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EASTERN NILE TECHNICAL
REGIONAL OFFICE



BARO-AKOBO-SOBAT MULTIPURPOSE WATER RESOURCES DEVELOPMENT PROJECT STUDY

BASELINE, DEVELOPMENT POTENTIALS,
KEY ISSUES AND OBJECTIVES REPORT

Annex 2: Biological environment

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	<p>BRL ingénierie</p> <p>1105 Av Pierre Mendès-France BP 94001 30001 NIMES CEDEX 5 FRANCE</p>
	<p>AURECON</p> <p>Ebène House – 3rd Floor – 33 Cybercity EBENE - MAURITIUS</p>

Date document created	17 February 2016
Contact	<p style="text-align: center;">Jean-Michel Citeau: Jean-Michel.Citeau@brl.fr Steve Crerar: stevecrerar@live.com</p>

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BARO-AKOBO-SOBAT MULTIPURPOSE WATER RESOURCES DEVELOPMENT STUDY

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ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
ACORD	Association for Cooperative Operations Research and Development
ACTED	Agency for Technical Cooperation and Development
BAS	Baro Akobo Sobat
CAMP	Comprehensive Agriculture Development Master Plan
CBA	Cost Benefit Analysis
CMA	Catchment Management Association
CRA	Cooperative Regional Assessment
DEM	Digital Elevation Model
EEPCCO	Ethiopian Electric Power Corporation
EHA	Erosion Hazard Assessment
EIA	Environmental Impact Assessment
ENID	Eastern Nile Irrigation and Drainage
ENCOM	Eastern Nile Committee Of Ministers
ENPM	Eastern Nile Planning Model
ENPT	Eastern Nile Power Trade
ENSAP	Eastern Nile Subsidiary Action Plan
ENTRO	Eastern Nile Technical Regional Office (NBI)
EPA	Environmental Protection Authority
FAO	Food and Agriculture Organization
GDEM	Global Digital Elevation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GTP	Growth and Transformation Plan
GWh/y	GigaWatt hour/year
HEP	Hydroelectric Power
IDEN	Integrated Development of Eastern Nile
ILWRM	Integrated Land and Water Resources Management
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature and Natural Resources
IWMI	International Water Management Institute
IWRDMP	Integrated Water Resources Development and Management Plan
IWRM	Integrated Water Resource Management
JMP	Joint Multipurpose Project
MAFCRD	Ministry of Agriculture, Forestry, Cooperatives and Rural Development
MASL	Meters Above Sea Level
MCA	Multi Criteria Analysis
MDG	Millennium Development Goals
MEDIWR	Ministry of Electricity, Dams, Irrigation and Water Resources
MERET	Managing Environmental Resources to Enable Transitions
MLFI	Ministry of Livestock and Fisheries
MoA	Ministry of Agriculture
MoEN	Ministry of Environment
MoWIE	Ministry of Water, Irrigation and Energy
MSIOA	Multi Sector Investment Opportunity Analysis
MTR&B	Ministry of transport, roads and bridges
MW	Mega Watt
MWC&T	Ministry of Wildlife Conservation and Tourism
NB-DSS	Nile Basin Decision Support System
NBI	Nile Basin Initiative
NCORE	Nile Cooperation for result project
NDVI	Normalized Difference Vegetation Index
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NGO	Non-Governmental Organization

Nile-COM	Nile Council of Ministers
PIM	Project Implementation Manual
PLSPP	Policies, Legislation, Strategies, Plans, and Programs
PPP	Private Public Partnership
PMU	Project Management Unit
PRSP	Poverty Reduction Strategy Program
RATP	Regional Agricultural Trade and Productivity Project
RPSC	Regional Project Steering Committee
RSS	Republic of South Sudan
RUSLE	Revised Universal Soil Loss Equation
SAP	Subsidiary Action Program
SEA	Strategic Environmental Assessments
SIS	Soil Information System
SLMP	Sustainable Land Management Program
SNNPR	Southern Nations, Nationalities and Peoples' Region
SRFE	Satellite Rainfall Estimates
SRTM	Shuttle Radar Topographic Mission
SSEA	Strategic Social and Environmental Assessment
SVP	Shared Vision Program
SWAT	Soil and Water Analysis Tool
SWOT	Strength Weakness Opportunity Threat
SWSC	Soil-Water Storage Capacity
UNDP	United Nations Development Program
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WaSH	Water Sanitation and Hygiene
WB	World Bank
WBISPP	Woody Biomass Inventory and Strategic Planning Project
WCYA	Women, Children and Youth Affairs
WEES	Water for Eastern Equatoria
WFP	World Food Program
WM	Watershed Management
WRMA	Water Resources Management Authority
WRMD	Water Resources Management and Development
WSS	Water Supply and Sanitation
WUA	Water Users Association

1. METHODOLOGY

1.1 PROCESS FOR STAKEHOLDER CONSULTATIONS

Numerous stakeholders consultations were conducted by the environmental team in South Sudan and Ethiopia. Consultations were conducted at Federal, Regional, Zonal and Woreda levels in Ethiopia and at Ministerial, state and counties levels in South Sudan.

The aim of the consultations were to get clear understanding of the basin's socio-environmental set up and to identify existing and potential challenges on natural and social environment of the basin and to obtain local knowledge and advices as how to conserve the fragile environment of the basin and how to integrate environmental issues in the proposed integrated BAS basin water resource development plan. Generic interview guide have been elaborated to facilitate stakeholder consultations. Hereafter is an example of guide used for consultations during the baseline phase:

Figure 1: Key points of discussion for stakeholder consultations conducted during the baseline phase

1. Missions, activities and capacities of the institution within the BAS, future projects within the BAS
2. Ecosystem in the BAS and their degree of interlinkages with water resources (identification of specific sensitive areas)
3. Habitats and species and status (good condition, threatened, severely threatened); status and conditions of protected areas of the BAS; opportunity and feasibility of the creation of additional protected area to conserve water-related ecosystems;
4. Ground/field knowledge validation of the maps produced in the study: Hydrographic network, Protected areas, land use, wetlands and floodplains;
5. Current tourism practices; potential for tourism/eco-tourism development within the BAS and main constraints for tourism development;
6. Threats to water-related ecosystems
7. Regulation and management within forest reserves; current forest conservation/rehabilitation projects;
8. Main ecosystem services (nature and quantification when possible);
9. Institutional arrangements in place

Source: this study

The target stakeholders were relevant Governmental and None Governmental Offices working on environmental protection, agriculture sector, forestry conservation, land use planning, water resource development, wildlife conservation, culture and tourism, etc.

Advices were obtained from various experts who are knowledgeable of the basin. Based on the suggestions given during the consultations, site visits to the specific environmental hotspots were conducted to get first-hand information.

The various consultations and field visits which were conducted specifically on the environmental aspects are listed in the following tables:

Table 1: Summary of consultations with focus on environmental aspects

Stakeholder met	Country	Location	Date
Ministry of Water	Ethiopia	Addis Ababa	27/04/2015
Local representatives	Ethiopia	Nekemte	28/04/2015
Local representatives	Ethiopia	Metu	29/04/2015
Local representatives	Ethiopia	Gambella	30/04/2015
Ministry of Environment	South Sudan	Juba	06/05/2015
Ministry of water and irrigation	South Sudan	Juba	06/05/2015
MPs Jonglei State	South Sudan	Juba	08/05/2015
MPs Eastern Equatoria	South Sudan	Juba	08/05/2015
Local representatives	South Sudan	Torit	09/05/2015
Bench Maji Zonal Agriculture and Rural Development Office	Ethiopia	Mizan Teferi	17/06/2015
Menit Goldia Woreda Agriculture Development Office	Ethiopia	Bachuma	18/06/2015
Menit Shasha Agriculture Development Office	Ethiopia	Jamu	18/06/2015
Sheka Zone Agriculture and rural Development Office	Ethiopia	Masha	19/06/2015
West Wellega Zone Agriculture and Natural Resources Development Office	Ethiopia	Gimbi	20/06/2015
Ministry of Agriculture, SLM Project Coordination Office	Ethiopia	Addis Ababa	22/06/2015
SNNPR Sectoral Offices	Ethiopia	SNNPR	18/06/2015 19/06/2015
Gambella Sectoral Offices	Ethiopia	Gambella	20/06/2015 21/06/2015
Ministry of Environment	South Sudan	Juba	20/01/2016
Ministry of Wildlife, Conservation and Tourism	South Sudan	Juba	20/01/2016
USAID	South Sudan	Juba	21/01/2016
UNOCHA	South Sudan	Juba	21/01/2016
WCS	South Sudan	Juba	21/01/2016
Nile Basin Discourse	South Sudan	Juba	22/01/2016
USAID	South Sudan	Juba	21/01/2016
UNOCHA	South Sudan	Juba	21/01/2016
WCS	South Sudan	Juba	21/01/2016
Nile Basin Discourse	South Sudan	Juba	22/01/2016
NABU	Ethiopia	Bonga	10/02/2016
MELCA Ethiopia	Ethiopia	Masha	11/02/2016
Yeki woreda	Ethiopia	Yeki	11/02/2016
Majang Zone	Ethiopia	Meti	12/02/2016
Bench-Maji Zone	Ethiopia	Mizan Teferi	11/02/2016
South Government Sheka Zone Administration Office	Ethiopia	Masha	11/02/2016
Illu Ababora Zone	Ethiopia	Metu	11/02/2016
Ministry of Environment, Forest and Climate Change	Ethiopia	Addis Ababa	17/02/2016
EWNRA	Ethiopia	Addis Ababa	18/02/2016
EWCA	Ethiopia	Addis Ababa	
HoARECN	Ethiopia	Addis Ababa	
African Parks	Ethiopia	Addis Ababa	17/02/2016

Source: this study

The identified environmental issues, challenges and suggestions forwarded during each consultation are described in section 2 of this report.

Stakeholders were also consulted regarding environmental aspects during the inception workshop (11th August 2015, Awasa, Ethiopia) and scoping workshop (24th & 25th November 2015, Khartoum, Sudan).

1.2 METHODOLOGY FOR DESK REVIEW / BIBLIOGRAPHY ANALYSIS

Information collected during stakeholder consultations has been enriched by a large desk review exercise. Various sources of documents and data were collected and analysed:

- ▶ ENTRO general and environmental studies on the BAS;
- ▶ ENTRO databases (especially GIS database);
- ▶ Older studies conducted on the BAS;
- ▶ Documents collected during the consultations with stakeholders;
- ▶ Various environmental papers and reports found on specific websites
- ▶ Information on on-going projects found on websites of institutions involved in biodiversity and watershed conservation in the basin.

The complete list of documents reviewed and analysed is presented in annex “references”.

The outcomes of the desk review are presented in section 3 of this report.

1.3 METHODOLOGY FOR SPECIFIC ANALYSIS ON WETLANDS DYNAMICS CONDUCTED IN THIS STUDY

As a result of the scoping phase, the need to better understand wetlands and inundation dynamics over time has been highlighted. As a response to this need, a specific analysis has been conducted in order to:

- ▶ Include inundation patterns in the modelling process;
- ▶ Have a better idea of wetlands intra and inter-annual variability to be able to assess potential impacts of water developments on these ecosystems and their services.

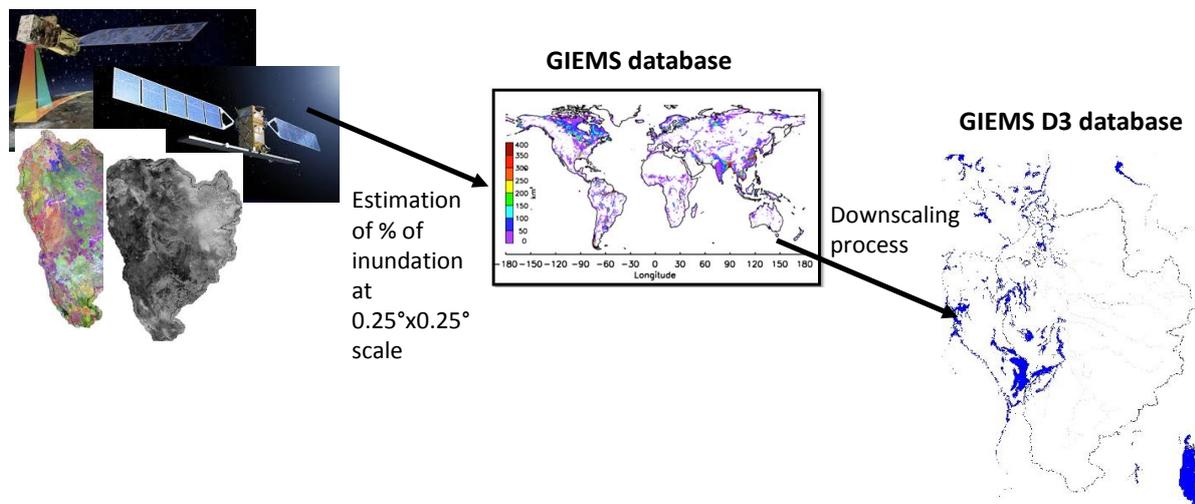
For this purpose, monthly inundation images of the BAS from 1993 to 2007 have been acquired and analysed. These monthly inundation images comes from a worldwide dynamic inundation database called GIEMS D3, which consists of a high-resolution global inundation map at a pixel size of 3 arc-seconds (approximately 90 meter at the equator).

This database is the result of a downscaling process of a less detailed dynamic inundation database called GIEMS. The Global Inundation Extent from Multi-Satellites (GIEMS) is a dataset providing the surface water extent and dynamics over the globe and over a long time record (1993-2007), based on a collection of satellite observations. The percentage of inundation is estimated over an equal-area grid (pixels of 0.25°x0.25° at the equator, i.e., roughly 28kmx28km), at a monthly time-scale.

The above explanations are synthetized in the figure below:

Figure 2: Origin of GIEMS D3 product used in this study

Various satellites observations



Source: This study

More information about GIEMS D15 can be found in the following papers:

- ▶ Moliane, L., Aires, F., Prigent, C., Fluet-Chouinard, E., Lehner B., 20 “Global, high spatial-resolution, dynamic and long-term inundation extent dataset, downscaled from GIEMS using topography information” *Journal of Hydrometeorology*, 14 (2), 594–607, doi:10.1175/JHM-D-12-093. 1, URL <http://adsabs.harvard.edu/cgi-bin/nph-dataquery?bibcode=2013JHyMe..14..594A&linktype=EJOURNAL>.
- ▶ Aires, F., Papa, F., Prigent, C., 2013. “A long-term, high-resolution wetland dataset over the Amazon basin, downscaled from a multiwavelength retrieval using SAR.”

Several activities were performed to analyse conducted thanks to this data:

- ▶ Comparison of inundation patterns with historical rainfall, hydrological flow patterns in order to assess the origin of inundation (spillover from the rivers, rainfall, underground water, combination of various factors, ...), localize main spillway, and assess the minimum flow required for inundation to start;
- ▶ Visualization of intra and inter-annual by compiling monthly and yearly inundation maximal extent;
- ▶ Elaboration of a maximal inundation extent of the wetlands identified in the literature by compiling 1993-2007 maximal extent and 2014-2015 wetlands and floodplain mapping.

The results of the 1st activity are presented in the hydrological report. The results of the 2nd and 3rd activities are presented in section 4 of this environment annex.

2. RESULTS, INFORMATION AND ADVICES COLLECTED DURING/WITH STAKEHOLDER CONSULTATIONS

Comprehensive minutes of consultations are presented in Annex 1. This section only presents a summary of the key outcomes of these consultations.

2.1 KEY INFORMATION AND ENVIRONMENTAL AND SOCIO-ECONOMIC ISSUES IDENTIFIED PER BIOPHYSICAL AREAS DURING STAKEHOLDER CONSULTATIONS

2.1.1 Highlands

During the stakeholders consultations, the following information and issues have been identified in the BAS highlands:

- ▶ Deforestation of natural forest for the expansion of farm land,
- ▶ Expansion of investors beyond the allocated land area and encroaching into forest areas /e Expansion of tea and coffee plantation by the investors / land requirement for agricultural investment (tea and coffee investment), more than 40 investors are registered in the zone and about 18,000ha has been given for the investors;
- ▶ Population growth and influx of people from other parts of the country, primarily for the search of job as daily labour and later on some of them shift to farm by clearing forest areas;
- ▶ Increase in population and need for farm land;
- ▶ Use of charcoal as main energy source and income by the community,
- ▶ Weakening of traditional forest conservation practice. Young generation became reluctant to follow the old traditions such as keeping sacred places, worship areas, etc.;
- ▶ Resistance of people for new technologies;
- ▶ Tendency of farmers to use shifting cultivation or tendency of look for virgin land;
- ▶ Soil acidity and low production per ha,
- ▶ Lack of alternative livelihood system;
- ▶ Lack of suitable technologies;
- ▶ Lack of electricity for lighting and cooking, which pressurize on forest for fuel wood;
- ▶ Immigration of people from other parts of the country and illegally settle in the areas by clearing forest cover;
- ▶ Plantation of eucalyptus trees in wetland areas, which dries wetlands and water sources;
- ▶ Increased need for timber production;
- ▶ Absence of significant benefit from the protection of forest resources for the local communities;
- ▶ Soil erosion on farm lands and steep slopes,
- ▶ Lack of alternative energy to substitute fuel wood consumption,
- ▶ Conversion of wetlands into farm land
- ▶ Construction of roads through high forested areas directly remove trees and create access for timber production and illegal cutting of trees,
- ▶ Lack of proper coordination between investment and environmental protection offices,

- ▶ Lack of environmental monitoring and follow up after the allocation of land for investment,
- ▶ Significant gaps in the implementation and enforcement of environmental laws,
- ▶ Lack of standard buffer zone (e.g, Federal EPA says 1km buffer zone between water bodies and any development, regional office says 2km, International says 150m),
- ▶ Weak setup of institution (Land utilization and administration and Environmental protection organized as one department under the Agriculture bureau which weakened the role of environmental protection).

2.1.2 Escarpments

During the stakeholders consultations, the following information and issues have been identified in the BAS escarpments:

- ▶ Slope and sliding nature of the soil;
- ▶ Soil erosion;
- ▶ Encroachment into forest areas for coffee plantation and other crop production;
- ▶ Illegal settlement;
- ▶ Labor attracted by the agro- investment from other parts of the country tend to shift to farming by clearing virgin forest;
- ▶ Forest clearance for tea plantation by the Indian Investors. The land allocation policy for investment which allows Federal investment office to allocate land for investors where the required land is more than 5000ha is affecting the natural resource. For instance, the tea investment area is the tower of water for the downstream areas including Alwero dam. Some rivers which were permanent before the impact on forest become seasonal due to the clearance of forest cover:
- ▶ Lack of proper land use plan.

2.1.3 Foothills / Piedmonts

During the stakeholders consultations, the following information and issues have been identified in the BAS Foothills / Piedmonts:

- ▶ In Torit area:
 - Trees and vegetation cover is diminishing in fast rate without any endeavor to replant or afforestation.
 - People are clearing trees for expanding farm land and for the production of charcoal. Charcoal is the main source of the energy in the country since there is no other alternative form of energy to substitute charcoal. Currently, charcoal is the easily available source of income for the rural people. At present, there is no approved law or policy regarding the conservation of environment.
- ▶ In SNPP:
 - Unplanned and unlimited grazing in the forest which is affecting the forest and forest products (coffee, spices, etc),
 - Conflicts between communities who are sharing the forest resources in the boundary of two communities,
 - Cross-border conflicts due to competition for grazing land and fish farming between local communities and ethnic groups of Southern Sudan. The other cause of the border conflict is cattle raid and killing people.

2.1.4 Flood Plains and wetlands

During the stakeholders consultations, the following information and issues have been identified in the BAS Floodplains and wetlands:

CHALLENGES IDENTIFIED IN THE SOUTH SUDANESE PART OF THE BAS

- ▶ Major challenges concerning wildlife:
 - Killing of wildlife by communities as well as by the army for wild meat,
 - Wildlife are facing huge problem from poachers and illegal traders (for example illegal people from Somalia kill wildlife for skin and other marketable parts). Wilde animals are also killed during the seasonal migration
 - Absence of national parks management plan,
 - Lack of awareness about the wildlife conservation and its use.
 - The impact is more severe during the mass migration of White eared Kob, one of the endangered species. They migrate to Gambella national park during the dry season as they can get water there and come back to South Sudan/Boma Park when the Gambela area is wet and muddy. The reason of migration is to search water in the dry period at the upstream and escape mud during the wet season. Their migration is considered by the local people as a sign for onset of rainy season and dry season.
 - Construction of the Jonglei canal has hindered the free movement of animals and denies access to larger grazing area.
- ▶ Major challenges concerning drinking water and water for livestock availability:
 - The semi desert areas are less populated area but with large number of livestock. The main challenge of the area is shortage of water for people and livestock. To solve this problem providing water should be seen as one of the components of the integrated water resources management project.
 - The possible source of water for this area seems harvesting water during the flooding season in cofferdams. The potential of ground water has not been assessed in detail. However, as per the information from local experts, ground water cannot be easily obtained in depths of less than 200m.
- ▶ Major challenges concerning pastoralism:
 - People are pastoralists that move in search of water and grazing land. Shallow wells drilled before are dried during the dry period. The drilled wells are not deep enough to sustain water during the dry period.
 - The pastoralist lifestyle is creating conflict due to the limitation of resources. According to the representative from South Kapoeta, nearly all of the major inter and intra-communal conflicts are linked either to cattle raiding and the subsequent spiral of violent retribution, or conflict among pastoralists and farmers over migration routes and access to water and pasture.
- ▶ Other environmental challenges:
 - Massive growth of Water hyacinth

CHALLENGES IDENTIFIED IN THE ETHIOPIAN PART OF THE BAS

- ▶ Gambella does not have its own environmental policy and guidelines,
- ▶ Lack of coordinated protection of environmentally sensitive areas like forest, wetlands and national park,
- ▶ Lack of management plan for the Gambella National Park,

- ▶ Lack of coordination between investment and environmental protection offices. Investors prepare EIA after they possessed the land and license. In principle, EIA should be a prerequisite for the possession of license. But in case of the Gambella, EIA is prepared just to indicate mitigation measures which makes EIA powerless tool.
- ▶ Influx of refugees into the region imposed adverse impacts on forest resources,
- ▶ Conflict between different tribes mainly due to cattle raid,
- ▶ Conflict between local community and pastoralists coming from Sudan in search of grazing and watering,
- ▶ Absence of strong cooperatives to supply farm inputs like fertilizers, selected seeds, etc,
- ▶ Shifting cultivation which has impact on forest resources,
- ▶ Water pollution by solid and liquid waste,
- ▶ Absence of liquid waste treatment plant for Gambella town,
- ▶ Absence of trucks to collect and dispose solid waste at the designated disposal site. (the designated solid waste disposal site is located 7km away from the Gambela town).
- ▶ Inventory of forest areas have been conducted and interpretation and analysis of the data is ongoing. The land use land cover map of the country is going to be issued within few months and will be available for the public. Regarding Gambela area, the inventory of forest resources has not been done so far and they are planning to undertake the inventory before finalising the land use land cover map of the country.
- ▶ There is currently an attempt to prepare and legalize a land use and development plan for Gambella. This effort is led by the Horn of Africa Regional Environment Center of the Addis Abeba University. It is funded by European Union (EU) through IGAD and relevant ministries is both the Federal and Regional government are members of the steering committee that finally approves the Land use and development plan.

2.2 SYNTHESIS OF MAIN ENVIRONMENTAL CHALLENGES IDENTIFIED DURING STAKEHOLDER CONSULTATIONS

Stakeholders' consultation and field visit revealed that the basin has the following environmental challenges:

- ▶ Forest degradation and deforestation in Upper catchment and Siltation of Reservoirs in Downstream

Forest degradation due to unplanned land allocation, farm expansion through deforestation and removal of indigenous trees for making charcoal and timber become severe. In rural as well as in an urban area of the South Sudan, charcoal is the main source of energy for cooking. There is no other alternative form of energy in the country at the moment. Each farmer is making charcoal for marketing. It becomes easily accessible business to get quick money to satisfy the financial needs of the rural people. During the field visit in Eastern Equatoria, we able to see that both sides of the road stacked with charcoal and Lorries were busy in transporting it to big cities like Juba. If charcoal making business continues at the current rate for some 5 and 10 years, the existence of trees in the woodland will be questionable.

Deforestation and degradation of upstream catchment will increase the rate of downstream reservoir and river bed siltation. It will also reduce amount of rainfall and eventually affect water availability. The siltation is also hindering the smooth use of river transportation. Therefore, water shade management is paramount important to sustain the existing and potential downstream water uses.

In order to minimize adverse impacts on forest the following measures are recommended during the consultation:

- Provide alternative energy, it could be biogas, solar, hydropower, etc,
- Use energy saving stoves,

- Promote reforestation/replantation,
- Include Clauses in Environmental policy that control or prohibit excess charcoal production/use.
- Promote alternative livelihood such as honey production, use of non-timber forest products like spices, incense, etc.

▶ Lack of Proper Wetland Management

Though the inventory and delineation of wetlands have not been done exhaustively, South Sudan is considered as the richest place of wetland. These wetlands are the lungs and kidneys of the ecosystem. Therefore, any development plan and implementation has to consider the sustainable functioning and existence of these wetlands. Water allocation for wetlands should be given priority. Source of water for each wetland has to be understood before any intervention.

▶ Wildlife Conservation Issues

Wildlife conservation is one of the environmental issues to be dealt in the integrated water resource development. The habitat comprising water, grazing area and migratory routes should be secured.

As per the African wildlife conservation assessment migratory animals mainly white-eared Kob are facing mass killing during the migration process. Therefore, maintaining safe migratory routes and creating awareness among the community and army forces need to be carried out. Connection of Gambella and Boma wildlife parks should be maintained. Undisturbed migratory corridors have to be included in the park delineation and management.

According to the undersecretary, the integrated water resource master plan project has to incorporate wildlife watering components to reduce wildlife killing particularly during the dry season migration for the search of water and grazing.

- ▶ Lack of proper coordination between investment and environmental protection offices.

2.3 SOLUTIONS/ACTIVITIES RECOMMENDED BY THE CONSULTED STAKEHOLDERS AND EXPERTS TO REVERSE OR ARREST ENVIRONMENTAL DEGRADATION OF THE NATURAL RESOURCES

During the consultation the following solutions/activities were recommended by the consulted stakeholders and experts to reverse or arrest environmental degradation of the natural resources:

- ▶ Promote small scale irrigation and increase productivity per ha of farm land;
- ▶ Develop mini-hydropower schemes in areas away from the main grid to replace fire wood and charcoal need;
- ▶ Introduce alternative livelihood systems like modern beehives, spice production and marketing, ecotourism, aquaculture, etc;
- ▶ Introduce energy saving stoves and better technologies, introduce coffee bricks from coffee husk for energy/cooking at coffee producing areas (Kefa, Sheka) and introduce solar lamps for lighting.
- ▶ Promote biological conservation works in the degraded areas including reforestation;
- ▶ Protect wetland areas, water towers and bamboo forest areas at the highland areas of the basin where tributary rivers of BAS originated;

- ▶ Strict implementation of forest management plan;
- ▶ Promote integrated and coordinated conservation works to avoid wastage of resources by doing redundant efforts,
- ▶ Establish strong coordination between investment offices and environmental protection offices to not locate investment projects on biodiversity hot spots and protected areas;
- ▶ Conduct prior EIA before allocating land for investment and accept the recommendation of ESIA as a main tool for decision.
- ▶ Conduct environmental monitoring and follow up after the allocation of land for investment;
- ▶ Work on capacity building and technology transfer;
- ▶ Include Clauses in Environmental policy that control or prohibit execs charcoal production/use.
- ▶ Work to link the forest are with carbon credit;
- ▶ Introduce farm technologies that help to produce high production from small farm land;
- ▶ Promoting ecotourism development
- ▶ Avoid allocating land for investment in high forest areas,
- ▶ Collect and dispose solid waste at designated place,
- ▶ Build capacity of cooperatives involved in solid waste collection and disposal by providing training and trucks;
- ▶ Collect and threat liquid waste of Gambella town,
- ▶ Build capacity of cooperatives involved in supplying farm inputs like fertilizers, selected seeds, etc
- ▶ Avoid tribe to tribe and cross boarder conflicts that caused mainly due to competition for grazing land, cattle raiding and watering points;.
- ▶ Solve civil unrest in South Sudan.

2.4 MAIN MISSING INFORMATION / DOCUMENTS

Several important documents and data which were identified during the scoping phase and required to various stakeholders during the consultations could not be collected at this stage. These documents include:

- ▶ Draft Environmental policy of South Sudan (currently submitted to the parliament for review and endorsement);
 - ▶ Socioeconomic surveys for Boma and Badingilo including all details , maps (including GIS files);
 - ▶ Ecological surveys for Boma and Badingilo areas including all details, maps (including GIS files);
 - ▶ Socioeconomic and ecological surveys conducted within protected areas or other natural resources conservation projects;
 - ▶ Documentation and maps relating to the preparatory work carried out in the Imatong mountains;
 - ▶ Land use maps (Shapefiles and associated data) for Boma, Badingilo and any other areas in the basin;
 - ▶ Boma and Badingilo draft management plans;
 - ▶ Reports on discussions on the Boma-Gambella landscape;
 - ▶ General description of the ecosystems provided by WCS for previous EIAs;
 - ▶ Gambella region draft land use management plan;
- Ethiopian forest inventory.

3. DESK REVIEW / BIBLIOGRAPHIC ANALYSIS

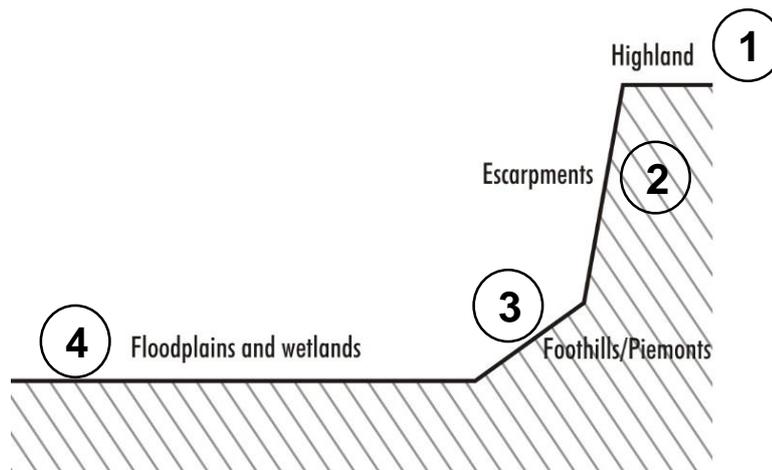
3.1 FLORA AND FAUNA, LAND USE, AND BIODIVERSITY FEATURES OF BIOPHYSICAL AREAS

3.1.1 Biophysical areas delineation

In the following paragraphs, the baseline information concerning environmental features of the BAS is organized per biophysical areas. This should allow a better understanding of the BAS environment functionalities and their interlinkages with water resources and uses than a classical thematic approach. During the scoping phase, the following observation has been established: landuse patterns, ecoregion limits of the BAS, and as a consequence, environmental and social features, challenges and potential identified are strongly linked to relief features of the BAS. The four following biophysical areas have been thus proposed (see figures below):

1. Highlands, located between 1,800 and 3,000 m, are part of the Ethiopian Upper Montane Forests, Woodlands, Bushlands and Grasslands ecoregion, mainly covered by dense forest and subsistence agriculture
2. Escarpments, characterized by very steep slopes, situated between 1,100 and 1,800 m - part of the Ethiopian Lower Montane Forests, Woodlands, and Bushlands ecoregion, mainly covered by forest, montane pastures and subsistence agriculture
3. Foothills / Piedmonts, situated between 700 and 1,100 m, are part of the eastern block of East Sudanian Savanna (Ethiopia) and Northern Accacia Commiphora Bushland an Thicket (South Sudan) / biome Tropical and Subtropical Grasslands, Savannas, shrublands and Woodlands) which are mainly covered by shrubs, dry savannas and Woodlands.
4. Floodplains and wetlands, situated between 370 and 700 m covered by Tropical and Subtropical Grasslands, Savannas, shrublands and Woodlands and the Sudd floodplains Ecoregion

Figure 3: Simplified schematic of the BAS relief and related proposed biophysical areas



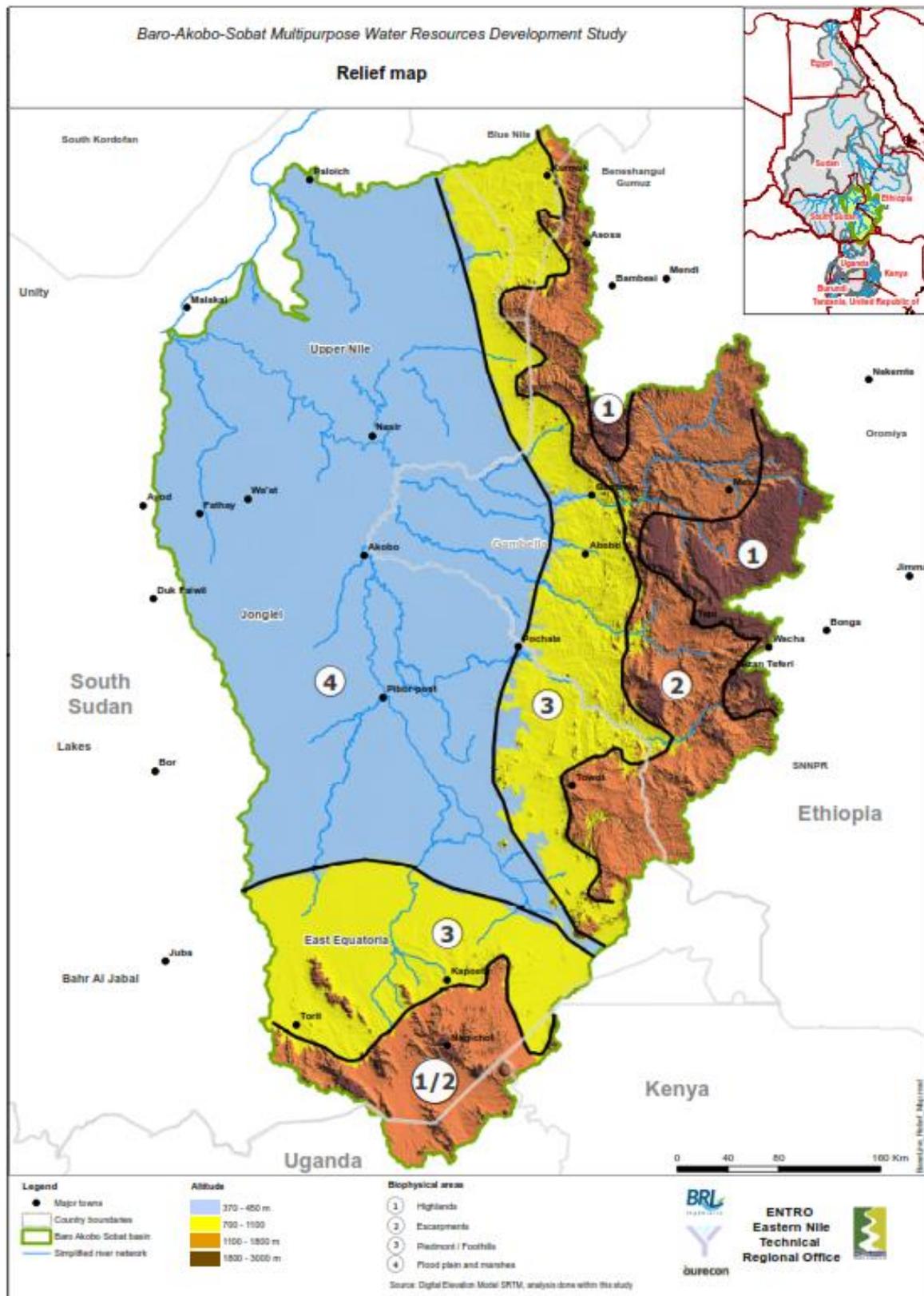
Source: This study

Table 2: Distribution of the BAS biophysical area

Biophysical area of the BAS	Surface area (km²)	% of the BAS
Escapments	57439	22%
Highlands	13956	5%
Piedmont / FootHills	65563	25%
Flood plain and plain	125668	48%
Total basin	262626	100%

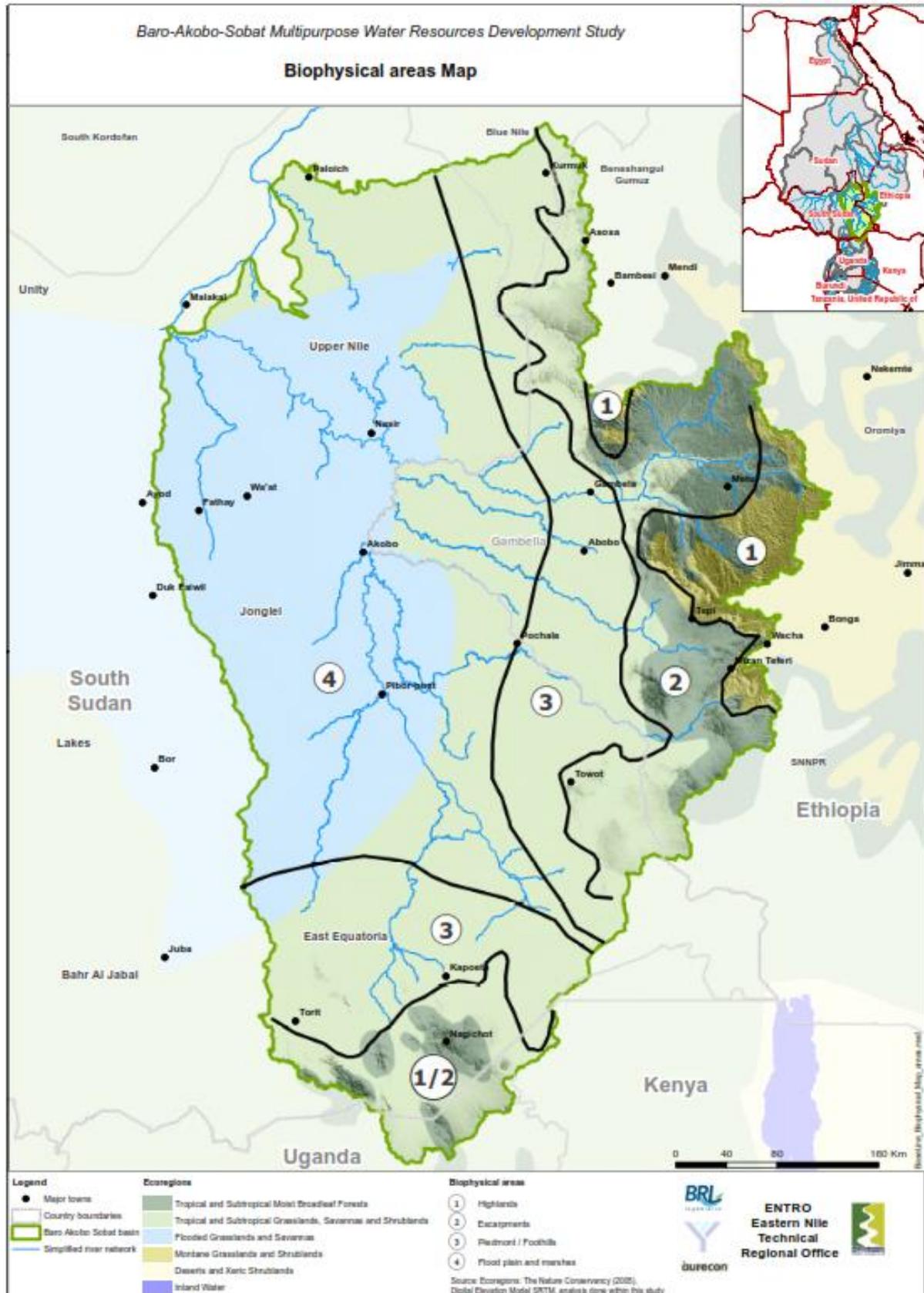
Source: this study

Figure 4: Relief of the BAS and proposed biophysical areas



Source: this study

Figure 5: Eco-regions of the BAS and proposed biophysical areas



Source: this study

3.1.2 Highlands

3.1.2.1 General features

Highlands are mainly situated in the western part and to a lesser extent in the southern part at an elevation of the basin, varying from around 1,800 m to 3,000 m (Mont Kinyeti in the Imatong mountains reaches up to 3,187 m). It is characterized by an undulating to rolling plateau, steeply incised by the major rivers with isolated high mountains such as Mount Tulu Welwel and Seccia (ENTRO, 2007a). These mountains areas are characterised by very high rainfall (from 2000 to 2500 mm per year) and moderate evapotranspiration compared to floodplains. The rainy season lasts from Mai to October.

These highlands consist of the head-catchments of numerous important rivers such as the Baro, Alwero, Gilo, Akobo and Kineti.

Population density is very high in the highland portion of the basin (see section 4.2 of the main baseline report).

According to (Burgess N. & al, 2004), Ethiopian highlands of the BAS are part of the **Ethiopian Upper Montane Forests, Woodlands, Bushlands and Grasslands ecoregion** and South Sudanese highlands are part of the **East African Montane Forests ecoregion**.

3.1.2.2 Ecosystems and vegetation

The natural vegetation of the BAS highlands was probably a mixture of closed forest (Friis, 1992) in (Burgess N. & al, 2004). Currently, the highland areas are still largely covered with forest, even if forests have been severely encroached by agriculture. Elsewhere in the ecoregion (outside the BAS), these forests have almost disappeared. There forest remnant areas in the highland are playing crucial role in regulating river flows. In highly populated areas steep slopes and mountain tops are being farmed. The figure below shows the vegetation distribution in the BAS highlands:

Figure 7: Distribution of main vegetation types in the BAS highlands

Vegetation type	Surface area (km ²)	% of the Highlands biophysical area
Forest	7975	57%
Predominantly farming (Micro-parcels) in mountain area	4904	35%
Predominantly farming (Micro-parcels) and riparian forest in mountain area	407	3%
Pastureland or natural herbaceous land in mountain area	363	3%
Wet area in valleys / hills (Perhaps grass or mountain wetlands)	227	2%
Urban area	34	0,2%
Rock with some natural vegetation (Herbaceous and shrub)	19	0,1%

Source: this study

The main highlands ecosystems are described in the sections below.

3.1.2.2.1 Highlands forest ecosystems

In the Ethiopian highlands, forest ecosystems include the following characteristic species: Albizzia gummifera, Syzygium guinnense, Allophylus abyssinicus, Schefflera abyssinica, Dracaena afromontana, Celtis africana, Chionanthus mildbraedii, Erythrococca trichogyne, Olea welwitschii, Vepris dainelli, Grewia ferruginea, Cyathea manniana, Croton macrostachyus, Phoenix reclinata, Sapium ellepticum, Pouteria adolfifriedericii, Dracaena steudneri, Schefflera volkensii, Milletia ferruginea, Macaranga capensis, Psychotria orophila and Ficus spp. Undergrowth in the high forest areas of Ethiopia

highlands of the basin also consists of coffee Arabica, Aframomum corrorima and Piper capense, which are economically important products of the forest.

In the South Sudanese highlands, the climax vegetation found between 1,500 and 2,600 m in the Imatong Mountain is closed evergreen forest with Podocarpus milanjanus, Olea hochstetteri and Syzygium spp. dominant over a shrubby understorey. Regret of Acacia xiphocarpa occupies large areas of old cultivation sites (ENTRO, 2007a). Between 2,600 and 3,000 m Podocarpus milanjanus again forms the climax vegetation, but is less mixed with other species, apart from a little Olea hochstetteri. This zone includes large areas of mountain meadow dominated by the sedge Bulbostyles atrosanguineus. The bamboo Arundinaria alpina is also found. Much of the ground is wet or swampy because of the combination of high rainfall and low potential evapo-transpiration. Above 3,000 masl, ferns, Erica arborea and Myrica salicifolia are dominant. Many species of herbs occur (ENTRO, 2007a).

Figure 8: Typical vegetation found in the BAS highlands



Riverine forest along Baro river at the road from Masha-Gore



Corrorima (*Aframomum corrorima*)



Timiz (*Piper capense*)



Coffee Arabica

Source: this study

3.1.2.2 Highlands wetlands ecosystems

Even if highlands wetlands could not be mapped within this study, many small wetlands are reported in the literature. EPA (2003b) in (ENTRO, 2014) estimated the total area of wetlands to be about 1.5% of the total land area of the highland plateau. In the Kafa zone for example, the wetlands represent the Afro-tropical Highlands wetland type of Ethiopia. They constitute swamps, marshes, forested wetland areas, peat swamps, and riverine wetlands and cover around 50, 000 ha (EWNRA, 2008).

The wetland flora of the highland plateau hosts commonly *Cyperus latifolius*, *Leersia hexandra*, and *Panicum hymenochilum*. In pristine wetlands *Guizotia scarba*, *Phyllanthus boehmii* and *Snowdenia petitiiana* are more commonly found and cultivated wetlands at the end of the rainy season and *Anagallis*

serpens, *Cyperus brevifolius*, *Fuirena stricta* and *Hygrophila auriclata* are more common in degraded wetlands and cultivated wetlands during the dry season (ENSAP-ENTRO, 2012) in (ENTRO, 2014).

Figure 9: Highland wetlands of the BAS



Source: (EWNRA, 2008)

3.1.2.3 Distinctive biodiversity features and wildlife

Highlands are **biologically rich** and **severely threatened**.

It's distinctive biodiversity features can be listed as follows:

- ▶ Is it endowed with a high level of endemism, including:
 - a high number of endemic plants,
 - covering an important part of the South and Central Ethiopian Highlands endemic bird areas;
 - at least ten amphibians endemic or near endemic (Burgess N. & al, 2004)
- ▶ It hosts the last important remnant forest of the Ethiopian Upper Montane Forests, Woodlands, Bushlands and Grasslands ecoregion and the last important forest area in Ethiopia.
- ▶ The cloud forests of the basin have international importance for their ecology, biodiversity and economy (due to significant contribution on the world market of coffee) (NABU, 2011).
- ▶ Three forest areas have therefore been designated as Biosphere reserves in the basin (Yayu, Kafa, and Sheka).
- ▶ Wildlife species in the Ethiopian Highlands include Colobus and Vervet Monkeys, Tree Squirrel, Lion, Leopard, Antelopes, Buffalo, Elephant, Porcupine, Aardvark, Wart Hog and Forest Pig (waterhok) (ENTRO, 2014).

3.1.2.4 Main threats to the BAS highlands ecosystems

3.1.2.4.1 Global threats to the BAS Highlands

The Ethiopian Upper Montane Forests, Woodlands, Bushlands and Grasslands ecoregion as a whole is severely threatened. In the highlands, the very high human population density, related widespread practice of subsistence farming, huge demand for land for farming and for natural products are the predominant reasons for the widespread loss of vegetation (Burgess N. & al, 2004). In some areas, the population density reaches up to 1,000 inhabitants per km² (NABU, 2011)

3.1.2.4.2 Specific threats to highlands forest ecosystems

The high land areas of the basin was formerly covered with high forest. But this days due to the population increase and expansion of farm into the forest cover, natural forest has significantly depleted. Only small portion of the basin has got remnant intact forest.

Annual average deforestation rate in the basin is expected to be around 1.2 - 1.6 % (Sutcliffe, 2009) in (ENTRO, 2014).

According to (NABU, 2007), the recent estimated rate of loss of highland forests reaches 80,000 - 200,000 ha/year in the Kafa region. If this rate remains constant in the future, the area covered with natural forest will have completely disappeared within 10 years (NABU, 2007).

(NABU, 2011) lists the following main drivers of deforestation and forest degradation in Kafa as follows:

- ▶ “Agriculture expansion: The conversion of forest land to agriculture is at first a way to increase the productivity. This can be mainly observed at forest borders, were farmers systematically clear the understorey (mostly initiated by forest grazing) and thereafter slash and burn the area. The harvested wood is used as an additional income (fire wood, or charcoal) or for the own consumption.
- ▶ Resettlement: If labor cannot support livelihood sufficiently, it results in a widespread illegal/uncontrolled use and conversion of forest land. It was observed, that dynamic forest perforation patches with unstable shape and size were settled by people without permission.
- ▶ Concessions (coffee): Large scale coffee investment (coffee investment area) is supported by the government. Due to the site requirements of Coffee plants, the upper storey of forest is thinned while the understorey is systematically removed. This practice decreases the biodiversity of the forest tremendously. Furthermore, the capability to store carbon is minimized. Local communities are banned for all purposes of forest use.
- ▶ Property rights: The unsecure defined allocation of property rights and the land tenure system in Ethiopia can be addressed as one of the main drivers for forest loss.
- ▶ Unsustainable use of forest resource: Legal and illegal forest use is increasing since customary user rights have been replaced by state sanctioned rights. Missing technical assistance in sustainable forestry and missing resource use (of plantations) from governmental side lead to illegal and unmanaged use of wood resource.”

Even if the situation can slightly vary from one place to another, the above described situation is representative of the threats to forests ecosystems in the highlands of the BAS.

3.1.2.4.3 Specific threats related to highlands wetlands ecosystems

Several studies studies undertaken by EWPR, Wetland Action (WA) and EWNRA in Western Oromiya Region, mainly in Jimma, Western and Eastern Wollega and Illubabor zones, revealed that wetlands have been drained for growing food crops now for more than a century (Hailu A, 2006).

Highlands wetlands also support other important uses for local communities. For example, wetlands uses and beneficiaries in Illubator are shown in the figure below:

Figure 10: Wetlands uses and beneficiaries of highlands wetlands in Illubator

<u>Uses</u>	<u>Estimate of Households Benefiting</u>
Social/ceremonial use of reeds	100% (including urban dwellers)
Thatching reeds	85% (for house construction)
Thatching reeds for granary roofing	>50%
Temporary crop guarding huts of reeds	30%
Domestic water from springs	50%
Craft materials	5%
Medicinal plants	100%
Dry season grazing	>30%
Water for stock	>30%
Cultivation	10%

Source: (Afework, 2001)

These various uses, when not properly managed, can contribute to wetlands degradation.

Figure 11: Brick making in highlands wetlands



Source: (EWNRA, 2008).

3.1.3 Escarpments

3.1.3.1 General features

The escarpments are generally situated between 1,100 and 1,800 m. These areas are characterised by very steep slopes (much more important than in the highlands and foothills). Escarpment section in the basin is a transition zone between highland and lowland areas. Some parts are also more flat like the Boma Plateau, situated between 1,100 and 1,300 m. The **Ethiopian Lower Montane Forests, Woodlands, and Bushlands** ecoregion surrounds the highlands ecosystems described in the previous section. In South Sudan, escarpments are part of the **East African Montane Forest** ecoregion.

Rainfall can reach 2,300 mm per annum and fall between Mai and October. Ancient Precambrian basement rocks form the substrate of the forests and woodlands and bushlands in deep river valley (Burgess N. & al, 2004).

Figure 12: Typical landscapes of BAS escarpments (left : Ethiopia; right: South Sudan)



Source: This study

3.1.3.2 Ecosystems and vegetation

The area supports East African evergreen and semi-evergreen forests, woodlands, and shrublands. Moister sites in southwest forest patches are dominated by tall trees, chiefly *Aningeria* and other Sapotaceae, species of Moraceae, and species of *Olea* (Burgess N. & al, 2004).

Figure 13: Woody grass land at the escarpment of Gambella Region (left) and Savanna forest of the Boma Plateau (right)



Source: this study (left) and (USAID, 2007b)

Transitional forests occur between 500 and 1,500 m in Illubator and Kefa and have rainfall close to 2,000 mm per annum. These transitional forests change to Afromontane forests at approximately 1,500 m altitude in the southwest, where the rainfall is between 700 and 1,500 mm (Friis, 1992) in (Burgess N. & al, 2004). *Coffea Arabica* is the dominant natural understory shrub and wildcoffee is harvested.

Figure 14: Imatong lowland forest



Source: (Safaris, 2016)

In the Akobo catchment around bench-maji and Sheka zones, edible roots like Taro and Enset are common and support livelihood of people. These edible roots are drought resistance and also help to soil conservation.

Figure 15: Taro at Kafa (left) and Enset at Sheka (right)



Source: this study

Figure 16: Distribution of main vegetation types in the BAS Escarpments

Vegetation type	Surface area (km ²)	% of the Escarpments biophysical area
Pastureland or natural herbaceous land in mountain area	14237,6	24,8%
Rock with some natural vegetation (Herbaceous and shrub)	12603,4	21,9%
Forest	7704,3	13,4%
Predominantly savanna generally dry (Herbaceous and shrub)	6457,2	11,2%
Predominantly farming (Micro-parcels) in mountain area	5845,0	10,2%
Predominantly transition savanna in hills area (Herbaceous, shrub, grass and rock)	5371,0	9,4%
Predominantly farming (Micro-parcels) and riparian forest in mountain area	3786,7	6,6%
Predominantly savanna temporarily wet (Herbaceous, shrub and some little farming area)	422,4	0,7%

Natural vegetation (grass and shrub) and riparian forest	404,7	0,7%
Irrigated farming or plantations	228,8	0,4%
Wet area in valleys / hills (Perhaps grass or mountain wetlands)	149,3	0,3%
Urban area	109,5	0,2%
Water surfaces	2,1	0,0%
Total	57439	100%

Source: this study

3.1.3.3 Distinctive biodiversity features and wildlife

The Ethiopian Lower Montane Forests, Woodlands, and Bushlands ecoregion, like the Ethiopian Upper Montane Forests, Woodlands, Bushlands, and Grasslands ecoregion from the BAS highlands, is part of the Afromontane archipelago-like regional center of endemism (White, 1983) in (Burgess N. & al, 2004).

It supports a variety of forest types with associated bushland and woodland habitats and consequently have high species richness and endemic species (Friis, 1992) in (Burgess N. & al, 2004). For example, the Mejang area is characterized by:

- ▶ A rich biodiversity: about 550 species of plants, 130 birds, 33 mammals and 20 species of Amphibians and Reptiles.
- ▶ Many rare and endemic species that are found in the area; e.g. 27 endemic plants, 3 endemic amphibians,
- ▶ Of endemic plants, three are endangered: *Aframomum zambesiacum* subsp. *Puberulum*, *Rinorea friisii*, and *Scadoxus nutans* (MELCA, 2014).

Coffea Arabica comes naturally in the escarpments, on the contrary to higher areas, where it has been transplanted (ENTRO, 2014).

(Yalden, 1996) in (Burgess N. & al, 2004) draw attention to the poverty of forest mammal fauna in the southwestern Ethiopian part of this ecoregion.

3.1.3.4 Main threats to the BAS escarpments ecosystems

For the time being, there is no significant pressure and human encroachment in the very steep parts of this area. They are covered with woody grass land and is used for grazing and wildlife habitat. This is why the escarpments host the largest areas of natural forest found in the Ethiopian Lower Montane Forests, Woodlands, and Bushlands ecoregion (Burgess N. & al, 2004). However in the future when access roads opened and fuel wood and charcoal needs increased, people could start exploitation of fuel wood and charcoal that would deplete woodland and cause degradation.

In accessible parts of the escarpments, all natural habitats are highly threatened because they have been reduced to small patches and are severely fragmented. Little habitat remains in its natural state, except in rocky ravines and other inaccessible areas. Agriculture is the main threat, coupled with exploitation of trees for fuelwood and timber. In many areas poor agricultural methods and overgrazing have resulted in intense soil erosion.

Specific causes of deforestation in Mejang area are identified as follows:

- ▶ Expansion of coffee plantation,
- ▶ Settlements and Agricultural expansion,
- ▶ Logging,
- ▶ Fire,
- ▶ Local wood consumption (MELCA, 2014).

The BAS escarpments ecosystems have been long poorly protected. As already mentioned, recent biosphere reserves on both highlands and escarpments have been created in the basin:

- ▶ Government of Ethiopia has adopted biosphere reserve approach for the first time in 2010 by creating the Yayu Coffee Forest in Oromia and the Kafa in SNNP regional states;
- ▶ The neighboring Sheka Forest has also become the third biosphere reserve in 2012 initiated and supported by MELCA Ethiopia (MELCA, 2014).

National Forest Priority Areas theoretically cover the entire forests areas of BAS highlands, escarpments and Foothills but do not provide effective protection and are not known at local level (NABU, 2011).

3.1.4 Foothills / Piedmonts

3.1.4.1 General features

Foothills or Piedmonts are situated between 700 and 1,100 m. They form a transition area between escarpments, characterized by very steep slopes and flood plains which are extremely flat. The rainy season lasts from April to September.

The foothills areas are part of the eastern block of **East Sudanian Savanna ecoregion** in Ethiopia and southern part of the basin and **Northern Accacia Commiphora Bushland and Thicket ecoregion** in the southwestern part of South Sudan. Both ecoregions belong to the Tropical and Subtropical Grasslands, Savannas, shrublands and Woodlands Biome. They are mainly covered by shrubs, dry savannas and Woodlands.

Figure 17: Typical landscapes of BAS Foothills / Piedmonts (left : Ethiopia; right: South Sudan)



Source: This study

3.1.4.2 Ecosystems and vegetation

In the foothills area, the vegetation is undifferentiated woodland with trees that are mainly deciduous in the dry season, with an understory of grasses, shrubs, and herbs. Typical trees found in these areas are: Combretum and Terminalia species, Anogeissus leiocarpus, Boswellia papyrifera, Lanea schimperi, and Stereospermum kunthianum. The solid-stemmed bamboo Oxytenanthera abyssinica is prominent in the western river valleys of Ethiopia. Dominant grasses include tall species of Hyparrhenia, Cymbopogon, Echinochloa, Sorghum, and Pennisetum (Tilahun, S., S. Edwards, and T. B. G. Egziabher editors, 1996) in (Burgess N. & al, 2004).

Figure 18: Lowland bamboo (left) and lowland woody grasslands (right) along Guba-Torit road



Source: This study

Figure 19: Distribution of main vegetation types in the BAS Foothills

Vegetation type	Surface area (km ²)	% of the Foothills biophysical area
Predominantly savanna generally dry (Herbaceous and shrub)	34029	52%
Predominantly transition savanna in hills area (Herbaceous, shrub, grass and rock)	13699	21%
Predominantly savanna temporarily wet (Herbaceous, shrub and some little farming area)	8381	13%
Rock with some natural vegetation (Herbaceous and shrub)	4179	6%
Forest	2128	3%
Pastureland or natural herbaceous land in mountain area	1439	2%
Marshes	1028	2%
Irrigated farming or plantations	382	1%
Natural vegetation (grass and shrub) and riparian forest	141	0,2%
Urban area	81	0,1%
Predominantly farming (Micro-parcels) in mountain area	51	0,1%
Water surfaces	24	0,0%
Total	65563	100%

Source: this study

3.1.4.3 Distinctive biodiversity features and wildlife

According to (Burgess N. & al, 2004), these ecoregions have low rates of faunal endemism, with only one strictly endemic mammal, 2 strictly endemic reptiles, 5 bird species for the Eastern Sudanian Savana ecoregion. However, this is an important area for endemic plants.

Threatened mammal species include elephants (*Loxodonta Africana*), wild dog (*Lycaon pictus*), cheetah (*Acinonyx jubatus*), and lion (*Panthera leo*). The roan antelope's (*Hippotradus equinus*) can also be found.

3.1.4.4 Main threats to the BAS Foothills ecosystems

According to (Burgess N. & al, 2004), the original wooded savanna habitat has been significantly reduced. The main treats to foothills ecosystems are:

- ▶ seasonal shifting of cultivation,
- ▶ overgrazing by livestock,

- ▶ cutting of trees and bushes for wood,
- ▶ burning of woody materials for charcoal,
- ▶ and uncontrolled wild fires.

The main threats to the species come from overgrazing, poaching and overhunting for meat.

Climate change consists of an additional threats while it exacerbates the above quoted impacts of human activities. Ability of the ecosystem to recover from overuse can indeed be reduced when there is little rainfall.

3.1.5 Flood Plains and wetlands

3.1.5.1 General features

This biophysical area covers more than the half of the BAS.

The Floodplains and wetlands biophysical area is situated between 370 and 700 m. It consists of very flat clay plains that stretch from northwards south soudanese foothills and westwards from Ethiopia foothills to the Sobat river. These plains have very gentle slopes between 0,01 and 0,012% (ENTRO, 2007a).

The rainfall reaches between 600 and 800 mm/year, falling between April and September during the hot season when temperatures average 30-33°C, dropping to an average of 18°C in the cooler season (Burgess N. & al, 2004). Mean annual evaporation from 1600 to 1900 mm/year (ENTRO, 2007a).

Vertisols have developed in the waterlogged conditions over these nutrient poor sediments, although fluvisols and patches of luvisols can be found along the river courses.

This biophysical area is by the two following ecoregions:

- ▶ The East Sudanian Savanna, which belongs to the Tropical and Subtropical Grasslands, Savannas, Shrublands, and Woodlands biome (also largely present in the foothills / piedmonts biophysical area),
- ▶ The Sudd Flooded Grasslands, which consists of Flooded Grasslands and Savannas.

Figure 20: Typical landscapes of BAS Floodplains and wetlands (left : Ethiopia; right: South Sudan)



Source: This study

3.1.5.2 Ecosystems and vegetation

The floodplain ecosystem supports a variety of plant species ranging from those adapted to wet environments, under water during several months in a year, to those adapted to more dry environments,

occasionally flooding or only by rainfall. Moving from the center of the swamps, the ecological zones grade from the open water and submerged vegetation of a river-lake, to floating fringe wetlands, to seasonally flooded grasslands, to rain-fed wetlands, and finally to floodplains woodlands (Hickley, 1987) in (Burgess N. & al, 2004)).

Cyperus papyrus is dominant at riversides and in the wettest swamps. *Phragmites* and *Typha* swamps are extensive behind the papyrus stands, and there is an abundance of submerged macrophytes in the open waterbodies.

Seasonal floodplains, up to 25 km wide, are found on both sides of the main swamps. Wild rice (*Oryza longistaminata*) and *Echinochola pyramidalis* grasslands dominate the seasonally inundated floodplains. Wild rice support a flooded period from 5 to 9 months, whereas *Echinochola pyramidalis* is inundated during less than 3 or 4 months in a year. The seasonally river-flooded grassland forms the 'toich', which yields dry season grazing areas important to the Nuer and Dinka agro-pastoralists. Yield is affected by the duration, timing and intensity of the flood (ENTRO, 2007a), varying from 1 ton/ha when non inundated to 7 ton/ha when inundated.

Beyond the floodplain, *Echinochloa haploclada*, *Sporobolus pyramidalis* and *Hyparrhenia rufa* grasslands cover the rain-fed wetlands. Mixed woodlands of *Accacia seyal*, *Ziziphus mauritiana*, *Combretum fragans*, and *Balanites aegyptica* border the floodplain ecosystem ((Denny, 1991) in (Burgess N. & al, 2004)). Riparian forests species include: *Celtis kraussiana*, *Ficus sycomorus*, *Mimusops kummel*, *Tamarindus indica*, *Maytenus senegalensis*, *Kigelia aethiopum*, *Syzygium guineense* and *Acacia* spp (ENTRO, 2007a).

Figure 21: Distribution of main vegetation types in the BAS wetlands

Vegetation type	Surface area (km2)	% of the Foothills biophysical area
Marshes	25799	21%
Predominantly savanna temporarily wet (Herbaceous, shrub and some little farming area)	16813	13%
Predominantly savanna generally dry (Herbaceous and shrub)	81206	65%
Pastureland or natural herbaceous land in mountain area	34	0,0%
Rock with some natural vegetation (Herbaceous and shrub)	1133	0,9%
Predominantly transition savanna in hills area (Herbaceous, shrub, grass and rock)	166	0,1%
Water surfaces	60	0,0%
Irrigated farming or plantations	229	0,2%
Urban area	54	0,0%
Petroleum domain	125	0,1%
Total	125668	100%

Source: this study

3.1.5.3 Distinctive biodiversity features and wildlife

The BAS hosts **one of the most important mammal migration of the world** (USAID, 2010b).

The **main migratory species is the White-eared Kob** (*Kobus kob leucotis*) due to the huge number of individuals. White-eared Kob are endemic to the BAS since migrations routes are nearly confined within the sub-basin limits/ White-eared Kob are listed as "least concerned" but faces increasing threats leading to population decline. The inclusion of the White-eared Kob in CMS (Convention on Migratory Species) Appendix 2 has been proposed in 2014 (CMS, 2014). White-eared Kob population estimations vary from one source to another. For example, (WCS-HoA, 2010) suggests that the total number of White-eared Kob is as high as 753 000; USAID (2010) estimates the total population at 1.2 million. According to some experts (Frost, W., 2014), this migration is the 2nd most important of Africa, after the Serengeti one. According to others, the White-eared Kob migration rivals that of the Common Wildebeest (*Connochaetes*

taurinus) in the Serengeti ecosystem (Kingdon, K. & Hoffman, M. (eds), 2013) or could be the most important one (HoA-REC, 2011).

Migration routes **are highly correlated with hydrological patterns** (HoA-REC, 2011). (Fryxell, J. M. & Sinclair, A. R. E., 1988) have studied the relationship between seasonal migration by White-eared Kob and resources (food, water) availability and shows that « seasonal migration by white-eared kob is linked to shifting distributions of critical resources”.

Appart from White-eared Kob the migration consists of **tiang, Mongalla gazelle and East African eland all followed by lion, jackal and hyena**. At the southern end of the migration they are joined by **zebra, Bright’s gazelle, giraffe and Beesa oryx**. There are also **roan antelope and buffalo** near the Ethiopian foothills (Frost, W., 2014).

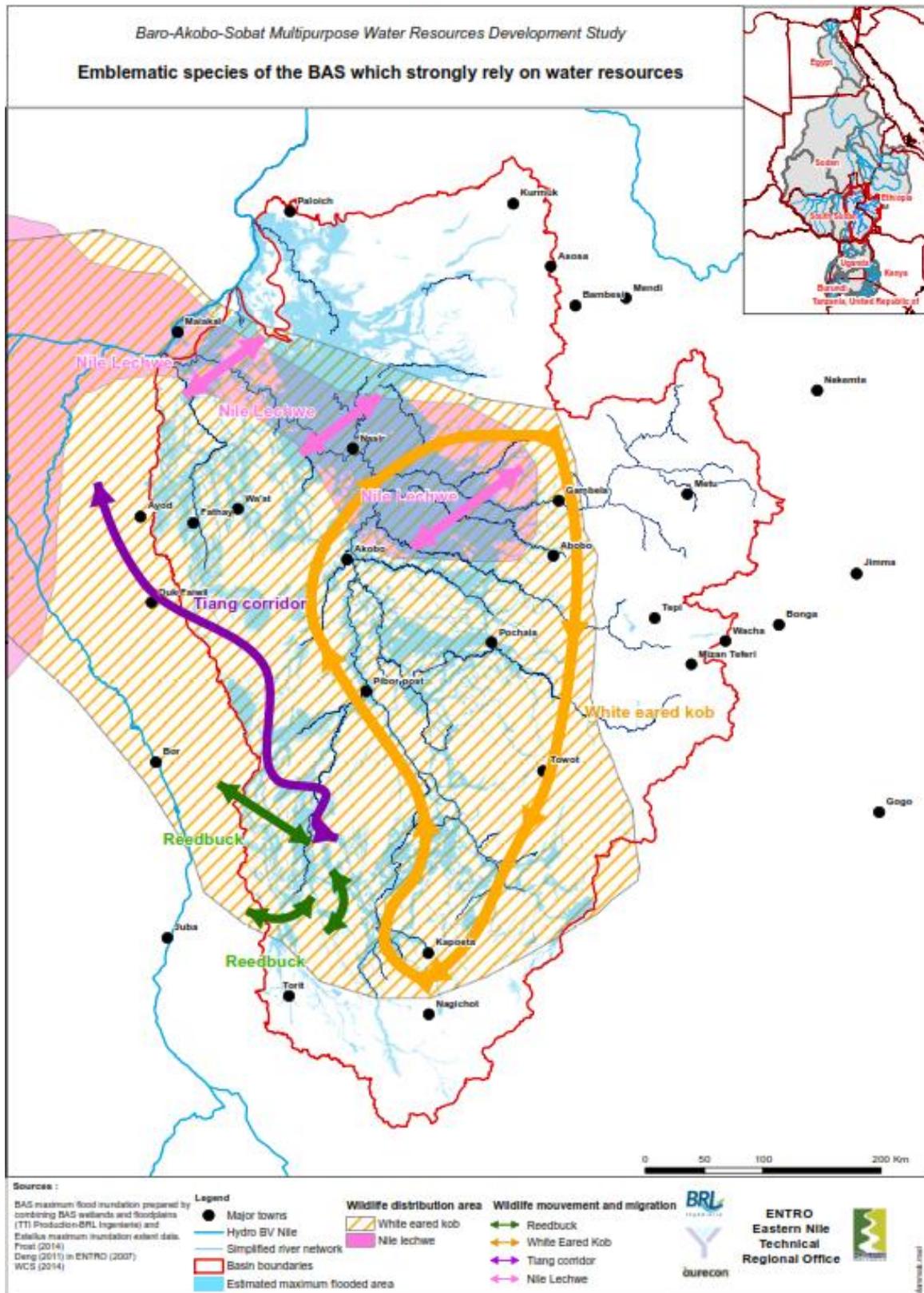
Figure 22 : White-eared Kob in floodplain grassland (left) and Nile lechwe (right)



Source: (Frost, W., 2014) (National geographic, 2015)

The BAS hosts the **Nile lechwe endangered species** which is present only in the Sudd swamps, in the Machar Marshes and in the Gambella region (Frost, W., 2014) (IUCN SSC Antelope Specialist Group , 2008) (Kingdon, K. & Hoffman, M. (eds), 2013). Nile lechwe’s primary habitat is swamps and marshes subject to seasonal inundation (Kingdon, K. & Hoffman, M. (eds), 2013). **Local patterns of flooding have the most influence on the species** (Kingdon, K. & Hoffman, M. (eds), 2013) as they follow the fluctuating margins between floodwaters and drier ground, moving up and down the flood tide lines with the seasons (Frost, W., 2014). Nile Lechwe population seems to be reduced to a very low density (Kingdon, K. & Hoffman, M. (eds), 2013) (Frost, W., 2014).

Figure 23: Emblematic mammal species habitats and migratory routes of the BAS

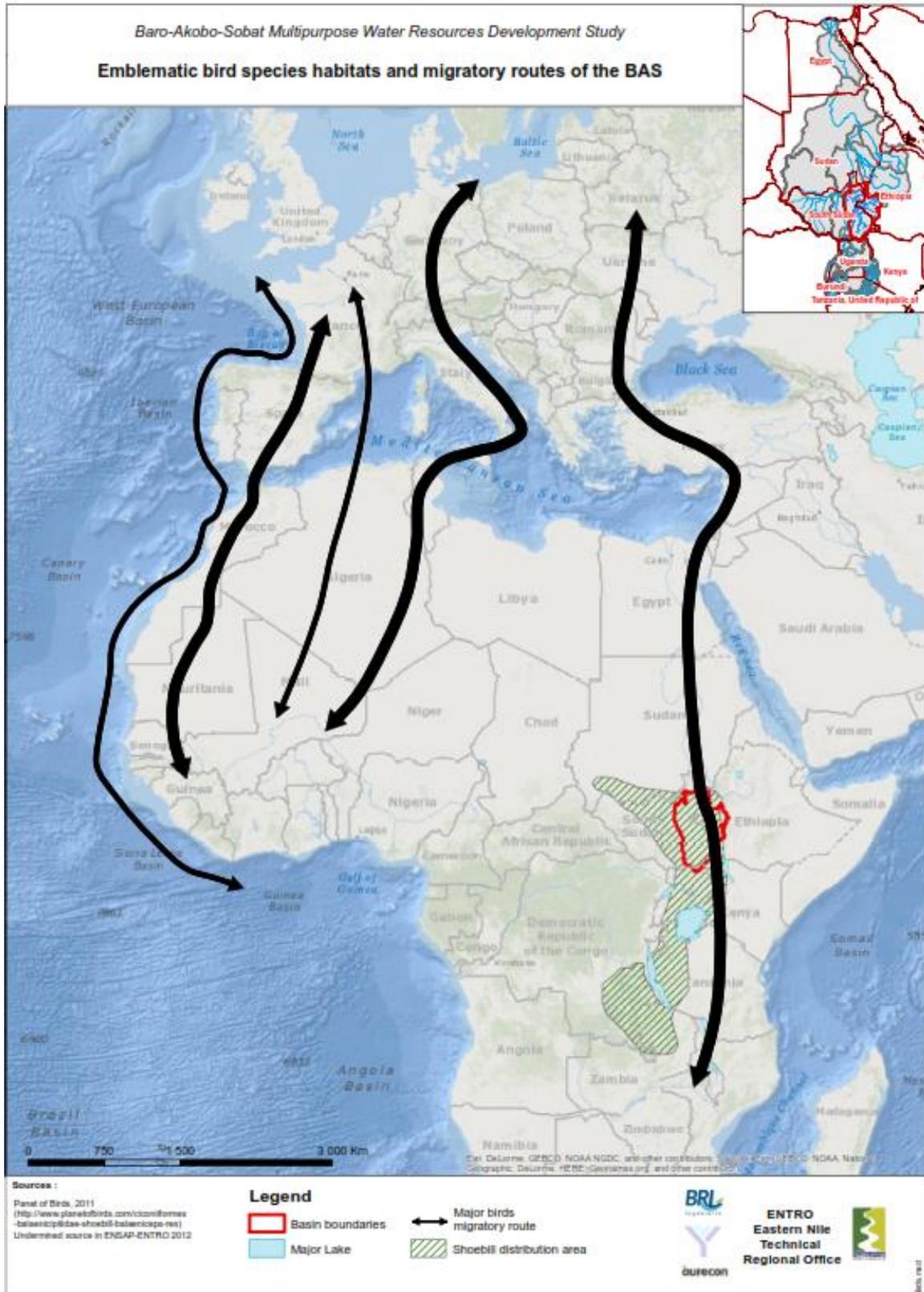


Source : this study

The BAS is situated on the major birds migratory routes between Africa and Europe and hosts an important population and diversity of birds (ENSAP-ENTRO, 2012) with more than 2.5 million using the floodplains of the Sudd annually, mainly migratory species moving between Europe and Africa (Robertson, 2001) in (Burgess N. & al, 2004)).

These wetlands also support the largest population of shoebill (*Balaeniceps rex*) in the world, estimated at around 6,400 individuals (Robertson, 2001) in (Burgess N. & al, 2004)). The area is also a stronghold for the great white pelican (*Pelecanus onocrotalus*), ferruginous duck (*Aythya nyroca*) ((Robertson, 2001) in (Burgess N. & al, 2004)), and black-cowd crane (*Balearica pavonina*) ((Newton, 1996) in (Burgess N. & al, 2004)).

Figure 24: Emblematic bird species habitats and migratory routes of the BAS



Source : this study

Werner's garter snake (*Elapsoidea laticincta*) is a near-endemic snake, but other amphibians and reptiles are unremarkable (Burgess N. & al, 2004).

The basin waters and wetlands host a **high diversity of fishes** (from around 90 to more than 100 species depending on sources) (ENTRO, 2007a). The main species found in the basin are *Lates niloticus* (Nile perch), and *Polypterus bichir* (Nile bichir), *Bagrus* spp., *Heterotis niloticus*, *Clarias gariepinus*, *Distichodus* sp., *Gymnarchus niloticus*, *Barbus* spp., *Synodontis* spp., *Hydrocynus* sp., *Citharinus* sp. and *Tilapia nilotica* (ENTRO, 2007a)

The BAS water bodies also support **various Malacofauna species**, including 13 gastropod species, (from which only one, *Gabbiella schweinfurthi* may be endemic) and 11 bivalve species (from which only the iridiniid *Chambardia marnoi* is likely distinctive and confined to this part of the Nil). Near the mouth of the Sobat, large zones were invaded by the big bivalve, *Etheria elliptica*. The colonies of these mollusks provided a habitat for a rich fauna of Ephemeroptera and Trichoptera. The genera *Amphipsyche*, *Cheumatopsyche*, *Aethaloptera* and *Ecnomis* predominated (ENSAP-ENTRO, 2012).

The **benthos of the Sobat River is similar to that of the White Nile**. The clayey bottom of the bed was sparsely populated by Chironomidae (*Polypedilum* sp., *Clinotanytus* sp., *Stictochironomus* sp., *Cryptochironomus* sp.) and Trichoptera. The total biomass of the benthos in the middle of the river was about 0.2 g m⁻² (ENSAP-ENTRO, 2012).

3.1.5.4 Main threats to the BAS Floodplains and wetlands ecosystems

3.1.5.4.1 Specific threats concerning wildlife

The main threats to the mammal migrating species come from overgrazing, poaching and overhunting for meat.

(Frost, W., 2014) and (Kingdon, K. & Hoffman, M. (eds), 2013) estimate that the survival of the Nile lechwe Ethiopian population seems highly precarious and the Sudanese one threatened. The main reported threats are the increased human pressure in the form of hunting / poaching; habitat degradation by domestic livestock, especially when large numbers of cattle penetrate the area during the dry season; oil exploration and current inadequate conservation measures.

Some population estimates emblematic migratory species of the BAS are summarized in the tables below:

Table 3: Population estimates of emblematic species of the BAS in the area

Date	Area investigated	Observation/estimation	Species	Source
2007	South Sudan	4 291	Nile lechwe	Frost (2014) quoting the aerial survey carried out by WCS
1983	South Sudan and Ethiopia	30 000 – 40 000	Nile lechwe	Aerial survey of Mefit-Babtie (1983) in Kingdon (2013)
1988	Machar	900	Nile lechwe	Hillman & Fryxell (1988) in Kingdon (2013)
2007	Boma National park Lottilla plains Jonglei area	700 000 46 000 12 000	White-eared Kob	Fay et al (2007) in Kingdom et al (2013)
1980-1983	Boma National park	800 000	White-eared Kob	Fryxell & Sinclair (1988)
Early 1980s	Boma ecosystem	Nearly 1 million	White-eared Kob	Fryxell (1985), Hillman & Fryxell (1988) in Kingdom et al (2013)
2009-2010	Gambella National Park	203 181 51 962	White-eared Kob	TFCI (2010)

Date	Area investigated	Observation/estimation	Species	Source
	Upper Akobo			
2010	Sudan's Boma-Jonglei Landscape	1.2 million	white-eared kob, tiang, Mongalla gazelle, and reedbuck	USAID (2010)
2001	Not specified	753, 000	White-eared Kob	WCS (2001)

Source: this study – compilation from various sources

Table 4: Recent wildlife population estimates from EWCA 2015 aerial survey in Gambella National Park

Specie	Scientific name	Individuals observed (n)	Population Estimate (Ŷ)
White eared kob	<i>Kobus kob leucotis</i>	29,458	399,299
Giraffe	<i>Giraffa camelopardalis</i>	33	447
Buffalo	<i>Syncerus caffer</i>	887	12,023
Roan Antelope	<i>Hippotragus equinus</i>	40	542
Tiang	<i>Damaliscus lunatus</i>	39	529
Hartebeest	<i>Acelaphusbushel apuslelwel</i>	16	217
Waterbuck	<i>Kobus ellipsiprymnus</i>	5	68
Nile lechwe	<i>Kobus megaceros</i>	28	192
Shoebill stork	<i>Baleaniceps rex</i>	26	34

Source: (EWCA, 2015) b

The empty canal is also detrimental to wildlife in the area (according to stakeholders' consultations). It indeed blocks the annual movement of the tiang southwest to their wet season grazing area, and many thousands are shot as they try to find crossing points (Burgess N. & al, 2004).

The recent and planned development of huge mechanized farms in Gambela can consist of an important threat to wildlife migration and habitat. According to (Pearce, 2011), canal and roads have been constructed, land has been cleared, 55,000 ha have already been planted, including 35,000 ha of rice, 10,000 ha of maize, and 10,000 hectares of sorghum and 20,000 hectares of oil palm and sugar cane should be added soon within the original boundaries of Gambela national park. These original boundaries have been revised in order to make way for new agricultural concessions.

Figure 25: Earth clearing before plantation of irrigated rice in Gambela (left) and farming in the original boundaries of Gambela national park (right)



Source : left : (Pearce, 2011) and right : (Gebresenbet F., et al., 2013)

3.1.5.4.2 Oil exploitation

Oil extraction and exploration is limited to the South Sudanese part of the basin, in Upper Nile State where there are 3 oil fields in activity: Paloch, Gumry and Adar Yale. Water quality issues have been reported to several NGOs by the local communities (Bonn International Center for Conversion, 2013; Cordaid, 2014). These communities usually rely on surface water for drinkable water and to provide water for the livestock. They have reported to the NGOs that they cannot use surface water anymore because of the pollution and noticed abnormal loss of livestock that they ascribe to oil contamination.

It should be noted that oil pollution can have adverse effects on surface water but also on groundwater and on the soils (polluted by oil residues).

3.1.5.4.3 Poor sanitation and waste management

Increased population density in the upper catchment areas and in the main towns of the basin, combined with poor sanitation and waste management can lead to local water quality problems.

Figure 26: Washing and sewage discharge in the Kenneti river (left) and untreated water for the Torit market (right)



Source: (MWRI, 2012)

3.1.5.4.4 Siltation of the rivers

During a field mission to Machar Marshes conducted in November and December 2012, siltation has been identified as an important issue.

Sand dunes and deposits in the Machar mouth have been observed and reported by local inhabitants on the Machar mouth, along the Khor Machar, on the Zure River / Adura river, and on the Baro river and its major spills and bifurcations. These deposits occurred in less than 10 years period and could have already important socio-economics, and environmental impacts. Erosion of the upper parts of the catchment seems to be the cause of the observed downstream siltation (ENTRO, 2012b).

3.1.5.4.5 Invasive species in waterbodies

Water hyacinth was observed during the site visit in Baro River below the Baro bridge at Gambella town. It is also mentioned during the discussion with South Sudan Transport office as a barrier for boat movement in Sobat River.

Water hyacinth (*Eichhornia crassipes*) is considered one of the world's worst weeds invading lakes, reservoirs, ponds, canals, and rivers because of its numerous adverse effects, because it:

- ▶ Creates impenetrable barriers and obstructing various uses of water,
- ▶ Leads to complete blockage of navigation and fishing routes,
- ▶ Hinders irrigation by impeding water flow, by clogging irrigation pumps, and by interfering with weirs. Increased water loss through evapo-transpiration,
- ▶ Provides a breeding ground for disease vectors such as mosquitoes and the vector snails of schistosomiasis,
- ▶ Leads to depleting oxygen to aquatic communities, resulting in lack of phytoplankton alters the composition of invertebrate communities, ultimately affecting fisheries,
- ▶ Destroys native plants and wildlife habitat (Rezene, 2014).

Figure 27: Floating Water hyacinth observed in Baro River below the Baro bridge at Gambella town (left)
Luxurious growth of water hyacinth at Koka Reservoir in Ethiopia (right)



Source: This study (left), (Rezene, 2014) (right)

3.2 PROTECTED AREAS AND BIODIVERSITY CONSERVATION / WATERSHED PROTECTION INITIATIVES

3.2.1 Protected areas

Around 30% of the basin surface area is covered by protected areas. The BAS totalizes over 30 protected areas which are briefly presented in the table below. Despite this large number and important coverage, important issues have been identified:

- ▶ Important (for biodiversity and livelihoods) and threatened ecosystems are not covered by any type of specific protection. This is for example the case of the Machar marshes (see figure below);
- ▶ Effective protection is quasi insignificant in the basin. However, recent planning initiatives (land use management plan under preparation in Gambela region and protected area management plan are under review for Badingilo and Boma national parks) and conservation projects in biosphere reserves can be noticed.
- ▶ Little general updated information is available, especially concerning National Forest Priority Areas, Forest reserves, and Game reserves;
- ▶ Little detailed information is available, including for the National parks.

Table 5: Main characteristics of protected areas in the BAS

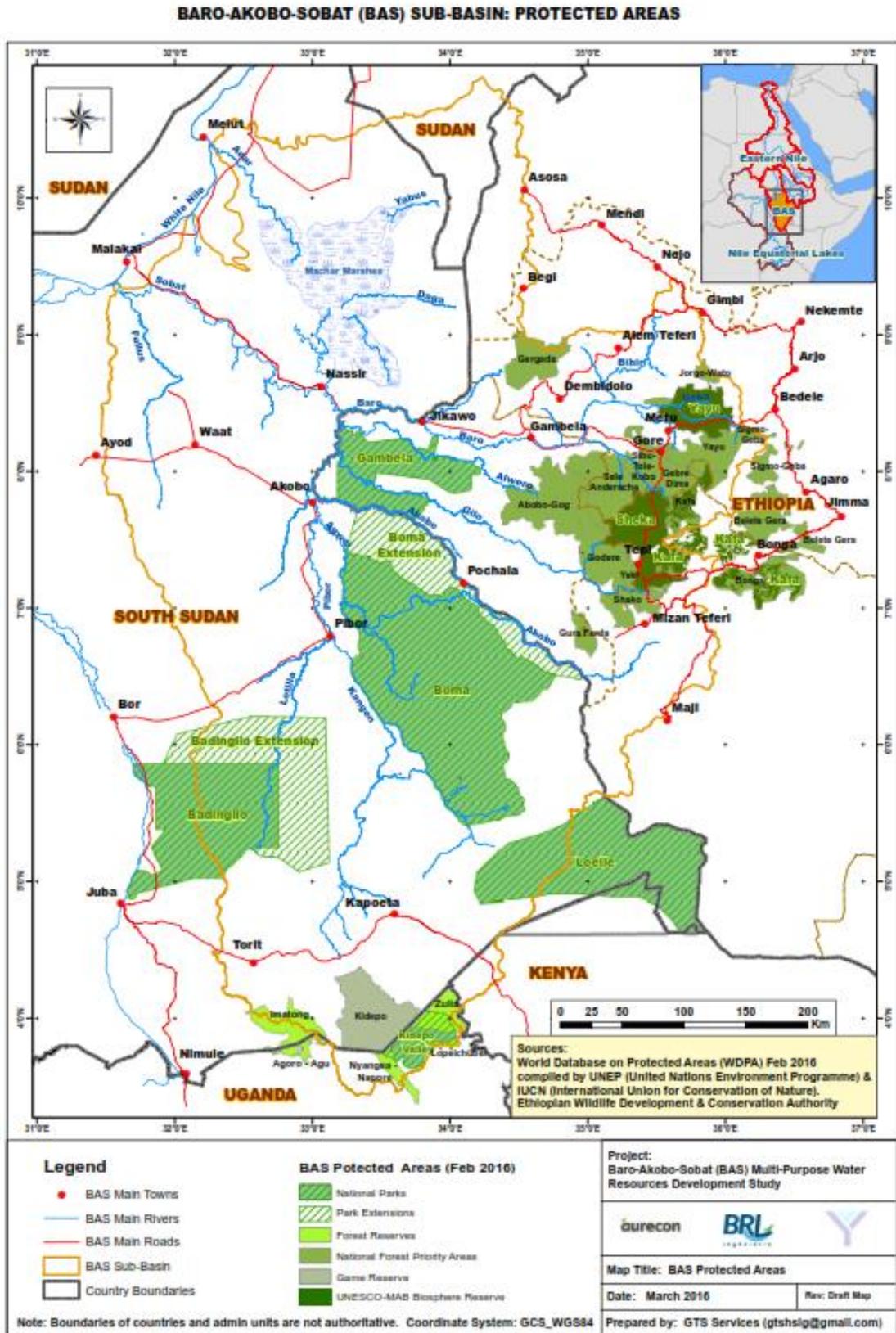
Type of protected area	Name	Country	Biophysical area	Total surface area (km ²)	Date of creation	Current status
National Park	Gambela	Ethiopia	Floodplains and wetlands	4,554	1973	Gazetted and demarcated in 2014. Cooperation between EWCA and African Parks for the management
	Boma	South Sudan	Floodplains and wetlands	19,747 (24,634 with the	1977	Cooperation between MWCT and WCS for the

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Type of protected area	Name	Country	Biophysical area	Total surface area (km ²)	Date of creation	Current status
			Foothills and Piedmonts	proposed extension)		management. Management plan under review. Currently closed for security reasons.
	Badingilo	South Sudan	Floodplains and wetlands	8,934 (16,658 with the proposed extension)	1986	Cooperation between MWCT and WCS for the management. Management plan under review
	Loelle	South Sudan	Floodplains and wetlands Foothills and Piedmonts	10,774		
	Kidepo valley	Uganda	Highlands, Escarpments	1,430	1962	
Forest reserve	Imatong	South Sudan	Highlands, Escarpments	1,159	1952	No management plan
	Agoro-Agu	Uganda		263	1948	No management plan reported
	Nyangea-Napore	Uganda		423	1950	
	Lomej	Uganda		8	1963	
	Lopeichubei	Uganda		167	1963	
	Zulia	Uganda		925	1950	
National Forest Priority Area	Gura Ferda	Ethiopia	Highlands, Escarpments	448		Bonga NFPA is the only demarcated NFPA in Kafa region; awareness level concerning NFPA is insignificant (NABU, 2011)
	Yeki	Ethiopia	Escarpments	874		
	Shako	Ethiopia	Escarpments	1009		
	Sibu-Tole-Kobo	Ethiopia	Highlands, Escarpments	1006		
	Jorgo-Wato	Ethiopia	Highlands, Escarpments	197		
	Sigmo-Geba	Ethiopia	highlands	741		
	Yayu	Ethiopia	Highlands	2301		
	Gergedda	Ethiopia	Highlands, Escarpments	1405		
	Abobo-Gog	Ethiopia	Escarpments, Foothills	2512		
	Gebre Dima	Ethiopia	Highlands, Escarpments	2075		
	Godere	Ethiopia	Escarpments	1699		
	Sele Anderacha	Ethiopia	Highlands, Escarpments	2791		
Game reserve	Kidepo	South Sudan	Highlands, Escarpments	2,856	1975	No management plan
Biosphere reserves	Kafa	Ethiopia	Highlands	2,474	2010	Cooperation between Kafa zone administration and NABU for the management. Management plan approved
	Yayu	Ethiopia	Highlands, Escarpments	1,662	2010	Management: various

Type of protected area	Name	Country	Biophysical area	Total surface area (km ²)	Date of creation	Current status
						administrative levels, Oromiya Forestry and Wildlife Enterprise, Oromiya Bureau of Agriculture and Rural Development and Ministry of Science and Technology. Management plan approved
	Sheka	Ethiopia	Highlands, Escarpments	2,396	2012	Cooperation between Sheka administration zone and MELCA for the management Management plan (2015-2019) approved

Figure 28: Protected area of the BAS



Source : this study

3.2.2 Existing conservation projects

The following on-going conservation projects have been identified :

- ▶ Improving South Sudan's Livelihoods and Ecosystems Through Water Management in the Imatong mountains

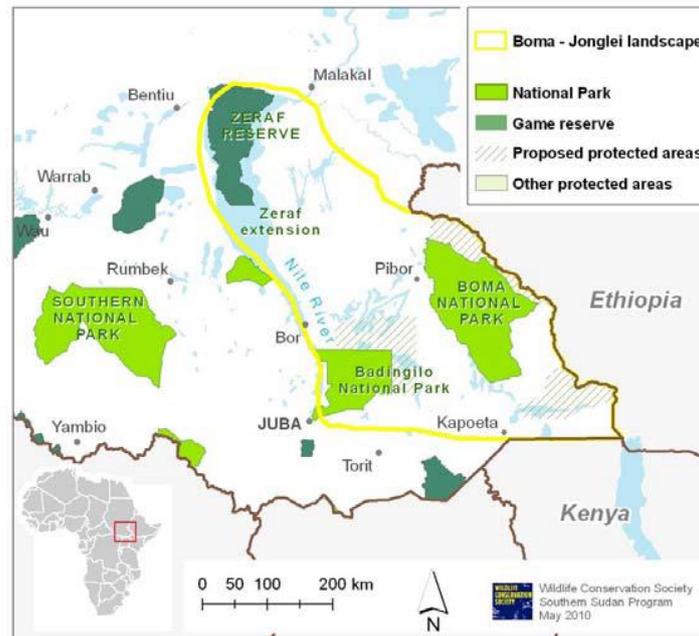
The African Wildlife Foundation has received a five year project grant from the Royal Netherlands Republic to secure the Imatong Mountains Water Tower in Equatoria State (African Wildlife foundation, 2014a). The projects aims at ensuring that the water tower of the Imatong Mountains, and particularly the catchment area of the Upper Kinyeti River are protected and sustainably managed, to ensure long-term water access to communities and ecosystems down river (African Wildlife Foundation, 2015). So far, a comprehensive socio-economic survey of the area has been conducted and published in 2014 (AWF, 2014b). Interventions in the middle part of the watershed should relate more to management of water use as well as agriculture (crop & livestock) use. By ensuring that water continues to permanently flow in the Kinyeti River, this project should contribute to securing livelihoods and food security around Torit for agricultural development and food security as well as safeguarding drinking water extraction for Torit town which will otherwise be in jeopardy. Furthermore, it should contribute to containing water related conflicts between farmers and pastoralists in the lower watershed and around Kinyeti's mouth (African Wildlife Foundation, 2015).

- ▶ Boma-Jonglei landscape project

This project was initiated in 2009 through a financial support from EU in order to promote trans-boundary, sub-regional interventions to respond to emerging issues and the environmental challenges through a financial support from EU (SSNCO, 2014). The program focuses on "strengthening institutional capacity, participatory land-use planning and resource management, establishing protected area management, improving community livelihoods, promoting ecotourism, and developing other incentives for sustainable land use to conserve this remarkable ecosystem and its magnificent wildlife migrations for the benefit of the people of Sudan and the world" (USAID, 2010a).

So far, integrated land-use and conservation plan for the Boma-Jonglei Landscape was developed through a fund from USAID/Sudan in 2010 and the Boma-Gambela Landscape has been identified as a pilot project (SSNCO, 2014).

Figure 29 : Location of the Boma-Jonglei landscape



Source: USAID (2010_a); Demetry (?)

► Protected Area Network Management and Building Capacity in Post-conflict South Sudan

This UNDP program planned for the period 2012-2016 aims at "laying the foundations for effective protected areas management by firstly, reassessing the present protected area estate to ensure the identification of key migratory routes and wildlife corridors within the protected area network and secondly, building the capacity of the Ministry of Interior and Wildlife Conservation to effectively manage and sustainably develop South Sudan's key protected areas" (UNDP, 2015).

It include specific activities in the BAS, such as socio-economic surveys, consultations with local representatives, demarcation and awareness raising on parks boundaries in Boma and Badingilo national parks (UNDP, 2015)

► IGAD Biodiversity Management Programme (BMP)

The Biodiversity Management Program (BMP) is a four-year (2015-2018) program implemented by IGAD) and funded by the European Commission (EC) (ICRAF, 2015).

The Boma-Gambela landscape is one of the 3 demonstration sites of the program. It should help to enhance the biodiversity management of the Boma-Gambella landscape whilst improving the livelihoods of the people of Gambella (IGAD, 2015). The activities performed include:

- Improvement of Gambella park administration and infrastructure,
- Development of an integrated Land use and development plan for the Gambella region,
- Wildlife movements monitoring,
- Value chain development (honey and shea butter).

- ▶ NABU Conservation and sustainable use of the last wild coffee forests of Ethiopia project in the Kafa forest Biosphere Reserve

The project is planned to run for 3 years (2014-2017), is part of the International Climate Initiative (IKI) and is supported by the German Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety. It aims to continue and expand former NABU programmes such as reforestation, participatory forest management and energy saving stoves, while introducing new components such as biodiversity protection and community based management strengthening. From 2009 to 2014, almost 1,600 ha of degraded forest and agricultural land have been reforested and 10,000 ha of natural forest was integrated into Participatory Forest Management (NABU, 2015).

- ▶ Kafa wetlands strategy

In 2008, a wetlands strategy for the Kafa has been established in order to reduce wetlands degradation, “fill the gap created in wetland management in Kafa zone and also to promote similar efforts all over the country by learning from this” (EWNRA, 2008). The main objectives of the strategy are listed as follows :

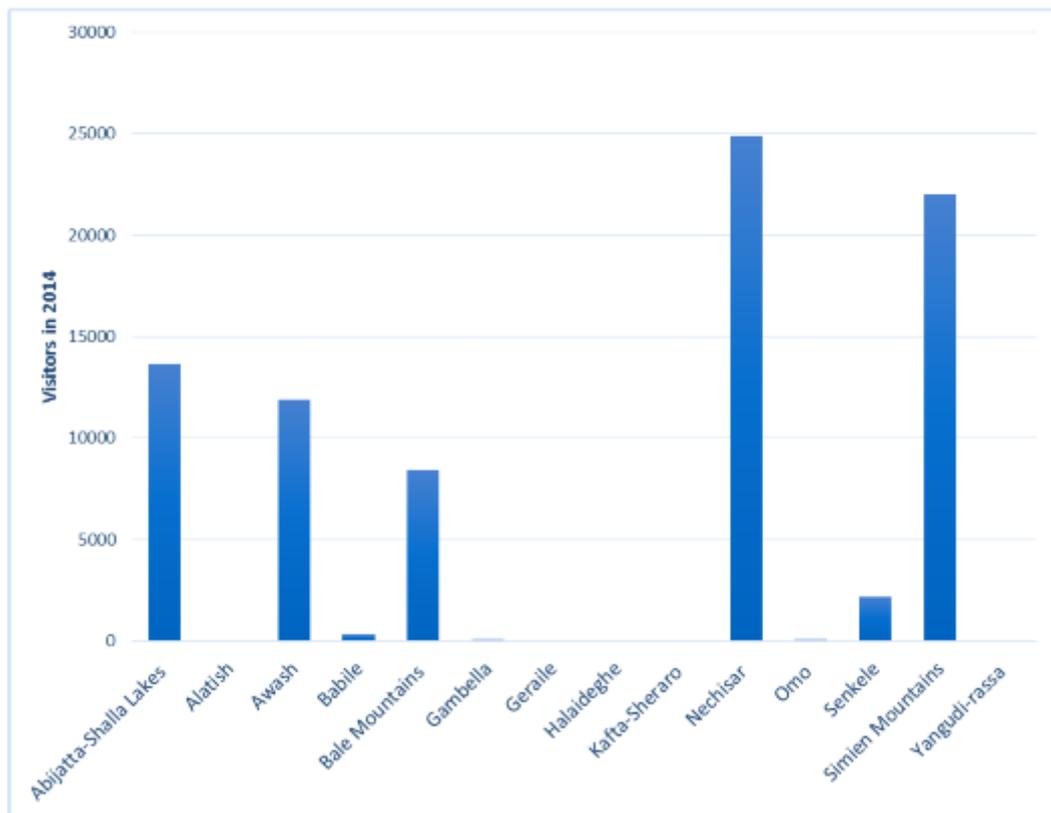
- “To integrate wetland management in to watershed or river basin management
- build data base on the wetlands of Kafa Zone and disseminate information on wetlands
- To secure support and promote relevant development and management studies/research for better wetland management” (EWNRA, 2008)

3.3 ECOTOURISM

Currently, tourism and ecotourism are largely underdeveloped in the BAS despite the huge potential offered by its rich natural resources, especially by water resources.

Since 2001, International visitor arrivals in Ethiopia have shown a strong upward trend (WTTC, 2014). Ethiopia has become a quite important tourism destination in Africa, not far from Kenya when one compares tourism and travel’s direct and total contribution to GDP. However, the Ethiopian part of the basin do not benefit yet from tourism growth (see figure below), mainly because of a lack effort to develop infrastructures that facilitate tourism and lack of coordinated management.

Figure 30: Visitors numbers and growth for all EWCA protected areas



Source: (EWCA, 2015)

Because of the huge potential for ecotourism in all biophysical areas of the basin, existing initiatives are going in several area. The main initiatives identified are:

- ▶ Gambela region, including Gambella national park, through IGAD BMP project. Beyond wildlife observation in the national park, the main attractions currently promoted by the Gambella region related to water resources and include bridges on the Gilo and Baro rivers, lakes and waterfalls.
- ▶ Development of management and business plan for ecotourism and edition of a visitors' guide in Kafa Biosphere Reserve, Bonga, Ethiopia. Current activities include bird watching, walk through coffee forest, waterfalls, visits of tea plantations, etc. Infrastructure such as hiking trails with picnic huts, wildlife observation towers and camping site have been set up as part of 2009-2014 NABU 1st forest and climate protection in Kafa.
- ▶ Social empowerment through group and nature interaction in Sheka zone, organized by MELCA offering the following activities: camping in the forest, trekking, night watch, ...
- ▶ Preparation of brochures by each regional state to be used by tourists and to advertise the available tourism potentials and attractions of their respective regions. These brochures contain valuable information about protected areas, list of wildlife species found in the protected areas and wildlife parks, landscapes, lakes, traditions, etc.

In South Sudan, tourism has emerged recently but is currently insignificant for security reasons. No readily available brochures were found. Tourism development suffers from security issues but also from bad accessibility and poor accommodation services. Wildlife discovering in the National Parks and trekking in the Imatong Mountains (Munt Kinyeti, South Sudan highest peak) consist of the high potential attractions of the south sudanese part of the BAS.

4. SATELLITE IMAGERY ANALYSIS INPUTS TO WETLANDS KNOWLEDGE IMPROVEMENT

4.1.1 Key results

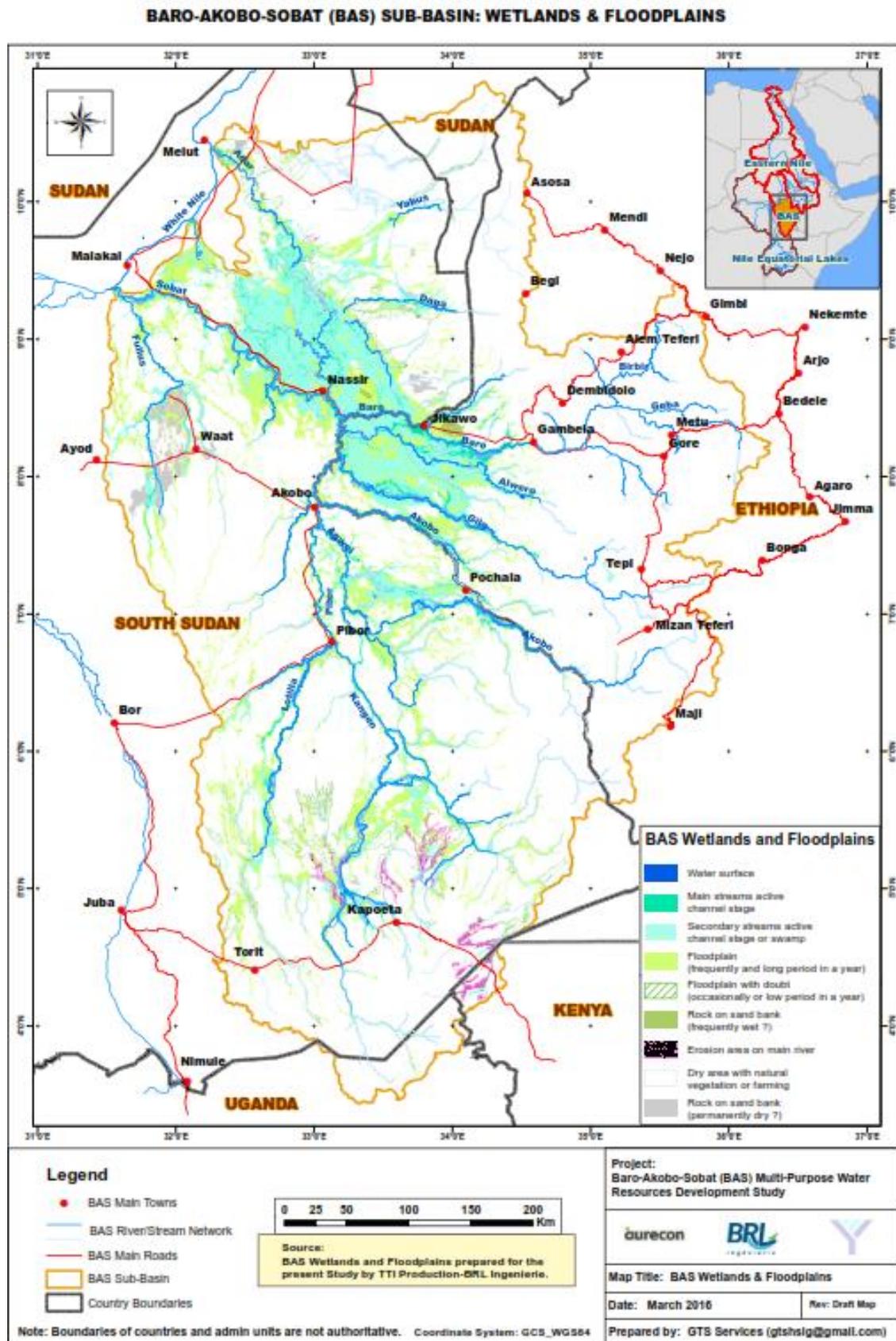
In order to better understand hydrological patterns of the BAS' wetlands, two types of data - both derived from satellite images analysis - have been used in this study:

- ▶ A static map of wetlands and floodplains based on 2014-2015 satellite images,
- ▶ 180 monthly inundation maps over the 1993-2007 period extracted from GIEMS D3 worldwide inundation database.

4.1.1.1 Static map of wetlands and floodplains based on 2014-2015 satellite images

This map have been elaborated specifically for this study, at the scale of the BAS. It is based on Landsat and radar satellite images from years 2014 and 2015.

Figure 31: Static map of wetlands and floodplains based on 2014-2015 satellite images



Source: This study

Figure 32: Distribution of the BAS wetlands' category

Type of wetlands	Surface area (km ²)	% of total wetlands
Main streams active channel stage	7233	12%
Secondary streams active channel stage or swamp	23069	38%
Flood plain (frequently and long period in a year)	24688	40%
Flood plain with doubt (occasionally or low period in a year)	4694	8%
Erosion area on main river	1505	2%
Water surface	38	0.1%
Total	61227	100%

Source: This study, from Static map of wetlands and floodplains based on 2014-2015 satellite images

It provides a **static visualization** of the wetlands of the basin. It shows various wetlands categories, such as :

- Main streams active channel stage,
- Secondary streams active channel stage and swamp,
- Frequent floodplain (frequently wet during long period in a year),
- Less frequent floodplain (occasionally wet or during a shorter period in a year).

It provides a comprehensive visualization (except of highlands wetlands). However, it provides only a partial visualization of the intra-annual variation of wetland size and distribution and does not allow any inter annual comparison.

4.1.1.2 180 monthly inundation maps over the 1993-2007 period extracted from GIEMS D3 worldwide inundation database

Extraction of GIEMS D3 worldwide inundation database on the BAS consists of 180 inundation maps of the basin: one for each month of the year on the 1993-2007 period.

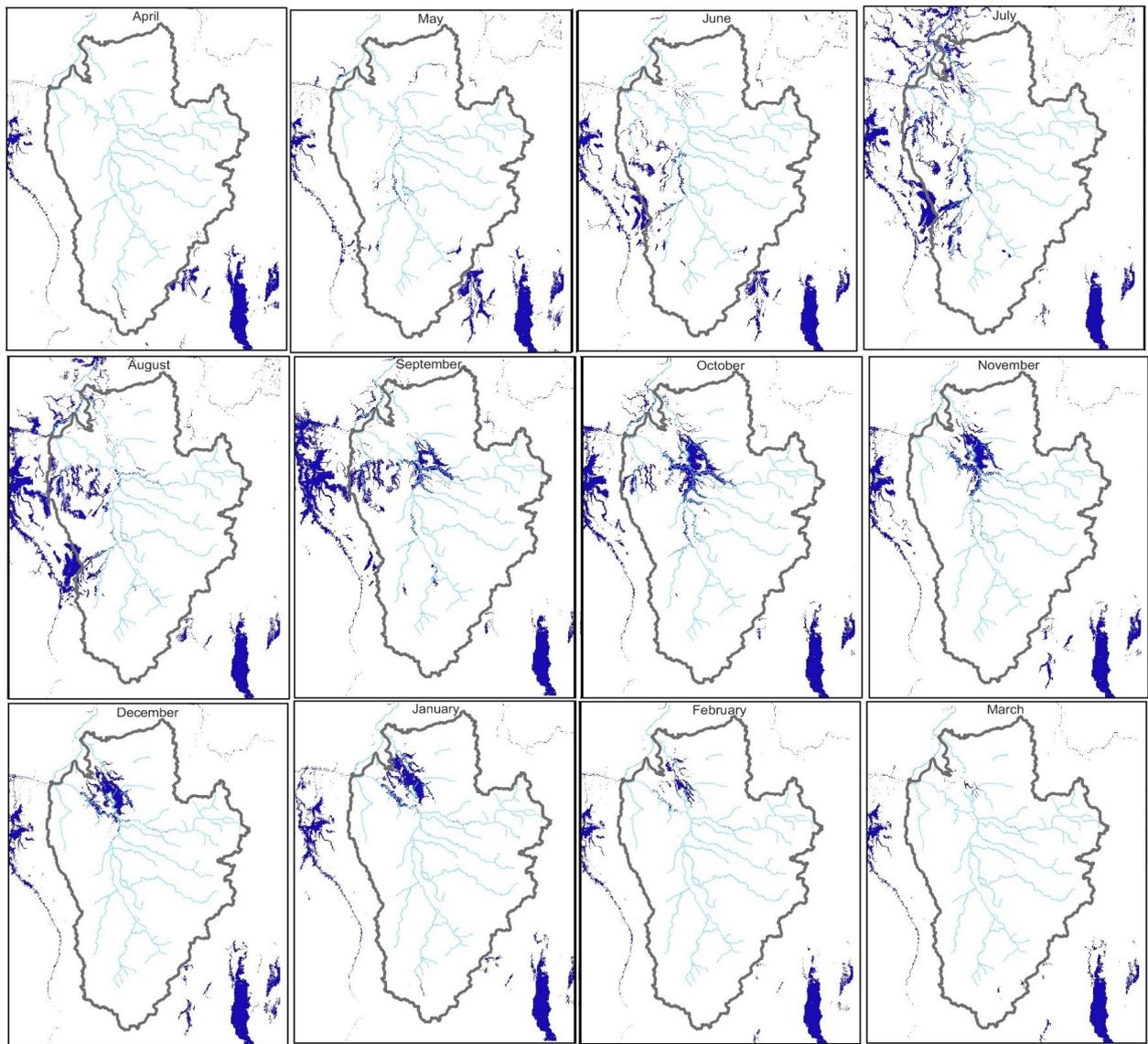
Comparison between the two sources of information combined with wetlands characteristics described in the literature analysis indeed suggests that GIEMS D3 database only shows:

- large inundated areas (scale is too coarse to catch up pools, small wetlands or small and average rivers of the BAS. For instance, it captures only major rivers such as the white Nile, Blue Nile and Baro at some points)
- open waterbodies and do not capture waterlogged lands and water under vegetation.

It does neither show distinction between wetlands' types.

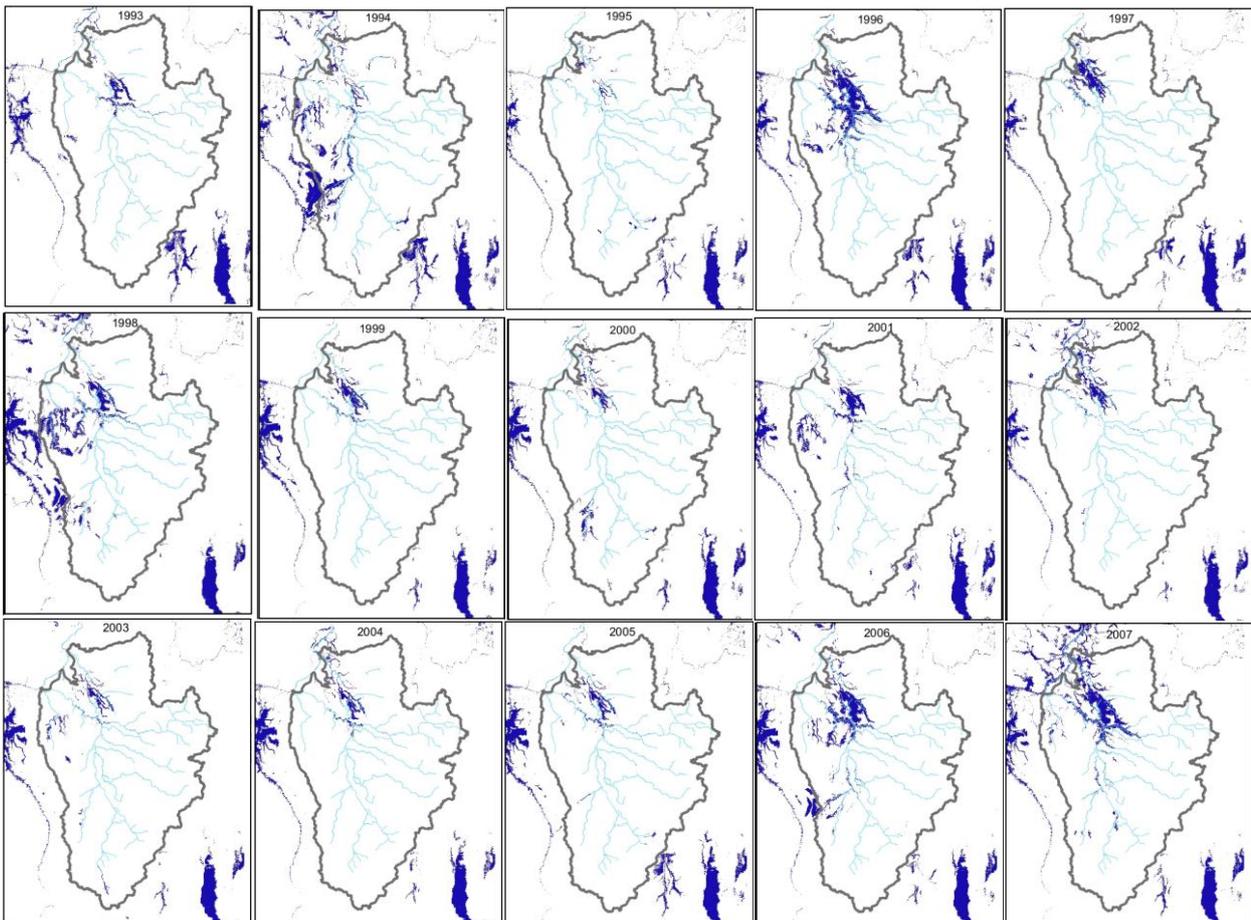
The figures below show the intra and inter annual variation of inundation patterns of the BAS derived from GIEMS D3 inundation database.

Figure 33: Maximum inundation per month over the 1993 - 2007 period



Source : This study from GIEMS D3 database

Figure 34: Maximum inundation per year over the 1993 - 2007 period

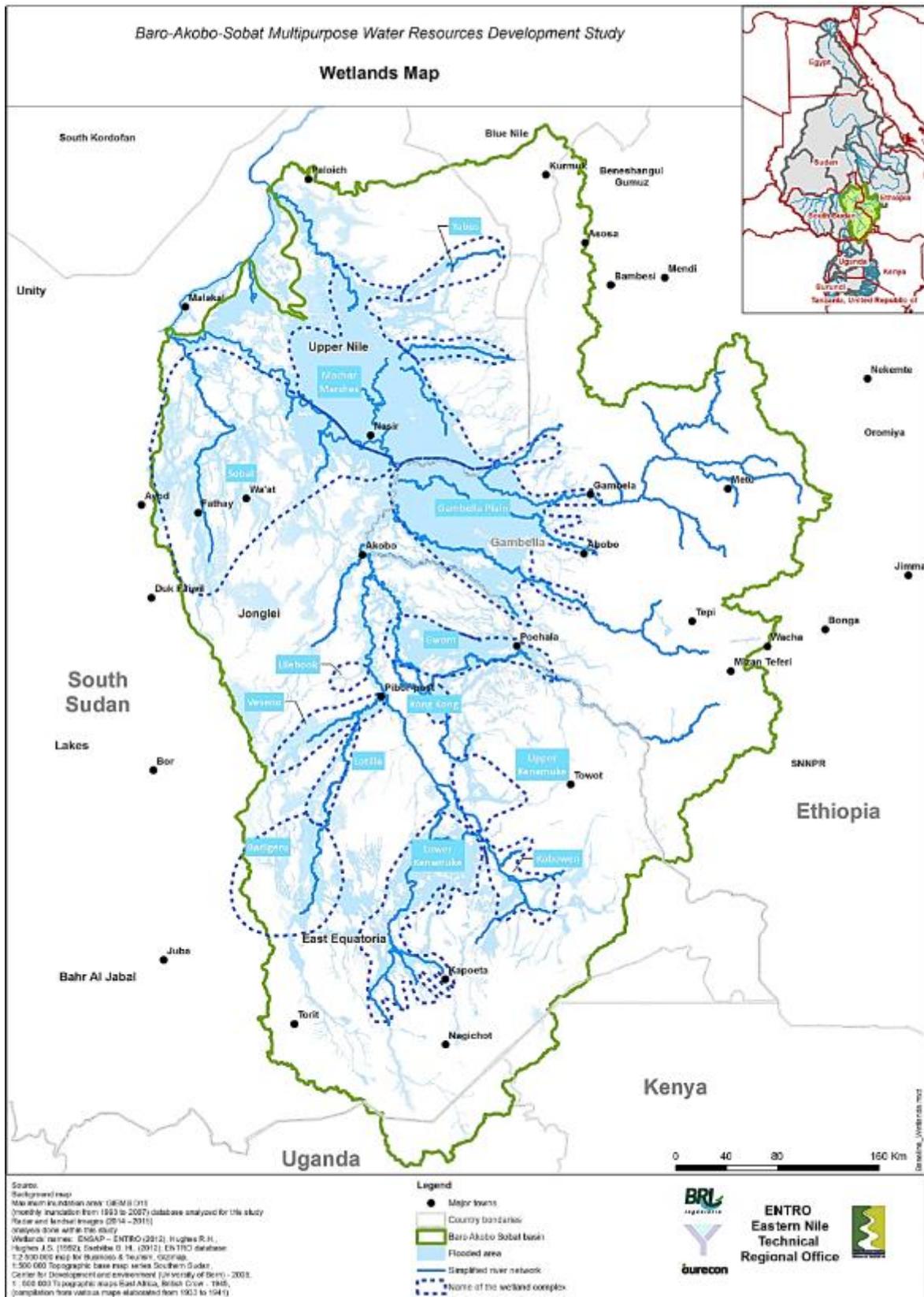


Source : This study from GIEMS D3 database

4.1.2 Potential maximal inundation area and potential maximum extent of wetlands of the basin

The figure below consists of a compilation of GIEMS D3 1993-2007 180 monthly images and the 2014-2015 wetlands static map. It should represent the inundation potential maximum extent and should be used for general guidance purposes only. Main wetlands names have been reported on the map according to literature review. This gives an indicative idea of the maximal extent of the various wetlands complexes of the BAS.

Figure 35: Potential maximal inundation area and potential maximum extent of wetlands of the basin



Source: this study

4.1.3 Key conclusions regarding wetlands

The analysis of the two above described sources of information lead to the following conclusions:

- ▶ The 2014-2015 static BAS wetlands map provide a comprehensive but static visualization of the BAS wetlands, whereas the 180 monthly inundation maps over the 1993-2007 period extracted from GIEMS D3 worldwide inundation database provide a dynamic but very partial visualization of the BAS inundation extent.
- ▶ An important part of the BAS plains is subject to inundation (representing up to around 60 % of the plains and 30 % of the total area of the BAS);
- ▶ Intra and inter annual variation are significant both in terms of surface area and location;
- ▶ In the southwestern part of the basin (Pibor, Nanam and Sobat sub-catchments), the major part of the wetlands consists of seasonal floodplains which rapidly dries up or drains into the river network, providing high quality grasslands up to the dry season. Only some isolated permanent marshes apparently offer standing water up to the dry season, such as the Badigeru and Upper Kenamuke wetlands.
- ▶ In the northeastern part of the basin (Agwei, Lower Akobo, Gilo, Baro, Alwero, Machar and Yabus), significant inundated / waterlogged areas remain up to the mid dry season after the wet season, offering a dense network of both high quality grasslands and numerous water sources.
- ▶ Overflows from the western Ethiopian rivers, especially from the Baro, seem to significantly contribute to the inundation extent and duration of the Gwom, Gambella plains and Machar marshes wetlands;
- ▶ During wet years, the BAS inundated area can be equivalent to the Sudd in terms of surface area during the month of October and November and even superior to the Sudd at the beginning of the wet season (June). However, BAS wetlands are characterized by more significant seasonal variations.

5. SYNTHESIS OF MAIN FINDINGS

Synthesis of the previous sections per biophysical area, with sub-chapters per thematic (biodiversity, ecotourism, livelihoods, catchment), or the contrary: to be agreed together.

5.1 BASELINE SITUATION

5.1.1 Main ecosystem services provided by the BAS ecosystems

5.1.1.1 The BAS natural resources are the main source of livelihood of the major part of the BAS population

In each biophysical areas of the basin, communities strongly rely on natural resources for food resources, construction material, fuel, coffee and timber production.

5.1.1.1.1 Domestic water use and food resources

Wetlands are vital for domestic water use when several rivers have dried up.

An important part of highland wetlands have been drained and are used for cultivation. In some parts of the lowlands of the basin, recession agriculture occur. In western Ethiopia, the production from wetlands has been estimated to contribute up to 50 – 60% of the household's food security where wetland areas are large enough. The importance of wetland production for farmers lies in the fact that the wetlands can be harvested at the end of the dry season, when other food supplies are becoming exhausted (Hailu A, 2006).

Floodplains and wetlands are key resources for livestock in the dry season since they provide high quality grass and water for cattle grazing and watering (Denny, 1991) in (Burgess N. & al, 2004). In areas where there are no wetlands or where rivers are ephemeral, farmers move their cattle in search of water every day (Afework, 2001). The **main valuable plants for grazing are flooded grasslands** such as :

- ▶ *Oryza* which provides high quality grazing for much of the year even into the dry season and yield only 1 ton/ha when not flooded to 7 ton/ha when deeply flooded for a long period;
- ▶ *Echinochloa pyramidalis* which also grows even during the dry season and is thus a year-round pasture (ENTRO, 2007a),

whereas main rain-fed grasslands provide less quality grass and don't last during the dry season.

According to (Hailu A, 2006), it "would be no exaggeration to claim that the survival of the country's livestock is directly linked to the abundance of wetlands".

Waterbodies and other wetlands provide important fish resources. For example, only for the Gambella region, the current fish production of the region has been estimated at about 380 tons/year and the fish production potential of the region should range from 15,417-17,308 tons/year according to (MoA, 2010). According to (Hailu A, 2006), fish is the main source of protein for the 'Agnuak', who live along the banks of the Baro and Gillo Rivers. Fishing is undertaken by men whereas women are heavily involved with fish processing and preservation.

In the southern part of the basin, wildlife also provide sources of proteins and commercial bush meat a source of income.

Afromontane natural forests also provide a variety of food products such as honey, spices, palm, wildfruits (Asseffa, 2007). In the Akobo catchment around bench-maji and Sheka zones, edible roots like Taro and Enset are common and support livelihood of people. These edible roots are drought resistance and also

help to soil conservation. Consultations also revealed that Sheka people make the livelihood majorly from the wild honey they produced in the forest. They have customary forest management associated with beekeeping which is called Kobbo in local language. It is forest management in which members of the community own part of the forest to use it only for hanging beehives and collecting of spices, which doesn't deter the sustainable existence of the species.

Some floodplain grasslands plants like *Oryza* can also be used as a crop at this end of the dry season when other sources of food become rare.

The sale of wildcoffee, growing under afro-montane highland and lowland Ethiopian forests is also an important source of subsistence for the local communities (NABU, 2015).

Medicinal plants are also found especially in highland wetlands (Afework, 2001).

5.1.1.1.2 Construction materials

Sedges (*Carex*) found in the BAS wetlands are widely used for thatching. For example, in Western Oromiya sedges prime importance is for thatching local houses (*tukuls*), among a variety of uses for the local communities, especially where other suitable materials are not available or are too expensive. In Illubabor Zone it is estimated that an estimated 85% of the local households use sedges or *cheffe* for roofing their houses or *Tukuls* (Hailu A, 2006) (Afework, 2001).

Bamboo forest are also used for construction in western and southern part of the basin.

Brick making is also reported in Oromiya wetlands (EWNRA, 2008) and in South Sudan.

5.1.1.1.3 Energy

Charcoal is considered as the main source of fuel used in the BAS urban centers and play an important role in forest and bushland degradation.

5.1.1.1.4 Timber

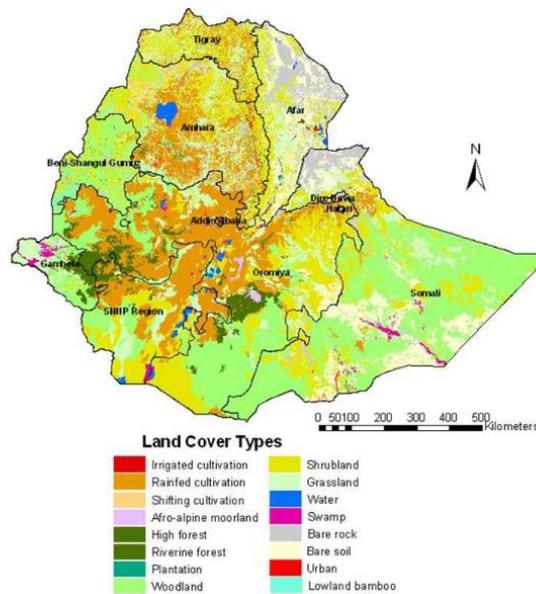
Afromontane highlands and lowlands forests offer large old high quality wood from *Daniellia oliveri* and *Khaya senegalensis* trees for instance.

(Asseffa, 2007) has estimated that households from Sheka forests generate about 44% of their income from forest and forest products.

5.1.1.2 Head catchments remnant forests and wetlands provide climate, flow and siltation regulation

Head catchments wetlands and forests are known to play an important role flood regulation and control, micro-climate regulation and erosion control. The extent of these services vary depending on local climatic, topographic and vegetation characteristics. The biophysical characteristics of the basin, the percentage of forest cover on the head catchments and the regional importance of the forest area (over 20% of Ethiopia's forest cover are located in the basin (FAO, 2010) in (Conservation, 2012)) make these services particularly important in the basin.

Figure 36: Dominant land cover types in Ethiopia, showing the importance of the BAS forests



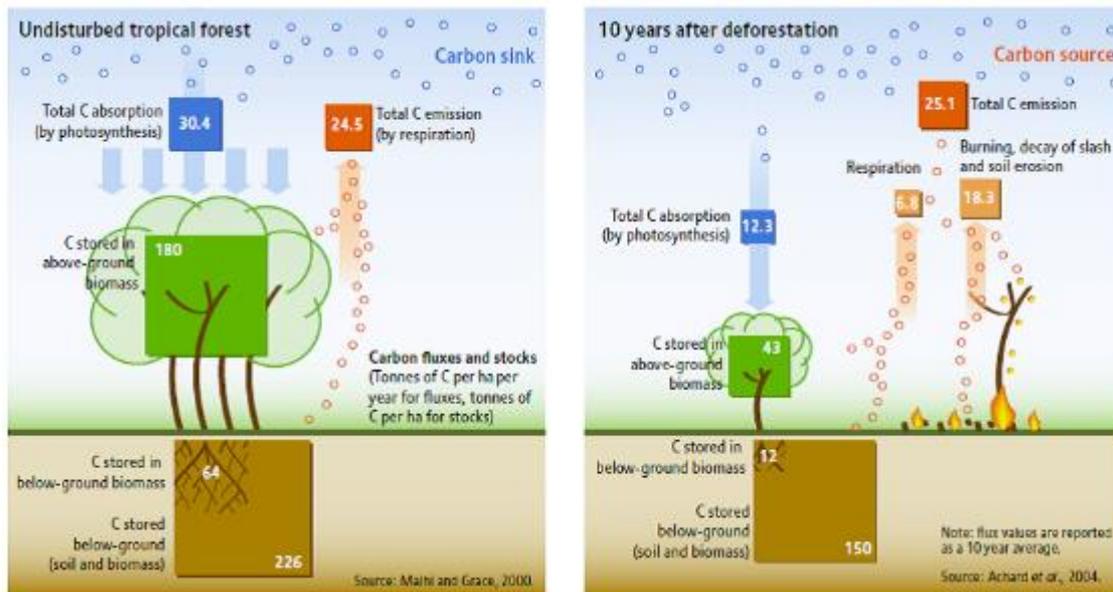
Source: (WBISPP, 2014) in (Conservation, 2012)

(Hailu A, 2006) reports that before deforestation and wetland drainage intensified in Highland Illubabor there was no history of flooding in the neighbouring Gambella Township. However, with increased deforestation and extensive drainage of wetlands flooding has become a major threat to Gambella Township leading to dikes construction.

Local experts in Majang zone revealed that some streams which were permanent some years back are now become seasonal as a result of deforestation and land use change and therefore stress the importance to protect the remnant forest cover of the upper catchment and promote reforestation works on degraded areas.

At the scale of the basin, highlands and escarpments forests also play a critical role in carbon sequestration. The following figure illustrates impacts of deforestation on carbon sequestration and emission:

Figure 37: Deforestation's impacts on carbon sequestration and emission



Source: (UNEP, 2009) in (EWCA, 2015)

5.1.1.3 The BAS ecosystems offer habitats for a rich biodiversity of flora and fauna

The BAS ecosystems support habitats hosting a rich flora and fauna, characterised by a high rate of endemism in the mountain and large endangered and threatened herds of mammals in the plains (cf section 3.1 of this annex).

5.1.1.4 Flood patterns influences wildlife habitats and play a critical role in their migration

According to (Kingdon, K. & Hoffman, M. (eds), 2013), the local patterns of flooding have the most influence on the Nile lechwe more than the differences between dry and wet seasons.

The flood extent directly influence the availability of resources (grass and water) on which antelopes rely, consisting in an important driver in the migration (Fryxell, J. M. , 1991) (Fryxell, J. M. & Sinclair, A. R. E., 1988).

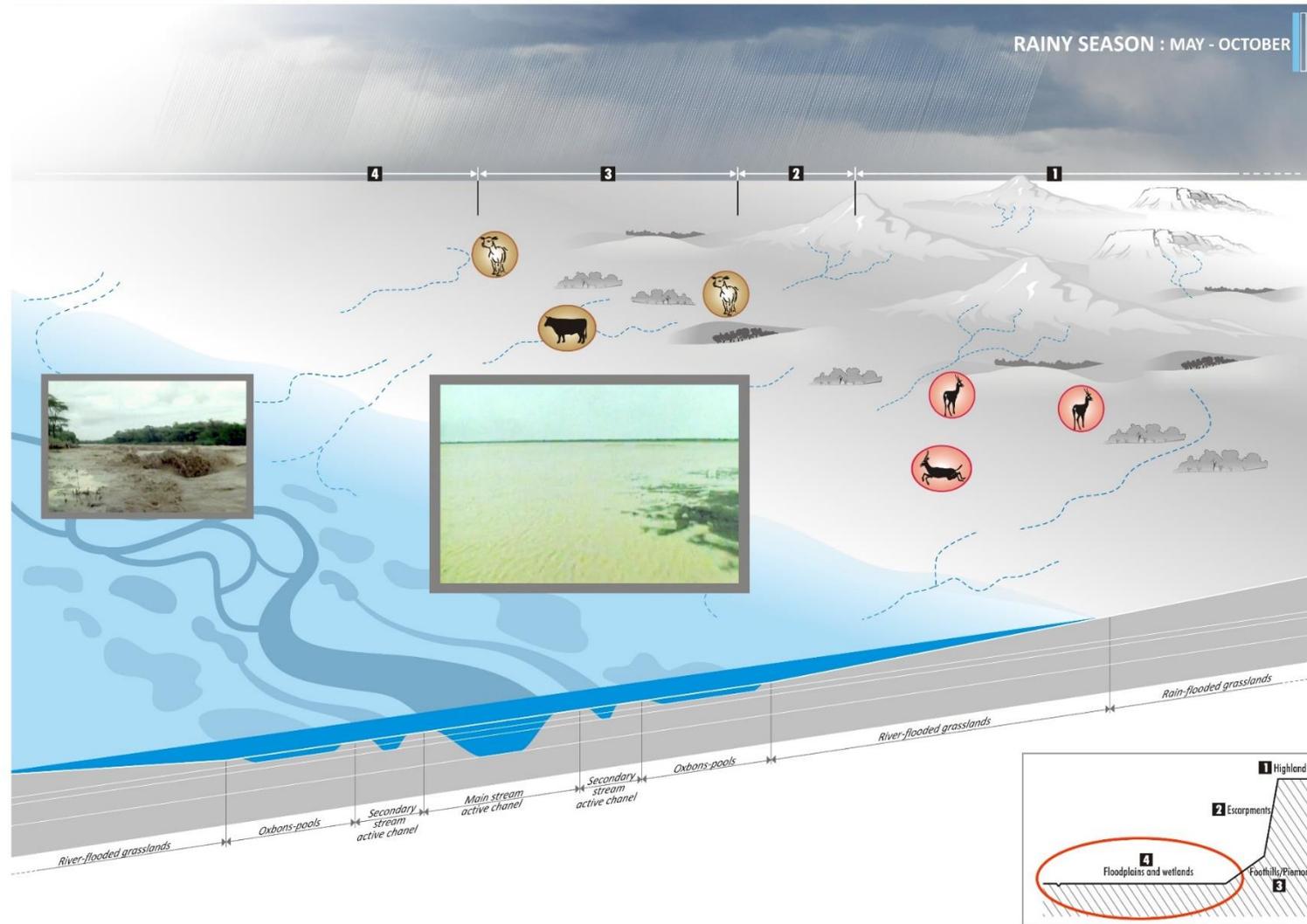
Birds habitats are also directly linked to flood recession areas (Zwarts L., 2012).

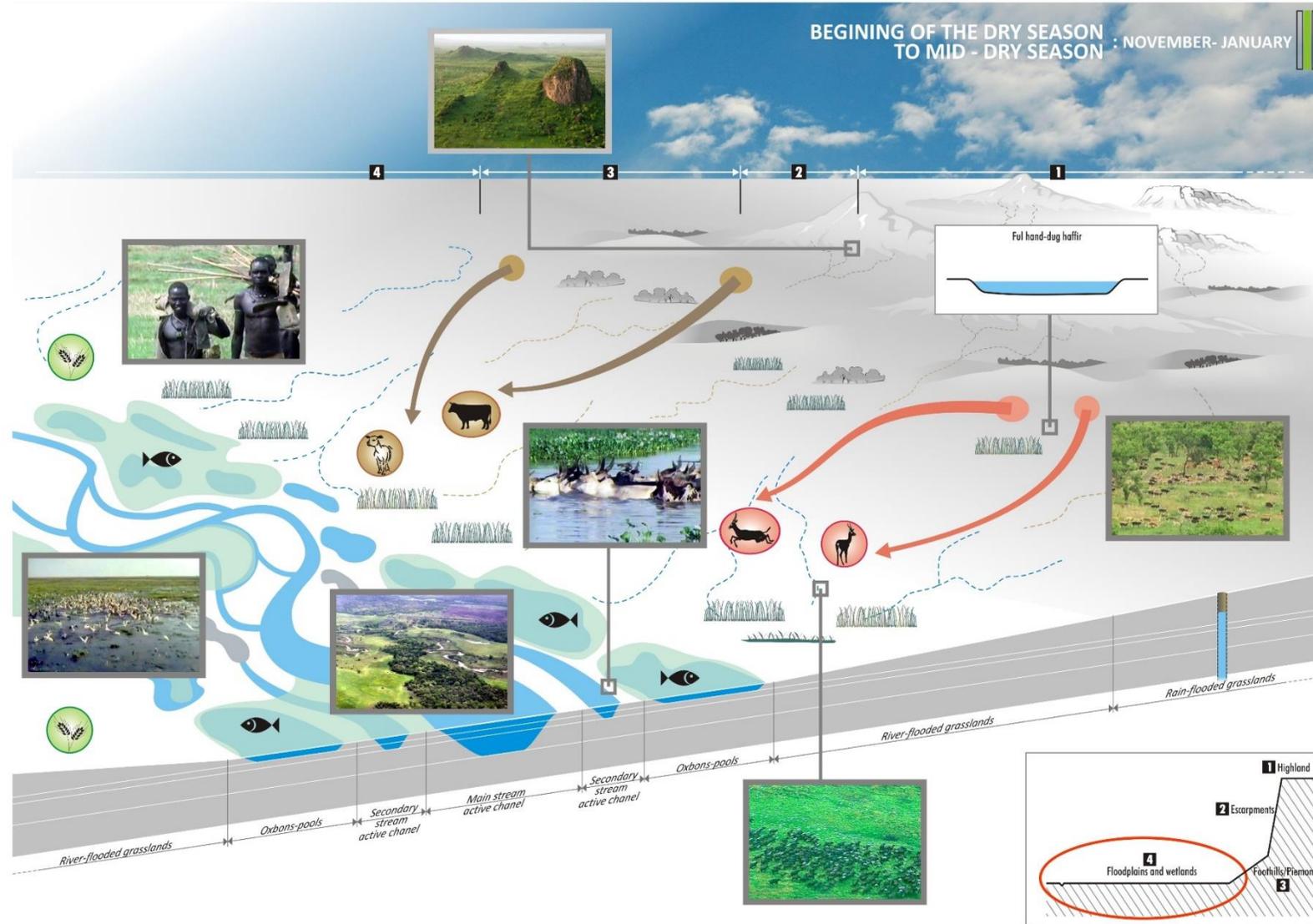
Apart from wildlife, the entire socio-economic organization and livelihood of the plains depend on floodplains and wetlands seasonal variations. The following schematics illustrate how both wildlife and human activities adapt to changing environment and natural resources availability. It shows uses of wetlands and floodplains at 3 periods of the year :

- ▶ The heart of the rainy season: June-October
- ▶ The beginning of the dry season up to the mid-dry season: November - January
- ▶ The end of the dry season : February to May

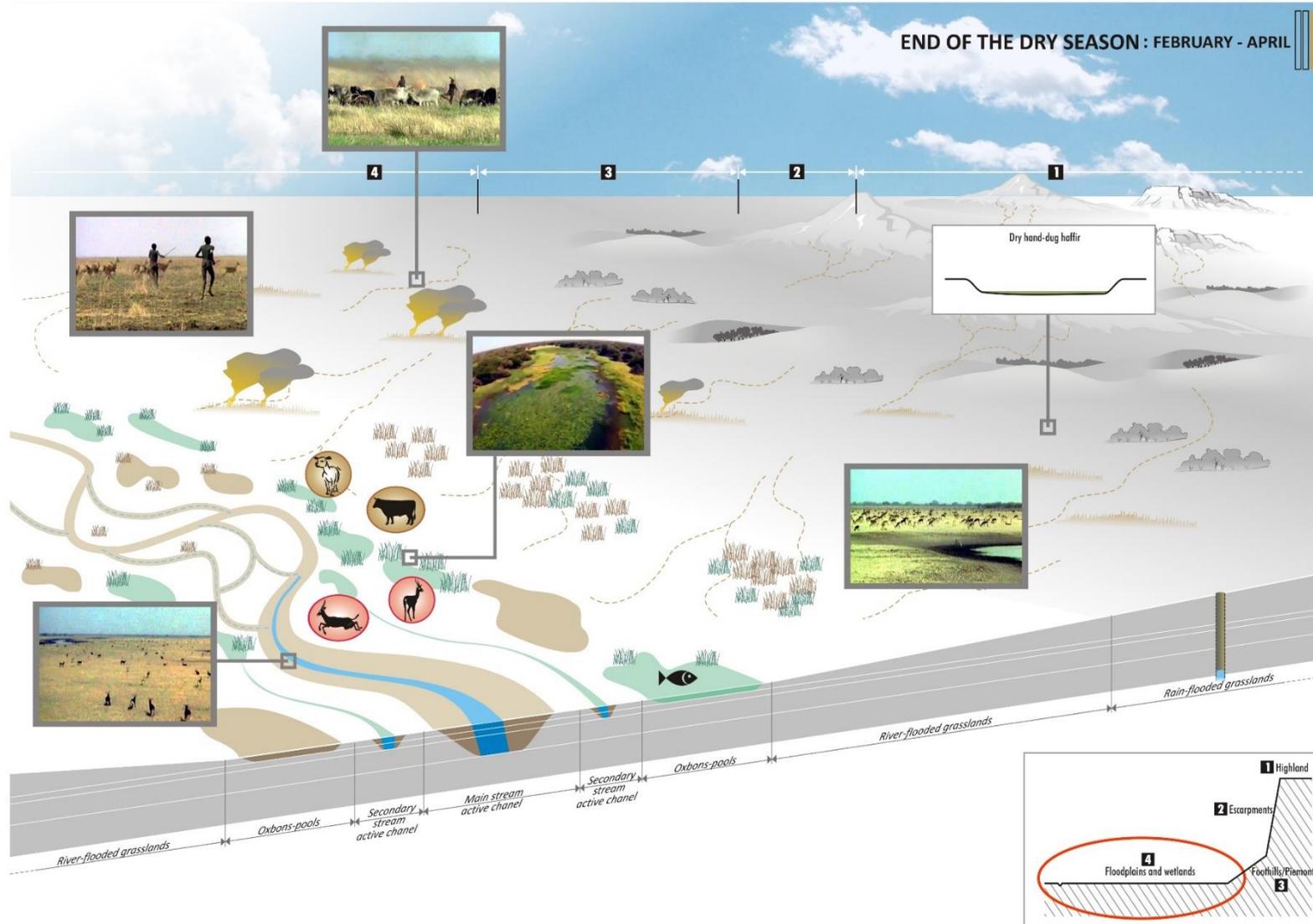
These schematics have been specifically elaborated for this study according information collected through consultations and literature review.

Figure 38: BAS Floodplains seasonal uses





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The above schematics show a simplified representation of human, cattle and wildlife movements according to the flooding gradient. The Figure 23 presented in section 2.1.4 of this annex shows wildlife movement at the basin scale.

5.1.1.5 Rich biodiversity and pristine landscapes offer a huge opportunity for tourism development

The variety of ecosystems of the BAS, its quite pristine character in an important part of the basin, the importance of the mammal and bird migration offer a huge potential for natural-resources based tourism.

Wildlife experts consider that the mammal migration of the BAS is equal to the Massai Mara – Serengeti one. The total annual numbers of visitors to this transboundary protected areas vary from 300,000 to 400,000. This is more than the current most visited national park of Ethiopia (Nechisar national park) and offer interesting perspectives for complementary sources of income for communities and for the two countries.

5.1.2 Synthesis of environmental specificities of the BAS

The BAS is one of the hot biodiversity spots in Africa:

- ▶ The presence of vast wetlands, flood plains, lakes, perennial rivers, high forest areas, wood and grass lands make the area rich in biodiversity.
- ▶ It hosts largest remaining forests of Ethiopia, including the few remaining intact primary Afromontane, Evergreen Forest Ecosystem, which supports a unique floral and arboreal primate species and natural or wild coffee genetic resource as well as rich bird species diversity.
- ▶ It supports one of the largest migration of mammals (total estimated at 1.2 million individuals) and bird in Africa – at least equivalent to the Massai Mara – Serengeti migration, which habitats and migratory routes mostly relies on water resources seasonal variations and flood extent and duration.
- ▶ It is endowed with quite preserved beautiful landscape.

Its population strongly rely on natural resources for domestic water, food resources, construction material, medicinal plants and sources of income.

Natural resources of the BAS provide other high value ecosystems services such as:

- ▶ Rainfall and moisture regulation by natural and open forests,
- ▶ Flow regulation and erosion control,
- ▶ Carbon sequestration,
- ▶ High potential for ecotourism.

Therefore the function of the BAS ecosystems is “reckoned as vital as it serves mainly to the maintenance of the biodiversity, of its watershed values, the environmental services it renders and of its economic values both at local, basin and global levels” (Berhan, 2008).

The existing threats on the BAS ecosystems, including deforestation and forest degradation as well highland and lowland wetland encroachment and degradation reduce the capacity of these ecosystems to provide the same level of services.

The current level of protection is very low but ongoing initiatives are promising.

5.2 DEVELOPMENT POTENTIALS

5.2.1 Multi-thematic potential development per biophysical areas of the BAS

5.2.1.1 Highlands

Highlands of the BAS basin has the following opportunities/ potentials:

- ▶ Alternative lively hood development potential that linked with the survival of forest such as modern honey production, none timber forest products, development of spices and connect to international markets.
- ▶ Potential to develop mini hydropower to reduce pressure on forest
- ▶ Potential to link forest with carbon credit.
- ▶ Potential to developing agro forestry
- ▶ High potential for Biodiversity Conservation (there is possibility of delineating and registration of Majeng forest as UNESCO Forest Biosphere)

5.2.1.2 Escarpments

Escarpments of the BAS basin has the following opportunities/ potentials:

- ▶ Biodiversity conservation,
- ▶ Landscape tourism,
- ▶ Catchment management.

5.2.1.3 Foothills / Piedmonts

Foothills of the BAS basin has the following opportunities/ potentials:

- ▶ Biodiversity conservation,
- ▶ Rain fed agriculture,
- ▶ Agro forestry,
- ▶ Grazing management,
- ▶ Hydropower development.

5.2.1.4 Flood Plains and wetlands

Flood plains of the BAS basin has the following opportunities/ potentials:

- ▶ Recession agriculture development potential,
- ▶ Dry season grazing for livestock and wildlife,
- ▶ Biodiversity conservation (mostly in wildlife protection areas and national parks),
- ▶ Aquaculture development potential,
- ▶ River fishery development potential,
- ▶ Irrigation potential.

5.2.2 Biodiversity, habitats and landscape conservation

5.2.2.1 Existing development projects in the basin

Existing development projects are described in section 3.2.2 of this annex.

5.2.2.2 Identification of new project areas in the basin

5.2.2.2.1 Wetlands monitoring

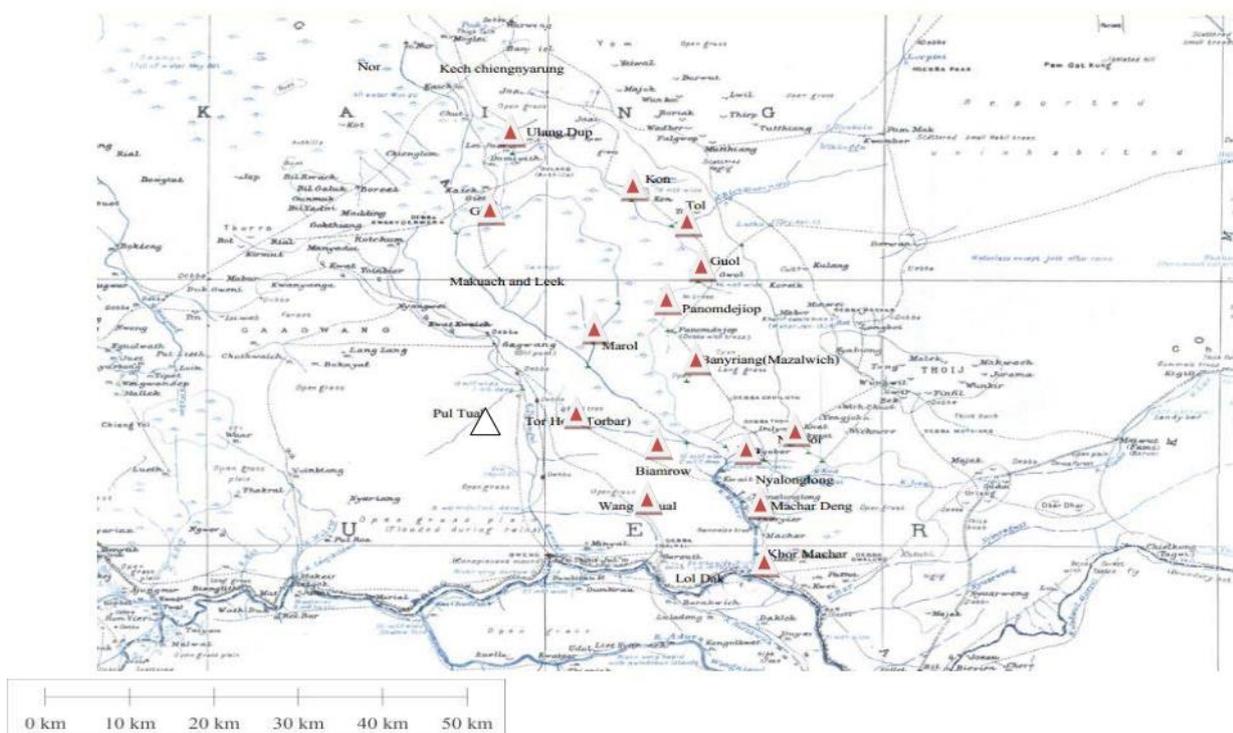
Literature review and stakeholders consultations have shown that wetlands knowledge is very low, especially on hydrological aspects.

This represents a key knowledge gap at the basin scale and is a key priority that should outstrip future water developments.

This idea is to create and monitor new water level and flow measurement sites in main wetlands in addition to the proposed measurement network.

During a field mission commissioned by ENTRO in 2012 water level and flow measurement sites in Machar Marshes have been proposed (see figure below):

Figure 39: Proposed water level and flow measurement sites in Machar Marshes



Source: (ENTRO, 2012b)

Socio-economic and updated fauna and flora survey should also be conducted in parallel as per proposed by (ENSAP-ENTRO, 2012).

5.2.2.2.2 Designation of the BAS main important wetlands as Ramsar sites

Designation of the BAS main important wetlands as Ramsar sites such as Badingilo, Gwom, Gambela plains and Marchar marshes. These wetlands have the potential to be recognized of international importance. Ramsar designation and related management plan implementation can be considered as an interesting tool to both protect wetlands ecosystems and improved livelihoods.

The following table illustrate the benefits of ramsar designation on wetlands condition.

Table 6: Benefits of designation of Ramsar sites in Asia

	% of Asian Contracting Parties reporting	
	Condition improving	Condition deteriorating
Ramsar Site	41 %	12 %
Other wetlands	12 %	47 %

Source: (Ramsar Convention Secretariat, 2013)

According to their spatial distribution, two potential Ramsar sites have been identified:

- ▶ Badingilo floodplains and marshes
- ▶ Marchar marshes, Gambela plains and Boma wetlands (Gwom)

The designation involves the following main activities:

- ▶ Engagement of the local community through awareness raising on the importance of the site to ensure their support and involvement in site designation, management and monitoring;
- ▶ Establishment of a broad-based 'site management committee'
- ▶ Elaboration and implementation of a management plan
- ▶ Periodic assessments of the management effectiveness focused on the effectiveness of conservation and on the benefits to the local community (Ramsar Convention Secretariat, 2013).

These activities should take into account existing management plans and landuse plans and rely on exiting management authorities in Boma, Badingilo and Gambela National Parks. Activites will have to be developed from scratch in the Machar marshes. Difficulties of acces during the wet season and security issues are potential obstacles to the development of such initiatives.

5.2.2.2.3 Reforestation and rehabilitation of degraded forest areas

The main current initiatives (mainly through biosphere reserves) concerning the forest ecosystems in the basin mainly deal with natural forest conservation and occur where the forest coverage is still dense. Already highly degraded land also need attention in order to offset the effect of deforestation such as erosion, soil loss, siltation in the river and climatic and hydrological impacts. Target areas could be highlands and escarpments cultivated ecosystems of

- ▶ The north-east head catchment of the Baro sub basin;
- ▶ The head catchment of the Akobo sub basin
- ▶ Torit area.

Figure 40: Highlands cultivated ecosystem in the Ethiopian part of the BAS



Source: This study

Activities could include afforestation, tree nurseries, catchment management, agroforestry, plantation of fruit trees, management of grazing in the forests, but also development of alternative energy sources like small hydropower, use of fuel conserving stoves, solar energy; creation of awareness among the local people, development of mechanisms to use dry grass for household energy purposes...

Tools such as Participatory Forest Management (PFM), revitalisation of National Forest Priority Areas, development of forest management plans and land use plans in sensitive areas (currently lacking in the Imatong Mountains for instance) could be involved.

The ongoing Ethiopian forest inventory could bring interesting information to specifically document the targeted area as soon as it will be published.

5.2.2.2.4 Development of solid and liquid waste management

According the stakeholders consultations, urban pollution by solid and liquid waste is becoming a concern in some parts of the basin. So far, little has been done in this field, which open a significant potential for improvement. Development of solid and liquid waste management should be associated with water quality monitoring.

5.2.2.3 Enabling environment

The ongoing trend which consists of formalising the existing protected areas network (boundaries demarcation, official designation) and designating management authorities (NGO in cooperation with environmental authorities) is a progress which bring a start of a fertile ground for the above identified potential developments. Moreover, the following strategic documents are under review:

- ▶ South Sudan draft environmental policy of the country is submitted to the parliament for review and endorsement,
- ▶ Boma management plan,
- ▶ Badingilo management plan,
- ▶ Gambela region land use plan.

Their endorsement should contribute to strengthen the legislative and strategical environmental framework in the basin.

In parallel, the ratification of the Ramsar convention by Ethiopia could benefit to the identified development projects.

5.2.2.4 Conclusion: conservation opportunities in the basin

Despite an important number and coverage of the BAS by protected area, the effective protection is very low. Important programs and projects are currently going on and should significantly improve the conservation situation if they succeed in achieving their goals.

Complementary initiatives are necessary, especially in areas which are not covered by existing initiatives such as the Machar marshes and the already high degraded land north-east of the Baro catchment, on the head catchment of the Akobo and around Torit.

5.2.3 Ecotourism development potential

5.2.3.1 Existing development projects in the basin

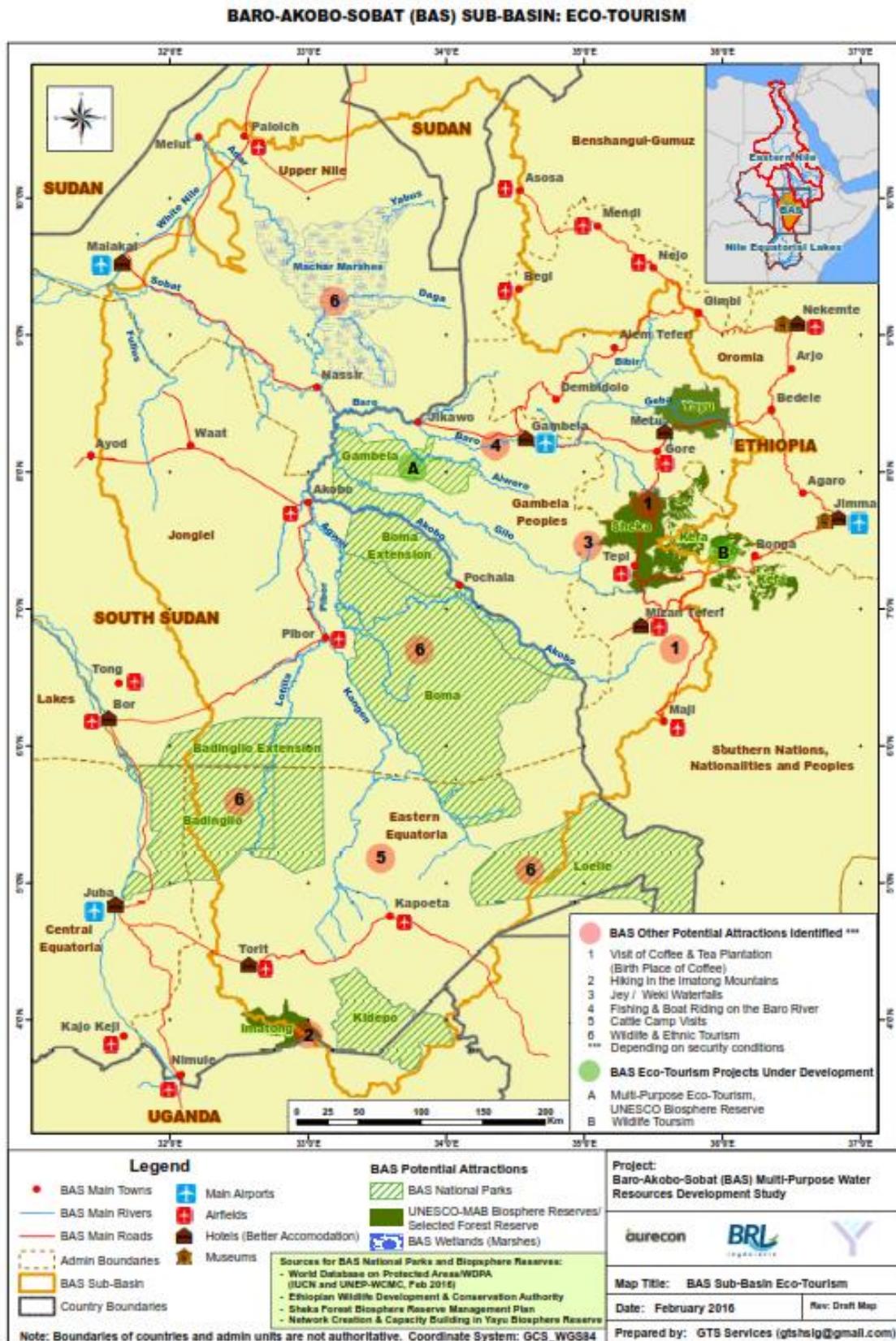
Existing development projects are described in section 3.3 of this annex and located in the Figure 41

5.2.3.2 Potential to develop ecotourism in the basin

As already stated, the potential for ecotourism development in the basin is huge, considering the current level of development and the natural assets of the basin.

The main potential ecotourism development identified through consultations and literature review are presented in the map below.

Figure 41: Main existing and potential tourism development in the BAS



Source: this study

5.2.3.3 Enabling environment

The two following facts illustrate the willingness of the two countries to further develop tourism and ecotourism:

- ▶ The Government of Ethiopia is currently “implementing a number of strategic measures to further develop the country’s tourism sector, including investment in infrastructure and capacity building on destination management and product development, through the recently established Tourism Transformation Council” (UNWTO, 2014).
- ▶ The Government of South Sudan, through “ The Eastern Equatoria State Local Government and Wildlife Conservation Minister Charles Lokonoi Ambrose vows to improve the sector with prime objective to boost economy especially in protected areas of wildlife conservation and tourism as key target to realize sightseeing attractions of wildlife both flora and fauna in the state” (Nakimangole, 2013).

The main impediment for ecotourism development is its political instability and the related security issues, especially in South Sudan.

5.2.3.4 Conclusion: opportunity to develop ecotourism

The BAS offer huge natural and cultural assets which conservation and valorization could be based on ecotourism. The willingness to develop it is there, stated by emerging various local and regional initiatives. On the short term, the opportunities are higher in the BAS highlands and escarpments given the security situation. On the mid and long terms, there are huge opportunities for ecotourism elsewhere in the basin.

5.3 KEY ISSUES AND OBJECTIVES

5.3.1 Key issues / challenges

The BAS key socio-environmental constraints identified thanks to stakeholders' consultations and literature review are described below:

5.3.1.1 Stress on Wetlands

In the marshes of BAS (Machar marshes and others), water stagnates and exposed to a high evaporation. However, the evaporated water is not lost from the system as it is partly recycled in the form of rain and it contributes to an increase of the air moisture index, which results in a reduction of evaporation in the dry season (Mohamed et al., 2005). Plans to reduce the inflow of rivers water into these wetlands by abstracting or regulating water at pick rivers flow would reduce the size and function of these wetlands and expected to have a negative effect on the climate, ecosystem and social fabrics of the basin. Unless adequate care is taken, a dramatic impact is to be expected on wildlife, livestock and fish, as dry season feed supply for wildlife and livestock will decrease due to reduced flooding, and wet season spawning areas for many fish species will also decrease.

Within the plateau area of the upper sub-basin there are many small permanent and semi-permanent wetlands, mostly occupied by *Cyperus latifolius*. These are mostly found in the upper reaches of the Sor, and Gabba rivers. These account for approximately 2% of the land area but they are becoming increasingly important as land pressures in the cleared area outside the forest increase. Management of wetlands for sustainable cultivation, when drainage is involved, is not easy and there has been extensive and, in some areas, complete, loss of wetlands in the southwest highlands of Ethiopia. The impacts of the loss of wetlands or their transformation for farming are considerable and are also distributed in different ways across the communities. Women and the poor are especially seriously affected when wetland cultivation leads to the loss of safe spring water for domestic use and the loss of plant materials for craft and domestic use. Similar losses are linked to wetland degradation, but in addition the typically richer cultivators loose out.

The main driving forces for wetland drainage cultivation are seasonal food shortages caused by grain storage problems and expansion of coffee plantation on previously cereals growing farm lands. More recently, there has been a growing demand from urban areas for cereals and vegetables which are grown in wetlands. Urban growth has been associated with the growth of the coffee-based economy and there has been some response by farmers close to urban centres to grow crops in response to these market opportunities. Resettlement in Ethiopia after the 1984 famine also led to the increased use of wetlands in some areas of Illubabor where the integrated resettlement approach was used. Local communities asked to host resettlers allocated them land which was not in use or not of prime quality, and in some cases this included wetlands. Settlers were also encouraged to cultivate wetlands for an early maize harvest as they did not have root crops which help local farmers fill the hungry season food gap.

In the mid / late 1980s, the NGO MFM developed a programme, in Illubabor, which sought to reduce the pressure for forest clearance by developing rural livelihoods in the areas outside the forest. One element in this was wetland drainage for vegetable cultivation. Although this element of the programme was closed by the late 1990s, it showed communities some of the possibilities, as well as some of the problems, that could be encountered in wetlands and provided a stimulus to further wetland drainage. Since the early 1990s there has been Wetland Task Forces in the south-west highlands of Ethiopia including parts of the upper Baro-Akobo sub-basin. In years when food shortages are severe in other parts of the country, the Task Forces set communities targets for additional wetland drainage and cultivation and regularly visit communities to ensure these are achieved. In some cases they are also requiring farmers to extend the drainage period and undertake double cropping in the wetlands

5.3.1.2 Loss of Biodiversity

Biodiversity Conservation in Ethiopia has given attention since long ago. The first National Park was established in the fifteenth century. King Zera' Ya'ekob (1434–1468) designated Menagesha-Suba Forest Area as one of the “crown forests” of the country. He ordered the area to be planted with seedlings of indigenous junipers from Wef-Washa Forest, located between Ankober and Debre Sina, and established Menagesha-Suba Park as the country's first protected area (PA).

The first recognized legislation on wildlife conservation in Ethiopia was passed in October 1908 by Emperor Menelik II (1888–1912), who decreed that elephant hunting should be regulated. Further legislation was passed in 1944 to regulate hunting of wildlife by ensuring that certain species were not overhunted. This early legislation demonstrates awareness of the limits of wildlife resources and the dangers people posed to them (Governance for Effective and Efficient Conservation in Ethiopia, by Fikirte Gebresenbet, et al).

Currently, there are many designated protected areas of land including National Parks, Wildlife Reserves, Priority Forests, Biosphere Reserves and Community Conservation Areas in Ethiopia. These are not only act as biodiversity ‘banks’, but also provide important spiritual places and centres for traditional ecological knowledge. These protected areas can also have a direct economic benefit; bringing in revenues from tourism and carbon trading.

However, the challenge is that Ethiopia's protected areas are increasingly degraded. Land is being converted for subsistence and commercial agriculture, timber use, fuel wood and construction, protected grasslands used for livestock grazing. The loss of forests and other protected land is underpinned by a growing population, unsustainable natural resource management, poor enforcement of existing legislation, uncertain land tenure and very low public awareness of the impact of climate change and the importance of biodiversity and ecosystems.

5.3.1.3 Loss of Natural forest

The dominant environmental change in the Baro-Akobo sub-basin is the loss of forest cover which is most marked in the southern and eastern part of the upper sub-basin where the main areas of forest remain. The FAO Forest Resources Assessment (FAO, 2010) estimates the annual loss for forests and other wooded land in South Sudan at 277,630 hectares.

Analysis by the WBISPP in the high forest areas of Ethiopia (Dima, Godere, Gog, Akobo and Gambela woredas) has estimated the rates of deforestation caused by expanding population was 2.23% per annum. Annual destruction of the woody biomass from the high forest areas for agricultural expansion in BAS basin of Ethiopian side was estimated at about 4,287 ha per annum in 1995. This will increase exponentially and it is estimated that Gambella Regional State could lose 32% of its high forest resources between 1990 and 2020. Some 68 per cent of the loss will occur in Godere and Dima woredas. These woredas are also exhibiting the fastest rate of decrease of forest.

The rate of deforestation is determined by the national and foreign demand for tree products. It is likely that deforestation (without significant improvement of protection) increases at least proportionally with the number of national consumers, but probably much faster due the number of consumers increases as a result of immigration, natural population growth and the extension of the market (e.g. to Kenya, Uganda and Sudan) due to the reduction of transport barriers. The factors playing an important role in deforestation are :

- ▶ **Clearing for cultivation:** The most important factor responsible for total forest clearing in BAS basin is cultivation. The average small scale farming household in the basin uses 0.4 to 1 hectares of land for the cultivation of subsistence crops. Currently, the total area under cultivation in low laying areas of the basin is still low. However, it may be expected that the cultivated area will increase proportionally with the increasing population and, in the longer term when agricultural mechanization becomes more common, even more. In Gambella area, mechanized farm is already booming. When the security situation improves, in South Sudan, mechanized agriculture is expected to expand in a fast rate. A survey of land-based investments (Deng, 2011) indicates that, from 2007 to 2010, foreign companies, governments and individuals have sought or acquired at least 2.64 million hectares (26,400 km²) of land for projects in the agriculture, biofuel and forestry sectors in South Sudan. Private investment projects in agriculture may help the basin's economy forward, but if social and environmental aspects are not taken into account, social and environmental cost may be very high. This is particularly the case with mechanized agriculture, which does not contribute much to employment.

Figure 42: Clearing of wood land for the expansion of farm in Torit State, south Sudan



Source: This study

- ▶ **Clearing for roads and settlements:** To create space for roads, settlements and other social and economic infrastructure, forested areas are often to be cleared. The area cleared is usually larger than the area occupied by the structures themselves. Moreover, the impact of human presence and land use associated with roads and settlements usually reaches much further than the original area cleared. Continuous use of forest products by people and passing livestock results in an impact gradient in a wide zone along and around such areas, which may stretch over a distance of up to 5 km or more away from roads and settlements (Deodatus, 1998) in (UNDP, 2011)). Currently, roads are being constructed at various areas where there were no road previously. These roads will open up vast areas in the basin that were previously isolated. Road construction will have a positive influence on the economy of these areas, but at the same time pressure on their resources and natural environment will increase considerably.
- ▶ **Charcoal burning:** The main fuel used in urban centres of the BAS basin is charcoal. In South Sudan, many returnees burn wood to make charcoal to generate income, because no license is needed and simple tools are required. Moreover, the forest belongs 'to nobody.' The production of charcoal requires large quantities of wood and likely contributes significantly to deforestation. The situation of charcoal production is similar in all the parts of the basin and considered to be one of the main causes of deforestation and land degradation. Large quantities of charcoal are also exported. Based on some monthly figures on charcoal exportation from the Renk County in Upper Nile State to Sudan, it is estimated that now annually in the order of 60,000 bags of charcoal are exported from Renk County, representing 2,700 hectares of deforested land (*Upper Nile State Ministry of Finance in* (UNDP, 2011)). This estimate is based on an extrapolation of the annual fluctuations in charcoal production due to seasonality. Since more charcoal may have been exported unregistered or illegally, the real figure is expected to be much higher.

Figure 43: Charcoal making at Sheka zone of Ethiopia (left) and Charcoal ready for sell at Torit area in South Sudan (right)



Source: this study

Table 7: Number of bags of charcoal taxed for exportation to northern Sudan in Upper Nile during the first months of 2011

Months	Bags of Charcoal taxed for exported
January	3,118
February	Unknown
March	7,596
April	3605
May	432

Source: Upper Nile State Ministry of Finance in (UNDP, 2011)

- ▶ **Brick making in South Sudan:** In the past, houses were made of sun-dried bricks. Nowadays more and more baked bricks are used. Brick bakers interviewed in the basin produced 120,000 bricks in one cycle, which are sold for 0.25 South Sudanese Pounds per piece (UNEP, 2007) in (UNDP, 2011). One brick-baking cycle uses 8 cubic metres of firewood. Building the kiln takes 7-14 days, baking 7 days and taking the bricks out another 7-8 days. In Upper Nile brick makers produced between 80,000 and 160,000 bricks per kiln using one truck load of wood for large kilns and a half a truck load for small kilns. One brick-baking cycle was half a month, which means that the presence of one kiln accounts for the utilization of an average of 18 truckloads of firewood per year.
- ▶ **Construction and fire wood:** The demand for construction and fire wood has increased due to the construction of new settlements and population growth. For timber, higher quality wood of larger older trees (*Daniellia oliveri*, *Khaya senegalensis*) is exploited. If taken in large quantities, important elements of the vegetation are removed, which impacts vegetation structure and may increase erosion (UNEP, 2007) in (UNDP, 2011)

Figure 44: Wood collected for sell at Sheka zone near Tepi (left) and Fuel Wood collected along the Tepi-Meti road (right)



Source: this study

- ▶ **Livestock grazing/browsing:** Livestock in the basin, particularly cattle, sheep and goats, consume grass and trees. Grazing is sustainable as long as the re-growth capacity of the vegetation matches the level of use. If the off-take by livestock is too high or if other factors of degradation (e.g. fire, clearing for different purposes, low rainfall, drop of water table) interact with grazing, the vegetation will degrade, which means that open tree savannas may fragment and on the long run they turn into grasslands or deserts (Miehe, 2010) in (UNDP, 2011). The impact of livestock grazing is less visible and more difficult to quantify than that of clearing for agriculture and cutting for charcoal, fuel wood or construction. The most important contribution of livestock to deforestation is the removal of seedlings, which eliminates the capacity of the forest to regenerate.
- ▶ **Fires:** Bush fire is one of the factors for the degradation of forest. It may originate from a number of causes:
 - Farmers use fire to remove vegetation for cultivation; sometimes they lose control and wildfires result;
 - Pastoralists use fire to remove dry grass cover and to stimulate re-growth of perennial grasses (green flush);
 - Hunters use fire to chase animals hidden in the vegetation;
 - On some occasions natural fires occur due to thunderstorms, but this is actually rare
 - since thunderstorms mainly occur in the wet season and they are accompanied by rain.

Fires destroy seeds, tree seedlings, rhizomes of perennial grasses and organic contents of the soil. Areas frequently devastated by fires lose tree re-growth and perennial grasses. Annual grasses, which have less nutritious value for livestock, gain an advantage from fire, since their seeds may survive in the subsoil or recolonize burned areas by dispersion through wind or herbivores.
- ▶ **Population Growth and Resettlement:** Population growth is in the order of 2.8% in the rural areas of the upper sub-basin. This growth is mostly due to natural increase, but there has been a long history, when permitted, of spontaneous migration of people in search of land or economic opportunities associated with the coffee economy, as well as planned resettlement from famine affected areas.

- **Forest Land Allocation for State Farms and Investors:** The process of forest land allocation for the estate farming in Ethiopia accelerated during the Derg government (1974-1991) as the road infrastructure in this area was improved. This saw the establishment of the 8,000 ha coffee estate at Bebeke, to the west of Mizan Teferi and established another state farm for coffee near Tepi covering around 5,000 ha. In the lower basin the state farm at Abobo was also established partly in woodland. Since the change of government in 1991, and the introduction of the free market, forest land has been allocated to investors on long leases for estate agriculture. This has mostly been done in SNNPRS where a rather favourable attitude to investors exists, compared to that in Oromiya where more stringent EIA procedures have been applied. The new estates are mostly in Sheka Zone, near Masha, along the road from Tepi to Gore, but also west of Mizan Teferi. Recent land allocation for investors become more common in Gambela region. In all cases the estates have been established in areas of high forest and experience shows that when options exist for using secondary / thinned forest within the allocated area, investors prefer the high forest. In general, land-use change in BASB is causing the extensive destruction of natural resources. For instance, Gambella National Park in Ethiopia is the country's largest national park formerly covering an area of 5061 km², with a unique ecosystem and wildlife composition. Many recognize great potential for wildlife conservation in this park, but this potential has not yet been tapped as it is expected. The state and federal governments carve up the land for "small" and big investments. Recently, the government established huge tracts of commercial farms within the former park area. Two large Indian and Saudi commercial plantations, Karuturi (300,000 ha) and Saudi Star (100,000 ha), have started producing rice encroaching to the national park area. As a result of these activities, EWCA and the Park Administration organized a workshop in December 2010 with the objective of re-demarcating the borders of the park. As a result the park area has re-demarcated and reduced from former 5061km² to 4575 km².

Figure 45: Wushwush tea plantation at Kafa



Source: This study

5.3.1.4 Soil Erosion

Soil erosion is a serious problem, which occurs particularly on sloping areas with coarse soil texture and poor vegetation cover. Factors accelerating erosion are cultivation, over-grazing, wildfire and other activities responsible for the clearing of the land's natural ground cover. The major consequences of erosion are loss of soil quality for natural vegetation and agriculture, and the siltation of rivers, lakes, dams and irrigation canals. Water erosion is more prominent in the highlands of the BAS basin due to higher human pressure, more sloping land and/ or generally coarser soil types compared to the landscapes dominated by the floodplains in the low laying areas of the basin.

5.3.1.5 Scattered settlement

The settlement pattern of the communities, where many rural communities are scattered along the river banks increasing susceptibility to flooding and reducing accessibility, thus making dissemination of technology more difficult.

5.3.1.6 Poor Agriculture Extension and Poor Credit Facilities

Agricultural extension programs not designed to address the complex socio cultural farming systems and agro – climatic conditions of the basin. Lack of or no rural credit facilities, agricultural input supply and market facilities, inadequate linkage between research – extension farmers and cooperatives, Prevalence of livestock diseases and crop pests, inadequate market infrastructure and marketing information system and traditional farming techniques (hand tillage) are among the constraints limiting agricultural productivity in the basin.

5.3.1.7 Lack of Peace and Security at Borders

Unpredictable conflict between tribes and ethnic groups within the region and cross border conflict with ethnic groups from the South Sudan as well as cattle raid impose instability in the border areas. There are sometimes offensive acts from ethnic groups who drove much number of cattle herds. Such activities are obstacle for development and growth efforts exerted by the people.

5.3.1.8 Poor physical and Social Infrastructures

Poor physical and social infrastructure and communication (Poor access to health and education services; Poor animal husbandry and animal health services; Poor market outlet, absence of roads and information, etc. are among the constraints of the basin development.

5.3.1.9 Unsustainable Hunting of Wildlife

The civil war and continuing insecurity has seen a proliferation of firearms among the communities in the South Sudan part of the basin. The proliferation of arms allows hunters to kill more wildlife with less effort. In the context of insecure tenure, wildlife has become an open access resource and well-armed hunters are rapidly depleting wildlife populations. It has also meant that conflicts over access to land and water have become appallingly violent and lethal in South Sudan. Lack of livelihood options for internally displaced people (IDP) and returning refugees in South Sudan has resulted in an overdependence on natural resources as a source of income, causing a rapid spread of unsustainable trade in bush meat across the basin. The sale of endangered species such as chimpanzees as pets is a growing concern in South Sudan.

Livestock grazing pressure, access to water and the transmission of wildlife-livestock diseases (e.g., bovine TB, rabies, rinderpest, cooties) are important factors affecting local wildlife, livestock and human communities as well as natural resource management (USAID, 2010c).

5.3.2 Proposed development objectives

With regard to BAS key environmental issues, development potential and existing initiatives, the following development objectives can be proposed:

- ▶ Encourage forest conservation based on livelihood development activities such as:
 - Modern honey production in the highland areas by linking with forest and biodiversity conservation,
 - Spices and coffee production inside the forest and connect the products to international markets,

- Linking forest conservation with carbon credit.
- ▶ Provide alternative energy sources in order to reduce deforestation and bushland degradation by:
 - developing mini hydropower projects at high land areas where the community are away from the main electricity line to reduce pressure on the forest of the highland areas
 - introduce energy saving stoves and lighting technologies to reduce need of charcoal and fire wood.
- ▶ Rehabilitate degraded highland areas by developing afforestation, agro forestry and catchment management.
- ▶ Strengthen the protected area network and promote transboundary natural resources and wildlife conservation by:
 - Designating the Badingilo and Machar marshes – Gambella plains – Gwom wetlands as Ramsar sites,
 - Delineating and promoting registration of Majeng forest as UNESCO Forest Biosphere
 - Delineating wildlife protection park along the Akobo river and interconnect Gambella and Boma national parks with wildlife movement corridor,
 - Promoting transboundary wildlife conservation through the establishment of a joint wildlife management plan between South Sudan and Ethiopian borders
 - Promoting ecotourism focusing on Gambella and Boma national parks and Sheka and Yayu forest biosphere reserves.
- ▶ Establish and implement a wetland monitoring network;
- ▶ Develop solid and liquid waste management;

5.3.3 Capacities building

During stakeholders' consultations, the following capacity building needs have been identified:

- ▶ Provide training to build capacity mainly in the GIS, satellite imagery and GPS use to inventory and delineate forest areas,
- ▶ Strengthen the capacity of Ministry of Environmental protection (particularly in South Sudan) with skilled manpower capable of preparing environmental guidelines and standards, Prepare land use plan and manage natural resource.
- ▶ Strengthen the biodiversity conservation institute in both Ethiopia and South Sudan,
- ▶ Establish Joint Wildlife conservation society/forum at the Ethio-South Sudan border;
- ▶ Establish Aquaculture department at each country and build capacity to promote aquaculture development.
- ▶ Establish BAS basin biodiversity conservation office and build its capacity.

ANNEXES

ANNEX 1: MINUTES OF MEETINGS

1. CONSULTATION IN SOUTH SUDAN

1.1 CONSULTATION WITH MINISTRY OF ELECTRICITY, DAMS, IRRIGATION & WATER RESOURCES

On May 6/2015 series of consultations were conducted in Juba with Government officials and experts. The first meeting was conducted at the Ministry of Electricity, Dams, Irrigation & Water Resources. After the introduction of the project and the objective of the team visit by the team leader, stakeholders to be part of the consultation were identified by the directorate of the Ministry of Electricity, Dams, Irrigation & Water Resources. The identified stakeholders in addition to Ministry of Water, Irrigation and Hydropower include Ministry of agriculture, Forestry, cooperatives and rural development, directorate of Electric and Dam, Ministry of Environment, Ministry of Transport, Roads & Bridges, Directorate of River Transport, Ministry of Wildlife Conservation and Tourism and Meteorology.

Some NGOs involved in development activities such as NERAS of Denmark, Netherland, GTZ, JICA were also identified as key stakeholders.

During the discussion with the officials and experts of the Ministry of Electricity, Dams, Irrigation & Water Resources some ongoing projects within the basin were identified. The major ones include: Comprehensive agriculture development master plan (including irrigation master plan) supported by JICA, African Wildlife conservation project at Eastern Equatoria funded by the Netherlands government/NGO, Gambela-Nasir/Melaka interconnection through navigation study supported by Sweden, Kenite hydropower Dam project at Torit area.

Question was raised by the director of Ministry of Electricity, Dams, Irrigation & Water Resources whether the study covers White Nile basin or not. The study tem member represented from ENTRO replied "for the time being the study not include White Nile basin but in the future the study may extended to White Nile based on the availability of finance. There was also argument on the naming of project because the naming didn't include Pibor River which is one of the tributary of Sobat River. Old geological map was referred to see the starting point of Pibor river and copy of the map was collected as part of the important data collection.

Challenges of the basin were also identified during the discussion. The major challenges raised by the participants of the Ministry of Electricity, Dams, Irrigation & Water Resources include:

- ▶ Instability of the country due to tribal unrest,
- ▶ Lack of adequate infrastructures (road, water supply, electric power)
- ▶ Flood and drought,
- ▶ Unplanned urbanization and land allocation,
- ▶ Limited number or skilled manpower to develop and manage the resources,
- ▶ Mass killing of wildlife (local community and army) for wild meat,
- ▶ Deforestation mainly for charcoal production,

Figure 46: Discussion with the officials and staff in the Ministry of Electricity, Dams, Irrigation & Water Resources in Juba



Source: This study

1.2 CONSULTATION WITH THE DIRECTORATE OF HYDRO ELECTRIC AND DAM

According to the directorate of Hydroelectric and Dam, there are 4 hydropower sites proposed in the basin including White Nile. Two power interconnection studies are ongoing, one from Uganda and the other from Ethiopia through Gambella.

Hydropower dam site proposed in Eastern Equatoria is on Kenite River. Refer SMEC study for the details. There are no big potential areas in the sub basin part of South Sudan but there are several stations in Upper part in Ethiopia. Inter connecting from the ongoing Ethiopian Renaissance Dam is not considered so far. However, the team members suggested considering it since there is transmission line from Sudan to northern part of South Sudan which can be benefited.

Figure 47: Discussion with the Directorate and experts of Hydro Electric and Dam



Source: This study

1.3 CONSULTATION WITH MINISTRY OF AGRICULTURE, FORESTRY, COOPERATIVES AND RURAL DEVELOPMENT

The director of the ministry explained the general ecology of the country. He mentioned wetlands, rain fed agriculture, fishery, irrigation and forest as major ecosystems. Rain fed agriculture is practiced in the southern part of the country where the rainfall is adequate. In southern part of the country including part of

the Eastern Equatoria rain starts in April and extended to October or November which promotes rain fed agriculture.

There is green belt zone along White Nile where crops grow twice in a year. But in the eastern and western flat plain water harvesting will require to supplement crop production by irrigation. Also in semi-arid areas where there are pastoralists it needs water harvesting to sustain their livelihood. The main problems of pastoralists were identified during the discussions which include:

- ▶ Lack of water infrastructures for the livestock and people consumption,
- ▶ Poor productivity of livestock (no improved breed),
- ▶ Low level of awareness among pastoralist (cattle are more for prestigious purpose rather than economic resource),
- ▶ Livestock products are imported from other countries (Uganda) while the cattle population is huge in the country,
- ▶ Conflict among tribes on water and grazing areas.

Regarding to ongoing projects it was mentioned that there is a comprehensive agriculture development master plan study which is expected to be finalized at the end of June. The study has also a component on irrigation (irrigation master plan which is the subset of the Comprehensive master plan study).

Figure 48: Discussion with the ministry of Agriculture, Forestry, Cooperatives and Rural Development officials and experts in Juba



Source: This study

1.4 CONSULTATION WITH THE MINISTRY OF ENVIRONMENT

During the discussion existing and potential challenges on the environment were asked by the consultant team. The following challenges were identified by the participants of the meeting:

- ▶ Lack of proper management for the national parks,
- ▶ Killing of wildlife for wild meat,
- ▶ Lack of wetland management and wise use of it,
- ▶ Lack of approved environmental policy of the country (the environmental policy is under review by the parliament),
- ▶ Unplanned urbanization and unplanned land allocation without considering sensitive environments like wetlands,
- ▶ River pollution by urban waste,
- ▶ Siltation of rivers by sediment due to removal of vegetation at the upper catchment,
- ▶ Shrinkage of rivers due to climate change,

- ▶ Reckless removal of trees for agriculture expansion and for commercial purposes mainly for charcoal production,
- ▶ Absence of land use plan in sensitive areas like Imatong mountains,
- ▶ Lack of wetland inventory and delineation (Wetland inventory study was initiated by RAMSAR but interrupted due to war),
- ▶ Local people are poor not because of potential resources but due to lack of knowhow to use the resources and community unrest due to war.

Potential resources in Eastern Equatoria include fertile land, forest resources (bamboos, Gum acacia) honey production, springs and rivers from mountain areas, etc.

Participants also mentioned that any development in the watershed must consider:

- ▶ Basin wise not administration based,
- ▶ All users must be addressed,
- ▶ Not develop projects by favoring some communities in the expense of others (equitable share of resources).

Figure 49: Discussion with the ministry of Environment in Juba



Source: This study

1.5 CONSULTATION WITH NGOs REPRESENTATIVES AND EAST EQUATORIA INFRASTRUCTURE DIRECTOR AND EXPERTS

Participants were from the government offices and NGOs (See the list of attendants).

According to the discussion with Eastern Equatoria state environmental director and our visit along the road to Torit, trees and vegetation cover is diminishing in fast rate without any endeavour to replant or afforestation. People are clearing trees for expanding farm land and for the production of charcoal. Charcoal is the main source of the energy in the country since there is no other alternative form of energy to substitute charcoal. Currently, charcoal is the easily available source of income for the rural people. At present, there is no approved law or policy regarding the conservation of environment. Draft Environmental policy of the country is submitted to the parliament for review and endorsement.

As a mitigation measures participants of the discussion raised provision of alternative energy sources like hydropower, use of fuel conserving stoves, creation of awareness among the local people, promote reforestation, promote fruit tree plantation, promote farmers to use bee keeping and honey production, identify easily affected tree species and ban its removal by law, develop mechanisms to use dry grass for household energy purposes, etc.

As per the participants of discussion, culturally local people abstain from cutting some trees, trees which are considered sacred and cutting them believed by the community to cause some spiritual problems. But this days due to the war and tribal unrest, these trees conserved by one tribe were cut by another tribe and culture of conserving the environment by traditional ways have been eroded.

Wildlife conservation expert from Africa Wildlife conservation indicated challenges on the wildlife resources. The major challenges are:

- ▶ Killing of wildlife by communities as well as by the army for wild meat,
- ▶ Absence of national parks management plan,
- ▶ Lack of awareness about the wildlife conservation and its use.

The impact is more severe during the mass migration of White eared Kob, one of the endangered species. They migrate to Gambella national park during the dry season as they can get water there and come back to South Sudan/Boma Park when the Gambela area is wet and muddy. The reason of migration is to search water in the dry period at the upstream and escape mud during the wet season. Their migration is considered by the local people as a sign for onset of rainy season and dry season.

As it was expressed in the discussion, there are historical sites in East Equatoria like the mass grave of the war victims and cultural site where reburial of bones after the flesh separated from the bones take place. Community crocodile farm practiced in some areas can also be utilized as a tourist attraction. In the East Equatorial state scenic beauty of the mountains can be the natural attraction for local and international tourists.

Figure 50: Discussion with the East Equatoria Directorate of Infrastructure and with NGO representatives in Torit



Source: This study

In addition to discussion with government officials and NGOs representatives site visit to the proposed hydropower site on Kenite River was conducted. The proposed hydropower site is located at about 20 km south of Torit town. The nearest village to the hydropower site is known as Hilok-2. The area is accessible by car though it could be difficult in rainy days.

The proposed dam site is located in the center of valley surrounded by two hills. The river flow was considerably high at the time of visit and its flood plain is wide enough to hold much water. Both sides of the river are covered by tall elephant grasses. Following the grass, riverine trees are observed which marks the boundary of high flood level. The major tree species observed include: Ficus spp, Acacia polyachantha, Combertum collinum, Terminalia collinum and variety of Acacia Spp. Ecologically the larger area of the Kenite river catchment is characterized by Savanna woody grassland, where the tree species dominated by Combertum Terminalia and Acacia comphora type.

The Kenite River eventually ends up in the wetland at the downstream. Currently there is no clear indication that Kenite river is connected with Baro Akobo-Sobat basin or not.

According to the representatives from Kapoeta area, water harvesting potential at semi desert areas of East Equator needs to be assessed. The semi desert areas are less populated area but with large number of livestock. The main challenge of the area is shortage of water for people and livestock. To solve this problem providing water should be seen as one of the components of the integrated water resources management project. The possible source of water for this area seems harvesting water during the flooding season in cofferdams. The potential of ground water has not been assessed in detail. However, as per the information from local experts, ground water cannot be easily obtained in depths of less than 200m.

The consulted officials suggested that if water is to be provided for people and cattle, the distribution and location should be selected carefully to avoid water use conflicts. Series of cofferdams or boreholes need to be developed at agreed locations based on the community consultation. After the construction, each water point should be managed by water use committee established by the community or use the existing traditional ways of resource sharing in the community. The location of water harvesting schemes should also consider overgrazing and land degradation impacts. The schemes should be planned in such a way that they will not invite tribal conflicts and community turbulence.

Figure 51: Kenite River at the proposed dam site (left) and nearest village to the proposed dam site known as Hilok-2 (right)



Source: This study

1.6 CONSULTATION WITH GOVERNORS FROM NORTH WEST KAPOETA AND SOUTH KAPOETA

As per the discussion, there are dry areas where surface water is not available. People are pastoralists that move in search of water and grazing land. Shallow wells drilled before are dried during the dry period. The drilled wells are not deep enough to sustain water during the dry period.

The pastoralist lifestyle is creating conflict due to the limitation of resources. According to the representative from South Kapoeta, nearly all of the major inter and intra-communal conflicts are linked either to cattle raiding and the subsequent spiral of violent retribution, or conflict among pastoralists and farmers over migration routes and access to water and pasture.

As per the discussion, supplying adequate water points at several places following the major grazing territories will solve the conflict and unrest of communities.

Slow by slow promoting sedentary settlement and shifting from pastoralist life style to mixed farming system expected to improve the livelihood of the people. Irrigation development using underground water could also help to improve the livelihood of people. Some individuals are exercising irrigation at the bank of Singata River by digging well on the dry river bed and pumping it for small scale irrigation. But the problem is the water level draw down in the dry season and become difficult to pump. The representative/Official

from South Kapoeta suggested that this integrated water resource development project is expected to solve such problems. The area has a seasonal river called Singata. It has large flow when the rain falls, but immediately the runoff disappeared in sand and become unavailable for use. The flow disappears in wetlands and sands before joining any known river system.

Water shortage is also common in rural towns. In some villages JICA has developed boreholes and installed pumps which operate using solar energy and they are working well. But in some villages boreholes dug were not functioning due to the maintenance problem. As per the officials, local communities are poor to cover the maintenance cost.

According to representatives from Kapoeta area to solve energy problem, investing in wind energy could be an option since there is high wind in the area.

According to the participants, other constraint for the resource management and development is shortage of infrastructures. Particularly road access to rural areas is a crucial problem. Road density at the moment is very low. During the rainy season most of the rural roads are impassable.

Also number of internally displaced people as a result of the civil conflict is increasing that leading to an unplanned land accusation and unplanned expansion of cities putting pressure on water and energy infrastructure within build up areas. Those left without energy obliged to cutting wood, which can worsen the problem of deforestation.

Figure 52: Meeting with East and South Kapoeta Governors at Torit



Source: This study

1.7 CONSULTATION WITH DIRECTORATE OF RIVER TRANSPORT

Discussion made with the directorate of river transport revealed that though the river transportation is the cheapest form of transportation in terms of load transporting; currently there is no river transport in Baro and Sobat river system. Except very small vessels, big boats are not using this river system. There were some initiatives to improve river transport. In the 2013th EGAD meeting river transportation was raised as one of the interconnection or means of transport between countries. Africa Development Bank also showed interest to fund the river transport development. But none of them so far showed concrete progress.

River transport from Melaka to Nasir is operational between May to September. In dry season due to water level drawdown boats can not float. The major challenges of river transportation are:

- ▶ Siltation of river channel,
- ▶ Shortage of flow in dry season,
- ▶ Absence of defined navigation channel/route,

- ▶ Narrowing of width of channel by sedimentation in some areas,
- ▶ Massive growth of Water hyacinth
- ▶ Sharp curves in the river system
- ▶ Shortage of budget for study and design of river transport,
- ▶ Lack of maintenance such as dragging of sediment from the channels.

Figure 53: Discussion with River transport directorate (left) and Port on white Nile at Juba (right)



Source: This study

1.8 CONSULTATION WITH METEOROLOGY DIRECTORATE

Discussion with the directorate of the Meteorology revealed that the coverage of meteorological station in South Sudan is low and the available data is only for recent time. Practically there are no meteorological stations in the Baro-Akobo-Sobat basin. Functional stations are only five distributed in five major towns. The data are being used mainly for the aviation purpose. There are some automatic stations installed by FAO but due to maintenance problem and war most of them are not functioning. Historic data which were collected before the separation of two countries could be found in Khartoum.

The available data from Juba can be obtained through official request by specifying the data type needed.

Challenges of Meteorological office raised by the directorate include:

- ▶ Shortage of equipment,
- ▶ Shortage of qualified man power,
- ▶ Lack of data processing facilities,
- ▶ Low coverage of meteorological stations in the country,
- ▶ War and instability of the country.

1.9 CONSULTATION WITH THE MINISTRY OF WILDLIFE CONSERVATION AND TOURISM

During the consultation undersecretary emphasized that the conservation of wildlife is very important and necessary. He mentioned the impact of former canal construction project without consulting the wildlife professionals and consequently the canal has been creating adverse impact on the wildlife movement. The canal has hindered the free movement of animals and denies access to larger grazing area. Therefore, this

study has to consult wildlife experts before launching any project in the Baro-Akobo-Sobat basin. The basin is one of the richest basins in wildlife.

Wildlife are facing huge problem from poachers and illegal traders (for example illegal people from Somalia kill wildlife for skin and other marketable parts).

Wild animals are also killed during the seasonal migration. To minimize migration it will be important to provide water points for dry season. According to the undersecretary the integrated water resource master plan project has to incorporate wildlife watering component which could minimize migration of wildlife and promote tourism in the basin.

1.10 CONSULTATION WITH WILDLIFE CONSERVATION SOCIETY (WCS)

The following information was obtained:

- ▶ The core activity of the organization is wildlife conservation but since this cannot be separated from the environment, they take a wider approach. 2 main kinds of surveys are carried out:
 - Socioeconomic. Understanding communities' livelihood strategies activities, conflicts, what do they need what do they want? What do they use their natural resources for?
 - Ecological surveys. These include some aerial surveys aimed at estimating populations and human activities
- ▶ Boma and Badingilo, which have been covered by these surveys, we need to request the results and documentation concerning these areas
- ▶ The Gwom wetland is included in the Boma reports. This wetland is very important for pastoralists and wildlife.
- ▶ Land-use planning has been done for Boma. Started for Bor county but stopped for security reasons
- ▶ They have GIS maps of protected areas (including extension, we took a hard copy). To be requested.
- ▶ Nothing has been done in Machar Marshes. The northern half of the country is effectively no-go.
- ▶ WCS did the preliminary work (surveys?) in the Imahong Mountains before AWS took over.
- ▶ Tourism. The war has effectively stopped everything. Boma is closed. There is a huge potential in both Boma and Badingilo. A site at Achuma (on border with Ethiopia) had been developed but stopped. There are draft management plans for Boma and Badingilo.
- ▶ Wildlife Management and Tourism policies are all drafted but stuck somewhere. There are draft Tourism regulations, Bill, Policy – to follow up with the Lt Gen.
- ▶ Cooperation with Ethiopia. Discussions on the Boma-Gambella landscape started in 2008 and is being discussed. There is cooperation with HOREC who are doing the land-use plan for Gambella (to be available soon).

2. STAKEHOLDERS CONSULTATION IN ETHIOPIA

2.1 CONSULTATION WITH SNNPR SECTORAL OFFICES

Discussion with the officers and experts in the water and energy office, land utilization and environmental protection office, tourism and culture office, economic and finance bureau, investment agency and early warning response and food security work process of the Southern Nations, Nationalities and Peoples Regional State was conducted on June 18 and 19/2015. The discussion was focused on identifying environmentally and socially sensitive areas, issues and challenges in the Baro-Akobo basin and possible solutions for the identified issues and challenges. In addition, availability of ongoing and planned projects in the basin were assessed.

The consulted officials and experts raised the following environmental and social challenges prevailing in the region:

- ▶ Land degradation and soil erosion,
- ▶ Lack of organized land use plan in the basin,
- ▶ Deforestation of natural forest for the expansion of farm land,
- ▶ Expansion of investors beyond the allocated land area and encroaching into forest areas,
- ▶ Lack of proper coordination between investment and environmental protection offices,
- ▶ Lack of environmental monitoring and follow up after the allocation of land for investment,
- ▶ Significant gaps in the implementation of environmental laws,
- ▶ Lack of standard buffer zone (e.g, Federal EPA says 1km buffer zone between water bodies and any development, regional office says 2km, International says 150m),
- ▶ Construction of roads through high forested areas directly remove trees and create access for timber production and illegal cutting of trees,
- ▶ Use of charcoal as main energy source and income by the community,
- ▶ Weak setup of institution (Land utilization and administration and Environmental protection organized as one department under the Agriculture bureau which weakened the role of environmental protection)
- ▶ Unplanned and unlimited grazing in the forest which is affecting the forest and forest products (coffee, spices, etc),
- ▶ Conflicts between communities who are sharing the forest resources in the boundary of two communities,
- ▶ Cross-border conflicts due to competition for grazing land and fish farming between local communities and ethnic groups of Southern Sudan. The other cause of the border conflict is cattle raid and killing people.
- ▶ Poor communication of study and research outputs in the country.

Activities being done to alleviate these challenges in the region as per the consulted officials and experts include:

- ▶ Conduct physical and biological soil conservation works on farm lands,
- ▶ Enrichment tree plantation in the forest areas,
- ▶ Organize jobless youth in cooperatives to develop forest products (spices, honey, fruit trees, wood work, etc,) and support their livelihood,
- ▶ Organize community members above 18 years in 1:5 and mobilize for watershed protection works (construction of terraces, tree plantation in degraded areas, area closures),

- ▶ Promote water harvesting and mini irrigation,
- ▶ Provide improved seeds,
- ▶ Provide training on how to protect environment and forest resources and how to survey and design physical protection structures (terraces, Gabions, etc),
- ▶ Delineate forest biospheres (Sheka biosphere and Kefa biosphere) in coordination with NGOs, e.g Nature and Biosphere Union (NBU),
- ▶ Provide financial support through microfinance credit for these who save 20% by their own will be given 80% of the project from the microfinance,

Food security office provides productive food support, family livelihood building and resettlement based on the willingness for those who are food insecure, particularly in Bench Maji zone of the basin.

Additional activities recommended to minimize environmental and social challenges include:

- ▶ Providing improved and fuel conserving stoves for the community who depend on the charcoal,
- ▶ Improving products of forest such as spices, honey, coffee through research and creating better market for these products (national and international markets),
- ▶ Promote solar energy to substitute charcoal so that deforestation will be reduced,
- ▶ Provide training to build capacity mainly in the GIS, satellite imagery and GPS use to inventory and delineate forest areas,
- ▶ Develop and implement forest management plan.

2.2 CONSULTATION WITH GAMBELLA REGIONAL STATE SECTORAL OFFICES

Similar to SNNPRS, discussions were conducted with officials and experts of sectoral offices of the Gambella Regional State. The consulted offices include water and energy office, land utilization and environmental protection office, tourism and culture office, economic and finance bureau and Gambella National Park Office.

The discussion was focused on identifying environmentally and socially sensitive areas, issues and challenges in the Baro-Akobo basin and possible solutions for the identified issues and challenges. In addition, availability of ongoing and planned projects in the basin were assessed.

The consulted officials and experts raised the following environmental and social challenges prevailing in Gambella regional State:

- ▶ The region does not have its own environmental policy and guidelines,
- ▶ Lack of coordinated protection of environmentally sensitive areas like forest, wetlands and national park,
- ▶ Lack of management plan for the Gambella National Park,
- ▶ Lack of coordination between investment and environmental protection offices. Investors prepare EIA after they possessed the land and license. In principle, EIA should be a prerequisite for the possession of license. But in case of the Gambella, EIA is prepared just to indicate mitigation measures which makes EIA powerless tool.
- ▶ Influx of refugees into the region imposed adverse impacts on forest resources,
- ▶ Conflict between different tribes mainly due to cattle raid,
- ▶ Conflict between local community and pastoralists coming from Sudan in search of grazing and watering,

- ▶ Absence of strong cooperatives to supply farm inputs like fertilizers, selected seeds, etc,
- ▶ Shifting cultivation which has impact on forest resources,
- ▶ Water pollution by solid and liquid waste,
- ▶ Absence of liquid waste treatment plant for Gambella town,
- ▶ Absence of trucks to collect and dispose solid waste at the designated disposal site. (The designated solid waste disposal site is located 7km away from the Gambella town).

Activities recommended to minimize environmental and social challenges include:

- ▶ Strengthen the coordination between investment office and environmental protection offices,
- ▶ Stop shifting cultivation to reduce deforestation,
- ▶ Conduct EIA before issuing license for the investment as a prerequisite for licensing,
- ▶ Avoid encroaching into National park and wildlife habitat,
- ▶ Prepare management plan for the Gambella National Park,
- ▶ Ensure availability of appropriate land for investment before inviting investors,
- ▶ Avoid allocating land for investment in high forest areas,
- ▶ Collect and dispose solid waste at designated place,
- ▶ Build capacity of cooperatives involved in solid waste collection and disposal by providing training and trucks
- ▶ Collect and treat liquid waste of Gambella town,
- ▶ Build capacity of cooperatives involved in supplying farm inputs like fertilizers, selected seeds, etc
- ▶ Avoid tribe to tribe and cross boarder conflicts that caused mainly due to competition for grazing land, cattle raiding and watering points.
- ▶ Solve civil unrest in South Sudan to reduce influx of refugees.

Figure 54: Discussion with Early warning and disaster prevention expert in SNNPRS



Source: this study

2.3 CONSULTATION WITH ETHIOPIAN WILDLIFE CONSERVATION AUTHORITY

Discussion was conducted with Ato Girma Timer, protected areas development and protection senior expert. He indicated that GNP is very important park in terms of biodiversity and being Trans Boundary Park. The park has been pressurized by investment activities and resized due to encroachment of farm activities. In terms of management, there is an interim management plan and the overall management of the park has been given to the African Parks Network Centre which is working under the Inter-governmental Authority for Development (IGAD).

The government of Ethiopia and South Sudan signed memorandum of understanding to jointly protect and develop trans-boundary parks.

There is also a proposed wildlife reserve area in the BA basin in Bench-Maji zone parallel to Boma national park of South Sudan, which is rich in wildlife species.

The Gambella national park has gazetted and there is map which shows the area coverage and boundaries.

Regarding the impact of the proposed water resource development project on the Gambella National park, Ato girma expressed his fear that if the migratory route between Gambella and Boma national parks is blocked by water resources development the impact on the wildlife and biodiversity would be significant. However, if the project properly designed considering the national parks and wildlife movement corridors, the impact would be minor.

2.4 CONSULTATION WITH HORN OF AFRICA REGIONAL ENVIRONMENT NETWORK CENTER

The organization is working on the integrated land use development plan in Gambela region. The project is under the literature review at the time of consultation on October 9/2015. The project also includes preparation of strategic environmental and social Assessment. As part of the consultation scheme, they established consultation units in Gambela region for each type of livelihood projects (eg, consultation unit for aquiculture and fishery, consultation unit for tourism, for small & large scale irrigation, etc.). They are preparing land use map for each zone including Gambela town.

2.5 CONSULTATION WITH NABU BRANCH OFFICE AT BONGA

After the study team introduced the BAS IWRDP, Ato Mesfine explained about Kafa forest Biosphere. He clarify that most of the Kafa forest biosphere is located in Omo basin, while some portion of it is situated in BASB. The total area of biosphere is 700,000ha. Out of which 43,150ha is a core conservation area where human interaction is avoided, 289,000ha is delineated as buffer zone while 164,000ha is delineated as transitional zone. There is lion and other wildlife species in the forest area, particularly in core reserve area.

NABU is NOG working on Nature and biodiversity project funded by Germen. The project branch office at Bonga town runs by 3 technical staffs and 10 rangers.

Three pillars of the project are (1) Rehabilitation, (2) Regional development and marketing and (3) Biodiversity campaign.

The project support livelihood of the community by promoting ecotourism, modern bee keeping, introducing energy saving stoves, use of spice and other none timber forest products. By doing so try to minimize encroachment of farm into forest areas.

As per the discussion, constraints faced to protect forest resources in Kafa zone include:

- ▶ Poverty of people living in the forest areas;
- ▶ Increasing population due to birth rate and immigration from other part of the country;
- ▶ Clearing of forest for expanding farm land;
- ▶ Allocation of forest land for agriculture investment;
- ▶ Climate change;
- ▶ Lack of coordination between different government institutes and weak enforcement of rules and regulations pertinent to natural resource conservation and management.

Activities being carried out by NABU to solve these pressures imposed on natural forest and biodiversity include:

- ▶ Biodiversity campaign in the community and schools;
- ▶ Promoting traditional ways of forest protection; Providing training on biodiversity for volunteers;
- ▶ Distributing energy saving stoves;
- ▶ Introducing Coffee bricks from coffee husk for energy/cooking;
- ▶ Introduce solar lamps for lightning.

NGOs working in the forest conservation and livelihood improvement in Kafa include: MELCA & ECOPIA

2.6 CONSULTATION WITH BENCH-MAJI ZONE AGRICULTURE AND RURAL DEVELOPMENT OFFICE

Ato Solomon Kelemwork, the head of Bench-Maji zone agriculture office explained that the woreda is endowed with natural resources. 46% of the land area of the zone is covered with forest and bushes. There is natural forest, gold mine at Dima area. Shako and Guraferda forest is potential area for biodiversity conservation. There is also a controlled hunting area in Gureferda. Tululiga is a regional wildlife protection park found in the Zone. There are also potential wildlife protection areas following the shore of Akobo river, where various wildlife species are dwelling.

Regarding water shed management, Sustainable land management project (SLMP) is working in two woredas since 2015. The conservation work is focused on soil and water conservation and reforestation of degraded areas.

Constraints identified during the discussion include:

- ▶ Soil acidity,
- ▶ Soil erosion at the highland and steep slope areas;
- ▶ Encroachment of farm into natural forest areas;
- ▶ Increase in population which is exacerbated by the immigrants from other parts of the country;
- ▶ Expansion of agriculture investment (Bebeka coffee plantation), Seka agro industry (3000ha mango plantation); Rubber tree plantation in Guraferda area.
- ▶ Lack of proper land administration and certification of land holdings;
- ▶ Low capacity in GIS application and use. Current land measuring is based on traditional ways which is not effective.

Figure 55: Discussion with Bench-Maji Agriculture and rural development head at Mizan town



Source: This study

2.7 CONSULTATION WITH YAKI WORED ADMINISTRATION OFFICE

The deputy head of the Yaki woreda explained that Sheka zone has three woredas, namely Masha, Yeki and Anderacha. Yeki woreda is consists of 22 kebeles. The woreda is endowed with natural forest and coffee. The woreda is also known for honey production and spices. Main spices found in the forest are Korerima (Afromom corrorima) and Timiz (Piper capense).

The woreda has also several tourist attractions such as water falls, forest, caves, lakes and culture of people.

As per the discussion, the major problems for natural forest and biodiversity conservation in the woreda are:

- ▶ Encroachment of farm into forest areas,
- ▶ population growth and influx of people from other parts of the country, primarily for the search of job as daily labour and later on some of them shift to farm by clearing forest areas;
- ▶ Expansion of tea and coffee plantation by the investors,
- ▶ Failure of law enforcement,
- ▶ Weakening of traditional forest conservation practice. Young generation became reluctant to follow the old traditions such as keeping sacred places, worship areas, etc.;
- ▶ Resistance of people for new technologies;
- ▶ Soil acidity,
- ▶ Slope and sliding nature of the soil.

Efforts done to date to protect the natural forest and environment in the woreda include:

- ▶ Lively hood improvement work by the government and NGOS. For example wild coffee conservation (WCC) an NGO has been working in the woreda on conservation and alternative lively hood promotion.
- ▶ Agriculture growth program (AGP) work on improving productivity through small scale irrigations and cattle productivity.
- ▶ Kobo which is traditional mechanism of communal forest protection by the community.

Activities needed to be promoted include:

- ▶ Expanding Agriculture productivity growth program in a larger scale;
- ▶ Promote community participatory forest development;
- ▶ Promote alternative livelihood mechanisms such as spice production and marketing, honey production and marketing, promotion of agro forestry;
- ▶ Working to get carbon credit by conserving natural forest as carbon sink.
- ▶ Promoting ecotourism development
- ▶ Conduct water and soil conservation work in the afro-montane rain forest areas and landslide prone areas.

2.8 CONSULTATION WITH MAJENG ZONE

Consultation was made with Ato Kemtu Tewu Deputy administrator of Majeng zone, and his experts at Majeng zone, Meti town.

The BAS basin Integrated Water Resource Development Study and its objectives were explained by the study team to the zonal administrator and experts working in sectoral offices. After briefing of the project, the study team requested the officials and experts to introduce their zone and existing potentials and constraints regarding natural resources use and management and to identify potential projects that could be considered in the BAS IWRDP.

The participants of the meeting briefed to the study team that Meti the capital of Mezheng zone is about 305 km away from the regional capital, Gambella. The zone consists of only two woredas, namely Godere and Mengeshi. The people of the zone are fully dependent on crop production (farming). The zone is one of the high rainfall receiving areas of the country. Rain fall extended for 9 months. The zone is one of the coffee producing areas of the country. There is about 225,000 ha forest land with high biodiversity.

As per the discussion, the forest resource is diminishing from time to time. There are no protected national or regional wild life parks in the zone.

Main causes of forest and biodiversity degradation are:

- ▶ Encroachment into forest areas for coffee plantation and other crop production;
- ▶ Illegal settlement;
- ▶ Labor attracted by the agro- investment from other parts of the country tend to shift to farming by clearing virgin forest;
- ▶ Forest clearance for tea plantation by the Indian Investors. The land allocation policy for investment which allows Federal investment office to allocate land for investors where the required land is more than 5000ha is affecting the natural resource. For instance, the tea investment area is the tower of water for the downstream areas including Alwero dam. Some rivers which were permanent before the impact on forest become seasonal due to the clearance of forest cover, and;
- ▶ Lack of proper land use plan.

As per the zonal officials, activities required to minimize forest and biodiversity degradation include:

- ▶ Promoting alternative livelihood mechanisms such as modern honey production, none timber forest products, spices and create market link for the products; Stop tea investment from expanding (so far 100ha of forest land has been cleared and planted tea);
- ▶ Land allocation for investors should be in consultation with zonal administration and prior EIA recommendation.
- ▶ Work to link the forest are with carbon credit;
- ▶ Look international market for organic coffee of Majeng.

- ▶ Introduce farm technologies that help to produce high production from small farm land;

Figure 56: Discussion with Majeng zone administrator and experts



Source: This study

2.9 CONSULTATION WITH SHEKA ZONE ADMINISTRATION OFFICE

The BAS basin integrated water resource Development study and its objectives were explained by the study team to the zonal administrator and experts working in sectoral offices. After briefing of the project, the study team requested the officials and experts to introduce their zone and existing potentials and constraints regarding natural resources use and its management. They explain that Sheka zone is located in the Southern Nations Nationalities and Peoples (SNNP) Regional State. The zone has three woredas, namely Mash, Anderacha and Yeki. The zone covers 2174.25 km², out of which 47% is covered by forest.

The zone has a UNESCO registered forest Biosphere reserve. The total area of forest biosphere reserve is 238,750ha. Out of which 55,255ha is a core area, 76,395ha is buffer area and the rest 107,100ha is transition zone. The core zone consists of dense natural forest, wetlands and bamboo forest and it is protected from human interaction except for the purpose of research, traditional beehive, religious purposes, ecotourism, scientific training and collection of medicinal plants.

Buffer zone is the forest area where both use and protection go hand in hand. In buffer zone activities which affect ecosystem will not be allowed. However, environmentally friendly land use such as traditional beehives, coffee plantation where the forest is not dense, collection of spices and none timber forest products can be exercised, but settlement, grazing, cutting of indigenous trees, farming on wetlands and clearance of indigenous trees from river sides will not allowed. Transition zone is area where settlement and environmentally friendly agricultural activities will be taken place. But large investment activities will not take place in transition zone.

As per the zonal agriculture expert, the major environmental constraints of the zone include:

- ▶ Encroachment of farm into forest area,
- ▶ Increase in population and need for farm land;
- ▶ Tendency of farmers to use shifting cultivation or tendency of look for virgin land;
- ▶ Soil acidity and low production per ha,
- ▶ Lack of alternative livelihood system;
- ▶ Lack of suitable technologies;
- ▶ Lack of electricity for lighting and cooking, which pressurize on forest for fuel wood;
- ▶ Immigration of people from other parts of the country and illegally settle in the areas by clearing forest cover;
- ▶ Plantation of eucalyptus trees in wetland areas, which dries wetlands and water sources;

- ▶ Increased need for timber production;
- ▶ Land requirement for agricultural investment (tea and coffee investment), more than 40 investors are registered in the zone and about 18,000ha has been given for the investors;
- ▶ Absence of significant benefit from the protection of forest resources for the local communities;

Participants of the discussion suggested the following measures to reverse or arrest environmental degradation of the natural resources, mainly forest:

- ▶ Promote small scale irrigation and increase productivity per ha of farm land;
- ▶ Develop mini-hydropower schemes in areas away from the main grid to replace fire wood and charcoal need;
- ▶ Introduce alternative livelihood system like modern beehives, spice production and marketing, ecotourism (there are about 200 ecotourism attractions in the zone), etc;
- ▶ Introduce energy saving stoves and better technologies;
- ▶ Promote biological conservation works;
- ▶ Protect wetland areas, water towers and bamboo forest areas;
- ▶ Strict implementation of forest management plan;
- ▶ Work on capacity building and technology transfer;
- ▶ Promote fish farm on rivers such as Baro, Ganji, Beku, and Gemedero rivers;
- ▶ Reforestation of degraded areas.

NGOs working in natural resources in the zone are: MELCA Ethiopia and Ethio-wetland.

SLM project is working mainly focusing on livelihood improvement in 11kebeles of the zone, forest conservation and awareness creation.

2.10 CONSULTATION WITH MELCA AT MASHA TOWN

MELCA representative at Mesha town explained that MELCA is a local NGO established to support sustainable forestry in Ethiopia. MELCA provide awareness on forest conservation, livelihood and education of school children about the use and benefit of natural forest. MELCA prepared land use map of three kebeles in Sheka through participatory action with each kebele communities. It played significant role in the process of registering the Sheka forest biosphere reserve in UNESCO. Promote establishment of cooperatives on spice production and marketing, Beekeeping and marketing and animal fattening. Also formulate club in schools named Sen. The purpose of the club is to create awareness among the school children about the conservation of ecosystem. They select volunteer students and take for five days to forest reserve areas and introduce tree species and their uses such as medicinal use, ecological and habitat uses , etc.

Figure 57: Discussion with MELCA Representative At Masha Town of Sheka zone



Source: this study

2.11 CONSULTATION AT METU TOWN, ILUABABORA ZONE

Iluababora zone consists of 22 Rural woredas and two urban kebeles. The zone is rich in water resources and forest. Baro Kela, Geba and Sore rivers are the main tributaries of Baro river originated in Iluababora Zone. Yayu forest biosphere reserve is also located in this zone. The core area of the biosphere is 21,000ha.

There are NGOs working on Wild Coffee Conservation (WCC) and Environmental Coffee Conservation Forum (ECCF) in the zone. SLM project is working in six woredas of the zone.

The existing environmental problems of the zone are:

- ▶ soil erosion on farm lands and steep slopes,
- ▶ Encroachment of farm into natural forest areas,
- ▶ Lack of alternative energy to substitute fuel wood consumption,
- ▶ Conversion of wetlands into farm land

Efforts being done to arrest these environmental problems include: Organizing youths in group and assign land area for tree nursery production, honey production, spice production and marketing.

2.12 CONSULTATION WITH THE MINISTRY OF ETHIOPIAN ENVIRONMENT, FOREST AND CLIMATE CHANGE

Consultation with protected forest directorate Dr Menassie Gashaye (Tel. 0912093330) was conducted on February 17/2016. He explained that the inventory of forest areas have been conducted and interpretation and analysis of the data is ongoing. The land use land cover map of the country is going to be issued within few months and will be available for the public. Regarding Gambela area, the inventory of forest resources has not been done so far and they are planning to undertake the inventory before finalising the land use land cover map of the country.

2.13 CONSULTATION WITH ETHIOPIAN WILDLIFE CONSERVATION AUTHORITY (EWCA)

Discussion was conducted with Ato Girma Timer, protected areas development and protection senior expert. He indicated that GNP is very important park in terms of biodiversity and being Trans Boundary Park. The park has been pressurized by investment activities and resized due to encroachment of farm activities. In terms of management, there is an interim management plan and the overall management of the park has been given to African parks network centre which is working under Inter government Authority for Development (IGAD).

The government of Ethiopia and South Sudan signed a memorandum of understanding to jointly protect and develop trans-boundary parks.

There is also a proposed wildlife reserve area in the BA basin in Bench-Maji zone parallel to Boma national park of South Sudan, which is rich in wildlife species.

The Gambella national park has been gazetted and there is a map which shows the area coverage and boundaries.

Regarding the impact of the proposed water resource development project on the Gambella National park, Ato Girma expressed his fear that if the migratory route between Gambella and Boma national parks is blocked by water resources development the impact on the wildlife and biodiversity would be significant. However, if the project is properly designed considering the national parks and wildlife movement corridors, the impact would be minor.

2.14 CONSULTATION WITH HORN OF AFRICA REGIONAL ENVIRONMENT NETWORK CENTER

The organization is working on the integrated land use development plan in Gambela region. The project is under the literature review at the time of consultation on October 9/2015. The project also includes preparation of strategic environmental and social Assessment. As part of the consultation scheme, they established consultation units in Gambela region for each type of livelihood projects (eg, consultation unit for aquaculture and fishery, consultation unit for tourism, for small & large scale irrigation, etc.). They are preparing a land use map for each zone including Gambela town.

2.15 CONSULTATION WITH ETHIO WETLANDS AND NATURAL RESOURCES ASSOCIATION (EWNRA)

The following information was obtained:

- ▶ Goal: develop awareness, skill and capacity for sustainable use of wetlands, forests, agro ecosystems and associated natural resources.
- ▶ Activities: documentation and information (under various studies), integrated wetland-watershed management (projects implementation: agricultural land husbandry, capacity building, community improvement, livelihood diversification, and income improvement, experience exchange visits, mainstream crosscutting issues), awareness and environmental advocacy, clean water and sanitation, participatory forest management, activities in favour of women...
- ▶ Record of major impacts on project sites
- ▶ Links with EPA for drafting wetland proclamation
- ▶ Location: head office at Addis Ababa and 8 field offices (3 within the BAS: Mizan Teferi, Masha, Metu)
- ▶ EWNRA brochure

- ▶ Expected soft documentation about past and current activities
- ▶ Many small wetlands located in the forest area (non-identified by the remote sensing analysis) are significant for upper catchment management (no census available...)

2.16 CONSULTATION WITH ETHIOPIAN ENVIRONMENTAL PROTECTION AUTHORITY (EPA)

The following information was obtained:

- ▶ EPA is in charge of the Ethiopian forest inventory (remote and field sensing): founded by FAO
- ▶ EPA involved in studies of buffer zone around main reservoirs (GIBE-GERD)
- ▶ Activities are planned into the GTP, such as forest rehabilitation
- ▶ Keep in touch for further documentation when available (forest census)

2.17 CONSULTATION WITH AFRICAN PARKS (APN)

The following information was obtained:

- ▶ APN is identified to implement the Gambella National Park Management Plan.
- ▶ APN has done surveys of Gambella – Omo wildlife.
- ▶ HoARECN establish a land use plan of Gambella area with livelihood improvement projects
- ▶ “There is currently an attempt to prepare and legalize a land use and development plan for Gambella. This effort is led by the Horn of Africa Regional Environment Center of the Addis Abeba University. It is funded by European Union (EU) through IGAD and relevant ministries is both the Federal and Regional government are members of the steering committee that finally approves the Land use and development plan.
- ▶ APN is a major player in the land use plan study, as it is responsible on the identification of a net of areas for wildlife conservation. The Ethiopian Wildlife Conservation Authority (EWCA) and ASU (?) are all stoners in this.”
- ▶ Meeting to organize with Martin Rickelton at Addis or Pablo Schapira in Gambella: ample information supported with maps (actual and proposed areas for wildlife protection) should be obtained
- ▶ Gambella National Park land use and management plan to be collected when approved
- ▶ Ethio-Russian Project: seasonal biological studies include lot of information on aquatic resources