MIOMBO NETWORK MEETING REPORT

Venue: Kaya Kwanga, Maputo

MN Host institution: GOFC-GOLD

Host Institution: Eduardo Mondlane University (UEM)

Funding Institutions: START, RUFORUM, UEM

Report Elaborated by: Natasha Ribeiro and David Nangoma

Maputo, 4th of July 2014

**Table of
Contents**

Acronyms

AECID	**Spanish Agency of Cooperation and Development**
AERC	**African Economic Research Consortium**
AFIS	**Advanced Fire Information System**
AFOLU	**Agriculture, Forestry and Other Land Use**
AGB	**Aboveground Biomass**
ALOS	**Advanced Land Observing Satellite**
AIACC	**Adaptations to Climate Change and Flood Monitoring**
AMESD	**African Monitoring of the Environment for Sustainable Development**
AVHRR	**Advanced Very High Resolution Radiometer**
BMBF	**German Federal Ministry of Education and Research**
CBO	**Community Based Organization**
CCIAM	**Climate Change Impact, Adaptation & Mitigation Programme**
CDM	**Clean Development Mechanism**
CEOS	**Committee on Earth Observation Satellites**
CEEPA	**Centre for Environmental Economics and Policy in Africa**
CHAPOSA	**Charcoal Potential in Southern Africa**
CIFOR	**Center for International Forest Research**
CSIR	**Council of Scientific & Industrial Research**
DNTF	**National Directorate of Land and Forest**
DRC	**Democratic Republic of Congo**
EACID	**Spanish Agency of Cooperation and Development**
EIA	**Environmental Impact Assessment**

EOS	**Earth Observation Systems**
ETM	**Enhanced Thematic Mapper**
EU	**European Union**
FAEF	**Faculty of Agronomy and Forest Engineering**
FANRPAN	**Food, Agriculture and Natural Resources Policy Analysis Network**
FAO	**Food and Agriculture Organization**
FCPF	**Forest Carbon Partnership Facility**
FOTE	**Friends of Threatened Ecosystems (Threatened Ecosystems Network)/ or Friends of the Environment**
FP7	**Seventh Framework Programme for Research**
FTP	**File Transfer Protocol**
GIS	**Geographic Information System**
GIZ	**Gesellschaft für Internationale Zusammenarbeit**
GLC	**Global Land Cover**
GPG -LULUCF	**Good Practice Guidance for Land Use, Land-Use Change and Forestry**
GOFC-GOLD	**Global Observation of Forest and Land Cover Dynamics**
GTOS	**Global Terrestrial Observing System**
GoJ	**Government of Japan**
GoM	**Government of Malawi**
ICRAF	**International Center for Research in Agroforestry**
IIED	**International Institute for Environment and Development**
IGBP	**International Bio-geosphere Program**
IUCN	**International Union for the Conservation of Nature**
IHDP	**International Human Dimension Programme**
IPCC	**International Panel for climate Change**
JICA	**Japanese International Cooperation Agency**

LiDAR	**Light Detection and Range**
LCCS	**Land Cover Classification Scheme**
LCLUC	**Land Cover/Land Use Change**
LUCC	**Land Use and Cover Change**
MESA	**Monitoring of Environment and Security in Africa programme**
MICOA	**Ministry for Coordination of Environmental Affairs**
MINAG	**Ministry of Agriculture**
MMCT	**Mulanje Mountain Conservation Trust**
MN	**Miombo Network**
MW	**Miombo Woodlands**
MODIS	**Moderate Resolution Imaging Spectroradiometer**
MSS	**Multispectral Spectoradiometer**
MSU-TRFIC	**Tropical Rain Forest Information Center at Michigan State University**
MRV	**Measurement, Reporting and Verification systems**
MW	**Miombo woodlands**
MZ	**Mozambique**
NAFORMA	**National Forest Monitoring & Assessment**
NASA	**National Space Agency**
NGOs	**Non-governmental Organizations**
NORAD	**Norwegian Agency for Development Cooperation**
NTFPs	**Non-timber Forest Products**
OSFAC	**Observatoire Satellitale des For d'Afrique Centrale**
PalSAR	**Phased Array type L-band Synthetic Aperture Radar**
CIFOR-PEN	**CIFOR Poverty and Environment Network**
PES	**Payment for Ecosystem Services**

PFM	**Product Forest Management**
PNRM	**Participatory Natural Resources Management**
ProBEC	**Programme for Basic Energy and Conservation**
TFCG	**Tanzania Forest Conservation Group**
TM	**Thematic Mapper**
T&NTFPs	**Timber and Non-timber Forest Products**
TWEP	**Tobacco Wood Energy Programme OSFAC**
RADAR	**RAdio Detection And Ranging**
RCMRD	**Regional Center for Mapping of Resources for Development**
REDD+	**Reducing Emissions through Desertification and Degradation**
RISDP	**Regional Indicative Strategic Development Plan**
RS	**Remote Sensing**
SADC	**Southern Africa Development Community**
SAFIRE	
SAFNET	**Southern Africa Fire Network**
SANSA	**South African National Space Agency**
SFM	**Sustainable Forest Management**
SPOT	**Satellite Pour l'Observation de la Terre**
SASSCAL	**Southern African Science Service Centre for Climate Change and Adaptive Land Management**
START	**SysTem for Analysis, Research and Training**
TFCG	**Tanzania Forest Conservation Group**
TM	**Thematic Mapper**
TWEP	**Tobacco Wood Energy Programme**
UEM	**University Eduardo Mondlane**
UK	**United Kingdom**

UMD	**University of Maryland**
UNDP	**United Nations Development Programme**
UNEP	**United Nations Environment Programme**
UNFCCC	**United Nations Framework Convention of Climate Change**
UoE	**University of Edinburgh**
USA	**United States of America**
USAID	**USA Aid**
USGS	**US Geological Service**
WARN	**West Africa Regional Network**
WB	**World Bank**
WCRP	**World Climate Research Programme**
WESM	**Wildlife and Environmental Society of Malawi**
WoodCAS	**Wood Carbon Accounting System**
WWF	**World Wildlife Fund**

Foreword

Following many years of dormancy, the Miombo Network reconvened for the first time at Kaya Kwanga in Maputo, Mozambique from 23rd to 25th July, 2013. The network meeting was hosted by the Faculty of Agronomy and Forestry of the Eduardo Mondlane University with support from GOFC-GOLD and START. It drew participants from research, academia, government and international donors and support agencies from across the globe. The meeting congregated more than 50 participants representing all the miombo ecoregion (Angola, Democratic republic of Congo – DRC, Malawi, Mozambique, Zambia, Zimbabwe and Tanzania) as well as Botswana, Germany, Netherlands, Japan, South Africa, Portugal, the UK and the USA).

The Miombo Network (MN) is the oldest regional network in southern Africa that fosters collaborative efforts in land cover monitoring and management within its network of countries covering Tanzania, DRC, Zambia, Mozambique, Malawi, South Africa, Zimbabwe and Angola. Miombo Network's goal is to achieve more effective and appropriate miombo woodlands management policies and practices in the region through the use of science-based research approaches, remote sensing and other geospatial information technology. The Network's purpose is to enhance the use of information from field observations and remote sensing of miombo cover for management and utilization in southern Africa.

With a very good beginning that saw the collection of a wide coverage of data collection and information on the processes and function of the Miombo ecosystem and supported by land cover and biomass changes, the Network's operations had progressively slackened owing to the changing dynamics of the network's membership and leadership. The meeting in Kaya Kwanga was an important initiative that aimed to resuscitate this important regional network and to build on the excellent work that has been done already; and especially to take advantage of the already existing datasets, available initial institutional memory and research expertise and harness new opportunities of north-south and south-south collaborations that are emerging.

The Network recognizes the many important ecosystem functions the Miombo woodlands/ecosystems play, especially amongst the lowest per capita income groups who constitute the largest percentage of the populations in the Miombo eco-region. At the same time, there is an increasing awareness that the ecological health status of the Miombo ecosystem is much affected not only by anthropogenic pressures these ecosystems are facing but also many other factors are at play, including climate change and the global socio-economic trends and political landscapes that affect decision making

for the effective management of the Miombo.

The meeting in Kaya Kwanga, Maputo, Mozambique discussed these and other issues for the better understanding of the Miombo, making comparative analyses and synthesizing various research and conservation efforts currently under way in the region and the available geo-spatial data acquisition technologies available for a better planning and management of the Miombo eco-region of the Southern Africa.

Acknowledgments

Helmschrot and Landing Mane

The Administrative Staff: Adélia Chavane and Cândida Zita.

1. Background to the Workshop

The Miombo Woodlands – Characteristics and Status

The name 'Miombo' or the 'Miombo woodlands' (MW) as they are variously referred to by ecologists describes those woodland ecosystems dominated by trees in the genera *Brachystegia, Julbernardia* and *Isoberlinia* of the family Fabaceae. The woodlands are known to extend across about 2.8 million square kilometers of the southern sub-humid tropical zone from Tanzania and Zaire in the north, through Zambia, Malawi and eastern Angola to Zimbabwe and Mozambique in the south. The woodlands constitute the largest more-or-less contiguous block of deciduous tropical woodlands and dry forests in the world.

Being the largest single ecosystem in this part of the world, the Miombo support livelihoods of about 54 million people in seven African countries, out of which 72% directly rely on the natural resources and ecosystem services derived there-from. In most poor countries of the region, people's livelihoods largely depend on the Miombo for fuelwood and polewood, fibre, food, charcoal and many other resources. With increasing human populations, the pressure on these ecosystems is immense.

Current land cover estimates of the Miombo vary from country to country with corresponding estimated woody biomass consumption varying greatly from high per-capita income to low income economies. What is common amongst the Miombo eco-region countries is that the Miombo woodlands are at a rapid level of decline owing to many quite common conservation factors such as deforestation, wild fires, unsustainable forest resources utilization, agricultural expansion into the woodlands among others. Correspondingly, in spite of very good forest management policies and legislations in the many countries of the Miombo eco-region, Miombo woodlands continue to be degraded or destroyed by unregulated charcoal burning and fuelwood extraction.

Institutions that are responsible for managing the forests, in most cases, are poorly resourced in terms of human and financial capacities to execute their protection roles, whilst there is also insuficient community collaboration in their management. The situation is precarious and calls for institutional, regional and international collaboration to understand the interplay of the issues that beset the management of the miombo.

Introduction to the Miombo Network

Founded in 1995 by a group of regional and International scientists[1] the Miombo Network is a regional alliance of researchers whose main focus was to foster collaborative efforts on land use and land-cover change and impacts for the Miombo eco-region of Southern Africa. It was initiated under the auspices of the IGBP/IHDP Land Use and Cover Change (LUCC) Project and the IHDP/IGBP/WCRP Global Change System for Analysis, Research and Training (START). The Network's goal was to support the development of sustainable Miombo woodlands management policies and practices through the collaborative data acquisition from land-based research and monitoring data and supported by remote sensing data and other geospatial information technologies. The Miombo Networks' purpose was and still remains to enhance the use of information from field observations and remote sensing of the miombo cover for management in southern Africa. The membership of the network is drawn from government, university and research institutions in the Democratic Republic of Congo (DRC), Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. Outside Africa, members include universities, research institutions and Non-governmental organizations (NGOs).

GOFC-GOLD and the Miombo Network Collaboration

Land cover mapping and monitoring is one of two primary themes of the Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD), a coordinated international effort that works to provide on-going space-based and in-situ observations of forests and other vegetation cover for the sustainable management of terrestrial resources and to obtain an accurate, reliable quantitative understanding of the terrestrial carbon budget. The GOFC-GOLD Land Cover theme is aimed at refining and articulating the international requirements for land cover related observations and making the best possible use of global land cover products from the existing and future satellite observing systems for forests management, policy decision making and global change research.

To execute and design projects, develop consensus algorithms and methodologies for product generation and validation, the GOFC-GOLD Land Cover Implementation Team works with GOFC-GOLD Regional Networks around the globe to bring together land cover data providers, users and researchers operating in a common geographic area, and represent a link between national agencies, user groups and the global user/producer. The Miombo Network of the southern Africa is one such collaborating network.

---

[1] *Paul Desanker, Almeida Sitoe, Dominick Kwesha, Pius Yanda, Manuel Ferrão, Hank Shugart,*

Miombo Network Activities and Current Status

Since its inception, the Miombo Network has been engaged in a number of activities carried out with existing collaborating institutions such as the Southern Africa Development Community (SADC), Forestry and Wildlife Authorities in the region, Remote/GIS sensing institutions in the region, National Mapping Agencies and other governments institutions interested as well as the World Wildlife Fund (WWF) Regional Offices, the International Union for the Conservation of Nature (IUCN) and the Food and Agriculture Organization (FAO).

Key activities undertaken by the Network include:

- *Provision of Data Access*

At its inception meeting in Malawi, the membership identified data availability as a major constraint for development of a strong scientific agenda, and in general, for global environmental change research in Central and Southern Africa. The Miombo CD project was then designed to make data widely available to Miombo Network Projects and more generally, to regional scientists. Through this project data were collated from various international data archives and from individuals, and processed to be accessible using a web browser on a CD-ROM (1995-1996). The end product was the creation of the Miombo Data Server set up in collaboration with MSU-TRFIC. (http://www.bsrsi.msu.edu/trfic/MIOMBO/).

- *The Southern Africa Millennium Assessment Project*

This was a regional SADC level studies project to which the Miombo Network's renowned researchers and scientists made contributions. Five key studies were conducted: the Zambezi basin assessment; the Okavango basin assessment; the Gariep basin assessment; the Gorongosa-Marromeu complex assessment and the Southern African regional-scale assessment.

Objectives of these studies were to among other things:

- Integrate formal and informal knowledge about ecosystem dynamics, the impact of ecosystem change on the quality and quantity of ecosystem goods and services, and linkages between social and ecological systems at multiple spatial scales;
- Provide scientific information to guide land use and environmental planning decisions in the SADC region;
- Identify information essential for sustainable resources utilization and management;
- Develop methods to undertake cross-sectoral assessments and effectively integrate information at different scales;
- Build the capacity of local resource users and decision makers at regional, national and local level to carry out integrated ecosystem assessments and act on their

findings;

- Increase access to data and scientific information to enable the different stakeholders to make wise environmental decisions and to comply with international environmental agreements;
- Assess the present condition, changes and trends in ecosystems, develop plausible future scenarios of change in the drivers of these, and determine the consequences for the long-term capacity of ecosystems to provide goods and services;
- Develop options to improve the management of ecosystems to ensure their sustainability and to satisfy human needs.

- *Adaptations to Climate Change and Flood Monitoring (AIACC)*

The overall goal of this project was to assess vulnerability to climate variability and extreme events in the Miombo region, mainly in terms of life, livelihoods, land use as a basis for production and livelihoods, and to guide adaptation. Specific objectives were to:

- Develop a regional integrated assessment team for the Miombo region and establish a summer institute on climate change.
- Develop critical datasets, a regional integrated model and other tools for analyzing impacts and adaptation for the region.
- Conduct case studies of recent droughts and floods in countries of the region (Zambezi River Basin).
- Apply the data, models and case study results in assessing vulnerability of life and livelihoods in the Zambezi/Miombo region under future climate change, with particular emphasis on droughts and floods.
- Identify critical adaptation plans of action across scales within the Zambezi River Basin – Miombo Region.

- *Woodland Carbon*

This project, in which the Miombo Network collaborated in, aimed to achieve a number objectives:

- Establish a regional observatory of land cover/land use change (LCLUC) that includes a set of Landsat MSS, TM and ETM, to provide a basis for collaborative assessment of land cover change at the regional level (this system was crowned WoodCAS – woodland carbon accounting system).
- Develop baseline land cover products for major gaps identified for the Southern Africa region, as well as regional products that highlight hot spots of land use change and major drivers of change.
- Collate forest inventory data from forest plantations in the region as well as soil carbon information as basis for a carbon accounting model and system.
- Implement carbon models based on CENTURY for below-ground carbon and biomass-based approaches for above-ground carbon for use in predicting spatially

explicit carbon accounts and potential for carbon improvement, for the southern Africa region.

- Develop a decision support tool that would be accessible via the web, and would enable exploration of carbon projects in landscapes of the region.

- *Linking Land Use with Carbon Assessment*

This project aimed to study Carbon Stocks and Nitrogen Stocks of various African Ecosystems under different management scenarios. Some of these projects are on-going but others were concluded.

With all these efforts, mostly carried out between 1995 and 2002, the Miombo eco-region activities have been conducted at more localized levels, and the membership had virtually disintegrated, a situation that called for a new reinvigorated initiative. The Network therefore met in July, 2013 in Maputo, Mozambique to **Re-launch the GOFC-GOLD Miombo Network with the theme: Building a scientific platform to address land use and land cover changes in the Miombo woodlands of southern Africa.** The list of participants is presented in Annex I.

The meeting had the following objectives to fulfill:

- To review the GOFC-GOLD Miombo Network goals that are:
    - To develop a fundamental understanding of the rates and causes of land cover changes in relation to land use patterns;
    - To predict the consequences of land use/land cover changes on regional climate, natural resources, water resources, carbon storage and trace gas emissions;
    - To develop a predictive understanding of Miombo woodland structure and function;
    - To understand determinants of distribution of species and ecosystems in the Miombo.
- To review and up-date the Miombo Network Science Plan.
- To evaluate the availability and suitability of remotely sensed data in support of the Miombo Network's Science Plan;
- To develop a 3-year Miombo Network Plan of Action.
- To distribute Landsat data from the 2012 GOFC-GOLD data training initiative.
- To explore the role of the Network in developing regional monitoring and research expertise for REDD+ monitoring.
- To review REDD+ requirements and ongoing monitoring activities in the region.
- To develop a plan of activities to strengthen forest carbon monitoring capacities through exchange and research synthesis.
- To discuss the GOFC-GOLD Network governance:

- o Review of sister networks such as SAFNet and OSFAC governance approaches and development of Miombo Network governance approach;
- o Elect the Miombo Network Executive Steering Committee.

2. Workshop Proceedings

The MN meeting was organized in 6 sessions divided by themes that represent topics of relevance to achieve the objectives, namely: Miombo woodland- country status, Monitoring of Miombo woodlands, measuring carbon stocks and REDD+, road map development towards the science plan, networking in southern Africa and fields of cooperation and Miombo Network governance. The detailed program of the workshop is presented in Annex II. Each session was composed of 3-4 presentations followed by plenary discussions, moderated by a facilitator and registered by 2 rapporteurs. The following is a summary of each presentation which highlights the main issues raised by the presenters. A collection of workshop's Pictures is presented in Annex III.

2.1. Opening ceremony

The session started with opening speeches from the Dean of the Faculty of Agronomy and Forest Engineering (FAEF), Prof. Emilio Tostão. The Dean emphasized the importance of the meeting to achieve FAEF's challenge of engaging in partnerships and networking across the region and abroad, which is crucial to meet its objective of carrying out research of relevance to the country and the region. He also stressed the role of the Miombo Network in propelling the activities of FAEF over the years.

Following, the representative of the National Directorate of Land and Forest (DNTF), Mr. Joaquim Macuacua, intervened by stating the importance of the Miombo Wooldands in Mozambique and in the region. Given this importance, Mr. Macuacua emphasized the need for a strong and active network that is able to influence policies and decision-making in the country and the entire Miombo eco-region.

Finally, the Deputy Vice-chancellor for academic affairs of the Eduardo Mondlane University (UEM), Prof. Ana Mondjana, emphasized the importance of the Miombo Network in promoting collaborative research that helps shaping decision-making in the region. Prof. Ana Mondjana also mentioned that this activity is particularly important in promoting UEM's Research Policy implementation. Prof. Ana Mondjana wished a productive event to the group and officially opened the workshop.

The opening session also included two contextualizing presentations. The first presentation was by Dr. Brice Mora, a representative of GOFC-GOLD, who introduced the

context of the MN within the GOFC-GOLD umbrella. Following, Dr. Dominick Kwesha and Dr. Paul Desanker, former board members of the MN, presented the history of the network.

Brice Mora referred the context in which the GOFC-GOLD emerged originally under the Committee on Earth Observation Satellites (CEOS) and later as one of the Panels of the Global Terrestrial Observing System GTOS (FAO GTOS Secretariat). GOFC-GOLD is a coordinated international effort to ensure a systematic and continuous program of space-based and on-the-ground forest and land cover observations. GOFC-GOLD operates as a network of participants implementing coordinated research, demonstration and operational projects and a vision to share data, information and knowledge, leading to informed action and decision support. It is considered as a long-term process of building an improved match between Observations, Data Products and User Needs. Within its structure the GOFC-GOLD has two Implementation Teams (Land cover and Fires) and supports several regional networks around the world. The Miombo Network is one of such regional networks, which belong to the Land Cover Implementation Team, thus its focus is on land cover & land cover change issues. The presenter referred some examples of GOFC-GOLD achievements namely:

- Land Cover: Extensive use of historical archives, global product, emphasis on validation, LCCS classification scheme.
- Fire: Global fire risk using satellite data, global and regional fire assessments.
- REDD: Several activities around the Sourcebook and beyond.
- Networks: Bringing regional expertise to bear in many parts of the world.
- Biomass: Galvanizing the scientific community to pursue new opportunities.

Brice also mentioned future directions and priorities for the GOFC-GOLD land cover implementation team namely:

- Operationalizing Monitoring (Empowering Countries) by developing and disseminating higher order products, time series products, multi-sensor products, multi-agency products and big data capabilities.
- Methods and Guidance: synthesis on existing monitoring methods exploration and R&D (assimilation).
- Validation: Coordination (methods and distribution), Population of Datasets, Land Cover Change among others.
- Capacity Building.

Paul Desanker and Dominick Kwesha gave a presentation on the history of the MN since its start up in 1995, under the auspices of the IGBP/IHDP Land Use and Cover Change (LUCC) Project and the IHDP/IGBP/WCRP Global Change System for Analysis, Research and Training (START). MN's launching was motivated by north-south collaboration and science to policy/management needs and the fact that over the years, many projects and

active groups/partners were active, both in the region and internationally, the background refers.

2.2. SESSION 1: Miombo Woodlands - Country Status

This session's objective was to give an overview of the Miombo Woodland's status in the region. Representative of each country gave a summary of the status in terms of the current situation, deforestation rates and driving factors and mitigation measures currently in place.

Angola

Virginia Lacerda Quartin from the University Jose Eduardo dos Santos presented the country status for Angola. The miombo woodlands represent the main forest ecosystem in this country, about 80% of the forest ecosystems. The MW is dominated by typical miombo species but *Isoberlinia angolensis* and *Brachystegiae spp.* are considered important tree species for charcoal, while *Marquesia macroura*, *Pterocarpus angolensis*, *Afzelia quanzensis* and *Guibourtia coleosperma* are important for timber. The deforestation rate in the country is high but with very high spatial heterogeneity. Huambo (with 31%) and Huila (with 27%) are the provinces with the highest deforestation rates. Energy in the form of charcoal and firewood are the main forest resources in Angola, but other products include: honey, raw materials, medicinal plants and fruits, which together contribute to food security for rural communities. At the current level of country growth and development, there is an increasing need for forest resources specially timber for the industry, housing and human settlement. This calls upon an ever-growing need for new and innovative forest management systems compatible with economic income and forest functions. The country has adopted several mitigation measures and actions including:

- The national forest inventory in 2012. This is an important activity that is in course and will update the deforestation figures from 2000. This activity is being conducted in collaboration with the FAO.
- Monitoring of Deforestation in Huambo province is an ongoing collaborative activity with SASSCAL and intends to detect the levels of deforestation while at the same time identify areas for protection.
- Development and implementation of the Forest Engineering Bsc. course since 2010 at the University Jose Eduardo dos Santos in Huambo in collaboration with the university of Cordoba and the Spanish Agency of Cooperation and Development (AECID). Currently there are only 11 forest engineers in the country thus an urgent need to increased numbers of human resources in the country.

Angola expressed an urgent need for capacity building in remote sensing techniques and other fields, to address forest resources as well as the development of infrastructures and human resources to use and apply remote sensing techniques.

Malawi

David Nangoma from the Mulanje Mountain Conservation Trust presented the country status for Malawi. Between 2000 and 2010 Malawi has undergone fast miombo cover changes (estimated at 2.3% per annum) especially in the north and south regions. For example, in 1973, 45% of the land in the country was covered by forests, but in 2010 only 20% of the forest cover remained as forest. Of the existing forest cover, miombo accounts for 92% of the forested land but it is now confined to protected areas. The main deforestation drivers in Malawi were listed:

- High Human population, thereby increasing demand for:
    - Land for settlement & farming;
    - Biomass energy and non-energy wood demands.
- Agriculture expansion;
- Uncontrolled forest *and* grassland fires;
- Inadequate government budgetary support;
- Political influence;
- Ruralization;
- Brick making.

Energy from biomass represents about 89% of the total energy consumption in the country and of this, the household sector is the most important in Malawi. The country has been engaged in several forest and tree management activities including:
- Wood Energy Plantations (World Bank);
- Blantyre City Fuel wood Plantations (NORAD);
- Improved Forest Management for Sustainable Livelihoods Programme (European Union);
- Forestry Replanting and Tree Nursery Project (GoM);
- Tree Planting and Management for Carbon Sequestration and Other Ecosystems Services (GoM);
- The Income Generating Public Works Programme (GoM/European Commission);
- Sustainable Management of Indigenous Forests Project (WESM, NGO);
- Mulanje Renewable Energy Agency (MMCT, NGO);
- Mountain Biodiversity Increases Livelihoods Project (MMCT, NGO).

In terms of monitoring, research and information dissemination the following have been important activities in Malawi:
- Permanent Sampling Plots in many forests (Forestry Research Institute of Malawi);
- The "Forest Resource Mapping" project under the "Forest Preservation Programme" (GoJ/GoM)

Capacity building is a major need in the country and in relation for land cover and land

cover changes the following were mentioned:

- To carry out forest inventories using standardized data capturing protocols for the miombo eco-region;
- To interpret satellite imagery and carry out GIS related forestry assignments;
- To be able to use various satellite imagery & monitoring tools for forestry management;
- To train the media on packaging and dissemination of forest and forestry related information.

Zimbabwe

Isla Grundy from the University of Zimbabwe stated the current situation of the MW in Zimbabwe, which is currently unknown as no formal research and estimations haven been performed since before 2000. The last estimations for the country report 53% of the land was covered by miombo in the 90's but by 2005 only 43% of the country was covered by the woodlands. However, miombo has undergone major changes mainly due to agricultural activities. The estimations indicate high figures of 330.000 ha annually in 2013 (CarbonGreen, 2013). Since 1986 some miombo areas reduced by 15-23% down to 3 - 4% cover and they are estimated to be totally deforested by 2014 -2016.

Apart from agriculture the main deforestation drivers in Zimbabwe are:
- Settlement expansion;
- Harvesting of non-timber forest products (NTFPs);
- Illegal mining operations;
- Infrastructural development such as dam and road construction;
- Fire.

There is a tension between the expansion of arable land and the preservation of wooded areas as many protected State Forests in Zimbabwe are now inhabited and cultivated. Recent tobacco boom amongst smallholders is catastrophic. Biomass consumption for energy has also increased in the last few years due to shortage of electricity in rural, peri-urban and even urban area. Another main limitation to the development of the woodlands in this country is low the low value attributed to the ecosystem services from woodlands, thus the potential for engaging people in ecosystem protection and recovery is compromised. Currently there is limited government and donor funding to help leverage forest activities and rehabilitation of the woodlands.

Besides limitation with protection and rehabilitation of the woodlands there have been several mitigation initiatives in Zimbabwe, including:
- Good policies and laws in place, but little implementation;
- Normal government activities left to NGOs and private sector;

- Motivated chiefs will conserve their areas;
- Private tree planting initiatives promoted by deforestation around urban areas – FOTE;
- Focus on income generating projects to promote woodland conservation as a second objective;
- REDD+ initiatives: none yet but several in the pipeline; and
- Government TWEP (Tobacco Wood Energy Programme) requires tobacco growers to plant 0.1ha of trees for every 1ha of tobacco grown.

The country expressed the following as its main capacity building needs:
- Growth and establishment of tree seedlings amongst farmers, community and schoolchildren;
- Sustainable tobacco production with reduced fuel requirements;
- Coppice management in miombo;
- Greater implementation of forest policies and laws.

Mozambique

Regina Cruz from the IUCN, Mozambique addressed the MW status for this country. Mozambique is one of the fast growing economies in the region and thus the dynamics of the forest resources is very high. The last forest inventory from 2007 estimated about 40,000,000 ha of forest, of which miombo woodlands comprised the greatest proportion. The annual deforestation rate in the country is estimated to be 0.58/year, which means a loss of about 219,000 ha per year. The main drivers behind these changes are shifting cultivation, firewood and charcoal production and commercial agriculture including forest plantations. Although highly important in the country, the current use of miombo resources is not estimated, but over 50% of the population depends on it to obtain fiber, food and medicines as well culture services.

National mitigation measures include forest management initiatives as well as those related to REDD+. Ongoing collaboration in the country has helped leveraging forest research in Mozambique. Some of the initiatives include the project with CIFOR and ICRAF for developing a sentinel site for Southern Africa´s Miombo Woodlands in north-western Mozambique; Technical Cooperation and Grant Aid of Japan Government-JICA to DNTF/MINAG-Project to establish REDD+ Monitoring System. These projects are under the supervision of the national directorate of forest and land.

Capacity development needs in Mozambique include the following:

- Awareness raising;
- Training;
- Forest monitoring;

- Law enforcement.

Zambia

Stephen Syampungani from the Copperbelt University addressed Zambia's current status. The country is the center of endemism of miombo woodlands and is currently covered by three main vegetation types, of which miombo comprises the largest amount - 67% of the country. Annual deforestation rates in this country vary among provinces, between 0.20% in southern and western provinces and as high as 2.47% in Luapala. At the national scale the rate of deforestation has doubled (from 0.34 to 0.66) from the period of 1965 to 1996 to the period between 1996 and 2005. Main drivers of change in Zambia are as in any miombo country, slash and burn, charcoal production, infrastructure development and fires. Underlying causes of deforestation include: a lack of political will and inconsistencies in policy and legislation, poverty and rural livelihood, limited institutional framework and inadequate staffing within the relevant government establishments.

The country is implementing a series of mitigation actions, key amongst which include:
- Community participation in forest management;
- Working with other organization e.g. CIFOR;
- REDD+ programme-UNDP-Forest Department;
- National tree planting funded by Copper Mines.

In addition, several international organizations and institutions have helped the country in implementing mitigation actions. Examples of such support are:
- Forest restoration research from Swedish Science Council;
- Systematic review of Carbon stocks and fluxes for miombo eco-region supported by CIFOR;
- SASSCAL project on Trial plots-Mwekera trial sites.

Tanzania

Alfan Rija and Lawrence Mbwambo both from the Sokoine University of Agriculture, Tanzania Forest Research Institute presented the Miombo woodlands status. Forests in Tanzania cover an area of 33.4 million ha of which 90% is represented by Miombo Woodlands distributed in central, southern and western Tanzania. The woodlands cover about half of the land territory and accounts for over 75% of the wood volume in the country. Estimations of biodiversity and biodiversity conservation issues have been considered secondary in Tanzania, which makes the understanding of miombo status difficult. However, there are studies indicating the biodiversity and woodland structure

may vary according to the management system. The presenters did not give figures on ecosystem deforestation rates but several studies in different parts of the country indicate high deforestation rates.

Main drivers of change in Tanzania are: subsistence farming, energy production, timber production, fires associated to other human activities, tobacco plantations, and collection of forest products. There are also indications that poaching has affected wildlife populations in the country and this may have an impact of woodland structure.

Mitigation measures that have been implemented in Tanzania include:
- Participatory Forest Management Programs. They were practiced in 2,323 villages (4. 12mil ha);
- REDD+ program started in 2007 but several activities were on ground before;
- Climate Change Impact, Adaptation & Mitigation (CCIAM) program, based at Sokoine University of Agriculture;
- NAFORMA program, which focus on forest inventory & map forests nationwide to provide status for carbon potential for the REDD initiatives.

Tanzania has been supported by several international and regional organizations in order to implement mitigation and adaptation activities. Some examples of this support are:
- Local NGOs e.g. Tanzania Forest Conservation Group (TFCG), which assist enhance assimilation of REDD+ activities in local communities;
- Village Governments (Local authorities) in implementing community based programs;
- DANIDA, FINLAND, WB supporting PFM in several parts of the country;
- REDD+ initiatives supported by government of Norway;
- FAO-Fin supported initiation of National Forest Monitoring & Assessment (NAFORMA), 2009;
- Tanzania-South Africa Fire Management Coordination Project- helps to address problems of forest fires.

Countries presentations clearly indicated several science/research and Earth Observation Systems (EOS) needs including:

Science/Research needs:
- Need to improve Inventories of standing stocks nationally:
  - Especially in tobacco growing areas and other associated lad uses;
  - Update total deforestation rates using new generation of high to medium resolution satellite images.

- Establish a network of Permanent sample plots for woodland monitoring;
- Improved understanding of value of natural woodlands to poor rural communities;
- Research into fast-growing alternatives to miombo woodland or Eucalypts as fuel to cure tobacco or energy in order to reduce fuel consumption;
- Find alternative timber species such as the giant Timber Bamboo *(Bambusa oldhamii);*
- Improved coppice management techniques;
- Research into sustainable tobacco production;
- Research into efficient charcoal production technologies;
- Alternative fuels - carbon dust briquettes; bamboo etc.
- Better barn management to increase heating efficiency
- Quantify Non Forest Products;
- Payment for environmental services (REDD+ and other).

Earth Observation Systems (EOS) Needs:
- Access to optical (ikonos, Geoeye and other high resolution images) and Radar imagery (Alos Palsar);
- Capacity building on the use and analysis of EOS;
- Development of infrastructures to allow better utilization of EOS;
- Access to new EO methods;

In general the countries suggested several collaborative activities for the miombo eco-region including:
- Carry out collaborative monitoring of miombo forests across the region;
- Share geo-info data on land cover change;
- Raise governments' awareness on LCC for sound policies towards conservation of miombo;
- Build capacity within and among national and regional institutions to integrate land cover data into decision-making processes, etc.

Session 1 included also an overview of the SADC forestry, REDD and fire program by Moses Chakanga from the SADC Secretariat. Discussions focused on common challenges for management and research needs in the region and how the network can contribute to the SADC forestry program. The presentation emphasized the origin of the SADC forestry program, based on the fact that forests are an important source of resources for communities and regional economy. Given this the SADC treaty calls upon a sustainable use of forest resources to improve the living standards of the people of the region and achieve regional integration and consolidate peace. Treaty's implementation is achieved through three main policy frameworks: Protocol on Forestry (2002); SADC Regional

Indicative Strategic Development Plan (RISDP) and Forestry Strategy (2010). SADC's forestry strategy (2010-2020) relies on several priorities namely:

- Climate Change adaptation & mitigation;
- Fire management;
- Trade in forest products;
- Participatory forest management;
- Conservation of catchment forests;
- Forest resource information;
- Energy supply and rural poverty; and
- Capacity improvement.

The presentation also gave a summary of SADC's fire and REDD+ programs, its aims and components. The program is being implemented in four pilot countries: Botswana, Mozambique, Malawi and Zambia. The following issues were raised as the main needs to SADC's forest sector:

- Data and information on indigenious forests;
- Land cover assessments;
- Forest Inventory (Vol. and biomass equations);
- Fire; and
- Valuation of forest sector contribution to national economies.

The SADC forest program requires linkages with scientific and practitioners networks in the region. Articles 4 and 22 of the Protocol on Forestry calls for Member States to collaborate with:

- Non-governmental organisations;
- Inter-governmental organisations; and
- Other entities and institutions (e.g. Networks – SAFNET, MIOMBO).

Chakanga emphasized the role of MN in implementing the SADC Protocol on Forestry through, among others, provision of scientific data and information on SADC forests.

The final presentation in this session addressed issues of fire monitoring in southern Africa from Riaan van den Dool from the CSIR Meraka Institute. The presentation stressed main factors associated with fires in Southern Africa such as: cultural perspective, fire management (different fire management strategies may influence the role of fires in the miombo ecosystem but information is needed), detecting fires from space (AMESD and

MESA projects were mentioned), Technology (AFIS portfolio was briefly discussed) and Community (social programs such as job creation and training and education are important). The presenter referred several AFIS developments such as: Burnt Area Derived Products, Burn sum layer MODIS time series from data cubes, AFIS Mobile App (iOS and Android), Local FDI indicators, Publishing of fire info / alerts (social media etc., GeoPhoto upload: crowd sourcing / user participation. In conclusion the presenter indicated that:

- Not all fires are bad;
- Satellite based monitoring solutions help to manage wildfires and minimize destruction caused by fire;
- The role of satellite based monitoring in carbon offset projects.

Summary of Session 1's Outcomes:

From the foregoing, it is clear that whilst countries have well developed forest management policies *and possibly* good legislative instruments, the Miombo woodlands have experienced modifications across the region due to several common factors (energy, mining, shifting cultivation, tobacco being the main referred driver of deforestation). It is also clear that in all countries of the region, the Miombo, quite increasingly, play significant socio-economic roles, which apparently are not well, articulated in the national governments development agendas. This is shown by the lack of political will by many governments to take Miombo woodlands conservation seriously in favour of other competing economic agendas. It is also clear that at the rate the Miombo woodlands are diminishing, it is difficult to carry out meaningful inventories using conventional methods without the help of technological earth observation systems. Current forest and woodland inventories and maps need to be revised to give a clear picture of the woodlands extent and coverage in order to contribute to management decisions. This session therefore highlighted a number of issues that the MN needs to quickly bring to light and help governments and development partners to address.

The session also acknowledged the wide range of initiatives either with the support of international or national institutions that are being carried out in the region. Potential for collaborative initiatives was discussed during the session. MN must have an active role in the SADC forestry program for which a policy brief aiming at the next SADC forestry program meeting is planned.

2.3. SESSION 2: Monitoring Miombo Woodlands

This session had 4 invited speakers which presented and discussed data, methods and techniques for Miombo woodlands monitoring including the existing opportunities with

new Landsat free data, improvements in land cover mapping using a user friendly algorithms and the use of remote sensing for fire and woodlands structure assessment.

The first presentation by Matt Hansen from the University of Maryland focused on forest cover monitoring in Africa using Landsat data. The presentation informed about the results of a project that indicates countries in the region that have loss and gain of forest cover. For large-scale monitoring of forest cover the presenter referred several needs: Systematic global acquisitions, No/low cost, Easy access and Minimal pre-processing. The presenter indicated several methodologies of calibrating and improving Landsat data analysis with clear examples of results for several parts of Africa. For example Mozambique presents the second highest forest loss, after DRC; and Tanzania came in third place. Methods included pixel-based processing to overcome constraints due to cloud cover in individual scenes. Also, methods for rapid processing are well developed, and they can be deployed to national application centres (some financial resources required for high-end computing equipment and short-term training). The turn-around, it was mentioned, can be very quick, and there is a need to identify new and better entry points - no need to start from raw data and can use high-level processed data and standard products to customize to local classification systems. The system can also produce cloud-free composites using a running window of 3 years or less. It is recommended to utilize all data available for a given location, not once scene.

In summary the presenter indicated the following major points:

- Pre-processing of data sets for user-friendliness is critical:

  - With national-scale normalized cloud-free inputs, almost any method of characterization can work;

  - Automation of pre-processing enables fast *iteration* of historical record as new understanding and/or methods are realized.

- Key to activity data in addition to quality is latency:

  - How to produce timely information on national forest dynamics?

  - Methods should be more formally evaluated in this regard – days/weeks for production of national-scale products.

- Analyst-driven characterization is key to providing ownership of the mapping process and products.

- Validation is critical:

- - Not ground lies, not model sensitivity, not using opportunistic sites;

  - A probability-based sample of independently-derived estimates of the variable of interest is required.

- Landsat acquisition strategy, cost and access model and pre-processing should be emulated by other systems – Sharing of methods within this context is very straightforward.
- Portability – the method has been implemented globally and at national scales for Indonesia, the USA, European Russia, the DR Congo, the Republic of Congo, Peru and Colombia.
- Very high spatial resolution capabilities should be initially used in sampling mode for validation and/or estimation (not for mapping).

The second presentation by David Roy from South Dakota State University addressed Landsat satellites, data access and the Landsat Science Team. The presentation focused on the existence of vast amounts of landsat data now freely available. The new generation of Landsat 8 data with improved spectral bands and better radiometric resolution is highly valuable. Landsat 8 has more data because it covers 60% more than previous landsat sensors and has better image data. The priorities of the Landsat team for the next 5 years is to improve data accessibility for the MN but with internet limitations in the region other ways of dissemination may be explored such as CDs and FTP systems.

The third presenter, Sally Archibald from CSIR – South Africa focused on the correspondence of Miombo vegetation to high rainfall savannah in Australia - an analysis of climatic drivers, fire patterns and tree life histories across two continents. The Miombo woodlands have correlates globally e.g. high-rainfall savannas in South America and Australia. Their vegetation is not always at 'climate potential' – i.e. the climate and soils can support higher woody biomass than is usually found because disturbances like fire (and human fuelwood harvesting) keep these systems below what potentially could be supported by climate. Whether or not Miombo woodlands should be managed to maximise tree biomass is something that needs to be assessed against the other ecosystem services that woodlands provide (including grazing, fuel wood, and medicinal plants) and against other biodiversity benefits of these mixed tree-grass systems. The author referred that definitions are important: Miombo woodlands should NOT be treated as forests in REDD+ initiatives, because they are ecologically very different from forests (Ratnam 2012). Assessing land cover change and degradation in Miombo is therefore a complicated process and the MN needs to be driving this process. The MN should also be acting to demonstrate the value of traditional African burning practices, rather than always assuming that fire use in Africa is detrimental. The author also stressed out the importance of understanding the ecological cues for odd leafing strategies (before the first rains arrive) – if they are driven by temperatures then changes in temperatures in

the next century could have a serious an impact on Miombo.

Following was a presentation by Renaud Mathieu from CSIR on Remote Sensing Research for spatial assessment in SA savannas and woodlands. Confirming that woody structure plays an important role in a wide range of ecological processes in Miombo woodlands and savannahs and has strong implication for biodiversity conservation, food and energy security, LULC and climate change. In southern Africa most datasets related to woody structure are coarse-scale global datasets and have not been widely validated for local biomes. Remote sensing techniques need to be implemented in a cost-effective, and repeatable manner, over large scale, and their performances need to be assessed for the region. The presentation reports on the progress of an on-going research program in the South African Lowveld to assess multi-scale and multi-platform remote sensing technologies to quantify and map woody structure parameters (woody height, cover and biomass) at a variety of scales. The program also seeks to enhance the technical capacity in the region to fully exploit the potential of airborne LiDAR and Synthetic Aperture Radar imagery in a combined fashion, technologies for which limited expertise is available and which are arguably the most promising approaches for 3D vegetation assessment. The presentation demonstrates i) the development of LiDAR-based woody maps and their use in the cal/val of a wide range of SAR products (TerraSAR-X, ALOS PalSAR, Radarsat-2, ENVISAT ASAR), and ii) how strategically located tracks of LiDAR data can also improve on the understanding of long term dynamics and effects of drivers (human, fire, herbivory) in mixed tree-grass ecosystems. It was concluded that there is a timely opportunity to develop SAR-based products of woody cover and biomass in the region and that this will require a coordinated effort of SADC countries and a regional network of long-term pilot sites to support large-scale products.

Summary of Session 2's Outcomes: there is a varied level and type of remote sensing data and methods available out there for woodland monitoring. Some of the data is freely available (such as Landsat) but others need some investment (LiDAR, AlOS PalSAR, etc). Methods for improved land cover classification and analyses are available and can be adapted to the Miombo woodlands conditions and implemented in the region. Some investment must be done in order to utilize these new techniques and methods. Adjustments include a clear definition of MW in the context of REDD+ and carbon estimation initiatives as they cannot be considered as forests. There is also a need to better understand the driving factors (e.g. climate and fires) to address MW ecology and monitoring. Monitoring of this ecosystem requires a network of long-term sample sites.

2.4. SESSION 3: Measuring Carbon stocks and REDD

This session comprised of 8 communications, which covered a varied range of related topics such as the GOFC-GOLD sourcebook, carbon estimations methods, and challenges in estimating carbon and community issues.

The first presentation by Brice Mora from the GOFC-GOLD was an Overview of REDD+ and the GOFC-GOLD REDD+ and Sourcebook activities. It indicated the objectives of the sourcebook which are:

- To provide transparent methods that are designed to produce estimates of changes in forest area and carbon stocks in a format that is user-friendly;
- To complement the IPCC GPG-LULUCF (2003) and IPCC Guidelines-AFOLU (2006) by providing additional explanations and enhanced methods;
- To foster technical understanding and build confidence for political discussions on specifying REDD MRV options and requirements; and
- Support REDD early actions at national level.

The sourcebook has about 1000 registered users, mostly from NGOs and government institutions that work on remote sensing applications. Last version released in 2012 for COP-18 and is aaccessible from the GOFC-GOLD LC PO website (www.gofcgold.wur.nl/redd). It has been advertised to more than 3,500 persons (beyond registered user list) via GOFC-GOLD LC PO newsletters and social media and downloaded 4,400 times in 2012.

The second presentation by Maria Pereira from the University of Wageningen focused on a proposed research and analysis for assessing REDD+ opportunities in Southern Africa. The research focuses on three main questions: where and why the forest dynamics happens?, what are the driving factors and the role of fire and what are the impacts on carbon stocks? The research project will have as a case study Mozambique as one of the second country with highest deforestation rates in Africa.

Joaquim Macuacua from DNTF presented a communication on the Development of Sustainable National Forest Resource Information Platform for Monitoring REDD+. The presentation informed about REDD+ activities in Mozambique in collaboration with Japan Grant Aid and JICA, which intend to develop a monitoring system to engage the country in the carbon markets. The country is taking a phase approach based on readiness (development of a strategy and capacity building), implementation (implementation of the strategy and demonstration initiatives) and full implementation based on research based action with MRV. The author briefly mentioned the history of developing policy for REDD+ implementation: i) 2009, FCPF R-PIN was submitted by DNTF-MINAG and MICOA and was approved to prepare RPP; ii) In March 2012, the draft of RPP was finalized and

submitted to FCPF by the Government of Mozambique represented by MINAG-DNTF and MICOA (with a support of JICA & DANIDA); iii) In January 2013 the last version of RPP was submitted and Grant Aid Agreement was signed in June. Existing national REDD+ initiatives include:

- Tree planting using indigenous species (Presidential initiative: One child one tree, one forest one community leader);
- Readiness preparation (FCPF);
- Establishment of National Sustainable Forest Resource Information Platform for Monitoring REDD+ supported by JICA;
- SADC-GIZ for MRV, for Mozambique in Mopane ecosystem in 26000 km^2 supported by SADC-GIZ;
- Some voluntary carbon projects by the private sector;
- Assessment on the Mangrove for carbon estimation in Zambezi river Delta with support of the USAID;
- Some studies on-going by research institutions.

The presenter did also mention the ongoing initiative of establishing a national Sustainable Forest Resource Information Platform for Monitoring REDD+, which will be coordinated and implemented by DNTF. This initiative intends to create a database system on forest resources, which also includes REDD+ registry, to develop a basis of national MRV, create a national RELs/RLs (Reference Emission Levels) for the Forest Resource Information and prepare a database on biomass and carbon estimations.

Jonas Franke from Remote Sensing Solutions, Germany made the fourth presentation on this session on Challenges and possibilities of remote sensing-based Miombo woodland inventories for forest management and REDD$^+$. This presentation addressed the capabilities of remote sensing high-resolution data as an integral part of REDD+ MRV (Measurement, Reporting and Verification) systems. Examples of such applications were reported such as the establishment of benchmark of Miombo forests in Mecuburi Forest Reserve, Mozambique. This example indicated the potential use of high-resolution RapidEye data to establish Historical baseline, current benchmark and future monitoring of forest cover and carbon stock. However, ground-based forest inventories are very important for RS-based monitoring. The presenter also mentioned the capabilities of low-resolution fire products for identifying fire clusters and provide more reliable assessments of patterns of fire occurrence. LiDAR can provide precise measures of forest structure and estimates of carbon stock. But an up-scaling approach using field plots, LiDAR transects and large-area coverage of satellite data is recommended. Finally, the author mentioned that high-resolution systems proved to be very suitable to monitor Miombo forest and its changes at small spatial scales. But the period for acquiring satellite data is crucial due to

seasonal effects of Miombo forest (phenology, fire occurrence and fast re-growth). „End-of-wet-season-imagery" is required for Miombo forest/woodland mapping (benchmark and change monitoring) and „end-of-dry-season-imagery" is required for detailed burned land cover mapping.

Iain McNicol and his team from the University of Edinburgh gave a presentation on Measuring and monitoring aboveground woody biomass from the stand to the landscape. The presentation was focused on a REDD+ pilot project focused in fire management in Tanzania, which was a collaboration between MPINGO conservation and development initiative, a Tanzanian NGO and UoE. One of the big questions of this initiative was understanding how forest biomass vary in space and time and what best approaches there are to understanding and mapping these patterns from the local level, right up to the regional scale. The presentation was then focused on providing information on how the question was addressed. Permanent sample plots were established in the field in which woody carbon and biomass stocks were assessed and related to the forest structure and diversity. These links are important to address how management activities can, not just promote carbon sequestration, but also have the benefit of maintaining key ecosystem services, such as the provision of timber and non-timber products as well as biodiversity. The authors also mentioned the use of Radar data as a novel method for mapping and monitoring AGB at high resolution, despite errors caused by i.e. topography. Simple automated processing chain has been developed to create AGB maps but detecting small changes (i.e. growth rates and minor degradation) remains uncertain at small scales (i.e. plot level). Thus it still requires ground data for calibration/validation and MORE PERMANENT SAMPLE PLOTS are needed in the region.

Kaala Mombe from CIFOR gave a presentation on Communities in the development of sub-national MRVs: do they really matter? The presentation related the potential of REDD+ project in the region but indicated that consultation and inclusion of local people is highly relevant for the sustainable land and forest management. Potential benefits from engaging people were mentioned: i) economic - from REDD+ payments (Carbon as a commodity can be managed and traded; household and community income stream) and ii) land and resource tenure security. The **involvement in measurement and monitoring** of forest carbon by local people can empower them as co-managers of areas under REDD+ projects. The presenter mentioned an example of a project in Zambia with the support of USAID, which intends to, among other things, engage local communities in forest management activities. The main role of communities in this project is seen as:

- Local community members can generate data and information about forests and trees;

- Data generated can be used to develop management plans but scaling up to a district level MRV is difficult;
- Village level data use:
    - Nature of data forms important (volume vs number of stems);
    - Mental maps of where resources are vs real maps;
    - Can village level institutions enforce exclusion?
    - Can they enforce own members encroaching on other villages from forest products?

Fernando Sedano from the University of Maryland presented a communication on Future Carbon Emissions in the Miombo Region. Rapid urbanization is reshaping demographics, socioeconomic structures and land use management practices over Africa. Urbanization is connected to an increase in the demand for agriculture land to feed urban population. The pressure for new agriculture land is likely to result in a shift in land management, in which traditional practices will be partially or totally displaced. The process could manifest in different forms: while in some locations it will force the intensification and disruption of the shifting cultivation cycles, in some other locations land abandonment associated to rural- urban migrations could result in lower rural population densities and lower land use intensity. Fire is the main tool for land management in the Miombo region and changes in land management practices derived from population growth and migration will have an impact in the fire disturbance regime. However the potential responses of the fire disturbance regime and fire carbon emissions to changes in population dynamics are still poorly understood. The lack of a clear understanding of the land cover and land use pathways at fine spatial resolutions prevent a more precise characterization of the fire regime and the accurate estimation of fire carbon emissions.

In the final presentation of this session Armenio Cangela from the Eduardo Mondlane University presented preliminary results on the Characterization and mapping of fire regime in the Niassa National Reserve during 2000 to 2012. The presenter referred to his study in Niassa National Reserve, the biggest conservation area of miombo woodlands in the region. The study addressed fire regime and how this is related to elephant dynamics, the human factor and also climate. The map presented by the researcher indicates clearly that fire regimes can be widely vary across the region but only places where fires are highly frequent and intense should be considered as priority for management and control as they may drive the woodlands to a different state.

Summary of Session 3' s Outcomes: REDD+ programs and initiatives are on-going in the region and the use of high (spectral and spatial) resolution data (LiDAR, RADAR, etc) is crucial. Methods and techniques for carbon estimations have been tested in the region;

the REDD+ sourcebook from GOFC-GOLD is key to harmonize estimations. Validation is also a key for the success of REDD+ thus the establishment of a common protocol for carbon estimation and training on field and satellite data collections and analysis is needed. There is an urgent need to engage local communities in REDD programs but there is a need for a better engagement of those in sustainable forest management.

2.5. SESSION 4: Road map development towards science plan

This session was dedicated to group discussions on key science areas for miombo woodlands. The identified focal areas were: I. **Patterns and rates of land cover change; II. Land use change integrated analysis: Process and drivers of land use change, III. Carbon and Biomass; IV. Ecology V. Miombo ecosystem management and adaptation to climate change and VI. Human dimensions of the miombo ecosystem.** The objectives and terms of reference for the group discussions are presented in Annex IV.

For each group the following questions were to be responded to:

- What are the key issues (questions – science, policy, management) and what are 3-5 priority project activities for the miombo region?
- What are key available results, references, datasets, projects or programmes that could form the basis or contribute to the focal area activities?
- Who are potential partners (within the miombo region and from outside the region)?
- What could be the implementation strategy (as a network) – what are possible next steps and who would be willing to take the lead?
- How can research sites/sample plots best be coordinated and set up for the miombo region?
- What are immediate and immediate future opportunities for funding this work?
- What are synergies with other networks, projects and programmes (within and outside the region)?

Summary of group I's Discussions: Patterns and rates of land cover change

Group I discussed issues of patterns and rates of land cover change, looking into existing remote sensing based data and techniques of analysis. Following are the key points of discussion for each question.

Question 1: What are the key issues (questions – science, policy, management) and what are 3-5 priority project activities for the miombo region?

The group identified three main areas for scientific development of the MN within the

context of land cover land cover change:

1. Making MN land cover and land cover change maps with network ownership:

- Need a miombo wide mapping activity;

- Need a meeting or working group for network consensus on issues raised in question 3.

2. A Miombo Network land cover & land cover change catalogue (information on where to find and how to get products) hardcopy/email/internet.

3. Capacity Building on:

- Fundamentals of computers, GIS and RS;

- Mapping of land cover and land cover change;

- Stage mapping tool and give a 2-4 day training on forest characterization methods and implementation, including mapping forest extent and loss from 2000 onward.

In this topic the group identified a few training opportunities such as:

- GOFC-GOLD training materials for REDD+ monitoring and reporting. PIs: Prof Martin Herold, Dr Brice Mora in partnership with the World Bank;
- UMD satellite forest mapping. PI: Matt Hansen.

4. Data access:

The group raised the need for a server (cost estimated in ~$US8000) for software and satellite free distribution. A better reflection and analysis about the host organization, funding and server management should be performed before proceeding.

Question 2: What are key available results, references, datasets, projects or programmes that could form the basis or contribute to the focal area activities?

Currently there are no systematic land cover or land cover change mapping for all the Miombo Network region but there is a varied global, regional and national remote sensing based products that can leverage this situation:

- **Global land cover products:**
    - AVHRR land cover from the 1980's to 1990s, provide baseline but less reliable;
    - MODIS land cover product suite 2000+ (MOD12, MOD44), global annual products so can get land cover change;

- o European land cover product suite (AFRICOVER, GLC2000), limited repeat;
- o No land cover *change* products currently available;
- o Global forest and bare ground 30m change from UMD.
- **Regional/National land cover products and maps:**
  - o SADC land cover map, mosaic of national (only SA, Zim, Tan, Moz, Malawi) 30m Landsat products aggregated to 1km, harmonized into ~12 classes, one period mid-1990s, so no change;
  - o DRC national land cover made by UCL (Belgium) SPOT/Landsat, one period;
  - o DRC facet (Hansen), 2000-2005 product, 2005-2010 – forest cover and change 30m;
  - o SA NLC2000 30m (NGI);
  - o MZ 2001, 2005, 2010 in preparation, Landsat 30m;
  - o MZ, land cover change, post-flooding 2000 & 2007 in flooded areas;
  - o SA, land cover change alarm with MODIS time series.
  - o RCMRD (Nairobi), lc for Zam, Nam, Ken, Bot, Zim, 2000's Landsat 30m.
  - o Repatriated USGS Landsat archive and Landsat 8 from SANSA.
  - o Topographic baseline data is available from national mapping agency, some are becoming digital;

- There is Interest in the region to access active remote sensing data (LiDAR/RADAR) and hyper-spectral data for scaling up training data and for validation but need documentation and free data access;
- The group raised the need for validation of existing global land cover products and the fact that historical land cover training data is available in some countries;
- Issues of awareness of land cover products within and among countries are important and the Miombo Network should consider the production of a land cover & land cover change catalogue with information on where to find and how to get products. This catalogue could be disseminated in hardcopy, email or the internet.

Question 3: Who are the potential partners (within the miombo region and from outside the region)?

The following partners were identified:

- o Miombo network universities;

- o Miombo network govt. national mapping agencies, forestry and agricultural agencies;

- o Regional Center for mapping of resources for development (RCMRD,

Nairobi);

- o Several NGOs in all countries and internationally;

- o Private companies engaged in forest resources management;

- o GOFC/GOLD regional networks – SAFNet, WARN, OSFAC;

- o European and U.S. Universities;

- o U.N agencies (FAO, UNDP, UNEP), World Bank.

Question 4: What could be the implementation strategy (as a network) – what are possible next steps and who would be willing to take the lead?

There is a consensus for the need of a miombo wide mapping activity. However, the group agreed on the fact that the implementation strategy should include a reflection on:

- What period of analysis should be used e.g., 1985-1990, 1990-1995 (for rates)?

- What data/resolution - Landsat 30m or higher resolution?

- What land cover classes that can cross-walk to existing national classification schemes?

- What land cover change classes?

Other issues that are important to consider for regional land cover and land cover change analysis are:

- Harmonized training data collection;

- Processing location;

- Development or adjustment of classification algorithm e.g. random forest;

- Distribution format and media/internet.

Network members generate product from within the region supported by external experts if needed.

Question 5: How can research sites/sample plots best be coordinated and set up for the miombo region?

The group indicated that there is historical training data across the region, but is better

systematized in some countries than others, but it will be challenging to harmonize in terms of sizes, types and kind of data to be collected in this sample plots. Sample plot should cross-walk to classification scheme.

Question 6: What are immediate and future opportunities for funding this?

The following opportunities were identified by the group:

- Use MN science plan as leverage for justification of project proposals (EU FP7, USAID, NASA, START were listed as the potential funding sources but other national and international sources exist;

- REDD+ projects should be responsive to national level reporting requirement and are at local/national scales and therefore may be a problem for miombo wide mapping;

- Capacity building in the region is important and there are opportunities out there such as the USAID capacity project funding, the EU development funding training funding & capacity building. The group also mentioned the great importance of START in training, capacity building and funding network meetings.

Question 7: What are synergies with other networks, projects and programmes (within and outside the region)?

The group concluded that there are too many to be listed but the MN should focus on finding the best synergies according to its priorities. Sister networks, SADC forestry program, REDD+ programs are examples of initiatives with whom MN should synergize.

Summary of group II and V's Discussions: Land use change integrated analysis: Process and drivers of land use change and Miombo ecosystem management and adaptation to climate change.

The group discussed issues of existing stakeholders, main drivers of changes, key research areas, the role of permanent sample sites and the role of the MN. The summary of the discussions are:

Question 1: What are the key issues (questions – science, policy, management) and what are 3-5 priority project activities for the miombo region?

- Past, present status of Miombo wooodlands?

- Future scenarios of land use change (+20 years);
- Knowledge of international initiatives for climate change mitigation, sustainable development. There is a need to place our work in this context, and how it can contribute to address raised issues;
- REDD+: how to jump in?
- REDD+ carbon oriented only, community services, environmental issues need to be considered;
- Scale of projects (national, international);
- Coordinate field information collection, for what project, where (statistically sound), what (observations, measurements)?

Question 2: What are key available results, references, datasets, projects or programmes that could form the basis or contribute to the focal area activities?

The key drivers of land use change vary by country and within countries but the following are in general regionally common:

- fire and herbivory;
- commercial use (plantations);
- charcoal, illegal logging…);
- agriculture (Commercial sector is wide spreading in the region but shifting cultivation is highly important).

Question 3: Who are the potential partners (within the miombo region and from outside the region)?

- Intergovernmental bodies (IPCC, FAO, GEO, …);
- Governmental institutions;
- Universities;
- NGOs (WWF,…);
- Private sector (forestry, energy, agriculture): targets of policy; including consulting companies;
- local communities.

Question 4: What could be the implementation strategy (as a network) – what are possible next steps and who would be willing to take the lead?

There is a need to identify and list past and current projects. This would help identifying, find synergies between projects, and elaborate new ones as well as identify relevant sources funding [START, FP7, CIFOR, space agencies, governments (Norway, Germany,

France, Japan, …), GOFC-GOLD among others].

The following action items were considered a priority:

- Reactivate/update webpage;
- List past and current projects: identify potential synergies, gaps;
- Paper, report on past and present status of Miombo woodlands, and discuss issues and gaps.

The MN works in a volunteer scheme participation mostly, but there is a need to develop it in order to be a more structured network with one person full time to coordinate, or assist a steering committee. At least contact points needed for each country (in Miombo network and in local governments). There is a need to provide support (funding applications, support letters, scientific and technical advice). The MN has a list of projects already done and ongoing and also by individual participants of the network but there is a need to develop regional projects to build/strengthen visibility and credibility.

Question 5: How can research sites/sample plots best be coordinated and set up for the miombo region?

It is important to list existing sites, what data is available (images, maps, ground information: sample plots, etc.). The initiative is already launched but a better structure and analysis on how to further develop this idea is needed. Development of a data sharing policy is important.

Summary of group III's Discussions: Carbon and biomass in the miombo region

The complete summary of this group's debate was lost due to file corruption but the general discussions were focused around the topics of: Aboveground biomass dynamics in the miombo region/ecosystem: measurement, modelling, scenarios; Below-ground carbon dynamics in the miombo region/ecosystem: measurement, modelling, scenarios and the developing products for specific users: natural resource management, CDM, REDD+, etc. The main conclusions of this group are:

- Fuel wood harvesting can be seen as a carbon mitigation option: Miombo woodlands are a renewable resource and it should be possible to earn carbon credits for managing them properly and burning fuel wood (renewable) instead of coal.
- Definitions of degradation and forest loss in Miombo need to account for the fact that Miombo tree biomass varies over time and space.
- Degradation can also result from an INCREASE in woody cover – eg bush

encroachment or planting of a forest where there used to be a savanna.

- The belowground carbon in order of magnitude is higher than aboveground carbon in the Miombo, therefore as long as the soil stocks are preserved; we should be open to a range of management options in terms of aboveground stocks.

Summary of group IV's Discussions: Ecology of miombo woodlands

The group discussed issues of miombo ecology in a slightly different way than the one suggested. It identified what its known, what are the questions still to answer, what are the potential partners, and what are the crosscutting issues.

Question 1: What do we know of the miombo ecology?

It appears that a lot of work has been done over the past twenty years. So what MN needs to do is:

- To carry out a comprehensive review of these works to build up a database of the literature and information for Miombo woodlands;

- Do a systematic Review of available papers for knowledge harvesting and identify research gaps.

- Current knowledge: classification, biodiversity, regeneration, ecophysiology, etc.

Question 2: What are the questions still in need to respond about the miombo ecology?

- What is the recovery pattern of miombo across different environmental gradient;

- What is the extent of the drivers (contribution of each drivers on biodiversity);

- What are the impacts of these drivers on miombo biodiversity and ecology;

- Identify current dataset available (spatial and temporal);

- Existing projects Projects in miombo. E.g are: Nyimba projects (Zambia), Integrated land use assessment project (Zambia), interaction of Fire and Miombo (Tanzania), Growth and Yield (Mozambique).

Question 3: What are the potential partners?

The following were identified as partners for the MN in terms of miombo ecology:

- CIFOR;

- National training institutions;

- Research and academic institutions (Eduardo Mondlane, Sokoine University, Copperbelt University, CSIR-SA);

- ICRAF;

- NGOs (e.g. Mpingo project in Tanzania);

- FAO- support operations.

- National government (Zambia, Mozambique)

- GEF

- SADC

- Cooperating partners (Finland, GIZ, START, Norway).

Question 4: How can research sites/sample plots best be coordinated and set up for the miombo region?

In terms of sites the group stated that there is a need to review on the existing sample plots (parameters collected, methods), to develop focused research sites (based on hydrological unit) and establish permanent sample plots in areas they don't have it. In terms of research methods the group addressed the need to standardize research methods to be used across the region and to agree on standard definition of miombo woodland in terms percentage cover (do we include savanna??).

Question 5: what are the Cross Cutting issues

- <u>Capacity Building</u>: Short courses on research methods, data analysis (GIS).

- <u>Linking research to policy</u>: Strengthen the link with SADC, Engage national natural resources and related sectors to the network.

- <u>Information sharing and dissemination</u>: establish and build research collaboration across the region.

Summary of group VI's Discussions: Human Dimensions

The group discussed several issues of MW utilization and management, existing projects, potential partners and synergies and the implementation strategy.

Issues of utilization:

- Subsistence – food, fuel and fiber;

- Commercial – biomass energy, timber and NTFP;

- Value addition – export of employment and revenues.

Issues of Management:

- Ground level;

- Institutional (including participatory management and protection);

- Policies.

Issues of undervaluation of miombo woodlands:

- Royalties applied

- Contribution of woodlands to livelihoods and national economy

Potential projects for MW:

- Valuation of miombo woodlands: Contribution to people's livelihoods and national economy.

- Value addition of miombo woodland resources:

    o Review of policies in the miombo countries;

    o Market analysis (supply and demand)– domestic and international;

    o Assess impact of export of revenue and employment.

- Incentives and benefit sharing:

    o To promoting people's and private sector engagement in SFM;

    o Sharing of royalties and revenue.

- Participatory natural resources management –review of lessons and good practices

- Energy:

  - Sources, alternatives and technologies for efficient production and consumption;

  - Illegal harvesting;

  - Generate information and build awareness of government;

  - Use of remote sensing and GIS for monitoring;

  - CDM/REDD+.

In terms of existing results, references, datasets, projects the group listed the following per category:

- Valuation – World Bank, CEEPA, CARE, WWF, FAO and other UN-agencies (Statistics), EU, CIFOR/PEN;
- Value addition – REDD+ - value beyond timber products and PES;
- Incentives and benefits – on-going CBNRM, government initiatives, PES, existing policies (ownership and institutional arrangements);
- PNRM – various initiatives and studies;
- Energy – CHAPOSA, PROBEC, CDM and REDD+, NGOs;
- Illegal harvesting of T&NTFP – TRAFFIC, EIA, Remote Sensing, Government law enforcement.

Potential Partners in the region were identified per category:

- Valuation – WB, CEEPA, MF/MP/Economic commissions, Statistics Bureau, academia, NGOs, private sector (timber, tourism,…), local communities - chiefs, CIFOR;

- Value addition – private sector, Min of Commerce and Trade, investment promotion agencies, SAFIRE, ICRAF, NGOs, academia, local communities;

- Incentives and benefits – forestry departments, academia, CBOs, local communities including leaders and private sector;

- PNRM – same as above;

- Energy – departments of energy, environment, private sector including small-scale charcoal producers, academia, NGOs;

- Illegal harvesting – police and law enforcement agencies including INTERPOL, EIA, TRAFFIC, local people.

In terms of synergies with other Networks and intuitions the following were listed:

- SADC

- SAFNET

- FANRPAN

- AFF

- CEEPA/AERC

- UNFCCC

- UN-REDD

- FCPF

In terms of funding the group discussed the need to develop concept notes and fundraise to leverage on on-going research in the institutions/people that are part of the network. Some funding sources were listed:

- NORAD
- WB/FCPF – NRA and REDD+
- Irish Aid
- EU
- UNDP, UNEP, Habitat, REDD+,
- Government

On the issue of implementation strategy the groups discussed several ways of doing it:

- Task forces;

- Identify centres of excellence on the different project areas;

- Leadership – the chair of the group and formation of a secretariat.

Summary of Session 4's Outcome: In summary the key issues for the Miombo Woodlands are: Focal area 1: updated mapping of land cover and land cover changes for the miombo ecoregion, Focal area 2 and 5: understanding of past, present and developing future scenarios of miombo cover, better position and role in the REDD+ context, Focal area 3: synthesize biomass data and define its economic value, Focal area 4: understanding issues of utilization, management and undervaluation of resources from the miombo

woodlands. There is an urgent need for data access, sharing and capacity building to implement the issues raised. However, several projects, initiatives and collaborative activities with international institutions exist in the region but there is a need to systematize what has been or being done to identify gaps and avoid an overlap of activities. In summary the role of the MN was identified to include:

- To promote high quality research in the region;
- To harmonize data (EOS and field data) to better prepare the region for REDD+;
- To promote capacity building but there is a need to specifically define the capacity building needs;
- To provide the link between science and decision-making;
- To leverage the inclusion of the human dimension in research and decision-making;
- To promote collaboration/synergies with other networks and initiatives in the region.

2.6. SESSION 5: Networking in southern Africa and fields of cooperation

This session intended to discuss the possibilities of synergizing with well-established sister networks in the region, namely SAFNet, OSFAC and SASSCAL.

The first presentation by Navashni Govender from SAFNet gave an overview of the network. SAFNet involves several stakeholders in the region including scientists, governments, Non-governmental Organizations, and a variety of end users. Its aim is creating, validating and disseminating information on fire and fire related science development. Focus areas of SAFNet are:

- To Provide satellite based fire products;
- Remote sensing based capacity building and training;
- Validation of new satellite fire products;
- To support fire policy development, monitoring and management by using accurate fire information, resources and training across spatial scales (regional, national and local).

SAFNet is currently engaged in several regional initiatives such as: AMESD, GIZ Trilateral Fire Management Cooperation Project and MESA. Finally the presenter discussed the links between the two sister networks (SAFNet and MN) which are related to the fact that there is considerable overlap with countries in SAFNet and the Miombo Network, stressing that a fire is both an important ecological & social driver. Therefore collaborative

work between the two networks is crucial to:

- Reduce duplication of already scare resources within the region;

- Increase validation sites and cover larger areas and different biomes in the region;

- Encourage and improve information sharing.

Joerg Helmschrot from SASSCAL presented a communication about the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL): Aims and potentials for collaborations. SASSCAL is a joint initiative of Angola, Botswana, Namibia, South Africa and Zambia, in cooperation with the German Federal Ministry of Education and Research (BMBF) to improve the regional capacity for knowledge-based decision making and to provide Regional Scientific Services addressing future trends of global change, risks and vulnerability for and of societies and ecosystems and the management of natural resources and ecosystem services. The institutional setup of SASSCAL is supported by a research component integrating 87 subprojects in five thematic areas (climate, water, agriculture, forestry and biodiversity) and capacity development for four years. About 20 sub-projects are directly or indirectly linked to research and capacity development in Miombo woodlands in the participating countries. The variety of Miombo-related research in SASSCAL covers aspects such as: i) monitoring and assessment of the extent and state of Miombo and associated woodlands, ii) mapping spatial pattern and dynamics using innovative earth observation products, iii) assessing deforestation and degradation of Miombo woodlands in hot spot areas, iv) establishing observatories to ensure long-term monitoring, v) developing climate change adaptation strategies for dry land forests, vi) sustainable use and management of savannah ecosystems resources, vii) assessing socio-economic and environmental impacts of bee-keeping and honey production, viii) assessment of the economic and environmental sustainability of the Namibian timber industry including timber trade from Miombo woodlands in Angola.

The SASSCAL research activities will also be linked to capacity development efforts in terms of establishing a regional master programme on dry land forestry, a post-graduate programme in Applied Science in earth observation, GIS and remote sensing and education and training for evaluation, monitoring and management of biodiversity. With its multi-faceted research portfolio and capacity development activities, SASSCAL offers a variety of opportunities for cooperation with the Miombo Network. Cooperation between both institutions and/or individual research groups may address the standardization of methods (monitoring, assessments), supporting integrated scientific cooperation (e.g. science partnerships) to target global change issues, linking academic/non-academic

capacity development programmes, exchanging information on strategies and best practice' guidelines for knowledge implementation and linking infrastructures (technical, institutional).

Landing Mane from OSFAC gave an overview of OSFAC - Observatoire Satellitale des For d'Afrique Centrale - Activities and ongoing projects. The presenter introduced OSFAC as an observatory created in 2000 in Libreville originally as a network, which was legalized in 2005 as a NGO. Its mission is to raise awareness and promote the use of satellite information through:

- Distribution of freely accessible satellite data and products;
- Technical training in GIS and remote sensing;
- Mapping services using GIS and remote sensing.

OSFAC Partners with government institutions, international and local NGOs, academic institutions and projects and is supported by USAID/CARPE and the EU. The presenter mentioned some products from OSFAC such as: National scale maps of forest cover type, extent and change, data sets are packaged into atlases and made available through its website to facilitate access to a broad range of users. An automated mapping method developed by UMD/SDSU and classification tree algorithms applied to map primary forest, secondary forest, swamp forest, woodlands and corresponding forest cover loss for 2000 to 2005 and 2005 to 2010. OSFAC has also been involved in REDD+ projects, validation campaigns, fire assessment initiatives and providing information to the decision making level. Main links with MN include:

- Information and data sharing: Earth Observation Data, geospatial data (Miombo Ecoregion), etc.
- Share information on Institutional sustainability ;
- Capacity building in GIS and RS and
- Research funding for joint projects on the Miombo Ecoregion.

Summary of Session 5's Outcome: There is potential for collaboration with sister networks which is crucial to reduce duplication of already scarce resources within the region, increase validation sites and cover larger areas and different biomes in the region and encourage and improve information sharing. Other fields of cooperation identified in this session are:

- Standardization of methods (monitoring, assessments);
- Collaborative and integrated scientific cooperation (e.g. science partnerships) to target global change issues;
- Linking academic/non-academic capacity development programmes, exchanging information on strategies and best practice' guidelines for knowledge

implementation and linking infrastructures (technical, institutional);

- Information and data sharing ; and
- Capacity building in GIS and RS.

2.7. SESSION 6: Miombo Network Governance

This session was focused on electing the steering committee. It was decided to elect an interim steering committee composed of 9 members namely: Natasha Ribeiro (Chair-Mozambique), Sally Archibald (South Africa), David Nangoma (Malawi), Stephen Syampungani (Zambia), Lawrence Mbwambo (Tanzania), Charles Jumbe (Malawi), Jean Mueng (DRC), Isilda Nhantumbo (IIED -Mozambique) and Paul Desanker (UNFCCC-Malawi). The SC held it's first meeting after the MN meeting and delineated several activities including: to produce a very concise and sharp meeting report. Issues of funding, marketing strategy and network structure were also briefly discussed but will be further addressed by the SC (See Annex V – minutes of the First Meeting of the SC). The committee agreed on meeting again either virtually or physically on the 20th of February 2014.

3. Summary of Workshop recommendations

At the conclusion of the MN workshop there was a common agreement on the need for the network to become active in the region **by making science work for policy and decision-making.** MN should be the driver instead of recipient of global policy regarding Miombo woodlands. In this context, **active engagement of the MN with the SADC forestry Program is crucial** and one way of doing it is to produce policy briefs about key topics in MW that can have a major influence in regional policies. There is a call for MN to contribute to specific topics of interest within the context of the SADC Forest Program, namely: Data and information on indigenious forests; Land cover assessments; Forest Inventory (volume. and biomass equations); Fire; and Valuation of forest sector contribution to national economies.

The network is requested to have more **active role on aspects of REDD+ to support decision-making in the region**. Specifically the development and application of methods and techniques for carbon estimations (the REDD+ sourcebook from GOFC-GOLD is key). Validation is also a key for the success of REDD+. Engaging local communities in REDD+ and SFM is crucial.

The network represents a good opportunity for collaborative research projects and several ideas were discussed during the meeting. One such idea was the possibility of

developing a **common protocol of MW long-term monitoring by establishing a network of permanent sample plots across the region**. This would bring the opportunity to build a common understanding of the woodlands and bring shared response to current and future global changes.

For each Science Plan's focal area several topics of interest for the MW were discussed including:

Focal Area 1: Patterns and rates of land cover change

- Produce land cover & land cover change map of the MW eco-region;
- Produce a land cover & land cover change catalogue;
- Improve the understanding of past, present status of Miombo wooodlands
- Develop future scenarios of land use change (+20 years);

Focal area 2: Land use change integrated analysis: Process and drivers of land use change

- Better understanding of the recovery patterns of miombo across different environmental gradient;

- Improve knowledge on the extent of the drivers (contribution of each drivers on biodiversity);

- Define what are the impacts of these drivers on miombo biodiversity and ecology.

Focal area 3: Carbon and biomass in the miombo region

- Map aboveground biomass distribution across the miombo eco-region;
- Develop a better understanding of the dynamics in the miombo region;
- Improve estimation on below-ground carbon dynamics in the miombo region;
- Developing products for specific users: natural resource management, CDM, REDD+, etc.

Focal area 4: Ecology of the miombo ecosystem

This focal area overlaps with the previous ones but it is clear that a lot of work has been done over the past twenty years, but there is a need to carry out a comprehensive and systematic review of these works to build up a database of the literature and information

for Miombo woodlands and identify research gaps.

Focal areas 5: Miombo ecosystem management and adaptation to climate change

- Improved understanding of rates and dynamics of use and impacts on the miombo ecosystems;
- Natural resource management policies: effectiveness and needs;
- Ecosystem-based adaptation in the miombo ecosystem.

Focal area 6: Human dimensions of the miombo ecosystem

- Valuation of miombo woodlands: Contribution to people's livelihoods and national economy;

- Value addition of miombo woodland resources: Review of policies in the miombo countries; Market analysis (supply and demand)– domestic and international; Assess impact of export of revenue and employment.

- Incentives and benefit sharing: To promoting people's and private sector engagement in SFM; Sharing of royalties and revenue.

- Participatory natural resources management –review of lessons and good practices

- Energy: Sources, alternatives and technologies for efficient production and consumption.

It was also agreed that **there is a lot of capacity** among the network members, but **there is still a need for capacity building** in the region on topics of:

- Remote sensing and GIS especially on the use of high resolution, radar datasets - programming skills are crucial for that;
- Field assessment methods;
- Data search, access and management capacities;
- Statistical data analysis methodologies;
- Ecosystem services assessment and valuation (economic value of NR).

Several partners (including the sisters networks), on-going initiatives and funding opportunities were identified for the region. These can be seen as entry points for

collaborative research, capacity building, data access and to link science to decision making. It is important that the network build up on these existing opportunities as a way of effectively performing its role.

4. Conclusion

Through the various sessions of the three days meeting of the Miombo Network meeting in Maputo, participants constructively engaged in rich discussions that bared it all: the Miombo Network's role in the management of the Miombo Eco-region was critical. The meeting recognised that whilst the initial efforts of the MN had created a formidable foundation for regional and national integration of project and programme implementation for furthering the Miombo management and development, a number of challenges beset the Network. Amongst the challenges largely included inadequacies in human capacities owing to migration of technical and specialised personnel to perform specialised tasks; inadequate collaboration at local and regional levels as well as unavailability of strategic and purpose-built data and information sharing protocols that could connect and stimulate policy and political decision making at government and/or intergovernmental levels.

During and towards the end of the meeting, members increasingly became aware that the MN is not just a network of individuals and scientists who satisfy personal and academic interests regarding the Miombo Woodlands, but rather an important and key ally for the development of the Miombo ecosystem which plays a key role in sustaining the livelihoods of millions of rural and urban people in various many ways, including wood energy provision, timber and non-timber forest products as well as promoting conservation of the same through the REDD+ programme, a programme that has great potential to turn around the economic and environmental value of the ecosystem across the region.

The Miombo eco-region faces common challenges and also common opportunities. A wide variety of projects are under implementation, albeit fragmented. Availability of remote sensed data and improved data sharing protocols provide a platform for information sharing and networking amongst various stakeholders in the region. Furthermore, with emerging cadre of young scientists, a greater opportunity arises for the Miombo networkers to collaborate in research through a commonly agreed research protocol across the region with agreed standardised data capturing, analysis, storage and analysis to influence policy and national developments.

The Miombo Network is an important focal point for the mobilisation and galvanising of financial and technical support from a wide variety of financing institutions such as the GOFC-GOLD, START, among others to support research, policy and advocacy works within the region. The new Miombo Network, it was noted, had its work cut: to achieve the

objectives aforementioned for the sustainable management of the Miombo woodlands in the region.

5. Annexes

ANNEX I: List of participants

ANNEX II: Workshop Program

ANNEX III: Workshop's pictures

ANNEX IV: Terms of Reference for the working groups

ANNEX V: Minutes of the 1st New Miombo Network Steering Committee meeting held at Kaya Kwanga

ANNEX I: List of Participants

No	Name	E-mail	Country/Network	Organization/Institution
		MIOMBO NETWORK MEETING		
1	Alberto Simone	albertoalbazino@gmail.com	Mozambique	MICAIA
2	Alfan Rija	alrija10@gmail.com	Tanzania	Sokoine University
3	Almeida Sitoe	almeidasitoe@gmail.com	Mozambique	UEM
4	Aniceto Chaúque	achauque2012@gmail.com	Mozambique	UEM
5	Anja Hoffmann	aahoffmann@email.de	Germany	GOFC-GOLD Fire IT
6	Brice Mora	brice.mora@wur.nl	Netherlands	GOFC-GOLD Land Cover
7	Carla Cuambe	carla.cuambe@fao.org	Mozambique	FAO
8	Charles Jumbe	charlesjumbe@yahoo.com	Malawi	Bunda College
9	David Atchimwene Nyama Nangoma	davidnangoma@yahoo.com; david@mountmulanje.org.mw	Malawi	Biodiversity Conservation, Research & Monitoring
10	David Roy	david.Roy@sdstate.edu	USA	South Dakota State Univ.
11	Dominick Kwesha	dkwesha2001@yahoo.co.uk	Mozambique	Green Resources
12	Esperança Chamba	erechamba@gmail.com	MZ	IIAM
13	Fernando Sedano	fsedano@umd.edu	USA	UMD
14	Iain McNicols	i.mcnicol@ed.ac.uk	UK	UOC
15	Isilda Nahntumbo	isilda.nhantumbo@iied.org	UK	IIED
16	Isla Grundy	isla.grundy@gmail.com	Zimbabwe	UZ
17	Ivan Remane	ivanremane@siu.edu	Mozambique	UEM
18	Jean Illunga Muneng Mutakej	jean_muneng57@yahoo.fr	DRC	Ministère Environnement et Conservation de la nature
19	Joaquim Macuácua	aa182877@yahoo.com.br	Mozambique	DNTF
20	Joerg Helmschrot	joerg.helmschrot@sasscal.org	Germany	SASSCAL
21	Jonas Franke	franke@rssgmbh.de	Germany	RSS
22	Jospeh Makero	makerojons@yahoo.com	Tanzania	Tanzania Forestry Training
23	Kaala Moombe	d.gumbo@cgiar.org	Zambia	CIFOR
24	Landing Mane	imane@osfac.net	DRC	OSFAC
25	Lawrence Mbwambo	irmbwambo@yahoo.com	Tanzania	Tanzania Forestry Research Institute
26	Letlamoreng Mosenene	Letlamoreng.Mosenene@Giz.De	Botswana	GIZ SADC MRV support
27	Luis Goulão	goulao@iict.pt	Port	IICT
28	Luis Manuel Miapia	miapialuis@yahoo.com.br	Angola	University
29	Manuel Ferrão		Mozambique	CENACARTA
30	Maria Pereira	maria2.pereira@wur.nl	Netherlands	WUR
31	Maria Regina Torres Cruz	mariareginacruz@yahoo.com	Mozambique	IUCN Mozambique office

32	Mário Paulo Pereira da Silva Falcão	mariopaulofalcao@hotmail.com; mariopaulofalcao@gmail.com	Mozambique	Eduardo Mondlane Univ.
33	Matt Hansen	mhansen@umd.edu	USA	University of Maryland
34	Moses Chacanga	mchakanga@sadc.int	Botswana	SADC
35	Natasha Ribeiro	joluci2000@yahoo.com	Mozambique	UEM
36	Navashni Govender	navashni.govender@sanparks.org	South Africa	SAFNET
37	Paul Desanker	pdesanker@unfccc.int	Germany	UNFCCC
38	Riaan van den Dool	rvddool@csir.co.za	South Africa	CSIR
39	Robin Beaty	robin.beatty@321fire.co.mz	Mozambique	321fire
40	Romana Bandeira	romana.bandeira467@gmail.com	Mozambique	UEM
41	Sally Archibald	sally.archibald1@gmail.com	South Africa	Natural Resources and the Environment
42	Stephen Syampungani	syampungani@cbu.ac.zm; ssyampungani@yahoo.com	Zambia	Copperbelt University
43	Virginia Lacerda	vmalacerda@hotmail.com	Angola	University
44	Faura M. C. Amade	fauracangy@yahoo.com.br	Mozambique	UEM/FAEF
45	Rosta Simão Mate	rostamate@gmail.com	Mozambique	UEM/FAEF
46	Konrad Wessels	kwessels@csir.co.za	South Africa	CSIR
47	Alberto Tomás	Albertotomas55@yahoo.com	Mozambique	Cecoma
48	Gloria Desanker	gdesanker@gmail.com	Germany	UNFCCC
49	Renaud Mathieu	rmathieu@csir.co.za		CSIR
50	Yasuko Inoue	yasuko.inoue317@gmail.com	Japan	DNTF – MINAG (JICA)
51	Jone P. Fernando Jr.	jonejunior92@gmail.com	Mozambique	UEM
52	Arménio Cangela	armeniocangela@gmail.com	Mozambique	UEM
53	Valerio Macandza	vmacandza@uem.mz	Mozamnbique	UEM

ANNEX II: Workshop agenda

Day 1: Tuesday, 23 July, 2013	
OPENING SESSION:	
08:00 - 08:30	Arrival and Registration at Kaya Kwanga
08:30 – 10:00 Including Q & A	Welcome remarks **Emilio Tostão (Dean of the Faculty of Agronomy and Forestry)** **Simão Pedro Santos Joaquim (Head of National Directorate of Land and Forestry, DNTF)** **Ana Mondjana (Vice-rector for Academic Affairs UEM)**
	Objectives and Agenda of the Meeting **Natasha Ribeiro**
	GOFC-GOLD Background and Land Cover **Brice Mora - GOFC Land Cover University Wageningen**
	The History of the Miombo network **Paul Desanker/Dominick Kwesha – UNFCCC Bonn Germany/Green Resources**
10:00_10:10	**Group Photo**
10:10 - 10:30	**Tea/Coffee Break**
SESSION 1: *MIOMBO WOODLANDS – COUNTRY STATUS*	
10:30 – 12:30 Including Q & A	Mozambique **Regina Cruz – IUCN**
	Tanzania **Alfan Rjia/ Lawrence Mwambo - Sokoine University/ TAFORI**
	Malawi **Judith Kamoto/David Nagoma – Bunda College**
12:30 – 13:30	**Lunch**
13:30 –	Zambia **Stephen Syampungani – Cooperbelt University**

15:30	Zimbabwe
	Isla Grundy – University of Zimbabwe
	Angola
	Vírginia Lacerda – José Eduardo dos Santos University
	SADC Forestry, REDD and Fire Progamme
	Moses Chakanga –SADC Natural Resource & Wildlife Management
	Plenary Discussion – Common challenges of Miombo woodland management: Research and Management needs
15:30 – 16:00	**Tea/Coffee Break**
16:00 - 17:00 Including Q & A	Fire Monitoring in Southern Africa
	Riaan van den Dool – CSIR South Africa
19:00	**Reception Dinner**

Day 2: 24 July, 2013
SESSION 2 CONTINUE: *MONITORING OF MIOMBO WOODLANDS*

08:00 – 10:00 Including Q & A	Africa-wide land cover extent and change mapping with Landsat **Matt Hansen – University of Maryland (UMD)**
	Landsat satellites, data access and the Landsat Science Team **David Roy –South Dakota State University (SDSU)**
	The correspondence of Miombo vegetation to high rainfall savanna in Australia - an analysis of climatic drivers, fire patterns and tree life histories across two continents **Sally Archibald – CSIR South Africa**
	Remote Sensing Research for spatial assessment in SA savannas and woodlands **Renaud Mathiew - CSIR South Africa**
10:00 – 10:30	**Tea/Coffee Break**

	SESSION 3 **MEASURING CARBON STOCKS AND REDD**		
10:30 – 12:30 Including Q & A	Overview on REDD+ and the GOFC-GOLD REDD+ and Sourcebook activities **Brice Mora – University of Wageningen**
	Proposed research and analysis for assessing REDD+ opportunities in Southern Africa **Maria Pereira - Wageningen agricultural university**
	Development of Sustainable National Forest Resource Information Platform for Monitoring REDD+ **Joaquim Macuácua – Department of Natural Resources/DNTF**
	Challenges and possibilities of remote sensing-based Miombo woodland inventories for forest management and REDD+ **Jonas Franke- Remote Sensing Solutions, Germany**
12:30 - 13:00	**Plenary Discussion - main topics extracted**
13:00 – 14:00	**Lunch**
	SESSION 3: MEASURING CARBON STOCKS AND REDD CONTINUE		
14:00 – 15:30	Carbon stocks and REDD+ in Miombo Woodlands **Iain McNicol – University of Edinburgh**
	Communities in the development of sub-national MRVs: do they really matter? **Kaala Moombe- CIFOR**
	Future fire carbon emissions in Miombo woodlands **Fernando Sedano – University of Maryland**
	Mapping fire regime in the Niassa National Reserve (2000 to 2012) **Arménio Cangela/Natasha Ribeiro –FAEF/UEM**
15:30 – 16:00	**Tea/Coffee Break**
16:00 – 17:00	Funding Fire Management - REDD Potential in Miombo Woodlands **Robin Beatty - 321Fire**
	Plenary Discussion – main topics extracted

Day 3: 25. July 2013	
SESSION 4: ROADMAP DEVELOPMENT TOWARDS SCIENCE PLAN	
08:30 – 8:45	Presentation and discussion of the draft Miombo Network Science Plan **Natasha Ribeiro**
8:45 – 10:00	Breakout groups
10:00 – 11:00 Including Q&A	Report back to Plenary **Tea/Coffee Break included**
SESSION 5 **NETWORKING IN SOUTHERN AFRICA AND FIELDS OF COOPERATION**	
11:00 – 12:30	Southern Africa Fire Network –SAFNet: Goals and common fields of cooperation Miombo **Navashni Govender**
	Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL): Aims and potentials for collaborations **Joerg Helmschrot – SASSCAL**
	OSFAC - Observatoire Satellitale des For d'Afrique Centrale - Activities and ongoing projects **Landing Mane**
	GOFC-GOLD Data training initiative **David Roy – GOFC-GOLD**
12:30 - 13:00 Including Q&A	**Plenary discussion**
13:00 -14:00	**Lunch**
SESSION 6 **MIOMBO NETWORK GOVERNANCE**	
14:00- 15:00	Network governance and election of steering committee **Natasha Ribeiro**
15:00 – 15:30	Evaluation of the meeting **Closing** **Romana Bandeira – Head of the Forest Engineering Department**
15:30 – 16:30	Miombo Network steering committee meeting Maputo City tour for the remaining participants who are not in the SC

ANNEX III: Workshop's Pictures (A-C: Workshop Plenary Sessions; D: lunch time; E: Visit to the Natural History Museum; F: Gala Dinner; G: Cultural event)

ANNEX IV: Terms of Reference for the working groups

Breakout groups

Objectives:

1. To identify and elaborate focal areas for a Science plan

2. To discuss elements of an implementation plan including setting up of modalities for permanent sample plots/study sites in the miombo regions

3. Start to form focus groups to work on common areas and core projects

Groups will be divided by core focal area:

Focal Area 1: Patterns and rates of land cover change

- Remote sensing of land cover change using Landsat
    - Access to data/distribution of Landsat data
    - Methodology development (validation, training sites, ...)
    - Development of land cover and change products for different uses at local to national and regional levels
    - Capacity-building and training in processing of Landsat data and product development
- Testing and application of other satellite systems (lidar/radar, etc)
    - Access to data
    - Development of improved allometric equations
    - Product development : biomass change products

Focal area 2: Land use change integrated analysis: Process and drivers of land use change

- Drivers of land use change at multiple scales
- Modeling of land use change
- Development of land use change scenarios
- Case studies
    - Tobacco production and impacts on land cover change at local to regional levels
    - Experiments in miombo recovery: coppice management, charcoal, etc

Focal area 3: Carbon and biomass in the miombo region

- Aboveground biomass dynamics in the miombo region/ecosystem: measurement, modelling, scenarios

- Below-ground carbon dynamics in the miombo region/ecosystem: measurement, modelling, scenarios
- Developing products for specific users: natural resource management, CDM, REDD+, etc

Focal area 4: Ecology of the miombo ecosystem

- Structure, growth, function, and dynamics of the miombo ecosystem
- Classification of the miombo ecosystem
- Regeneration and recovery ecology of the miombo woodlands: coppice ecology, fire ecology
- Biodiversity in the miombo ecosystem
- Ecophysiology of the miombo species

Focal areas 5: Miombo ecosystem management and adaptation to climate change

- Rates and dynamics of use and impacts on the miombo ecosystems
- Natural resource management policies: effectiveness and needs
- Ecosystem-based adaptation in the miombo ecosystem

Focal area 6: Human dimensions of the miombo ecosystem?

- Socio-economics of the miombo at community level
- Landscape management/spatial aspects of development and their impacts on miombo ecosystems (corridors, agricultural systems, afforestation, etc)
- Exploration of scenarios for alternative land uses

ANNEX V: Minutes of the 1st New Miombo Network Steering Committee meeting held at Kaya Kwanga

The Miombo Network Steering Committee

Minutes of the 1st Meeting held at Kaya Kwanga on Thursday, 25th July, 2013

Present:

Dr Paul Desanker (Ex-officio)	UNFCC
Dr Natasha Ribeiro	Universidad Eduwardo Mondlane
Dr. Steven Syampungani	Copperbelt University, Zambia
Dr. Charles Jumbe (*Meeting Chair***)	Lilongwe University of Agriculture & Natural Resources
Dr. Lazarus Mbwambo	Tanzania Forestry Research Institute
Dr. Jean Muneng	Southern Congo (OSFAC)
Dr Isilda Nhantumbo	IIED
Mr D. Nangoma (*Secretary***)	Mulanje Mountain Conservation Trust

Apologies:

Dr. Sally Archibald	CSIR, South Africa

** Denotes volunteer positions, for this meeting.

1   Opening

1.1   The *Chairperson* called the meeting to order at 16:30 hours. He congratulated members present for accepting to steer the Committee and advance the objectives and spirit of the renewed Miombo Network. He noted that the meeting needed to discuss, among other things, the outcome of the meeting; a Policy Brief; governance structure of the Committee; issues of office bearers to take various responsibilities and funding issues.

2   Agenda

2.1   Being the first meeting, the issues outlined by the *Meeting Chair* constituted the agenda of the meeting.

3   The Secretariat

3.1   Members agreed that the University Eduardo Mondlane (UEM) would constitute the Secretariat with Dr. Natasha Ribeiro still taking lead. The meeting further agreed of the need to develop a Portal at the UEM through which to share technical issues relating to the Network's activities. Following activities were agreed as priority issues:

    3.1.1   The Kaya Kwanga Workshop Report to be developed and shared;

    3.1.2   Development of a Policy Brief that would address not more than five (5) key issues;

    3.1.3   Creation of awareness to SADC about the Miombo Network activities;

    3.1.4   Finalizing the Science Draft Plan (presenters at the workshop to provide briefs of what they are doing to enrich the Plan – the secretariat to ask presenters for this info.);

    3.1.5   Development of a Strategic Plan for the Network following the six thematic areas of the Research Plan.

4   Activity Time-line

4.1   Development and distribution of the Workshop Report by 16th September, 2013. **Action:** Dr. Natasha Ribeiro;

4.2   Development of Terms of Reference for the Steering Committee and a possible Governance Structure for the Miombo Network. **Action:** Dr. S. Syampungani (Zambia) to take lead and share with Dr. C. Jumbe (Malawi) before sending to Secretariat for wider membership sharing and approval, by 10th August, 2013;

4.3   Policy Brief to include summaries/abstracts of what others are doing in the Miombo eco-region. **Action:** Dr. Natasha Ribeiro – to contact presenters immediately, and the Brief by 15th August, 2013.

4.4   Development and finalize the Science Plan. **Action:** Dr. Natasha Ribeiro with input from all members of the MN – by 31st January, 2014;

4.5   Steering Committee membership to reconvene for Strategy Development. **Action:** All, 20th February, 2014;

4.6   Update the Miombo Network webpage currently hosted by GOFC-GOLD: **Action:** All.

4.7   Membership to start lobbying for the funding of the network; noting that this can happen only when the research plan and strategic plans are in place. Members within the Steering Committee who are well connected were urged to sell the Miombo Network to potential funding institutions such as CIFOR. REDD+, CBD etc;

The committee agreed to maintain Dr. Natasha Ribeiro as Chairperson for the Steering Committee.

5   Date of the next meeting

Members agreed tentatively to meet next on 20th February, 2014 for the Strategy Development, with option of discussing much business on the web.

6   Closing

There being no other matters for discussion, the *Chairperson* thanked all members for their active participation and closed the meeting at 17:50 hours.