REDD+ alignment strategy, aiming to bring traditional projects consistent with REDD+ objectives.

The DRC furthermore has been praised for the highly participative character of its REDD+ preparation process, involving continuous and intensive consultation with an ensemble of actors including public administrations, civil society, the private sector, and technical partners.

In June 2012, the mid-term assessment of the REDD+ process recommended finalizing the REDD+ National Strategy and gradually entering the investment phase.

In November 2012, the National REDD+ Strategy Framework was validated by the Council of Ministers. It aims, thanks to appropriate implementation modalities framed by relevant safeguard measures, for sustainable green growth based on human development. It relies on a financial mechanism: the REDD+ National Fund established in November 2012 through the signing of an Agreement Protocol between the Ministry of Finance and UNDP/MPTF.

This National REDD+ Strategy Framework and the REDD+ National Fund were presented at the COP-18 in Doha in December 2012, thus demonstrating a strong political buy-in of REDD+ by the DRC.

2013: start of the investment phase and implementation of the REDD+ Strategy

The DRC planned to move from REDD+ strategy preparations to the concrete testing of tools, measures, and activities in 2013.

A request for complementary funding was submitted to the FCPF to finalize the preparation according to Readiness Package indicators in order to render operational the national accounting system (MRV), create the REDD+ National Registry, and deploy REDD+ in the provinces.

In order to initiate the reforms needed for the implementation and success of REDD+ investments, in May 2013 the government integrated five REDD+ actions into its Economic Governance Matrix, a framework for monitoring the implementation of reforms agreed with multilateral financial institutions. The DRC thereby committed itself to implementing a national land use policy, to pursue land and forest reforms, and to supervise mining and oil investments with the aim to minimize their impact on deforestation and forest degradation.

Photo 5.8: Makala Project poster campaign

The REDD+ National Strategy Framework has two main objectives:

- to develop an emissions reduction program for a 12 million hectares area (the future Mai Ndombe Province): an Emissions Reduction-Project Idea Note (ER-PIN) was submitted to the FCPF's Carbon Fund in June 2013;
- to capitalize the REDD+ National Fund before the end of 2013 and to develop an investment plan to demonstrate that REDD+ can have a leverage effect to establish a green development model based on sustainable rural development that produces multiple co-benefits, including the conservation and enhancement of forest carbon stocks, poverty reduction, and improved living conditions.

The Republic of Congo

In February 2008, following the drafting of its "Project Idea Note" (PIN), the Republic of Congo was selected as a pilot country by the FCPF. A $ 200 000 grant agreement was signed between the Republic of Congo and the World Bank. The R-PP drafted in 2010 was validated in April 2012 and the operational plan was finalized in November 2012.

An already operational national coordination

In August 2012, the Republic of Congo created an operational REDD+ National Coordination supported by international consultants and assistants. The coordination comprises the following cells: (i) information, education and communication; (ii) legal; (iii) action and projects; (iv) environmental and social assessment; (v) modeling/reference level; (vi) MRV, (vii) logistics and IT, to which is added a "documentation and research" section.

A strategy developed in the implementation phase

The vision of the government of the Republic of Congo is based on improved living conditions and a revitalized economy to ensure sustainable development while limiting the risks of deforestation and forest degradation. This vision opposes those economic globalization forces that can act to the detriment of natural forests such as the development of large-scale agriculture, bioenergy, and extractive industry.

For the Republic of Congo, REDD+ is an opportunity to establish truly sustainable development within a green economy framework. The development of a national strategy started in February 2013 by establishing working groups in strategic sectors: forest, environment, agriculture, mines, energy, etc., and through the finalization of a REDD+ national strategy development protocol. All sectors with a direct link to forests and trees were taken into account in the identification of strategic themes and areas of intervention.

Necessity of developing a reference level

The Republic of Congo, which historically has had low deforestation rates, proposes that reference levels rely strongly on modeling future scenarios. Three main thrusts are envisaged for the development of RLs:

1. The estimation of deforestation and degradation over the last 20 years will be developed by the monitoring, measurement, reporting, and

verification system (M&MRV), which will determine forest carbon stocks, emission factors, and the mapping of land use changes;

2. Knowledge of the causes of deforestation and forest degradation based on a cartographic study of these phenomena;

3. The prospective assessment of circumstances that may result in significant changes in historical trends. This assessment will be based on current demographic and micro-economic data, the construction of possible future scenarios linked to changes in the economy and agricultural practices, notably cash crops such as oil palm, etc.

Financial support already available

The financial supports available are: UN-REDD: $ 4 million; FCPF: $ 3.4 million; FFBC: $ 350 000 under the framework of support for MRV sub-regional projects; and GEF/World Bank: $ 350 000 under the REDD+ subregional project to reinforce technical and operational capacities of the National REDD+ Coordination.

Cameroon

Establishing structures

After the R-PIN (Readiness Plan Idea Note) was adopted in July 2008, several REDD+ projects and initiatives were developed and implemented by civil society organizations and MINEPDED technical partners. Following REDD+ information, awareness building, and stakeholder consultation workshops, the R-PP drafting began in June 2011, the National REDD & Climate Change Platform was created by civil society organizations in July 2011, and the REDD+ process Steering Committee was established in June 2012. The national R-PP validation workshop was held in July 2012; this document was presented to the FCPF in August 2012 and approved in February 2013, followed in March 2013 by an R-PP activity planning workshop.

REDD+ coordinating structures exist at the national level (Inter-Ministerial Committee), the level of donors and non-governmental organizations (NGOs), notably CCPM (the coordinating circle of MINFOF/MINEPDED partners) which has within it a REDD+ subgroup, and the REDD+ and Climate Change (REDD+ & CC) National Platform established by civil society organizations.

Within the government, MINEPDED ensures the leadership of the process as the political and operational focal point of the UNFCCC, in collaboration with MINFOF. A national coordination was set up to steer the REDD+ process, this body is composed of members of both MINEPDED and MINFOF.

The technical secretariat includes the following authorities: the UNFCCC focal point, the national REDD Coordinator, and the Forestry Director. The technical secretariat includes four cells: (i) IEC (information, education, and communication), which also supports the technical secretariat when preparing documents for inter-ministerial and institutional strategy meetings; (ii) SESA (Strategic Environmental and Social Assessment) responsible for assessing and creating environmental and social management frameworks (ESMF); (iii) reference scenario and MRV cell, which manages the carbon stock management registry – it works in collaboration with the National Climate Change Observatory (NCCO); (iv) the cell responsible for setting up REDD+ projects and programs and supervising their implementation, optimizing their results, and strategy building.

Pending funding

Since the R-PP was validated by the FCPF in March 2013, consultations have been underway to find the financial means to implement this strategy.

The Central African Republic (CAR)

An institutional framework in place

In the CAR, the REDD+ institutional framework is composed of three bodies: (i) the REDD+ National Committee (REDD+ NC); (ii) the REDD+ Inter-Prefectorial committees (REDD+ IPC); and (iii) the REDD+ Technical Coordination (REDD+ TC). The REDD+ NC is composed of 20 members from civil society, the private sector, and the government. There are three REDD+ IPCs, each with 45 to 54 members from civil society, the private sector, and the government. The REDD+ TC includes the permanent technical Secretariat and five thematic groups: (i) information, education and communication (IEC); (ii) legal and land; (iii) modeling and reference level; (iv) socio-environmental assessment; and (v) Measuring, Reporting and Verification (MRV). The permanent technical secretariat is overseen by the national REDD+ Coordinator, assisted by a technical counselor and an expert responsible for monitoring REDD+ IPC activities.

Consultation, participation and dialogue: the priority

During the R-PP development phase, ten consultation workshops were held and over 100 key persons were individually consulted to obtain their viewpoints, ensure their support for the national REDD+ strategy, and explain the contents of the R-PP. These consultations will be continued through the 2nd quarter of 2014 with individual interviews and national and provincial workshops.

Understanding the causes of pressure on forests to better plan land use

The country has 28.3 million ha of forest, covering nearly 45 % of its surface area. Eighty percent of these forests are savanna forest while 20 % are dense forest located in the southwest of the country, where they are industrially logged, and in the southeast, where concessions have not yet been granted. The CAR's rainforest has lost 4 % of its total surface area in 20 years, or about 0.2 % per year, while the national deforestation rate is estimated to be approximately 0.13 % per year, equivalent to the degradation rate, which is relatively low.

The major pressures on the forest result from: (i) extensive livestock farming; (ii) slash-and-burn agriculture; (iii) uncontrolled exploitation of wood and non-timber forest products (NTFP); and (iv) the development of infrastructure (roads, mines, housing). To better understand these pressures, it is necessary to undertake studies on (i) woodfuel production and consumption; (ii) agricultural and pastoral production; (iii) logging for domestic and export markets; (iv) mining, artisanal and/or industrial (gold, diamonds, uranium, etc.).

REDD+ strategic options

In order to identify the policy options to fight the pressure on the forests, a synthetic analysis of past programs and possible future actions was conducted, using a Strengths, Weaknesses, Opportunities, Threats matrix. Four main policy options were identified: (i) complete the zoning of the territory; (ii) improve agro-silvo-pastoral yields; (iii) promote sustainable forest management; and (iv) reinforce institutions and governance.

The REDD+ implementation framework

The CAR wishes to develop an integrated, participatory, effective and efficient approach that fully and sustainably involves all of the stakeholders concerned to implement its REDD+ national strategy, the aim of which is to contribute to the sustainable development of the country and to global efforts to combat climate change.

Social and environmental impacts

As soon as the implementation of the R-PP has begun, a Strategic Environmental and Social Assessment (SESA) will be conducted. This SESA will rely on the existing national and functional legislative framework. Following this SESA, an Environmental and Social Management Framework (ESMF) will minimize potential negative impacts and maximize co-benefits.

Necessity of developing a reference level

In order to establish such a level, it is necessary to have an assessment of past GHG emissions (not yet undertaken in the CAR) as well as disaggregated statistical data on the main pressure factors identified.

Given future anthropogenic pressures that could be under-estimated by applying approaches based on past data alone, the CAR favors the construction of a net GHG reference emission level using historical trends adjusted to future changes.

Of the different methods envisioned by the country for the prospective scenarios, the ones selected were (a) the use of the "CongoBIOM" equilibrium economic model (an adaptation of GLOBIOM[33] by the International Institute for Applied Systems Analysis (IIASA)) in a medium and long-term approach and (b) sectoral change predicted by different models for specific sectors. In addition to challenges inherent in modeling recognized by the country, the CAR intends to improve the collection of regular data for the analysis of sectoral developments, in part thanks to the MRV plan, and to reinforce the capacities of the Climatology, Mapping, and Geographic Studies Laboratory (LACCEG) for data processing.

The CAR was divided into four zones (Southwest Forest, Bangasso Forest or Southeast Massif, Sahelian Domain, and Sudanian Domain) to better identify the causes and factors of pressure on the forests and permit the development of subnational reference levels and a map of future deforestation probabilities based on the geographic variables obtained by the GEOMOD algorithm.

33 GLOBIOM model is used to analyse the competition for land use between agriculture, forestry, and bioenergy, which are the main land-based production sectors. http://www.iiasa.ac.at/web/home/research/modelsData/GLOBIOM/GLOBIOM.en.html

Photo 5.9: On the Ntem river in northern Gabon

The CongoBIOM "top-down" modeling approach and the "bottom-up" subnational spatialization will be compared to improve the reference level (box 5.7).

Gabon: a unique case

Gabon is committed to the "Gabon Emergent" Strategy, an overall policy framework spearheaded by the Head of State. This plan is the foundation of the country's development policy ("Industrial Gabon, Green Gabon, and Service Gabon" are its three pillars) based on valuing human and natural resource potential.

Within this strategic plan is the National Climate Change Plan, which is dedicated to low carbon emission development, together with other plans in process of formalization such as the national land use plan. To ensure satellite-assisted environmental monitoring, a satellite receiving station also is being established. All deforestation, forest degradation, climate change and REDD+ projects and programs must align with the Head of State's Strategic Plan.

Legal and institutional frameworks have been set up to promote the formulation and execution of different plans and strategies. Examples include (i) the Climate Council, responsible for drawing up the climate plan, established in 2010, (ii) the inter-ministerial commission on land use, (iii) the Gabonese spatial studies and observation agency for the satellite component, etc. The reforms underway, particularly the sustainable development law, await the creation of a National Sustainable Development Council under the direct authority of the Head of State that will be responsible for orienting the implementation of plans and sectoral strategies.

Alignment of all REDD-related projects and programs with the national strategy

Gabon's REDD+ strategy is based above all on knowledge and control of the country's resources and space; this is why the country has committed to carrying out:

- a national climate plan;
- a land use plan to better manage its resources and development choices;
- the LEDS (Low Emissions Development Strategy) program supported by the United States government, which aims to introduce climate considerations into Gabon's development plans;
- a multi-resource, national forest inventory;
- the creation of a Gabonese Spatial Study and Observation Agency (AGEOS) by order of 25 February 2010, responsible for following up the national climate plan and evaluating the impact of climate change on the environment;
- the creation of Central Environment Divisions in all concerned Ministries;
- an umbrella sustainable development act;
- a revision of the environmental code through the environmental protection act;
- a revision of the forestry code.

Gabon considers that its efforts to combat climate change must not be restricted to the forests, which are already taken into account through ongoing subregional initiatives. It finds that the REDD+ process, in its current form, is inconsistent with national conditions. It therefore has chosen other policy strategies to combat climate change. It fears that prevailing trends would put Gabonese forests under the control of international agencies.

3.1.2 The countries without an R-PP

Burundi

Burundi does not yet have a REDD+ strategy. It is at the beginning of the first phase. A request was sent to UN-REDD and to FCPF for the R-PIN. In 2012, Burundi nominated the REDD+ Coordinator and a climate focal point. In March 2013, with the support of the MRV regional project, Burundi began its deliberations during its inception workshop.

Rwanda

Rwanda is planning for sustainable development by promoting a sustainable, low carbon economic environment. The MRV regional project conducted an inception workshop at the end of May 2013, and it will support the start-up phase of the Carbon Investment Fund. In 2010, Rwanda nominated a REDD+ focal point and a climate focal point. It is important to note that Rwanda is implementing a project funded by the Congo Basin Forest Fund (€ 4.5 million over 4 years) with a " forest management" component whose main mission is to fight against deforestation and the degradation of forest resources.

Equatorial Guinea

The view of REDD+ is under development. A national team was set up to draft the R-PP, and is active. The foundation, Conservation International, is supporting the development of the REDD+ strategy. In March 2013, Equatorial Guinea signed the World Bank/GEF project and the MRV project.

Chad

Chad does not yet have a national REDD+ strategy. It is at the start of the preliminary phase and will prepare its R-PP with the support of the MRV regional project. The National REDD+ Coordinator was nominated in 2009. The inception workshop of the MRV regional project took place in Ndjamena 16-17 September 2012, and the National REDD Committee was set up. In the framework of the MRV regional project, Chad organized an awareness building workshop from 24 to 26 April 2013 in Ndjamena. An inter-ministerial committee plan is being finalized. Chad is among 17 candidate countries that have submitted an application to join the FCPF.

São Tomé and Príncipe

The country's efforts focus more on the climate than on REDD+. Nonetheless, the country nominated a REDD+ Coordinator in 2012.

3.2 Capacity Building and REDD+ on the regional level

Several REDD+ capacity-building initiatives currently exist on the regional level. This section provides a brief, non-exhaustive description of two initiatives.

Why take a regional approach?

A regional approach would allow the most to be made of the future REDD+ mechanism. Congo Basin countries must meet a number of shared challenges that are both institutional and technical. The regional approach, by complementing national efforts, is justified by the following:

- **From a political point of view**, the regional approach gives more weight to Congo Basin countries in international negotiations.
- **From a technical point of view**, it provides access to state of the art techniques and methodologies, notably to measure and monitor forest carbon.
- **From an economic point of view**, it allows substantial economies of scale thanks to a good regional coordination and sharing of costs related to capacity building and to analytical and field work.
- **From an ecological point of view**, the regional approach is relevant because it enables an overall vision of the causes of forest evolution.

3.2.1 The World Bank / GEF project

Thanks to the Global Environment Facility (GEF/FEM), the World Bank is supporting the Congo Basin countries' REDD+ regional approach with a grant of $ 13 million. The objective is to reinforce the institutional and technical capacities of countries preparing for the future REDD+ mechanism. The project was approved in July 2011 and officially launched in March 2012. It will run for 5 years. It is structured around three technical components and one transversal coordination component:

<u>Component 1.</u> Improve knowledge and coordination

a. Reinforce dialogue and coordination in the area of REDD+;

b. Promote an inclusive approach and the representation of different stakeholders in technical discussions and REDD+ regional negotiations;

c. Respond to the specific needs of countries by reinforcing the national REDD+ Coordinations.

Component 2. Capacity building

a. Establish a scientific platform to measure and monitor forest carbon ;

b. Develop allometric equations to estimate the biomass and carbon stock of Congo Basin forest ecosystems.

Component 3. Integrate the REDD+ concept into sustainable forest management projects

a. Set up a support cell for REDD+ pilot projects ;

b. Define methodologies to promote REDD+ in the Congo Basin.

Component 4. Ensure the management of the project

a. Coordinate the activities of different components ;

b. Ensure the project's administrative and financial management ;

c. Contribute to reinforcing partnerships ;

d. Ensure the project's safeguard policy.

3.2.2 The COMIFAC-FAO-INPE regional MRV Initiative

The Congo Basin countries currently lack a reliable, operational and REDD+-compliant forest monitoring system. In order to meet the UNFCCC commitments for REDD+ and allow a coordinated response within the COMIFAC countries, the COMIFAC Executive Secretariat (ES) initiated consultations with the Congo Basin Forest Fund (CBFF) to develop a regional Monitoring and MRV project for all ten COMIFAC countries

Under this Initiative, the Executive Secretariat of the COMIFAC asked the United Nations Food and Agriculture Organization (FAO) and the National Institute of Space Research of the Ministry of Science and Technology of the Federal Republic of Brazil (INPE) to jointly prepare a full Monitoring and MRV project proposal. The Initiative proposes to build upon the FAO forestry management experience and the Brazilian forest monitoring experience to develop a NFMS in the Congo Basin countries, while also coordinating these activities with other international initiatives active in COMIFAC and to provide support for REDD+ activities. The initial project of the Initiative is entitled : "*National Forest Monitoring and MRV with a regional approach to the Congo Basin countries.*" The overall objective of the project : Support the development and implementation of NFMS and MRV in COMIFAC countries. This initial project will build capacities and implement the systems through a preparation (quick start) phase and an investment phase.

The Initiative's core objectives

The core objectives of the Initiative are :

1. Raise awareness and train stakeholders ;
2. Support clear institutional arrangements in the countries ;
3. Develop a R-PP for countries that do not have one ;
4. Develop a NFMS action plan for all countries ;
5. Identify regional activities that can support NFMS ;
6. Submit the NFMS projects and regional projects for funding in a second phase of the project.

Technical approach

Countries that elect to develop a NFMS under the Initiative will use the UN-REDD Program NFMS methodology. This approach allows countries to comply with the REDD+ requirements through a sustainable, stepwise approach. The process should allow for incremental efforts to improve performance, recognizing countries' varied capabilities and national circumstances. Under this approach, a NFMS can serve simultaneous functions ; a monitoring function and a MRV function.

- The monitoring function of the NFMS is primarily a domestic tool to allow countries to assess a broad range of forest information, including information needed for REDD+.
- The MRV function for REDD+, on the other hand, refers to the estimation and international reporting of national-scale forest GHG emission and removals.

The monitoring function can be defined broadly, depending on national circumstances, but in the UN-REDD context monitoring relates to the outcomes of Phase II demonstration activities and national policies and measures for REDD+.

The MRV function comprises three main components : (i) the satellite land monitoring system (SLMS) ; (ii) the national forest inventory (NFI) ; and, (iii) the national GHG inventory. The SLMS and the NFI components are used to provide inputs into the forest sector component of the GHG inventory.

4. First experiences from in-country technical implementation

This section will examine certain aspects of REDD+ and describe how some initial, country experiences and studies are helping to advance our understanding of how REDD+ could be implemented. The section will review : (i) REDD+ safeguards ; (ii) mapping of multiple benefits for REDD+ ; (iii) how REDD+ and FLEGT can be integrated together ; (iv) the importance of land tenure and REDD+ ; and, finally, (v) reference levels.

4.1 REDD+ Safeguards design and implementation in the Congo Basin

Congo Basin countries are at different stages in the design and implementation of REDD+ safeguards, which is indicative of uneven REDD+ Readiness progress in general. Table 5.3 presents the status of REDD+ safeguards development in the four countries in the region which have prepared a R-PP : Cameroon, the CAR, the DRC, and the Republic of Congo.

The four REDD+ Readiness components discussed are :

- **Readiness Management Arrangements** : This component refers to the institutions leading the country readiness process at the national level. Congo Basin countries have established national-level institutions to lead the REDD+ Readiness process. These institutions normally include government representatives from different levels and sectors and a strong participation of civil society organizations' (CSO) and indigenous peoples' representatives. Nevertheless, the effective functioning of these institutions remains a challenge. DRC's national REDD+ committee, for instance "is not functioning within its mandate" and "does not provide orientation to the REDD National Coordination" (Hoefsloot, 2012).
- **Consultations during R-PP preparation and R-PP implementation :** In general, the Readiness process has enabled the participation of various stakeholders during the R-PP preparation (and implementation, in those countries already in that phase), particularly of CSOs' and indigenous peoples' representatives. In Cameroon and Congo, CSOs managed to strongly influence the R-PP. In the DRC, the Climate and REDD+ Working Group of CSOs have been closely involved in all aspects of the readiness process, including by leading in producing some of the main deliverables such as a study on the causes of deforestation and forest degradation. CSOs have also supported and engaged with the governments in developing working documents such as a communications and outreach strategy and a road map for governance reform.
- **National implementation framework :** In general, the Congo Basin countries identified weaknesses in their current REDD+ enabling regulatory framework and proposed new policies, regulations and/or legislation to address complex issues such as land tenure and forest rights, benefit sharing and funds management.

• **SESA and Safeguards Information System:** All countries are going to conduct a SESA during the R-PP implementation. The DRC is the only country to have finalized the process and developed an ESMF (see below).

Table 5.3 : *REDD+ Safeguards in some of the Congo Basin countries*

Country	Readiness Management Arrangements	Consultation during R-PP preparation	Safeguards	Implementation Framework
Cameroon	-REDD+ Steering Committee created (19 members, including 1 CSO and 1 indigenous peoples (IP) representative) - National REDD & CC Platform of CSOs made up of 20 networks of organizations and social movements.	-National, regional and local consultations held by agro-ecological zones. Participation of CSOs estimated at over 60 %, 7 % for IPs. Consultation and participation plan prepared for R-PP implementation.	- SESA to be conducted as part of the R-PP implementation. This will be Cameroon's first experience with the tool.	- Revision of existing regulations to address REDD+ planned. The type regulations to be revised and the extent of the revision is currently under assessment.
CAR	-The National REDD+ Committee established by ministerial regulation (20 members, including 5 from CSOs in addition to 4 IP representatives).	-Ten consultation workshops completed during R-PP preparation. Consultation and communication plan for R-PP implementation approved.	- SESA to be conducted as part of the R-PP implementation.	- New regulations are planned (Presidential Orders, a REDD+ Law). - National REDD+ registry planned.
DRC	- National REDD+ Committee (14 members, 2 from CSOs and 2 from IP organizations) established. - GTCR – Climate and REDD+ Working Group, created as key partner in Readiness process.	-Multi-stakeholder consultations held at national and decentralized levels during R-PP preparation and implementation.	- National social and environmental principles and criteria for REDD+ - SESA / ESMF finalized.	- Adopted decree on REDD+ projects. - National REDD+ fund under advanced design. - Regulations on benefit sharing expected to be adopted.
Congo	- National REDD+ Committee (30 members, 8 from CSOs and 6 from IP organizations) established. - National CSOs Platform around REDD+ created and active, despite ongoing internal disputes.	- Major CSOs and IP organizations involved in forest and rural development participated. Consultations followed process similar to that of VPA-FLEGT discussions. - Consultation and participation plan prepared for next phase.	- SESA to be conducted during R-PP implementation, led by the General Direction of Environment of the Ministry of Forestry	- REDD+ Law is expected to be drafted during Readiness process. - National registry for REDD+ activities created? Agreed upon?

4.1.1 REDD+ Safeguards at the country level – the case of the DRC

The DRC built its national REDD+ strategy based on analytical work and on-the-ground experience from ongoing interventions that address drivers of deforestation and forest degradation. Safeguard considerations were incorporated into both of these work streams. On the analytical side, the strategic environmental and social assessment (SESA) helped make sure the emerging REDD+ strategic options duly considered social and environmental risks. On the experimental side, six pilot government projects financed by the CBFF, and several additional REDD+ projects, are in the early stages of development across the DRC. A process to screen those projects against social and environmental safeguards has been elaborated and tested.

As project developers (private sector and NGOs primarily) attempted to get official permits from the Congolese government to develop REDD+ projects ultimately aiming to generate tradable assets, the Ministry of Environment and its National REDD Coordination Unit developed regulations and procedures for the national approval of REDD+ projects ("homologation"). These include the establishment of an on-line REDD+ national registry to collect and make publicly available the information about these REDD+ projects. The regulations also determine the conditions under which project developers (private firms, NGOs, church groups, local communities and government agencies) can market emission reductions from REDD+ on international markets.

As part of that, a stepwise administrative process was established to ensure that : (i) project developers and their financial partners undergo due diligence and anti-money laundering controls, thus mitigating the risks of illegal activities ; (ii) projects do not overlap, thus avoiding "double counting" ; (iii) projects are approved by the multi-stakeholder National REDD Committee, thus promoting their legitimacy ; (iv) projects are validated under internationally recognized carbon and socio-environmental standards – Verified Carbon Standard (VCS), Climate, Community and Biodiversity Alliance (CCBA), UNFCCC-IPCC – within four years of national approval, thus preventing speculation and promoting environmental integrity as well as ensuring the respect for safeguards ; (v) projects report periodically on verified results, carbon transactions and lessons learned, thus contributing to building capacity through the national strategy development process and promoting better understanding of the feasibility of REDD+ under varying conditions (e.g. different project business models, different social, cultural and physical circumstances, and the variety of challenges that must be met in implementing REDD+ on the ground).

The DRC has also developed national social and environmental standards for REDD+ (Box 5.4) through a highly participatory process led by the CSOs. The purpose of these standards is to provide a standardized basis to assess the performance of specific REDD+ projects geared towards voluntary or emerging compliance carbon markets as well as REDD+ initiatives more generally. In time, these standards should replace the CCBA standards currently required for REDD+ projects. However, the standards will need specific operational procedures, and in-country capacity will need to be developed before they can be applied in the field.

Box 5.4 : DRC's National Social and Environmental Standards for REDD+

The DRC's National Social and Environmental Standards for REDD+ are composed of seven key principles. Each of these key principles contains a series of criteria and indicators. These standards will need to be met by all REDD+ projects and initiatives.

- **Principle 1 :** Projects / REDD+ initiatives must protect natural forests, promote increased environmental services and enhance the conservation of biodiversity.
- **Principle 2 :** Projects/ REDD+ initiatives should promote transparency and good governance.
- **Principle 3 :** Projects / REDD+ initiatives should avoid loss or damage, provide remedies and implement mechanisms for just and fair redress for any loss and / or damage suffered by third parties (i.e. communities and other stakeholders).
- **Principle 4 :** The economic and social benefits generated by projects / REDD+ initiatives should be equitably shared by the stakeholders.
- **Principle 5 :** Projects / REDD+ initiatives should favor the emergence of new economic opportunities to contribute to the sustainable development of local and indigenous communities.
- **Principle 6 :** Projects / REDD+ initiatives must ensure the effective and efficient participation of all stakeholders, including indigenous and local communities located within their boundaries.
- **Principle 7 :** Projects / REDD+ initiatives must respect human rights, including the rights of the workers they employ and the rights of concerned communities (i.e. parties to the project) to land and natural resources.

To support the administrative processes associated with project approvals, a national REDD+ registry was created (Box 5.5). This system is expected to manage the information associated with the application of the National Social and Environmental Standards for REDD+ as well as the Environmental and Social Management Framework, among other things. The registry will provide information to the National Safeguards Information System, which, along with the National Forest Management System, serves as an institutional tool for the generation and sharing of data on the location of deforestation, forest degradation, and other biophysical parameters potentially relevant to safeguards application. Additionally, independent tools, such as "Moabi" (Box 5.6), could be used for collecting and distributing, information on the drivers of deforestation and could help with monitoring the implementation of REDD+. Figure 5.2 shows how these systems are integrated and communicate with one-another.

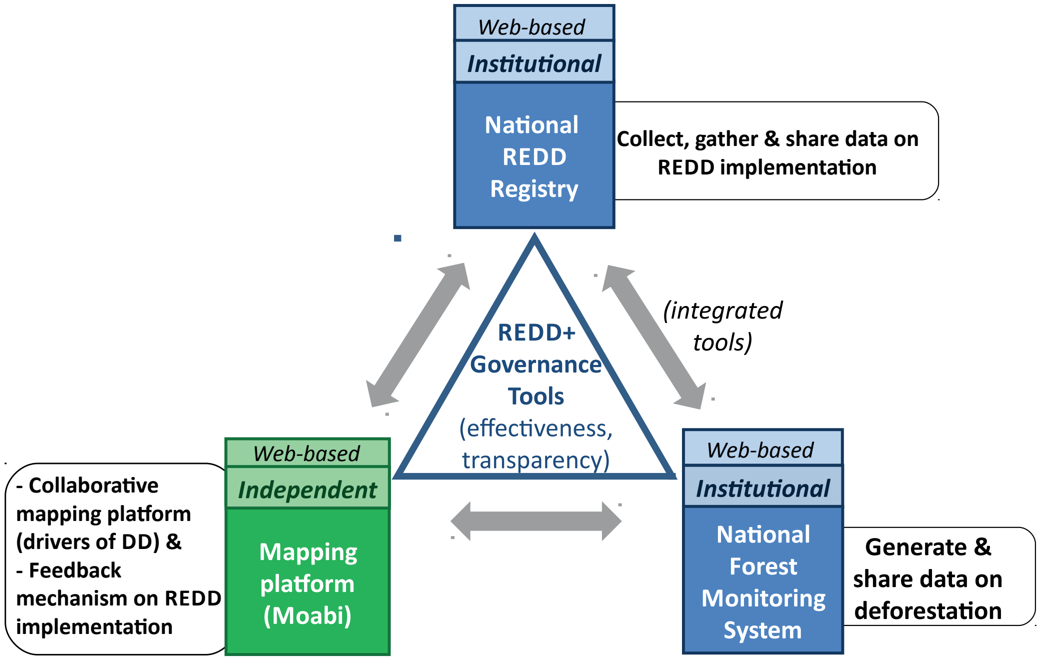

Figure 5.2 The REDD+ monitoring and evaluation tools in the DRC

Box 5.5: Registry of REDD+ projects in the DRC

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OFAC

In its strategy to reduce greenhouse gas emissions (GHG) from forest land conversion, the DRC has opted for a "projects"[34] option "which, via an interlocking approach[35], enables local contributions toward a national strategy." These projects are financed and handled by external MECNT partners (private, civil society, international NGOS, etc.)

In the absence of a clear international regulating framework, a strategy which integrates the projects allows for better preparation of the national REDD+ program. With this gradual approach, the emerging national REDD+ program must show a clear path for projects which meet the minimum regulatory standards within national accounting and registry bodies (the Katoomba Group, 2011).

In order to document GHG emission reductions and ensure that environmental and social safeguards are respected, a decree was issued on 15th February 2012[36]. This decree defines the eligibility criteria and the approval procedure of REDD+ projects; it specifies that all DRC REDD+ project managers must be registered in the DRC national registry and must follow the approval procedure manual.

This national register is the "public repository whose goal is to record information related to the REDD+ projects approval procedure, for which we wish to keep a record of in order to certify accuracy. This information includes names (of individuals and companies), legal documents, dates, geographic details, key numbers and proof of relevant information associated with REDD+ projects (consultations, verifications, validations, transactions, etc.)".

It was developed by the REDD-DRC National Coordination in partnership with OFAC and its establishment has been the subject of several exchanges amongst international experts.
It is accessed via an online database within an IT platform and includes all features which allow the management of the administrative approval process and the endorsement of the projects.

34 See box 8.4 of the 2010 Report on the State of the Forest of the Congo Basin.
35 The English term "nested approach" is very often used in texts in French.
36 Ministerial Decree No. 004/CAB/MIN/ECN-T/012 of 15 February 2012 and the ratification procedure manual are downloadable on the site http://www.observatoire-comifac.net/REDD.welcome.php

As well as recording REDD+ projects, it allows all relevant information to be made available to the public. It therefore also ensures the transparency required to satisfy the international regulatory framework being created. Another advantage is that not only does it allow referencing of the REDD+ projects in the DRC, but also of the REDD+ initiatives[37]. Internet links to other information tools on REDD in the DRC, especially the National System of Surveillance of the DRC Forests and the "Moabi" software, allow for the exchange of officially recognized and validated data.

This efficient tool, whose automatic saving system prevents any loss of data, will be made available to other COMIFAC countries.

37 A REDD+ Initiative: enabling or sectoral initiative having a direct or indirect short- or medium-term impact on greenhouse gas emissions from deforestation or forest degradation, conservation, sustainable management and the increase in forest carbon stocks and aimed to contribute to the national REDD + strategy.

Box 5.6: Moabi DRC and Independent REDD+ Monitoring in the DRC

Moabi DRC (rdc.moabi.org) is a collaborative mapping system that supports local civil society efforts to monitor REDD+ implementation in the DRC. It combines social networking and spatial mapping to create a community of users to collect and validate data on activities such as mining and logging which could cause deforestation (figure 5.3). Moabi DRC was initially piloted to track land use planning and monitor parameters related to REDD+, such as the displacement of deforestation and forest degradation beyond the boundaries of pilot project zones and unplanned deforestation and degradation. GIS data can be uploaded and updated directly on the platform with quality control maintained by experts from government ministries to NGOs collecting spatial data related to REDD+ pilot projects and drivers. With technical and the financial support from the WWF, the platform is managed by OSFAC – a DRC registered NGO specializing in forest monitoring of Congo Basin rainforests. It was endorsed by the DRC REDD+ Coordination Unit.

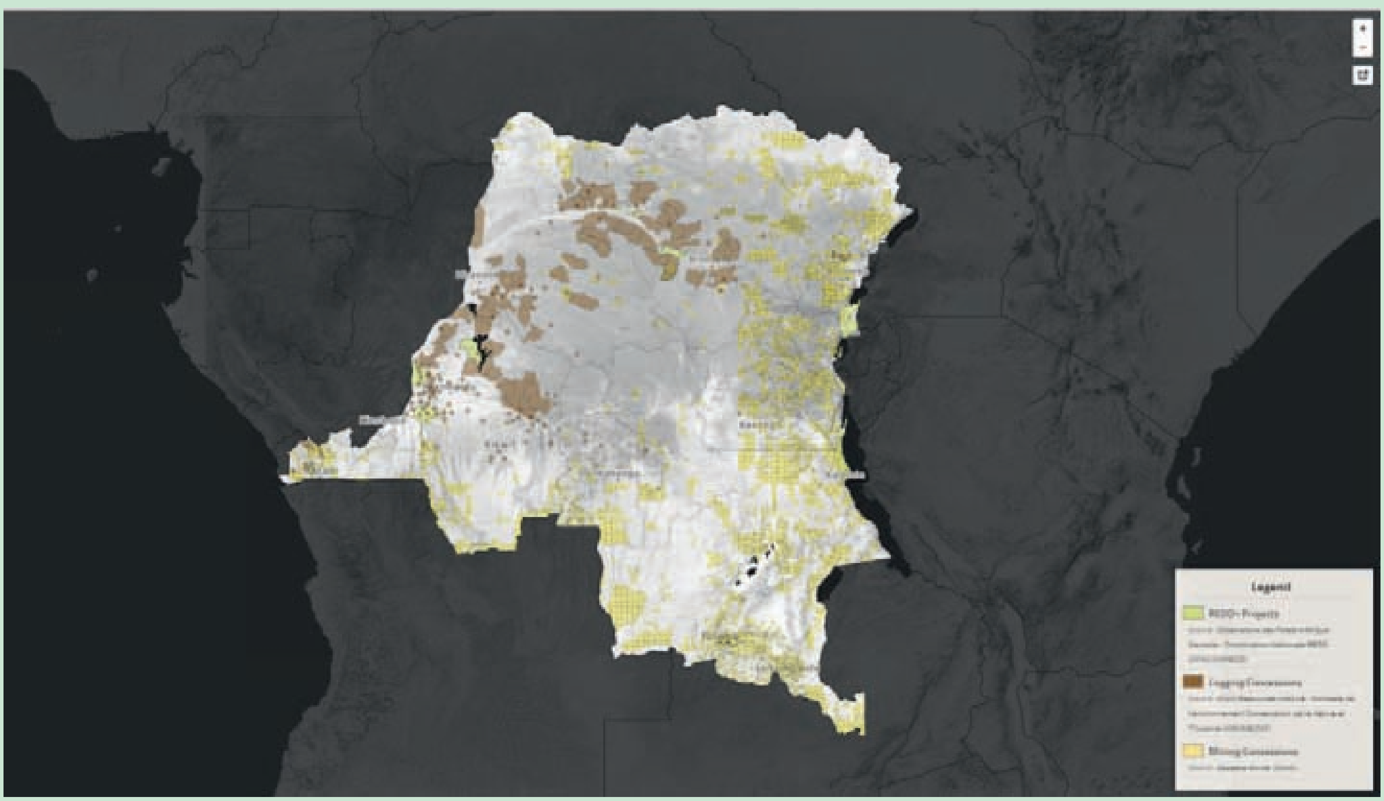

Figure 5.3: Screenshot of Moabi DRC

Since its launch in June 2011, Moabi DRC has demonstrated a novel approach to independent REDD+ monitoring and contributed to the implementation of REDD+ in the DRC. The platform hosts the largest publicly available database of drivers of deforestation in the DRC. These drivers include mining and logging permits, oil and gas concessions, road rehabilitation projects, and informal mining activity. These data were contributed through the development of both formal and informal data sharing agreements with government agencies, such as the Ministry of Mines and the Ministry of Infrastructure, and civil society groups, such as the International Peace Information Service. These data were used to conduct a spatial analysis of competing land use claims for REDD+ pilot projects. The study identified 190 competing claims within the domain of proposed REDD+ pilot projects in the DRC which could result in future deforestation, including 77 road rehabilitation projects, 58 mining permits, and 7 oil blocks which directly overlap with REDD+ project areas (figure 5.4). This information will support the development of more accurate deforestation and forest degradation reference scenarios and more efficient REDD+ project implementation.

Moabi's implementation raised a number of technical, institutional, and financial challenges. Because the platform was only available via the internet, field data collection by civil society groups and local communities was restricted. This limitation prevented the gathering of some types of field data, such as local opinions of REDD+ projects, community land tenure, and certain drivers of deforestation like illegal logging. Capacity restrictions also impeded the development of an independent consortium of NGOs and government institutions to support and maintain the platform. Additionally, the project did not have sufficient technical capacity for updating the platform code or for providing the necessary technical training for project partner organizations. Proprietary and sensitivity issues also restricted which data could be shared on the platform. Government ministries were often reluctant to disclose the financial information related to extractive and infrastructure projects, and civil society groups did not want to disclose community land tenure information. Finally, Moabi DRC did not have sufficient financial resources to cover the long-term costs of managing the mapping platform or a data-sharing consortium for the platform. Future independent REDD+ monitoring platforms will need to integrate mobile mapping tools for field collection and ensure that the system can be managed by the implementing institutions. Perhaps most critically, independent monitoring systems need sustainable financing models. To maintain independence from the government and key REDD+ implementing institutions such as large NGOs and donor agencies, costs need to be distributed among the consortium of organizations benefiting from the platform.

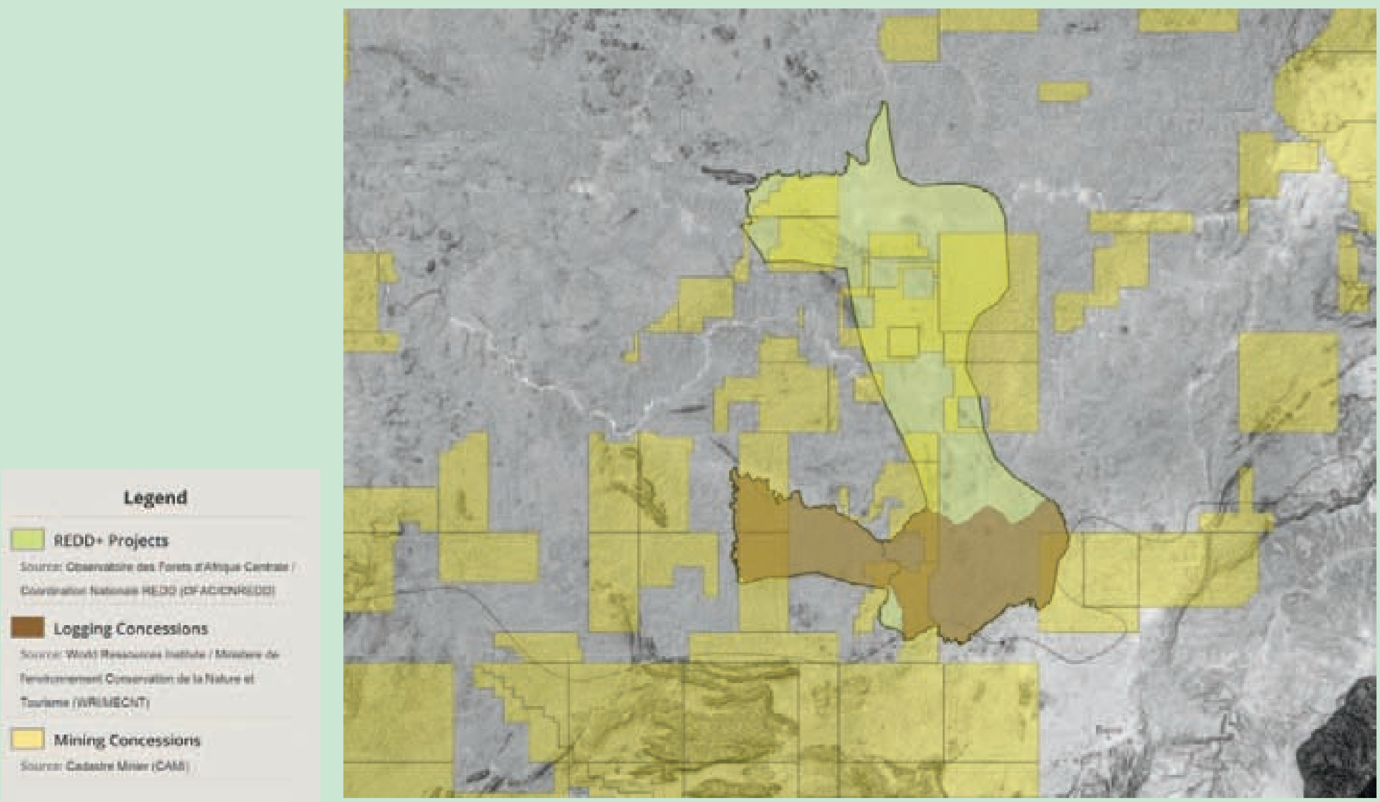

Figure 5.4 Competing land use claims within Mambasa REDD+ Project, DRC
Source: Moabi DRC

Major challenge in the DRC: implementation capacity

To mitigate the risks of corruption, the approval and reporting processes for the DRC's National REDD+ Registry are fully digitalized and accessible online to the public. Project developers report on projects using password-protected access and independent third parties verify the data. To promote transparency, all of the information is directly integrated into the NFMS.

The National Registry, the NFMS and Moabi have not been fully utilized, mainly because of the institutional and human capacity weaknesses to operationalize the safeguards information systems and effectively apply the safeguards procedures in the field.

More generally, the full establishment of the DRC National Environmental Agency, which is in charge of monitoring environmental safeguards for projects in all sectors (mining, forestry, energy, etc.), including those programs associated with REDD+, has been substantially delayed. Given its broader mandate and the higher institutional and human capacity required for its proper functioning, it is imperative that it received the appropriate resources to monitor the application of safeguards in REDD+ activities in the DRC.

Photo 5.10: Selling firewood – Brazzaville, Congo

4.1.2 Main opportunities and challenges for the implementation of REDD+ Safeguards

The design and implementation of REDD+ safeguards in the Congo Basin countries provide important opportunities for ensuring REDD+ contributes to poverty reduction and broader environmental protection. On the other hand, the implementation of these safeguards is also fraught with challenges.

Opportunities:

• Since monitoring and reporting on social and environmental safeguards is a requirement under the UNFCCC and from other multilateral and bilateral REDD+ initiatives, countries in the region have new incentives to adopt them. Countries with strong safeguards will likely attract more REDD+ investments, both from public and private sources, further strengthening the motivation for their implementation.

• The REDD+ Readiness process is promoting unprecedented levels of capacity building on issues related to safeguards in these countries. As a result, some innovative national-level initiatives are being rolled out, such as DRC's Social and Environmental Principles and Criteria for REDD+. As seen in the Republic of Congo and the DRC, governments are also using REDD+ Readiness funds to strengthen the capacity of entities in charge of monitoring and reporting on safeguards (such as the National Environment Agency in both countries).

• The REDD+ Readiness process has opened new venues for the participation of other stakeholders in the decision-making processes, some of which have been traditionally excluded or marginalized, such as indigenous peoples' representatives.

• Effectively demonstrating sustainable emissions reductions from deforestation and forest degradation on the ground will require countries to tackle complex governance issues such as land tenure reform and forest-user rights.

Challenges:

• The Congo Basin countries have demonstrably weak capacity to monitor and report on safeguards, particularly at the local, decentralized level. In the DRC, the National Environmental Agency was created by act of Parliament, but it is not operational. The monitoring of existing Environmental Impact Assessments for other projects is spotty at best, and nonexistent in most cases.

• Regulations and legislations are often not enforced. As an example, although the DRC has issued a decree outlining the "REDD+ Projects' Approval Process", no currently existing REDD+ project has followed the process nor registered its information in the National Registry. Again, this is likely linked to the government's lack of capacity.

• The multiplicity of standards and approaches to safeguards, especially in a context of weak capacity, creates confusion for countries and increases implementation costs. Countries are often unsure how to respond to the requirements from different initiatives, and they are unclear whether following the requirements of these initiatives would allow them to comply with the UNFCCC requirements.

• Although CSOs and IPs are theoretically well represented in the national institutions in charge of steering the REDD+ process, often these institutions are not operational or do not have effective decision-making power. This has been the case with CSO and IP representation in the DRC National REDD+ Committee thus far.

• Addressing long-standing governance challenges in the forest sector will take time to complete, especially given the complex vested-interests surrounding them, as discussed elsewhere.

4.1.3 Conclusions and the way forward

Some of the Congo Basin countries (particularly DRC and Congo) have demonstrated significant progress in advancing their domestic REDD+ Readiness processes, including the design of approaches and tools to deal with REDD+ safeguards such as the DRC's Social and Environmental REDD+ Criteria and Principles. The REDD+ Readiness process in most of the Congo Basin countries has also exhibited high levels of multi-stakeholder participation, including by CSOs' and indigenous peoples' representatives. In addition, some countries, particularly the DRC, have already enacted regulations to deal with REDD+, which mandates REDD+ projects adopt internationally-recognized environmental and social standards as part of the project approval process.

However, implementation of these safeguards poses complex challenges. Given the weak capacity of most governments, particularly on the local level, monitoring and reporting compliance with the safeguards and then enforcing remediation will be difficult. Furthermore, the proliferation of safeguard principles, criteria and tools may add to the confusion.

As a way forward, continued capacity building at all levels is required. Countries should test new tools for monitoring and reporting, such as using new information technologies (Moabi being an example) or outsourcing some of the monitoring functions to third-party entities (such as to NGOs or even private firms). Instead of creating new institutions, as much as possible existing institutions, systems and processes should be further developed and build on. As an example, existing bodies in charge of ensuring compliance with national safeguards policies should be strengthened by the REDD+ process.

Congo Basin countries have an opportunity with the broad availability of donor funding to strengthen their national policies, laws, and regulations relating to safeguards and to create robust safeguards information systems so that in addition to climate change mitigation REDD+ will also result in social benefits to forest-dependent communities and broader environmental gains to the country and the region.

Photo 5.11 : Sedimentation on the edges of a forest rig, Gabon

During the UNFCCC negotiations on REDD+, COMIFAC countries maintained a joint position on various issues pertaining to RELs and RLs.

4.2.1 Issues related to the choice of REDD+ activities

When choosing the REDD+ activities (among the five types) to implement, REDD+ participating countries determine the scope of their intervention. The COMIFAC countries always wanted the five REDD+ related activities to be considered on an equal basis. They also have consistently maintained that "reference scenarios" should take into account historic rates of forest degradation and efforts to conserve and increase carbon stocks through sustainable forest development. By considering emission-producing activities alongside carbon sequestration activities, the COMIFAC countries have advocated for the adoption of RLs rather than RELs. This position is justified because the Congo Basin forests are affected by degradation more than deforestation due to the steady efforts of several COMIFAC countries to sustainably manage their forests despite limited resources.

The countries of the Congo Basin have presented numerous submissions[38] to the UNFCCC :

- "*the consideration of degradation as part of deforestation constitutes an essential priority for the countries of the Congo Basin… and the consideration of degradation does not pose a methodological problem*" (UNFCCC on 10 September 2007) ;
- *"The establishment of sustainable development schemes seeks to conserve forests and thereby prevent the emissions that would arise in the absence of such development schemes. These prevented emissions should be taken into account. However, initial emissions caused by the exploitation of forest concessions under sustainable management are not expected to be factored in. In the same vein, improved forest management may help mitigate emissions which should be estimated and compensated. Similarly, enhanced forest carbon stocks achieved through sustainable management also should be estimated and compensated.* (UNFCCC of 20 March, 2008).[39]

4.2.2 Issue of scale

The COMIFAC countries supported a flexible approach leaving room for the opportunity to progressively develop their REL and/or RL by starting with a subnational or local REL and/or RL before developing a national REL and/or RL : *"The Congo Basin countries took note that the establishment of mechanisms for reducing emissions from deforestation can rely on various levels of action, local and national. Given the diversity of national circumstances, it is important to be open-minded and flexible in selecting the approaches and relevant level of action to be adopted"* (UNFCCC on 10 September 2007[40]) and "*Subnational and national approaches are compatible and relevant in Congo Basin countries. The subnational approach helps to garner requisite experience to gradually progress towards a national approach."* (UNFCCC on 20 March 2008[41]).

4.2.3 Methodological issues

The COMIFAC countries have defended the option of adjusting their REL and/or RL in accordance with national circumstances : *"Reference scenarios based only on historical trends would severely penalize countries of the Congo Basin. The latter propose that the reference scenario (be it in a national or project approach) should, beside the historical trend, include a development adjustment factor which will take into account national and international circumstances (for example : demographic trends, agriculture, food self-sufficiency, development of infrastructure, renewable energy, etc.),* [42]*… The IPCC Good Practice Guidance on Forestry, Evaluating Emission Factors and Review Procedures provide data quality assurance".*[43]

38 See FCCC/SBSTA/2007/MISC.14
39 See FCCC/SBST A/2008/MISC.4
40 FCCC/SBSTA/2007/MISC.14
41 FCCC/SBST A/2008/MISC.4
42 Idem 40
43 Idem 41

4.2.4 Data and submission issues

The Congo Basin countries maintained their position on data and the submission of REL and/or RL during negotiations: in Durban (2011), the COMIFAC countries argued that data used to develop RELs and/or RLs should follow IPCC principles, namely completeness, coherency, transparency, comparability and accuracy. They also proposed that RELs and/or RLs be reviewed every 5 years[44] (UNFCCC of 10 September 2007).

The Congo Basin countries consistently supported submissions to the UNFCCC made by the COMIFAC for the defense of rain forests, notably those related to RELs and/or RLs in preparation at the Durban negotiations.[45]

Issues specific to the sub-region in the development of RELs and RLs

In the State of the Forest 2010, it is noted that "*common specifications for all countries in the Congo Basin should be used in methodologies to establish each country's reference level*", which should ensure a coherent approach, facilitate synergies, and prevent perverse effects such as leakage. Ideally, this methodology should be developed under the auspices of the COMIFAC, without preventing countries from adapting their REL and/or RL approach to national circumstances.

The adoption of a joint methodological approach means adopting a shared definition of "forest", referring to the same historical reference period, considering the same REDD+ activities, harmonizing classification systems and using the same emission factors to estimate emissions and carbon sequestration. While this may not pose any particular technical problems, it can have important political implications: consultations regarding this harmonization have not yet taken place.

Issues related to methodologies for estimates

An important challenge for the COMIFAC countries is to accurately estimate the extent of degradation of carbon stocks in forest areas. Inventory data sets enabling an analysis of the evolution of these stocks are rare. Several approaches will thus need to be combined, including an analysis of the evolution of volumes of wood extracted on forest concessions and other forests (timber, fuelwood, charcoal, etc.), the annual growth rates of forests, remote sensing, etc.

Free 30 m spatial resolution Landsat images could be used for historical analyses of forest degradation. However, to determine damage caused by selective logging, for example, high- resolution spatial images (with a resolution of 1-10 m) are required. Experts in the sub-region have not yet sufficiently mastered the use of radar or LIDAR imagery, which is often quite expensive.

Even with high spatial resolution satellite data, certain countries will encounter difficulties using these data to estimate forest degradation or enhanced stocks resulting from sustainable development schemes. This pertains particularly to dry forest and wooded savanna areas of Chad, the Central African Republic, northern Cameroon and southern sections of the Democratic Republic of Congo and the Republic of Congo. While field validation is indispensable, it is complex to implement in low density and highly fragmented forest ecosystems.

Data availability and accessibility

The availability and accessibility of various relevant data sets, whether satellite or field data, is an important issue in the sub-region.

The plethora of carbon stock MRV initiatives, coupled with a lack of coordination between donors, renders the progress of these initiatives difficult to monitor, calls into question the relevance of the data produced for developing RELs and/or RLs, complicates the identification of desirable synergies, leads to duplication and inconsistencies, and demands redoubled efforts. Furthermore, competent authorities are neither informed about certain research work nor allowed access to data and outputs due to intellectual property rights. Such counter-productive situations run against national interests. Aware of these challenges, the COMIFAC countries recently initiated two regional projects funded by the World Bank and the Congo Basin Forest Fund (CBFF) to create a regional registry of MRV initiatives and to reinforce collaboration and data sharing.

The high cost of high-resolution satellite images, as well as of radar and LIDAR data, limits the capacity of sub-region countries to use remote sensing to undertake the analyses needed to monitor forest degradation and restoration. The operating costs and technical challenges of

44 FCCC/SBSTA/2007/MISC.14
45 See FCCC/SBSTA/2011/MISC.7

interpreting the data produced hinder countries in the sub-region from using these techniques on a regular basis or over their entire territory (see Chapter 1). Intellectual property rights limit access rights, notably for financial reasons, to data sets developed by others.

National circumstances

During UNFCCC negotiations, COMIFAC countries have steadfastly argued that RELs/RLs should be adjusted according to different national factors. The desire to consider factors with significant potential impact on forest cover makes sense because Congo Basin countries are at the very beginning of their "forest transition", or at the level of Stage 1 in the figure below (figure 5.5). However, without the implementation of preventive measures, their development and demography could lead to sharp growth in their forest GHG emissions.

Diverse situations are found across the Congo Basin. Some countries can point to particular situations such as armed conflict, specific deforestation and degradation drivers, illegal extraction of wood, fires and other natural catastrophes, etc., that affect forest cover. The quasi-permanent cloud cover over certain regions and difficulties in accessing others for geographic or security reasons complicate the adjustment of RELs/RLs.

The next steps for the Congo Basin countries

Several countries of the sub-region are still in the planning stages of their REDD+ strategy[46] and the development of their RELs and/or RLs is far from imminent. Only the DRC, which has benefited from the support of the FCPF and UN-REDD Program over several years has made much progress. The other countries of the sub-region will benefit from the DRC's experience. Thanks to the technical support received, Cameroon and the Republic of Congo will soon begin to develop their RELs/RLs. The other countries of the sub-region, thanks to two regional capacity building projects funded by the World Bank and CBFF, are beginning their national REL/RL deliberations by developing a national MRV action plan.

These two regional projects will facilitate exchanges on the feasibility and relevance of common approaches, methodological and policy questions related to the development of RELs and/or RLs, data sharing, and lessons learned.

Given the varying progress achieved by each country, it would seem that the submission of RELs/RLs will stretch over several years. Furthermore, it would be wise to wait while certain key elements regarding the MRV system (which will have certain consequences for the REL/RLs) remain to be defined, notably the parameters, supervision, and technical evaluation process of RELs and RLs.

Photo 5.12: Logs destined for export, transiting the town of Ndjolé, Gabon

46 To date, only the DRC, the Republic of Congo, Cameroon, and the CAR have developed a Readiness Preparation Proposal (R-PP).

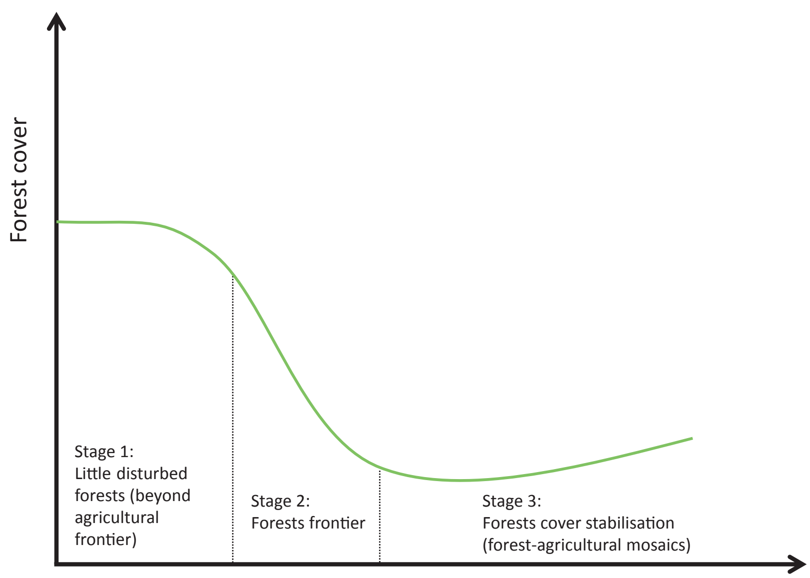

Figure 5.5: Stages of forest cover transition.
Source: Angelsen, A. (ed.) 2008 – (English and French).

Box 5.7 : Quantification of future deforestation in the Congo Basin by means of a global partial balance model

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IIASA

The aim of modeling deforestation in the Congo Basin countries is to gain a better understanding of the possible deforestation dynamics during the forthcoming decades by analyzing the impact of internal and external pressures on the region. This exercise can help build and support the position of the Congo Basin countries in international negotiations on climate and biodiversity. For example, the question of reference scenarios in REDD+ is among the points which have not yet been decided but are crucial for a region with a large area of forest cover and a historically low deforestation rate (Martinet *et al.,* 2009). Modeling will also make it possible to test policies and assist with planning activities in the region (European Commission, 2011).

GLOBIOM is a partial equilibrium model which can be used to study land use changes across the globe (Havlik *et al.,* 2013; Havlik *et al.,* 2011; Schneider *et al.,* 2007). The sectors of the economy integrated into this model are the most significant for land use, namely agriculture (18 crop types and six animal species) and the forestry sector. Production from these sectors may be used for animal or human consumption and for energy production. Production therefore depends on (i) population growth, (ii) changes in dietary habits, (iii) economic growth and (iv) public policies. GLOBIOM is an optimization model whereby the solution ensures the highest possible production and consumption levels taking account of the various constraints present in the economy. Maximization of producer and consumer surplus is also considered (McCarl and Spreen, 1980).

The model is founded on a global database which integrates information on soil type, climate, topography, land use, crop type and management type. The database is built with simulation units ranging from between 10x10 km and 50x50 km (Skalsky *et al.,* 2008). From this, one can "zoom" into the Central African region taking account at the global level of "shocks" which occur in other regions but which influence the regional balance through international trade. Simulations are carried out for every ten-year period, taking into account changes in land use in the preceding period.

Based on the GLOBIOM model, the CONGOBIOM model takes into account the specific characteristics of the Congo Basin countries (Megevand *et al.,* 2012) and has yielded the following results:

- Large risk of acceleration of deforestation in the Congo Basin over the next 20 years, notably due to the development of transport infrastructure (Mosnier *et al.,* 2012).
- The increase in agricultural yields may lead to an increase in deforestation if a resulting price reduction leads to a strong increase in demand, internal and/or from other regions, which would increase cultivated areas (Alcott, 2005; Jevons, 1865).
- The potential competition between the objectives of deforestation reduction and development of the sub-region must not be neglected.
- The introduction of strict constraints on deforestation without measures to assist the farming sector is liable to result in internal price increases and to increasing food imports, while the development of infrastructures and of the farming sector without reinforcing management capacities may increase deforestation.

In conclusion, the effectiveness of REDD+ policies depends on a good balance between control and incentives on the one hand, and on strong inter-sectorial collaboration on the other hand.

In order to take into account forest degradation processes and all existing information on land use in Central Africa, a second version of the CONGOBIOM model was introduced in 2012 for a four-year period as part of the REDD-PAC (REDD+ Policy Assessment Center) project (www.redd-pac.org). In that process, the model was adapted to the country level. The main goal is to identify REDD+ policies which favor economic development and biodiversity conservation.

The question of how REDD+ can be integrated with other benefits, such as biodiversity conservation, is often posed. Bonobo conservation in the DRC is presented here as an example of how this question may be approached.

REDD+ can contribute to a range of policy goals in addition to climate mitigation. Social benefits, such as poverty alleviation (including from carbon payments), clarification of land tenure and better forest governance may arise from the implementation of REDD+. In addition, REDD+ can help secure ecosystem services that underpin local livelihoods (e.g. non-timber forest products and soil erosion control) and national economies, (e.g. through the preservation of vital water cycles and by providing recreational benefits for tourism). At the same time, by maintaining or restoring natural forests, REDD+ can be beneficial for the conservation of forest biodiversity. However, there is also a need to avoid risks to biodiversity conservation from REDD+. For example, if plantations of non-native species are used to enhance carbon stocks, this may damage natural ecosystems.

The potential benefits from REDD+ interventions are highly context-dependent and depend on both the value of the individual forest in terms of biodiversity and ecosystem services and on the pressure on the forest, which varies from place to place. Carefully designed REDD+ interventions in strategic locations could benefit the climate as well as help to conserve rare and endangered species.

The *Direction des Inventaires et Aménagements Forestiers* (DIAF) of the DRC's Ministry of the Environment, Nature Conservation and Tourism, the OSFAC, and the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) are collaborating to map potential environmental benefits from REDD+ in the DRC with support from the UN-REDD Program. A first report, containing spatial analysis on the potential for biodiversity conservation benefits under REDD+, was launched in July 2012 (Musampa *et al.,* 2012).

Spatial analysis can also be used to identify and illustrate potential tradeoffs between the benefits from REDD+. For example, if REDD+ interventions were selected only for their carbon emission reduction potential, there is a risk that valuable forest biodiversity and ecosystem services, which do not overlap with these areas of high carbon potential, will suffer negative impacts. In the following section, we use bonobo conservation as an example to illustrate these concepts.

Figure 5.6 shows a spatial analysis of the bonobo (*Pan paniscus)* range (Caldecott & Miles, 2005) alongside existing protected areas (WRI, 2010), logging concessions (WRI, 2010) and historic deforestation between 2000 and 2005, and 2005 and 2010 (OSFAC, 2010). Forests near areas that have recently been deforested are assumed to be at a relatively high risk of future deforestation. Table 5.4 indicates potential REDD+ interventions in the DRC and how they could be designed to secure bonobo habitat, based on the information presented in Figure 5.6. However, these interventions do not substitute for holistic conservation planning for bonobos, which should include determining where the largest populations of bonobos are located within their range.

Photo 5.13: Baka hut in north of Gabon

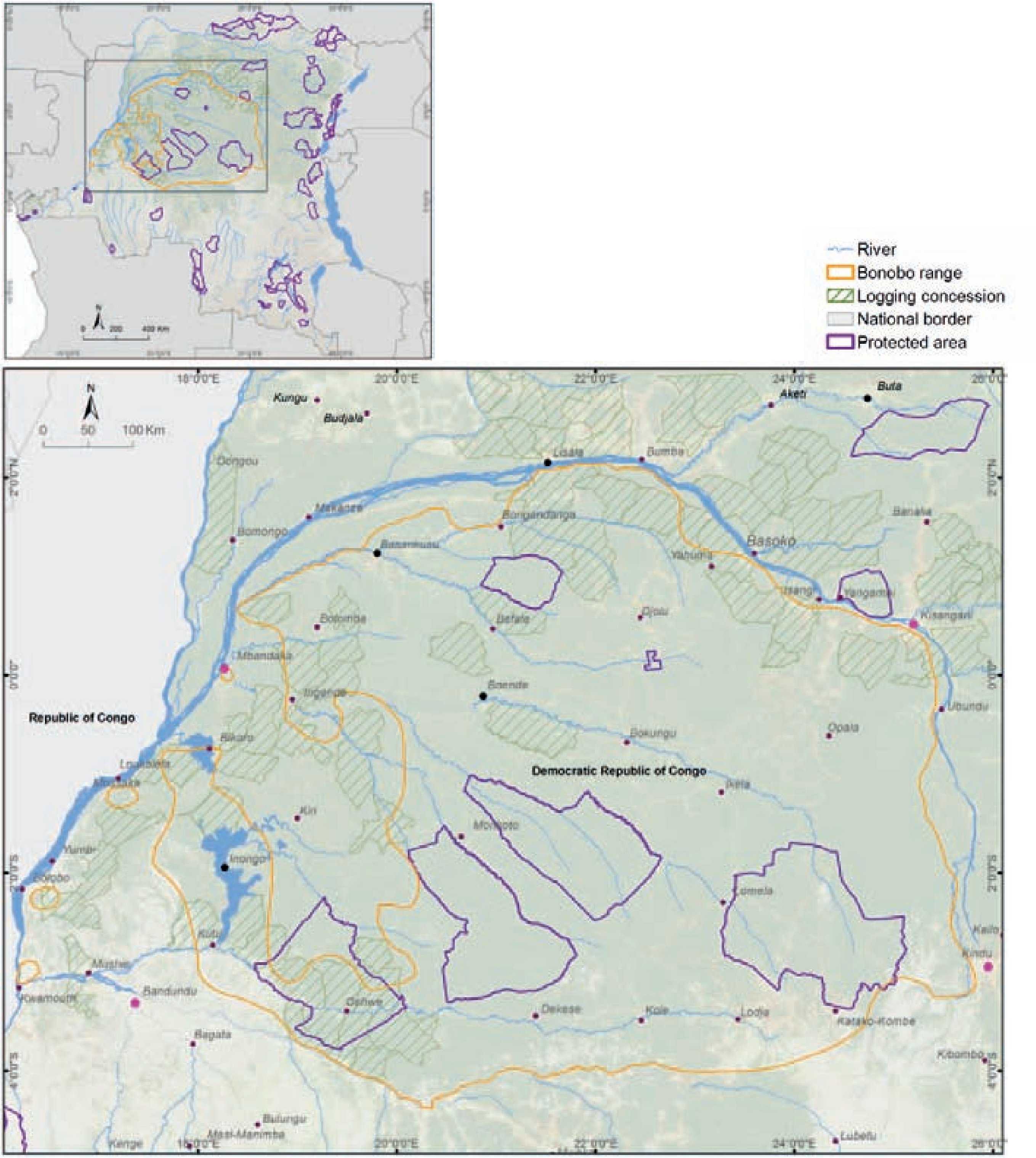

Figure 5.6: A demonstration of how spatial analysis can support planning for multiple benefits from REDD+, using bonobo conservation as an illustration. This map may support decision makers in planning for different REDD+ interventions, some of which are indicated in Table 5.4. The map shows a bonobo range map (Caldecott & Miles, 2005), protected areas and logging concessions data (WRI, 2010) and newly created bonobo reserves (MECNT, 2009 a, b, c). Land cover data and recent forest cover loss (OSFAC, 2010) are used as the base map. Forests within protected areas come under the forest zoning category of Forêts classées[47] that is referred to in Table 5.4.

47 *Forêts classées* is a forest-planning category in the 2002 Forest code of the DRC under which user rights are restricted and industrial activities prohibited. Forests within protected areas, sanctuaries and botanic gardens automatically fall under this category (see Articles 12-16 of the 2002 Forestry Code of the DRC).

The bonobo is classified as an endangered species and, unlike its nearest relative, the chimpanzee, it is only found in the DRC (Fruth *et al.,* 2012). Bonobo conservation in the context of REDD+ planning illustrates a potential tradeoff between the benefits from REDD+. Bonobos do not continuously occupy the range shown on the map (figure 5.6) but, instead, favor mixed forest and savanna woodland habitats (Caldecott & Miles, 2005). Because savanna woodlands have lower carbon stock than other forest areas, these forests might not be targeted by REDD+ interventions. Furthermore, if the sole focus of REDD+ is on high biomass (and high carbon) areas without regard to additional benefits, REDD+ activities may even be detrimental to biodiversity conservation, because REDD+ activities might shift land-use pressures from high biomass forest areas to savanna woodlands and thereby inadvertently but negatively impact important bonobo habitat.

In summary, spatial analysis of biodiversity and ecosystem services can help to identify REDD+ interventions that result in multiple benefits. It can also demonstrate where there is a tradeoff between potential benefits and highlight risks that may result from implementing REDD+ in certain areas.

Table 5.4: *This table describes some possible REDD+ interventions that may be carried out in the DRC. It highlights how the map in figure 5.6 may help identify the location of the interventions that will deliver biodiversity benefits to bonobos. Support to bonobo conservation is used as an example of a multiple benefit from REDD+.*

REDD+ interventions from the DRC's REDD+ framework strategy (CN-REDD, 2012)	**Zone in which this intervention could be undertaken with potential benefit to bonobo conservation**	**Potential benefits for bonobo conservation[48]**
Forest zoning through the definition of a Permanent Forest Domain and the designation of 15 % of forests as "*Forêts classées*" (classified forests).	Forests which intersect with bonobo range.	Zoning new areas as *Forêts classées* between existing *Forêts classées* may reduce fragmentation of bonobo populations. This intervention may be particularly timely as Junker *et al.* (2012) estimated that there has been a 29 % reduction in suitable conditions within the bonobo's range since the 1990s.
Tenure reform: Resolve conflicts between forestry concessions and protected areas. Clarifying the status of these areas of overlap may help avoid the deforestation and degradation associated with uncertain land tenure (Quan *et al.*, 2008).	Forest concessions that overlap with protected areas, in bonobo range.	Clarification of the status of these protected areas would inform the targeting of conservation actions and reduce degradation of threatened habitat.
Sustainable management of forests, facilitated by encouraging logging companies to undertake certification and improve their concessions' management plans.	Forest concessions that overlap with bonobo range.	Habitat degradation, partly through commercial logging, is one threat to the bonobo (IUCN, 2012). Prioritising sustainable management of forests in concessions which may contain bonobos could have a positive impact on populations, particularly if the management plans limit the number of logging roads opened, which have been shown to have a negative impact on populations (IUCN & ICCN, 2012).
Other possible REDD+ interventions		
Strengthen protected areas through participatory community forest patrolling.	Current protected areas where historic deforestation has occurred. Forests near to areas that have recently been deforested are assumed to be at a relatively high risk of deforestation in the future.	Commercial hunting for bushmeat threatens bonobo populations (IUCN, 2012). Guard protection within parks is associated with higher population densities (Guislain & Reinartz, 2010/2011), while also reducing deforestation.
Forest rehabilitation through the replanting of native tree species in degraded areas.	Forest areas in the bonobo range that have experienced deforestation between 2000 and 2010.	Restoring degraded land increases the amount of suitable habitat for bonobos, which is currently under pressure (Junker *et al.*, 2012).

48 The distribution and population density of the bonobo is uncertain within its range, which is patchily occupied. Interventions could only be assumed to be beneficial for bonobos where they are present.

4.4 How REDD+ and FLEGT are coming together in the Congo Basin

FLEGT stands for Forest Law Enforcement, Governance and Trade. While REDD+ is associated to international negotiations on climate change mitigation, FLEGT is linked to a policy package put forward by the European Union – the EU FLEGT Action Plan – which aims to reduce illegal logging by strengthening sustainable and legal forest management, improving governance and promoting trade in legally produced timber (see Chapter 2). Timber-exporting countries can engage in FLEGT notably through a Voluntary Partnership Agreement (VPA), which is a legally binding trade agreement with the EU to ensure that timber products exported to the EU come from legal sources and benefit from preferential market access. By mandating consensus-building in the country concerned, FLEGT VPAs have prompted a broad range of stakeholders to come to the table and provided a forum for discussions about forest governance and sector reform.

The Congo Basin is a region with strong country engagement in both the REDD+ and FLEGT VPA processes. Three countries have signed a FLEGT VPA with the EU – the Republic of Congo, the CAR and Cameroon – and two countries have entered into formal negotiations for a VPA – Gabon and the DRC. The same countries have also engaged in REDD+, with varying degrees of advancement. The Congo Basin is one of the regions that have most evidently and simultaneously engaged in both processes.

The combined expected benefits of the FLEGT VPA (i.e. future preferential access to the EU market for timber products) and REDD+ processes (i.e. future incentives for reducing forest-related emissions) have helped to ensure that forest sector reforms remained high on the political agenda over the last few years. Both processes work towards the common objective of improving forest governance and the sustainable management of forest resources. They also share the ambition to go beyond traditional forest sector interventions, and address underlying drivers of deforestation such as weak or inadequate policy coordination and land use planning, unclear legal frameworks, non-transparent decision making, corruption, etc. In a way, the FLEGT VPA and REDD+ processes are complementary and results-based, leading towards a more legal and sustainable timber trade (FLEGT VPA) and carbon and non-carbon benefits (REDD+).

The interactions between FLEGT and REDD+ are particularly important in the Congo Basin given the relative importance of the formal and informal forest sectors. FLEGT helps to clarify and enforce legal standards in the formal forest sectors, which tends to lead to more sustainable forest management and contribute to REDD+ objectives. The artisanal logging sector has been more challenging to include in FLEGT VPAs due to its informal nature in the region, and the incentive that REDD+ can bring to improve practices is expected to be essential. The issue of regulating informal activities is often related to forest rights and tenure reforms in the region, another area where the combined political importance of FLEGT and REDD+ stands a higher chance of advancing these difficult reforms. Also, with agricultural expansion expected to be the most important future driver of deforestation in the Congo Basin, FLEGT VPAs may provide lessons and experiences in promoting in-country dialogue to address challenging issues around clearing of forest for agricultural commodities.

Photo 5.14: Logs washed onto Gabon beaches

Despite these commonalities, the FLEGT and REDD+ processes are not always well-connected in the Congo Basin countries. In some countries, the process dynamics are different or stakeholders have engaged in each process without an integrated vision of how to advance the two processes together. Gradually, stakeholders in the region are starting to realize the opportunities to integrate the REDD+ and FLEGT processes more closely. In the Republic of Congo, for instance, where the R-PP identifies the implementation of the FLEGT VPA as a strategic option for REDD+ development, a common information platform has been created for both the FLEGT VPA and REDD+ processes in order to increase transparency and facilitate access to information. Also, the civil society is organized to participate in a coordinated way in the two processes. In the DRC, common REDD+ and FLEGT institutional structures are now being tested at provincial level to avoid a duplication of efforts that the parallel decentralization of these processes could lead to. Significant experience in independent forest monitoring gained from the FLEGT process in the Republic of Congo, Cameroon and the DRC is relevant to REDD+ monitoring. Many of the national REDD+ strategies now seek to build on these FLEGT forest monitoring experiences to develop the structures and methods needed for independent monitoring in the context of REDD+.

4.5 REDD+ : land rights and tree tenure

The REDD+ process requires definition and clarification of land rights and tree tenure.

It is difficult to imagine a national REDD+ land-use strategy without identifying and taking into account the zoning of forests to be conserved over the long term. The legal status (property of the state, individual persons or entities, public authorities, national estate or public estate) of these "permanent forests" or "permanent forest estate" remains open. In Cameroon, the permanent forest estate (legally constituted through a classification act) is the property of the state and local public authorities. In Gabon and the DRC, protected areas are classified as public domain, but the notion of the permanent forest estate is not directly understood as an explicit land-use planning category.

The permanent forest estate or the permanent forests is not entirely classified as a single legal category. Similarly, a forest land tenure classification can include both permanent and non-permanent forests. For example, within a community forest, wooded areas managed in a simple manner can co-exist alongside areas that have been or that will be converted to agriculture. In this case, "community forests", often the only legal status accessible to communities, describe a social reality that is outside a single legal category : community land, an area where different user rights are exercised. In the DRC, where local community forests are undoubtedly more widespread than in Cameroon, one can imagine a portion of community forests with a forest management plan contained within a future permanent forest estate while other community forest areas are designated for other uses.

The question of land rights and the sharing of carbon benefits depends heavily on the REDD+ architecture adopted by various countries. While, as foreseen in the negotiations, payments are made at the national (or provincial) level, the transmission of incentives to local actors will seemingly take place through "Payment for Environmental Services" (PES) type projects and programs, and the issue of carbon ownership should not arise (see box 5.8). However, the establishment of contractual agreements with populations (communities, family units), so that they preserve their forests or restore the ecosystem, will require the recognition of exclusive rights over the areas concerned. These exclusive rights do not necessarily imply a recognition of full and entire ownership (some rights can be restricted), but these factors must be taken into account in existing law.

In contrast, if REDD+ projects are compensated based on their performance, issues specific to carbon rights will arise. It is sometimes noted that local land rights must be clarified in order to plan how REDD+ carbon benefits are to be shared. This needs to be clarified. If one dismisses the idea of compensating local users for the carbon stock contained in their forests but adopts the principle of compensating measurable efforts (which assumes a reference scenario) the question of land rights (" who does the forest belong to ? ") becomes secondary in relation to actors engaged in conservation, reforestation etc. The question of ownership of carbon credits will only arise when there are huge profits (once all project costs have been covered). If, in this case, the holders of customary rights are able to claim a share of the benefits, what will the states, which often consider themselves to be the owners of the forests, demand?

Box 5.8: A national payment program for environmental services (PES) for the application of the REDD+ into the Democratic Republic of Congo?

The DRC has opted to establish a "National Redd+ Fund" (NRF), mainly with international financing, to fund the policies and measures intended to combat deforestation and forest degradation. These can be on the one hand, "REDD+ projects" advanced by private organizations which have available private or international public financing (World Bank funding, Congo Forest Basin Fund, GEF, FFEM, etc.); and on the other hand, the national PES program financed mainly by the NRF and other sources. The PES is one of the government tools intended to meet national deforestation prevention goals which aims to modify destructive «slash and burn» farming techniques practiced by villagers in forested and peri-forested areas. The PES consists of both contractual tools (including conditionality) based on incentives, as well as investment tools to enable building, with PES beneficiaries, sustainable and profitable alternatives to destructive farming practices.

The PES consists of two distinct, inseparable sections:

- Investments intended to structurally change the current agrarian system, –where this system negatively impacts the forest canopy– in order to increase crop yields from areas targeted by zoning plans, and to enable farmers to manage fertility via other means than the annual clearing of a new forest areas. These investments also enable diversification of local economic activity through the introduction of non-farming activites wherever possible and realistic. The creation of new plantations comes under this "investments" category (even if maintenance and upkeep may belong in the first category; commitment to a micro-zone plan, stabilizing land usage). Generally-speaking, these investments are aimed at households and rarely at communities.

- The creation of the national PES program must proceed after mapping the opportunity costs of maintaining the forest canopy. This will illustrate the average potential gross margins of different crops which could be produced in forested zones. This mapping of potential margins must allow for a choice of eligible areas for PES programs, priotitizing those areas where the likelihood of converting forest into farm land is very high in the short term and ignoring areas where the the forest canopy is not seriously under threat in the short-run. Other criteria may be taken into acount, such as the proximity to protected areas or transportation or restored transportation routes (increasing deforestation risk).

It has been suggested that PES projects should be identified and managed by organizations or companies on the basis of specifications drawn up by the CN-REDD, while the Environmental Services Division (ESD) refers these proposals to an experts committee whose responsibility is to evaluate their relevance and feasability.

5. Lessons learned and considerations for future implementation

REDD+, as a new climate policy and finance instrument was welcomed by governmental and non-governmental stakeholders in the Congo Basin, although with different expectations and understanding about what REDD+ could achieve and the associated risks. Despite the fact that the REDD+ mechanism entails sophisticated capacities to design and operate, many Congo Basin countries have embraced it and remained determined to try to implement it.

Furthermore, REDD+ has represented a revitalization of the importance of forest conservation and the promotion of sustainable rural livelihoods in the region after years with little political commitment and slow progress. REDD+, thanks to its potential trigger of international finance, has attracted political attention to the objective of forest conservation, while embedding it within a broader context of sustainable development.

REDD+ has attracted a wide array of stakeholders in the Congo Basin, bringing different experiences and priorities to the table. In this sense, REDD+ has created a multi-stakeholder dynamic around forest conservation and forest-related sustainable development not seen with previous endeavors. Although there has been a divergence of views and approaches, the integrating potential of REDD+ is powerful and should be further exploited. In essence, REDD+ has injected the participatory spirit of international climate-change policy into national forest policy, fostering a multi-stakeholder dynamic in forest policy reforms and in forest program design.

However, while there is a general feeling of optimism and enthusiasm surrounding the REDD+ mechanism in Central Africa, some stakeholders have grown skeptical. Some of the problems they have identified with the REDD+ process in Central Africa include:

- The creation of expectations that cannot be fulfilled, especially because progress has been slower than anticipated at the onset of the REDD+ Readiness processes;
- The generation of vague discussions, planning initiatives, and excess analytical consultations among development practitioners and officials (who are often members of the urban elite), which are often disconnected from local realities; and,
- A focus on forest carbon, which may dilute other conservation and development priorities.

These concerns with REDD+ must be considered to raise awareness of risks, methodological shortcomings and misconceptions.

After four full years of REDD+ in the Congo Basin, many reports, analyses and urban-based consultations have been conducted (e.g. R-PPs, studies on the drivers of deforestation, mapping of carbon densities, and countless workshops and consultative meetings). While these processes may seem to be disconnected from the realities of forests, deforestation and forest peoples, this sentiment offers an incomplete reflection of the reality. REDD+ as a national – and new – mechanism does require substantial national-level analysis, dialogue and planning, especially if it is to influence and reform policies.

At the same time, over the past four years, REDD+ endeavors across the region have stimulated a number of initiatives at the local level, including new projects (and investments), consultations, and new approaches to development planning and project formulation (e.g. moving beyond traditional conservation to tackle the fundamental drivers of deforestation). In the DRC, national REDD+ Readiness efforts have mobilized and significantly raised forest investments (e.g. Forest Investment Program (FIP) or the CBFF), to levels never seen before in the Congo Basin. Overall, the region has witnessed a smooth blending between national analysis and dialogue, on the one hand, and pilot projects and local investments, on the other.

In spite of these encouraging developments, there are a number of pending issues and potential risks around REDD+ that are specific to the Central African region:

- If the conditions for the REDD+ mechanism become too complex (as defined by the UNFCCC negotiations), the Congo Basin countries may be left behind because of their comparatively weaker national capacities. There are two possible solutions to this problem: (i) countries in the region could remain proactively engaged in negotiations to ensure that technical and policy requirements are adequately accessible to the region; and, (ii) robust, credible and ad-hoc REDD+ systems that suit the current conditions of the region are designed and implemented.

- If donors do not further engage in REDD+ in the region and deploy the level of fast-start climate financing that has been pledged, countries will begin to lose hope in the benefits of REDD+.
- If governments in the Congo Basin do not conduct the fundamental forest sector policy reforms required for implementing REDD+, and they do not demonstrate the ability to manage climate finance with due diligence and respect for key social and environmental safeguards, the flow of financial support required for REDD+ will not follow.

These crucial bottlenecks must be overcome to sustain healthy REDD+ processes, or this latest and promising endeavor for forest conservation and sustainable rural livelihoods will likely not succeed.

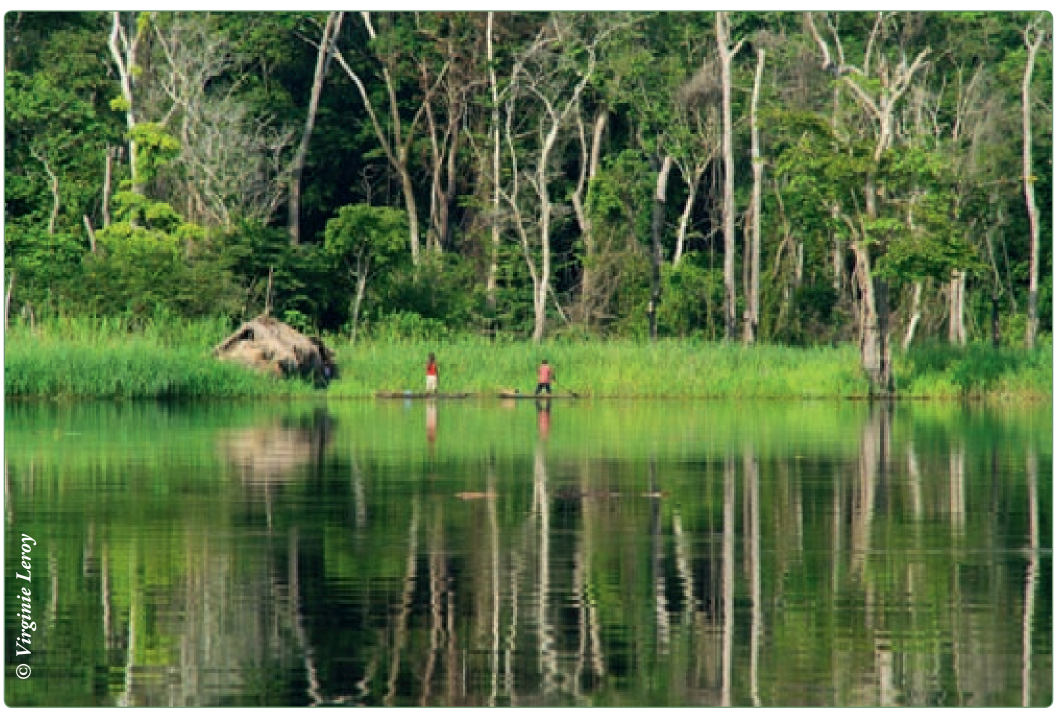

Photo 5.15: Fishermen on the Lukenie River, DRC

PART 3

FORESTED AREAS OTHER THAN DENSE HUMID FOREST

CHAPTER 6

The forest areas of the savannas and steppes of Central Africa

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1. Introduction

The use of the terms “savanna” and “steppe” has not always been accepted by all botanists, most of whom consider that these terms are not of African origin (White, 1983). Depending on the physiognomy of the vegetation, some authors prefer the terms “tree formation”, “scrub formation” and “grass formation”. The concept of a savanna developed in the second half of the 20th century with contributions of English-speaking and French-speaking scientists and researchers from countries where this natural environment is present. The word “savanna” includes multiple concepts, which have developed as a function of various geographic approaches. Thus its definition varies according to biogeography, ecological conditions, climate, soils and geomorphology. At a meeting held in Yangambi in 1956, specialists in African phytogeography discussed savannas but without reaching a precise definition (Aubréville, 1957). Trochain (1957) and Riou (1995) defined savannas as terrestrial plant formations dominated by *Gramineae*. The definition currently used in Central Africa is that of Letouzey (1982), for whom the savanna is a “grass formation comprising a carpet of tall grasses measuring at least 80 cm in height at the end of the growing season, with flat leaves at the base or on the stubble, and herbaceous plants and grass of lesser size”. The African savannas are a fundamental environment for people who practice transhumant animal husbandry and seasonal growing of crops there.

Photo 6.1 : A view of the savanna plain – Ngounié, Gabon

The savannas of Central Africa can be divided into three large complexes:

- the savannas on the southern border of the equatorial forest massif; in Congo they are to be found along the coast, in the Niari valley, in the Bateke region and in the Congo Basin. They extend in the north towards Gabon and in the south towards a large part of the Democratic Republic of Congo (DRC);

- the savannas on the northern edge of the equatorial forest massif, together with the forest, form a mosaic; this is the transitional zone between the semi-deciduous forest in the south and the Sudano-Guinean savannas to the north;

- the integrated savannas within the forest massifs, e.g. the Lopé savannas in Gabon and the Northern Impfondo savannas in the Congo Basin.

The steppes are open grass formations, comprising a discontinuous herbaceous carpet and composed mainly of annual species, with the occasional presence of a few timber species. They are associated with either the degree of aridity (climatic steppe) or to the soil (edaphic steppe). The timber stratum is of low density and less than 10 m in height (Letouzey, 1982). According to Aubréville (1957), depending on the amount of timber growth there are three types of steppe: grass steppe, scrub steppe and bush or tree steppe. The steppe differs from the savanna in having scanter vegetation, replacement of large *Gramineae* by smaller *Gramineae*, and fewer tree and scrub species, the latter being adapted to the aridity (smaller leaves, thorns).

The three savanna complexes in Central Africa share several common characteristics: in all regions they coexist with the forests and regularly burn during the dry season. The steppes, on the other hand, are protected from fire by the discontinuous nature of the herbaceous carpet, which is mostly composed of annual species that disappear during the dry season (Letouzey, 1982). The steppes, like the savannas, are threatened by desertification and climate change and by non-sustainable agricultural and environmental practices, which is leading to a decrease in their biological diversity and the appearance of invasive species. Accordingly, the management of the natural resources of the savannas and steppes are among the major environmental concerns at the global level. The United Nations Convention to Combat Desertification (UNCCD), adopted in Paris on 17 June 1994, defines a framework for developing these ecosystems through an integrated approach and measures that will contribute to their sustainable development. Unfortunately, the forest areas within the savannas and steppes of Central Africa have so far received very little attention compared with the dense rainforests. However, all the Central African countries have integrated these areas into their national policies on reduction of greenhouse gases in the forestry sector, notably by promoting measures (payment for environmental services) that will encourage the conservation of these forest areas.

Photo 6.2: Steppes of the Bateke Plateau, Congo

2. The environmental and socio-economic context of the savannas and steppes of Central Africa

The savannas and steppes of Central Africa are subject to substantial climatic variations in the course of the year linked to the movement of the inter-tropical front. Rainfall is low compared with that in the dense rainforest areas. It is extremely variable over time, area and intensity, which may reach 200 mm/hour. In the dry season the low humidity of the air and the very strong insolation cause generally high air and soil temperatures.

Soils have a number of common characteristics:

- their evolution is slow and their depth often shallow;
- the organic matter is highly weathered, and is either scanty and superficial or where more abundant. and distributed throughout the soil profile;
- the structure is, in general, poorly defined;
- the mineral elements show relatively little deterioration;
- the clay colloids are stable;
- the soluble elements are concentrated at one level of the profile and may give rise to nodules or calcareous, gypsiferous or saline crusts;
- hydromorphic areas are frequent, especially in semi-arid conditions;
- the risks of wind and water erosion are very high.

Photo 6.3: Mosaic of forests and savannas – near Berberati, CAR

The savannas and steppes of Central Africa are used for livestock rearing and growing crops. The crops are essentially rain-fed and consequently dependent on the characteristic climatic variability of these regions. The role of livestock in the agricultural economy of the countries with savannas and steppes is very important. Livestock production in the early years of the 21st century is an essential and vital component of the area's production systems, accounting for about 11 to 15 % of the gross domestic product (GDP) of Cameroon, Chad and the Central African Republic (Jamin *et al.*, 2003). Livestock production also plays an important role in the development of sustainable agriculture of the savanna region in Central Africa. In the three above-mentioned countries, agriculture contributes 32 % of GDP on average. Although currently small in terms of the number of livestock and people involved, the free and anarchic use of the natural plants by transhumance encourages the expansion of these herbaceous areas (Boutrais, 1985; Eba'a Atyi and Boukong, 2010).

Fishing, beekeeping and the gathering of non-timber forest products also form part of the economic activity of these regions.

3. The forests in the savannas and steppes of Central Africa

The forest areas outside the dense rainforests in Central Africa vary according to whether they are situated in the Guinean-Congolese, Sudanese, Zambezian or Sahelian regions, or in the various transition zones such as the Sudano-Guinean area, the Guinean-Congolese/Zambezian area, or the Sudano-Sahelian area. In some cases, altitude causes changes in the plant composition of these areas regardless of their climatic zone.

3.1. Forest areas in the savannas of the Guinean-Congolese region

The peri-forest or integrated savannas:

These are large expanses of savanna which develop as broad massifs on the edges of forests or within the forest massif (integrated savannas). They comprise forest-savanna mosaics which include forest elements and savanna elements. The trees and shrubs in the peri-forest savannas are scattered, while the grass in these areas forms a continuous carpet (Mayaux *et al.*, 1997). In some cases, strips of forest surrounded by vast areas of savanna are found along alluvial benches: these are forest galleries. They are situated primarily in Cameroon, Gabon, the Republic of Congo, the Central African Republic (CAR), and DRC.

Photo 6.4: Lopé National Park station, Gabon

3.2 Forest areas within savannas in the Sudano-Guinean region

This is the transition area separating the Guinean-Congolese and Sudanese regions. White (1986) describes them as a very narrow band of vegetation situated in the north of the Guinean-Congolese region and traversing the following three Central African countries as far as Uganda:

• Cameroon: the high plateaux in the west, the Adamaoua plateau, the Mbam and Noun valleys;

• CAR: according to Boulvert (1980), the center around Dekoa and to the south-west of Bouca; towards the south-east of the country between Mouka and Obo; in the south on the Ouaka plateaux and around Bossembelé; and to the west in the Carnot and Bouar savannas;

• DRC: north-west of Equateur province; north of the Uélés and east of Ituri.

These areas contain grass savannas, wooded savannas, clear forests and dry dense forests, according to the terminology used by Aubréville (1957) and Letouzey (1982). The illustrations of these various formations are taken from Letouzey's manual on forest botany (1982).

Box 6.1 : Linear forestry in the highland humid savannas of west Cameroon

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The highland humid savannahs of west Cameroon offer a wide variety of landscapes. The vegetation, modified by human activities, is a mosaic of crops, grasslands and small forest patches (sacred forests, gallery forests, etc.).

High population densities (180 to 250 inhabitants/km²) put heavy pressure on land and natural resources. Farmers have integrated trees into their lands, notably in the form of hedges, to obtain needed diverse timber and non-timber products. These hedges have evolved over the years, from multi-use plantations with a combination of numerous woody and shrubby species to a veritable "unilinear", at times monospecific, tree plantations. In this hedge-and-field system, the following types of hedges are found: mixed or multi-species hedges, *Eucalyptus* and *Pinus sp* hedges, *Polyscias fulva* hedges, *Podocarpus latifolius* hedges and *Entandrophragma candollei* hedges.

Mixed hedgerows originally start out as fences made of closely spaced pickets of *Ficus sp* that will, for the most part, generate shoots. They are linked horizontally by raffia palm fronds attached with raffia twine. These hedgerows are gradually enriched with diverse species from cuttings or non-grafted plants including *Dracaena sp, Croton macrostachyus, Vitex cienkowskii, Ficus thonningii, Schefflera barteri, Canarium schweinfurthii, Vernonia amygdalina, Kigelia africana, Khaya grandifoliola, Markhamia lutea, Albizia glaberrima, Spathodea campanulata, Adenocarpus mannii,* etc.

***Eucalyptus sp* and *Pinus sp* hedges**: as the growth of local species in mixed hedges is slow, a trend in the last few decades is to plant fast-growing exotic species in monospecific rows. The monospecific hedges do not exhibit the multiple functions of mixed hedges, but serve to demarcate land and to produce wood. The most widely used species is eucalyptus which provides poles, stakes, sawn wood and firewood. Eucalyptus sustainably produces these wood products by growing new shoots through mixed-age coppice. Pine also is planted to mark the boundaries of "concessions".

***Polyscias fulva* hedges**: this local fast-growing species produces a light wood which is easy to sculpt. In the Foumban region, where it is used to make traditional elongated masks, it has become scarce. Planted in close rows, it grows rapidly (Njoukam *et al.,* 2008).

***Podocarpus latifolius* hedges**: this species, native to Mont Oku in the northwest of Cameroon, grows at altitudes of 2400 to 2900 m. Farmers plant them in single, closely packed rows (up to 4 trees per meter) to demarcate their fields. Seeds are sown in the dry season on wetlands. Seedlings are transplanted during the rainy season. Podocarpus produce poles and sawn wood (Temgoua *et al.,* 2011).

***Entandrophragma candollei* hedges**: Kosipo is a mahogany which did not naturally exist in the village of Bayangam in northern Cameroon. It was introduced over a century ago by a peddler who brought in seeds that he planted on his farm. Since then, this species has been planted in hedgerows and on the edges of traditional dance areas. It produces very handsome, straight and cylindrical boles.

3.3 Forest areas in savannas in the Guinean-Congolese/Zambezian transitional region

According to White (1986), these Central African landscapes comprise :

- plant formations equivalent to the dry dense forests and clear forests (DRC – provinces of Bandundu and Katanga) ;
- grass savannas, wooded savannas and scrub savannas in the Republic of Congo (Niari valley, cataract plateaux, Bateke) and in DRC (provinces of Bas-Congo, Bandundu, western and eastern Kasaï, and Katanga).

Figure 6.1 : Dry dense forest (Letouzey, 1982).

The **dry dense forests** in figure 6.1 have little herbaceous undergrowth ; this is very different from the herbaceous flora of neighboring savannas (Schnell, 1976). Rainfall is 1 000 to 1 500 mm per annum with a clearly marked dry season. Exceptionally, they may occupy dry and stony soils in wetter regions. An example of the composition of these forests in the Sudano-Guinean zone of CAR is given by Boulvert (1980) ; he gives them the name "dense semi-humid forests with *Anogeissus leiocarpus-Abizia zygia*". In the Guinean-Congolese/Zambezian transitional area, White (1986) states that the dry dense forests are scattered over the Kwango plateau (Katanga province, DRC, where they are known as "mabwati"). The timber species characteristic of the dry dense forests are listed in Annex 3.

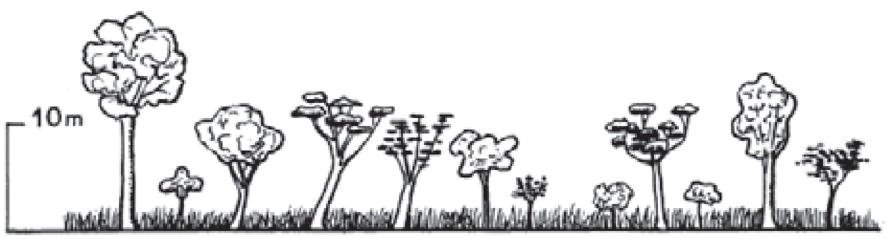

Figure 6.2 : Wooded savannas (Letouzey, 1982).

Wooded savannas are formations in which the trees and bushes form a clear cover (20 to 70 % coverage) which allows copious light penetration (figure 6.2). The timber species characteristic of wooded savannas are listed in Annex 3.

Tree savannas (figure 6.3) are characterized by a continuous herbaceous stratum of at least 80 cm in height with a very variable timber cover (2 to 20 % of cover). The timber species characteristic of the tree savannas are listed in Annex 3.

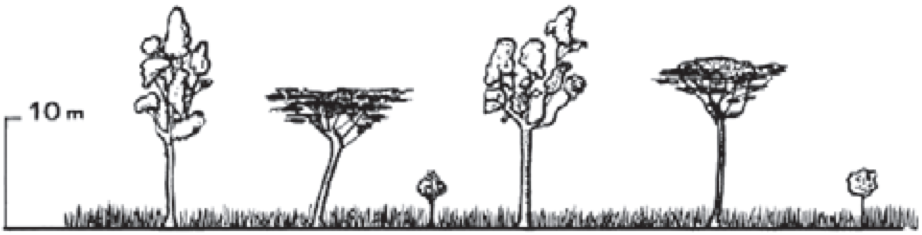

Figure 6.3 : Tree savanna (Letouzey, 1982).

The scrub savannas (figure 6.4) resemble the wooded savanna but the tree stratum is replaced by a bush stratum (Annex 3). The proportion of bush cover is less than 70 %.

Figure 6.4 : Scrub savanna (Letouzey, 1982).

3.4 Forest areas of savanna in the Sudanese region

These are found in a narrow strip which runs through :

- Cameroon : high basins of Faro, Bénoué, Mayo-Rey, Northern Vina and Mbéré ;
- CAR : according to Boulvert (1980), the southern limit is sinuous (to the west it begins at a latitude of approximately 7° north, at the center the curve descends to 6° North and in the east it descends again to 6°30' North after rising to 7°45' north ; the average northern limit is below 8°30' north ;
- Chad : extreme south.

These landscapes contain mainly clear forests. The timber species characteristic of the clear forest are listed in Annex 3. Clear forests (figure 6.5) are dominated by legumes and *Combrataceae*. They are composed of bulky trees with short trunks and a broad crown rising to approximately 20 m and with, in most cases, small deciduous leaves.

3.5 Savanna-forest landscapes in the Zambezian region

In Central Africa, these landscapes are found only in the province of Katanga in the DRC. The clear forest is the most widespread type of vegetation and the most characteristic of the Zambezian region (White, 1986). Here, the clear forest of the "miombo" type predominates. In terms of flora and physiognomy, the miombo is very different from the other types of clear forest. It is almost always dominated by *Brachystegia* species, alone or in association with *Julbernardia* and *Isoberlinia*. The dominant species are extremely gregarious and are found only rarely with other types of vegetation. It is the shape of the dominant trees which gives the miombo its characteristic appearance. Their trunks are in most cases short but relatively thin and the branches first climb sharply upwards before spreading out to support the light crown, which is not very thick, and flat at the peak ; it produces feather-shaped leaves. The miombo is generally between 10 and 20 m in height.

Figure 6.5 : Clear forest (Letouzey, 1982).

3.6 Forest landscapes in the Sudano-Sahelian and Sahelo-Sudanese transition zone

The Sudano-Sahelian zone forms a transition between the Sudanese region and the Sahelian region and corresponds to a band lying approximately between latitudes 8°30'and 10° North and running through Cameroon, CAR and Chad. The Sudano-Sahelian zone comprises a dry grass savanna, scrub savanna and tree savanna. In CAR, Boulvert (1980) distinguishes a northern and north-western subsector with *Daniellia oliveri, Burkea africana* and *Lophira lanceolata* ; the central and eastern subsector with *Anogeissus leiocarpus, Albizia zygia* ; and the southern subsector with *Daniellia oliveri* and *Terminalia glaucescens*.

In the north of the Sudano-Sahelian zone is a transition zone leading to the Sahelian region : this is the Sahelo-Sudanese zone. In CAR, Boulvert (1980) situates it between 9°30' and 10° North (the Sahelo-Sudanese zone of Birao).

3.7 Forest landscapes in the Sahelian region

These landscapes occur over a great part of Chad and relatively small parts of Cameroon and CAR. The plant formations are principally steppes.

The characteristics common to the various types of steppe relate to physiognomy. Timber vegetation is more or less non-existent or scant. Herbaceous vegetation is discontinuous and plant production, which is highly seasonal, is often very limited.

In accordance with the Yangambi Agreement (Aubréville, 1957) on the nomenclature of types of African vegetation and following the characteristics and density of timber species, there are five principal types of steppe : tree steppe and/or scrub steppe, bush steppe, thorn steppe, succulent steppe and grass steppe. These various types of vegetation develop according to the type of soil.

3.7.1 Sahelian tree and scrub steppes, and bush steppes

Tree steppes (figure 6.6) develop with precipitation between 400 and 600 mm/year. Tree and scrub vegetation is very scant. The timber species of these steppes are listed in Annex 3.

3.7.2 Succulent steppes and grass steppes

Succulent steppes (figure 6.7) are steppes with abundant grassy plants (*Cactaceae*) with a broad representation of succulent plants (Annex 3). Grass steppes are steppe-like formations dominated by herbaceous plants such as *Loudetia simplex, Bulbine abyssinica* and *Panicum turgidum*.

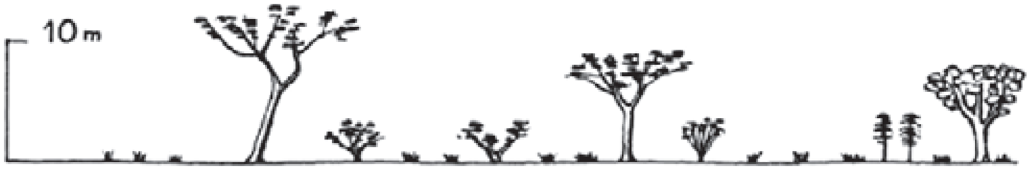

Figure 6.6: Tree and/or scrub steppe (Letouzey, 1982).

Figure 6.7: Succulent steppe and grassy steppe (Letouzey, 1982).

3.8 Forest landscapes in the Afro-mountainous region

These are found mainly in:

- the high plateaux and mountains of western Cameroon;
- the Kivu chain and contiguous high plateaux in DRC;
- the mountains of Rwanda;
- the mountains of Burundi.

Between these areas, relics of Afro-mountainous forest landscapes are intermittently in São Tomé and Príncipe , the Bioko Islands in Equatorial Guinea and Gabon (Vande Weghe, 2002). In Cameroon, Rwanda and Burundi these forests have been subjected to strong agricultural and pastoral anthropic pressure.

According to White (1986), on each mountain vegetation is highly variable. In addition, White (1986) states that, although the floristic differences are often very marked from one group to another on the same mountain, the flora of a particular massif as a whole generally appears fairly close to that of other massifs, whether nearby or distant, so that the collective flora of the "Afro-mountainous archipelago" shows remarkable continuity and uniformity. The timber species characteristic of the Afro-mountainous forest landscapes are listed in Annex 3.

Apart from the Afro-mountainous dense rainforest (1 200 to 1 500 m in altitude), White (1986) draws attention to the presence of the following plant formations:

- the **undifferentiated Afro-mountainous forest**: it usually replaces the rainforest at higher altitudes on wet slopes and at a comparable altitude on dry slopes; it generally receives less precipitation than the Afro-mountainous dense rainforest;
- the **bush formation and the Afro-mountainous evergreen thickets** are found on most of the high mountains of Africa; their floristic composition varies greatly but comprises certain elements of the *Ericaceae* family;
- the **Afro-mountainous scrub formation** replaces the bush formation and the above-mentioned *Ericaceae* thickets on the surface soils of high mountains, in particular on exposed rocky crests; these low scrub formations are very mixed formations in which the following are observed beside the scrub: *Gramineae*, *Cyperaceae*, herbaceous plants (mainly geophytes), bryophytes and lichens.

Box 6.2: The forest areas of burundi

Sylvestre Ndonse
Focal point FRA/FAO et MPFN/FAO

Burundi covers an area of 27 834 km² in the center of Africa. It is surrounded by Rwanda to the north, the Democratic Republic of Congo to the west and Tanzania to the south and east. Burundi has four forest types which cover approximately 13.4 % of the country's surface area:

1. **The natural forests** are all within the national parks, forest reserves and protected areas managed by the MEEEATU through the INECN.

2. **The state forests** are forests planted on state land which are managed by the state and local communities in compliance with the Burundi Forest Code. This shared management method involves the local communities in the protection of natural resources. The communities work on the protection and sustainable management of the forests. In this way, local communities can access the forests and take advantage of the benefits deriving from their exploitation and/or use. Earnings are shared according to ratios which have been negotiated between the participating parties: forestry management groups, local administration and the Forestry Administration.

Nonetheless, the adoption of this management method across the whole national territory is compromised by a lack of finances to carry out forest inventories and devise forest management plans. Another difficulty is the lack of follow-up and evaluation, which makes it impossible to properly evaluate successes achieved.

3. **Communal forests** are forests planted on communal land. They are managed by the local communes. One of the ministerial provisions is that 30 % of revenue from exploitation must be used for replanting and/or maintenance of the forests exploited.

4. **Forests and/or private trees** that are on private land. These are micro-forests, clusters of trees planted trees along contours for anti-erosion purposes or trees planted on pastures located outside of farming land where they form paddocks. All of these tree plantations constitute rural or community forestry. To farm these forested areas, a " cutting license" and authorization to transport farmed products are necessary. These two licenses are subject to the preliminary drawing up of a legal commitment to replant farmed trees or forest. These management procedures facilitate the control and traceability of forest products as well as control of the resulting revenue.

However, these rules are not always respected. Some farmers exploit trees outside of the areas specified in the official documents or declare false surface areas.

Photo 6.5: Terraced cultivation on the Rwandan hills

Box 6.3: Forest areas in the savannas of rwanda

Thaddée Habiyambere
CEFDHAC

Rwanda, with a surface area of 26 338 km², is also known as the land of a thousand hills. Its terrain is characterized by steep slopes and altitudes ranging between 900 and 4 507 m. The climate is temperate, with an average annual temperature of 18.5°C and 1 250 mm of rainfall.

A natural forest in the northern volcano chain contains many of the last remaining mountain gorillas. A relic of dense mountain rainforest remains on the Congo-Nile Ridge to the west. On the more gently sloping hills in the center, the natural vegetation has all but disappeared because of crop and livestock farming. The altitude of the plateaus and plains of the southeast and east is less than 1500 m. They were originally covered with wooded savannah and shrubland that were heavily degraded by clearing for agriculture and the cutting of fuel wood for Kigali city. Apart from a few scattered exceptions, the remaining wooded savannah and shrubland is located in Akagera National Park, which covers 108 500 ha.

The assessment of the national forest cover carried out in 2012 included all woodland areas larger than 0.25 ha. The assessment was conducted by "The Geographic Information Systems & Remote Sensing Research and Training Center" of the National University of Rwanda (CGIS – NUR) and by the "Reforestation Support Program" (PAREF)/Rwanda Natural Resources Authority (RNRA). The assessment revealed that wooded savannah covers 1 772 ha and shrubland 260 674 ha. The majority of these forest types are located in districts of the Eastern (258 491 ha) and Southern (695 ha) provinces, and the districts of Kigali City (59 ha).

Natural forest occupies a total of 385 226 ha in Rwanda, with wooded savanna and shrubland comprising 262 446 ha, or 68% of the forest.

Photo 6.6: Slopes of Karisimbi Volcano - part of Volcanoes National Park, Rwanda

3.9 Areas occupied by the various types of savanna and steppe

Estimates of the areas occupied by the forest areas of savanna and steppe in the 10 countries of Central Africa are listed in table 6.1. Excluding the grass savannas, it is estimated that these areas amount to approximately 152.7 million hectares.

To this table should be added the data for Chad published by FAO (2010: dense forests/gallery forests (183 146 ha), clear forest/wooded savanna (3 147 370 ha), tree formations (8 177 430 ha) and scrub formations (8 846 660 ha).

Table 6.1: *Estimate of areas covered by the various types of vegetation in the 10 countries of the Congo Basin (in 1000s of ha).*

Country	Clear forest/and or dry dense forest	Wooded savanna and/or tree savanna	Scrub savanna	Grass savanna
Burundi	35.1	297.1	222.7	201.9
Cameroon	1 292.1	11 901.7	2 561.2	177.4
Congo	297.8	2 659.4	2 101.6	1 192
Gabon	1.3	787.2	619.3	341.7
Equatorial Guinea	0.2	0.005	0.001	0.1
CAR	3 430.8	34 381.4	4 002.3	62
DRC	23 749.1	36 994.9	6 705.5	4 372.7
Rwanda	0.004	1.8	260.7	153.7
São Tomé & Príncipe	*	*	*	*
TOTAL	28 806.4	87 023.5	16 473.3	6 501.5

Adapted from "State of the forest 2010"
** Data not available*

4. Functions and services of wooded areas of savannas and steppes in Central Africa

4.1 Providing subsistence

In the savannas and steppes of Central Africa, the inhabitants' livelihoods depend on harvesting woodfuel, fodder and non-timber forest products.

4.1.1 Woodfuel

Traditionally, fuelwood is taken by the local people from wooded areas near villages. Dead wood is generally collected from natural formations and fallow land, and living trees are felled when new fields are cleared. Wood for heating and charcoal are the principal domestic energy sources.

Eba'a Atyi *et al.* (2013) estimated that the annual consumption of woodfuel in the urban areas of Cameroon is 2 203 496 tons for fuelwood and 356 530 tons for charcoal, with a total estimated gross revenue of FCFA 186.81 billion per annum.

The gathering of wood for household needs constitutes a heavy workload for women, whereas trade in wood and charcoal is conducted by men.

In CAR, 97.2 % of inhabitants use woodfuel for cooking, but only 3 % is in the form of charcoal. The use of charcoal is gradually growing in the towns but remains marginal (de Wasseige *et al.*, 2012). Even in Bangui charcoal accounts for only 5.5 % of domestic energy consumed (Salbitano, 2009, cited in State of the Forest 2010). Numerous tree species are sought for fuelwood or charcoal because of their energy qualities, which may threaten the existence of dense slow-growing species such as *Dalbergia melanoxylon* or *Prosopis africana* and certain fruit- or timber-producing species. The most widely used species in the Cameroonian savannas are listed in table 6.2.

Photo 6.7: Treating eucalyptus for fuelwood – Bukavu, DRC

Table 6.2: *Savanna species currently used as woodfuel in the savannas of Cameroon*

Spontaneous species	Species protected by man
Afrormosia laxiflora,	*Annona senegalensis*
Burkea africana,	*Prosopis africana*
Combretum glutinosum	*Bombax costatum*
Detarium microcarpum	*Dalbergia melanoxylon*
Hexalobus monopetalus	*Diospyros mespiliformis*
Lannea fructicosa	*Khaya senegalensis*
Strychnos spinosa	*Vitellaria paradoxa*
Securidaca longipedunculata	*Ximenia americana*
Xerroderis stühlmannii,	
Gymnosporia senegalensis	
Terminalia avicennioïdes	
Terminalia glaucescens	
Mitragyna inermis	

Photo 6.8: Woodfuel collection in a savanna zone

The species listed in table 6.3 are commonly used in the Cameroonian steppes (Kemeuze *et al.*, 2013).

The volume of standing fuelwood is estimated at 8.5 m^3/ha in the tree and scrub steppes of Cameroon. Total consumption of fuelwood and charcoal in this region has been estimated at 666 536 tons and 20 058 tons respectively (Eba'a Atyi *et al.*, 2013). In general, the demand for fuelwood and charcoal in the tree and scrub steppes of Central Africa outstrips natural growth. To meet this demand, appropriate reforestation programs are needed.

Table 6.3: *Steppe species commonly used as woodfuel in Cameroon*

Spontaneous species	Species protected by man
Bauhinia rufesens,	*Acacia albida,*
Boscia senegalensis,	*Balanites aegyptiaca,*
Cassia sieberiana	*Dalbergia melanoxylon*
Combretum microcarpum	*Diospyros mespiliformis,*
Ficus spp.,	*Sclerocarya birrea,*
Grewia bicolor,	*Vitex doniana*
Grewia tenax,	
Lannea acida,	
Leptadenia pyrotechnica	
Piliostigma thonningii	
Pterocarpus lucens,	
Sterculia setigera,	
Ziziphus mauritiana	

4.1.2 Wood for the manufacture of handles of tools and other utensils

Various tools and utensils (mortars, pestles, tool handles, etc.) are made from the wood of numerous species, including *Anogeissus leiocarpus, Balanites aegyptiaca, Dalbergia melanoxylon, Sclerocarya birrea,* etc. (Fondoun, 2001).

Photo 6.9: Hoes and axes with wooden handles

4.1.3 Fodder

In the savannas and steppes, trees and bushes constitute an important stock of fodder for livestock which provides essential nutrients including proteins, vitamins and minerals (Bergonzini, 2004). This type of fodder is essentially sought at the end of the dry season for new leaves and in the middle of the dry season for fruit (pods). Acacia pods are particularly appreciated by livestock producers, who store them to feed their cattle during the dry season. Pastoral farming is dependent on aerial dry-season fodder (persistent leaf species or species which bud off-season), which may then constitute over 50 % of the cattle's feed requirement, exceeding dry straw. Fodder can also be produced by species such as *Acacia nilotica, Faidherbia albida, A. Senegal, Prosopis africana* planted in the open or in hedges or managed in agro-forest parks.

The steppes of Central Africa are an important pasture area. Cattle in the extreme north of Cameroon are estimated to number 2 100 000 (Moumini, 2012). However, the discontinuous nature of the herbaceous cover is a factor which limits livestock production. Unlike the savanna regions in the strict sense, the available herbaceous biomass is produced only during the brief rainy season. The timber species are highly dispersed, and mostly thorny, but constitute an important fodder resource, notably for goats and camels. The principal timber forage plants found in the area are: *Acacia* spp., *Adansonia digitata, Annona senegalensis, Balanites aegyptiaca, Borassus aethiopum, Boscia senegalensis, Bauhinia rufescens, Detarium senegalensis, Diospyros mespiliformis, Faidherbia albida, Ficus sp., Grewia bicolor, Hyphaene thebaica, Prosopis juliflora, Sclerocarya birrea, Sterculia setigera, Tamarindus indica, Terminalia brownii, Ziziphus mauritiana.* Shrubs over 3 m in height are trimmed by the farmers in the grazing areas to feed their cattle.

In the steppes, livestock production is seasonal and there are three types of producer: transhumant, sedentary and semi-sedentary. In addition, the productivity of natural pastures is low (3-4 tons dry matter/ha/year) (Awa *et al.*, 2004) while stockbreeding practices remain essentially extensive. Under these circumstances, sustainable pasture management techniques and fodder crops are high priorities.

4.1.4 Non-timber forest products

The forest areas of the savannas and steppes of Central Africa provide numerous non-timber forest products, among which the most exploited are gum arabic (*Acacia nilotica, A. Senegal, A. seyal,* etc.), shea nuts (*Vitellaria paradoxa*), the fruit and leaves of *Balanites aegyptiaca*, tamarisk pods (*Tamarindus indica*), the fruit of *Hyphaene thebaica*, the jujube seed (*Ziziphus mauritiana; Z. spina-christi*), dates from *Phoenix dactylifera* and medicinal products from *Khaya senegalensis*. These and many other species have multiple uses (medicinal plants, cosmetics, human food, etc.).

Straw is another of the most exploited resources and is used to make roofing for houses, matting, fences, etc.

Honey is an important resource which is used, *inter alia*, to make mead. This drink is very popular and gives rise to a thriving business. The honey is harvested in hives or directly from hollows in tree trunks. The hives are often made from tree bark (*Khaya senegalensis*). This activity is an important source of income for local people.

Photo 6.10: Gum arabic from Acacia seyal

Photo 6.11: A beehive, whose honey is used in the production of hydromel

Box 6.4: Two non-timber forest products – pioneers of the savannah and steppes of Central Africa

Gum arabic *(Acacia senegal, Acacia seyal and Acacia laeta).*

Gum arabic is an edible raw material used as a stabilizer or emulsifier by the food industry (for candy, soft drinks, confectionery, pastries, creams and tablets), in the pharmaceutical industry (pills, tablets, pâtes pectorales, capsules, syrups) and the chemicals industry (paint, gouache, glues, ceramics and foundries). In its producing countries, gum arabic is used as a traditional medicine to treat various illnesses.

In 2002, Africa exported approximately 54 000 tons of gum arabic. Sudan was the main export country, exporting 34 162 tons, or 63 % of total African exports; Chad exported 10 664 tons (20 %) and Nigeria 6 556 tons (12 %). However, world gum demand has not been entirely satisfied since the beginning of the Sudan civil war.

Chad and Cameroon are the main producers of gum arabic in Central Africa. Njomaha (2008) estimates that Cameroon produces around 1 000 tons/year, 400-600 tons of which are sold to Nigerian businesses. According to R. Peltier *et al.* (2010), the average buying and selling price is 228 and 353 FCFA/kg, respectively. Exports of gum arabic totalled 288.95 tons in 2007 (R. Pelter *et al.*, 2010). In 2007, the price/ton was approximately $ 4 500, compared with $ 1 500 in 2003.

The shea butter (karité) industry *(Vitellaria paradoxa)*

Shea butter is used by the food, pharmaceutical and cosmetics industries for its intrinsic properties linked to its composition of glycerides and high unsaponifiables content. Shea oil constitutes a significant amount of fats in the year-round diets of rural Sudanese savannah inhabitants. Shea nuts have countless uses: as an extremely nourishing food on festive occasions, as a reliever of tensions during massage, as a laxative, etc.; shea butter is also used as a cosmetic for hair and skin treatment. Shea nut cake is used to ward off termites and as a coating on walls in houses. Flowers' pollen or nectar is gathered by the bees to make honey and it is also used as a flavor to add to tea. The bark of the tree is used as internal and external protection against parasites.

Cameroon, the Central African Republic and Chad are the main Central Africa producers. Very little is produced in the DRC and none at all in the Congo. Shea nut and shea butter production in the producing countries are not known. Chad produces an average of 250 000 tons of shea nut per year (Ndem Louba 2001).

The sector remains informal. Harvesting and processing of shea fruit are mostly carried out by women. The collected fruit and grains are sold as dried nuts or converted into butter. There are several different traditional methods of shea butter extraction. Processing in Cameroon is traditional, however in the Central African Republic, producers are increasingly using power presses.

4.2 Services provided by the forest areas of savannas and steppes in Central Africa

4.2.1 Conservation of biodiversity

The savannas and steppes constitute habitats for numerous animal and plant species. A large number of protected areas have been created in the savannas and steppes of the various countries of Central Africa. By way of example, Cameroon counts nine protected areas in the savanna and steppe regions. In CAR there are at least ten protected areas. The types of wildlife living in these environments have already been described in previous reports in the State of the Forest of Central Africa, notably the State of the Forest 2010 (de Wasseige *et al.*, 2012).

Apart from this wild fauna, numerous plant species useful to man – for food, medicine, etc. – are conserved in these protected areas (Betti and Mebere Yemefa'a, 2011).

4.2.2 Protection of soils and watershed areas

The timber species in the savanna and steppe areas provide a multitude of ecosystems services: reduction of flooding and runoff and reduction of soil loss from erosion (Boli Baboule, 1996; Hiol Hiol, 1999), maintaining the water quality of springs and rivers, and buffering the local microclimate (Myers, 1988; Hamilton and Taylor, 1991).

4.2.3 Carbon sequestration

Although it has been demonstrated that forest ecosystems store more carbon than those of the savanna regions, the fact remains that savannas, through their substantial cover, constitute carbon sinks that can contribute to the mitigation of climate change. We have as yet very little information on the storage capacity of these open environments. However, it is estimated that 2 791 million tons of carbon are stored in the miombos (dry forests with *Julbernardia*), 4 149 million tons in the deciduous wooded and scrub savannas, and 1 770 million tons in grass savannas, brush and scattered trees (Nasi *et al.*, 2009). Little or nothing is known about the carbon stock of the steppes of Central Africa.

4.2.4 Cultural roles

Traditional rites are generally conducted within forests or sacred woods. These islands of forests are forest relics protected by the local inhabitants. The sacred forests, once conserved for socio-cultural reasons, are increasingly proving to be veritable ecological reservoirs. They influence the microclimate, constitute refuges for certain endangered species, and constitute small "hotspots" of biodiversity, endemism and pools of genetic resources. They regulate the hydraulic regime and protect the banks of the watercourses along which they are generally situated.

The sacred woods or forests also function as botanic gardens, especially for medicinal plants. Nectar-bearing plants encourage beekeeping, an important source of income for the local inhabitants. In the Adamaoua, the sacred forests cover an area of about 1 600 ha and about 1 050 ha in the far north of Cameroon. Sacred woods or forests are also reported in Chad, CAR, Congo and DRC.

4.2.5 Leisure activities

The protected areas in the savanna regions are visited by many tourists each year. These ecosystems with open landscapes are popular because tourists can readily view the wildlife. The tourists come from Europe, Asia, America and also other African countries. The statistical data on the number of tourists visiting these ecosystems are not currently available but according to the OFAC National Group for Chad, over 63 040 tourists visited Chad in 2010.

Photo 6.12: The forest maintains the quality of vital water resources

5. Threats to the forest areas of the savannas and steppes of Central Africa

Globally speaking, desertification and climate change constitute the main threats to the savannas and steppes of Central Africa. Other threats are poaching, wild fires and the non-sustainable exploitation of water and other natural resources.

5.1 Desertification

According to the United Nations Convention to Combat Desertification, the term "desertification" designates the degradation of land in arid, semi-arid and dry sub-humid zones as a result of various factors including climate change and human activities. Desertification and climate change are closely linked.

TerrAfrica, cited by Walter (2011), estimates the loss of continental agricultural GDP at over 3 % per annum as a direct result of the loss of soils and their minerals. In 1997, UNEP determined that the soils of the savannas and steppes of Central Africa were either degraded or very degraded. Desertification and land degradation manifest themselves through, *inter alia*, the impoverishment of land and plant resources caused by irrational agricultural practices, transhumance, wild fires or non-sustainable exploitation of water and timber resources. These factors have not been systematically studied and generally there are only qualitative indications or indications in a limited area.

Action to combat desertification is one of the priorities of the convergence plan of COMIFAC, which, in September 2008, adopted the Subregional Programme of Action to combat the degradation of land and desertification (PASR/LCD).

Photo 6.13: Termite mounds on the Mandji plains – Ngounié, Gabon

5.2 Poaching

Poaching poses a threat to wildlife. Elephants, rhinoceroses, hippopotamuses, and lions are the main species targeted by poachers who, in most cases, use firearms. In February 2012, 450 elephants were killed in the Bouba-Ndjida National Park (Cameroon) and in July 2012, 65 elephants were killed in Chad.

5.3 Wild fires

Even though wild fires explain the dynamics of vegetation on the savannas, their importance and roles are not always clearly defined (Louppe *et al.*, 1995; Jeltsch *et al.*, 2000 in Jacquin A., 2010). Their effects on plant formations are variable according to when and how often they occur (Van Wilgen *et al.*, 1990 in Jacquin, 2010). The fires at the beginning of the dry season, which are easily controllable, would appear to promote the development of timber species to the detriment of herbaceous species (Louppe *et al.*, 1995; Scholes and Archer, 1997, in Jacquin, 2010). These fires cause the development of new growth in timber vegetation which has a considerable fodder value (Gillon, 1983, in Jacquin, 2010). They cause a smaller risk of soil erosion than fires at the end of the dry season (Bertrand and Sourdat, 1998, in Jacquin, 2010). On a year-by-year basis, regular burning appears to degrade grass savanna by disrupting inter-species competitive relations and appears to cause regression of the herbaceous stratum to a steppe formation (Schule, 1990, in Jacquin, 2010). In the long term, these fires have a negative impact on soil nutrients, in particular through pyrodenitrification (Crutzen and Andreae, 1990). The absence of fire promotes the regeneration of forest, which reduces the grazing value of the savannas (Jacquin, 2010). Fire, acting as a regulatory and stabilizing agent in the coexistence of grass and trees is therefore a factor in the maintenance of savannas, notably by destroying seedlings of the forest species which colonize them (Aubréville, 1949; Mayaux *et al.*, 2003; King *et al.*, 1997).

5.4 Non-sustainable exploitation of water resources

Several countries share the same watercourses whose waters are used by the inhabitants of each of the countries concerned. This is the case with the Lake Chad basin between Cameroon, CAR, Nigeria and Chad. The watercourses in this basin, and notably their flood plains support a multitude of economic activities. The water resources of Lake Chad have been overexploited for many years and are threatened by inappropriate agricultural practices, overgrazing, deforestation, and dam and water-impounding projects. These activities and droughts have greatly reduced the area of this lake, which is posing a real problem for the survival of the coastal populations.

Photo 6.14: Volcanic craters from the 1999 eruption on Mount Cameroon

6. Conclusion and prospects

The forest areas of the savannas and steppes of Central Africa are heterogeneous and occupy a substantial area, estimated at 154.4 million hectares. They comprise a rich biodiversity used by local inhabitants as fodder, medicine and food, woodfuel, etc. These people also harvest non-timber forest products which have fostered important economic activity such as gum arabic and shea. In addition, these forests provide numerous environmental services, notably carbon capture which remains largely undocumented, soil and watershed protection, water balance regulation and cultural and recreational facilities.

However, inappropriate agricultural practices, overgrazing, the excessive cutting of woodfuel, the irrational exploitation of water resources, together with recurrent droughts and flooding constitute the main threats noted in the forest areas of the savannas and steppes of Central Africa.

The effects of fires on the dynamics of savannas are not always clearly known. They either cause a regression of the herbaceous stratum to a steppe formation, or they permit the maintenance of the savannas, but in any event the uncontrolled fires at the end of the dry season constitute a threat to the forest areas of both savannas and steppes.

The present chapter has described the various functions of the savannas and steppes which make these areas discrete ecosystems adapted to xeric conditions. In addition, the exposure of these areas to natural disasters (floods, droughts, sandstorms, etc.), desertification and the risks of genetic erosion makes them very vulnerable. It is therefore necessary that they receive particular attention. The integration of these areas into national REDD+ strategies already constitutes a notable step forward. Initiatives on a regional scale must be undertaken, as in the case of dense rainforests, to ensure the sustainable management of these ecosystems. Financing is essential in order to implement the Subregional Programme of Action to combat land degradation and desertification (PASR/LCD) because the savannas and steppes deserve to be areas for priority action.

Photo 6.15: UFE Mouliéné – scrub savannas – Mouyondzi, Congo

CHAPTER 7

Agroforestry and tree domestication in Central Africa

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1. Introduction

Central Africa contains the second largest contiguous rainforest in the world. The Congo Basin forest plays a fundamental role in regulating the global climate and is also regarded as a biodiversity hotspot. In addition to its global importance, the forests are an important economic resource, providing direct formal employment in the timber industry, commercial agriculture and related industries, and for sustaining livelihoods for local populations including indigenous groups.

This Central Africa region also holds large rural populations which are characterized by widespread poverty, low agricultural productivity associated in part to steadily degrading natural resource bases, poor access to markets, weak rights to the forest and its products, and high climatic risks (World Bank, 2012). The rural poor are highly dependent on the forests, remnant woodlands, homestead trees, and mixed agricultural and forestry production systems for their subsistence, e.g. fuel wood, food, medicine and fodder needs (FAO, 2009).

Overall annual deforestation rates are lower in Central Africa than other regions: -0.224 % between 2000 and 2010 compared to -1.32 % in humid West Africa forests (Word Bank, 2012). The main driver of deforestation in Central Africa is the clearing of forests for agriculture, which accounts for more than 80 % of forest cover loss in Cameroon (CARPE, 2005). Similar drivers of deforestation have been documented for other Central African countries (see chapter 1). Forest clearing for agriculture includes not only slash-and-burn shifting cultivation, which has long been recognized as a key driver of deforestation in the dense forest areas (Ndoye and Kaimowitz, 2000), but also for cash cropping, most notably, cocoa (*Theobroma cacao)* (Sunderlin *et al.*, 2000). Government's promotion of cocoa as a major cash crop in Cameroon and in other Central African countries from independence until the 1980s had a considerable impact on forest integrity. In the 1990s, cocoa cultivation was less profitable as a result of declining global market prices. However, since 2005, with the current trend (increasing global market prices), cocoa planting in Cameroon has accelerated at the expense of forests (World Bank, 2008 cited by Eba'a Atyi *et al.*, 2009).

Demand for household energy, primarily fuelwood, is recognized as an increasing driver of deforestation (World Bank, 2012), especially around rapidly growing urban centers like Kinshasa, Africa's second largest city with over ten million inhabitants. The sub-region also has important forests and woodlands outside of the dense, humid forests, where higher population densities increase the demand for household energy. For instance, the eastern mountain forests in the DRC are densely populated similar to the western montane highland forest regions in Cameroon. Of the DRC's total forested area of 120 million ha, the 40 million ha of dry land forests in the North-East and South exhibit higher deforestation rates than the closed-canopy humid forests (see chapter 1).

Photo 7.1: Slash-and-burn is the first step of converting forest to crop production

Land degradation following vegetation change, especially deforestation is one of the most serious problems facing global agriculture, as it affects two billion hectares (38 % of the world's cropland). Many smallholder farmers in the Central African humid tropics are trapped in a cycle of poverty, hunger and malnutrition as a result of land degradation. As a consequence, farmers continually increase the area planted for subsistence agriculture to meet food security needs, and demands for woodfuel increase with rapid population growth. The only option to reverse this trend is to use the available land more efficiently. Therefore, this means that existing farmland has to be made more productive by either increasing the yields of existing good quality cropland or rehabilitating degraded farmland to bring it back into full production. In effect, this means either further expanding Green Revolution-like technologies (Borlaug, 2007) or seeking another solution.

In temperate countries, where there is enough capital to invest in technology, the first strategy is the more appropriate. In the tropics, although the Green Revolution has greatly improved yield potential and the quality of a number of staple crops, poor farmers have often been unable to access seeds, fertilizers and pesticides, the core Green Revolution technologies. According to Leakey (2012), adopting and implementing agroforestry technologies will help improve the productivity of staple food crops by improving soil fertility and promoting agro-ecosystem functions. In addition, the domestication of indigenous species with diverse values (food, medicine, fuelwood, income etc.), could increase trade and business opportunities for farmers that would improve their livelihoods. Together, these steps could provide a generic and adaptable model for more sustainable agriculture in the tropics, which builds on the success of and enhances the outputs of the Green Revolution (Leakey, 2012; Leakey and Asaah, 2013).

2. Agroforestry: definition and concept

Even though agroforestry is a relatively new subject of scientific study, it is a traditional practice with a long history in many parts of the tropics (King, 1968; Nair, 1989). Previously, agroforestry was defined as the set of land use practices which involve the deliberate combination of woody perennials and herbaceous crops and/or animals in some spatial arrangement or temporal sequence on the same land management unit, such that there are significant ecological and economic interactions between the woody and non-woody components (Sinclair *et al.*, 1994). What seems to be different now from the traditional approaches is the greater use of trees for the production of diverse tree products, as opposed to simply providing environmental services, which has led to the domestication of trees within the agroforestry system (Simons and Leakey, 1996; Tchoundjeu *et al.*, 2006). Accordingly, the most recent definition of agroforestry considers it, "a dynamic, ecologically-based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels" (www.icraf.cgiar.org). In essence, agroforestry combines the protective attributes of forestry with the productive characteristics of both forestry and agriculture to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems.

Photo 7.2: Cocoa beans

3. Pillars of Agroforestry

Agroforestry involves the intensive management of the interactions between intentional combinations of trees with crops and/or livestock as components of an integrated agro-ecosystem. These key characteristics are the essence of agroforestry and distinguish it from other farming or forestry practices. To be described as agroforestry, the land-use system should satisfy the following criteria :

Intentional combinations of trees, crops and/or animals, designed and managed as a whole unit, rather than as individual elements that may occur in close proximity.

Intensive management of trees, crops and/or animals within the land use system to maintain both their productive and protective functions.

Interactive management of trees, crops and/or animals within the land use system to optimize the biological and physical interactions between the different components, enhance the production of more than one harvestable component at a time, and provide environmental services, such as conservation benefits for the watershed.

Integration : The tree, crop and/or animal components are structurally and functionally combined into a single, integrated management unit. Integration may be horizontal or vertical, as well as above or below ground. Such integration utilizes more of the productive capacity of the land and helps balance economic production with resource conservation and the provision of other environmental services.

Agroforestry systems generally combine at least two of the components of trees, crops and/or animals in an optimum fashion. The components influence each other and the wider environment. The interactions could be beneficial within the system or create competition for space, water, light and nutrients. However, competition can be minimized by selecting the appropriate tree species and managing the agroforestry system so that competition is reduced (Asaah, 2012).

Agroforestry and Tree domestication technologies

Various agroforestry technologies have been developed to meet specific land-use needs. Some of these include hedgerow intercropping and/or improved fallows for soil fertility management, woodlots, windbreaks, live fencing, boundary planting, home gardens, trees on crop lands, trees on water ways and flood plains, trees in pasture and rangelands, buffer zone agroforestry, and *taungya*. The *taungya* system is in essence, the growing of annual agricultural crops along with the forestry species during the early years of establishment of the forestry plantation (Nair, 1993). In all of these cases, trees are typically added to agricultural landscapes to create desired benefits (increase soil fertility status, availability of diverse fruits, condiments, medicinal products etc.) and to restore essential ecological processes needed to sustain agriculture productivity, rather than to restore natural ecosystems.

Declining soil fertility is a major challenge within agricultural landscapes in most countries of Central Africa. Typically, individual farm sizes are quite small, from less than 2 to 5 hectares. Farming provides for household needs and seldom for producing food for sale. As a consequence, farmers do not generate sufficient cash income to purchase fertilizers and other inputs that would help to maintain good crop yields. In addition, as the forests regress, farmlands become more degraded and soil fertility declines. Similarly, there is a decline in the diversity of living organisms that are essential for the maintenance of life processes, such as nutrient and carbon cycling, food chains, pest and disease control, pollination, etc. Additionally, while modern agriculture has dramatically increased the yield potential of many staple food crops, the consumption of a diet increasingly based on starch-based foods like cassava, cocoyams and maize, as well as the reduced consumption of traditional foods, has resulted in an unbalanced diet, malnutrition and a greater susceptibility to disease in many highly populated areas (Asaah *et al.*, 2011).

Photo 7.3: Maintaining trees on farm land generally helps maintain soil quality

Agroforestry is a delivery mechanism of multifunctional agriculture (Leakey, 2010), and it better addresses the issues of: declining soil fertility; rehabilitation of degraded land; restoration of above and below-ground biodiversity; sequestration of carbon; and, protection of soils and watersheds. Well-known, widely tested and increasingly adopted agroforestry practices like planting leguminous tree and shrub species in agricultural fallows improve soil fertility (Cooper *et al.*, 1996; Kanmegne *et al.*, 2003; Degrande *et al.*, 2007). Between 1988 and 1998, ICRAF developed two improved fallow technologies. The first technology developed was the rotational tree fallow system with *Calliandra calothyrsus.* This technology increases crop yields if farmers cut the trees back at 0.05 m above ground level and prune the trees twice during cropping (Degrande *et al.*, 2007). In addition to soil fertility improvement, *Calliandra calothyrsus* fallows manifest many additional short-term benefits such as the reduction of weeds, the provision of fuel wood and stakes, and the attraction of bees to associated apiaries, as the *Calliandra* trees flower almost all year round. However, the trees occupy the land permanently and soil fertility improvement is only observed for a number of years.

Second, to overcome a number of the constraints with tree fallows, a shrub fallow was designed, using *Cajanus cajan* in a relay cropping system. Relay cropping basically, is an option whereby different crops are planted at different times on the same farm, and both (or several) crops grow together during part of their growing cycle. An example illustrated in photo 7.3, is planting leguminous species for soil fertility enhancement into a maize crop before it is mature. According to a review by Degrande *et al.* (2007), farmers responded positively to this technology because of higher crop yields, ease of clearing the *Cajanus* fallows, and the shading out of weeds by the shrubs. The shrub fallows were particularly appreciated by women, because the shrub fallows require less labor than other fallow systems (with perennials) and because these shrubs (which are annuals) can be planted on lease land. However, wider dissemination of tree and shrub fallows was constrained by the lack of an adequate seed supply system and poor extension strategies. Nevertheless, results from a wide range of sites in Cameroon achieved maize yield increases of about 70 % on average and in some areas three or four- fold gains were possible (Degrande *et al.*, 2007).

In Burundi, the mixed rows of grass families/legumes planted along contour lines are increasingly used as a protective measure for soil fertility management. Controlled testing in an extremely steep and erodible region (kaolisol humus-bearing clay soil of central Mumirwa) has shown interesting results. In a cassava-growing system, the mixed rows reduce water runoff, decreasing the flow by 50 % and soil loss by 96 % (Bizimana *et al.*, 1992). In Kanyosha, Burundi average flows of between 3.9 % and 6.7 % on a 45 % gradient slope (Rishirumuhirwa, 1997) were attained with bands of *Setaria* and *Calliandra* versus 12.3 % in the absence of zonal planting. According to the same author, an entire mulch of a banana tree reduces flow to 1 %, in contrast with 74-79 % on a bare plot.

4. Participatory tree domestication

The World Agroforestry Centre (ICRAF) and its partners began a program for the domestication of underutilized and indigenous trees in the mid-1990s. This program sought to improve the quality and yield of products from traditionally important species. In addition to meeting the everyday needs of local people, these products are widely traded in local and regional markets. As a result of domestication, underutilized crops have the potential to become new cash crops for income generation. They also have the potential to counter malnutrition and disease by diversifying the diet and energy sources of local people and by increasing the dietary intake of micro-nutrients, which are known to boost the human immune system among other health benefits (Ajibesin, 2011). These indigenous tree species also play an important role in enhancing agro-ecological functions, and can mitigate climate change by increasing carbon sequestration (Asaah, 2012).

Domestication is a complex process akin to evolution in which human use of plant and animal species leads to morphological and physiological changes that create a distinction between domesticated taxa and their wild ancestors (Purugganan and Fuller, 2009). Interestingly, domestication of food and tree crops has occurred for more than 13 000 years (i.e., since the last ice age), and it arose independently in several regions (Gepts, 2002). In spite of the geographic and climatic diversity in the different regions, there is a remarkable similarity in the set of traits which were selected for in completely unrelated types of crops.

In perennial crops, individuals that exhibit a more compact growth habit (fewer, shorter branches, as opposed to the tall, single-stem, wild variety) are generally selected for through the process of domestication. Selecting for a more compact growth habit is reported to have a positive impact on the harvest index (ratio of harvested part to overall aboveground biomass) and the size of the fruit or grain (Donald, 1968 cited by Gepts, 2004). There have also been many changes to the reproduction systems of the trees through domestication (Elias and Mckey, 2000 ; Gepts, 2004). In general, domestication has increased the number of species that reproduce via self-fertilization, also known as "selfing", or resulted in the replacement of sexual reproduction by vegetative propagation in order to maintain the trueness in type of cultivated individuals when faced with the possibility of outcrossing with wild relatives.

A tree is normally considered "wild" when it grows spontaneously in self-maintaining populations in a natural or semi-natural ecosystem and when it can exist independently of direct human action (FAO, 1999). In contrast, it is considered to be domesticated when it has undergone purposeful selection for specific genetic characteristics, and when it is propagated and cultivated in managed agro-ecosystems (Leakey and Newton, 1994). For example, fruits of *Dacryodes edulis* under domestication on farms in most of Central Africa, where reported by Waruhiu *et al.* (2004) to be 66 % larger than those obtained from trees in the wild in Cameroon and Nigeria. Crop domestication has been limited to less than 0.05 % of all plant species and about 0.5 % of edible species (Leakey and Tomich, 1999). According to FAOStat (2010), out of a total of 400 000 flowering plants species, less than 200 have been domesticated as food and feed plants, and just 12 species provide 75 % of the food eaten.

Interestingly, some innovative farmers have reacted to deforestation and the decrease in the supply of traditional tree products by selecting and growing these trees within their farms. This farmer-driven domestication, in which species are brought into a managed environment through planting or retention, demonstrates that farmers will spontaneously invest in indigenous fruit species. Asaah *et al.* (2003) and Leakey *et al.* (2004) reported that farmers were selecting and multiplying *Irvingia wombolu* and *Irvingia gabonensis* (bush mango) trees, in Cameroon and Nigeria respectively, that have 44 % larger kernels over other, similar trees of the same species (particularly in south-eastern Nigeria). Farmers in southern Cameroon have also been reported to select particular trees of *Irvingia* species for their large fruit size as well as other characteristics such as taste and yield (Schreckenberg *et al.*, 2006). Finally, the selective planting by farmers in Cameroon and Nigeria, as reported by Waruhiu *et al.* (2004), has resulted in *Dacryodes edulis* fruits from trees on farms being 66 % larger than those obtained from trees in the wild.

Photo 7.4: Banana and cassava cultivation on a former charcoal processing site, Bateke plateau – Mampu, DRC

Farmers have developed these strategies to become self-sufficient in food, micro-nutrients, medicines and many other daily needs (Tchoundjeu *et al.*, 2008). The actions by farmers to retain natural seedlings on their farms and in their home gardens, to eliminate trees with products (fruits/nuts) with less desirable attributes, and to sow and/or disperse the seeds of the more desirable fruit trees close to their homesteads, are thought to be a form of "commensal" domestication (Leakey and Asaah, 2013). This commensal approach to domestication constitutes one of the building blocks of the pathway to participatory tree domestication. Participatory tree domestication combines agricultural science and technology with traditional knowledge as an integrated package (Tchoundjeu *et al.*, 2006). The domestication of agroforestry trees could therefore be considered a necessary step in promoting sustainable agriculture because domestication helps to diversify the species which generate income in local and distant markets, improve diets and health, meet domestic needs, and restore functional agro-ecosystems, as well as empowering local communities (Leakey, 2012).

Work to domesticate agroforestry species in order to improve the yield and product started in Cameroon in 1997 with a focus on the priority species identified by farmers (*Irvingia gabonensis*, *Dacryodes edulis*, *Ricinodendron heudelotii*, *Garcinia kola*, *Cola spp*, *Pausinystalia johimbe,* and *Prunus africana*). The techniques and strategies employed ; vegetative propagation, characterization of genetic variation, tree selection, and cultivar development have been extensively reported elsewhere (see reviews by Tchoundjeu *et al.*, 1998 ; 2006 ; Leakey *et al.*, 2005 ; 2008). Uniquely, Cameroon researchers worked directly with local communities to identify and promote the use of local knowledge (Tchoundjeu *et al.*, 2006 ; 2010). This approach successfully developed techniques and strategies for participatory tree domestication that empower local communities, promote food self-sufficiency, generate income and employment, and enhance nutritional benefits (Asaah *et al.*, 2011). Furthermore, evidence that agroforestry can help rural communities become self-sufficient on an area of less than 5 ha (Schreckenberg *et al.*, 2006 ; Degrande *et al.*, 2006) is growing. Consequently, the domestication of indigenous fruit and nut trees, which is increasingly recognized as an important component of agroforestry, is impacting rural development, contributing to the alleviation of poverty, malnutrition and hunger (Asaah *et al.*, 2011 ; Tchoundjeu *et al.*, 2010). Agroforestry has recaptured and utilized farmers' knowledge about trees, seeds, crops, soil and livestock to establish more integrated, diverse, productive, profitable, healthy and sustainable land-use systems.

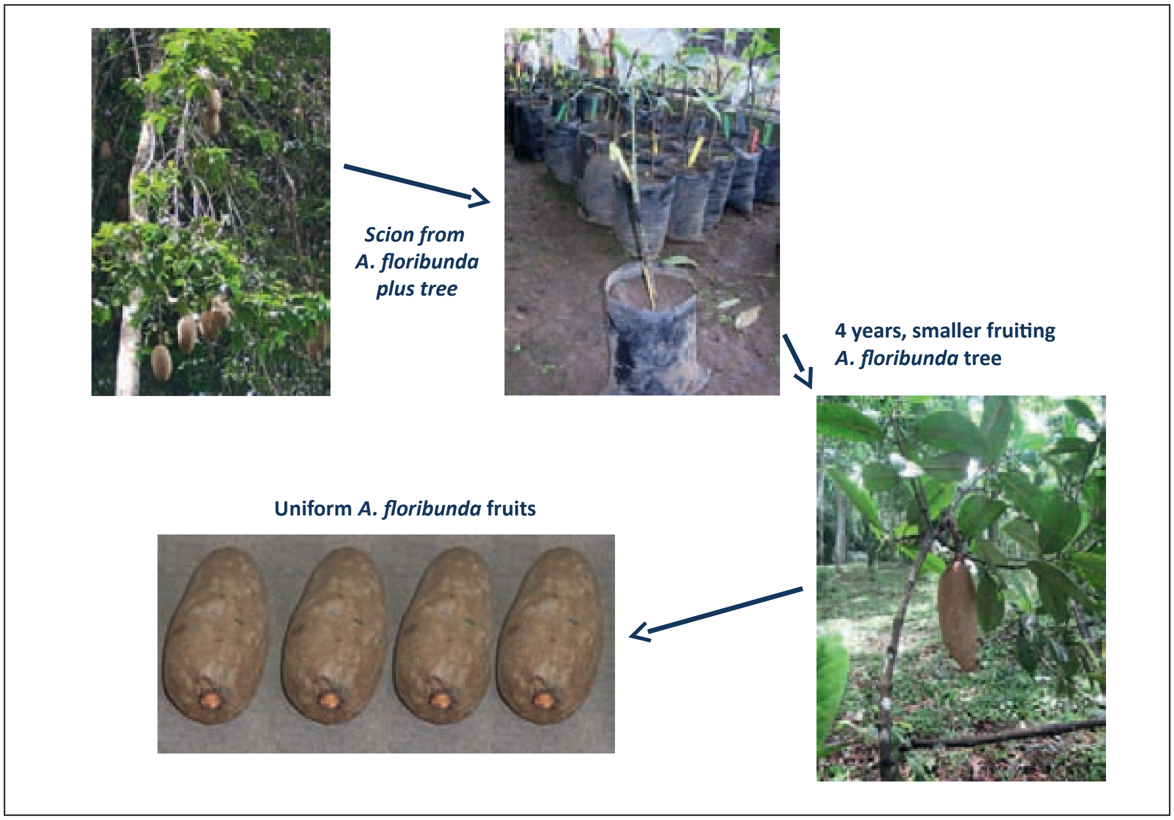

Figure 7.1 : Shortened juvenile phase to fruiting ; 4 years via grafting down from 12 years in Allanblackia floribunda, Cameroon

Source : Ebenezer Asaah

5. Outcomes of Agroforestry and Tree domestication

5.1 Biological and Environmental outcomes/impacts

The planting, promotion and adoption of "fertilizer trees", such as *Calliandra calothyrsus*, *Acacia angustissima, Sesbania sesban, Tephrosia vogelli,* and *Cajanus cajan* that fix atmospheric nitrogen and restore soil fertility is one of the main environmental outcomes of agroforestry. However, more farmers adopted the practice in higher-populated, less-forested savanna ecosystems than in the dense, humid forest (Degrande *et al.*, 2007). In the western highlands of Cameroon for instance, Rural Resource Centers (RRC) promote the planting of over 52 500 fertilizer trees annually (Asaah *et al.*, 2011) for soil fertility management, apiculture, fodder banks and woodfuel. RRCs are knowledge and demonstration centers (hubs) that act as an interface between research institutions and farmers for the promotion and diffusion of technological innovations within a target area. Between 2007 and 2008 in one of the RRCs, the RIBA Agroforestry Resource Center (RARC), the number of farmers planting fertilizer trees rose from 208 to 360 (Asaah *et al.*, 2011). These improved fallows have now become a well-accepted technology in most of the communities and farmers are reporting that their crop yields have doubled or tripled. This

Photo 7.5: Banana plantation after clearing, Gabon

significant increase in staple food crop productivity is a great contribution towards reversing observed tends of food insecurity in some rural areas in Cameroon. This increased yield could allow farmers to plant smaller areas of food crops while at the same time making space available for other types of crops in order to meet other needs. Leguminous trees and shrubs also attract bees, and many communities have adopted apiculture, providing more access to honey, a better substitute for refined sugars. The RARC is located on a 7 hectare plot that was completely bare and degraded, and had been abandoned by farmers. Today, the soils have been rehabilitated through agroforestry and the yields of wheat, maize, beans and potatoes have doubled. Furthermore the site now has a diverse range of tree species serving different purposes such as : woodfuel, windbreakers, fodder production for livestock and forage for bees. Moreover, increased tree cover, arranged along the contours of the hillsides, also protects the soil and reduces the risks of soil erosion while protecting watersheds.

In Burundi, one of the main environmental advantages of agroforestry is erosion reduction. For example, progressive terraces on the Kiyange hill in the village of Makebuko where agroforestry was initiated by the FAO in 1997 are still being maintained by farmers. Bugomora hill farmers have reduced the silting up of the Nyamaso swamp in Muyinga (Anonymous, 2011) with anti-erosive mixed rows. Agroforestry also enhances the beauty of the scenery, especially where diverse tree species are dispersed within fields or planted along contour lines at large scale. Other, less noticeable effects, could relate to the reduction of climatic changes and improvement of the local micro-climate.

The environmental outcomes of tree domestication in Central Africa include the development of new tree crop types (cutting, marcots, grafts) and new cultivars of indigenous fruit/nuts species with improved product quality and greater market demand. Tree domestication is occurring in many countries in Central Africa (Cameroon, Equatorial Guinea, Republic of Congo, and the DRC) and with several dozens of species. However, participatory tree domestication is most advanced in Cameroon, where improved cultivars have been developed through vegetative propagation techniques by local farmers for cultivation aimed at meeting their household needs. It is hoped that the development and integration of improved cultivars will increase the supply of these products in coming years, because the demand for tree products like bush mango kernels (*Irvingia* spp) and Eru/Okok leaves (*Gnetum africanum*) currently exceeds the quantities that can sustainably be obtained from the wild. According to Tchoundjeu *et al.* (2010), Asaah *et al.* (2011) and Leakey (2012), the tree products will be sold – at first locally and then more widely – both regionally within the Central Africa countries and in Europe and America.

The integration of these potential new cash crops into diverse farming systems has also resulted in more stable and healthier agro-ecosystems. Diverse systems, of either mixed crops or land use mosaics, are thought to improve the general agro-ecosystem functions and could reduce the incidence of pest and diseases (Schroth *et al.*, 2004). According to McNeely and Schroth (2006), agroforestry systems are more supportive of biodiversity than mono-crop systems, although the maintenance of high levels of biodiversity may often depend on the presence of natural habitats in close proximity. In a recent study, Asaah (2012) and Asaah *et al.* (2010 ; 2012), reported that trees of vegetative origins allocated their biomass differently, with less fine roots and more primary roots and shoots, suggesting that clonal cultivars

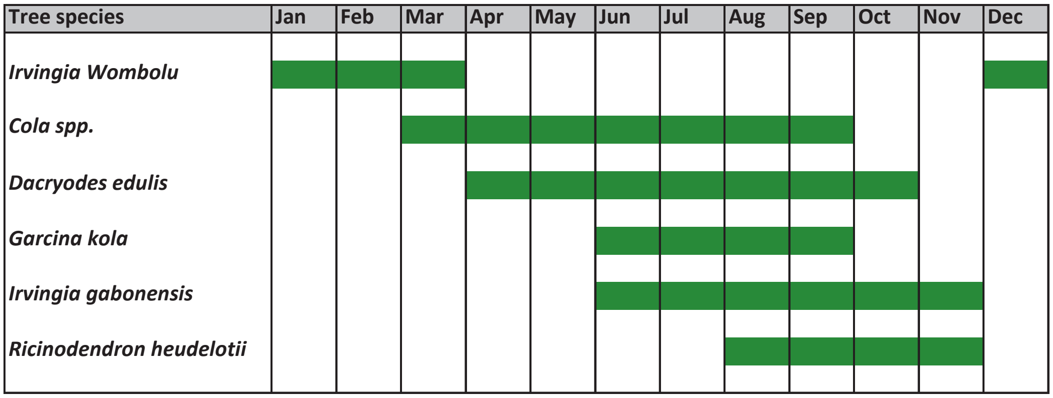

Figure 7.2 : Year-round harvest of some key agroforestry trees in Central Africa
Source : Kehlenbeck et al., 2013

are less likely to be competitive with annual crops. Perennial trees are biological sinks of carbon, with the additional benefit of climate change mitigation. Available evidence suggests that cultivars which have been produced using vegetative propagation could store double the amount of carbon in their shoots and primary roots than trees propagated by seeds, an unexpected benefit of tree domestication (Asaah, 2012).

5.2 Commercial and social outcomes/impacts

There are several social and commercial outcomes of agroforestry and tree domestication leading to greater environmental sustainability, and better livelihood options to both women and youths as they're are increasingly important actors in the production, management, harvesting/ post harvesting, value addition and marketing of agroforestry products. According to Asaah *et al.* (2011) and Degrande *et al.* (2012), rural resource centers (RRC) are now delivering both education and training in agroforestry and tree domestication, as well as in business management, so that farmers can earn money from the sale of plants and their tree products.

One impressive outcome of tree domestication is the development of tree nurseries and the potential of income generation from the sale of desired cultivars of indigenous fruit trees. In north-west Cameroon, Tantoh Mixed Farming Common Initiative Group (MIFACIG), one of the RRCs that adopted agroforestry and tree domestication over 10 years ago, along with its satellite network of nurseries, sold over $ 21 000 of plants in 2009. About 35 % of that income, i.e. $ 7 350, went to the satellite nurseries owned by farmer groups. Additionally, GIC PROAGRO, another RRC in western Cameroon that adopted agroforestry and tree domestication five years ago, had a plant-derived income from the sales of soil fertilizer species that was estimated at around $ 1 750 in 2007. Starting in 2008, this RRC focused on producing and selling improved cultivars of indigenous fruit trees like Kola (*Cola* spp), Safou (*Dacryodes edulis*) and other adapted exotic fruits like Avocado (*Persea americana*), and their income rose to about $ 40 000 in 2009 (Asaah *et al.*, 2011). This suggests that cultivars derived from superior trees of diverse species could be among the biggest source of income in the nurseries developed by farmers. Furthermore, it is hoped that all of these communities will also be

Photo 7.6: Tree savanna in Akagera National Park, Rwanda

able to further increase their income by selling fruits from the cultivars already integrated into their agricultural landscape.

Agroforestry also increases household incomes in Burundi. Although a comprehensive study has not been carried out to estimate benefits from the various agroforestry products or services, three categories of benefits are identified, as follows:

(i) job creation from plant production in nurseries; setting out of contour lines and planting according to the approach used by the project SEW (Sustainable Energy Production Through Woodlots and Agroforestry). For example, 310 967 man – days with 39 % women participation for installing micro-afforestation's using the HIMO (High-intensity Labor) approach (IFDC, 2011);

(ii) sale of produce (wood, fodder, *Pennisetum* stalks, milk, honey, etc.);

(iii) woodwork (sawing, carpentry, carbonization, etc.).

According to Asaah *et al.* (2011), within the highlands of Cameroon some farmers were observed to be planting between 10 and 120 fruit trees on their farms. Similarly in DRC, a diversity of species produced through vegetative propagation has been integrated into the agricultural landscape by farmers (table 7.1).

Table 7.1: *Species already integrated in 2012 in farming fields, DRC*

Species	Technique used	Area
Dacryodes edulis (Safou)	Aerial stratification	12 ha
Treculia africana	Stratification by bedding	9 ha
Monguifera indica	Aerial stratification	16 ha
Citrus spp	Aerial stratification	24 ha

6. Challenges for Agroforestry and Tree Domestication Implementation in Central Africa: need for reforms on rights and tenure

In order for agroforestry to fulfil its full potential of improving livelihoods and providing environmental services, the appropriate strategies, institutions, and financial mechanisms need to be in place. To accomplish these objectives, Foundjem-Tita and Degrande (2012) made the following policy recommendations:

(i) *Put in place a comprehensive program to develop capacity, guide and implement agroforestry strategies*. Appropriate policies, policy instruments, strategies and implementation mechanisms are required to reap the full benefits of agroforestry. Furthermore, these changes require concerted action between many organizations, including all government ministries interested in tree planting. Such a program would define clear objectives and targets and would require adequate financial and sectorial affiliation.

(ii) *Develop a clear distinction between agroforestry products harvested from trees on-farm and non-timber forest products (NTFPs) collected from the wild*. Thanks to recent advances in tree domestication research, farmers will likely be able to plant most of the NTFPs with high economic value, which are currently being collected from the wild. Furthermore, development projects in the domain of climate change mitigation and adaptation (including REDD+ programs) will likely further encourage tree planting by farmers. Thus, there is a need to develop specific criteria to distinguish agricultural and agroforestry products from forestry products and NTFPs. Since it is difficult to visually differentiate tree products harvested from the wild from those harvested on farmers' fields, certificates of origin may be useful.

(iii) *Facilitate access to land and secure ownership*. The process of obtaining land certificates should be simplified to allow farmers to have secure ownership of the land and the trees they plant on that land. On the other hand, strategies are needed either to encourage land markets or to redistribute land to enterprising farmers in another manner.

(iv) *Provide additional incentives to encourage farmers to plant more trees.* Farmers have developed agroforestry as a traditional land use practice with minimal assistance from either governments or NGOs. Nevertheless, policies that provide additional incentives for farmers could accelerate the adoption of agroforestry. These include : assistance for the production and distribution of quality tree planting material ; policies that add value to tree products, for example through investments in improved processing of tree products ; and, policies to help disseminate appropriate tree propagation and tree management skills to farmers through vast extension programs.

Photo 7.7: Terrace crops on the Rwandan hills

7. Conclusion

It is clear from this review that agroforestry and tree domestication in Central Africa is dynamic and expanding both geographically and in species. Domesticating new tree crops based on traditionally important wild trees in Central Africa has greatly enhanced the multifunctionality of agroforestry systems. If the potentials of agroforestry and tree domestication are properly harnessed, they could rehabilitate degraded lands, restore agroecosystem function and provide a sustainable pathway to lift poor smallholder farmers out of poverty, malnutrition and hunger. There is therefore an urgent need for a political and economic recognition that agroforestry and tree domestication, can immensely contribute to national domestic food budgets, foster new social infrastructure and cultural relations, help the emergence of new businesses and thereby mainstream local economic growth and improve the well-being of both rural and urban populations in Central Africa.

CHAPTER 8

Forest plantations in Central Africa: new forms of forestry to meet new business needs

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1. Introduction

The Congo Basin forests constitute the second largest tropical forest after the Amazon. These ecosystems are extremely important. Sustainable management policies are beginning to produce visible results in the field and a regional process, the Convergence Plan is currently being implemented (COMIFAC/CBFP).

Even if deforestation in the wet zones is still not widespread, deterioration and damage may still be seen on the outskirts of the big cities, in dry zones and on the edges of the dense forest.

Planting a tree has strong ancient symbolic and universally recognized significance. In recent decades, diverse forest plantations have become vital components of sustainable tropical forest management. They increasingly contribute to the perennial production of both commercial and non-commercial goods and services, and they are at the heart of global climatic and environmental challenges.

The term "forest plantations" is perceived in various ways. In Central Africa, despite past successful efforts, the planting of trees in forests has long been considered by a large number of actors in the forestry sector useless at best and predatory at worst, while paradoxically, very large natural forest areas have been converted into industrial farming plantations (oil palm, rubber tree, for example).

Photo 8.1: Funtumia Plantation, a rubber and medicinal tree, destined for industry, Cameroon

2. An ancient practice that makes the most of past lessons

First attempts at domesticating and planting tropical tree species date back to the beginning of the 20th century. In the middle of the 20th century, several arboretums, which have provided valuable lessons, were introduced in Bilala (Congo), Mbalmayo (Cameroon), Sibang (Gabon) and Yangambi (DRC). This allowed for testing the suitability of many native species for domestication and adaptation for production. Adjusting the tropical forest silvicultural techniques to those used in temperate plantations was, however, not without failures or a good deal of trial and error. But with knowledge and understanding gained from experience, management techniques in tropical plantation forestry were developed. This achievement has taken many forms, which contributed to timber and non-timber products, both which are vital to national forest economies.

Scientific knowledge has accumulated in a variety of technical fields. In Pointe Noire (Congo), for example, intensive clonal silviculture of eucalyptus was perfected in the beginning of the 1970s. Techniques developed in Congo led to the creation of several millions of hectares of high-yield plantations in the inter-tropical zone which created new jobs and wealth. These clonal plantations were established in Latin America, Asia and South Africa, but not in Central Africa, unfortunately – with the exception of the eucalyptus clonal area of 42 000 hectares planted around Pointe Noire (Congo).

3. Planting trees, an important institutional indicator

Photo 8.2 : Restocking Mukulungu Plantation (Autranella congolensis), 7yr old tree, CAR

In Central Africa, nearly all forestry departments in charge of the forests are state-owned or partly state-owned organizations dedicated to forest plantations, such as : ANAFOR (National Agency for the Support of the Development of the Forest) in Cameroon ; SNR (National Reforestation Service) in Congo ; or DHR (Horticulture and Reforestation Authority) in the Democratic Republic of Congo.

These organizations spearheaded major plantation projects from 1960 to 2000 and have often been fundamental to innovation. They have, for the most part, been financed by a tax collected by the forestry fund and redistributed to projects accordingly, the annual "Day of the Tree" being one of these. The majority of these organizations are now confronted with operating constraints : the gradual reduction of financing ; non-replacement of agents over several years ; a global drop in technical standards ; and a reduction in operational capacity. This despite the fact that stronger global emphasis on plantations programs is considered important to combat climate change, and to satisfying national needs for timber products and the creation of wealth in rural areas.

In parallel, several private forest plantation projects, formal and informal, are emerging in Central Africa, gradually replacing projects which were predominantly managed by state-run forestry institutions.

It would be wise to rethink the goals and means of these state-run organizations as soon as possible in order to modernize them, strengthen their expertise and develop their traditional role as executing agencies without neglecting private initiatives, which must be favored.

4. A rapidly-evolving regional situation: increasing demands

The current situation exists in an international context increasingly constrained by rapid changes in rules and regulations and the ever-increasing multiple demands and changes of civil society.

The prevalent extensive cultivation system of managing natural forests, even with certified forestry which is considered sustainable, produce a low return on investment. Profitability is usually insufficient and especially uncompetitive in relation to other land uses. Global, regional and local demand for timber products (timber, industry and energy) and for their associated services (health, employment, etc.), raises the question of whether a raw material sufficient in quality or quantity can be produced at competitive prices. The ever-increasing pressures on the land result in significant increases in environmental mitigation requirements and their related costs (certification, legality, etc.). Thus, increasing costs of managing natural forests and ever-increasing pressure on the land often lead to a specialization of production forests and the types of products. Moreover, climate change will have important long-term repercussions (positive or negative) on the forests while some speculative operations (farming, etc.) will undoubtedly cause very short-term repercussions.

New opportunities, linked to debates on climate change and REDD+ mechanisms in particular, are based on the remuneration of carbon stocks and flows. If these mechanisms fully develop, forest plantations could play a major role in REDD+.

Finally, continuous population growth in both rural and urban areas, and the persistence of unsustainable farming methods are major elements of the inevitable degradation of natural forests. Slash-and-burn farming in woodfuel production is by far the most important cause of degradation and deforestation. How can these threats be addressed?

5. A road to the future: cultivate the national forest

In this unstable and ever-changing environment, new forms of forestry must be invented so the forest ecosystems of Central Africa maintain their important role in national economies. Unless comprehensive preservation via complete protection of the forests ("sanctuarization") is adopted, which will inevitably be partial and random, new types of forestry should be proposed for natural forests which will make it possible to protect them while at the same time making them productive. These new types of forestry are necessary. In many cases, they still remain to be invented because the premise of reconstitution of natural forests in identical form or of a sufficiently rapid natural renewal between two periods of logging is unlikely to be feasible. Consequently, current forestry techniques must be improved to allow economically viable and sustainable production of timber products (especially timber, but also others).

Forest plantations, through their diversity, make it possible to develop new types of forestry techniques that apply to natural forests (cfr following paragraphs). These new techniques, if carried out correctly, will not only avoid jeopardizing the sustainability of the forests, but will help to ensure their sustainability through the creation of greater income. The improved use of natural forests will form the basis on which to guarantee greater sustainability of these ecosystems.

The management of forests, including plantations, is again becoming a priority on national and regional agendas. It is enabling the emergence of new development strategies which are of interest to both international financiers and actors in the private sector.

Photo 8.3: Pépinière villageoise dans la province du Bas-Congo – Projet Makala – RDC

6. Planting a tree: everything except insignificant

Planting a tree, let alone a forest, is first and foremost a voluntary act, a sign of hope and a long-term investment. It requires thought, a strategy, effort and cost. Behind each planted tree there is willpower and a human action, where the final success depends on coherence. In several regions, planting a tree is considered to be an act of "land claim", whereas cutting down a tree in a natural forest is a right of use. Formal law addresses forest use more frequently than forest regeneration or the introduction of new plantations.

The planted forests are not natural forests. The artificial ecosystems of planted forests are often more productive, but also more fragile than natural, spontaneous forests. Although, for their care and management, these two "groups" of ecosystems come with a number of principles and they are the result of different complex technical processes. These techniques, which must be adapted to each situation, also depend on the desired end-products (timber, wood for energy, NTFP, enhancement of the environment, etc.).

Sustainable management of planted or natural forests needs a clear and stable institutional environment. Moreover, a good command of technical tools and assessment of expected financial, social and environmental costs and benefits constitute the principal elements to be considered before any silvicultural operation is undertaken.

7. New demands and values for forest plantations

The recent and imminent evolution of tropical societies in an increasingly globalized context has given rise to new demands vis-à-vis forest plantations. Indeed, the exploitation of natural tropical forests is facing increasing constraints such as environmental, social and demographic pressures, and increasing demands for goods and services.

New demands from society are also expanding the role of forest plantations. Challenges linked to global changes (climate, energy, water and agriculture), the evolution of processing technologies, the character of evolving international markets, and the privatization of the forestry sector are increasingly affecting forest plantations. Reforestation species and their uses must be diversified so as to adapt to the varying scales of production and intervention (individual, village, territorial, industrial…).

With this in mind, a new silvicultural adapted to the tropical forest plantations can bring with it solutions for:

- Producing homogenous timber raw material for industry or energy or a raw material for subsequent processing such as green chemistry, etc.
- Intensifying management and increasing productivity of managed forests, improving their economic performance, concession profitability and enhancing sustainability.
- Restoring degraded natural forests (due to itinerant slash-and-burn farming, for example) or marginal natural forests (lightly-covered forests and/or interrupted renewal process).
- Re-creating diversified forest spaces in areas where these have disappeared, and with it a number of goods and services previously supplied by the natural forests in local communities and, more widely, in nearby territories.
- Protecting areas of symbolic importance (forests with high conservation value, protected areas, fragile zones) by creating buffer peripheral zones where local populations will be able to find needed products.
- Providing recreational areas and "green lung" areas via urban and peripheral afforestation.
- Marking the territory and thereby providing to local stakeholders "appropriation tools" for spaces with uncertain legal status.

- Intensifying farming by the introduction of trees in the farming and forest-farming systems.

Traditionally introduced specifically for wood production and related wood resources (energy, paper pulp, saw, etc.), diverse plantations are now integral to forest management and to territorial plans to which they can contribute further economic value. They also contribute to the creation of social and environmental value, as well as to the foundations and organization of both urban and semi-urban areas of the territory. They protect sensitive areas (affected by erosion and protected areas, for example). Finally, they often support local natural biodiversity if correctly and professionally managed.

Photo 8.4: Three years of assisted natural regeneration on sandy soils – Makala Project, DRC

8. The forest plantations – integration and social and community development factors

Interaction between people and forest ecosystems, regardless of whether they are natural or artificially planted is a common element. Contrary to industrial plantations, which rely on financial investment, social forestry depends essentially on informal labor. Thus, 1 000 hectares planted for industry could produce as much or more than what 1 000 village plantations of 1 hectare each would produce. On the other hand, the outcome in terms of social integration, local distribution/redistribution of income and poverty reduction is very different.

Small farmers' plantations are increasingly included in a farming, industrial forestry or conservation farming system. "Social logging" integrates a spatial mosaic dimension through planning and zoning norms, and guarantees overall sustainability of the system. However, technical knowledge regarding forest plantations is generally lacking amongst local communities. Strengthening their knowledge requires substantial and long-term investment to transfer knowledge and techniques which would allow them to better plant and manage this investment.

A tree in a city, just like any tree outside its natural habitat, acts as an essential element of well-being (improvement of the environment, aesthetics, shady areas…) and the provision of diverse goods and services to rural and urban populations.

Land security and/or benefits gained from plantations limit large-scale development of plantations by local actors. Popularizing individual or village plantations requires a very shrewd approach, so as not to collide with traditional powers and also in order to integrate local rights into national laws and policies, which are often few and far between and rarely spelled out in detail.

The ownership of plantations by local populations is a key factor in contributing toward their sustainability. This entails important but gradual efforts to adapt and adjust to local norms as well as specific, targeted public policies.

9. Diversified technical tools and itineraries for varied goods and services

There is no conflict between natural forests and plantations (in the broad sense), more specifically there is a continuum of complementary situations and techniques. Clonal plantations, improved village agroforestry or agro-industrial plantations, assisted natural regeneration, natural forest restoration of disturbed ecosystems, semi-urban forests, etc. are merely aspects of the same concept.

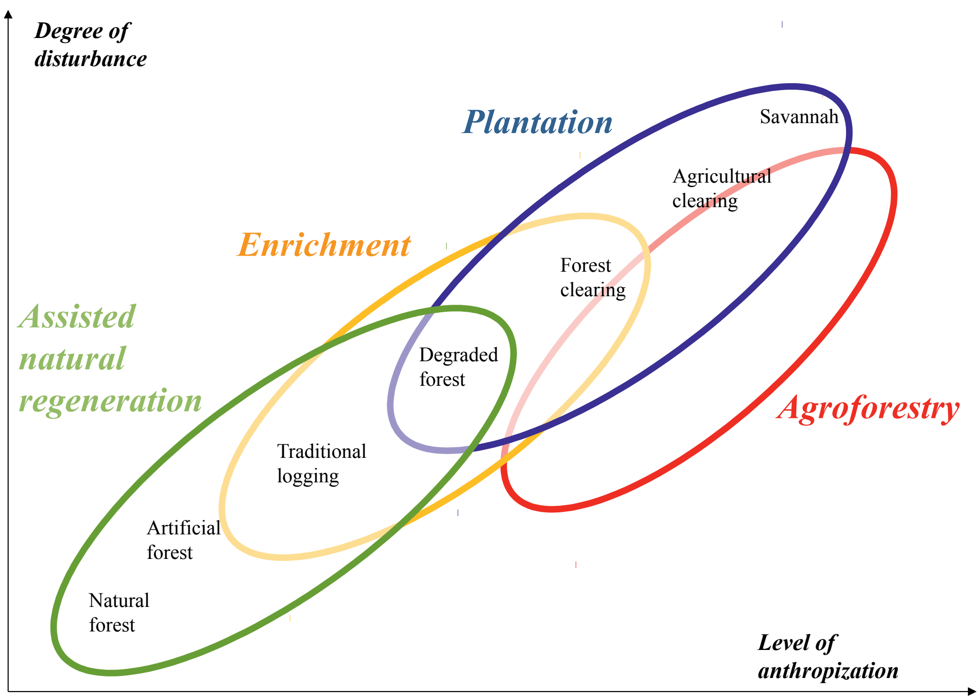


Figure 8.1 : Relative place of the various "plantation" tools according to levels of degradation of natural forests and anthropic pressure

Many technical processes for forest plantations are adapted to different local situations. These techniques tend to strengthen – not replace – the role of the natural forests. In this context, local and exotic species must be taken into consideration and adapted to context and goals pursued.

Central Africa has many examples of forest plantations and attempts to manage natural forests. All of these examples provide us with much knowledge and important lessons.

9.1 Forest plantations

Farming wood (fiber, energy, etc.) in the same way we farm corn or poplars is the challenge faced by mass plantation developments. This requires knowledge and implementation of approaches, techniques and economic foresight derived from intensive agricultural practices. Of course, everyone has in mind millions of hectares of intensive eucalyptus or pine plantations in Brazil or South Africa. Central Africa has, however, been a forerunner in this area, but for the last

30 years, global conditions (investment security, for example) have not favored the maintenance and expansion of intensive forest plantations. This environment could be improved with new actors, new investors and new markets, and with a more secure and stable institutional context.

The following concrete examples are not exhaustive, but they provide a good picture of the immense potential existing in Central Africa and in neighboring countries, even though the total areas reforested are not equal to the potential areas available. It should be made clear at this point that oil palms are not regarded as forest plantations but rather as agro-industrial plantations.

9.1.1 High-yield industrial plantations of exotic species in savannas or deforested zones

Clonal eucalyptus – Pointe Noire – Congo – 40 000 ha – EFC Company

As the result of research and development conducted without interruption for over 40 years, these high-productivity industrial clonal plantations (15 m^3/ha/year on average) are intended for the supply of industrial wood for paper pulp. This large area has served as an example. Most intensive clonal tropical eucalyptus plantations are based on this model and on the clonal multiplication techniques developed here. These plantations are currently being subjected to strong social pressures due to the expansion of the city of Pointe Noire.

Hevea – Kisangani – DRC – 10 000 ha – State

These plantations are distributed all along the River Congo and its tributaries. Political instability has stopped latex production, but the plantations are still in place and it would not be difficult to revive *Hevea* forestry oriented towards timber production (sawn wood or energy) pending the revival of latex production.

Teak – Bassama – Cameroon – 200 ha – State

These teak plantations were initiated by the State in several stages some 20 years ago. Even though ecological conditions for this species are not optimal, this plantation, without genetic improvement of any kind, produces between 4 and 5 m^3/ha/year of small sawn wood. It is in the process of gradually being converted to coppices.

Photo 8.5: Industrial eucalyptus plantation – Pointe Noire, Congo

9.1.2 Plantations of local species of timber of value on savannas or degraded forests

Okoumé – Mvoum – Gabon – 14 000 ha – Sogacel

Aged between 30 and 55 years and inserted in a planted area of 39 000 ha, this *okoumé* plantation is becoming mature and subject of a logging and replanting project. Its average productivity of 10 m^3/ha/year demonstrates the ability of local forestry species to provide industrial production of prime economic importance.

Ayous – Batouri – Cameroon – 200 ha – Alpicam/STBK

This recent, partly clonal plantation constitutes the first phase of an ambitious *ayous* development project. The technological characteristics of this species are particularly appreciated by the timber industry. The species is easily domesticated. It has a strong colonization capacity through natural regeneration on logged areas or farmland. Its young growth is rapid, which gives it many advantages.

Limba – Bilala – Congo – 100 ha – SNR

Aged between 30 and 60 years, the limba (*Terminalia superba*) plantations in Mayombe were initiated after completion of many research projects. Their growth is very strong (over 10 m^3/ha/year). A selection of superior clones has been developed successfully here. Timber quality is good and a part of the plantation has already been harvested. This plantation clearly shows that it is possible to reduce the rotation period and to lower the optimum age of harvest compared with a well-managed dense forest.

9.1.3 Creation of buffer zones around protected areas

Acacia – Goma – DRC – 5 000 ha – Ecomakala project

Peasant acacia plantations have been under development since 2005 around the Virunga Park with the aim of developing an alternative activity to wood-cutting and poaching within the park. Over 5 000 ha have been planted by 5 000 peasant farmers, which has enabled substantial timber production for energy purposes. The use of earnings from this production needs, however, to be reviewed in order to make it a genuine source of income and incentive for planters.

9.1.4 Wood production for local use (energy, etc.)

Eucalyptus – Antananarivo – Madagascar – 100 000 ha – Private planters

The eucalyptus plantations have been developed for over 50 years by small private planters (0.5-1 ha on average) on degraded land. Without any external encouragement, these planters have created a productive area (3-5 m^3/ha/year) which supplies the capital and the major cities with wood for energy. This area, often a coppice grown on aged trunks with amateurish management is an excellent example of the success of informal private initiative in response to urban demand.

9.2 Agroforestry (see chapter 7)

Agroforestry comprises a multitude of agricultural systems in which the tree is one of the components of the area concerned. The association of trees with another crop, fruit-growing or stockbreeding exhibits many forms according to the local context and the objectives of the farmer, for example the cocoa and coffee agroforestry systems in southern Cameroon, whose rationale is more agricultural than forestry-related.

9.3 Trees outside the forests

Trees outside forests are characterized by low density – a few dozen trees per hectare – in various areas. This is an unavoidable fact in certain rural landscapes and also in urban and suburban landscapes in Central Africa. Low tree density is closely associated with increased human population density and the development of small areas (generally, urban plots or hut gardens).

9.4 Urban and peri-urban plantations

Trees in towns are a result of urban development works, such as hedge rows and parks. In this case wood production is not the primary objective.

Brazzaville – Patte d'oie – Congo – 150 ha – MDDEFE

Apart from its role as an urban forest, the *Patte d'oie* forest in Brazzaville is an urban wooded area with great symbolic value. Despite numerous attempts at dismemberment because of land interests and pressures, a large portion has been conserved. Further conservation efforts are being made and reforestation is continuing with both local species and eucalyptus. The plantation's role in marking territorial boundaries is particularly important.

Photo 8.6: Truck loaded with eucalyptus logs near Pointe Noire, Congo

Eucalyptus – Kinshasa – DRC – 100 ha – Makala project

Some 11 000 eucalyptus saplings have been planted by a project in a district of Kinshasa. At the rate of two saplings per plot, over 5 000 urban plots have been planted with a total area of over 100 ha. The visual effect, which is immediate, is raising great expectations among the local population, who are also happy to see their environment upgraded.

Green belts – Ndjamena – Chad – 657 ha – MERH

In 2009, Chad initiated an ambitious and voluntary program for the greening of a belt around the capital as part of its national "green belt" program. Over 200 ha have already been planted with the cooperation of all ministries. The effects in terms of greening and the regeneration of local species, both herbaceous and timber, are very positive and already noticeable.

Photo 8.7: Industrial nursery – Pointe Noire, Congo

9.5 Silviculture of natural settlements

The future of the natural timber forests of Central Africa depends to a large extent on the ability of managers to intensify the practices developed in regional territorial plans, and even to develop the very concept of such plans. What is involved is nothing less than moving from on the practice of extensive felling to more intensive management without jeopardizing the functions, goods and services furnished by these ecosystems.

The gradual advent of new non-forestry actors such as organizations for the conservation of nature enables the forests to be seen in a new light, a view sometimes far removed from that solely based on the harvesting of the timber resource. In addition, growing international and regional demand for non-conventional products (reconstituted wood, etc.) or for new uses (bioenergy, green chemistry, etc.) should help to greatly modify the perception of timber uses. It would no longer be a case of adapting uses to the natural resource available but the opposite, namely gradually adapting the resource to the needs of society.

In this context, the principle of the multi-functionality of forests and the scale of application should evolve. In fact, all the functions of ecosystems must not necessarily be fulfilled at the scale of the individual plot but, on the contrary, multi-functionality can be achieved over a broader scale by juxtaposing plots under different management. These two levels, local and global, are complementary and must therefore be taken into account. Various silvicultural techniques for natural forests have already been put into practice. They have generally been based on the forestry techniques that were used in temperate stands (e.g. in Europe). However, these systems are complex and costly, and they have largely been discarded, especially in the increasingly stringent environment facing private forestry companies. Minimal-cost strategies are now being developed by several actors in the forestry sector because of the constraining political, institutional, fiscal, economic and competitive medium and long-term conditions prevailing in many central African countries.

Industrial demand for homogeneous wood products and the gradual disappearance of very large diameter trees is leading to a decrease in average felling diameter. Efforts to find an acceptable level of profitability will inevitably lead to an intensification of extraction. One can thus imagine a scenario in which increasingly destructive forest "mining" will lead to accelerated degradation and deforestation and herald the end

Photo 8.8: Protected young tree in a manioc field – Bateke plateaux, DRC

Photo 8.9: Individual nursery for Makala project - Kisangani, DRC

of the forest. However, one can also envisage a situation where increased extraction will be offset by adapted forestry methods that will enable an increase in the density of higher-value species. The future silvicultural of natural Central African forests would thus inexorably approximate to the methods developed in other latitudes, where the manager constantly monitors the renewal of stands, the growth of trees and the harvesting of products. A conference organized by CIRAD in Montpellier in November 2011 reviewed this important issue (IUFRO, 2011).

One of the major constraints on the cost, and hence the development of silvicultural techniques in natural forests is the time factor. The costs may be substantial. If technological procedures are not properly mastered and integrated into the harvest plans, the calendar and the operational budget in logging operations, substantial costs could prove fatal to the profitability of the whole enterprise. These costs should also be calculated against profits anticipated in the long-term since the ultimate objective is a real increase in the volume of wood harvested and a corresponding decrease in unit management and harvesting costs.

9.5.1 Assisted Natural Regeneration (ANR)

Forestry operations are rarely followed by appropriate concomitant measures because management is based on the forests' capacity for natural regeneration, evaluated on the basis of inventories. Many examples point to the capacity of ANR to promote such regeneration.

Enrichment, the planting of seedlings or seeds in tracks, once widely used after logging has been practically abandoned because of the high cost related to thinning the regrowth over several years, as very rapid regrowth casts a deep shadow over the seedlings and creates competition for daylight. Regeneration in logging gaps creates the same problem and requires care and very precise and coordinated work with the logging team. In order to be successful, these techniques must be carefully thought out and integrated into management before logging begins. Felling for seeding (opening of cover and clearing of undergrowth) could be practiced in order to promote natural regeneration under or near seed-producing trees which have been identified and preserved. This technique requires good knowledge of the phenology and methods of reproduction of dense-forest species and of their social and ecological behavior, but this knowledge is still largely under-documented. In much degraded forests, such as the forest fallows on the Bateke plateaux in the DRC, ANR is employed by farmers who clear forest growth in order to grow temporary crops before leaving the land fallow. The technique consists of keeping seed-producing trees on the margin of their plots and in the selection and conservation of seedlings when crops are weeded. The protection of these stems and seedlings enables the rapid return of the forest after the plots are left fallow. Thus these plots retain their forestry role, which makes it possible to maintain farming and forestry productivity in extensive areas.

In the *marantacea* areas of northern Congo, the natural seeding cycle of trees is interrupted by this undergrowth vegetation. The sowing of skidder tracks with seeds or seedlings of sun-loving species can yield excellent results by retaining productivity in areas which have lost their timber potential. Nevertheless, the reintroduction of trees must be followed up in order to avoid damage due to excessive pressure by fauna (uprooting and trampling).

9.5.2 Thinning and clearing

Provided they are clearly identified, regeneration spots may comprise thinning and clearing in order to limit competition from competing species or species at risk (lianas, etc.) and to promote the development of selected future stems.

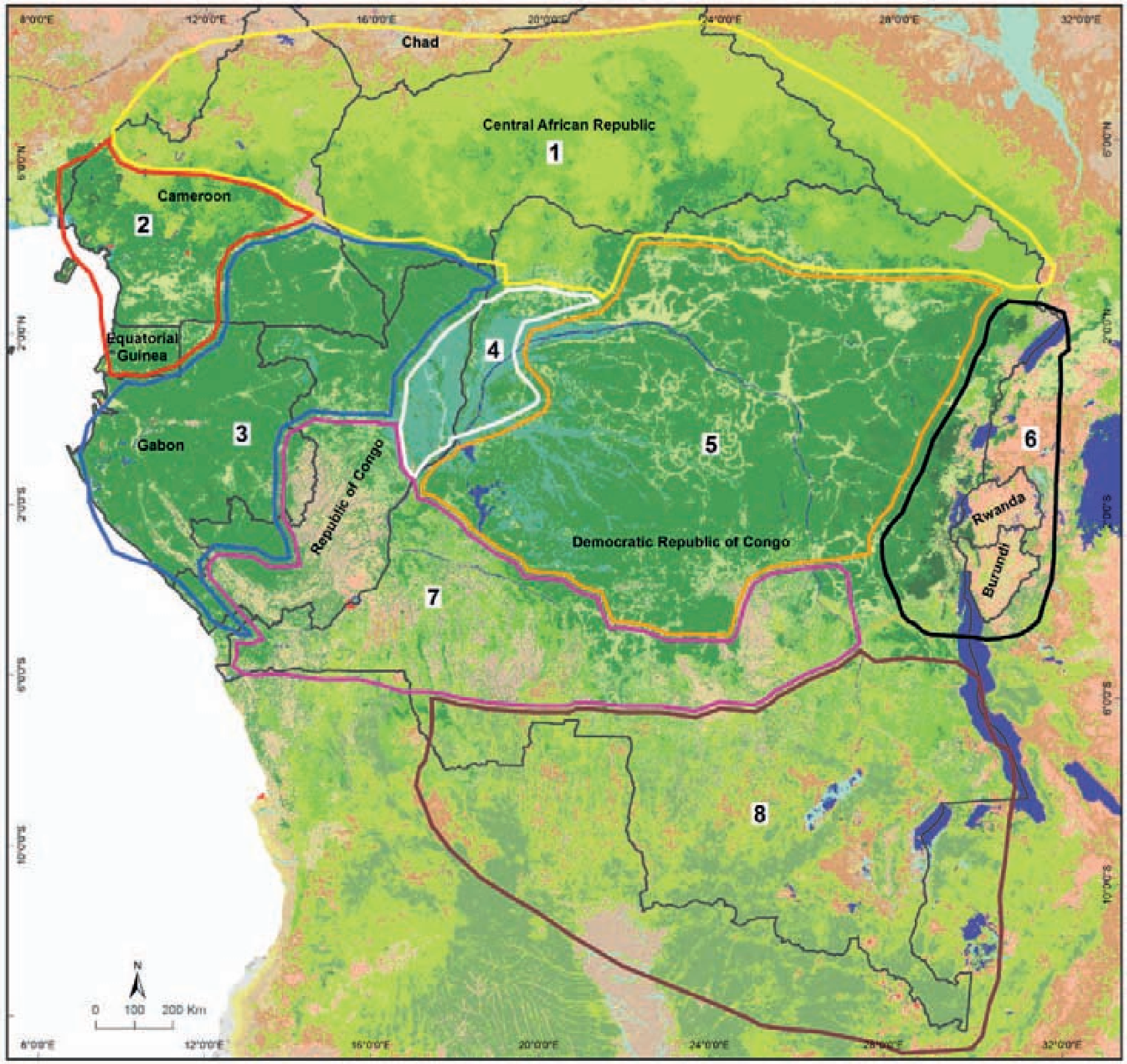
9.5.3 Selective thinning

A move to selective thinning has already been made in certain forest concessions. Part of the non-essential forest cover and certain low-value species are cut down in order to promote the growth and development of stems of higher-value species. These thinnings must maintain a balance of flora sufficient to conserve the various functions of these complex ecosystems.

10. Tools and priority steps according to socio-ecosystems

A socio-ecosystem (SES) is an integrated and complex system of ecosystems and human societies interacting with one another. This system is relevant in order to take into account the multiple interactions between its various components and thereby answer the questions arising concerning development paths. Central Africa is a complex of forest socio-ecosystems. Eight SES have been identified (figure 8.2) in which forest plantations and new forestry techniques do not have the same potential, the same feasibility or the same interest.

The map below shows the spatial distribution of these SES. For each of them, the level of disturbance of natural ecosystems and their degree of "anthropization" play a key role in the choice of objectives pursued, and consequently the plantation and silvicultural techniques to be prioritized. Table 8.1 proposes targeting regional priorities on the SES where the impacts of forest plantations may be strongest and investments the most interesting.



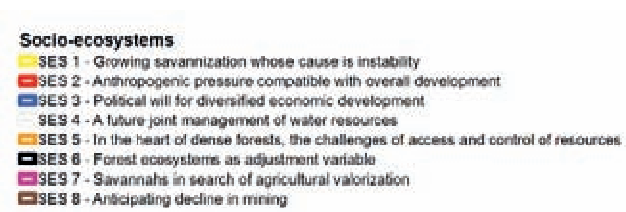


Table 8.1 : *Intérêts des plantations sur les SES*

	Socio-ecosystem							
	1	2	3	4	5	6	7	8
Plantation	Middle	Middle	Middle	Low	Low	High	High	High
Assisted natural regeneration	High	High	High	Middle	High	High	High	Middle
Agroforestry	High	High	Low	Low	High	High	High	Middle
Peri-urban plantations	Middle	High	Low	Low	Low	High	High	High
Forestry natural stands	Low	Low	High	High	High	Middle	Low	Low

Interest	
High	
Middle	
Low	

Figure 8.2 : Map of forest socio-ecosystems in Central Africa and interest for different forest management modes.

11. Understanding the effects

Much has been said about the essentially negative impact (eucalyptus, certain types of pine, etc.) of forest plantations on ecosystems. The international debate on forest plantations reached a peak in the 1980s and 1990s. The massive introduction of more or less adapted exotic species, poorly assimilated or unassimilated technical procedures, recurrent conflicts with local population groups, a fragmentary approach and virulent policies on the part of ecological organizations and certain sections of civil society in both north and south gave rise to much controversy and opposition, which was unfortunately sometimes justified. This debate on forest plantations is currently coming to an end, mainly due to the combination of several convergent phenomena. Because of the increase in international needs for timber, an ever-increasing share of the needs for timber and timber by-products is now based on the development of forest plantations. The identified effects of climate change are weakening natural ecosystems and are likely to impede natural adaptation processes.

Table 8.2 lists a number (not complete) of possible direct or indirect positive effects related to the development of forest plantations in Central Africa.

Table 8.2: *Several effects of the development of forest plantations in Central Africa*

Ecological effects	Soil Water Transformation of natural ecosystems, catalyst effect Naturalization of exotic species Invasive species
Social effects	Individuals Villages and rural communities Urban and semi-urban populations Local appropriation Fair sharing of profits
Economic effects	Intrinsic profitability Profitability in relation to other farming methods Types of investments and management methods A response to needs at all levels
Institutional effects	Policies Regulations Tax Incentives Privatization Land-law Customary law Research Access to knowledge
Effects of development	Land use Land development Management strategies Processing procedures Supply-chain

12. Invest in forest plantations?

Without doubt, the best manner in which to address the issue is to develop a pragmatic approach, guided by objective choices and supported by the reality of the field.

The planted forests are not intact natural forests

Behind every plantation there is a human decision. Because of their simplification in relation to natural ecosystems, the planted ecosystems are higher yielding (for a given yield) but are also more fragile. Behind their apparent ease (what's simpler than planting a tree…), precise techniques are applied for which the complexity is often underestimated. Moreover, the plantations must allow transferability of use of the land after the final cutting. Each plantation project represents an investment (financial, human, etc.) to which a benefit (financial or other) is expected.

Outstanding successes/success stories, not without resounding failures

In the 1960s-1970s, several plantation programs appeared in all Central African countries, mostly managed by the states and often thanks to international financing. Green barriers, semi-urban plantations, afforestations, "Day of the Tree", afforestation for protection, enriching plantations, etc. are amongst several examples. Unfortunately, apart from some spectacular and sustainable successes still present as examples, the results are mixed. The notable neglect of public authorities in the field, geopolitical uncertainties, a climate not conducive to long-term investment, and the use of inappropriate techniques all contributed to an end to plantations. Several African projects were suspended while during the same period, planted forests became a fundamental component of forestry management in Latin America and Asia. In the last twenty years, attempts at silvicultural in dense forests have been left to the state because of a perceived lack in profitability. It should also be noted that for an entire decade, a sense of dogmatism led to explicitly excluding artificially planted trees from sustainable forestry management certification programs. Fortunately, this attitude has evolved.

A renewed interest in planted forests and silvicultural has been observed over the last few years. Socio-economic advancement, changes in the labor market and new challenges linked to climate change are causing increasing deterioration and imbalance between man and the ecosystems.

Causes of failures or multiple under-achievements

Most of the noted failures are strictly man-made and merely reflect implementation errors and overall lack of necessary skills and knowledge. There are several types of failure:

- Insufficient or erroneous preliminary **strategic analyses** (lack of long-term objectives and/or follow-up);
- Approximate or non-adapted **technical practices** (choice of species, of sites, of technical processes);
- Poor judgment/assessment of **social challenges** (non-ownership by local communities, conflict, etc.);
- Non-resolution of **land tenure prerequisites** (pressure for other use, real estate or agricultural speculation);
- Erroneous **economic calculations** (less productivity than forecast, no income or non-reinvested income);
- Underestimated **political or institutional** constraints (tax, regulations, etc.);

Photo 8.10: Acacia auriculiformis plantation – Bas-Congo, DRC

- Insufficiently recorded **environmental impacts** (plantations in dense forest, erosion, etc.) ;
- Reforestation projects often burdened with debt due to **discontinued financing**. These require financing right up to the first harvest (taillis) or the first cutting (mature timber forest) to be financially profitable while projects generally only finance the planting phase which is then abandoned due to lack of funds.

A lack of scientific data, particularly for plantations of local species

Acquiring scientific data is absolutely essential to develop plantations, particularly for local species. Most studies have in fact been devoted to exotic species (genetics, silvicultural, technology, etc.). On the other hand, the behavior and potential for reforestation with local species are still largely unknown. The few and only reference works concerning mature trees come from the various arboretums scattered around the subregion. New research projects are nevertheless tending to fill part of this gap in knowledge.

Many potentially usable species have not, or have hardly been tested in plantations because they did not figure among the major timber species. With the exception of certain species such as ayous, limba, okoumé and a few other "pioneer" species, their growth and productivity are practically unknown. Among these are species whose regeneration is linked to forestry fallows or in highly degraded forests and whose young growth may be very rapid. Only through better knowledge of ecological requirements, of methods of reproduction (the lack of seeds seriously curbs the development of such plantations) and of behavior will it be possible to diversify the range of local species which are potentially usable in plantations.

Towards the sustainable management of planted forests

Several "reference systems" for the sustainable management of forestry plantations (notably principles, criteria, indicators and verifiers) exist in the region, both for natural forests and for plantations (OIBT, FSC, etc.). These reference systems propose guidelines for the sustainable management of forestry plantings, but complying with the guidelines does not necessarily guarantee success. They must be disconnected from certification, which is a marketing tool. The fact remains that the only valid indicator is, in the final analysis, comparison between forecasts and reality on the ground at the time of harvesting.

The "artificialization" of the environment makes it necessary to acquire knowledge and innovative know-how. Research and development must necessarily precede strategy and be applied to plantations over the long term. The mutual exchange of knowledge and know-how and the sharing of information at the regional level would certainly be very beneficial to the whole community engaged in reafforestation.

Investments are not limited to the planting of trees but must include the cost of long-term work (management, maintenance, silvicultural) up to harvesting or the first marketable thinning. Many failures are in fact attributable to the abandonment of plantations which nevertheless started off successfully.

Public intervention needs to be rethought : the design of effective, credible and sustainable incentives. The private sector alone cannot take all the risks, even for the benefit of future generations. It needs, in return, security for its investments.

Photo 8.11 : Old eucalyptus in the planted Mampu Forest, DRC

13. Conclusion

The development of new silvicultural practices for natural forests and the development of forest plantations in degraded forest zones or savannas pose major challenges for Central Africa. "Traditional" methods of management used today (even if only recently) must be re-examined in light of all kinds of new issues, challenges and demands confronting Central African countries and societies. To not develop forestry management capacity and technologies endangers the entire forest ecosystem with the risk of disastrous degradation or even disappearance of the forest. This would then lead to economic and human non-competitiveness compared with other more remunerative short-term use of the land. Accelerating the establishment of new forestry management practices will nonetheless only occur with strong and loyal support from central African political institutions and administrations.

PART 4

LAND USE IN CENTRAL AFRICA

CHAPTER 9

Allocation and use of forest land: current trends, issues and perspectives

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[1]RRI, [2]USFS, [3] James Cook University, [4]GIZ, [5]CEECEC, [6]CIFOR, [7]WRI, [8]FAO, [9]CIRAD, [10]CRDPI, [11]MRV/FAO Project

1. Introduction

Facing on one hand the challenges of growth and development, and on the other a need to sustainably use natural resources, the countries of the Congo Basin are at a crossroads. To meet these challenges, national policies are relying on the exploitation of natural resources and the expected increase of public revenue (CEA, 2010). The national economies are in effect heavily dependent on exogenous income and income generated from natural resources (Philippot, 2009). The latter account for a large part of government revenues: 26.8 % in DRC; 28.6 % in Cameroon; 53.9 % in Gabon; 67.6 % in Chad; 79 % in Congo; and 88 % in Equatorial Guinea (FMI, 2012).

The industrial and commercial use of the earth's natural resources profoundly affects how land is allocated and the land use schemes under development (Schwartz *et al.,* 2012). Biodiversity conservation, the development of large infrastructure projects, and the implementation of land use planning schemes furthermore influence each other. In other words, the search for livelihoods at the local level, growth, development, biodiversity conservation, and land use planning are correlated and form an indivisible whole (Hagen *et al.,* 2011; Angu *et al.,* 2011).

This chapter addresses the question of land allocation and use and the sustainable management of natural resources, notably forests and biodiversity, in a sub-region engaged in fighting poverty and confronting the challenges of good governance (Oyono, 2013a). It seeks to transpose these issues onto the field of policy development. The main concepts related to forest land use planning are presented in the first section of the chapter. The second section identifies the breakpoints between the past and present concerning the way land is used. The third presents a general overview based on "country cases". The fourth section describes the externalities in play since the beginning of the 2000s, particularly with the massive engagement of new actors. The last section addresses the prospects for land use planning in relation to sustainable forest management and biodiversity conservation.

2. Conceptual clarification

The concepts normally associated with planning the allocation and use of forest land generally refer to the notion of a cadastre (Cauquelin, 2000). These conceptual categories often are blurry or poorly understood: land use, land allocation, land cover, classification of forests, forest zoning, etc. The following seeks to clarify some of these concepts (Sidle *et al.*, 2012).

Box 9.1: Land use planning

Land use planning is a process by which stakeholders (local community members, traditional authorities, government representatives, private sector actors, scientists, etc.) come together to discuss and determine how to manage the resources of a given geographic area for future generations […]. If carried out in a participatory manner, zoning is an excellent land use planning process. […]

Most countries in the sub-region have developed national zoning plans, but these are often incomplete. In the conservation landscapes of the Congo Basin, there is, however, much to be learned from land use planning processes. Using the appropriate methodologies, such processes outline a vision of space in zoning operations that define macro and micro-zones. Macro-zones are vast geographic areas (protected areas, community agro-forestry areas, extractive concessions, etc.) which often are split into different land use micro-zones depending on the management plan.

Source: Adapted from Sidle et al. (2012) and authors.

Photo 9.1: Trees planted in former farm plots

Land use: land use practices implemented by human societies for diverse socio-economic activities. These practices may lead to changes in ecosystems, biological diversity, and water and climate cycles. To maintain multiple environmental services and conserve biodiversity, some forest areas in the Congo Basin were classified as environmental protection and biodiversity conservation areas.

Land allocation: land-use selection practices for a specific purpose. The allocation is a result of a planning process involving all stakeholders: the government, local populations, private sector, civil society, research institutions, etc. Changes in land allocation influence the soil and microclimate.

Land cover: physical land types. Mapping land cover allows a better grasp of the state, evolution and natural and/or anthropogenic dynamics of ecosystems and territories.

Classification: set of procedures used to place a forest into the private domain of the State. This classification is made through a regulatory act fixing the geographic boundaries and management objectives of this forest (production, recreation, environmental protection, biodiversity conservation).

Zoning: planning techniques used to designate areas for specific uses. It divides space into distinct geographic areas in a process of land planning, allocation and territorial development.

3. Disruption Factors (1990-2010)

The past decade has been marked by significant institutional developments and disruptions in local land use patterns (Hagen *et al.,* 2011). Although some of these changes are specific to certain countries or particular areas, many common factors are emerging across the sub-region of the Central African rain-forested countries such as policy reforms and the signing of international conventions (Oyono, 2009; Djeukam *et al.,* 2013). Many of these effects are the result of pressure from the donor community while others are related to economic developments such as globalization, highlighting both the interconnectedness of the world and growing regional coordination. Policy, legal and institutional developments in effect since the mid-1990s strongly shape land use planning options and land use schemes, with both positive and negative impacts on sustainable resource use and conservation.

3.1 Forest and land policy reforms

Some of the most significant land use developments across the Congo Basin region over the last decade result from forest law reforms (Yangen *et al.,* 2010). In many countries, more elaborated forest management planning is now required and restrictions have been placed on the logging sector, at least nominally. For example, log export bans were put in place by Cameroon in 1999 and Gabon in 2010, while the Democratic Republic of Congo (DRC) suspended logging titles in 2002 (Putzel *et al.*, 2011). Although many of these legal revisions have moved the region towards more rational and sustainable forest management, others have had mixed results and have in some cases opened new opportunities for corruption and nepotism. For example, management plans may be so complex that they are impossible to enforce with the technical capacity and resources available (Goncalves *et al.,* 2012). Another example is the growth of "artisanal logging" in the DRC since the moratorium on logging concessions. Much of the large-scale logging has merely been replaced by unpermitted companies and continues under the guise of local activities (Global Witness, 2012).

Box 9.2: Forestry reforms – the momentum is increasing!

The democratic transitions which have been under way in the Central African countries since the early 1990s constitute a key stage in their political-institutional evolution. […] The constitutions have been revised to promote the legalization of political pluralism. Laws promoting political participation have been promulgated. […] The CAR in 1990 and Cameroon in 1994 initiated a broad legal and administrative restructuring of the management of their forests. […] For example, in Cameroon the new forestry legislation establishes the basis for a form of technical decentralization which transfers to the decentralized territorial and local communities, responsibilities for the management of forests and the financial benefits deriving therefrom. The Central African and Cameroonian initiatives have rapidly been replicated and new forestry legislation has been promulgated in Equatorial Guinea (1997), the Republic of Congo (2000), Gabon (2001), DRC (2002) and Rwanda (2005). The revision of the forestry act in Burundi dates from 1985; it therefore slightly preceded this overall trend.

Source: Oyono (2009)

At the same time, several countries in the sub-region adopted reforms or international commitments recognizing the tenure rights of forest communities. For example, the 2002 DRC Forest Code provides for legal recognition of local community forests and the possibility of community forest concessions. While these aspects of the law cannot yet be implemented because of delays in implementing the regulations, the law might signal a shift away from complete state management and control of forest resources. In Cameroon, the forestry law, which is currently under revision, provides for some local community forest management, but the rights of communities are relatively limited and subject to government oversight. The Republic of Congo, meanwhile, passed legislation recognizing the rights of indigenous peoples to land and forest resources. Many laws include an increased recognition of the unique place for women and indigenous groups in the land use planning process (Wily, 2012). While the sub-region lags far behind other areas in terms of local community forest ownership and management, the increased civil society engagement in the reform processes over the past decade has opened more possibilities for local forest management and livelihoods improvement (RRI, 2012). Land reforms have also been a topical concern in the sub-region since the 2000s. While the Republic of Congo and Gabon have already revised some provisions of their land legislations, such revisions are also underway in Cameroon, the DRC and Central African Republic.

Photo 9.2: Forest base camp – Moyen Ogooué, Gabon

Over the past decade, several countries in the sub-region endorsed international commitments that, when implemented nationally, will affect how forests are managed. For example, the *United Nations Declaration on the Rights of Indigenous Peoples* and the *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* increased the recognition of local community and indigenous peoples' rights to forestland. One initiative that has prioritized the involvement of local communities is the Central African Regional Program for the Environment (CARPE), led by the U.S. Agency for International Development (USAID). Through the framework of land use planning at the landscape scale introduced by CARPE with the focus on a multi-faceted approach to biodiversity conservation, community rights, sustainable development, and the potential of ecosystem services, the involvement of local communities in forest management in the Congo Basin has greatly expanded (Yanggen *et al.,* 2010). Over the last ten years, more than 150 macro-zones have been defined in landscapes across Central Africa, and each one has been created by working directly with communities and governments at a local scale.

3.2 Global economic trends and their local impacts

Another major development over the past decade has been a broader international influence in the region. This international influence became more obvious during the global financial crisis of 2008, which led to decreased demand for wood and wood products in Europe and the subsequent departure of some of the major European forest concessionaires from the area (hastened by competition from illegal operators due to poorly enforced regulations). These departures, in turn, had reverberating effects at both the national and local scales. For example, a study of the effects of the global financial crisis in the Sangha Tri-National landscape showed that "global demand for timber decreased and this led to suspension of logging activities and lay-offs of staff by logging companies; both biodiversity and livelihood indicators deteriorated" (Sayer *et al.*, 2012). This and other similar studies and anecdotes are reminders of the interconnectedness of the world economy, even in some of the most remote and least developed locations.

The increasing influence of China in the region reflects this broadening international engagement in the sub-region. China has invested approximately $ 0.7 billion in five of the Congo Basin countries (Cameroon, the DRC, Equatorial Guinea, Gabon, and the Republic of Congo), with the DRC accounting for over half of that amount (Engelhardt, 2010). For example, the Congo Basin has had notoriously poor infrastructure but with a renewed focus on improving road networks in the past decade, there have been several funding commitments from multilateral and bilateral sources, including China (Putzel *et al.,* 2011). The improvements that may result from this renewed focus are likely to hasten economic development but also to increase deforestation and forest degradation unless couched in a well-organized and managed sustainable development context.

The sharp rise in large-scale land acquisitions since 2000 and especially since 2007, often referred to as the global land rush, has had important initial impacts in the sub-region. The acquisitions by foreign and domestic investors, while often speculative, have targeted areas with weak local land rights security in an effort to obtain low-cost land to produce agricultural and energy commodities (World Bank, 2010). Many countries in the sub-region have issued long-term leases to investors while ignoring local customary land rights. This phenomenon has been primarily driven by the increased demand for palm oil as well as biofuels. The growth of palm oil production has been a topic of particular concern for environmental organizations which worry that primary rainforest land will be cleared to make way for oil palm plantations (Tollens, 2010).

Photo 9.3: Industrial eucalyptus plantation – Pointe Noire, Congo

Thus far, however, most Congo Basin oil palm investments have been in established, old plantations or at small-scales for local consumption. However, increased demand, and concurrent production in the Congo Basin, is expected. For example, Cameroon has increased its output over the last decade and has plans to nearly triple production by 2020 (Megevand, 2013). Included in this increase is an oil palm concession issued to Heracles Farm (an American company) that overlaps with an existing biodiversity protected area and community lands (Oyono, 2013b). A Singapore-based multinational has acquired a large surface area for agri-business in Gabon (see country case below). Similarly, a one-million hectare oil palm plantation, to be established for biofuel production, was recently under review by the DRC government (Carrere, 2010). Recently, South African multinationals have acquired thousands of hectares of land for maize production in southern Congo. The next decade will undoubtedly see more investment. This land rush could cause long-lasting negative impacts on local communities and their customary land tenure rights (Wily, 2012).

3.3 Emergence of new cross-sectorial strategies

International efforts to support Congo Basin countries to reduce deforestation and eliminate illegal logging have made significant progress over the past decade. Mechanisms aimed at compensating efforts intended for the reduction of emissions from deforestation and degradation (REDD+) are being implemented in the subregion. Two of the Congo Basin countries (the DRC and the Republic of Congo) are REDD+ pilot countries, with three others (Cameroon, the Central African Republic, and Gabon) involved in REDD+ planning or activities in less formal ways. REDD+ brings together government officials, international experts, civil society, and local communities around the issues of deforestation and forest degradation, and more generally moves the country towards the development of a natural resource inventory and land use planning process, both required for successful participation in REDD+. The time and energy spent on REDD+ and related carbon mitigation programs underlines the increasing concern over climate change and the international recognition that tropical rainforests have an important role to play in climate change mitigation. However, due to limited progress in international negotiations and the challenges resulting from weak forest governance, a significant part of country level efforts are being delayed.

The long fight to reduce illegal logging in the Congo Basin took important steps during the past decade. Efforts led by the Forest Law Enforcement, Governance and Trade (FLEGT) program resulted in several countries agreeing to enter into negotiations to eliminate the export of illegally-logged timber into the European market. Cameroon, the Central African Republic, and the Republic of Congo have concluded a Voluntary Partner Agreement (VPA) with the EU, committing these countries to significant changes in forest management practices ; whereas the Democratic Republic of Congo and Gabon are in the negotiation phase of the process (Megevand *et al.*, 2013).

4. Current trends

Nearly 40 % of usable land in Central Africa is neither cultivated nor protected, and is sparsely populated (Deininger *et al.,* 2011). If forest areas are excluded, 20 % of Central African land is usable and available for agricultural expansion. The race for agricultural land and natural resources, including metals and fossil fuels, is drawing a flow of investment into the region. Multi-national and private companies are negotiating large concessions with governments (Ochieng Odhiambo, 2011 ; Hoyle and Levang, 2012 ; Karsenty and Ongolo, 2012 ; Feintrenie, 2013). Agro-business projects and speculative land investments are multiplying, leading to ever higher land prices, latent conflicts and social damage (Anseeuw *et al.*, 2012). Large forest areas are threatened, as is access to land for rural populations (Cotula *et al.,* 2009 ; de Wasseige *et al.,* 2012). Furthermore, large agricultural and mining investments require associated infrastructure such as roads and railroads (Oyono, 2013c).

From a historical perspective, large scale land acquisition is not, however, a new phenomenon. There have been several waves : the development of large colonial plantations, the recovery and renewal of these plantations by newly independent states, and the privatization of large state plantations during periods of liberalization in countries of the region. The current wave thus is the fourth large-scale land acquisition wave (see Oyono, 2013 for the case of Cameroon). Nonetheless, forests have been preserved overall because of a lack of communication infrastructure, political risks, and a poor business climate which deterred investors (Megevand *et al.,* 2013). This, however, is changing with the political stabilization and economic emergence of countries in the region : agro-business and mining investors are showing renewed interest. Examples of the developments underway in some countries of the sub-region are presented below.

4.1 Gabon

Gabon covers a surface area of 267 668 km². Recent land acquisitions in Gabon were made to meet agro-industrial needs. In the absence of an existing land allocation and use plan, these long-term concessions were attributed by the President of the Republic, at times superceding existing forest permits or after a "declassification" procedure. A $ 1 535 million contract was signed in November 2010 between the Government of Gabon and the multinational Singaporian company OLAM. With a total of nearly three million hectares, this company has become the largest land holder after the Gabonese government. This "giant contract" includes several projects : special economic zones, oil palm and rubber plantations, and a fertilizer factory. These activities have led to changes in land statutes and new legal supervision in certain forest areas. Other legal and land use changes have taken place in Gabon in the fields of biodiversity conservation and forest management. Table 9.1 lists the lands converted to new forms of use over the last three years.

Table 9.1 : *Lands affected by change from 2010 to 2012 in Gabon*

Site	Area (ha)	Manager/" Owner "»
Former permits not integrated into forest development	2 000 000	OLAM
Palm and rubber groves of Estuaire, Ngounié and Woleu-Ntem	300 000	OLAM
Greater Mayumba	656 000	SFM/Gabon and OLAM
Unclassed conservation series	240 008	Forest companies
Nkok Special Economic Zone	1 390	OLAM
Monseigneur Raponda Walker Arboretum inMondah	6 747	National Parks Agency

Photo 9.4: Prospecting and marking a dense forest for logging, Gabon

The issue of land allocation and use involves several public institutions, namely seven ministries and two national agencies operating directly under the President of the Republic. The Ministry of Water and Forests and the Ministry of Territory Planning can implement initiatives involving the planning, allocation, and use of land, and territorial management. Only these two ministries can introduce land classification and allocation decrees. These two national agencies have comparatively more technical responsibilities. However, there is no official inter-sectoral coordination with regard to land use, leading to procedural problems.

Overall, the planning and implementation of land use and allocation schemes falls today at the confluence of several actions, notably the grabbing of land for agro-business (see table 9.1), the establishment of forest and mining concessions, and the construction of communication infrastructure. Under such conditions, conflicts are emerging and multiplying between property investors, and between property investors and rural populations, who often are supported by environmental advocacy organizations. The existing and foreseeable conflicts result from the superposition of land allocation and uses, for example, protected areas and mining concessions and a lack of inter-sectoral coordination at the state level. To this may be added factors inherent in institutional arrangements, particularly a lack of prior consultation and information sharing with the populations concerned.

To better supervise the developments underway, the state has taken a series of decisions. In 2012, the government of Gabon published the "Plan Stratégique Gabon Emergent" (Emerging Gabon's Strategic Plan) (PSGE), to better develop and harmonize activities across all sectors. Many actions identified within the PSGE address land use planning for different sectors and at different scales. To coordinate among sectors at the broadest scale, the PSGE initiated a flagship program in "Strategic Planning and Land Use". Three actions are listed within this program: elaboration and monitoring of the implementation of PSGE; the development of regional land use development plans; and, the development of a national land use plan. As set forth in the PSGE, the goal of the "Strategic Planning and Land Use" program is to define priorities and objectives for different uses of the land at a national level and to produce a national land use plan that identifies broad-scale, major zones by sector.

Once these zones are defined, each sectoral managing institution (ministry/agency) will be responsible for defining its land use within the zone, in line with sectoral plans of the PSGE. In other words, the national land use process is intended to guide and coordinate macro-level land zoning among sectors; within each zone, sectoral or local-level land use planning is to be managed at an appropriate operational scale. This national land use planning process was first initiated in October 2011 under the authority of the *Secrétariat Général du Gouvernement* (SGG). At that time, the SGG convened all implicated government institutions to the table in an official process to regroup various land-use-related initiatives into one coordinated land use planning process.

Despite its small surface area, 28 051 km², Equatorial Guinea comprises an essential component of the Congo Basin forest. The dense Equato-Guinean forest represents 80 % of the country's entire surface area (de Wasseige *et al.*, 2010). For many decades, forest resources were the lungs of the national economy, contributing up to 20 % of GDP in 1997 (CBFP, 2006). With the discovery of oil on Bioko Island in 1996, this contribution began an inexorable decline, and accounted for only 0.2 % of GDP in 2011 (CIA, 2012). On one hand, the oil boom is an indirect opportunity for natural resource conservation through the potential mobilization of additional financial resources. On the other, this phenomenon remains an important threat to biodiversity due to the accompanying human pressure and ensuing development of infrastructure in a context marked by the absence of a national land use planning scheme.

The management of natural resources mainly falls to two ministries, the Ministry of Agriculture and Forestry (MAB) and the Ministry of Fisheries and the Environment (MPMA). While MAB is the competent forestry body, the situation is less clear with regard to protected areas, which according to current laws fall under both ministries. In effect, Law n° 1/1997 of February 18, 1998 on Forest Use and Management stipulates in article 8 that MAB is the body in charge of land classification and allocation. The law provides for a National Land Classification and Allocation Commission to carry out these tasks. However, Law nº 7/2003 of November 27, 2003 on Environmental Management stipulates that MPMA is the competent ministry with regard to the classification and management of protected areas.

To date, the Commission in charge of allocating lands stipulated in Law n° 1/1997 has not yet been formed. Furthermore, the classification and allocation of lands is conducted in a piecemeal fashion by MAB and MPMA. Within MAB, there is the National Institute for Forest Development and Protected Area Management (INDEFOR-AP), also competent with regard to protected areas. On the ground, this translates into numerous overlaps between different land use categories (see figure 9.1). In practice, when a forest concession is classified on an area where one or several forest plots already exist, the operator can log the area by signing a contract with the holders of the plots. When a protected area is superimposed over an area where one or several forest plots already exist, industrial logging can no longer be conducted on the area in question. Beyond this overlap management strategy, the World Resources Institute has noted that nearly 33 % of the total communal forest area (19 462 ha) and 9 % of the total nature reserve area (12 519 ha) overlap with other land use types (WRI, 2013).

Given the above, there is an urgent need to improve the governance of forest lands in Equatorial Guinea. In the short term, this involves the effective operationalization of the National Commission in charge of land classification and land use planning as set down in the Forest Law, and, over the medium term, reform of the legal system to resolve institutional conflicts and consolidate efforts through the creation of a joint land use planning platform. It also is urgent to develop and implement a national land allocation plan and a forest zoning plan. Whether the development objectives outlined by the government – such as the "Horizon 2020" development plan aiming to make Equatorial Guinea an emerging country – are achieved will depend greatly on these innovations.

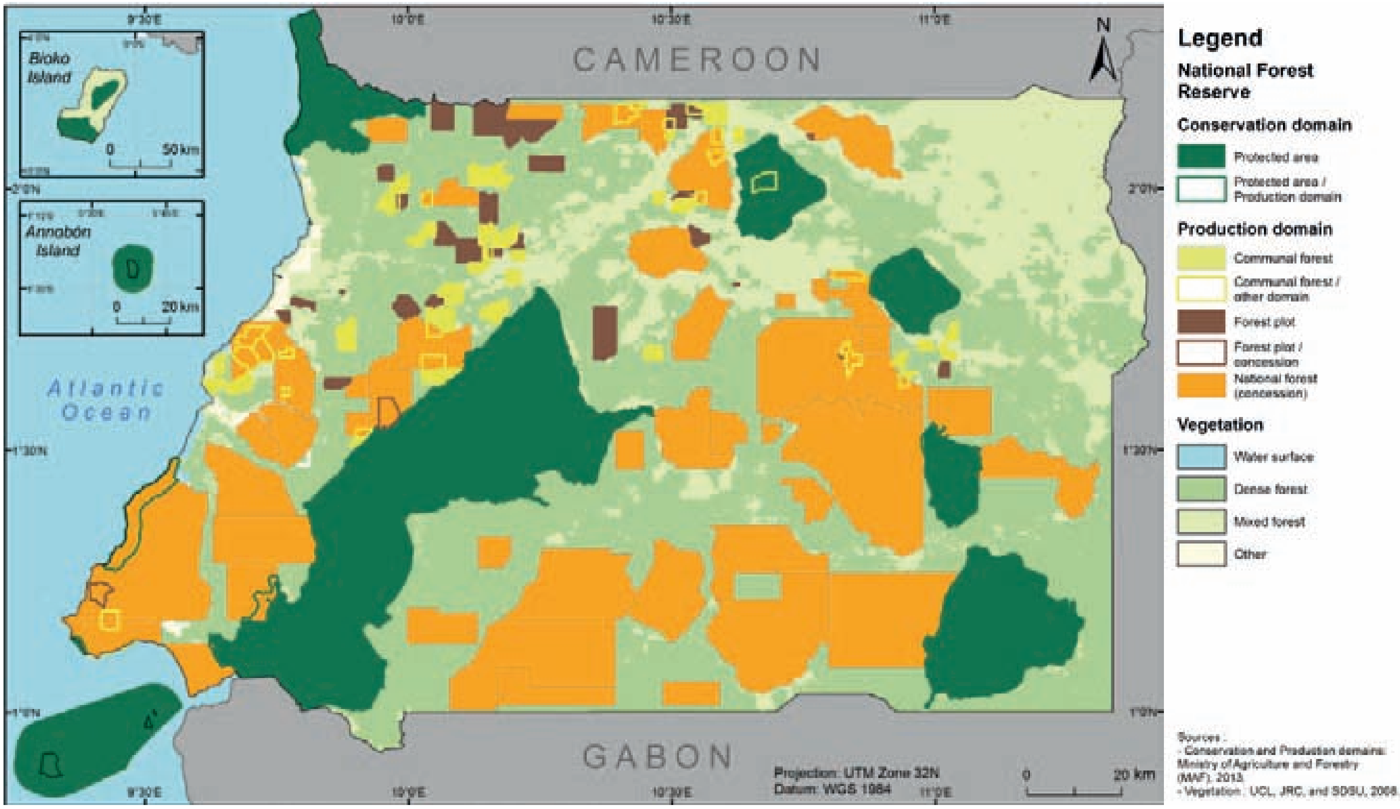

Figure 9.1 : Overlapping types of land uses in the forest domain.
Source : WRI, 2013

4.3 Democratic Republic of Congo (DRC)

The DRC is a country the size of a subcontinent. Covering approximately 2.3 million square kilometers, the country enjoys a climate and hydrographical and geological context which are extremely favorable for its socio-economic development. Over 60 % of its territory is covered in forest. Its fresh water bodies represent nearly 3.5 % of the territory and contain nearly 50 % of the fresh water of the African continent. Its ecosystems, both land and water, harbor fauna as diverse as they are unusual, with certain specimens rare and indeed even unique in the world. Important underground mineral and oil resources are abundant. The country today is at an historic turning point and is facing a land rush. The DRC is currently the world's second largest provider of land to multinational agribusiness corporations.

A characteristic of land management in the DRC is a low level of policy development and implementation. Sectoral laws, mainly the land, mining, forestry, and agricultural codes, often are incoherent and uncoordinated. Certain ministries have appropriated the prerogative to allocate areas without taking into account national development needs. This situation, aggravated by the absence of communication between different sectors, has given rise to serious contradictions and misunderstandings regarding land allocation and use. Furthermore, "competing" practices, often implemented illegally, generate numerous conflicts between different land and resources users (mining, agriculture, and forestry activities, infrastructure development, small scale farming, biodiversity conservation, energy, etc.) at different activity levels (industrial and intensive, artisanal and subsistence, etc.).

There is no framework to coordinate all of the agencies working to develop the territory, whether at the national, provincial, or local level. Yet such a framework is needed to define the main strategic orientations regarding land cover and use and the spatial orientation of public, private, and community investments. Legislation regulating one sector does not assess the possible consequences for policies regarding other sectors. The allocation and use of lands consequently can be anarchic, resulting in the unsustainable exploitation of natural resources. The various economic sectors are developing in a context of increasing pressure due to demographic growth and their own need to expand.

These discrepancies and the superimposition, indeed entanglement, of competing land and resource use schemes are at the root of latent and/or open conflicts: mining concessions encroach on protected areas, as is the striking case of the exploration of hydrocarbons in Virunga National Park; commercial forests compete with local community lands and protected areas; industrial agricultural concessions encroach on forest land needed for traditional agriculture; forestry and agro-forestry projects linked to the carbon market conflict with traditional uses of neighboring populations, etc.

Photo 9.5: Slash and burn farming, rice fields – Oriental Province, DRC

To respond to the needs of different land use sectors, the DRC will progressively launch a national zoning process with a pilot phase that will be implemented in three provinces (Province Orientale, Equateur and Bandundu). The intersectoral steering committee operates under the coordination of the ministry in charge of forests. This zoning will commence with a prospective intersectoral study, carried out by the government, which will focus on the allocation of the overall space based on national development priorities. The DRC already has a land use plan at the community level covering about eight million hectares. This planning was begun by CARPE and its partners, including several national NGOs in existing conservation landscapes (see Chapter 11 of SOF 2010). This micro-zoning is based on participatory mapping and permitted the property rights of local communities to be determined. These are now in a position to negotiate and they can participate, on an equal footing, in the national land-use planning process.

Box 9.3: Use of national space – Sectoral ambitions

The sectoral ambitions for the use of national lands vary according to the sectors and potential resources concerned. Thus, for its development, the hydrocarbon sector alone plans to use up to 80 % of the national territory. The mining sector claims 42 %. The agricultural sector is counting on 80 million hectares of arable and irrigable land, i.e. about 34 % of the country. The conservation sector, which currently occupies about 12 % of the territory, plans to develop and cover 17 %, in accordance with the objectives declared at Nagoya. As to the logging sector, the areas to be assigned to it have not yet been defined through lack of a clearly-defined forestry policy. At present, the forest concessions cover about 12 million hectares. The lifting of the moratorium on the granting of new concessions, the granting of forest concessions to local communities and the formalization of small-scale logging will significantly increase the area of production forests. In order to achieve sustainable management of natural resources, it will be necessary, through negotiation, to re-dimension the ambitions of the various sectors and to explore the possibilities of multiple, non-conflictive and non-prejudicial uses of land within a fixed national space.

São Tomé & Príncipe covers 1 001 km². Its last forest inventory dates to 1999 (Salgueiro and Carvalho, 2001), but it was incomplete; the latest complete survey was conducted in 1989 (INTERFOREST AB, 1990). Despite the lack of information on forests, there are indications of increased deforestation and forest degradation (de Lima, 2012; Jones *et al.*, 1991). These correspond to strong socio-economic changes experienced in recent years, namely a steep population growth from 137 599 inhabitants in 2001 to 187 456 in 2012 (+36 %) (Instituto Nacional de Estatística, 2013). In 2006, São Tomé & Príncipe created the Obô Natural Parks, covering 26 136 ha in São Tomé and 4 412 ha in Príncipe (Direcção General do Ambiente, 2006). Despite encompassing a large proportion of the country, these parks are not effective in protecting the forest because they receive very little funding and managers have almost no ability to enforce environmental legislation.

Forest loss and degradation are driven by large-scale projects, but also by diffuse small-scale activities. Because of insufficient forest monitoring, it is hard to say how much each of these activities are impacting forest ecosystems in São Tomé & Príncipe , but it is likely that both have significant negative impacts. Agro-industrial plantations cover a total of 44 758 ha and this area is likely to increase in coming years. To understand the current challenges involved in planning the allocation and use of land in São Tomé & Príncipe , one must study the past.

Beginning in 1975, most of the colonial plantations were transformed into state-run agricultural enterprises (industrial cocoa, coffee, coconut and oil palm plantations). This process was poorly regulated. The promulgation of the 1991 Land Act (Law n° 3/91) marked the beginning of agrarian reforms that defined a new status for land and new land allocation procedures. The ceding of state run lands began in May 1993. The Land Act distinguishes four specific land regimes: public State domain; private State domain; national parks and reserves; private and community property. For example, the National Land Reform Institute issued 101 community land titles of 140 000 ha. The Forest Law, published in November 2002, is based on this spatial specialization.

Among the large-scale projects that might directly affect forests, oil palm concessions stand out as having some of the greatest impacts. This venture, led by Agripalma, a Santomean company involving national investors and an oil palm giant, has now been downscaled to 3 000 ha in the South of São Tomé Island, after a temporary review of the contract arrangements. Other significant agroforestry investments include: a concession to the Libyan company, “Monte Café”, to invest in high-quality coffee; the development of SATOCAO, a national society created to invest in cocoa plantations; and, PAPAFPA, a government program that is investing in cooperatives to export high-value agricultural goods. A large portion of Príncipe has been ceded to HDB, a South-African company, to implement a development plan, which aims to create the first eco-sustainable island in the world.

New infrastructure also has the potential to indirectly affect forests. Among the most important is the rehabilitation of roads, which will facilitate access to the forest, namely in the South of São Tomé. Additionally, the construction of a deep-water port is planned in order to facilitate timber exports. In the short run, this infrastructure development will increase timber harvesting. Small-scale, diffuse activities that are threatening São Tomé & Príncipe forests include small-scale farming (namely commercial horticulture in the highlands of São Tomé), logging, unregulated hunting, and palm wine collection. Logging is largely deregulated and takes place mainly in public lands, where most high-quality timber remains (de Lima, 2012). Given São Tomé & Príncipe ’s insularity, its forests are likely to be particularly vulnerable to invasive exotic species (Dutton, 1994). Since the largest forest blocks are within two relatively large Obô Natural Parks, most pressure and areas of potential land-use conflict are on their borders.

The absence of policy integration among land allocation and use initiatives (agri-business, infrastructure development, biodiversity conservation and community activities) results in damage to the forests. There is a very little planned, proactive collaboration among the various public agencies responsible for land allocation and use issues. Even though São Tomé & Príncipe has a very small land surface area compared to other countries of the Congo Basin, there are many land conflicts resulting from both overlapping concession types and from land competition between small producers and big land users and investors. For example, large investments have been kept outside the Obô Natural Parks borders, but displace small-scale activities and create the potential for land-use conflicts. Moreover, the development of oil palm plantations has a high potential to create conflicts, as oil palm plantations will have to either be established in national parks or in areas already ceded to small-scale farmers (de Lima, 2012).

With the support of foreign partners, the state has developed a set of tools : agro-ecological zoning ; national forestry development plan ; agriculture and sustainable development policy map ; agricultural potential map ; national biodiversity conservation strategy and national poverty reduction strategy. These tools must be implemented effectively alongside sustainable land use planning to keep the agro-industrial threat under control. To that end, there is a need for sound land policy, land allocation practices and use schemes in São Tomé & Príncipe . Recommendations from the proposal of the national plan for forest development (Salgueiro and Carvalho, 2001) should be implemented and integrated with strategic plans from related sectors, such as conservation, agriculture and public infrastructures. These recommendations should also be updated, supported by newly collected data on the distribution and state of São Tomé & Príncipe forest resources, and take into account new opportunities, such as the emerging market of carbon credits.

4.5 Burundi

With a population of over 8 million and an average density of 310 inhabitants/km², Burundi (27 830 km²) is one of the African countries where issues and challenges of land and resources allocation, tenure, and use are extremely critical, particularly as 90 % of the population live in rural areas. The subdivision of land resulting from inheritance practices has greatly reduced the average size of farms, estimated to be 0.3 ha per six-person household. This situation is leading to grave problems related to the appropriation and allocation of rural land, problems which are reinforced by land speculation.

Agriculture remains the country's dominant land use. According to the 2010 National Agricultural Strategy, the agricultural area used was 792 510 ha in 1982 (out of the 1 674 810 ha of arable land), leaving 627 580 ha undeveloped. At that time, the cultivated agricultural area coefficient in relation to the total agricultural area was 47.3 %, representing considerable future development opportunities. Subsistence agriculture today, however, covers 90 % of cultivated land (about 1 210 000 ha), or approximately 30 % of the country's land area. Nonetheless, there has been an expansion of industrial crops in the country – with 9 700 ha of selected variety palm groves, 3 000 hectares of natural " Dura " variety palm groves, 10 000 ha of tea and about 100 000 ha of arabica coffee.

Land allocation and use are complex issues in Burundi because of multiple factors. The main threats to the sustainable use of land and resources are related to the dynamics between actors presented below :

- Population migration and mobility, accentuated during conflicts in the country : for nearly half a century, strong migration has taken place from less fertile to more fertile areas. This concentration of the population on fertile areas has resulted in the over exploitation of these lands and their resources.
- The intensification of land use through the creation of industrial forest plantations. Since the 1980s, Burundi has invested heavily in industrial tree plantations. Alongside communal woods, there are private/individual tree plantations and plantations belonging to religious groups.

Photo 9.6: Partition of agriculture, forest and protected areas – National Volcanoes Park, Rwanda

• Agricultural and agro-industrial concessions constitute the third type of threat. The country has numerous medium-size tea concessions, most often inherited from colonial companies. Incorporated onto public land, these concessions have become the property of local elites. The country is experiencing an internal land grab and monopolization of land by elites. Public land is being converted into private land on massive scale.

The planning of land allocation and use falls under several public institutions. The responsibility for the cadastre and for titling has shifted several times between different ministries. "Titres fonciers" and "cadastre" will become one entity. The cadastre is now located in the Ministry of Water, Environment, Territory Planning and Urbanism. The Ministry of Agriculture and Livestock is involved in land-use planning. The responsibilities for decentralization and local governance are in the hands of the Ministry of the Interior and the Ministry of Decentralisation and Communal Development. The Forestry Department is in charge of forest plantations while the National Environment and Nature Conservation Institute (INECN) is responsible for protected areas. The National Commission for Land and Other Properties was set up in 2006 and has the authority to mediate and resolve land disputes related to refugees and internally displaced persons, to obtain compensation, and to update the inventory of state-owned lands (KIT, 2012). For land governance, including forest land, Burundi developed its Land Policy Letter in 2008. A Coordination Unit was set up in 2009 to support the implementation of the new land policy (KIT, 2012). Its task is to facilitate inter-ministerial cooperation, donor coordination and collaboration with civil society. This coordination is, however, difficult to establish. Since then, a new land Code was promulgated in 2011.

Box 9.4 : Little foreign agricultural investment, but internal land grabbing

In Burundi, foreigners are granted equal protections to person and property by the Constitution of 2005, without restrictions on foreign ownership of land. However, there is little land available, the land administration is heavily bureaucratic and the political environment is unstable. The country has not yet attracted many foreign investors in the agricultural sector, but there is a lengthy history of land grabbing. It took place primarily during the long period of internal armed conflicts (1993-2001), partly on public land and along the lakes. Numerous parcels were reallocated to local elites. These reallocations, which have since been legalized, are sources of tensions.

Source : KIT (2012).

Land use is at the heart of a variety of conflicts. The tragic events of 1972 led to a massive outpouring of refugees (about 300 000 people) into neighboring Tanzania. These people left the country before the creation of protected areas and the installation of large national reforestation blocks in the 1980s. The creation of 1 100 ha of nature reserves in Rumonge Commune, 5 000 ha of plantations in Vyanda Commune and the Ruvubu Nature Reserve (50 800 ha) greatly reduced agro-pastoral areas in the south and northeast of the country, accentuating conflicts over access to land. The 1993 war also resulted in a second wave of refugees into Tanzania. Their return is generating conflicts over the appropriation of land.

Internal refugees, referred to as "displaced persons", have found, for want of better alternatives, unauthorized settlement sites on state and communal woodlands and protected areas. Buffer areas around reserves have completely disappeared. Furthermore, the scarcity and fragmentation of land is inducing landless people to establish themselves in an anarchic and illegal manner on state and private lands, including forest land, which appear vacant. Government services are unable to put a stop to these spontaneous settlements which create a source of conflict over land use. In 2007, a mining exploration permit covering 95 % of Ruvubu National Park was awarded to the company Danyland. This example of superimposed land use schemes illustrates the weak intersectoral coordination in the country.

Burundi has a national sustainable land use strategy placed under the technical responsibility of the Ministry of Territorial Planning. It includes the development of a national development plan, provincial development plans, and a national village-based program (development planning at the village level). Concretely, this strategy emphasizes the development of forest plantations. Nonetheless, if this strategy is not implemented in a participatory manner (notably with rural communities), there is a real risk that it will only heighten conflicts between the different users.

4.6 Republic of Congo

The Republic of Congo (342 000 km²) contains 21 278 180 ha of forest land. This is the third largest forest area on the African continent after those of the DRC and Gabon (de Wasseige *et al.,* 2012). Seventy percent of these forests are considered to have commercial potential and hold high biological diversity : over 300 species of timber have been identified. Savanna covers 35 % of the country, stretching over the plain of Niari, the Bateke plateaux, and the Congolese Cuvette. Figure 9.2 highlights the country's forestry potential relative to the area of forest concessions attributed (in orange).

Congo's economy is based mainly on the exploitation of hydrocarbons, which represent 88 % of the country's exports. Timber forest products (wood, charcoal and wood products), the second export commodity, accounted for only 3 % of exports in 2010 (Le Roy, 2011). Because of food deficits, 20 % of imports are made up of meat, fish and agro-industrial products.

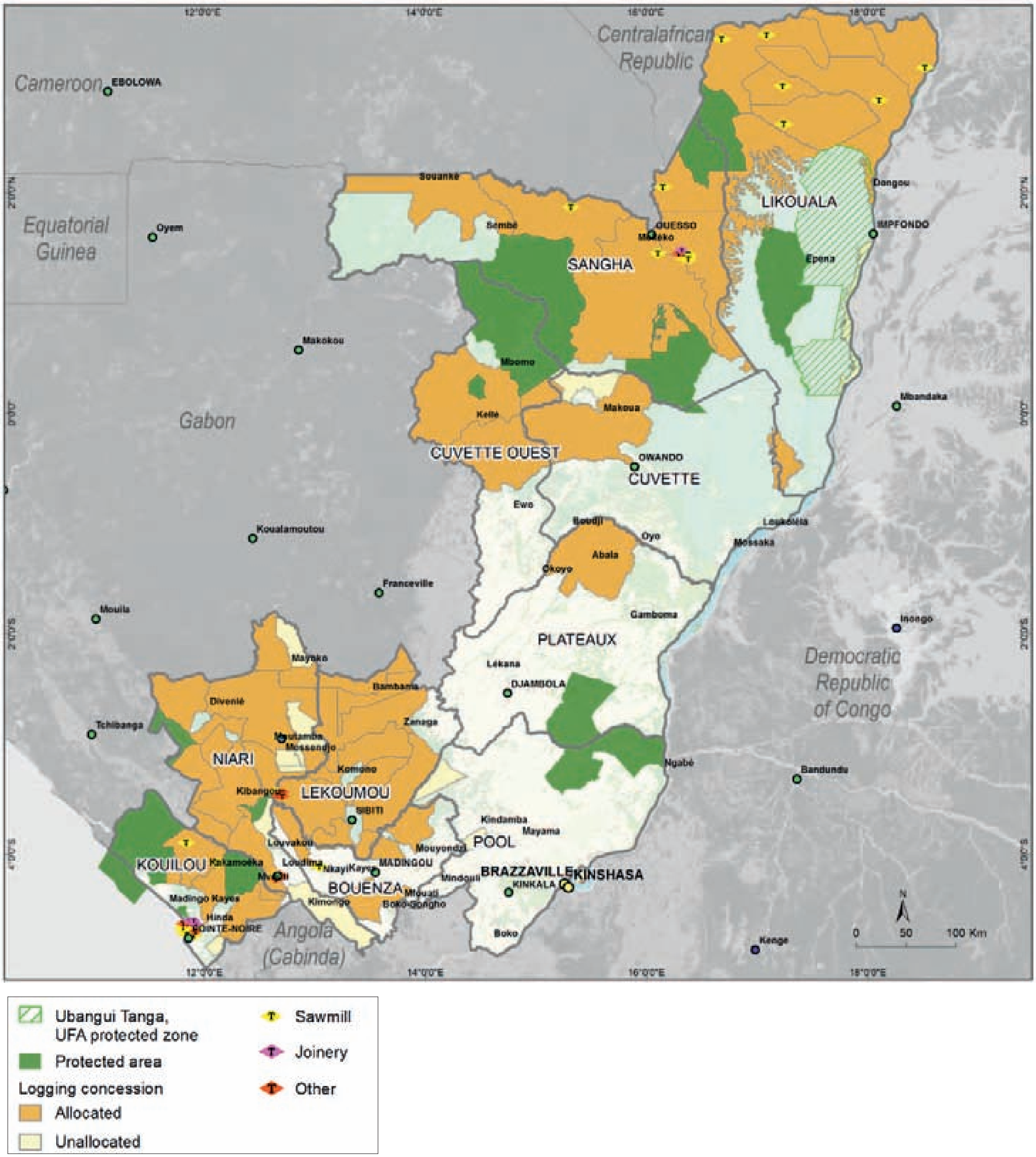

Figure 9.2 : Republic of Congo forest atlas. In orange, forest concessions, on which mining concessions are being superimposed. http ://www.wri.org/tools/atlas/map.php ?maptheme=congoforest.

Source : WRI

Forest management in the Republic of Congo is governed by Law n° 16-2000, of 20 November 2000, concerning the Congolese forest code. The forest code divides the national forest domain into two parts: the state forest domain and the privately owned forest domain. The state forest domain includes both the permanent and the non-permanent forest domain, and includes the forests of the private state domain, forests belonging to public entities, communal forests, and forests held by other local or territorial government bodies. The forests in the private state domain are those which are classified according to decrees by the Council of Ministers. The Congolese forest domain is divided into 34 Forest Management Units (UFA) varying in size from 200 000 to one million ha (PAGEF, 2012). The UFAs include Forest Exploitation Units (UFE).

Photo 9.7: Small-scale sawyers, Congo

Outside the national forest domain, there are 73 000 ha of artificial plantations, mainly cloned, fast-growing species like eucalyptus (60 000 ha), as well as pine (4 500 ha), limba (7 500 ha) and diverse species (1 000 ha). Industrial eucalyptus plantations supply the Pointe Noire wood chip factory which has produced over 400 000 tons of wood chips for export annually since 2008. Numerous agro-industrial actors (Oyono, 2013), which are major land users, are also present in the country, including:

- the Société Agricole et de Raffinage Industriel du Sucre (SARIS), in Niari valley (Bouenza department). This is a subsidiary of the French Castel and Vilgrain group. SARIS cultivates 12 500 ha of sugar cane on a 20 000 ha concession;
- the Malaysian company Atama, which in 2010 acquired the right to develop an agro-industrial palm oil production complex on 470 000 ha (including 180 000 ha of plantations) in the departments of Cuvette Centrale and Sangha. The concession was previously covered with degraded forest (according to official statutes) derived in part from a declassification of the Ngombe UFE (managed by IFO);
- the Congo-Agriculture company of South Africa, which since 2012 has been developing a 20-year maize project in Niari and Bouenza on a 80 000 ha concession. The concession is situated on the permanent state domain. This project is struggling to find an agreement with the customary land owners;
- ENI Congo (an Italian oil group) is planning to create oil palm plantations on 70 000 ha of savanna. In the short run, two experimental plantations are planned in Ngabé in Pool (2 500 ha) and Kibangou in Niari (2 500 ha);
- the LignAfrica project, implemented by the Forest Resources Management (FRM) engineering consulting firm, will set up about 6 500 ha of eucalyptus plantations in the sub-prefectures of Ignié and Ngabé as part of a carbon offset project;
- the Olam group has set itself up in Ouesso region, in the north of the country, to revive the cocoa sector.

Mining concessions also are increasing with a large number of new mining companies (Devey, 2013). It is difficult to access information on the areas conceded. Mining currently is organized as follows:

- iron mining: in the south of the country, Congo Mining (a subsidiary of the Australian company, Equatorial Resources) is to launch iron exploitation in Niari department in early 2014. Also in Niari, the concession managed by DMC Iron Congo, controlled by the South African group Exxaro, will begin production in 2014 with iron reserves estimated at 2.6 billion tons. In Lékournou department, a giant iron mining concession was awarded

to the South African Iron Ore and the Swiss Xstrata. In the north of the country, Sundance Resources and Core Mining (two Australian groups) have acquired two iron mining concessions (Devey, 2013);
- potash mining: very large potash deposits are located in the south of the Congo and two mining and processing projects, controlled by Australian and Chinese companies, are under development (Devey, 2013).

In 2005, the Ministry of Planning, Territorial Management, Economic Integration and NEPAD (MPATIEN) developed a National Territorial Management Plan (SNAT) for the Republic of Congo. It aims to reduce disparities between Pointe Noire and Brazzaville and the rest of the country. To this end, the planned objectives are to implement the following (MPATIEN, 2005):
- a "communications and energy framework". This will permit the Congo to reaffirm its historic role as a transit country in Central Africa;
- a sustainable management of forest and environmental resources by positioning itself as a leading country in Africa in the forest sector and in the field of natural resource conservation; and
- a national mapping of areas suitable for agriculture, livestock farming, fishing and fish farming.

The priority of agricultural development is set down in the National Food Security Plan (PNSA). In 2011, the Congolese government launched a National Afforestation and Reforestation Development Program (ProNAR) which aims to "establish one million hectares of diverse and varied plantations over a ten year period" (MEFDD, 2012). Nearly half of the plantations planned are in the center of the Congo, notably in the departments of Pool (200 000 ha) and Plateaux (250 000 ha). ProNAR will enable the Congo to meet national and international demand for biomass energy, timber, non-timber forest products (NTFL) and carbon sequestration.

The Congo's Ministry of Forest Economy and Sustainable Development (MEFDD) hosts the interactive Forest Atlas of the Congo, a forest information system operated by a joint World Resources Institute (WRI)–MEFDD team. "Organized around a GIS (geographic information system) platform, the Atlas facilitates access to objective, up-to-date information on the Congolese forest sector. One of its main objectives is to strengthen forest management and land use planning by bringing all major land use categories onto the same standardized platform. The joint MEFDD-WRI team updates the forest Atlas database as new information becomes available and periodically publishes reports, posters, and online and CD/DVD mapping applications." (WRI, 2013)

The Republic of Congo has committed to an inter-ministerial coordination of the allocation of land and natural resource use. The creation of a Land Affairs Ministry to coordinate negotiations between ministries when concessions are being attributed is a strong indication that this is happening. The interactive forest Atlas also is an indication of a desire on the part of the State for transparency. It would be advisable to generalize this approach through the creation of a multisectoral national atlas with the other ministries. The conduct of a national agricultural production potential study should enable the Ministry of Agriculture to better target the development of production areas, and permit informed decisions during negotiations with agro-industrial groups (Oyono, 2013c).

4.7 Central African Republic (CAR)

The CAR covers 622 984 km². From a political perspective, it is a fragile state, with unstable central institutions. The development of political and legal instruments relating to the allocation and use of land is a very uncertain process in the CAR. Two principal legal instruments apply: land legislation and forest legislation. The last time significant modifications were made to land legislation was in 1964. A draft land bill was written in 2012 but has not been finalized due to recent events in the country. The CAR governs and administers its forests based on Law n° 08/022 of 17/10/2008 of the forest code: forest land is divided into two domains; the permanent forest domain and the non-permanent forest domain. The permanent forest domain is sub-divided into the state forest domain and the public forest domain. The most economically important resources are concentrated in the permanent forest domain (logging forests and diamond basins).

Logging status has not changed appreciably since 2010. Concentrated in the forests of the southwest, logging is mainly industrial, organized in the form of a stable number of concessions. The 14 attributed logging and management permits (PEA) are all under fixed logging and management agreements. Only three PEA (165, 186, 187) have changed status since 2010 (see table 9.2). Intensive illegal logging by armed groups has been reported, with damaging consequences to customary property rights and concession holders.

Table 9.2: *List of logging permits (PEA) and forest companies in 2013*

Nº PEA	Forest Company	Status	Status of plans	Source of Capital	Administrative area (ha)
164	Thanry	Awarded	Approved (CDAE)	China	193 800
165	IFB	Awarded	Approved (CDAE)	France	119 000
167		Not Awarded			
169	IFB	Awarded	Approved (CDAE)	France	150 208
171	SEFCA	Awarded	Approved (CDAE)	CAR	296 306
174	SEFCA	Awarded	Approved (CDAE)	Lebanon	333 000
175	SOFOKAD	Awarded	Approved (CDAE)	China	96 281
183	SEFCA	Awarded	Approved (CDAE)	Lebanon	294 478
184	VICA	Awarded	Approved (CDAE)	China	221 907
185	SCAF	Awarded	Approved (CDAE)	Greece	294 478
186	IFB	Awarded	Approved (CDAE)	France	109 444
187	SCD	Awarded	Approved (CDAE)	Italy	88 547
188		Not Awarded			
189		Not Awarded			
Total					2 061 669

Source: CDF, WRI.

Mining projects were under development and being finalized, at least through 2012. The state promoted the development of the mining sector, the only sector capable of attracting major international investment. Although the CAR joined the Extractive Industries Transparency Initiative (EITI) in 2011, it remains very difficult to obtain hard data on this sector despite the efforts of NGOs and civil society to reinforce transparency in the legal procedures for awarding permits.

The southwest of the country is dotted with artisanal diamond mines whose activities, which are poorly documented, add to deforestation. There is very little available information regarding agro-industrial projects. Local elites, with the

Photo 9.8 : Palm nuts are used to make oil, among other things

support of foreign "mercenaries", have acquired an option to create medium size plantations (oil palm, maize, soy).

As in many other domains, the question of the allocation and use of land is supervised by institutions that have been weakened by sustained political instability. The CAR regularly suffers from armed rebellions. The transitional government of national unity (set up under agreements with the Séléka rebel coalition in January 2013 prior to the latter's victory) created a new Ministry of Water, Forestry, Hunting and Fishing, which has been retained by the current government.

Under the successive governments that have ruled the country, inter-sectoral coordination regarding the planning of land allocation and use has been practically non-existent, creating the impression of ceaselessly starting from zero. The successive central governments furthermore have been unable to establish state control over the entire country. Armed groups create their own rules regarding the use of land and resources. The result is the irreversible deregulation of the occupation and use of land on one hand and increased diamond mining on the other.

From a conventional perspective, conflicts over land use involve the overlapping of logging and mining in the southwest of the country. The issuing of new mining exploration permits inevitably will result in logging concessions overlapping on protected areas. Alongside this type of conflict, there are vertical conflicts between the state and local communities and indigenous populations, whose property and forest rights are minimized in legislation. The CAR has a law regarding the promotion and protection of indigenous peoples which has no legal force. Lastly, the Balkanization of the country between armed groups, local and foreign rebels, and "warlords" has generated conflicts over the use of land and resources, not only between the armed groups and local communities, but also between these groups and the central government.

It is difficult to decipher the government's response mechanisms regarding land allocation. This state is wracked by incessant convulsions that disrupt the strategic efforts of international and national experts. A mapping inventory is underway, coordinated by the Forest Data Center (CDF) cell, which should provide a more precise picture of the industrial plantations in the southwest forest area. The development of a national REDD+ strategy likewise will bring greater clarity to the integration of forest plantations and REDD+ projects in the overall question of land use in the CAR.

4.8 Cameroon

With a territory of 475 442 km², Cameroon today is facing an acceleration in forest changes from large infrastructure projects, the multiplication of extractive concessions (mining and oil), and the large scale conversion of land to agricultural uses. Although reliable statistics are not available, it is known that these activities cover a considerable amount of land and forest. In 2013, the accumulated demand for large scale conversion of land to agricultural uses was estimated between 1.6 and 2 million ha (3.3 to 4 % of the country's surface area), and will increase over the coming years.

Major infrastructure projects and extractive concessions are part of the large infrastructure and industrial investment defined in the Strategy Document for Growth and Jobs (DSCE), an ambitious foundation for government development and economic growth actions through 2035. The main infrastructure projects are the Lom Pangar, Memve'ele and Mekin hydro-electric dams, the Kribi and Limbe deep water ports, the Yaoundé-Douala highway, the Mbalam-Kribi railroad, etc. The extractive concessions involve the exploration and exploitation of hydrocarbons (gas and oil) and minerals along the southern coastal area, and the exploration, exploitation and processing of cobalt, nickel and manganese deposits in Lomié, diamond in Mobilong, iron in Mbalam, bauxite in Ngaoundal and Mini-Martap, and rutile in Akonolinga.

The large-scale conversion of land for agricultural purposes lacks transparency. Conversion takes place through transfer, disposition, concession or sale. Large-scale land transfers are not new. Global food and financial crises have pushed investors to externalize and to secure their food production on a global scale by acquiring, through long-term emphyteutic leases, vast areas of agricultural land. In the last few years, about twenty large-scale land acquisition operations have been completed for the production of palm oil, rubber, rice, and maize over the national territory. However, the most emblematic initiatives have been south of the 5th parallel in the southwest, south, coastal, and central regions (Hoyle and Levang, 2012; Oyono, 2013b). These include, for example:

- the exploitation of oil palm on 73 086 ha over 99 years in Ndian and Koupé-Manengoumba in the southwest by SG Sustainable Oils Cameroon (SGSOC), a subsidiary of the American Héraklès Farms company;
- the 41 388 ha concession of the Singaporian company GMG Hevecam to cultivate rubber in Nyeté, Lobé and Kribi;
- the 78 529 ha concession in Dibombari, Mbongo and Edéa awarded to SOCAPALM to grow palm oil;
- numerous land acquisitions made by Asian multinationals in the department of Nkam (Hoyle and Levang, 2012). One also should note the 10 000 ha ceded to the Chinese Iko Agriculture Development Company in the department of Haute Sanaga for rice production.

Photo 9.9: Palm grove near the Cameroon coastline

The pivotal planning instrument for land allocation and use is the Cameroon forest zoning plan. This instrument exists alongside cadastral arrangements, notably for mines, and a zoning experiment initiated by CARPE around national park complexes on the borders with Gabon, Congo, and the CAR. Above the zoning plan, there is the 1994 Forest Law and the 1974 Public Land Law, both in advanced stages of revision. In 2011, Cameroon passed a law framing territorial management and sustainable development. As in other countries in the region, there is a clear lack of inter-sectoral coordination between the ministries most involved in land issues: the Ministry of Forests and Fauna, the Ministry of the Environment and Nature Conservation, Ministry of Mines, Ministry of Territorial Planning and Management, Ministry of Agriculture and the Ministry of Decentralization. The superimposition of different and conflicting uses on the same area is one result of this absence of coordination.

The land footprints of large infrastructure projects and extractive industries, and the large-scale land acquisitions for agricultural uses, reveal, generate, and crystallize conflicts resulting from overlapping logging and mining or agro-industrial permits, and between mining permits and protected areas (see figure 9.3). Other conflicts result from the legal duality between modern and customary land and forest rights, generating disputes between concessionaires and local communities (Oyono, 2013b).

Photo 9.10: A camp used by loggers to inventory tree species in a concession

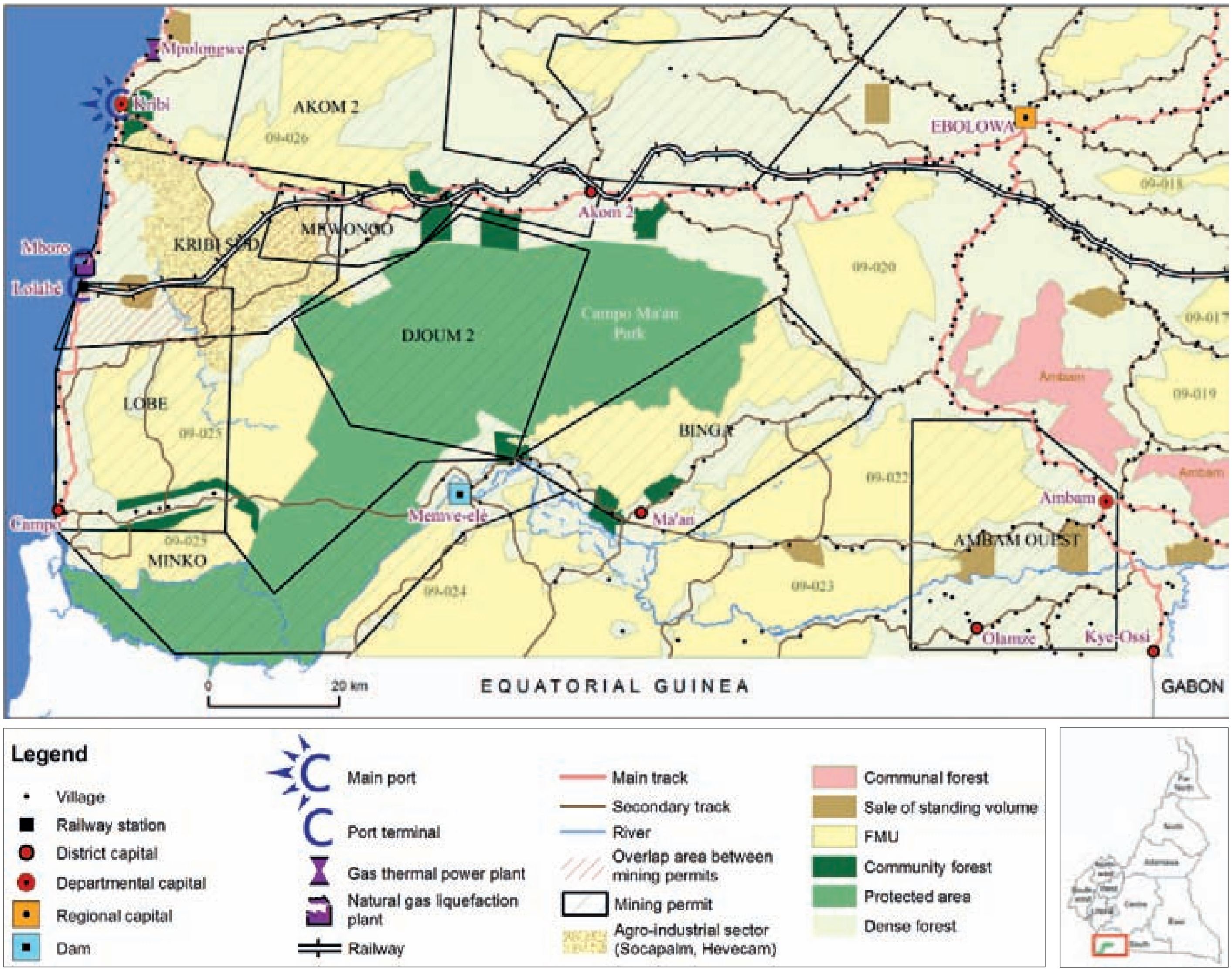

Figure 9.3 : Overlapping of land use schemes around the Campo-Ma'an National Park (in green)

The Cameroon government is developing response mechanisms to these problems : the revision of forest and land legislation, the implementation of the Framework Law for territorial management and the revision of forest zoning. The problems related to land allocation and use could be resolved. For this, critical reforms must be undertaken, and modern integrated natural resource management tools must be developed and implemented. It would be advisable to coordinate the different laws, recognize customary land practices – rather than excluding and/or leaving them to the mercy of foreign investors and elite officials – develop a single national land register, institutionalize impact studies and generalize the practice of "prior informed consent".

5. Analysis of New Actors

The new economic actors in Central Africa are mainly the new forest concessions and agro-industries, mining companies, "carbon planters", and conservation actors. Forest land transactions have opened the door to these new actors. The national economies and citizens hope for a share in the wealth which they will create, even if the practices of these new operators often are fairly opaque and indifferent to environmental and social consequences, raising legitimate concerns (Karsenty, 2010 ; Putzel *et al.,* 2011 ; Karsenty and Ongolo, 2012). The quickening forest "land grab" is only part of the overall large-scale land investment phenomenon.

While this movement goes back to the beginning of the European colonial period in Africa (Cotula *et al.*, 2009 ; Karsenty, 2010 ; Deininger, 2011 ; Anseuw *et al.,* 2012), current large-scale land investments are giving center stage to actors whose motivations and rationales should be better understood. A first review of forest actors operating in the Congo Basin was made by the CBFP (2006), and highlighted the diversity of actors involved.

Since then, forest lands of the Congo Basin have faced economic, socio-political, and environmental changes. These have led to the reshaping of the forestry sector actor landscape that was described in 2006. A new typology highlights several categories of actors (Jorand and Manganella, 2012) :

- States (European, Asian, and North American), instigators of investment in African countries ;
- local investors, acting in a personal capacity and including political, administrative, and economic elites ;
- international financial institutions and pension funds ;
- private banks ;
- socio-professional organizations ;
- multinational companies.

However, this list is not quite complete, as it seems to omit an important category of actors who operate in the emerging niche of forest carbon transactions. From a geopolitical perspective, Deininger (2011) and Anseuw *et al. (*2012) distinguish three groups of investors in the large-scale land acquisitions : (i) emerging countries such as China, Brazil, India, and South Africa ; (ii) Persian Gulf oil states such as Saudi Arabia, United Arab Emirates, Qatar, and Kuwait ; and (iii) northern developed countries.

Photo 9.11 :Discussion between DGE and representatives of a company, Gabon

The motivations of private actors, notably the multinationals, private banks and pension funds, are fairly conventional, as they seek to maximize their profits and provide better returns for their shareholders (Cotula *et al.,* 2009 ; Saturnino *et al.,* 2012). States are investing in land in a quest for food security for their people – by producing food and agricultural raw materials outside their borders – and in mining to meet their raw materials and energy needs (Cotula *et al.,* 2009 ; Deininger, 2011 ; Anseuw *et al.,* 2012). In both cases, land investors are driven by a desire to guarantee growth in their home countries, and are not necessarily taking into account the interests of the host country (Jorand and Manganella, 2012).

Protecting forest ecosystems and combating climate change seem to be the main motivations of investors operating in the "carbon" niche and of those working for the conservation of rich biodiversity and threatened forest ecosystems (Karsenty and Ongolo, 2012). This niche is attracting heterogeneous actors : States (Norway) ; the World Bank (Forest Carbon Partnership Facility) ; international NGOs (WWF, WCS, CI) ; national NGOs (Environment and Development Center in Cameroon and the Council for the Defense of Legality and Traceability in the DRC) ; and private project holders. All of these actors are seeking new funding derived from the globalization of environmental concerns.

If the trends in forest land transactions are analyzed, it must be concluded that the ensemble of investors follow a “rent capture” logic. This revenue seems to be at the heart of an emerging system favoring new users of Central African forest lands. The heterogeneity of actors is becoming more pronounced and the changes underway are eroding the preeminent role of states in this new landscape configuration. This is a major change in relation to the conclusions published by the CBFP in 2006.

The increasing diversity of players, coupled with decline in the role of states (Karsenty and Ongolo, 2011), risk prejudicing collective sustainable management efforts and the conservation of Central African forest ecosystems. The forests of Central Africa are not infinite and cannot allow the unplanned attribution and grabbing of large areas to continue indefinitely. The “forest land market” and the dynamics of policies focused heavily on economics will unavoidably foster competition and conflict between various land use sectors. This development will further weaken customary land use practices (Mertens and Belanger, 2010 ; Hoyle and Levang, 2012 ; Schwartz *et al.*, 2012).

6. Overall Summary and Outlooks

The past decade in the Congo Basin saw the emergence of new forest legislation, international commitments to improve national forest governance and the impact of global economic trends on local forest management. Significant progress was made in the design of programs, laws and regulations, yet because of the challenges faced by the sub-region a more robust commitment by national governments to strengthen local forest management will be required to achieve management objectives. The Congo Basin forests are under increasing pressure to produce agricultural and other commodities, conserve biodiversity, sequester carbon and provide local livelihoods. Balancing these disparate interests will make the next decade especially challenging.

After decades of relative stability, the extent and condition of Congo Basin forests may now be entering a period of rapid change, a kind of transformational cycle. There is a proliferation of new infrastructure under construction in the region, which is opening up areas that have previously been relatively inaccessible – and much more infrastructure is planned. Much of this infrastructure is driven by investments in extractive industries. This infrastructure will greatly facilitate logging, but it also seems highly probable that colonists and investors will develop agriculture along these roads. Similar infrastructure investment is occurring in the DRC with roads penetrating into the forest zone from the densely populated East African countries. These roads are encouraging the mining of minerals such as gold, coal and coltan and are also allowing timber and agricultural crops to be transported to the growing markets of East Africa.

Infrastructure can focus development efforts, and roads and railways can provide opportunities for development corridors to improve market access. Optimists see such development corridors as an opportunity, because farmers and associated services can be concentrated in smaller areas and this might lessen the pressure on remote forests. There might be a shift in patterns of population and agriculture development in coming decades, which might lead to more intensive and profitable agriculture in accessible areas and an exodus of people from remote forest areas, which could be a win-win scenario. However, pessimists see development occurring in an opportunistic way throughout the Congo Basin with catastrophic results for the environment and the potential for problems of governance.

Other changes are occurring that will determine the future of the Congo Basin forests. World demand for food crops and biofuels is expanding rapidly. Oil palm, soy, sugar and other industrial crops are expanding into areas of the Congo Basin where land resources are presently

Photo 9.12: Laterite quarry, Gabon

under-exploited. Many international investors are exploring options for investing in the forest zone and the new and planned infrastructure is providing an incentive for investment. At the same time, timber harvesting may be less profitable. Markets for high-value timber in Europe are declining and rigorous certification rules make it more difficult to access African timber. The traditional vertically integrated timber trade, with loggers in the Congo Basin linked to manufacturers of wood products in Europe, may be giving way to a less integrated trade sector similar to many other internationally traded commodities, where products find their way to Asian markets. Prices in Asia are lower and the loggers have less long-term commitment to the market chain in this scenario.

There has been an expansion of interest in payments for environmental services in the Congo Basin forests. REDD+ has the potential to compensate governments and local people for avoided deforestation and should encourage forest conservation. However progress in getting REDD+ to a stage where it can be operational at a sufficient scale is slow. Doubts are emerging as to whether carbon buyers will be able to offer carbon prices equal to the opportunity costs of tropical forests and whether regional governments will be able to put into place sufficiently strong institutions to manage these complex programs.

The resources available to fund conservation programs have never been greater. The Congo Basin Forest Fund managed by the African Development Bank has joined the ranks of bilateral funds supported by Germany, France, United Kingdom and the USA, which, together with private foundations and NGOs, are supporting local and landscape scale conservation initiatives. While much progress is already being made on the ground, procedures are often onerous and the disbursement of funds to the field is slow. The Congo Basin forests are poised for change. Interest and funding for their conservation has never been greater but the pressures on forest resources are also mounting. Populations are growing and droughts in dryer areas around the Congo Basin may encourage people to move towards the more humid regions. Climate change will have an influence on all dimensions of the Congo Basin, on its forest, its biodiversity and its agriculture. A mosaic of forest and non-forest areas is likely to emerge in the future; this outcome could allow for people's increased prosperity as well as the sufficient conservation of forests to ensure the region's exceptional biodiversity.

Alongside ecological and economic issues, forest land and resource allocation and use are also challenged by secular social issues. The sub-region is home to communities of hunter-gatherers (forest-dependent, considered as indigenous people), living besides Bantu communities. Most of the currently acquired concessions, notably mining and logging concessions, are also reserves in which these indigenous people ensure their livelihoods. In addition, community rights to land and forest resources have been disqualified by the concessionary model since the colonial period. There is a need for strategies and policies giving a substantive recognition, with secure tenure rights, to local communities and indigenous communities. There is a need for alternative policy options and an alternative vision taking into consideration these social issues. In addition, due to the lack of reliable data on all the aspects of land use and land investment in the Congo Basin, the context and challenges presented here are only partly understood. Therefore, there is a need for data collection and knowledge sharing on the new expansion of the concessionary model in the sub-region. The next State of the Forest Report should deepen our knowledge of the context and challenges.

Photo 9.13: Dugout canoe in front of a raft of logs – Bandundu Province, DRC

CHAPTER 10

Rural societies and multiple land use practices: perceptions of conservation and development projects within the framework of multiple land use systems in Central Africa

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1. Introduction

Despite persistent efforts by Central African governments and the international community to reduce poverty in rural areas, local and indigenous populations are still very poor. Triggered by continuous poverty and failures of policymakers and economic operators to bring about meaningful developmental changes in their lives, a cross section of indigenous and local populations is increasingly questioning the motives of conservation[49] and development initiatives (Pullin *et al.*, 2001). This is catalyzed by the paradox that even though Central Africa is so rich in terms of natural resources, its population remains very poor and this is manifested in the absence of socio-economic and health infrastructure especially in rural communities, despite the presence of numerous conservation and development projects (CEFDHAC, 2007).

According to some stakeholders, there is dissonance between the theory and practice of conservation and development, mainly because conventional theories hold that it is possible to promote local development and sustainable use of natural resources. However, in practice, local communities are often still unable to meet their basic needs, and this has resulted in anger, further alienating some stakeholders (including local communities) from the conservation discourse (Sutherland *et al.*, 2004). For example, an in-depth analysis of the causes of poaching in the Bouba N'Djida and Lobeke National Parks in Cameroon and the Conkouati Douli National Park in the Republic of Congo revealed that frustration and the lack of an inclusive conservation strategy have caused a segment of the local population to collude with poachers in order to have their own share of the booty and to reduce the population of elephants which destroy their crops (ECCAS, 2013). Unfortunately, and contrary to expectation, some stakeholders are of the opinion that some conservation organisations (e.g. Ngoila Mintom in Cameroon) and some large-scale agro-industrial concessions (e.g. Herackles Farms) have stymied their development efforts, mainly because the conservation areas and agro-industrial concessions deprive them of access to ancestral farming and forest lands.

Also, there is increasing suspicion about the strict command and control management of national parks, which is a persistent threat to rural peoples' livelihoods. For example, rural residents are often excluded from accessing or managing the resources in these Protected Areas (PAs), which in turn negatively affects their subsistence. This is often because there is a lack of basic alternatives available to help cope with strict government conservation efforts in lands that have been expropriated from them by the governments. Rural populations complain that some of their basic human products are found only in national parks; indeed, recent IUCN studies have shown that forest products can contribute 25-40 % to rural incomes (up to 75 % for hunter-gatherers). There is also the issue of human-elephant conflict, where increasing numbers of elephants and other animals harbored in PAs and forest concessions destroy crops planted on rural populations' agricultural lands. Empirical evidence has shown

49 In this chapter "Conservation" has to be understood as conservation of the environment, wildlife and flora to the exclusion of any other activity of human exploitation (apart from tourism).

Photo 10.1: Transporting fuelwood – Yangambi, DRC

that these issues have not only created some outright conflict between indigenous populations and decision makers (Eyebé *et al.*, 2012), but have also prompted some decision-makers and conservation actors to start sincerely rethinking and redefining their strategies in an effort to stop this increasingly confrontational attitude from escalating. Some conservation researchers and practitioners are of the opinion that it is equally important to exchange and analyze project failures and lessons learned, in addition to successes, in order to obtain a realistic understanding of conservation impacts and to make consequent improvements (Knight, 2006; Sutherland *et al.*, 2004).

This increasing poverty of rural population is partly inflated by the duality of current land management practices in the region where some key environmental/land policies and legislations are at variance with some major contemporary development and conservation objectives. For example, persistent conflicts between legal/constitutional and customary resources "ownership" or tenure have precipitated latent and overt conflicts linked to the management of natural resources because some segment of the rural population strongly feels that they have been disenfranchised of their ancestral lands and rights.

Historically, it should be recalled that land use practices in most Central African countries date back to the pre-colonial and colonial periods when most colonial masters (French, British, German, Belgian and Spanish) used their respective laws and tools to manage lands in their colonies. After independence, most countries simply adopted these colonial laws in their new legal and policy frameworks. However, not long afterwards, they started encountering some major implementation hurdles at the local level because indigenous populations remained steadfast to their pre-colonial traditional and customary land rights that supported socialization between members, guaranteed economic benefits, advocated for socio-cultural continuity and consolidated their territorial and administrative gains. After all, cultural gatekeepers like village chiefs and elders were expected by their subjects to protect these important traditional values, which, at times have been at variance with some key legal resources ownership provisions of current nation-state. These implementation hurdles and "voids" have partially provoked the on-going revision processes of the land tenure laws (Cameroon and DRC), forestry and wildlife codes (Cameroon, DRC, Congo, etc), environmental law (DRC), etc. Although multiple land use practices exists today (e.g. agro-industry, protected areas (PAs), community hunting zones, mining, etc), most contemporary land use planning and implementation laws, strategies, tools, methods recognize three main zones (i) extractive resource (economic operators), (ii) community zones (for community use and management, and (iii) Protected Areas (for conservation of natural resources).

This chapter aims to explore local perceptions of conservation and development projects, notably by evaluating projects results (successes and failures), identifying the effects of resource policies and proposing key recommendations to ensure that the desired outcome of conservation and development projects are attained at the local level. It will also be an opportunity to tackle these problems through the eyes of local and indigenous peoples who sometimes have the opinion that the continuous desire to conserve natural resources sometimes pushes other stakeholders to forget about their plight and the important role they can play in the entire project cycle to ensure positive impact. In other words, it is an exploratory work that aims to understand and evaluate local and indigenous populations' perceptions on conservation and development projects. We will use qualitative and quantitative data to evaluate whether the different land use management strategies currently being proposed are advantageous or detrimental to local communities in terms of the sustainability of their livelihood options and the sustainable use of natural resources. Most development actors are increasingly interested in the quantification of socio-cultural and economic benefits accrued from the implementation of development and conservation projects at the local level. After all, it is evident that the perception of conservation and development options can trigger either positive or hostile actions by the local population. Positive perception could depend on the presence of infrastructure (roads, health centers, schools, houses, etc.) and on the effective inclusion of the local and indigenous populations in conservation and development actions through pre-defined good governance structures. Also, because we are dealing with socio-cultural institutions at the local level, it is important to analyze how these different land use options impact local institutions, local laws and regulatory frameworks, social statuses and roles, and how changes in these land use options are gradually influencing behavioral change through socialization and cultural diffusion. For example, how do local populations interact with strangers, migrant workers and park managers, and how does this influence their attitudes towards the management of local conservation and development interventions. In this chapter, we will assess the impact of the various land use options, patterns and practices on the livelihoods of dependent communities, on the conservation of natural resources at the local level, and on dependent communities' perceptions of the conservation and development practices going on around them.

Box 10.1. Contribution of natural resources to the earnings of rural households in Cameroon and the Republic of Congo

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The local communities and indigenous peoples of the forest zones depend on natural resources daily for food, clothing and hygiene. A study[50] on how natural resources contribute to their earnings was conducted in 2012 through interviews of 160 rural households in Cameroon and 70 in Congo.

Contribution of natural resources to household earnings

Two types of earnings were analyzed: monetary earnings and earnings in kind (independent consumption of natural resources). Figures 10.1 and 10.2 show the contribution of timber and non-timber forest products, crop/livestock/fishery products and other sources of revenue (employment, commerce, money transfers, etc.) to the average annual earnings of these households in Cameroon and Congo respectively and distinguish monetary resources from resources in kind (subsistence consumption). Table 10.1 estimates their monetary value.

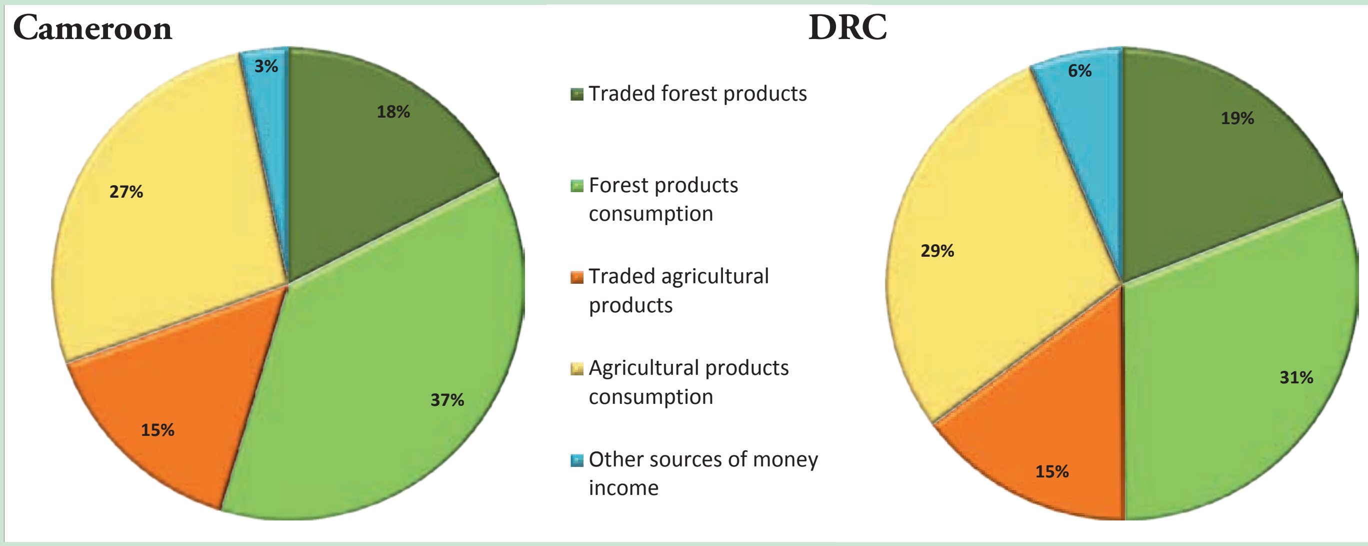

Figure 10.1: Contribution (in %) of natural resources to the annual earnings of households in Cameroon and in Congo

Table 10.1 shows that in Cameroon the earnings derived from forestry products are close to those derived from farming and fishing, whereas in Congo agricultural earnings far exceed those derived from forestry products. The other sources of income represent only 8.5 % and 14.7 % of global earnings respectively.

Table 10.1: *Contribution of various sources of earnings to the average annual earnings (in CFA) of Cameroonian and Congolese households (2012)*

	Cameroon	Congo
Forestry products	3 371 827	2 693 379
Agricultural and fishery products	3 559 685	3 577 148
Other sources of income	647 305	1 077 635
Total annual earnings	7 578 817	7 348 162

Source: Survey 2012

The difference between these two countries is linked to the presence in Cameroon of a number of NGOs which assist local inhabitants to derive greater value from non-timber forest products and to market information systems which place farmers in contact with buyers. The earnings also differ according to ethnic groups: the Bantous, who are more oriented towards the market economy, have higher earnings than those of the Baka in Cameroon and the Bayaka in Congo, who are more subsistent.

50 For this study the toolbox for measuring forest dependence-poverty developed by the International Union for the Conservation of Nature (IUCN), the Overseas Development Institute (ODI), the International Center for Forestry Research (CIFOR) and Winrock International was used.

Origins of natural resources

The various natural resources are derived from different environments, whether natural or cultivated.

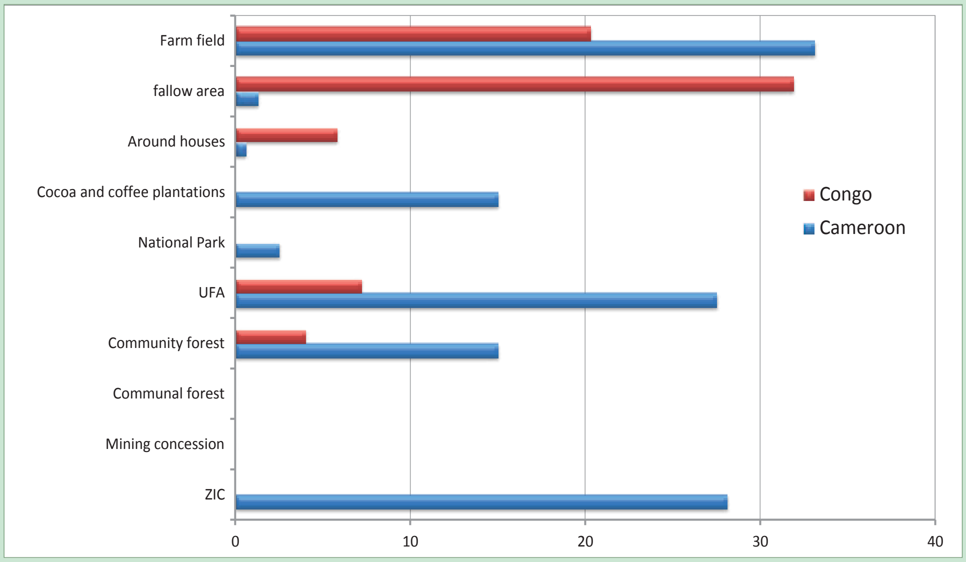

Figure 10.2 : Distribution of places of origin of natural resources in Cameroon and Congo (%)

In Cameroon, households exploit natural resources mainly from their fields, the Forest Management Units (UFA), the hunting areas (ZIC), the community forests and the cocoa and coffee plantations, whereas in Congo these resources are mainly derived from fallow areas, then fields used for crops and UFAs, but with differences according to ethnic group (table 10.2).

Table 10.2 : *Principal places of harvesting (in %) of households according to ethnic group in Cameroon and Congo*

	Congo		Cameroon	
Principal places of harvesting	**Bayaka**	**Bantou**	**Baka**	**Bantou**
Fields under cultivation	7.1	29.3	36.3	30
Fallow areas	60.7	12.2	2.5	7.5
Around houses	0	9.8	1.3	0
Cocoa and coffee plantations	0	0	1.3	28.8
National park	0	0	2.5	2.5
UFAs	17.9	0	28.8	26.3
Community forests	10.7	0	23.8	6.3
ZICs	0	0	32.5	23.8

For the Bantous, field crops are the main resources, whereas the Bayaka harvest mainly from fallow areas. The Baka obtain resources mainly from the forests (UFAs and community forests), fields under cultivation and ZICs.

The modes of land use and the resources derived from them by different communities gives rise to numerous conflicts, which makes it difficult to define a common view of sustainable natural resources management. However, local communities and indigenous peoples should take part in REDD+ projects because they are the ones primarily concerned by climate change. It is necessary to evaluate how REDD+ mechanisms will affect these local communities, how they will enable traditional land rights to be respected and how they will guarantee the equitable distribution of the benefits and obligations resulting from these projects.

2. Contribution of multiple land use practices to local development

2.1 Overview of the issues

Although different land use practices have been studied over the years in Central Africa, there has been very little evaluation of the socio-cultural and economic impacts of these various land use practices on rural communities. In fact, most governments and non-governmental organizations showcase the validity and reliability of various land use methodologies rather than analyze how communities perceive these land use practices and the socio-cultural, environmental and economic impact of these practices at the local level.

Perhaps this is because some conservation organizations are either solely interested in biodiversity conservation, or they only see the improvement in rural peoples' livelihoods as a means to an end, instead of as an end in and of itself. These views by conservation organizations often determine how local communities perceive conservation actors and projects. Empirical evidence has shown that these perceptions might also depend on the impact these projects have on livelihoods and socio-cultural practices. This brings us to the question of why some conservation and development projects fail at the local level, despite the zeal of Government and international community to succeed. As said earlier we need to start thinking about the actual impact of these land use practices on local communities. For example, although the forest sector contributes, on average, between 5 and 13 % of the GDP of Central African countries (FAO, 2002) and 6 % to Cameroon's GDP (COMIFAC, 2010), local communities still remain very poor (Yanggen, 2010 ; Angu, 2010). Are these interventions bearing fruits or hindering the full involvement or participation of local poor populations ? It is also important to understand how traditional and customary land use management practices are at times at variance with modern management options masterminded by "external actors" (policy makers, NGOs, donors, etc.).

Although we need some time and resources to carry out a comprehensive analysis of the link between land uses options/planning, conservation and the sustainable livelihoods of local communities, some field experiences are already giving room for such an analysis. However, although we do have some field datasets, they seem to be so limited that they could hardly be used to make generalization. Also, many times practitioners lack an appropriate evaluation methodology to determine whether they are meeting their goals. In short, the planning process is still in its embryonic phase, but thanks to the efforts of participatory planning (e.g. the USFS planning guides) countries have started taking the matter seriously.

Because of this scarcity of field data, the authors of this chapter are not suggesting they have all of the answers to these questions. However, we strongly believe that the initial results of these case studies should be used to provoke discussions that will ultimately pave the way for a comprehensive evaluation of the impacts of the various land use practices proposed by conservation and development projects in rural areas in the future. This discussion is vital right now, when conservation and development actors are almost unanimous in their opinion that we can only attain sustainable conservation if we put local communities at the fore-front (i.e. using a people-centered approach to conservation) (Yanggen, 2010). We hope subsequent versions of the State of the Forest Report or other publications could draw from our examples to enrich future publications.

2.2 Rural populations, customary institutions and traditional land use practices in Central Africa

In Central Africa, rural societies are socio-cultural entities that are generally composed of two or more villages and are recognized by the government as a management unit. Because land use activities are key to understanding and predicting behavioral patterns in rural communities, it is important to understand and define the socio-economic activities (e.g. agriculture, hunting, forest harvesting, artisanal mining, slash-and-burn agriculture, etc.) that characterize rural societies. Additionally, because each village has a historically-defined territory where its inhabitants collectively commune and share available resources, values and norms, there are often conflicts when part of their territory is allotted to a foreign company or designated as a national park, especially when this occurs without seeking their consent.

Typically, a village (or grouping of villages) is composed of the village chiefs and the traditional village council (often the heads of main lineages and dominant socio-cultural groups), manage the collective natural resources within the territory. The village chiefs are often descendants of the apical ancestor or founder of the village, and they are usually believed to ensure the link between the village inhabitants and their ancestors and sometimes land fertility (such as ensuring abundant wildlife or agricultural production). The village chief is often considered the peace maker, because his role is to negotiate and find common ground during conflicts, order the repartition of agricultural lands, and control hunting and forestry activities on farmlands or concessions. Because most villagers believe in them, especially as cultural gate-keepers, these traditional institutions have remained in place in some form, even during the colonial and post-colonial periods. Access and use rights to lands and forest resources are also negotiated in a system of traditional authority, clans, family lineage and individual households (Akwah and Yoko, 2006). We noticed that local populations in some of our study areas, especially in the Sangha Tri-National (TNS), Dja-Odzala-Minkébé (TRIDOM), Bikoro, Bateke Plateaux etc. are strongly attached to their customary institutions, where land is considered a common

Photo 10.2: Brick-making ovens are big wood consumers – Kisangani, DRC

heritage as both a physical and cultural inheritance from ancestors. However, with the promotion of community-based management by the government and local communities receiving the proceeds derived from community management, we are gradually witnessing an urban to rural migration, especially in south-eastern Cameroon (Angu, 2001 ; Angu, 2010b) ; this is in contrast to the normal rural-urban migration occurring in most countries (UN, 2012). This is mainly because villagers who migrated to the cities in search of a better lifestyle were confronted with immeasurable hardships in towns, and seeing new opportunities and initiatives in rural villages, they changed their minds and went back to the villages. However, their time spent in the cities somewhat alienated them from village values and patterns, and their return to the village has often created conflict with fellow villagers, especially the village chiefs and other village elites, over natural resource management.

Empirical field data gathered from project sites in Central Africa, notably in Bikoro (DRC) and the Trinational Sangha (TNS-Cameroon, the Congo and the CAR), the Bateke Plateaux (Gabon), revealed that the main authorities regulating access to community land and forest resources at the village level are the customary chief, the local administrative chief and the heads of families or clans. The customary chiefs are the main custodians of community natural resources because they mediate and resolve local-level conflicts related to forests and other land use practices. Traditional practice dictates that people who are not native to the village such as migrant workers cannot have direct access to land and forest resources. Clans, families and even groups of villages can negotiate their access to land and forests via the customary chief, village elders or heads of families with customary claims to the land or forest. Moreover, any migrant or non-native that needs farmland has to consult with the customary authority to gain access to the land, or he can rent land from natives of the village. Minority or vulnerable groups such as Pygmies find it difficult to integrate themselves in the society because they must negotiate their access to land and forest resources by sharecropping and, if necessary, donating gifts to the customary chiefs and head of families or clans (as in the case of Bikoro). Also, since most of the societies are patrilineal, tradition holds that women cannot have direct access to land except via their husbands or other siblings. Single women and widows without children usually negotiate their access to land through the heads of families and the customary chief. The customary chief and the head of family or clan with a customary claim to the land or resources typically negotiate and distribute parcels of the forest land. However, this differs from matrilineal societies where women can have direct access to land (e.g. some southern parts of Gabon). It should be noted that traditional land tenure systems in rural African societies are very flexible, with mostly unwritten land policies and laws.

However, in most countries in the region, especially the DRC, Congo and the CAR, the governments have not yet finalized and vetted provisions that will enhance the role of communities in natural resource management (e.g. the signing of an implementation decree of community forestry) (Hoare, 2010). This often results in conflict between local populations and large-scale economic operators who use their land for either large-scale plantation farming or mining. Also, the ability of local communities to attain and mobilize resources to improve their livelihoods is often constrained by their inability to effectively engage in forestry and development interventions (Bartley *et al.*, 2008). Also, most national laws and codes recognize local communities as user groups with only use rights to natural resources, while embedded customary institutions retain de-facto property rights at the local level (Klaver, 2009).

This demonstrates the importance of culture to the daily lives of rural communities in Central Africa, and, contrary to expectations, why it is difficult to cede key customary socio-cultural policies and laws that rural communities have upheld for many years or decades. Conservation or development projects should take into consideration these societal traits when building their projects and programs, because otherwise the chances there are greater that they will not succeed (Waylen *et al.*, 2010 ; Ostrom, 2009).

2.3 Decentralized management of natural resources and multiple land use practices in rural Central Africa

The concepts of decentralization and deconcentration are very important to our analysis of the impacts of multiple land use patterns and practices on socio-economic development and conservation at the local level. The deconcentration and decentralization of authority are old administrative and political practices from the colonial and post-colonial Congo Basin countries (Oyono, 2009). Deconcentration is a process whereby power is devolved to nominated subordinate authorities who are given the power to make decisions in the name of the central power (e.g. regional or provincial governors, senior divisional officers, divisional officers, etc.). Territorial decentralization, on the other hand, is a form of power organization where the government creates decentralized public personalities, with specific attributes and functions, and gives them the necessary resources to perform their job, while retaining the power to supervise them (Owona, 2011). In many of the countries in Central Africa, the decentralized decision-making authority belongs to councils.

Decentralization of natural resource management, notably forest management, is generally called technical or sectoral decentralization. Here, the government devolves some of its powers and management responsibilities to actors or institutions at lower levels of the political, administrative and territorial hierarchy. This form of decentralization is more recent and less well-known to the public at large (Ribot, 2007). Table 10.3 summarizes the experiences with the decentralization of forest management in the sub-region.

Table 10.3: *Recipients and purpose of the decentralization of natural resource management in five countries of the COMIFAC*

Countries	Beneficiaries	Categories or Sectors
Chad	Councils	Tree planting
Cameroon	Councils	Forest
Congo-Brazzaville	Councils	Forest
Burundi	Councils	Tree planting
Rwanda	Councils	Tree planting

Devolution, which is another component of transfer of management power and responsibilities, could be seen in the following mechanisms in Central Africa (Oyono, 2009).

The following mechanisms illustrate devolution, which can involve the transfer management powers and responsibilities: the management of community forests and hunting zones in Cameroon (currently being implemented), the process of creating and managing community forests or concessions in the DRC (yet to be implemented), the creation of community conservation areas in eastern DRC (currently being implemented), the creation and management of community forests in Gabon (Community forest decree came out last January 2013, but pilot projects have been going on through the *Comité Communautaire de Gestion Locale* found in the buffer zones around the national parks), and the management of *Reservas de Poblados* in Equatorial Guinea (currently being implemented).

Because it is difficult to quantify the socio-economic impact of forest decentralization and the devolution of power and responsibilities (to local structures) on local development and conservation objectives, the efficiency of decentralized

Photo 10.3: Protection of a young tree in village area

natural resources management is hard to measure. However, efforts to decentralize natural resources management in Cameroon over the past 10 years appear to have resulted in the empowerment of local communities and the construction of socio-economic infrastructure like schools, health centers, etc. Unfortunately, the analysis is complicated by the lack of a comprehensive and transparent public database to measure whether these schemes are effectively contributing to local development and the sustainable management of natural resources. For example, the implementation of the Congolese model, where socio-economic benefits could be measured in terms of the availability of basic needs (water, houses, roads, involvement in development projects, etc), is highly awaited, because it can act as a source of inspiration and comparison for other devolution models among the Congo Basin countries (notably the community forests in Cameroon and, to a certain extent, in Gabon). Also, the Congolese model could show some improvement in the recognition of the rights of communities in land use planning and zoning (Hagen *et al.*, 2011). This could be done by making sure that realistic policies and laws are conceived and implemented at the local level (Eyebe *et al.*, 2011).

There are several methodological difficulties that constrain our results (Ebamane, 2009). In all the countries, especially in Cameroon, revenues derived from the management of council forests are earmarked for multiple uses, including local development (Cuny, 2011). However, it is very difficult to measure development results. Although numerous socio-economic infrastructures have been established, they do not yet meet the needs and expectations of the population because they have been only partially implemented due to poor planning and organizational deficiencies. For example, neither the first nor the second editions of poverty reduction strategy documents anticipated the expected contribution of the decentralized management of natural resources on local development.

Does the decentralization of forest management favor conservation and local development? To understand this complex question, we feel it should be analyzed holistically (i.e. socially, politically, economically, technically and strategically). However, although it is very difficult to obtain a comprehensive research report on this, it is certain that decentralization of forest management has favored conservation and local development (e.g. COVAREF (to some extent) in the TNS (Cameroon), tourism projects management by local communities in the Volcanoes National Park in Rwanda). This can only be possible not only if local communities respect their management plans or other sustainable management norms but also if other stakeholders like Governments respect their own part of the bargain. Unfortunately, we have witnessed numerous cases of the illegal exploitation of natural resources because of weak monitoring by the line government ministries, insufficient collective action by local communities, and inadequate institutional arrangements by local government officials (Oyono, 2006). Also, some field experiences in Cameroon have shown that management by council forests results in both good and bad ecological outcomes, depending on the harvesting practices used and the degree that conservation laws and policies were enforced (Cuny, 2011). It should be noted that, with the exception of Community Forestry management in Cameroon and its generally negative balance sheet, with the exception of pockets of successes in some areas, there has been no comprehensive analysis of the outcome of decentralized forest management in Central Africa.

In the eastern DRC, community conservation has advanced significantly thanks to the efforts of conservation organizations like Conservation International, WWF, and Dian Fossey Gorilla Fund International (DFGFI) over the past 20 years. Natural reserves in North Kivu are positive examples of how the 2002 Congolese Forestry Law has promoted decentralized management far beyond the expectations of stakeholders (Oyono and Lelo Nzuzi, 2006). A pilot community conservation project, which is based on mutual learning of key local stakeholders, is also currently being implemented in Bikoro in the Equator Province in the DRC (Taylor, 2011); because of the strength of local institutions, powerful traditional chiefdoms, governed by *Mwamis* (customary chiefs), guarantee the respect for and protection of management norms and arrangements, as well as the collective action of the local population in controlling the resources. This mechanism, which is also being implemented in Rwanda and Burundi, is synonymous to decentralized management, and it is showing positive results in the sustainable management of natural resources (Mehlman, 2010).

Our field experiences highlight three lessons learned:

1- Decentralized management of forests and power devolution are not only new concepts, but are also not welcomed by the central government authorities, especially in countries that have a strong tradition of centralization (e.g. most Central African countries). However, because of the fear of conflicts, widespread corruption and mismanagement, most countries are now using this model to facilitate sustainable forest management. It is therefore important for stakeholders to encourage countries to continue, especially because it is a slow and cumbersome process.

2- It is important to institute national revenue databases and monitoring programs in all countries. Currently, it is difficult to measure the exact contribution of this mechanism to rural development and the sustainable use of natural resources because of the absence of national databases.

3- Decentralized management and power devolution could promote development and ecological sustainability if the devolved powers and responsibilities are sustained by well-defined institutional arrangements, backed by real political will and respect for the rights of local communities. These rights would be protected judicially. It might also be interesting to know when local rights could be juxtaposed or substituted to the rights of other actors like private sector. Should we reduce state land (and the global size of concessions) or, on the contrary, define and implement different land use options in and out of state lands?

It is urgent to carry out comprehensive ethnographic research on the contribution of decentralized forest management and power devolution to poverty alleviation and conservation in Central Africa. Establishing national databases to monitor how the local councils' funds derived from tree planting are invested is essential to determine if and how these funds are contributing to local development. If restructured and adapted, the experiences with the Annual Forest Royalties program (AFR) in Cameroon could serve as an example of these practices in other forest countries. The AFR is a tax levied to logging companies to facilitate local development in areas adjacent to their logging concessions. It is also important to study how to adjust our decentralization efforts to the on-going REDD+ process in countries of the sub-region.

2.4 Multiple land use practices within the framework of conservation and development project in rural Central Africa

Keeping in mind local land tenure and decentralization dynamics, it is now important to examine different land use practices, their contribution to local development and conservation, and how they are perceived by local actors. In fact, there is insufficient evidence to show whether these conservation and development projects are succeeding or failing. Data from field projects reveal that decades of conservation and developmental projects have inculcated varying perceptions by rural communities, largely depending on their degree of success or failures (Knight *et al.*, 2006; Pullin *et al.*, 2001).

Photo 10.4: Charcoal market – Kisangani, DRC

2.4.1 Community forests and related community forest concessions

A community forest is a forest area legally managed by local and indigenous populations to improve their livelihoods and foster conservation objectives. According to the Cameroon Forestry Law n° 94/01 of January 1994 and its Implementation Decree n° 95/531PM of August 23, 1995, "community forestry aims to increase the participation of local populations in forest conservation and management in order to contribute to raising their living standards" and "to secure substantial benefits for village communities as well as to motivate them to better protect forest cover". This definition is similar to the intentions of the community forestry policies in other central African countries, notably in the DRC, Gabon and the CAR. However, field data show that these policies are not fully in practice because of three main implementation hurdles. First, the possession and management of community forests is a technically complex and challenging endeavor for local communities who are typically lacking in experience and training, especially if they are not supported by external elites, NGOs or other government or private projects (Oyono *et al.,* 2006; Cuny, 2011). Second, some communities become discouraged because the procedure to acquire a community forest is bureaucratic, cumbersome and expensive (Angu, 2007). For example, in Cameroon where community forestry is more advanced, a modest estimate of the development of a simple management plan is close to $ 30 000. This is prohibitively expensive for many rural communities, and it helps to explain why a large sector of the population has a negative perception of community forests. For example, the Kongo Community Forest in South East Cameroon had numerous conflicts with government officials because they found it very difficult to elaborate and revise their Simple Management Plan because of lack of financial and technical resources. Finally, since many communities lack the necessary capacity to exploit forest resources commercially, some solicited large economic operators to help them fund the process and, unfortunately, some funders take advantage of villagers (Angu, 2010). The situation is the same in some community forests where community committee members have contracted small-scale loggers to harvest timber (e.g. Ngola-Achip Community Forest of the TRIDOM landscape), and the villagers are either not aware of the activities, or receive very little money from the sale of wood (e.g. $ 48 per cubic meter) (Angu, 2007). Many community forests in the TRIDOM landscape (Kongo, Ngola Achip, etc.) have not had positive outcomes because of the poor management of the forest by the elites, some local NGOs and small scale exploiters who dictate the management process. In 2007, during the Annual Exploitation Certificate in Cameroon, there were only 142 operational community forests with a maximum surface area of only 500 000 hectares. Technical constraints have generated additional financial costs (Julve *et al.*, 2013) that are not compensated by markets to sell their goods.

Available data reveals that there are about 470 designated community forests in Cameroon today. However, only 200 have signed the *Convention Définitive de Gestion* (Definitive Management Agreement) with the government, and in 2012, only 142 were in possession of certificates authorizing them to exploit their forests. Gabon only has two community forests while the DRC (Nord Kivu) has six functional community conservation zones. It should be noted that these zones were initially created by local communities and later vetted by the central administration as nature reserves. Equatorial Guinea has about 49 *Reservas de Poblados*, with a total surface area of about 59 780 ha, according to INDEFOR-AP (*Instituto Nacional de Desarrollo Forestal y Gestion de Areas Protegidas*).

In the middle of 2000, annual revenues from community forest management in Cameroon increased from CFA 1 480 000 ($ 2 960) to about CFA 23 800 000 ($ 47 600), including all administrative and management costs. In 2011, more than half of the community forests under exploitation in Cameroon generated from CFA 10 000 000 to CFA 15 000 000 ($ 20 000-$ 30 000). These revenues included salaries for employees and the compensation of management committee members. Community revenues are generally used for socio-economic development projects at the local level (schools, health centers, community water projects, rural electrification, community agriculture, markets, education, etc.). The Ngola-Achip Community Forest in eastern Cameroon generated CFA 34 000 000 during their first five years. However, the contracts they signed with some economic operators were not lucrative, even after increasing the price of their products from CFA 24 000 ($ 48) per cubic meter between 2001 and December 2003 to CFA 34 000 ($ 68) per cubic meter in 2004 (Angu, 2007).

Although these sums might seem impressive, the average revenue per person derived from the exploitation of community forests is very small (Beauchamp and Ingram, 2011), and their impact in terms of community and private infrastructure is equally limited (Ezzine *et al.,* 2008). Community forests cover a limited surface area in the village (Lescuyer, 2012), and they are mostly managed by only a handful of people with little transparency and accountability to the communities. This has frustrated many community members and created discord with the promoters of these projects such as the government, NGOs and the private sector. Also, these operational difficulties have promoted corruption and illegal practices (Castadot, 2007 ; Ndume, 2010). As a result of these shortcomings, various actors have gradually relegated the issue of sustainability and equal sharing of cost and benefits to the background (Assembe-Mvondo, 2006). Furthermore, the corrupt practices and lack of perceived impact has decreased the zeal of communities to obtain and manage community forests through this mechanism. This partly explains the reluctance of other countries in the sub-region to develop community forestry initiatives. Community forestry is perceived negatively because of these failures to deliver positive, broad-based community benefits. Conflicts are also rampant between rural communities and the government, because local communities are often not involved in negotiations and they experience negative outcomes from the exploitation of these resources. For example, many local communities feel that although some of their activities are laudable, they have gradually been hijacked by these actors. Also, women often feel disempowered by the system because they believe that their voices are sidelined, and, even if they are involved, their participation is marginal.

Photo 10.5 : Sale of construction poless

The "command and control" strategy dominates the management of community forest concessions. For example, the authority of customary chiefs concerning land allocation and management has been gradually eroded. Data from projects in the Bikoro area (DRC), TRIDOM and TNS, have revealed that well-to-do and politically-connected village elites and economic operators have helped to establish police posts and administrative procedures (or have consolidated existing ones) to boost their influence and indirectly undermine their legitimate authorities, thus thwarting calls for land tenure reform and good governance. Local administrative authorities have constitutionally-backed legal powers, which are directly recognized by the government (as in the case of Bikoro). These people compete with customary chiefs for power, and their "illegitimate" interference has led to numerous conflicts and pseudo-management. In some areas, the power of the customary chiefs with respect to the access to and use of forest resources is very strong at the village level, while in other areas (like Dja, etc.) local elites and local administrative authorities dilute or influence the power of the village chief. However, even if the power of customary chiefs is well respected, this power is not statutorily legal, as it is only recognized by the state via the negotiation of social responsibility contracts (*cahiers des charges*) with the logging companies or through the creation of a Community Forest Simple Management Plan, in which the state is the real power broker. Because they negotiate their powers through government officials, most economic operators (big or small) pass through powerful elites, bypassing traditional village structures. Also, most members of the community forest committees are well-to-do and educated villagers, who have a high social status, are actively engaged in the organization, and can speak well in public, instead of the poor and less privileged villagers (e.g. Pygmies and women).

Because of these disparities it is only logical to say that some elites and some influential members of the management committees benefit more from these projects than the less privileged villagers who find it difficult to make contributions to the organization. As a result, many villagers do not have the willingness to participate in decision-making meetings resulting in a general lack of communication between the villagers and the executive committee.

From the above analysis, we have gathered the following lessons learned and recommendations. In theory, community forests were conceived as a way to facilitate the decentralized and sustainable management of forest resources. However, in practice, there have been numerous problems with their implementation, notably with effectively securing the rights of local and indigenous populations to manage natural resources. Furthermore, although there was some initial political will by the governments of the regions to secure the rights of local populations through their forestry laws and other regulatory frameworks, administrative bodies resist implementing these policies either because they (administrators) think that local populations rights and prerogatives are being usurped by other local partners or because they believe that local populations are incompetent and cannot sustainably manage the resources (Ribot, 2002 ; Oyono, 2004). There are six recommendations which may help to arrest this sad situation :

1. Create incentives for specialized administrative bodies, especially deconcentrated bodies, to cede part of their management powers to local actors ;

2. Train communities to master the whole process, enabling them to become empowered citizens ;

3. Improve governance at the local level ;

4. Carry out an inclusive and participatory land tenure reform process that includes all stakeholders ;

5. Generate seed money to help communities elaborate and implement their community management plans ; and,

6. Connect communities with lucrative markets to help them sell products from their community forests.

2.4.2 Council Forest

Although council forest, that is forest owned by a local council, is only modestly implemented in Cameroon, with eight council forests currently being exploited, a segment of the rural population where council forests are working complains that they have not yet felt the impact of council forests on their daily lives. Furthermore, some countries like DRC are hesitant to implement this policy because they are discouraged by the lack of concrete outcomes for rural communities; however it is possible that there has been a lack of documentation on the impact of these projects on the livelihoods of local populations (Becker and Tchala, 2011). Also, the economic gains derived from the exploitation of council forests are still very low in Cameroon: only about 11 % of the rural council budget (Tchala *et al.,* 2013), even in predominantly forest areas. This poor performance is made worse because the initiators of the policy had very high expectations of the financial benefits from council forests. In fact, it was initially thought that most of the rural councils' budgets, especially in municipalities with very low economic activities other than forest exploitation, could be attained through the council forest scheme. Although it is estimated that council forests have generated some permanent jobs, the impact in terms of revenue invested in socio-economic infrastructure is still low (Tchala *et al.*, 2013). Also, the participation of the population in decision making, development, management and exploitation of council forests has not been encouraging (Assembe-Mvondo and Oyono, 2004; Poissonnet & Lescuyer, 2005; Collas de Chatelperron, 2006; Assembe-Mvondo and Sangkwa, 2009), and this lack of participation has alienated some communities, because they perceive council forests as an "elitist scheme" beyond the reaches of ordinary rural communities.

Moreover, even though council forests are thought to help lay the foundation for good local governance by improving accountability of electors, practical field experience has shown that the activities of some mayors and municipal councilors does not reflect this (Cerutti *et al.*, 2010; Bigombé, 2000). This experience has gradually created negative perceptions by local communities, which are expressed in the persistent conflict between the population, mayors and municipal councilors for the control, distribution and investment of resources.

Photo 10.6: Clearing of a charcoal grindstone – Kamaulu Village, DRC

However, in comparison to community forestry, the annual revenues from council forests have been encouraging, although limited in scope and geographical area. For example in Cameroon, Dimako Council Forest (East Region) is often cited as a success story for the local management of forest resources. Between 2004 and 2010, this Council generated about CFA 1 000 000 000 ($ 2 000 000), for an average net annual revenue of about CFA 54 500 000 ($ 109 000). The net annual revenue of the Dimako Council Forest, which represents about 80 % of the council's budget, was used as follows: 50 % on investments, 30 % on functioning, 10 % on regeneration of the forest, and 10 % for the local population (Cuny, 2011). While the two last activities were difficult to evaluate, some of the funds were directed towards education, electrification and health initiatives (Cuny, 2011). Also in 2010, the Djoum Council Forest (South Region of Cameroon) generated about CFA 233 000 000 ($ 465 000). These funds were predominately used to construct the Djoum market, as stipulated in the Council Development Plan.

Lessons learned and recommendations: While council forest policies are recognized in the legislation of countries like Cameroon, Chad, Burundi, Congo, Rwanda and the CAR, only Cameroon is actually implementing these policies, with eight operational council forests. This lack of robust implementation results from the fact that, contrary to expectations, some councils in Cameroon have not seen the benefits of council forests because of the expensive and cumbersome process required to acquire and manage them. This has discouraged other councils from engaging in the process.

Cameroonian authorities need to simplify the process and effectively use their administrative authority to help councils manage the process of creating and managing council forests. Even though investing in a council forest may be a more lucrative strategy in the end, because the process takes so long, some councils prefer to generate revenue through the exploitation of timber with private companies on private forest concessions, which are managed by the line forestry ministries. Similarly, mayors, who have short-term political goals in mind, are reluctant to invest in council forests, because it often takes longer than one term in office to see the benefits, and it is possible that their political opponents could benefit from the long-term gains if they do not win reelection. It is therefore necessary for the line ministries to develop some short-term incentives for mayors to invest in council forests, because if well managed, they could help trigger local development and improve natural resource governance. Also, since Cameroon is a pioneer country in establishing council forests, other countries like Burundi, Rwanda, Chad, Congo and the CAR (who have instituted council forests in their legislations but not yet implemented them) are closely observing the Cameroonian experience. At the regional level, it is important for COMIFAC to analyze results, and if warranted, develop a plan to help these countries re-engage or engage in the process.

Photo 10.7: Village dialog within the framework of Makala Project – Bas-Congo, DRC

2.4.3 Community hunting zones

Tangible field experiences have revealed that social customs regulating the access to resources in community hunting zones follow much the same principles as agricultural and other land use practices. This is because kinship and friendship ties are important factors in determining the access to, and exploitation of natural resources both on farmlands as well as in hunting and gathering concessions. However, when keenly scrutinized, the rules are different depending on the country, the ethnic group or religious affiliation, and the availability of resources. For example, rules are often relaxed (especially for strangers) when there is more than enough geographical space and resources for everybody. However, when geographical space and resources are limited, the rules become stricter (Angu, 2010b). This flexibility helps to protect cultural space and resources, facilitates internal collaboration, reduces conflict, and promotes dialogue to ensure equal sharing of cost and benefits between community members. Additionally, communities may enact various social control mechanisms to avoid what Hardin (1968) called "the tragedy of the commons", which is typified by the unlimited and free access to, use of and the eventual depletion of resources. Therefore "governance in the management of these common resources or public goods" (Ostrom, 2010) is for the good of all. This is exactly the underlying objective of the management of community hunting zones in Central African Republic.

Prior to the establishment of community hunting areas by the government, most peoples had customary hunting areas. In many cases, historical management of these territories has changed over time in response to colonial influences, introduction of state laws, centralization of authority with the state, and the reduction of authority of customary chiefs (Walters, 2012). In the case of the Bateke people of Gabon, although their traditional way of managing hunting territories has largely stopped, there are still vestiges of their system and a sense of ownership in the wildlife; this had led to some communities attempting informally to control illegal hunting in their areas (Walters, 2012). In formally defined community hunting zones, although rules governing the access to hunting territories are sometimes well defined and collectively agreed upon, it is often difficult to identify general rules for the management of wildlife resources at the local level. Harvesting modalities, especially techniques, periods, and types of species, can be extremely variable and, in some cases, not fully implemented by local chiefs, community leaders or segments of the population.

In Cameroon, because of these difficulties, the governments of the region and other conservation and development actors like WWF and GIZ supported the Committees for the Valorization of Wildlife Resources (COVAREF) to facilitate the effective management of community hunting zones in the South-East. They are administered at the community level. We observed that some redistribution mechanisms were put in place through this program to help all social structures, age groups and strata benefit from hunting. For example, MINFOF encouraged and stimulated local populations to sustainably manage wildlife through numerous models: participatory zoning, developing incentives to create village organizations charged with the management of wildlife (COVAREF, etc.). They did this by disbursing dividends to village communities accrued from safari hunting. At present almost 10 *Zones d'intérêt cynégétique* (ZIC) and 15 *Zones d'Intérêt Cynégétique à Gestion Communautaire* (ZICGC) have been created in south-eastern Cameroon (the Cameroonian Government has created 47 ZIC and 24 ZICGC all over the national territory). The ZICGCs were handed over to COVAREF who, in addition to receiving benefits from the ZICGCs, also receive a 10 % concession/leasing tax and 10 % killing or hunting tax in ZIC. The figure 10.3 shows the evolution of financial proceeds paid to six active or existing COVAREF in the region between 2000 and 2010.

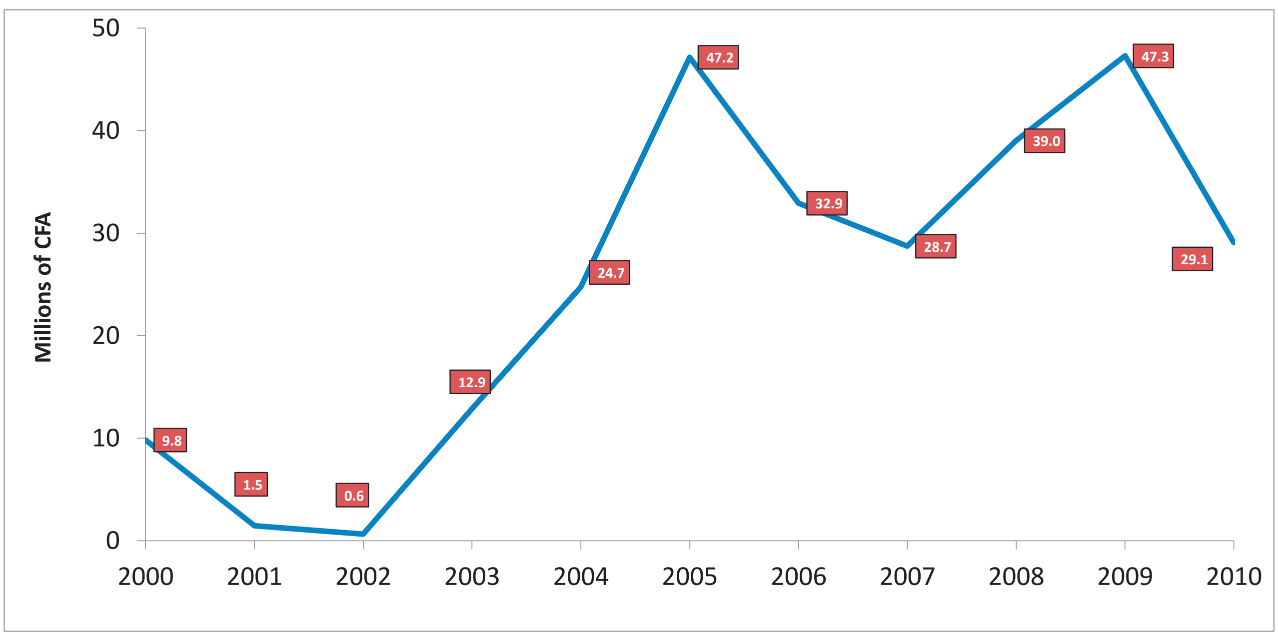

Figure 10.3: Evolution of funds (in million CFA) of 6 Committees for the Valorization of Wildlife Resources (COVAREF) in south-east Cameroon from 2000 to 2010.

Source: WWF, non published

Funds derived from the activities of COVAREF were used to implement key community investments. For example, over this period, communities benefited from more than 200 micro-community projects valued at close to $ 632 000 in the health, education, and water domains (Defo and Tchamba, 2012). According to Eyebe *et al.* (2011), most of the funds were tailored to the development of social infrastructure like classrooms or healthcare centers. Between 2000 and 2004, activities of 16 ZICGCs (exploitation "*en affermage*") in south-eastern Cameroon generated about CFA 43 000 000 ($ 86 000).

Photo 10.8: Signs of erosion and obstruction of valley floor from the construction of a forest road, Gabon

In the CAR, the PGTCV project managed wildlife within the framework of village territories ("*terroirs villageois*") and with funding from the French Fund for World Environment (FFEM) through the Conservation and Sustainable Use of the Central Africa Forest Program (ECOFAC). PGTCV has supported rural communities to sustainably manage wildlife through management and harvesting of unprotected mammalian wildlife (e.g blue duiker) that were mainly sold in urban areas or for domestic use. Because their biological and ecological characteristics favor rapid reproduction, in some villages in Central African Republic, villagers found it profitable to hunt such species. However, as previously discussed, village chieftainships often control the access to and exploitation of these wildlife resources.

For about 15 years now, the *zones cynégétiques villageoises* (ZCV) from the CAR have ensured the redistribution of hunting taxes to populations and villages whose territories are located within the boundaries of the safari hunting zones. These funds are used to construct social amenities like roads, bridges and resting camps, as well as for the maintenance of current infrastructure, which helps to create local employment. In short, the ZCV have helped maintain the safari hunting industry in the north-central region of the CAR despite numerous political upheavals. This has also helped reduce poaching at the local level and resulted in the protection of large mammals like buffaloes and Derby eland.

However, although this is a positive step, these resources are inadequate when compared to the generalized and widespread poverty in rural areas in south-eastern Cameroon and the CAR. The designation of community hunting zones is not a panacea, because it is plagued with numerous biological and human problems. For example, it is very difficult for communities to manage hunting zones which are smaller than the size of their village because some animals like elephants will always migrate out of the village hunting zones. It is equally difficult to manage migratory species on one particular village territory, because these species require habitats that span across several village territories and concessions which are not controlled by the villagers. Additionally, large mammals like elephants are difficult for villagers to manage. Accordingly, these species require collaborative management between several entities. However, even where there is collaboration, villagers are often not in favor of conserving elephants close to their farms because they can destroy agricultural crops. Although the economic, health and conservation impacts of the human-elephant conflict are known, the social impact depends on the capacity of communities to support the presence of these flagship species and to accept some degree of conflict (Woodroffe *et al.*, 2005). On numerous occasions, the Central African Forest Commission (COMIFAC) has concluded that it is necessary to develop strategic and operational approaches to reduce these conflicts, especially because field experiences have shown that human communities still remain hostile to the outcome of this conflict (FAO, 2012b).

The above analysis has generated the following lessons learned and recommendations. Although communities and other development and conservation partners are not yet satisfied with the socio-economic results attained, the decentralization of the management of wildlife resources in south-eastern Cameroon and the CAR has contributed to local development (e.g. employment, tourism infrastructures, etc.) However, the process has revealed several impediments, like the lack of a viable and consistent legal and regulatory framework to promote good environmental governance at all levels and the insufficient capacity of local communities to effectively manage this activity. If these shortcomings are addressed, we believe that good and effective management of community hunting zones is possible. It is also necessary for communities to elaborate rules to determine access rights to all sites, especially to vulnerable sites (e.g. endangered habitats, protected species, etc.), because without consistent rules powerful members of the community might be able to exploit those resources illegally and illegitimately. Management of resources could be done with the help of village Committees who would be able to monitor them with the help of a local monitoring mechanism, and this would require the development and transfer of an adaptable local monitoring system which will in turn strengthen the political dialogue both at the micro and macro levels. Also, before any community-hunting zone is established, a zoning system based on indigenous land use practices should be adopted, because this would strengthen local authority, build capacity of local and indigenous actors and create more incentives to better manage their territory. However, land use planning is a tricky process, and it should be participatory and formalized with a management plan. Finally, it is important for conservation and development actors to help villagers elaborate and implement long and short-term local socio-economic development and conservation plans, which define criteria for employment and outline strategies to address widespread immigration by outsiders.

In working with communities which historically hunted in an area, understanding the cultural foundations of their previous or current hunting management will be key to successfully engaging with the community. Ethnographic studies on current and past hunting in the area and establishing long-term relationships with communities will help build an understanding of how communities manage and perceive wildlife and will be important for developing any community based wildlife management programs. Capitalizing on existing wildlife management techniques or monitoring efforts would probably be welcome by communities.

Photo 10.9: An area devoted to traditional religious rites in a rural setting

Also, it is necessary to push for research on wildlife in community and safari hunting zones which are not well known (especially their biological and socio-economic traits). As discussed earlier, well managed community-hunting zones could be instrumental in the sustainable management of key wildlife species and also support local development. The government should continue to create economic, social and cultural incentives to enable villagers to fully participate in the management of wildlife and avoid conflict with conservation bodies. This innovative approach will help to ensure that national wildlife management policies, legislation and funding go towards the conservation of wildlife within community hunting zones and not just towards protected species, as is the case today.

Photo 10.10: Transporting of goods and people on a traditional raft – Lindi River, DRC

2.4.4 Agro-industrial development and local populations: new oil palm plantations and tools for transparent management

Investments in oil palm plantations have substantially increased since 2000 in Central African countries, either in new plantations or by rehabilitating and extending existing plantations. Agro-industries like the Cameroon Development Cooperation (CDC) and the *Société Camerounaise des Palmeraies (*SOCAPALM) in Cameroon, the *Société d'Investissement pour l'Agriculture Tropicale* (SIAT) in Gabon, and Brabanta in the DRC have undertaken reforms to expand and improve the management of their plantations in order to increase yields. Concomitantly, new agro-industrial plantations are being established (e.g. SG Sustainable Oils Cameroon PLC (SGSOC) with Herakles Farms in Cameroon, Olam in Gabon, Atama in Congo and PHC in the DRC), and feasibility studies are underway for new plantations (SIVA and GMG in Cameroon, ENI-Congo and Fri-El-Green in Congo). About 870 000 ha of industrial plantations are currently being exploited in the region, and more than 260 000 ha are being considered for the creation of new plantations or the extension of old ones (Feintrenie, 2013). For example, it is projected that Olam, an Indo-Singaporean company, in Gabon will have an oil palm plantation of 100 000 ha which would be divided in 2 sites (Mouila and Kango) while in the Republic of Congo, Atama, a Malaysian company, leased a surface area of 470 000 ha in 2010, on which 180 000 ha will be planted with oil palms. These agro-industries have both positive and negative impacts on the livelihoods of rural dwellers.

Most of these companies are attempting to align their activities with the appropriate legal and political procedures. For example, Atama has respected the legal procedures necessary to acquire and manage agro-industrial concessions in Congo, including following a 2-year process required before the government can grant an authorization to occupy state land for a 25-year renewable period (Feintrenie, 2013). This process included conducting an Environmental and Social Impact Assessments (ESIA) and gaining (FPIC) from the local communities, after what an Environmental and Social Management Plan (ESMP) was submitted to the public authorities. Similarly, before acquiring the authorization to lease government lands for oil palm plantations, Olam-Gabon underwent the following Roundtable on Sustainable Palm Oil (RSPO) model:

1. The government accepted, in principle, to lease a concession to Olam;

2. Olam consulted with potentially affected communities and determined the effect the plantation projects would have and then signed a FPIC in each village;

3. Olam excluded zones where FPIC were refused by the population;

4. Olam carried out an ESIA;

5. High Conservation Value (HCV) zones, where environmental impacts of the project would be negative, were left out of the concession.

As a result of this process, plantations were reduced from 20 000 ha to 7 300 ha in Kango, 38 000 ha to 15 000 ha in Bitam, and 51 000 ha to 7 000 ha in Mouila from what the government initially allocated to the enterprise (Feintrenie, 2013). The goal of this process is to make sure the socio-economic and cultural rights of the rural population are protected and the environmental impact of the plantations limited to a minimum. Olam-Gabon should benefit in the future from new proposals of land allocation by the State, in order to get to the 100 000 ha of oil palm plantation.

Olam-Gabon which has been present in Gabon since 1999, has opted to partner directly with the Gabonese Government to avoid any legal or administrative hurdles. Olam-Gabon oil palm plantations are under a public-private joint-venture, where Olam International holds about 70 % of the capital and the Gabonese State holds about 30 %, whereas rubber plantations are shared between 80 % to Olam international and 20 % to the Gabonese State. The State's contribution is mainly in the form of allocating forest concessions (the exploitation of timber accounts for about 40 % of Olam's activities in Gabon), land concessions for rubber and oil palm plantations (300 000 ha of emphyteutic lease, which is long lease), and tax exoneration (TVA, import-export taxes, etc.). Olam is expected to construct a fertilizer manufacturing facility (ammonia based) under a joint-venture with the Tata Chemicals Groups (25 %), the Gabonese Government (12 %) and Olam-International (60 %). This will create employment, facilitate the transfer of technology, and foster local development. With its sizable investment, notably in agro-industry and the exploitation of timber, as of 2016 Olam will become the second largest private employer in Gabon, with more than 19 000 employees estimated in 2020 and a capital investment of $ 2.5 billion estimated between 2011 and 2022. This sizable investment explains why Olam is an important partner for the Gabonese State in their national strategy for an "emerging Gabon", in which they will intervene in two of the three components the "Green Gabon" and "Industrial Gabon" (Feintrenie, 2013).

Photo 10.11: Eucalyptus fuelwood collection – Pointe Noire, Congo

Similarly, Atama's Development Plan projects that it will finish planting oil palm and complete the occupation of the concession in 40 years, with the creation of between 3 000 to 5 000 ha/year. The contract includes numerous social and local development clauses. For example, the company will establish life-camps in each zone of 36 000 ha (5 zones), with the goal that life-camps will evolve into villages for company employees, with schools, health centers, stores, religious buildings (at least a church and a mosque), and other amenities. The company plans to employ about 27 000 people once fully grown. As a consequence the density of population will increase in the area, from less than 2 inhabitants/km^2 in 2012 to about 18 inhabitants/km^2 in 2060 (Feintrenie, 2013). This population growth will induce an increased pressure on forest-land to produce food crops, and an increase pressure on wildlife for bush meat. These impacts on the environment have been estimated in the ESIA, however the implementation of an Environmental and Social Management Plan (ESMP) is needed to ensure actions are taken to limit these impacts (e.g. planning of food and meat supply to the village markets). Olam-Gabon's plantations will have the same local impact of increased population and increased pressure on forest lands and wildlife.

A good planning of such large scale projects, following clear procedures, will limit negative outcomes and enhance positive results for local livelihoods and national economies. FPIC, if conducted scrupulously with full information provided to the affected population and actual negotiations on the engagements of the enterprise, might be a guarantee against land grab, and might enhance good partnership and economic benefits for all the stakeholders. Transparency of deals and negotiations are keys to success. Where FPIC and ESIA are not conducted in a transparent way, or not done at all, social conflicts might rise in answer to a feeling of unfair contracts, or land grabbing, or a complete refusal of the project by the local people (Feintrenie, 2013). This is the case in South-West Cameroon, where the American enterprise SG-SOC has a project of oil palm plantation, the Herakles Farms. The enterprise signed a convention in 2009 with the Minister of Economy Planning and Regional Development to develop an oil palm plantation on about 70 000 ha. But this convention has not been accompanied by a transparent discussion with the other public institutions involved (for example the Ministries of Forest and Agriculture), or with the villages impacted by the project. The lack of transparency raised a lot of complaints from local villagers, national and international NGOs and resulted in a complaint to the RSPO and Herakles withdrawal from the organisation. It is still unclear at the beginning of 2013, what is the operational plan of SG-SOC, how much land will be planted in oil palm, what will be the compensations and benefits for the local population, and what is the State's position regarding the project?

Photo 10.12: Artisanal logging – Maniema, DRC

2.4.5 Protected Areas

In Central Africa, protected areas (PAs) provide an important land use option which has the potential to both deliver conservation results and support sustainable development and poverty alleviation (Angu, 2012).

However, each of the IUCN PA categories has specific management objectives and goals which in turn have implications for local communities. Rural communities are often at odds with PA managers because they lack understanding of how these PAs could contribute to local development and rural conservation objectives. Evidence from some national parks (e.g. Dja, Volcanoes) demonstrates that consistent and open dialogue with rural society in PA management has helped reduce conflicts with other actors, boosted conservation dynamics and increased local development (IUCN, 2004). Also, some research has facilitated the integration of local knowledge into the PA management efforts.

However, while PAs have contributed greatly to the conservation of important species, there are some operational difficulties that make it difficult to involve rural communities. Some communities view protected areas as zones expropriated from them by the government or other actors like conservation NGOs without compensation. Successful PA management depends on the manager, context, place, time and people, and putting rural communities' needs first is important (Mauvais, 2010). Because of the multiple and conflicting interests in PAs, a management approach that takes the various interests groups is needed. For example, we have seen in the early 2000s that the Consultation Forum of Actors involved in conservation and development in and around the Conkouati Douli, the Dja, the Kahuzi-Biega and Volcano National Parks respectively in Congo, Cameroon, the DRC and Rwanda created great impact among rural communities, PA managers and extractive industries, because partners, especially local government authorities, gradually moved from the command and control strategy to consultation. Before this, some local populations hardly knew (or saw) the national park conservators who, at times, lived in distant cities instead of the national parks. Unfortunately, these forums came to an abrupt end because of a lack of funds. Also, experiences in Lobeke, Nki and Boumba Bek National Parks in South-East Cameroon have shown that utilizing the landscape approach to PA management can help take into account various interest groups, including rural communities. As part of the landscape approach, community-based natural resource management (CBNRM) zones have been created adjacent to PAs to facilitate local participation in livelihood activities and conservation. These livelihoods activities help to gain support of the local population in the conservation of these PAs. Normally, the peripheries of these PAs are characterized by two community land use zones : community forests and community hunting zones. Conservation activities in the national parks are influenced by activities in these zones. In other words, the management structure of these zones directly and indirectly affects local development and conservation through the amelioration of sustainable livelihoods. In Gabon, *Comités Communautaires de Gestion Locale* are being created in the buffer zones around the national parks, in part to encourage dialogue with the local people about resource management in the buffer zone ; choices about which communities to involve and at what distance to the park will be critical for the successful and meaningful engagement. It should be noted that this is consistent with the landscape approach, which posits that PAs cannot be managed as isolated entities because they exist within a broader context of larger functioning ecological systems which integrate the CBNRM zones and the Extractive Resource zones (Angu, 2012).

In order to facilitate buy-in from rural communities in the sustainable management of PAs, we should consider the following recommendations and lessons learned :

First, local populations will only be comfortable with PA management if PA managers fully integrate local socio-cultural and economic priorities into the on-going biophysical conservation strategy, because very few communities will participate in community conservation efforts that do not promote local development and their general wellbeing. It is therefore important to make sure that these areas are managed in a participatory and transparent way from the beginning of the process.

Second, field experiences have shown that since PAs do not exist in isolation, a multiple land use approach should be encouraged, especially an approach that recognizes the dual role of rural communities in participating in the sustainable management of PAs to deliver conservation results and creating and managing zones adjacent to those PAs. This would help to legitimize the communities' actions, create buy-in and foster local development. However, if these communities do not have the markets to sell their services to visitors (e.g. ecotourism) or their products (community zones), these efforts may be fruitless. Without this, and despite all the efforts of PA managers, it will be very difficult for communities to understand the real value of conserving biodiversity especially because the value is not only monetary or economic but also intangible (Kamanda *et al.*, 2003).

Third, because some communities think that some stakeholders purposefully want to control and exploit them (e.g. village elites who live in towns and some decentralized government officials), they will likely welcome any short or long term training in the management of PAs and community zones adjacent to PAs. They believe that it is only through this that they will be the master of their own destinies within the framework of collaborative management where all actors are respected and empowered to make meaningful decisions regarding the management of the PA.

Finally, because most communities do not fully exploit the resources in the community forests or hunting zones adjacent to the PAs, they are often discouraged by the lack of results from exploitation. However, if PA managers could develop innovative strategies to utilize the full potential of the various components of rural communities vis-à-vis available natural resources (e.g. gender and the exploitation of non-timber forest products or education of youth to facilitate ecotourism and fishery) perhaps this would facilitate the involvement of rural population and the generation of additional income.

Photo 10.13 : Fabricating roofing from palm leaves – Congo

3. Conclusions and perspectives

Photo 10.14 : A traditional stove

In most of these cases, we have noticed that forestry, agro-industry and other development interventions have had negative consequences on the land use patterns of the poor and less privileged villagers and their livelihoods. The land use pattern of non-natives (e.g. the Pygmy groups and migrants) often depends on their ability to negotiate access to the land and forest resources with the customary chief and the head of families or clans. These groups of villagers are also excluded from the benefits of forestry interventions, because the ability of a villager to engage in and derive benefits from development interventions often depends on the power resources of the villager. Therefore, the inequality in material resources among the villagers tends to increase the livelihoods of the wealthy and educated villagers while the poor and less privileged villagers continue to live in poverty.

Also, the results demonstrated that most of the land use patterns in our area of interest are determined by ethnicity and the power resource of the villager. The high degree of social differentiation and ethnic inequality reproduce inequalities in power, status and wealth (Fraser, 1997), and these differences influence how villagers engage in and perceive interventions to improve their livelihoods (Gaventa, 2002 ; Cornwall, 2002) and ensure conservation. Many conditions have propagated these inequalities. First, property rights to land and forest resources are determined by ethnic identity and ancestral claims ; those without ancestral claims do not have direct access to land and forests and are excluded from any benefits generated from the investment in the land and forest resources (forestry intervention). Second, many villages have a high degree of social differentiation where high social status controls

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Photo 10.15: Fishing camp on the Lukenie River

all the material resources from the interventions, and this has negative consequence on the livelihoods of the poor and less privileged villagers (Pygmies and women).

Also, the inequality in power and resources in some communities has resulted in ineffective collective action and narrows the livelihoods opportunities gained from these interventions for the poor and less privileged villagers. This is in contrast with the design principles for common pool resource management (Ostrom, 1990) that advocate for a more robust and democratic structure for managing common resources. This inequality in power and resources have generated "free rider" behavior (Olson, 1965 ; Eggertson, 1990), as the committee members tend to ignore the common interests of the village and focus on their private interests in these interventions. This inequality in power and resources is partly due to lack of trust (Bourdieu, 1977 ; Putnam, 1993), and the notion of ethnic identity which is very common in these villages.

This notion has fragmented the villages into family or ideological lines, making it difficult to produce true collective effort. It is therefore imperative that policy makers take a "people-centered approach" to their conservation and development endeavors because communities are increasingly demanding improved livelihoods to facilitate their involvement in conservation projects. In other words, a conservation and development approach that favors local development as perceived by local actors and not development as perceived by outsiders or strangers is needed. It is now obsolete for conservationists to think that successful conservation means excluding humans from "pristine" ecosystems void of any human contact. After all, it is increasingly becoming clear that the causes of deforestation and forest degradation are found outside of the forest. For example, local populations encroach in PAs either because they lack sustainable livelihood options in their villages or lack employment in the management of PAs or other extractive resource zones (Angu, 2012).

In short, local communities make decisions on land use for the following practical reasons :

- Local communities heavily depend on natural resources for their livelihoods. For example, wildlife is their source of protein, they need to cultivate land to maximize or complement food production, they need formal employment (forest and mining concessions) to support their families (schools, healthcare, etc.) ;
- Local community members can become conservation participants if they perceive sustainable management of natural resources as a pathway to local development and not exclusionary ;
- Governance structures should be reinforced, because key governance reforms are either not implemented or are falsely interpreted

by some central government authorities for egoistic reasons.

Also, substantial governance reforms should be initiated to cope with emerging themes like extractive industries, climate change and REDD+. It is clear that no conservation projects or even land use methods would be successful if indigenous and local communities are not only involved in the system, but that their conservation efforts are actually leading to improved living standards. Without this, there will be little or no buy-in from local and indigenous communities. For example, we have seen cases where communities either support poaching (or suddenly became poachers) or illegal logging if they are disgruntled with the system. Policy and legislative frameworks are the bedrock or any socio-cultural and political system because they help control and maintain the structure, facilitate cohesion among actors, reduce conflicts, and above all, promote the effective management of natural resources (Angu, 2010). This is why it is important to reform our natural resource policy, judicial and legislative frameworks because field experience has shown that, albeit some laudable efforts, they are increasingly archaic, having been designed under different conditions two or three decades ago. Even those that were revisited in the early 2000s (the DRC, etc.) are experiencing some practical difficulties coping with emerging themes like climate change, REDD+, payment for ecosystem services (PES), mining, etc. Yet if incorporating these newly emerging themes cannot reconcile conservation and sustainable development, especially at the local level, most local communities will continue to perceive conservation projects as fare-fetched ideas conceived, developed and implemented to benefit outsiders. After all, this is why it is generally said that Central Africa is so rich in natural resources but so poor in terms of local and national development (CEFDHAC, 2007). We strongly believe that this paradox will be solved by effectively implementing land use policies and systems that comprehensively address the interests and needs of all resource users, but especially the needs of rural communities. This is a must, if the globally important natural resources of Central Africa will meet the needs of future generations.

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ANNEXES

ANNEX 1A : Annual deforestation rates (gross and net) of Central African rainforests between 1990 and 2000, and between 2000 and 2010* (with standard error bar).

		1990 – 2000			2000 - 2010		
Country	n	Gross deforestation	Gross Reforestation	Net Deforestation	Gross defores-tation	Gross Reforestation	Net Deforestation
Cameroon	45	0.13% (0.04%)	0.04% (0.01%)	0.09% (0.04%)	0.08% (0.03%)	0.02% (0.01%)	0.06% (0.04%)
Congo	65	0.09% (0.02%)	0.03% (0.01%)	0.05% (0.02%)	0.07% (0.02%)	0.00% (0.00%)	0.07% (0.02%)
Gabon	63	0.07% (0.02%)	0.02% (0.00%)	0.05% (0.02%)	0.03% (0.01%)	0.01% (0.00%)	0.01% (0.01%)
Eq. Guinea,	7	0.13% (0.08%)	0.10% (0.06%)	0.03% (0.07%)	0.04% (0.03%)	0.05% (0.03%)	-0.01% (0.02%)
CAR	26	0.11% (0.03%)	0.03% (0.01%)	0.09% (0.03%)	0.06% (0.02%)	0.01% (0.00%)	0.05% (0.02%)
DRC	114	0.24% (0.05%)	0.03% (0.01%)	0.22% (0.04%)	0.20% (0.04%)	0.00% (0.00%)	0.19% (0.04%)
Humid Forests	171	0.19% (0.03%)	0.03% (0.01%)	0.16% (0.03%)	0.14% (0.03%)	0.00% (0.00%)	0.14% (0.03%)

*Preliminary results

Sources: UCL (1990-2000) and JRC (2000-2010))

ANNEX 1B : Annual deforestation rates (gross and net) of Central African dry forests between 1990 and 2000, and between 2000 and 2010* (with standard error bar).

		1990 – 2000			2000 - 2010		
Country	n	Gross deforestation	Gross Reforestation	Net Deforestation	Gross deforestation	Gross Reforestation	Net Deforestation
Cameroon	17	0.23% (0.10%)	0.02% (0.02%)	0.21% (0.10%)	0.10% (0.05%)	0.00% (0.00%)	0.10% (0.05%)
CAR	41	0.17% (0.06%)	0.06% (0.02%)	0.11% (0.06%)	0.39% (0.19%)	0.00% (0.00%)	0.39% (0.19%)
Chad	108	0.81% (0.50%)	0.61% (0.32%)	0.20% (0.46%)	0.57% (0.27%)	0.09% (0.09%)	0.49% (0.23%)
DRC	62	0.42% (0.10%)	0.15% (0.09%)	0.27% (0.12%)	0.47% (0.16%)	0.03% (0.02%)	0.44% (0.16%)
Dry Forests	228	0.36% (0.07%)	0.14% (0.06%)	0.22% (0.08%)	0.42% (0.11%)	0.03% (0.01%)	0.39% (0.11%)

*Preliminary results

Source : JRC

ANNEX 2 : Assessment of projected climate change signals: overview of number of projections used under five climate models and high and low emission scenarios.

	CMIP3	CMIP5	WATCH	RCMs	ALL
"HIGH" scenario	14	10	3	4	31
"LOW" scenario	16	20	3	7	46
Both scenarios	30	30	6	11	77
Detail of the analysed subensembles.	*Models : Projections of 14 (HIGH)/16(LOW) different global models from the CMIP3-ensemble have been included *Scenarios: SRES A2 (HIGH); SRES B2 (LOW) *Analysed data: Daily data available for periods 1961-1990, 2046-2065 and 2081-2100 on the original global model grids.	*Models : Projections of 8 different global models (r1li1p1-realisation) from the CMIP5-ensemble have been included in both scenario groups. For the MPI-ESM also the r2i1p1 realisations have been used. *Scenarios: RCP 8.5 (HIGH); RCP 4.5 and RCP 2.6 (LOW) *Analysed data: Daily data available for periods 1961-1990, 2036-2065 and 2071-2100 on the original global model grids. .	*Models :.Bias corrected projections of 3 different GCMs (CNCM3 ; ECHAM5 ; IPSL). The uncorrected projections of all models are part of the CMIP3-ensemble. *Scenarios: SRES A2 (HIGH); SRES B2 (LOW) *Analysed Data: Daily data available for periods 1961-1990, 2036-2065 and 2071-2100 on a regular 0.5 degree global model grids.	*Models : Projections of 2 RCMs (REMO and RCA) each forcedwith output of two GCMs of the CMIP5-ensemble (MPI-ESM ; EC-EARTH) have been included in both groups. *Scenarios: RCP 8.5 (HIGH); RCP 4.5 and RCP 2.6 (LOW). Note that for RCP 2.6 only the RCA-EC-EARTH projection was available in addition to the two REMO projections. Analysed Data: Daily data available for periods 1961-1990, 2036-2065 and 2071-2100 on the CORDEX-Africa domain with horizontal resolution of 0.44 degree.	

CMIP 3 : Coupled Model Intercomparision Project no. 3 of the World Climate Research Program (WCRP) – Several Global Climate Models (**GCMs**) has been run in this project. Climate simulations of the CMIP3 project are the data base of the 4th Assessment Report of the IPCC.

CMIP 5 : Coupled Model Intercomparision Project no 5 of the World Climate Research Program (WCRP) – Several Global Climate Models (**GCMs**) has been run in this project. Climate simulations of the CMIP3 project are the data base of the 5th Assessment Report of the IPCC.

r1i1p1 and **r2i1p1** is the ensemble identifier of a set of simulations each of the global climate models (**GCMs**) had to do within in the **CMIP5** project

ECHAM5; IPSL; CNCM3; MPI_ESM, EC-EARTH are names of global climate models (**GCMs**) which have been used among others in the **CMIP3** and **CMIP5** projects, respectively.

SRES: Special Report on Emission Scenarios – the **SRES** scenarios define the greenhouse gas emission pathways for the **CMIP3** simulations and therefore the base for the 4th Assessment Report of the IPCC. Altogether 4 different scenario groups are available – **SRES A2** defines a high emission scenario; **SRES B2** defines a low emission scenario;

RCPs: Representative concentration pathways – the **RCP** scenarios define the greenhouse gas emission pathways for the **CMIP5** simulations and therefore the base for the 5th Assessment Report of the IPCC. Altogether 4 different scenario groups are available – **RCP 8.5** defines a high emission scenario; **RCP 4.5** a medium to low emission scenario and **RCP 2.6** defines a low emission scenario.

More information on the emission scenarios can be found in chapter 3.2 of the final report of the project "Climate Change Scenarios for the Confo basin": (http://www.climate-service-center.de/imperia/md/content/csc/kongo/raport-final_francais_scenarios-des-changements-climatiques.pdf)

CORDEX is the coordinated regional climate downscaling experiment. In this initiative global climate model (**GCM**) simulations are spatially refined over almost all inhabited regions of the world by using different regional climate models (**RCMs**).

REMO and **RCA** are names of regional climate models which have been used among others in the **CORDEX** initiative. **RCA-EC-EARTH** defines a simulation with the regional climate model (**RCM**) named **RCA** using data of the global climate model (**GCM**) named **EC-EARTH**

ANNEX 3 : Characteristic ligneous species of plant formations in forest areas other than dense rainforest

Characteristic ligneous species	I (*)	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
Anogeissus leiocarpus		++				+	++	+							
Abizia zygia		++					++								
Marquesia macroura,			++												
M. acuminata,			++												
Berlinia giorgii,			++												
Lannea antiscorbutica,			++												
Daniellia alsteeniana,			++												
Brachystegia spiciformis,			++		++										
B. wangermeeana			++		++										
Parinari curatellifolia			++												
Isoberlinia doka				++	+										
Monotes kerstingii				++											
Uapaca togoensis				++											
Terminalia laxiflora				+		++									
Grewia mollis				+		++									
Combretum hypopilinum				+		++									
Burkea lophira				+		++									
Daniellia oliveri				+		++	++								
Julbernardia					++										
Burkea africana,							+	++							
Lophira lanceolata							+	++							
Terminalia glaucescens.							+	++							
Butyrospermum parkii							++								
Balanites aegyptiaca								+	+	++					
Tamarindus indica							+								
Guiera senegalensis								++							
Ziziphus spp								+							
Sclerocarya birrea,								+							
Hyphaene thebaïca								+	+	++					
Calotropis procera									+	++					
Acacia seyal								+	+	++					
Piliogstigma reticulata								+	++	+					
Combretum glutinosum									+	++					
Guiera senegalensis									+	++					
Adansonia digitata							+								
Acacia spp										++					
Maerua crassifolia,										++					
Salvadora persica										++					
Acacia senegal									+	++					
Boscia senegalensis										++					
Cadaba farinosa										++					
Xeromphis nilotica										++					
Bauhinia rufescens										++					
Acacia polyacantha									++						
Dichrostachys cinerea											++				
Jasminum spp											++				
Euphorbia poissoni												++			
E. kamerunica												++			
Apodytes dimidiata													++		

Characteristic ligneous species	**I** (*)	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**XIII**	**XIV**	**XV**
Halleria lucida													++		
Ilex mitis													++		
Kiggelaria africana													++		
Nuxia congesta, N. floribunda													++		
Ocotea bullata (including O. *kenyensis),*													++		
Podocarpusfalcatus (including *P. gracilior), P. latifolius,*													++		
Prunus africana,													++		
Rapanea melanophloeos s.l.													++		
Xymalos monospora													++		
Blaeria														++	+
Erica														++	+
Philippia														++	+
Vaccinium														++	+

(*) The ligneous species of the peri-forest savannas are those of the neighboring Guineo-Congolese forest.

I Peri-forest or integrated savannas
II Dense dry forests in the Sudano-Guinean zone
III Dense dry forests in the Guinean- Congolese/Zambezian transition zone
IV Clear forests in the Sudanese region
V Clear "miombo"-type forests
VI Wooded savannas
VII Tree savannas (2)
VIII Shrub savannas (2)
IX Tree steppes
X Shrub steppes
XI Bushy steppes
XII Succulent steppes
XIII Undifferentiated Afro-mountainous forest
XIV Bushy formation and Afro-mountainous evergreen thickets
XV Afro-mountainous shrub formation

(**) Tree savannas and shrub savannas of the Sudano-Sahelian and Sahelo- Sudanese zone.

ANNEX 4 : Enrichment of felling gaps in a productive forest

Title	*Contacts*
Enrichment of felling gaps in a productive forest in Central Africa	Kasso Daïno Jean-Louis Doucet
Organization	***Country***
Gembloux Agro-Bio Tech, Belgium	Gabon, Cameroon

Context and objective

Throughout Central Africa, the natural stocks of numerous commercial rainforest species appear to decline after the first felling in the absence of management techniques. The enrichment of production forests is aimed at maintaining a good density of these species.

Effective actions

A management technique has been used in various forest concessions in Cameroon and Gabon. Briefly, it consists of: (1) georeferencing the forest clearings aged between 4 and 6 months, a sufficient time-lag for seed germination in the soil seedbank; (2) clearing non-commercial forest regrowth species and planting high-value sapling species which have been produced and grown in nurseries; (3) cutting back competing vegetation in the enriched clearings for two years (maintenance).

Results

This enrichment technique has proven effective. Evaluations made after 2 to 2.5 years show that the assamela, pao rosa, iroko and the moabi are the species which perform best in the semi-evergreen forests in Cameroon and the okoumé and the padouk are those who adapt best to clearings in Gabon.

Impacts, lessons and prospects

Choosing a forest clearing for enrichment depends on the characteristics of the individual forest clearing, the characteristics and behavior of the species to be introduced and the local wildlife that are likely to affect the development of the species in question. As of mid-2013, logging companies in Central Africa were regularly practicing the enrichment of logged clearings. The enrichment of forest clearings supported by forest certification guarantees is both an ecological and cost-effective means of maintaining an abundance of commercial species and the economic role of the tropical forest.

ANNEX 5 : Enrichment of skidding tracks in *Marantaceae* forests

Title Enrichment of skidding tracks in *Marantaceae* forests	***Contacts*** Jean-François Gillet Jean-Louis Doucet
Organization Gembloux Agro-Bio Tech	***Country*** Congo

Context and objective

To develop forestry activity along skidding tracks where heavy machines have created a breach in the dense canopies of giant *Herbaceae*.

Effective actions

This forestry technique has been tested in the certified logging concessions of CIB/OLAM in the north of the Republic of Congo. It is implemented in the recently exploited annual felling quotas and comprises three stages : (1) delimitation, with the aid of GPS, of the *Marantaceae* pockets to be enriched ; (2) the systematic clearing of natural regeneration along skidding tracks, the elimination of competing vegetation and enrichment by planting saplings from nurseries ; (3) one year later, new thinning of all saplings introduced.

Results

Observation has shown that in zones with high wildlife densities the enriched pockets suffer substantial damage, leading to the mortality of about one-third of saplings after two years. When there is less pressure by large wildlife, the success rate is better with 75 % survival of healthy seedlings. With natural regeneration in the absence of wildlife pressure, the species that perform best are ayélé, essessang, limba, bilinga and tali ; in the case of planted species, ayous, padouk, afromosia and wengué fare best. These are all rapidly-growing commercial rainforest species.

Impacts, lessons and prospects

The forestry action proposed has been tested in a pilot project (Gillet, 2013). Before replicating the technique on a large scale, it must be validated by long-term study. The enrichment of the environment with commercial rainforest species would also make it possible to increase the capacity of sparse forest to restore atmospheric carbon.

ANNEX 6 : ECOmakala Project

Title	***Contacts***
ECOmakala project	Thierry Lusenge, Mone Van Geit Geert Lejeune
Organization	***Country***
WWF	DRC

Context and objective

In North Kivu, the most densely populated province of the DRC, over 90 % of the population depends on firewood for their energy needs. The forestry resources harvested legally are not sufficient to meet the needs of the population. Thus, almost all the forests near the city of Goma have been felled. The great majority of the wood supply currently comes from illegal felling carried out in the Virunga National Park.

The ECOmakala Project (EU, IFDC/DGIS, WWF ; 2007-2013) was intended to reforest 5 000 hectares lands belonging to small landowners (plots of 0.25 to 5 ha) on the edges of the Virunga National Park with their collaboration. The main objective of the project is the sustainable production of charcoal to supply the rural populations living near the city of Goma and the National Park.

***Effective action*s**

Since November 2007, 5 483 ha have been planted (and validated) in cooperation with over 5 000 farmer-planters (private landowners) and with the support of 63 local farmers' associations. The fuelwood needs of the city of Goma could be met by the planting of 19 000 to 24 000 ha of rapidly-growing species.

Results

Over the years, reforestation has achieved a genuine momentum. Participation in the project by both local associations and communities has been steadily increasing. There is also a strong knock-on effect : famers living next to ECOmakala famer-planters are undertaking new forestation of their own accord. This knock-on effect results from the good growth of the trees and the fact that the plantations are becoming increasingly visible in the landscape.

Impacts, lessons and prospects

Mobilizing small landowners is an effective approach. Although it is more complicated and costly than working with large landowners, this approach has a greater socio-economic impact. An effective and robust follow-up scheme is necessary to estimate the plantations' biomass and carbon storage. The vitality of the local associations is a crucial factor in the success of such projects, as is the strengthening of capacities (training).

The current challenge is to demonstrate that the marketing of charcoal (makala) can be economically viable, but since the planters have no control over the farmgate price, they derive little or no profit from it (break-even or zero-profit operation). It is mainly the market intermediaries who reap the profits. In order to improve the earnings of producers, therefore, more work must be done to group planters in a cooperative structure which will permit the marketing of makala at a remunerative price.

The reforestation done through the ECOmakala project and future planting must be incorporated in a REDD+ pilot project entitled " ECOmakala+ " which will ensure a coherent and integrated framework of several existing initiatives.

ANNEX 7 : ALPICAM : Research and development for sustainable management and the certification of ayous plantations

Title	*Contacts*
ALPICAM R&D Sylviculture strategy integrated in a perspective of sustainable management and certification of ayous plantations	Didier Bastin (Alpicam) Françoise Plancheron (ONFi)
Organization	***Country***
ALPICAM-GRUMCAM-STBK	Cameroon

Context and objective

Reafforestations in the forest-savanna contact zone are being carried out jointly by ALPICAM and its partner STBK in Cameroon's Batouri region. The ayous (*Triplochiton scleroxylon*) is the leading species in this afforestation project covering 1 000 ha of severely degraded grass and low-level scrub savannas.

Effective actions

A park containing ayous trees has been created in order to supply a nursery cuttings unit. The ayous cuttings are planted in association with teak (stumps) and *Acacia mangium*. The cultural role of these two accompanying species is to promote the shape and pruning of the ayous. The technical planting practice combines mechanical means (clearing, subsoiling, maintaining spaces between rows) with local manpower (planting in pots, hoeing and cutting of vines from seedlings).

Results achieved

Over 200 ha have been planted on two plantations. The nursery's production capacity has been increased to 25 000 ayous seedlings a year. This production should permit the development of full plantations in degraded forest zones in the UFAs in the south-east of Cameroon.

Impacts, lessons and perspectives

In Cameroon, the ALPICAM company (ALPI spa Group) has been engaged in a certification process for several years. It obtained the OLB legality certificate and a CoC FSC traceability certificate in 2009 for all its forest concessions and processing units in Kika, Mindourou and Douala. It is currently pursuing its efforts towards FSC certification. The company has confirmed its desire to proceed further with sustainable management through the creation, in November 2009, of a "Research and Development in Forestry Service" attached to its Management and Certification Unit which was set up in 2006.

This R&D program, implemented with the permanent technical assistance of ONFi, comprises several areas of the natural forest. At the same time, the work being done should permit the creation of an ayous plantation in the savanna zone. Ayous is widely used in wood veneer factories in Cameroon.

This project, which is being undertaken in the context of the Clean Development Mechanism received the "no-objection letter" on 17 March 2009 from the national compliance authority (MINEP). In the long term, this sustainably managed ayous plantation will enable the two partner companies to limit the need for new forest land to supply their industries.

ANNEX 8 : The *Acacia senegal* plantations in Northern Cameroon

Title	***Contacts***
The *Acacia senegal* plantations in Northern Cameroon	Régis Peltier
Organization	***Country***
CIRAD	Cameroon

Context and objective

The Cameroonian development organizations, notably Sodécoton, through the "Peasant development and land management (DPGT)" and "Water, soil and trees (ESA)" projects encouraged the planting of *Acacia senegal* between 1990 and 2006 by the farmers whom they were training. The purposes of these plantations were to restore the fertility of soils degraded by constant crop-growing and to produce gum arabic.

Effective actions

The areas planted annually grew rapidly between 1999 and 2003 and then diminished. In 2009, despite about 700 ha of successful gum tree plantations (SODECOTON-DPA/ESA, 2006), most of these plantations were poorly maintained and above all showed no signs of tap-holes for the gathering of gum.

Results

The felling of 15-year plantations has on average produced 39.6 m^3/ha of useful fresh wood, whose sale as firewood has earned 1 090 €/ha. Over the duration of the plantation, these earnings have been higher than those of gum arabic, which are estimated at 760 €/ha. Crops have been grown after felling of the trees, and maize production (first year) and cotton (second year) are over two times higher than controls in plots that have not been reforested. Being aware of the multifunctionality of this tree (wood, gum, fertility, honey, fodder), many farmers in the Bénoué region (between Garoua and Lagdo) now prefer it to *Eucalyptus camaldulensis*, which nevertheless produces more wood. This species remains reserved for the production of poles, in 4x4 m plantations, treated in a regular coppice with rotation every 4-6 years. These eucalyptus plantations occupy about 100 ha around the towns of Maroua, Garoua and Ngong.

Impacts, lessons and prospects

These *Acacia senegal* plantations are very effective in restoring the fertility of farmland, but the creation of *Faidherbia albida* tree parks is another possibility for improving agricultural production. Since 1990, more than 1 million young *Faidherbia albida* trees were protected by the "assisted natural regeneration" method in the alluvial valleys in the far north of Cameroon around the town of Maroua through an initiative of IRAD and CIRAD with the support of the DPGT and ESA projects. Problems now arise with regard to the thinning and pruning of these parks because the agro-forestry species protection law prohibits all felling. It is hoped that the new Rural Code, currently in the approval process, will enable the farmers to benefit from this investment by producing firewood and forage.

ANNEX 9 : " Unilinear " sylviculture in high wet savannas : case of Western Cameroon

Title	***Contacts***
"Unilinear" sylviculture in high wet savannas: case of Western Cameroon	Raphaël Njoukam Régis Peltier
Organization	***Country***
CIRAD/IRAD	Cameroon

Context and objective

The high wet savannas of Cameroon are situated in the Western Administrative Region, which has a great diversity of landscapes. As a result of human activity, the old landscapes of dense semi-deciduous forest at medium altitudes, the peri-forest savanna and mountain formations have disappeared

Effective actions

In certain densely populated provinces (180-250 inhabitants/km^2), strong pressure on land and natural resources has existed for a long time. Farmers, in their constant search for timber and non-timber products, have integrated trees on their land, notably in the form of quickset hedges. These have evolved over the years, ranging from plantations with a mixture of several multi-use tree and shrub species, to a veritable " unilinear " and mono-specific sylviculture.

Results

Initially, the quickset hedges are fences consisting of green *Ficus sp* stakes planted very close together, most of which take root. In order to strengthen them, they are bound together horizontally by raffia palm ribs (" bamboos ") fixed by links made of bark also taken from much younger raffia leaves. Gradually, these hedges are enriched by other species whose principal uses are : vertical " filling " hedges, medicinal uses, occasional forage, fruits or edible leaves, timber, wood for everyday use or firewood, and the use of leaves as organic fertilizer. These hedges also serve to mark property limits. Other hedge systems also exist : *Eucalyptus sp* and *Pinus sp* hedges, *Polyscias fulva, Podocarpus latifolius ex milanjianus* or *Entandrophragma candollei* hedges.

Impacts, lessons and prospects

This peasant model of " unilinear " sylviculture, although developed on a small scale is sustainable and integrates well within the environment. The forestry authorities should, by creating incentives, support and encourage these efforts to integrate and manage timber products on the land. Unfortunately, the expansion of such initiatives is often impeded by laws which are unsuited to local situations or are misinterpreted.

ANNEX 10 : Recreating village forest areas

Title Village plantations for the reconstitution of forest	*Contacts* Emilien Dubiez emilien.dubiez@cirad.fr
Organization CIRAD/Makala project	*Country* DRC

Context and objective

Very strong pressure is being exerted on the forest areas of the basin which supply fuelwood to the city of Kinshasa. 120 km to the south of the capital near Kisantu (Bas Congo Province), there remain only fruit trees for the production of charcoal. In order to reconstitute multifunctional forest areas, therefore, it is essential to motivate the village communities and give them technical support and training.

Effective actions

The Makala project has supported endogenous groups (families) in preparing "simple management plans" (PSGs). The families are, in fact, the first beneficiaries and managers of wood as a resource. Seven PSGs have been prepared for seven areas in three villages (Kinduala, Kingunda and Kinkosi). In parallel, 27 tree nurseries have been set up in other villages near Kisantu. Over 60 000 trees have thus been planted in degraded land. Numerous local species have been used, including *Millettia laurentti, Maesopsis emini, Pentaclethra macrophylla, Terminalia superba, Ricinodendron heudelotii, Canarium schweinfurtii, etc.*

Results expected

The social communication and training provided under the project should enable the respective families to continue project activities in the long term, from nursery to reforestation. At the end of 2012, the PSGs prepared by the families were finalized, officially approved and marked by sign boards installed on the land indicating the management decisions reached. These PSGs should enable the families to independently pursue the development of their land and the rational management of their forest resources.

Impacts, lessons and prospects

The persons targeted must master all the technical stages, from the production of seedlings in nurseries to the maintenance of plantations. However, the communities have not yet completely mastered all the stages needed to develop and maintain plantations. The seedling survival rates of approximately 40 % demonstrate the need to continue support to the communities in order to assure the sustainability of their village plantations. The execution of the PSGs and compliance with the rules for the use of managed areas must be monitored with a view to more effectively integrate management principles into the community dynamic. The future of the natural and planted forest areas will be secured only when all the technical stages have been mastered.

ANNEX 11 : A private operator involved in the management of forest plantations in Gabon

Title	***Contacts :***
Management of forest plantations at Mvoum (Gabon)	Philippe MORTIER / Deputy Director pfm@lignafrica.com
Organization	***Country***
PFM (Mvoum Forest Plantation Company)	Gabon

Context and objective

In 2010, in order to support the industrialization policy instituted by the Head of State, the Ministry of Watercourses and Forests initiated a study on the revival of a reforestation program in Gabon. In this context, a private operator decided to associate himself with the State through the Deposit and Consignment Bank in order to rehabilitate and derive value from old okoumé forest plantations, which were poorly maintained and illegally exploited.

Progress of work end May 2013 :

- The preliminary studies to evaluate the resource have been completed and the PRM Management and Development Plan is being drafted ;
- The 19 km of rehabilitated tracks provide access to plantations which have reached maturity and will be exploited as from the second half of 2013 ;
- The personnel for the logging unit have been recruited and trained ;
- The documents to ensure the traceability and legality of the timber are available ;
- The commercial contacts have been made and supply contracts concluded ;
- The nurseries are operational : old greenhouses have been rehabilitated and the orders for plant material have been placed.

Results :

• The PFM company has been established and its structure is being set up ;
• The resource is known, and the division of the plantation into plots for the next three years has been established and is being put into effect on the ground.

Impacts, lessons and prospects

• Before the end of 2013, 100 or so people will be recruited in the area of the town of Ntoum ;
• The PFM company will have reached cruising speed by the end of 2013 or early 2014 ;
• The first sowing and cuttings were undertaken in nurseries in the first half of 2013 ;
• The first planting campaign will begin at the end of 2013 and in 2014. The species to be planted are : mainly teak and okoumé, and gmelina, Australian acacias, eucalyptus, etc. ;
• The first audits for certification purposes will be carried out in early 2014.

ANNEX 12: Data for Cameroon

Contribution of the forestry sector to the national economy

Economic data	2006	2007	2008	2009	2010	2011	2012
Contribution to GDP (%)							
Tax revenues (FCFA)			20 485 006 448	10 729 743 182	8 626 200 920	21 301 131 011	18 369 471 958
Direct employments (Nbr)	13 000				13 000		
Indirect employments (Nbr)	150 000						

Log production

Year	Volume (m³)
2006	2 296 254
2007	2 894 221
2008	2 166 364
2009	1 875 460
2010	2 348 150
2011*	2 440 605
2012*	2 437 300

**Validation workshop excluding*

Main timber species harvested in the formal sector (volume harvested in m³)

Species	2005	2006	2007	2008	2009	2010	2011*	2012*
Ayous/Obeché	656 655	799 820	684 560	756 311	480 360	688 465	642 667	633 426
Azobé/Bongossi	97 020	117 265	112 771	107 359	113 343	139 780	156 803	163 733
Dabéma					64 855	51 928		
Fraké/Limba	77 653	86 449	70 682	75 732	65 067	66 891	95 543	122 203
Ilomba	40 552					53 977	66 727	50 418
Iroko	84 669	89 658	89 324	79 632	80 741	95 786	77 940	88 567
Kosipo	41 315	45 367	43 751	46 151	35 267			43 717
Movingui	37 961	50 870	37 662				36 307	
Okan	40 618	87 762	61 683	67 859	118 819	106 605	117 908	132 266
African padauk		45 252	31 136	38 248	48 963	55 977	66 840	73 512
Sapelli	378 756	377 142	395 469	408 068	264 771	343 797	365 446	375 729
Sipo				30 901				
Tali	153 375	159 788	144 989	189 580	181 531	199 802	226 611	237 922
Total other species		436 635	417 391	366 523	421 743	545 141	587 809	515 808
Total	**1 608 574**	**2 296 008**	**2 089 418**	**2 166 364**	**1 875 460**	**2 348 149**	**2 440 601**	**2 437 301**

**Validation workshop excluding*

Production by type of logging title (m³)

Type	2005	2006	2007	2008	2009	2010	2011*	2012*
Timber recovery permit (timber salvage authorization and timber removal authorization)	141 743	154 830	215 919	189 942	257 437	186 406	46 419	7 313
Timber concession	1 683 045	1 866 228	1 757 056	1 559 092	1 397 174	1 842 176	1 831 443	1 628 056
Provisional concession				374 188	171 830	86 999	55 590	82 107
Sales of standing volume	157 336	275 195	116 447	43 141	49 019	232 568	488 256	695 381
Communal forests							18 897	24 443
Total	**1 982 124**	**2 296 253**	**2 089 422**	**2 166 363**	**1 875 460**	**2 348 149**	**2 440 605**	**2 437 300**

**Validation workshop excluding*

Production of the 10 most important companies (m³)

Company	2005	2006	2007	2008	2009	2010	2011*	2012*
ALPICAM	75 183		78 444	86 259	62 945		92 380	61 547
CAFECO SA						53 998		
CAMBOIS	102 119		98 697	48 832	110 268	100 528	71 340	
CFC	71 744	91 767	73 827	93 220		94 799	66 632	63 102
CIBC		66 757						
CUF		85 436			66 297	147 593	135 078	82 854
FB							68 363	
FILIERE BOIS			59 293					
FIPCAM				68 218	67 670			
GRUMCAM		105 893	91 737	135 144		85 305	66 537	84 332
GWZ	90 774	71 857			68 478			
Ingénierie Forestière	81 057							
LOREMA							90 609	87 555
PALLISCO	67 742	97 943	90 416	140 702	94 354	118 386		84 932
PANAGIOTIS MARELIS			57 540					
PLACAM	61 172							
SEFAC	99 918	84 972	94 723	91 918	94 163	127 566	75 967	116 219
SFID	79 634	65 194		211 195	81 042	106 291		85 677
SIBAF	64 535	65 848						
SIM								62 975
STBK		93 386	116 726	134 311	61 405	115 904	147 782	162 758
TRC			81 106	65 916	86 227	65 071	67 017	
Other companies						1 332 709	1 558 896	1 545 352
Total	**793 878**	**829 053**	**842 509**	**1 075 715**	**792 849**	**2 348 150**	**2 440 601**	**2 437 303**

**Validation workshop excluding*

Processed products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Sawnwood	660 000	601 000			912 462		993 000	
Peeled veneer	4 980	4 290			62 000		54 790	
Sliced veneer	63 000	57 000			1 826			
Plywood	23 000	18 000			22 700		23 110	
Total	**750 980**	**680 290**			**998 988**		**1 070 900**	

Exports by type of products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012*
Logs	146 000	316 000		257 578	413 000	607 647	582 301	496 871
Sawnwood	660 000	601 000		524 632	343 118	696 166	593 363	591 222
Planed sawnwood				52 887	21 867	40 945		
Peeled veneer	4 980	4 290		2 843	31 220	52 548	44 790	37 606
Sliced veneer	63 000	57 000		59 408	1 000	78	210	0
Plywood	23 000	18 000		17 983	11 350	17 084	13 114	17 942
Total	**896 980**	**996 290**		**915 331**	**821 555**	**1 414 468**	**1 233 778**	**1 143 641**

Export destinations (m³)

Region	2006	2007	2008	2009	2010	2011*	2012*
COMIFAC countries	1 904		3 771	4 095	4 305	693	806
Africa excluding COMIFAC countries	43 384		50 726	30 210	57 529	140 768	51 921
North America	19 435		16 369	9 574	14 732	25 351	27 129
Asia	277 956		289 857	435 686	606 861	613 614	583 241
European Union	632 020		550 841	340 520	730 707	445 058	472 649
Other destinations	19 530		3 431	1 087	832		4 372
Total	**994 229**		**914 995**	**821 172**	**1 414 966**	**1 225 484**	**1 140 118**

**Validation workshop excluding*

Management of forest concessions

Management status	2007		2008		2009		2010		2011		2012*	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)	91	247 758			78	199 940					101	264 135
Forest already classified					52	3 533 008	86	3 533 008			62	3 947 981
Process not initiated					13	1 396 884						
Under definitive agreement (management plan approved)			65	4 207 862	75	5 341 895	86	5 341 895			92	5 637 731
Under provisional agreement (management plan in preparation)			38	1 866 171	21	1 039 789	11	1 039 789			12	669 734
Total	**91**	**247 758**	**103**	**6 074 033**	**239**	**11 511 516**	**183**	**9 914 692**			**267**	**10 519 581**

Processing units

Type of units	2007		2008		2009		2010		2011*		2012	
	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)
Industrial sawmill	51	519 941			67		51		108			
Peeling plant	5	64 286			7		5		3	44 000		
Slicing plant	4				66		4		4			
Total	**60**	**584 227**			**140**		**60**		**115**	**44 000**		

Protected area in 2011*

Protected area type	Number	IUCN category	Total area (ha)
National park	18	II	2 860 531
Wildlife reserve	6	Ib	702 995
Zoological garden	3	--	6
Botanical garden	1	Ia	44
Wildlife sanctuary	3	III	95 667
Flora sanctuary	1	Ia	1 000
Forestry reserve	77	Ia	492 072
Total	**109**		**4 152 315**

**Validation workshop excluding*

ANNEX 13 : Data for Gabon

Contribution of the forestry sector to the national economy

Economic data	2007	2008	2009	2010	2011*	2012
Contribution to GDP (%)	4.3	3.02	4.50	1.7	1.8	
Tax revenues (%)						
Direct employments (Nbr)	12 868	12 420	14 121	11 275	20 000	
Indirect employments (Nbr)			5 000	2 000		

Log production

Year	Volume (m^3)
2005	2 769 902
2006	3 220 957
2007	3 350 678
2008	2 057 537
2009	3 947 231
2010	1 861 116
2011*	1 597 889
2012*	1 709 413

**Validation workshop excluding*

Main timber species harvested in the formal sector (volume harvested in m^3)

Species	2005	2006	2007	2008	2009	2010	2011*	2012*
Andoung							8 994	6 248
Azobé						74 261	68 067	73 056
Bahia						14 841		
Beli						10 493	38 447	23 785
Bilinga							11 801	12 632
Bubinga (Kevazingo)							12 241	47 151
Gombe						14 141		
Movingui						11 741	8 732	8 221
Okan						54 232	53 541	62 322
Okoumé	1 772 737	2 061 412	2 144 434	1 130 535		1 045 151	920 890	991 898
Padouk						29 625	53 906	51 930
Tali (Missanda)						26 001	27 703	15 790
Total other species	997 165	1 159 544	1 206 244	1 818 900		580 630	393 567	416 380
Total	**2 769 902**	**3 220 956**	**3 350 678**	**2 949 435**		**1 861 116**	**1 597 889**	**1 709 413**

**Validation workshop excluding*

Production by type of logging title (m^3)

Type	2007	2008	2009	2010	2011*	2012
CFAD	527 478		1 885 648	1 410 949	1 410 949	
CPAET					186 940	
Lots ZACF	9 157					
PFA	566 275		798 973	445 167		
PGG				5 000		
PI	508 056		668 739			
PTE	1 128 147		258 026			
Other	611 565					
Total	**3 350 678**		**3 611 386**	**1 861 116**	**1 597 889**	

Production of the 10 most important companies (m³)

Company	2007	2008	2009	2010	2011	2012
Bois et sciages de l'Ogooue	119 794					
Bonus Harvest			266 424			
Compagnie des bois du Gabon	118 930					
Compagnie Equatoriale des Bois	323 975		259 689			
Compagnie forestière des abeilles	132 023		291 020			
Cora wood	78 896		263 674			
Exploitation gabonaise des grumes	82 681					
GEB	87 308					
HTG	195 506					
RFM			266 302			
Rougier Gabon	390 778		322 670			
SBL			265 251			
SEEF			384 719			
SFIK			264 127			
TBNI			306 242			
Toujours vert	107 747					
Other companies	1 713 040		903 308			
Total	**3 350 678**		**3 793 426**			

**Validation workshop excluding*

Processed products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Sawnwood	200 151	200 239	296 406	280 379	196 423	337 741	439 022	
Planed sawnwood				1 269	3 299	921	1 547	
Peeled veneer	237 501	180 717	180 516	202 282	183 124	281 615	295 660	
Sliced veneer	2 856		1 285	0	0	0	0	
Plywood	819 122	32 900	84 795	140 931	76 724	71 000	91 408	
Total	**1 259 630**	**413 856**	**563 002**	**624 861**	**459 570**	**691 277**	**827 637**	

**Validation workshop excluding*

Exports by type of products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Logs	1 586 228	1 768 080	1 938 079	1 649 309	1 631 374	0	0	
Sawnwood	152 724	158 250	157 856	222 739	150 591	278 236	469 621	
Planed sawn-wood					1 139	971	834	
Peeled veneer	171 899	188 213	144 135		130 902	196 804	210 934	
Sliced veneer	2 256		1 889		0	0		
Plywood	87 177	29 906	28 384		802 99	54 707	44 758	
Total	**2 000 284**	**2 144 449**	**2 270 343**	**1 872 048**	**1 994 305**	**530 718**	**726 147**	

**Validation workshop excluding*

Export destinations (m³)

Region	2005	2006	2007	2008	2009	2010	2011*	2012
COMIFAC countries					125	119	0	
Africa excluding COMIFAC countries	73 628	86 594	140 635		77 588	71 828	75 227	
North America					2 944	9 544	0	
Asia	1 033 117	1 290	1 377 571		3 017	67 090	191 993	
European Union	479 398	391 392	419 872		245 266	338 336	298 788	
Other destinations					33 992	43 801	89 423	
Total	**1 586 143**	**479 276**	**1 938 078**		**362 931**	**530 718**	**655 431**	

**Validation workshop excluding*

Management of forest concessions

Management status	2007		2008		2009		2010		2011*		2012	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)	12	74 392			13	100 383	15	114 891	23	178 034		
Forest already classified	1				14	3 012 375	1	493				
Process not initiated									59			
Under definitive agreement (management plan approved)	10	3 025 173			12	3 419 475	19	4 606 248	26	6 173 350		
Under provisional agreement (management plan in preparation)	33	6 018 597			22	6 473 759	33	5 845 652	31	5 538 638		
Total	**56**	**9 118 162**			**61**	**13 005 992**	**68**	**10 567 284**	**139**	**11 890 022**		

Processing units

Type of units	2007		2008		2009		2010		2011*		2012	
	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)
Planed sawnwood (parquets, moldings)					1	2 952	1	0	2			
Plywood plant	4	236 000			5	122 000	5	108 000	5	241 000		
Industrial sawmill	60	1 013 487			72	1 033 750	74	1 031 515	97	2 001 756		
Peeling plant	12	673 600			10	466 824	10	445 392	10	514 000		
Slicing plant	1	10 000			0	0	1	2 000	0			
Total	**77**	**1 933 087**			**88**	**1 625 526**	**91**	**1 586 907**	**114**	**2 756 756**		

**Validation workshop excluding*

Protected area in 2010

Protected area type	Number	IUCN category	Total area (ha)
National park	13	II	3 013 842
Wildlife reserve		Ia	
Wildlife and flora sanctuary		--	
Integral Reserve		--	
Hunting zone		IV	
Zoological garden		--	
Botanical garden		--	
Total	**13**		**3 013 842**

ANNEX 14: Data for Equatorial guinea

Contribution of the forestry sector to the national economy

Economic data	2006	2007	2008	2009	2010	2011	2012
Contribution to GDP (%)		0.22		0.01			
Tax revenues (%)							
Direct employments (Nbr)	2 000			490			
Indirect employments (Nbr)							

Log production

Year	Volume (m³)
2006	
2007	524 799
2008	88 097
2009	13 760
2010	309 849
2011*	337 223
2012*	375 843

**Validation workshop excluding*

Main timber species harvested in the formal sector (volume harvested in m³)

Species	2006	2007	2008	2009	2010	2011	2012
African mahogany			2 093	701			
Azobé	9 528	28 387	10 431	1 322			
Dabema	1 663	57 541					
Dibétou	6 525						
Doussié	3 598						
Eyong		5 693	2 972				
Ilomba	7 652	31 313	28 683	2 081			
Iroko	9 856		2 127	629			
Kosipo		8 189					
Limba			2 329				
Movingui			1 446				
Okan		33 020					
Okoumé	242 560	247 133	13 482	1 886			
Onzabili	2 153						
Ozigo				567			
African Padauk		17 878	7 307	760			
Sapelli		15 005		930			
Sipo				417			
Tali	114 377	22 212	5 972	846			
Wengué	1 632						
Total other species	6 438	48 055	11 256	3 622			
Total	**405 983**	**514 426**	**88 098**	**13 761**			

Production by type of logging title (m³)

Type	2007	2008	2009	2010	2011	2012
Community forest	84 262	0				
Rental contract for logging	420 074	88 097	13 760			
Timber concession	20 463	0				
Total	524 799	88 097	13 760			

Production of the 10 most important companies (m³)

Company	2006	2007	2008	2009	2010	2011*	2012*
ATO	3 089	1 816					
CHILBO	15 755	23 457	8 980		11 519	9 176	
COMALI	20 357	31 838	18 400	3 048	18 587	23 741	
MATROGUISA	1 782	1 123	630				
RIO MUNI TIMBERLAND	7 856	32 036			25 462	14 489	
SAFI	187						
SHIMMER INTERNACIONAL	286 702	309 369			127 944	158 188	
SIJIFO	2 913	9 991	24 053	2 028	34 319	42 403	
SINOSA	4 153	12 541					
SOFMAL	63 188	102 628	36 034	8 685	73 784	50 621	
Total	405 983	524 799	88 097	13 760			

**Validation workshop excluding*

Processed products (m³)

Products	2006	2007	2008	2009	2010	2011	2012
Sawnwood	1 432	784	1 385	5 576			
Sliced veneer	25 989	27 644					
Peeled veneer		293	17 503	11 214			
Total	**27 421**	**28 721**	**18 888**	**16 790**			

Exports by type of products (m³)

Products	2006	2007	2008	2009	2010	2011*	2012*
Logs	450 061	547 299	142 676	23 385	234 455	237 928	301 335
Sawnwood	403	600		3 375			
Planed sawnwood							
Peeled veneer				8 388	19 288	15 625	13 036
Sliced veneer	31 819	31 101					
Plywood							
Total	**482 283**	**579 000**		**35 149**			

**Validation workshop excluding*

Export destinations (m³)

Region	2006	2007	2008	2009	2010	2011	2012
COMIFAC countries							
Africa excluding COMIFAC countries	12 515	10 680		1 565			
North America				35			
Asia	373 942	492 705		16 472			
European Union	92 276	77 240		17 046			
Other destinations				31			
Total	**478 733**	**580 625**		**35 149**			

Management of forest concessions

Type of units	2007		2008		2009		2010		2011	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)										
Forest already classified										
Process not initiated										
Under definitive agreement (management plan approved)										
Under provisional agreement (management plan in preparation)			1	50 000						
Total			**1**	**50 000**						

Processing units

Type of units	2006		2007		2008		2009		2010		2011	
	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)
Industrial sawmill			1				2					
Plywood plant			2				2					
Peeling plant			5				4					
Slicing plant	4	27 471										
Total	**4**	**27 471**	**8**				**8**					

Protected area in 2009

Protected area type	Number	IUCN category	Total area (ha)
Naturel Monument	2	III	39 000
National Park	3	II	303 000
Scientific reserve	2	Ib	51 500
Natural reserve	6	IV	192 500
Total	**13**		**586 000**

ANNEX 15 : Data for Central African Republic

Contribution of the forestry sector to the national economy

Economic data	2007	2008	2009	2010	2011	2012
Contribution to GDP (%)			13	10		
Tax revenues (%)						
Direct employments (Nbr)			4 000	4 000		
Indirect employments (Nbr)				6 000		

Log production

Year	Volume (m^3)
2005	454 402
2006	624 861
2007	
2008	555 143
2009	348 926
2010	324 283
2011*	424 447
2012	

Main timber species harvested in the formal sector (volume harvested in m^3)

Species	2005	2006	2007	2008	2009	2010	2011*	2012
African mahogany	8 075	4 841	1 926	2 024				
Azobé				603				
Aningré	42 228	29 327	34 506	26 059	18 717	6 452	8 510	
Ayous	108 577	93 557	81 279	111 020	67 952	31 182	59 718	
Bété		1 033	840	819				
Bossé	4 263	5 177	5 122	3 544				
Dibétou	1 270	9 419	8 390	14 066	10 482	13 758	17 652	
Doussier		4 051	3 059	1 791				
Fraké				2 093				
Iroko	32 062	18 620	22 458	20 398	11 228	12 035	17 623	
Kosipo	6 786	17 174	24 033	30 921	12 548	16 798	22 050	
African Padauk		2 019	6 195	9 314		9 675	12 312	
Pao rosa		17 538	1 107	830				
Sapelli	215 220	335 604	295 954	271 283	188 206	185 619	215 616	
Sipo	21 896	28 909	21 098	28 329	17 359		13 937	
Tali						3 045		
Teck				456	1 616			
Tiama	3 095	14 399	14 561	16 493	5 176	5 931	17 623	
Total other species	10 931	43 193	17 469	15 100	15 183	35 396	39 406	
Total	**454 403**	**624 861**	**537 997**	**555 143**	**348 467**	**319 891**	**424 447**	

**Validation workshop excluding*

Production by type of logging title (m^3)

Type	2005	2006	2007	2008	2009	2010	2011*	2012
Logging and management permit	454 402	617 578	526 122	545 613	347 559	323 208	423 606	
Harvesting special permit		7283						
Harvesting special permit (SEBOCA)			11 875	9 529	502	842		
SETEC					865	133		
Teck exploitation							841	
Total	**454 402**	**624 861**	**537 997**	**555 143**	**348 926**	**324 183**	**424 447**	

**Validation workshop excluding*

Production of the 10 most important companies (m³)

Company	2005	2006	2007	2008	2009	2010	2011*	2012
IFB	67 429	87 489		77 930	60 087	53 848	83 930	
SCAD	56 003	69 746		55 896	21 947	20 905	31 523	
SCAF	36 339	44 153		23 654	10 372			
SCD				7 223	10 246	14 880	12 970	
SEBOCA		7 283		9 529	502	842		
SEFAC							185 396	
SEFACA	42 229							
SEFCA	131 493	222 351		223 656	151 032	152 714		
SESAM	8 688							
SETEC					865	133		
SOFOKAD	56 635	40 888		12 391	7 624			
THANRY	16 665	32 411		44 373		3 790	33 805	
VICA	76 922	120 540		100 491	86 252	77 171	75 983	
Other companies							841	
Total	**492 403**	**624 861**		**555 143**	**348 927**	**324 283**	**424 448**	

**Validation workshop excluding*

Processed products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Sawnwood	454 402	624 861		73 675	61 849	45 138	54 176	
Planed sawnwood								
Peeled veneer	4 686	84 304						
Sliced veneer								
Plywood	1 434	805		194	863			
Total	**460 523**	**709 970**		**73 869**	**62 712**	**45 138**	**54 176**	

**Validation workshop excluding*

Exports by type of products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Logs	145 912	192 259		155 301	111 464	147 893	152 278	
Sawnwood	52 940	70 779		62 233	40 477	36 657	38 413	
Planed sawnwood								
Pelled veneer		6 270						
Sliced veneer								
Plywood	5	475		72				
Total	**198 856**	**269 783**		**217 606**	**151 941**	**184 550**	**190 691**	

**Validation workshop excluding*

Export destinations (m³)

Region	2005	2006	2007	2008	2009	2010	2011*	2012
COMIFAC countries	4 896	15 166			1 474		889	
Africa excluding COMIFAC countries						114	772	
North America								
Asia	22 106	64 420		58 541	45 011	49 574	60 050	
European Union	113 491	111 499		92 475	64 568	98 206	90 591	
Other destinations	5 418	1 174			412		25	
Total	**145 911**	**192 259**		**151 016**	**111 465**	**147 894**	**152 327**	

**Validation workshop excluding*

Management of forest concessions

Management status	2007		2008		2009		2010		2011*	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)			14	106 271	17	129 463				
Forest already classified			1	27 956	1	27 956			1	27 956
Process not initiated			3	674 561	3	674 561			3	675 245
Under definitive agreement (management plan approved)			7	2 454 000	7	2 454 000	11		11	3 021 773
Under provisional agreement (management plan in preparation)			3	582 789	3	582 789				
Total			**28**	**3 845 577**	**31**	**3 868 769**	**11**		**15**	**3 724 974**

**Incomplete data and validation workshop excluding*

Processing units

Type of units	2007		2008		2009		2010		2011*	
	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)
Planed sawnwood (hardwood floors, moldings)										
Plywood plant			1	15 000	1	864	1		1	
Industrial sawmill			8		7	500 000	7		6	
Peeling plant			1		1	700	1			
Slicing plant										
Total			**10**	**15 000**	**9**	**501 564**	**9**		**7**	

**Validation workshop excluding*

Protected area in 2010

Protected area type	Number	IUCN category	Total area (ha)
National park	5	II	3 272 700
Presidential park	1	II	170 000
Special reserve	2	IV	314 815
Integral reserve	1	Ia	86 000
Wildlife reserve	7	VI	3 030 000
Total	**16**		**6 873 515**

ANNEX 16 : Data for Republic of Congo

Contribution of the forestry sector to the national economy

Economic data	2006	2007	2008	2009	2010	2011	2012*
Contribution to GDP (%)	5.6			7.6	8.8	1.6	3
Tax revenues (%)							0.22
Direct employments (Nbr)				5 020	5 822	7 305	7 305
Indirect employments (Nbr)				5 000			

**Validation workshop excluding*

Log production

Year	Volume (m^3)
2005	1 386 473
2006	1 330 980
2007	1 331 951
2008	1 212 118
2009	974 529
2010	1 314 281
2011	1 462 990
2012*	1 405 421

Main timber species harvested in the formal sector (volume harvested in m^3)

Species	2005	2006	2007	2008	2009	2010	2011	2012*
African mahogany	14 840	11 874	24 633					
Agba/Tola					7 158	924	1 313	1 647
Aniégré	331	5 545	2 199					
Bilinga				11 508	13 970	25 128	30 731	17 356
Bossé	59 229	41 214	45 146	25 337	15 772	24 202	17 814	25 695
Dibetou					5 934	2 772	7 090	7 122
Iroko	42 014	30 601	16 983	15 018	12 978	22 505	22 372	20 398
Kosipo	4 320	12 177	29 641	13 269				
Moabi	5 417	4 266	5 167					
Niové					4 950	2 815	4 208	3 448
Obeché				21 068	17 989	4 976	40 929	52 036
Okan								
Okoumé	343 632	316 098	295 221	343 652	412 406	540 563	546 440	449 456
Sapelli	496 547	539 264	575 591	197 838	158 708	399 850	370 400	407 283
Sipo	72 906	75 971	80 076	35 749	128 530	53 641	49 035	52 379
Tali/Kassa				10 584				
Tiama								
Wengué	16 604	16 594	25 862	21 766				
Total other species	313 371	276 355	211 386	516 329	196 134	236 905	372 658	368 601
Total	**1 369 211**	**1 329 959**	**1 311 905**	**1 212 118**	**974 529**	**1 314 281**	**1 462 990**	**1 405 421**

**Validation workshop excluding*

Production by type of logging title (m³)

Type	2005	2006	2007	2008	2009	2010	2011	2012*
Management and processing convention (CAT)	1 300 209	1 264 267	915 624		899 354	1 205 903	1 288 122	1 329 587
Industrial processing convention (CTI)	36 617	58 055	50 776		69 681	77 247	78 657	8 554
Exploitation contract (CEF)					5 172	12 620	13 299	14 464
Special permit					322	18 511	82 912	16 926
Other								35 890
Total	**1 336 826**	**1 322 322**	**966 400**		974 **529**	**1 314 281**	**1 462 990**	**1 405 421**

**Validation workshop excluding*

Production of the 10 most important companies (m³)

Company	2005	2006	2007	2008	2009	2010	2011	2012*
ASIA Congo				71 604	116 599	163 436	201 468	91 051
Bois et Placages De Lopola (BPL)	45 574	48 636	54 403		26 795	29 791	28 926	37 551
Compagnie Industrielle des bois du Niari (CIBN)	170 330	154 522	188 459	143 304	154 146	153 182	131 289	93 145
Congolaise industrielle des Bois (CIB)	341 681	359 546	374 510	298 252	158 568	175 206	189 458	200 711
FORALAC	57 086	41 139	32 337		39 327	40 258	48 026	54 379
Industrie de Transformation des Bois de la Likouala (ITBL)	37 045	35 386	19 892	20181				
Industrie Forestière de Ouesso (IFO)	175 648	162 804	163 639	146 616	164 670	200 598	186 028	187 904
Likouala Timber (LT)	165 728	67 124	94 618	74 961	56 594	52 463	65 513	75 205
Mokabi SA	74 043	98 848	126 099	96 114	13 918	100 301	105 285	111 023
Sino Congo Forêt (SICOFOR)				79 247	78 793	136 908	161 557	149 797
Société Thanry Congo (STC)	20 319	42 247	57 231	27 721				
Taman Industrie	78 239	167 703	53 715	54 673	84 616	116 963	99 659	126 181
Other companies				199 445	80 503	145 175	245 781	278 474
Total	**1 165 693**	**1 177 955**	**1 164 903**	**1 212 118**	**974 529**	**1 314 281**	**1 462 990**	**1 405 421**

**Validation workshop excluding*

Processed products (m³)

Products	2005	2006	2007	2008	2009	2010	2011	2012*
Sawnwood	219 932	258 679	212 719	196 553	199 283	178 228	227 649	288 072
Peeled veneer	14 376	2 224	44 826	31 537	33 468	35 021	33 788	46 261
Sliced veneer	0	0	0					
Plywood	6 390	7 456	8 665	8 612	22 101	25 060	18 620	24 525
Molding products		9 953	11 300					
Logs		163 183	248 648	416 174				
Chips				164 301				
Other					347 307	351 524	258 213	237 123
Total	**240 698**	**441 495**	**526 158**	**817 177**	**602 159**	**589 833**	**538 270**	**595 981**

**Validation workshop excluding*

Exports by type of products (m³)

Products	2005	2006	2007	2008	2009	2010	2011	2012*
Logs	709 710	632 665	522 497	528 688	546 005	798 954	855 739	738 146
Sawnwood	163 075	181 365	209 122	174 937	93 014	132 187	147 478	161 795
Planed sawnwood	0	0	0	0	0			
Peeled veneer	13 040	3 968	15 307	21 775	19 153	18 038	22 152	20 275
Sliced veneer	0	0	0	0	0			
Plywood	1 974	2 980	1 755	660	113	167	5 443	1 573
Other	17 731	135 282	250 746	341 924	354 171	323 193	199 812	194 872
Total	**905 530**	**956 260**	**999 427**	**1 067 984**	**1 012 456**	**1 272 539**	**1 230 624**	**1 116 661**

**Validation workshop excluding*

Export destinations (m³)

Region	2005	2006	2007	2008	2009	2010	2011	2012*
COMIFAC countries		3 289	1 450	3 559	2 500	100	5 239	284
Africa excluding COMIFAC countries	26 135	26 785	11 962	103 137	6 825	31 588	8 983	48 403
North America	15 870	11 226	22 773	13 710	7 366	11 703	13 945	13 956
Asia	483 137	444 311	400 491	459 774	514 437	68 292	43 489	783 851
European Union	386 549	319 210	295 679	333 025	460 483	533 833	210 232	233 584
Other destinations	--	151 439	267 071	154 775	20 845	632 023	948 736	36 572
Total		**956 260**	**999 426**	**1 067 980**	**1 012 456**	**127 7539**	**1 230 624**	**1 116 650**

**Validation workshop excluding*

Management of forest concessions

Management status	2006		2007		2008		2009		2010		2011		2012*	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)													29	493 824
Forest already classified														
Process not initiated							17	4 031 603	15	2 739 143	15	2 739 147	15	2 739 137
Under definitive agreement (management plan approved)	3	1 907 843	3	1 907 843			1	195 510	6	3 260 783	7	3 504 159	8	3 536 689
Under provisional agreement (management plan in preparation)					22	6371718	19	5047367	21	6339823	22	6096447	20	6 119 010
Total	**3**	**1 907 843**	**3**	**1 907 843**	**22**	6 **371 718**	**37**	**9 274 480**	**42**	**12 339 749**	**44**	**12 339 753**	**72**	**12 866 097**

**Validation workshop excluding*

Processing units

Type of units	2007		2008		2009		2010		2011		2012*	
	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)	Nbr	Capacity (m^3)
Industrial sawmill	25	1 000 000			26	199 283	26	1 100 000	26	1 100 000	26	1 100 000
Peeling plant	6	210 000			4	33 468	4	210 000	4	210 000	4	210 000
Slicing plant					2	22 000	2	22 000	2	22 000	2	22 000
Plywood plant	4	30 000			3	22 101	3	30 000	3	30 000	3	30 000
Molding plant					2	10 000	2	10 000	2	10 000		
Total	**35**	**1 240 000**			**37**	**286 852**	**37**	**1 372 000**	**37**	**1 372 000**	**35**	**1 362 000**

** Validation workshop excluding*

*Protected area in 2012**

Protected area type	Number	IUCN category	Total area (ha)
National park	3	II	2 286 350
Community reserve	1	VI	438 960
Wildlife reserve	3	IV	675 000
Biosphere reserve	2	-	136 000
Gorilla sanctuary	2	-	79 000
Chimpanzee sanctuary	2	-	7 000
Hunting zone	2	-	65 000
Forest reserve	1	-	74
Total	**16**		**3 687 384**

**Validation workshop excluding*

ANNEX 17 : Data for the Democratic Republic of Congo

Contribution of the forestry sector to the national economy

Economic data	2006	2007	2008	2009	2010	2011*	2012
Contribution to GDP (%)			0.26	0.17	0.08	0.08	0.02
Tax revenues (%)							
Direct employments (Nbr)	15 000				13 000		
Indirect employments (Nbr)							

**Validation workshop excluding*

Log Production

Year	Volume (m^3)
2005	
2006	220 680
2007	310 000
2008	353 247
2009	373 284
2010	249 539
2011*	329 013
2012*	147 376

**Validation workshop excluding*

Main timber species harvested in the formal sector (volume harvested in m^3)

Species	2005	2006	2007	2008	2009	2010	2011*	2012
African mahogany	4 497	7 468	13 576	19 101	14 807		4 945	
Afrormosia	18 680	11 043	31 138	29 009	25 273	1 217	21 391	
Bomanga (Evène)			13 370			9 402		
Bossé clair		5 581		10 319		10 010	5 220	
Iroko	34 475	17 923	24 036	29 818	33 116	32 526	30 153	
Kosipo	4 189			8 303	12 768			
Limba (Fraké)		3 717						
Sapelli	34 792	65 465	60 914	56 542	62 079	68 561	79 811	
Sipo	20 565	31 773	26 952	30 537	39 356	15 964	15 902	
Tchitola	3 979		9 385		15 725	7 158	8 762	
Tiama	9 669	11 992	10 986	15 716	17 312	10 416	5 714	
Tola	16 141	23 939	24 134	25 701	27 093	9 627	111 130	
Wengué	7 691	16 905	51 971	55 722	61 005	34 160	27 217	
Total other species	15 257	24 875	43 514	72 479	64 751	39 542	18 769	
Total	**169 935**	**220 680**	**309 976**	**353 247**	**373 284**	**238 585**	**329 013**	

**Validation workshop excluding*

Production by type of logging title (m^3)

Type	2005	2006	2007	2008	2009	2010	2011*	2012
Artisanal cutting permit			24 966	96 122	15 215	34 098		
Industrial cutting permit	487 477	489					26 365	
Ordinary cutting permit (ACIBO)			309 976	708 326	539 914	638 590	816 467	
Total	**487 477**	**489**	**334 942**	**804 448**	**555 129**	**672 688**	**842 832**	

**Validation workshop excluding*

Production of the 10 most important companies (m³)

Company	2005	2006	2007	2008	2009	2010	2011*	2012
Azimuts Services							2 754	
BIMPE AGRO		8 894	13 794	10 149	8 250			
CFT	5 014	4 178						
FORABOLA	3 608	11 359	17 184	26 251	22 322	20 935	11 093	
ITB	12 831	11 328	36 259	19 310	30 213	20 460	9 674	
LA FORESTIERE DU LAC		3 263		14 570	5 551		12 834	
RIBA CONGO						7 371		
SAFBOIS	18 151		14 643	12 410	5 682	2 361		
SEDAF	13 557	35 500	18 794	22 815	18 326	7 321	2 429	
SICOBOIS			8 063				15 273	
SIFORCO	78 607	87 975	65 740	94 735	93 473	82 254	105 042	
SODEFOR			48 699	64 693	66 597	74 324	10 878	
SOEXFORCO		4 917				4 179		
SOFORMA	14 417	5 910	14 417	25 277	63 135	15 262	17 222	
TM-BOIS	7 288	37 428	48 442	35 085	31 977	5 724	32 716	
MISALA YA BA NTOMA	4 121							
SAFO	5 396							
Other companies	6 950			27 952	27 758	9 349		
Total	**169 940**	**210 750**	**286 035**	**353 247**	**373 284**	**249 539**	**219 915**	

**Validation workshop excluding*

Processed products (m³)

Products	2007	2008	2009	2010	2011	2012
Sawnwood		28 645				
Planed sawnwood		4 300				
Peeled veneer		3 330				
Sliced veneer		840				
Total		**37 115**				

Exports by type of products (m³)

Products	2005	2006	2007	2008	2009	2010	2011*	2012
Logs	111 243	150 883	208 087	189 086	124 038	124 038	123 431	
Sawnwood	25 704	26 192	30 382	28 645	25 838	25 838	29 738	
Planed sawnwood	5 134	891	1 152	970	225	225		
Peeled veneer					0	0		
Sliced veneer	1 171	2 549	1 392	840	0	0		
Plywood		5 525	6 762	3 330	0	0		
Other	785	890 748	1 152			98		
Total	**144 037**	**1 076 788**	**248 927**	**222 871**	**150 101**	**150 199**	**153 169**	

**Validation workshop excluding*

Export destinations (m³)

Region	2005	2006	2007	2008	2009	2010	2011*	2012
COMIFAC countries					0	0		
Africa excluding COMIFAC countries	16 058	15 695	11 876	42 540	12 835	12 835	11 869	
North America	4 584	5 126	5 146	55 221	1 749	1 749	3 115	
Asia	9 780	16 750	35 021	50 128	46 207	46 207	111 938	
European Union	138 940	176 767	221 251	137 292	184 680	184 680	89 217	
Other destinations	1 027	75	6 431		0	0		
Total	**170 388**	**214 412**	**279 725**	**285 181**	**245 471**	**245 471**	**216 139**	

**Validation workshop excluding*

Management of forest concessions

Management status	2006		2007		2008		2009		2010		2011*		2012	
	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area. (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)	Nbr	Area (ha)
Total annual cutting range (AAC)														
Forest already classified	28	22 653 178												
Process not initiated														
Under definitive agreement (management plan approved)														
Under provisional agreement (management plan in preparation)			46	6 590 628										
Total	**28**	**22 653 178**	**46**	**6 590 628**										

**Validation workshop excluding*

Processing units

Type of units	2007		2008		2009		2010		2011	
	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)	Nbr	Capacity (m³)
Industrial sawmill										
Peeling plant										
Slicing plant										
Total										

Protected area in 2010

Protected area type	Number	IUCN category	Total area (ha)
National Park	7	II	8 250 000
Natural reserve	11	IV	6 440 250
Hunting zone	54	VI	11 104 750
Botanical garden	4	III	531
Zoological garden	3	III	10
Total	**79**		**25 795 541**

ANNEX 18 : Data for Chad

Protected area in 2010

Protected area type	Number	IUCN Category	Total area (ha)
National Park	3	II	687 520
Wildlife reserve	7	IV	2 594 300
Biosphere reserve	1	IV	195 000
Total	**11**		**3 476 820**

ANNEX 19 : Data for Rwanda Republic

Protected area in 2010

Protected area type	Number	IUCN Category	Total area (ha)
National park	3		229 093
Ramsar site	1		
Natural reserve	2		1 700
Total	**6**		**230 793**

ANNEX 20 : Data for Burundi

Protected area in 2011

Protected area type	Number	IUCN Category	Total area (ha)
National park	2	II	90 800
Natural reserve	6	Ib	19 832
Protected landscape	4	V	13 335
Natural monument	2	III	742
Total	**14**		**124 709**

ANNEX 21 : Data for São Tomé-et-Príncipe

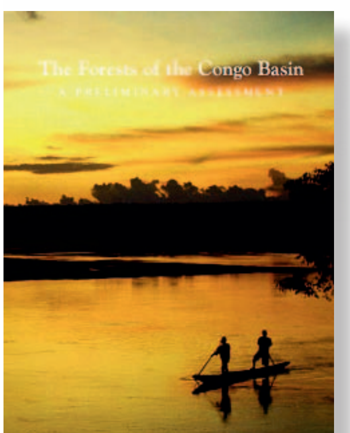
Protected area in 2013

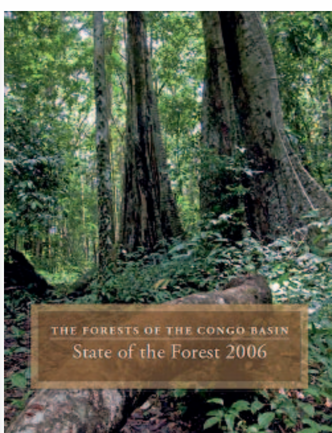
Protected area type	Number	IUCN Category	Total area (ha)
National park	2	II	29500
Wildlife reserve	-	-	-
Biosphere reserve	1	-	14200
Total	**2**		**35200**

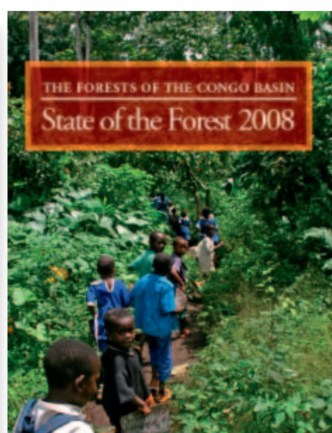
The area of the Natural Park of Príncipe is included in the Biosphere reserve and in the Natural Parks. This explains the total of 35 200 ha.

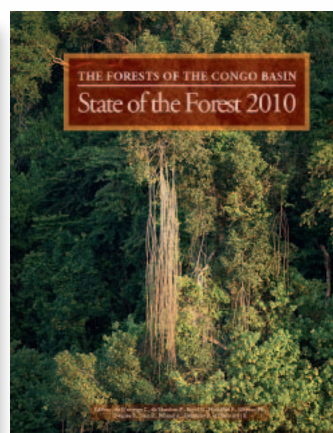
Previous reports on the State of the Forest are available for download in .pdf format at:

http://www.observatoire-comifac.net/edf.php?l=en









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