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NBI Technical Reports: Wetlands and Biodiversity series

Sudd Wetland Economic Valuation of Biodiversity and Ecosystem Services
for Green Infrastructure Planning and Development

WRM/WBS-2020-03

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

On behalf of:



Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

of the Federal Republic of Germany

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ACRONYMS

CBA- Cost-Benefit Analysis
CBD- Convention on Biological Diversity
CBOs- Community Based Organizations
CCI-LC- Climate Change Initiative land cover (CCI-LC)
DDR- Disarmament, Demobilization and Reintegration
EIAs-Environmental Impact Assessments
FGD- Focus Group Discussions
ESA- European Space Agency
FAO- Food and Agriculture Organization
GEF- Global Environmental Fund
GIS- Geographic Information System
KII- key informant interview
LULCS- Land Cover Classification System
LULC- land use land cover
ICSS- Interim National Constitution of Southern Sudan
IPBES- Intergovernmental Platform on Biodiversity and Ecosystem Services
IPPC- the International Plant Protection Convention
IWRM- Integrated Water Resources Management
MA- Millennium Ecosystem Assessment
MODIS- Moderate Resolution Imaging Spectro radio Meter
MoFA- Ministry of Foreign Affairs
NAPAs- National Adaptation Programs of Action
NBI- Nile basin initiative
NBSAP- National Biodiversity Strategy and Action Plan
NDS- Nation Development Strategy
NGO- Non-governmental Organization
NPV- Net Present Value
RS- Remote Sensing
SSDP- South Sudan Development Plan
SSWS- South Sudan Wildlife Service
TEEB- The economics of ecosystem and biodiversity
UNCCD- United Nations Convention to Combat Desertification
UNEP- United Nations Environmental Programme
UNFCCC- United Nations Framework Convention on Climate
UN- United Nations
USAID- Untied States of America International Development
USD- United States Dollar
USGS-United States Geological Survey
WB- The World Bank
WFP- World Food Programme

EXECUTIVE SUMMARY

One of the recent developments and initiation in Nile basin is that A “TEEB-inspired study”, focusing on wetland ecosystems. The Nile Basin Wetlands TEEB, coordinated by the Nile Basin Initiative (NBI), focusing on raising awareness about the importance of wetland ecosystem services to regional, national, sectoral and local-level development processes. Under this process, fairly sizable, with more than 200 published documents on ecosystem valuation were identified covering all the riparian countries. Although incorporating a wide range of wetland types, the geographical distribution of the studies is patchy and South Sudan is among the countries with limited attempt of such studies. It is based on this backdrop that this in-depth site-specific valuation study to conduct TEEB analysis on the Sudd wetland is undergoing. The key objective of this assignment by Nile Basin Initiative (NBI) was to conduct economic valuation of biodiversity and ecosystem services of Sudd wetland to inform green infrastructure planning and development in the face of in situ and ex-situ development interventions. Specifically, to this end market price and value transfer approach has been employed to solicit the total economic value of the wetland.

Different stakeholders have been identified with direct and indirect contribution and concern on the Sudd wetland which and be further classified as global (external), national, state and local level stakeholders. The global stakeholders refer to the external agents that are directly or indirectly contributing and thereby making impact on the wetland. The national, state and local level stakeholders are all internal stakeholders but differ in the level and scope of involvement in matters of the wetland. The national level stakeholders are engaged in broader contexts and mainly focus on formulating policies and regulations for wetlands and other resources of the nation; allocate budget; negotiate and approve global and regional treaties; monitor the implementation of policies and regulations; prioritize budgeting for different activities; attract funding from donors; and design and approve projects related to wetlands among others.

The Ministry of Environment and Forestry is in charge with the protection and conservation of the environment and the sustainable utilization of environmental resources which includes wetlands among others. The Directorate of Wetland and Biodiversity under the Ministry is also tasked with drawing policy and strategies which helps to apply not only domestically but also conventions signed by the government to conserve the wetlands of the country. With regard to conventions, while the Ministry of Foreign Affairs and International Relations is the political body for different agreements, the Ministry of Environment and Forestry is the technical body which drafts the different

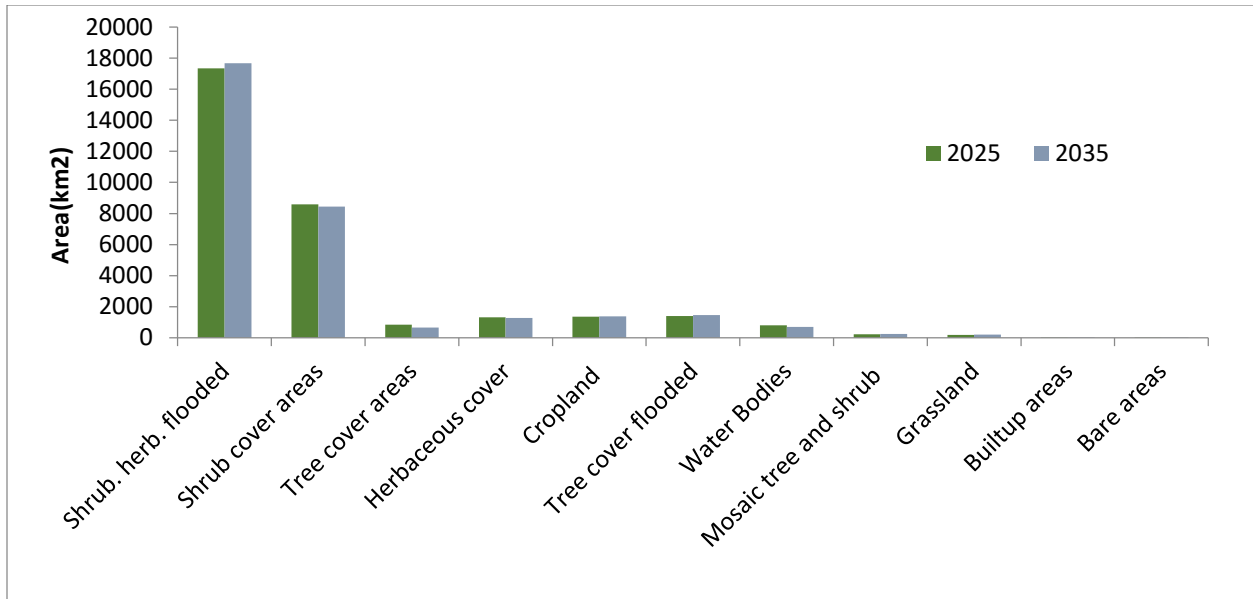
agreements. The different Universities and institutions, while building the capacity of the bureaucracy through different formal and informal trainings, are also sources of knowledge base and research on the potential, degradation, challenges, and alternative interventions of the wetland.

The external stakeholders play vital role in the providing different funding for the protection and conservation of different natural and environmental resources, capacity building initiatives, and conducting different studies among others. For example, UNEP is the major donor in regard to environmental and climate change programming where integrated water resources and wetland management is one of the activities by the same. South Sudan joined the GEF in April 2013 and was to engage in working on GEF enabling activities (to fully qualify for funding from GEF), including a NAPA, National Biodiversity Strategy and Action Plan (NBSAP) and country self-assessment.

The size and land cover of the Sudd wetland for the year 2015 is shown in table below. The total area of the wetland stood at about 32,000 squared KM. Out of this, about half of the wetland is covered by shrubland – herbaceous cover flooded followed by shrub cover areas and herbaceous covers. Bare areas, built-up areas and grasslands constitute the smallest portion of the wetland, respectively.

Land cover	Year-2015
Cropland	1311.12
Herbaceous cover	1382.94
Tree cover areas	1117.08
Mosaic tree and shrub	209.79
Shrub cover areas	8770.95
Grassland	169.2
Tree cover flooded	1314.81
Shrubland herbaceous cover flooded	16892.73
Built-up areas	1.71
Bare areas	0.45
Water Bodies	893.52
Total Areas(km2)	32064.3

The LULCC of the wetland for different years (2015 to 2025 and to 2035) was produced that has been used for the wetland’s total economic valuation at different points in time. As can be seen from graph below, the LULCC of the wetland shows that there is an increasing trend for crop land and grasslands while the water body of the wetland and the vegetation cover decline through time.



For this study, the current total value is estimated based on the LULCC data for the year 2015. The total economic value (TEV) of the wetland for 2015 is estimated at about \$3.3 billion. The result shows that the wetland has major contribution for the community as it provides more than \$253 million worth of provisioning services per annum while it also contributes about \$148 thousand worth of water transportation services. The wetland also provides regulating and biodiversity services worth of about \$1.8 billion and \$1.2 billion, respectively in the form of microclimate regulation, flood control, and water regulation.

Comparing the total economic value across time for the different LULCC, reveals that the total economic value of the wetland declines from year 2015 to 2025 and then to 2035. However, this decline didn't occur for all the ecosystem services computed in this study. The provisioning ecosystem services increased from 2015 to 2025 and then to 2035 mainly due to the increase in cropland and grasslands. The remaining ecosystem services; that is, the cultural, regulating and biodiversity services declined through time as a result of the decline in the vegetation cover.

The findings clearly highlight that the current land use pattern is no sustainable and hence a viable option has to be thought of. Two alternative development scenarios are proposed in this study. The status quo versus and the wise management and utilization of the wetland. The wise management and utilization scenario again include sub-components such as: wise utilization of the wetland; sustainable and climate resilient livelihoods; and community water, sanitation and hygiene. Each sub-component has its own proposed intervention for the successful execution of the sub-

components. The second scenario is between the status quo and the green development path. The green development path dictates that South Sudan has to balance between its economic development needs and the wetland and its ecosystem services. It has two sub-components: building institutions, capacity and conservation awareness; and the green infrastructure development.

Among the measures that are needed to curb the status quo situation of the wetland are a) building strong institutions is very crucial in efficiently conserving, managing and utilizing the wetland; b) emphasis should be given to allocating the necessary budget for the execution of the different institutions' mandate; c) the country should prioritize on achieving green development and thereby the construction of green infrastructure; d) given that Sudd is one of the wetlands of international importance, the government should strive to reap the benefits from tourism activities in and around the wetland; and e) the government should work to secure additional sources of financing from local, regional and global actors including in the form of climate financing from afforestation and reforestation measures.

1. INTRODUCTION

1.1. Background and Rationale to the Study

The interest in ecosystem services has greatly increased after the publication of the Millennium Ecosystem Assessment (MA). Following the MA, the concept has been widely accepted among scientific and policy communities, and as a result of this, new approaches have been developed to value the services and thus better integration of the concept in research, conservation and development sectors (Daily and Matson, 2008). Moreover, in response to the lack of economic perspective of biodiversity loss and ecosystem degradation in the MA framework, The Economics of Ecosystems and Biodiversity (TEEB) came into effect emphasizing more on joint efforts of ecologists and economists in ecosystem services valuation (TEEB, 2010). To strengthen further the role of biodiversity and ecosystem services in human wellbeing and to promote sustainable development, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) came into effect with comprehensive interlinkages among diverse scientific disciplines, stakeholder interests and knowledge systems (Diaz *et al.*, 2015).

Despite such endeavors and success at global scale, much is still left with the challenge of bringing useful models and information to bear at different ecological scales (i.e. global, biome, landscape, ecosystem, plot and plan level) and institutional scales (i.e. individual, family, community, local, regional, national and international scales) (Hein *et al.*, 2006). Particularly to support assessments at local scales where most decisions are made, by considering the social, economic and bio-physical contexts of values associated with alternative ecosystem services (Tallis and Polasky, 2009). Any valuation cannot be policy relevant without integrating locally relevant data and knowledge alongside the application of appropriate scientific and socio-ecological approaches (Pandeya *et al.*, 2016).

About 18 of the 24 ecosystem services assessed in the MA study were found to be deteriorating. Similarly, ecosystem degradation currently taking place in Africa (AEO, 2013) is comparable to that which took place during the industrial revolution of the 19th century in Europe (Gafta and Akeroyd, 2006). Wetlands degradation is also one of the major causes for ecosystems deprivation. The poor, who are relatively highly dependent on wetlands ecosystem services, were found to be disproportionately affected compared to the non-poor. Because wetlands provide multiple benefits of ecosystems that many of the locals in developing countries rely on for their livelihoods. Although

interventions to restore wetlands ecosystem were not designed as poverty reduction mechanism but primarily as means of improving natural resource management, proponents argue that interventions to improve degradation of wetlands can improve the welfare of the poor through the provision of in-cash or in-kind flow (by participating in conservation efforts and practices), and as a means of household income diversification. There are also contrary arguments that the impact negatively on the poor because implementations are based on the assumptions of a well-defined property rights regime; secure land tenure, stable institutional and governance structure, and sufficient capacity of local communities to negotiate effectively, but these factors that are not well defined in developing countries. Thus, the need to recognize and value wetland ecosystem services is important for better decision makings to enhance wetlands ecosystem services.

The key to all human uses of ecosystems, and indeed human life are the supporting functions described as “those that are necessary for the production of all other ecosystem services, such as primary production, production of oxygen, and soil formation” (MEA, 2005). These functions are the basic biophysical life-support systems of the planet that make all other functions, indeed life itself, possible. Supporting functions make possible economic functions captured in the category “provisioning” services. These include the products directly obtained from ecosystems including market and quasi-market goods and services such as food and fiber, fuel, medicines, and fresh water. Bringing the idea of preserving supporting functions fully into economic theory and policy frameworks is not an easy task. Sustaining the supporting functions of the world’s biophysical systems implies in many cases maintaining them intact, including their evolutionary potential to adjust to large and sudden changes (Cowdy and Lang, undated).

Currently, the importance of wetlands is reflected by the growing number of valuation studies (Dessu *et al.*, 2014; Skourtos *et al.*, 2003; Schuyt, 2005; Agimass and Mekonnen, 2011; Mulatu *et al.*, 2014; Mulatu *et al.*, 2018). Numerous economic valuation studies of wetlands around the world have been carried out; however, most of these studies have focused on wetlands in developed countries and are very limited in developing countries. On those studies carried out for developing countries, African wetlands are clearly underrepresented. At the same time, African wetlands are facing serious threats, but the importance of their protection for the survival of local people is increasingly recognized (Schuyt, 2005). Therefore, conducting economic valuation of biodiversity and ecosystem services to inform green infrastructure planning and development in the face of in-situ and ex-situ development interventions is vital for better understanding of sustainable wetlands management in Nile Basin.

One of the recent developments and initiation in Nile basin is that A “TEEB-inspired study”, focusing on wetland ecosystems. The Nile Basin Wetlands TEEB, coordinated by the Nile Basin Initiative (NBI), focusing on raising awareness about the importance of wetland ecosystem services to regional, national, sectoral and local-level development processes. Under this process, a fairly sizable, with more than 200 published documents on ecosystem valuation was identified covering all the riparian countries. Although incorporating a wide range of wetland types, the geographical distribution of the studies is patchy and South Sudan is among the countries with limited attempt of such studies. It is based on this backdrop that this in-depth site-specific valuation study to conduct TEEB analysis on the Sudd wetland is undergoing. The key research questions guiding this study are:

- ✚ What are the current challenges and drivers of the challenge of the wetlands in South Sudan?
- ✚ Who are the beneficiaries and losers from the wetlands?
- ✚ What are the current investments and development interventions around the wetland areas?
- ✚ What are the other optional investments in wetland areas?
- ✚ How best can influence policy making and planning for better development decision makings?

1.2. Objectives of the Study

The key objective of this study (as specified in the call by Nile Basin Initiative (NBI)) is to conduct economic valuation of biodiversity and ecosystem services of Sudd wetland as an example, to inform green infrastructure planning and development in the face of in situ and ex situ development interventions in South Sudan wetlands.

The specific objectives are:

- To investigate economic, social and cultural beneficiaries of the Sudd wetland
- To determine the current value of the Sudd wetland ecosystem services
- To determine the economic impacts of the Sudd wetland degradation and loss
- To determine the value-added or costs avoided in investing on the Sudd wetland conservation and wise-use of available resources for integrated development decision making

1.3. Scope of the Study

The scope for this study is defined geographically, conceptually and methodologically. Geographically, it has been challenging to exactly delineate the boundary of Sudd Wetland partly due to the seasonality nature of the wetland. Plus, there is no an officially demarcated boundary for the Sudd wetland. During the Juba stakeholder consultation meeting, a question on the boundary of the wetland with regard to inflow and outflow was raised that regarding inflow at Mangala and outflow at Malakal which are the major ones and the others with minimal impact in volume of water inflow and outflows. Even if this issue gives some clue on the boundary of the wetland, it doesn't give a full extent of the wetland area. We developed the map of Sudd wetland with coordinates of the boundaries using the GIS data collected from the NBI-Sec. and by consulting other literature that could provide useful inputs for this exercise.

Conceptually, we initially proposed to use the total economic valuation framework. But, during Kampala technical TEEB evaluation meeting, it was clearly highlighted that the framework is just a framework to guide environmental valuation studies. Indeed, it is not possible to value everything as stated in the framework and we have been advised to select the major ecosystem services provided by the Sudd wetland. Accordingly, for the Sudd wetland, based on the Kampala technical TEEB evaluation meeting, provisioning, regulating, biodiversity conservation and cultural ecosystem services (particularly transport services) have been identified for ecosystem valuation of the Sudd. These ecosystem services are further elaborated in the methodology part of this report. Another conceptual issue raised in the meeting was whether to evaluate the stock or the flow of the resources. A good example for this is that the Sudd wetland is a Ramsar Registered site of international importance which could be considered as having a good potential for tourism. However, since there is no or little tourism activities in and around the wetland, it has been highlighted that we just don't need to value what is not existing. Hence, the focus is on valuing the flow of the resources.



Figure 1. 1: Nile Basin Wetlands TEEB: Valuation Studies Technical Meeting – focus on the context for the economic valuation of wetland ecosystem services- Kampala, Uganda

Methodologically, the initially developed inception report has been ambitious and optimistic on the availability of data and the possibility of primary data collection; being cautious though on the conditions in the ground. We developed the survey and data collection instruments that will help us to conduct such exercises. However, from both in Kampala, TEEB technical review meeting and in Juba, stakeholder consultation meeting, it is clear that the issue of primary data collection may be difficult and the available secondary sources are very limited. Hence, we applied a mix of market price and benefit transfer approach for the provisioning services and the benefit transfer approach for cultural, regulating and biodiversity ecosystem services of the wetland.



Figure 1. 2: South Sudan National Wetlands consultation workshop—briefing on expected TEEB exercise to the participants related to the two wetlands in Nile Basin – Juba, South Sudan



Figure 1. 3: South Sudan National Wetlands consultation workshop – The participants split into different groups for discussion – Juba, South Sudan

1.4. Significance and target audience of the Study

The Sudd wetland is one of the wetlands within the nine-basin located in South Sudan and like many other wetlands in the region, the Sudd wetland is threatened by both external and internal forces. Among the challenges of the wetland is the Jongeli Canal, contamination of river or sub-surface water, pollution from oil spillage, hydropower dams among others. Hence identifying potential interventions to conserve the wetland are vital. For this purpose, this study proposed of different alternative development scenarios in reference to the business as usual land use pattern. An attempt was also made to highlight the implication of these interventions and required investment. The findings of this study can be used for policy decision making at national and sub-national level and finance allocation for implementation. The target audience of this study are local communities, Non-governmental organisations, and research institutes. The findings of this study can be used for decision making by stakeholders such as Ministry of Finance, Ministry of Environment and Forestry, Ministry of Water, Ministry of Petroleum, Ministry of Dams and Energy, Ministry of Wildlife and Tourism, and state governments (counties).

2. OVERVIEW OF WETLAND AND RELATED POLICIES AND STRATEGIES IN SOUTH SUDAN

At the country's formation in 2011, formal governing institutions were created, but given the years of conflict and the breakdown of former structures, they commenced from a generally low foundation. The new government's capacity to formulate policy and implement programs is still limited, but is developing and evolving. It should be further strengthened. South Sudan is signatory to the Montreal Protocol to the Vienna Convention on Substances that Deplete the Ozone Layer, the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol to the UNFCCC, the International Plant Protection Convention (IPPC), the Convention on Biological Diversity (CBD), and the UN Convention to Combat Desertification. The institutional frameworks to accomplish environmental and climate-change commitments, however, are still at the nascent stage due to the low priority given to them in the context of the ongoing situation of conflict, as well as the lack of technical capacity and financial resources.

Being a young Government, the Government of Republic of South Sudan (GRSS) is still in the process of enacting various legislations, and among the pieces of legislation that are yet to be developed is a comprehensive Environmental Act. For this reason, only pieces of legislation that are relevant to the environment have been enacted and reviewed in this report. The table below summarizes the bulk on information discusses under this chapter.

Table 2. 1: Summary of the different Environmental and Wetland Policies, Laws, Regulations and Plans

Policy, law, regulation, and plan	Relevant provision (theme)
Post 2015 SDGs	The 15 th Goal states “protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forest, combat desertification and halt and reverse land degradation and halt biodiversity loss. This goal is directly linked to wetland conservation and intervention related to improving land health.
Intended Nationally Determined Contributions	South Sudan prioritizes three sectors for low carbon development and puts forward several options per sector: Energy generation and use, reforestation and deforestation, and transport sectors.
The Interim National Constitution (ICSS), 2005	Part three, article 44 of the Interim Constitution of Southern Sudan (The Environment) has guaranteed every person or community the right to have a clean and healthy environment.
The Transitional Constitution (TCRSS), 2011	Under Article 14 – every person or community shall have the right to clean healthy environment, the obligation to protect the environment, the right to have the environment protected through appropriate legislative action and other measures.

The National Development Strategy (2018-2021)	conducting a baseline survey on the status and sources of environmental pollution as well as developing legislation, regulation, standards and guidelines on environmental pollution management among others.
South Sudan Development Plan (SSDP), 2011-2016	Sustainable development through enforcing environmental and social impact assessments; accede to and ratify applicable and beneficial multilateral environmental treaties, conventions and agreements; and promote inclusive participation, access to information and good governance.
NAPA to Climate Change 2016	Promotion of reforestation and agroforestry; sustainable management and conservation of wetlands; promotion of climate-smart agriculture; improved drought and flood early warning systems; and strengthening institutional capacity
The environmental Protection Bill 2013	Aims to protect the Environment and to promote ecologically sustainable development that improves the quality of life.
The Wildlife Conservation and Protected Areas Bill 2015	Covers all matters concerned with Wildlife Conservation, the establishment and management of protected areas and the sustainable management and conservation of South Sudan's natural heritage and wildlife for the benefit of its citizens.
The Draft Wildlife Bill 2013	Coordination with other relevant authorities of all issues affecting wildlife management including issues of security, infrastructure, private investment and land use planning.
The Forests Bill 2009	Is meant to operationalize the Forestry Policy covering all matters concerned with all forests and woodlands and all forest reserves in the country.
The Water Bill 2013	Aims to conserve available water resources, to manage water quality and to prevent pollution of ground and surface waters; manage floods and droughts and mitigate water-related disasters, and; establish appropriate management structures including mechanisms for inter-sectoral coordination and stakeholder participation.
Draft National Environment Policy 2013	Aims to maintaining the balance between the environment and development needs through sustainable use of the natural resource base; creating public awareness of the importance of protecting the environment; and providing the basis for formulation of biodiversity and ecosystem protection and management policies, laws and guidelines.
The South Sudan Wildlife Conservation and Protected Area Policy 2012	Envisions an effective and professional Wildlife Service that will guide the sustainable management and utilization of natural resources, including land, water, fauna and flora for the benefit and enjoyment of the people.
The Environmental Policy and the Environmental Protection Bill 2010	Emphasizes the importance of carrying out Environmental Impact Assessments (EIAs) in relation to any activity that may affect the environment.
The Water Policy	States that the right to water shall be given the highest priority in the development of water resources; rural communities shall participate in the development and management of water schemes; and the involvement of NGOs and the private sector in water projects shall be encouraged.

The Forestry Policy 2014	Proposes the ratification of the UNFCCC so that the country can benefit from the Clean Development Mechanism (CDM); emphasizes the need for measures “so that South Sudan can access financing under Reduced Emission from Deforestation and Forest Degradation (REDD).”
Minerals Law and Policy	The Mining Act 2012 - provides a framework for the management of the mining sector consistent with international standards; and provides for Community Development Agreements for Mining Licenses and environment and social provisions. The Petroleum Act 2012 - emphasizes maximum petroleum recovery within a framework that seeks to ensure the safety, security and protection of the environment, and requires transparency, accountability and ethical behavior on the part of both licensees and the government; requires conducting SEIA.
Fisheries Policy	Decentralization and co-management; embeds the FAO Code of Conduct for Responsible Fisheries; integration into sector wide and national planning; facilitates monitoring and progress

2.1. Post 2015 Sustainable Development Goals (SDGs)

The SDGs framework addresses key systemic barriers to sustainable development such as inequality, sustainable consumption patterns, weak institutional capacity, and environmental degradation that the MDGs neglected (ISSC, 2015). It has seventeen (17) Goals (SDGs) and one hundred sixty-nine (169) targets(UNDG 2015). The 15th Goal states “protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forest, combat desertification and halt and reserve land degradation and halt biodiversity loss” is essential for fulfilling the environmental, socio-cultural and economic needs of present and future generations and, therefore, plays a vital role in the international agenda for achieving a better life for all human societies. This goal is directly linked to wetland conservation and intervention related to improving land health. Furthermore, Goal 13 of the SDGs highlights the importance of taking urgent action to combat climate change and its impacts which could have direct implication for wetlands such as Sudd.

2.2. Intended Nationally Determined Contributions (INDC)

South Sudan submitted its Intended Nationally Determined Contributions (INDC) in September 2015, but has not submitted its First NDC to the UNFCCC. Taking into consideration the 50 years of conflict that destroyed the little infrastructure and governance structure that existed prior to the conflict, in its INDC South Sudan presents itself as being highly vulnerable to the negative effects of climate change, mainly due to the dependence of its population on climate-sensitive natural resources for their livelihoods, limited institutional and technical capacity, appropriate technologies and financial

resources to support the implementation of for climate adaptation interventions. The INDC notes that in South Sudan climate change is already occurring – particularly unpredictable rain patterns, recurrent droughts, flash flooding and excessive heat that result in food insecurity and famine. Implementation costs of adaptation and mitigation actions up to 2030, is estimated at over USD 50 billion and is conditional upon international support.

In its INDC the country commits to undertake a national GHG-inventory to allow assessment for mitigation potential and to quantify emission reductions. South Sudan prioritizes three sectors for low carbon development and puts forward several options per sector: Energy generation and use, reforestation and deforestation, and transport sectors. For adaptation, a sectoral approach was adopted for the INDC with priority actions based on observed adverse effects of climate change on the sectors: agriculture and livestock; health; adapting vulnerable communities to climate change; forests, biodiversity and ecosystem; infrastructure; and institutional and policy options. The country's objective in this regard includes prioritizing the enhancement of climate resilience in the agricultural sector through the promotion of climate-smart agriculture, livestock improvement, enhancement of fisheries productivity and soil erosion control. In the Capacity building and transfer of technology component of the INDC, the areas identified which would benefit mitigation and adaptation include renewable energy technologies, climate information systems, water technologies (e.g. waters savings, recycling, harvesting and irrigation), methods and tools to assess climate impacts, vulnerability and adaptation, and transportation technologies that are climate resilient.

2.3. The Interim National Constitution of Southern Sudan, 2005 (ICSS)

The ICSS was the supreme law of Southern Sudan which stipulates the legal aspects for the protection and management of the environment and natural resources. The environmental record of South Sudan dates back to its ICSS where there were clear provisions on environmental issues of relevance for the country at large and its people in particular. Part three, article 44 of the Interim Constitution of Southern Sudan (The Environment) has guaranteed every person or community the right to have a clean and healthy environment. The Constitution further commits all levels of government in Southern Sudan to sustainable development in order to ensure that the environment is protected for the benefit of present and future generations, through reasonable legislative action and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting rational economic and social development so as to protect genetic stability and bio-diversity of Southern

Sudan. And also, all levels of government in Southern Sudan shall promote energy policies that will ensure that the basic needs of the people are met while protecting and preserving the environment.

The Interim Constitution also specifies land issues that are under National powers (Federal level) and those under the control of states as well as joint powers (concurrent powers) shared by the Federal and States institutions. The states manage issues related to State lands that are not under National control. These include: management, lease and utilization of lands belonging to States, town and rural planning and agricultural lands within the state boundaries. The concurrent powers include matters related to urban development, planning and housing, electricity generation, waste management, consumer safety and protection, water resources other than inter – state waters and regulation of land tenure and the rights on land. Articles of the Constitution have also provisions on the right to expropriate land and compensation to the owners, protection of cultural heritage and religious sites, as well as issues related to the safety and protection of the inhabitants, beside penalties incurred for environmental damage and pollution as well as respect of the International Environmental Agreements, ratified by the Government of the Republic of South Sudan.

2.4. [The Transitional Constitution of the Republic of South Sudan, 2011 \(TCRSS\)](#)

In 2011, the Government of South Sudan adopted an amendment to the 2005 Interim Constitution renaming it the “Transitional Constitution of the Republic of South Sudan”. Under Article 14 “The Environment” the Transitional Constitution states in part (1) that every person or community shall have the right to a clean and healthy environment. While in part (2) states that every person shall have the obligation to protect the environment for the benefit of present and future generations. And, in part (3) every person shall have the right to have the environment protected for the benefit of present and future generations, through appropriate legislative action and other measures that: (a) prevent pollution and ecological degradation; (b) promote conservation; and (c) secure ecologically sustainable development and use of natural resources while promoting rational economic and social development so as to protect genetic stability and bio-diversity. Also, in Part (4) that all levels of government shall develop energy policies that will ensure that the basic needs of the people are met while protecting and preserving the environment.

2.5. [The National Development Strategy of South Sudan \(2018-2021\)](#)

In the Nation Development Strategy (NDS) several issues are considered to be critical to deliver the NDS objectives for the people of South Sudan. Four cross-cutting issues specifically are identified as

important: environment, women and youth, capacity-building and Local Service Support (LSS). The broad nature of these issues means that they cannot be categorized into any of the other clusters. The NDS aims to mainstream these important cross-cutting issues across all clusters through integrating initiatives into sectoral action programs during implementation. Facilitating access and participation by women and youth in governance, peacebuilding and economic opportunities must be clearly reflected in implementation of cluster strategic priority actions. Environmental concerns must be seriously considered for the sustainability of potential gains in economic development and service delivery. The ultimate aim of the NDS is to improve the standard of living of the people of South Sudan.

Among the issues identified to be priority strategic actions in this regard are conducting a baseline survey on the status and sources of environmental pollution as well as developing legislation, regulation, standards and guidelines on environmental pollution management among others. Under the natural resources sector the following activities are highlighted to be performed: a) to review and update policies and strategies for development of the agricultural sector, b) to develop priority infrastructure for wildlife conservation tourism c) to improve the productive capacity of livestock and fisheries resources, and d) to conduct baseline

2.6. The South Sudan Development Plan (SSDP) (2011 – 2013 and later extended to 2016)

The main guiding document for the development of the country was the South Sudan Development Plan (SSDP) which addresses conflict management, poverty reduction and economic development. One of the goals of the document was to strive for less dependence on oil. The Government's role was not to undertake economic activities itself, but to create an enabling environment for economic development by assuring peace, security, rule of law, macroeconomic stability, basic infrastructure and effective tax administration (GOSS, 2011).

The SSDP was structured through four 'Pillars', namely: (1) governance, (2) economic development, (3) social and human development, and (4) conflict prevention and security. Within these pillars, cross cutting issues are defined as (1) anti-corruption, (2) capacity development, (3) environment, (4) gender, (5) HIV and AIDS, (6) youth, and (7) human rights. Under the Governance Pillar, the Government's role is to:

- a) ensure that development is sustainable through enforcing environmental and social impact assessments for all development programmes and projects, b) accede to and ratify applicable and beneficial multilateral environmental treaties, conventions and agreements, and c) promote inclusive participation, access to information and good governance in sustainable natural resources management and environmental protection.

The Economic Development Pillar covers the following priority programme areas: (a) agriculture and forestry, (b) roads and road transport development, (c) development of energy, mineral and mining sectors (including oil), (d) animal resources and fisheries, and (e) Water resources management, development, utilization and provision of sanitation services. Environmental sustainability of economic development and related activities including oil extraction, logging and charcoal production is to be ensured. The use of environmental impact assessments (EIAs) is required for infrastructure and power supply development.

The Social and Human Development Pillar envisages environmental awareness-raising of children, and improved health and sanitation facilities focusing particularly on the youth. A national early warning system will be developed to reduce risks of disasters. The Conflict Prevention and Security Pillar will ensure environmental awareness-raising of disarmament, demobilization and reintegration (DDR) participants as well as the requirement of EIAs for all major construction projects.

2.7. The Republic of South Sudan National Adaptation Programs of Action (NAPA) to Climate Change 2016

National Adaptation Programmes of Action (NAPAs) serve as simplified, rapid and direct channels for Least Developed Countries to identify and communicate priority activities to address their urgent and immediate adaptation needs. NAPAs emerged from the multilateral discussions on adaptation measures within the UN Framework Convention on Climate Change (UNFCCC). South Sudan's NAPA therefore specifies five priority activities (referred to as Priority Adaptation Projects) for effective climate change adaptation across the five-identified priority thematic areas, namely: i) Environment: Promotion of reforestation and agroforestry to reduce vulnerability to droughts and floods; ii) Water Resources: Sustainable management and conservation of wetlands in South Sudan; iii) Agriculture: Promotion of climate-smart agricultural techniques to improve livelihoods and food security under changing climatic patterns; iv) Disaster Risk Reduction: Establish improved drought and flood Early

Warning Systems in South Sudan through an improved hydro-meteorological monitoring network; and v) Policy and Institutional Framework: Strengthening the institutional capacity of the Government of South Sudan to integrate climate change into national policies and planning processes. These five Priority Adaptation Projects therefore represent the most urgent and immediate adaptation needs in the country.

However, it is also noted that the other Adaptation Project Options identified through the NAPA process remain important and that ideas/activities/elements can be blended across projects and thematic areas when designing final project concepts for implementation in the country. The NAPA process also identified other guiding principles for adaptation projects in South Sudan, including that:

- Adaptation projects should promote conflict resolution and peace-building.
- Gender equality should be considered in the design of adaptation projects.
- Adaptation projects should target those groups most vulnerable to climate change impacts.
- Adaptation projects should contribute to the further development of legislative and regulatory frameworks in South Sudan.
- Adaptation projects should promote livelihood diversification.
- Capacity building – of human, institutional, technical and financial resources – should be included in the design of adaptation projects.
- Adaptation projects should promote long-term research on climate change adaptation, including the collection of baseline information.
- Indigenous knowledge should be included in the design of adaptation projects.
- Land tenure must be considered when deciding the location for adaptation projects.

2.8. The National Biodiversity Legislation

Many of the key national legislations for biodiversity management in South Sudan are still in the form of Bills before the National Legislative Assembly. The Bills include: The National Environmental Protection Bill 2013; The Draft Wildlife Bill 2013 and the Wildlife Conservation and Protected Areas Bill 2015; The Water Bill 2013; and the Forests Bill 2009. The Draft Policies include: The Draft National Environment Policy 2013; and the South Sudan Wildlife Conservation and Protected Area Policy (Draft of June 2012). The inclusion of these draft bills is due to the fact that there is no adequate information on the current status of the drafts; i.e., whether they are still at draft stage or they have been ratified. In addition, the inclusion of such drafts shows at least the intention and desire in terms

of managing the resources stipulated in each draft which mainly address the ecosystem services considered in this study.

2.8.1. The Environmental Protection Bill 2013

This bill is a key pending legislation that aims to protect the Environment in South Sudan and to promote ecologically sustainable development that improves the quality of life. It grants the right to a decent environment to every person and the concomitant right to bring an action to enforce that right if it is threatened as a result of an activity or an omission. The Bill if enacted into law will empower the Ministry of Environment and Forestry to supervise and co-ordinate all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment including biodiversity. This will include stock taking of the natural resources in the country and their utilization and conservation; examining land use patterns to determine their impact on the quality and quantity of natural resources, and; carrying out surveys which will assist in the proper management and conservation of the environment. That means establishing an Environmental Information Centre that will undertake an inventory of South Sudan's biological diversity and ecosystems as a priority for the Ministry.

2.8.2. The Wildlife Conservation and Protected Areas Bill 2015

The Bill covers all matters concerned with Wildlife Conservation, the establishment and management of protected areas and the sustainable management and conservation of South Sudan's natural heritage and wildlife for the benefit of its citizens.

2.8.3. The Draft Wildlife Bill 2013

The Bill establishes an autonomous South Sudan Wildlife Service (SSWS) as proposed by the Constitution with a board of trustees and headed by a Director-General both appointed by the President. One of its key functions will be coordination with other relevant authorities of all issues affecting wildlife management including issues of security, infrastructure, private investment and land use planning. This will be done by ensuring the enforcement and implementation of the law with respect to the use of wildlife, the management of protected areas and other uses of natural resources.

2.8.4. The Forests Bill 2009

The Forest Bill is meant to operationalize the Forestry Policy covering all matters concerned with all forests and woodlands and all forest reserves in the country. The Bill provides for a governance structure for all the forests in the country, national sustainable forest management standards, certification systems and schemes, and private and voluntary standards; procedures and decision-making processes, and; complaint and appeal mechanisms.

2.8.5. The Water Bill 2013

This bill provides protection of water sources from pollution, erosion or any other adverse effects by creating Protected Zones within a catchment draining to, or above any water facility forming part of a water supply or any catchment, lake, reservoir, aquifer, wetland, spring, or any other source of water (section 34). The Bill aims to develop procedures for prioritizing allocation of water resources for different social, economic and environmental uses, efficiency, system reliability and environmental sustainability principles. It also aims to conserve available water resources, to manage water quality and to prevent pollution of ground and surface waters; manage floods and droughts and mitigate water-related disasters, and; establish appropriate management structures including mechanisms for inter-sectoral coordination and stakeholder participation.

2.8.6. Draft National Environment Policy 2013

The aim of the drafted Bill is to ensure the protection, conservation and sustainable use of the natural resources of South Sudan without compromising the tenets of inter-generational equity. This includes maintaining the balance between the environment and development needs through sustainable use of the natural resource base; creating public awareness of the importance of protecting the environment; and providing the basis for formulation of biodiversity and ecosystem protection and management policies, laws and guidelines.

2.8.7. The South Sudan Wildlife Conservation and Protected Area Policy (Draft of June 2012)

It envisions an effective and professional Wildlife Service that will guide the sustainable management and utilization of natural resources, including land, water, fauna and flora for the benefit and

enjoyment of the people of South Sudan. It provides for the formulation of legal frameworks for rationalizing the protected area system and wildlife utilization and benefit sharing.

2.8.8. The Environmental Policy and the Environmental Protection Bill (Draft January 2010)

The South Sudan National Environmental Policy has been drafted to achieve sustainable development in light of the following factors (draft January 2010): 1) The upcoming huge investment and development activities following the attainment of comprehensive peace in the country; 2) Emerging environmental management challenges pertaining to diversion of land use systems, urban sprawl, oil exploration in the Sudd wetlands, loss of biodiversity, waste management and others; 3) Ineffective environmental governance due to inadequate institutional capacity and limited government budgetary allocation for environment; 4) The need to harmonize the environmental legal frameworks with sectoral legislation and guidelines; 5) The need to decentralize and devolve management of the environment to the lowest levels of government within the framework of the federal system of rule; 6) The current state of environmental degradation as manifested in widespread pollution by the oil industry, increasing loss of biodiversity due to over-exploitation of forests, inadequate environmental sanitation associated with urban sprawl, and desert encroachment southwards; 7) Lack of reliable information and data on the environment and limited research capacity.

The policy is based on the following principles: good governance, sustainable development, prevention, subsidiarity, the precautionary principle, scientific knowledge, skills and expertise, and 'The Polluter Pays'. The policy gives guidance to all relevant sectors: agriculture, biodiversity, energy, fisheries, forestry, health, human settlements, industry, livestock, mining, oil, roads, tourism, transportation, water and sanitation. It emphasizes the importance of carrying out Environmental Impact Assessments (EIAs) in relation to any activity that may affect the environment.

2.9. Current Policies and Legislation

As stated above, no adequate information is available, at least for now, whether those bills are still at draft stage. Hence, we assume the following are the policies and legislations that are in use for the different environmental and resource issues. Like the draft bills, these also cover a range of issues that have direct implications for this study. The land policy has direct implication for the ownership

and governance of land and resources while the water, forestry, and fisheries policies stipulate on the use and management of these resources and the resultant ecosystem services.

2.9.1. The Land Policy

The Transitional Constitution of 2011 states that all land in South Sudan is owned by the people of South Sudan, and charges the government with regulating land tenure, land use and exercise of rights to land. The constitution classifies land as public, community or private land, and requires the Government of Republic of South Africa (GRSS) to recognize customary land rights when exercising the government's rights to land and other natural resources. The constitution does not clarify the extent to which customary rights can limit government's rights, but does require that all levels of government incorporate customary rights and practices into their policies and strategies. As a result, the Land Act (2009), the Local Government Act (2009) and the Investment Promotion Act (2009) were developed to establish the institutions and mechanisms of governance that would address pressure points and fill vacuums created by conflict, uneven development and lack of transparency and accountability in resource governance (GRSS, 2011).

The three laws mentioned above established the fundamental framework for the fair and transparent administration of land rights in South Sudan. For example, the Land Act regulates land tenure and equally recognizes rights to customary, public and private tenure. Only South Sudanese citizens can own land, but foreigners can lease land. The document defines rights and restrictions of land users and owners. The Land Commission supervises the application of the Land Act and its institutional set-up at the different administrative levels is elaborated in the Act. The Act prescribes EIA for investment projects, but there are no elaborate provisions for land use planning such as land use categories or planning and allocation procedures. The Local Government Act defines primary responsibilities of local government and traditional government authorities in the regulation and management of land, which includes charging customary institutions with particular responsibilities for administering community land rights.

On the other hand; the Investment Promotion Act establishes procedures for facilitating access to land for private investment, including by foreign investors, in ways that balance the interests of both current right holders and investors. Although a framework has been developed, government officials have a poor understanding of the laws and lack the capacity to interpret and carry them out. There

is also a lack of awareness by the population as a whole, which further impedes progress (GRSS, 2011).

2.9.2. The Water Policy

In December 2007, the GRSS adopted the South Sudan Water Policy, which states that access to sufficient water of an acceptable quality and quantity to meet basic human needs is a human right. The policy provides that: the right to water shall be given the highest priority in the development of water resources; rural communities shall participate in the development and management of water schemes; and the involvement of NGOs and the private sector in water projects shall be encouraged. Apart from customary laws governing access to grazing and fishing grounds for communal use at a local level, currently there is no formal system for allocating water resources for different social and economic purposes in the country.

2.9.3. The Forestry policy 2014

Recognizes the critical role played by forests in providing “critical environmental services, water catchment and in mitigating climate change.” The forestry policy proposes the ratification of the UNFCCC so that the country can benefit from the Clean Development Mechanism (CDM). It also proposes establishing a designated national authority “to facilitate the flow of climate change benefits to South Sudan.” The policy also emphasizes the need for measures “so that South Sudan can access financing under Reduced Emission from Deforestation and Forest Degradation (REDD).” It calls for delineation and gazettement of forests to attain a national forest cover of 20 per cent of land area.

2.9.4. Minerals law and policy

The Interim constitution of South Sudan states that all levels of government will protect and ensure the sustainable management and utilization of minerals, including oil.

The Mining Act of 2012: provides a framework for the management of the mining sector consistent with international standards, including licensing, environmental protection guidelines and the use of technology to ensure as much mineral resources as possible are recovered from the ground. It also provides for Community Development Agreements for Mining Licenses and environment and social provisions.

The Petroleum Act 2012: The Act states that ownership of petroleum is vested in the people and to be managed by the government for their benefit. The Act also emphasizes maximum petroleum recovery within a framework that seeks to ensure the safety, security and protection of the environment, and requires transparency, accountability and ethical behavior on the part of both licensees and the government (SSIS, 2012). The Petroleum Act is relevant because of the increasing adverse environmental impacts associated with petroleum development in the country on the one hand, and the potential to use funds generated from petroleum sales and taxes for biodiversity management: Oil exploration is carried out mainly in the central flood plains of Jonglei, Lakes and Upper Nile States which are also endowed with vast natural resources including forests, livestock, wildlife and aquatic resources. The Petroleum Act provides that a SEIA to be undertaken by that the oil contractor or licensee in compliance with international standards to determine any present environmental and social damage, establish the costs of repair and compensation and determine any other areas of concern. Whereas the petroleum industry in the country has express a desire for environmental compliance, the Ministry of Petroleum and Mining is still developing policies and measures to safeguards the environment and govern the oil and mining sector to include EIA, environmental sensitivity atlas, multi-institutional monitoring, hazardous waste management, conservation of drilling and campsites, and oil spill contingency plans.

2.9.5. Fisheries policy

The 2006-2011 Fisheries Policy also placed inadequate emphasis on co-management as the key to management of capture fisheries and aquaculture, and failed to place the private sector squarely as the main engine for growth in the sector. A new Fisheries Policy is required with a different emphasis. This new policy:- a) is consistent with the aims and ideals of the transitional constitution, including decentralization of powers and co-management as a guiding theme through the whole sector b) embeds the principles contained in the FAO Code of Conduct for Responsible Fisheries in all activities and sub sectors c) places the private sector as the engine for growth in the sector d) provides a coherent and participatory roadmap to the sector objectives, which can be seen and understood by all stakeholders from all sectors e) provides a sound basis for integration into sector wide and national planning f) facilitates the capture of funds to address the priority policy areas g) facilitates monitoring of progress towards achieving the stated objectives h) is realistic and implementable.

2.10. Concluding Remark on the Enabling Environment for Wetlands in South Sudan

South Sudan, the newest nation among the comity of nations, getting its independence in July 2011, is endowed with vast and rich natural resources. Its natural capital includes arable land, grasslands, tropical forests, rivers, wetlands, lakes, biodiversity, minerals, oil, etc. One of the top priorities of the Government of South Sudan is to develop and implement sustainable management plans in the sub-sectors of the environment sector, so that the exploitation of natural resources does not adversely impact the environment. Hence, different attempts have been made, albeit insufficient, towards these goals in collaboration with different international organization. In the above paragraphs an attempt has been made to highlight the different formulation of environmental policies, standards and guidelines, and enforcement of these instruments with some bearing to wetlands in particular and environmental issues in general.

Though a new nation, there has been some strives to formulate different rules and regulations that have direct bearing on the environment. Starting from the ICSS, environmental issues have been clearly stated. Article 44 of the ICSS and Article 14 of the TCRSS give provisions for environmental issues. Both the national development strategy of the country (DSSS) and the South Sudan Development Strategy (SSDP) considers environmental issue in cross cutting category as it has implications on different sectors of the economy. In its INDC, South Sudan has considered reforestation and deforestation activities among the proposals for low carbon development while in its adaptation strategies agriculture and livestock, forests, biodiversity and ecosystem were put forward as areas for priority actions. The five priorities thematic areas (environment, water resources, agriculture, disaster risk reduction, and the policy and institutional framework) identified in the NAPA of South Sudan have direct implications for wetland management. All these measures show that environmental issues have been given some consideration which can be considered as a good enabling condition for wetland management in the country.

Though the legislative initiatives towards national biodiversity are many, this is the area where most of the initiatives remained at draft level. These initiatives have direct implication for the Sudd wetland and hence finalizing these draft bills into legislation could be important in partially protecting wetlands of ecosystem importance such as Sudd wetland. The continued conflict and war in the country has not only hampered the completion of such legislative initiatives but also the protection of natural resources of high importance and Sudd wetland is one of them. This latter condition could further exacerbate the conflict in the means of forced migration and competition for

resources. Sustainable and equitable management of resources, such as forests, oil, wetland, water and minerals, will contribute to peace and economic prosperity and one way to ensure this is to establish mechanisms for protecting and sustainably using natural resources. Hence such legislative initiatives should be given high priority as they set the rules of the game.

All the above discussion set the rules of the game both for the use, ownership and management of the Sudd and other wetlands and the ecosystem services that are derived from it. They all are important for this study because they have direct bearings to one or more of the ecosystem services considered in this study. Namely: provisioning (crops, timber, grazing, fuel wood, fishing, etc.) cultural (transport, education, tourism), and regulating services (carbons sequestration, water purification and attenuation, and soil erosion). Also, one of the efforts of this study, for example, is to propose conservation options for the wetland and such proposal is incomplete without thoroughly understanding the rules of the game and the organizations involved in managing the ecosystem services and the resources that generate such services. More than anything else, the Sudd wetland is given status of wetlands of international importance and since it is geographically located in Southern Sudan, it falls under the jurisdiction of the Government of Southern Sudan (GOSS) in terms of policy and its management.

3. OVERVIEW OF THE SUDD WETLAND IN SOUTH SUDAN

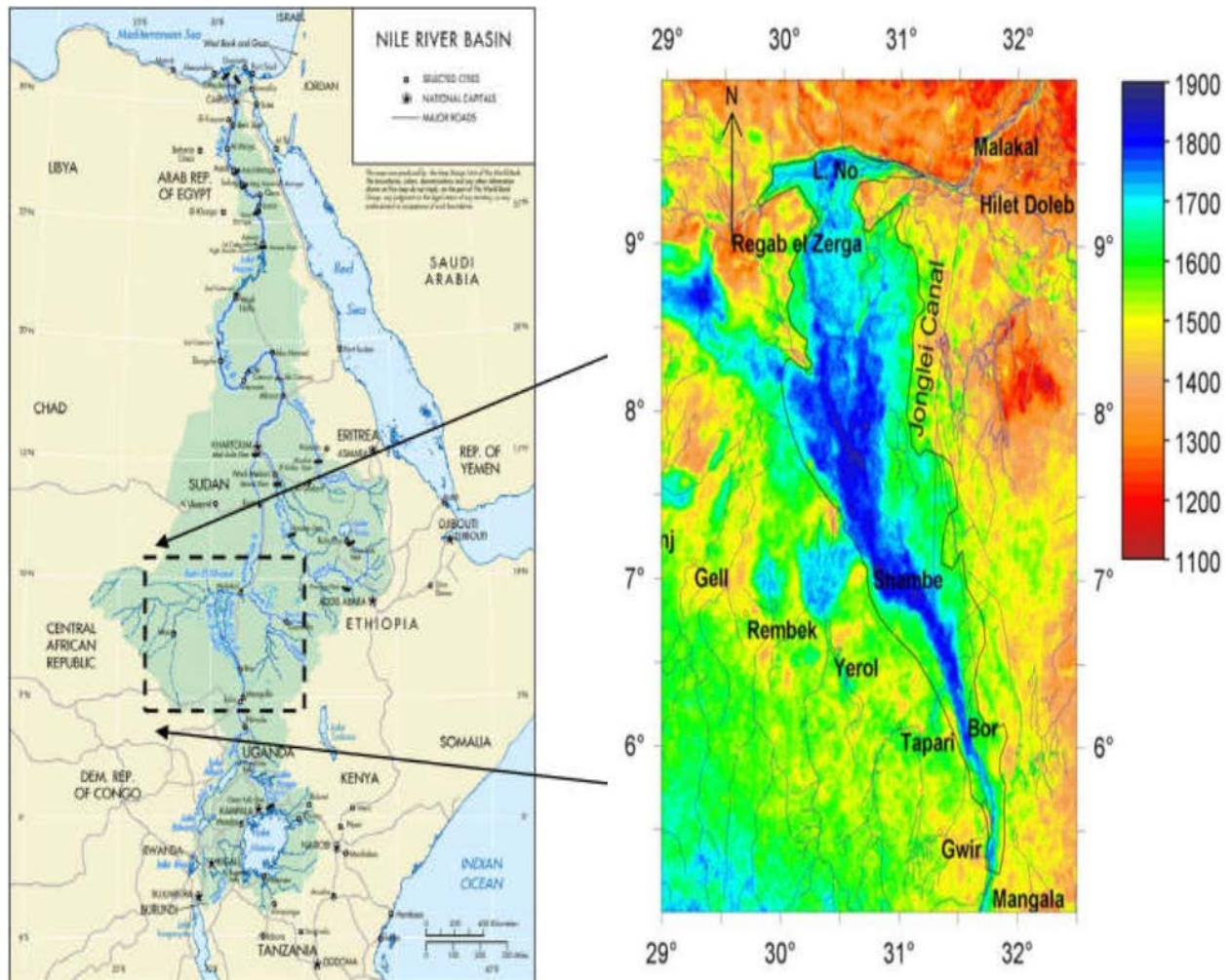
3.1. The Sudd Wetland

South Sudan has an area of approximately 640,000 km². The country is situated in the Nile catchment area, receiving water from the highlands of the Central African Republic, Democratic Republic of Congo, Ethiopia and Uganda, which flows into a low and vast clay basin covering much of South. The lowest part of this basin forms one of the world's largest swamps, the Sudd wetland, and other smaller wetlands. Altitude varies between 600 and 3000 m above sea level; the lowest point is found in the extreme north of Upper Nile State and the highest in the mountains of Eastern Equatoria State. Most of South Sudan has a semi-humid climate, with annual rainfall ranging from 200 mm in the southeast (Eastern Equatoria) to 1200-2200 mm in the forest zone in Western Equatoria and the Equatorial highlands. In the northern states, rainfall varies between 700- and 1300-mm. Mean average temperatures vary between 26° and 32°. Rainfall is seasonal: the rainy season is from April to December and causes seasonal flooding of floodplains. The seasonal climate patterns cause cyclic relations in the ecosystem and hence determine land use patterns of cultivation, livestock grazing and fisheries (MoE and UNDP, 2012).

The Nile wetlands ecosystems include a wealth and variety of swamps, marshes, seasonally inundated grasslands, swamp forests, floodplains and the wetland edges of lakes and rivers. The Sudd Wetland is one of these ecosystems located in South Sudan and recognized under the Ramsar Convention as a Wetland of International Importance (Azab, 2017; MoE, 2015). The Sudd is one of the world's largest wetlands averaging 57, 000 square km but can cover an area of up to 130,000 square km depending on the discharge from the Albert Nile. The permanent swamps, usually close to the main river course are permanently wet. However, substantial parts of the Sudd are seasonal swamps created by flooding of the Nile or when ponds are filled seasonally with rainwater (Mohammed *et al.*, 2005). Principal wetlands in South Sudan are the Sudd and Machar swamps which offer considerable socio-economic livelihood opportunities for agricultural, pastoral and fishing communities. The Sudd flood plains are a rich habitat for flora and fauna such as fish, mammals, birds, reptiles, amphibians and other rare species. Hydrological and ecological functions of these wetlands such as water quality improvement and food provision both contribute to ensuring ecological and sociocultural stability in the region. In addition, the inaccessibility of the Sudd provide protection for several species of wildlife (MoE, 2015). The Sudd is also pivotal in regulating the weather patterns in the Sahel, the Horn of Africa and the greater East Africa region. The Sudd acts as a barrier to the

southward encroachment of the Sahara Desert and its preservation and management is consequently expected to be South Sudan's most significant contribution toward buffering against the impacts of climate change at the regional level (UNEP, 2018). In the Sudd and Bahr el Ghazal wetlands, water stagnates and a high proportion evaporates. 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 (Mohammed *et al.*, 2005). The presence of the Sudd and other wetlands as a climate buffer and as a resource for agriculture, livestock, fisheries and various Non-Timber Forest Products (NTFPs) creates South Sudan a unique potential for sustainable development even in relative terms with its neighbors (MoE and UNDP, 2012).

Figure 3. 1: The Sudd area with its boundaries in South Sudan and Nile River Basin



Source: Mohamed and Savenije (2014)

The most important environmental issues that would affect wetland biodiversity in South Sudan would be the construction of large hydroelectric power dams and other related development schemes like construction of the Jonglei Canal or dykes along the River Nile. Such schemes would divert and effect changes in the water flow regime and irreversibly or partially destroy downstream ecosystems. Contamination of river or subsurface water by discharged pollutants, wastewater and oil spilled from the wrecked or sunken river transport ferries is also inevitable. The Sudd wetlands are also threatened with pollution and eutrophication as a result of either oil spillage during oil exploration or overuse of agrochemicals during agricultural production. Mineral exploitation without adequate mitigating measures (particularly oil exploration in wetlands such as the Sudd wetlands) has been also highlighted as one of the major challenges. All these would severely affect wetland biodiversity including fish which is a critical resource for the communities living in the area. South Sudan is already experiencing the impacts of climate change and more is anticipated if the current trend of global warming continues. Some of the direct impacts include changes in weather patterns as manifested in decreasing rainfall, increased temperatures and higher evapotranspiration rates, especially at the Sudd wetlands (MoE and UNDP, 2012; MoE, 2015).

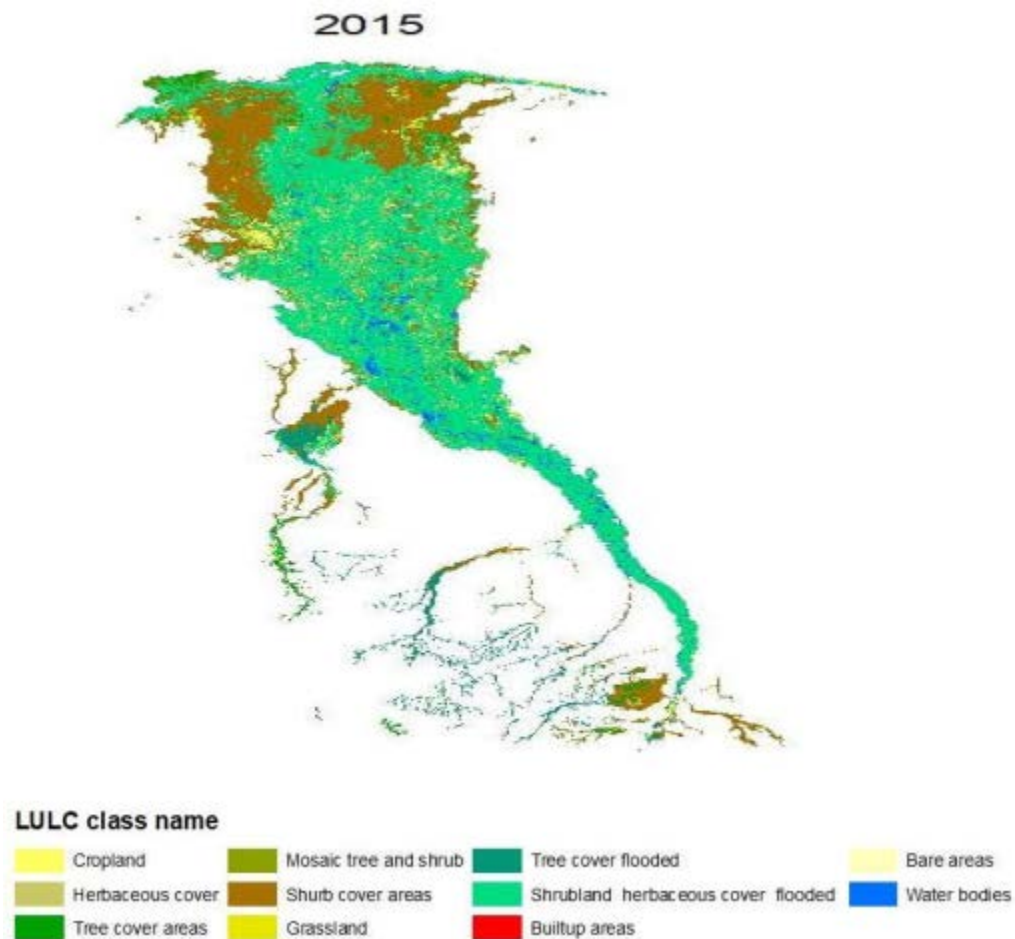
On the other hand, the Sudd wetland has the potential to be of great economic value to South Sudan if it is managed for environmental, economic and social sustainability. The wetland serves as a filter that controls water quality and a sponge that stabilizes water flow. It is the major source of water for domestic, livestock, and wildlife use and an important source of fish. The socio-economic and cultural activities of local people are dependent on its annual floods and rains to regenerate floodplain grasses to feed their cattle, as they move from permanent settlements on the highlands to dry-season grazing in the intermediate lands and return to the highlands in May-June when the rainy season starts (<https://rsis.ramsar.org>). A meta-study of similar ecosystems estimated the potential economic value of a number of the Sudd wetland's benefits – including its symbolic value for the national identity, its role in climate change mitigation, the regulation of the flow of the White Nile and the support it provides to the country's unique wildlife and cultures – to be nearly US\$ 1 billion per year. This figure represents only a fraction of the total value of the Sudd's non-economic values (UNEP, 2015).

3.2. Ecological Features of the Sudd Wetland

Moving laterally from the center of the swamps, different successive vegetation zones are recognized grading from as stated in Riak (undated):

- (i) *Open water vegetation*: This ecotype is dominated by free-floating-leaved plants like *Eichhornia crassipes*, *Lemna gibba*, *Azolla nilotica* and *Nymphaea lotus* as well as submerged vegetation e.g. *Potamogeton*, *Trapa* and *Ceratophyllum* spp in both flowing waters and lakes. Microphytes are prevalent in lakes but less so in the flowing turbid waters of the main channel. The diatom *Aulacosiera granulata* dominates the phytoplankton during the dry season but is replaced by the cyanobacterium *Lyngbya limnetica* during the wet season when the river velocity and turbidity are high.
- (ii) *Permanent swamps*: These occur on land that is flooded throughout the year. The most prevalent types of plants are the floating and fringe vegetation, dominated along the banks of the river by massive stands of *Cyperus papyrus*, *Vossia cuspidata*, *Phragmites karka* and *Typha domingensis*. Associates of the *Cyperus* swamp are climbers and ferns.

Figure 3. 2: The vegetation cover map of the Sudd wetland



(iii) *River flooded grassland or Toich*: These grasslands are seasonally flooded to varying extent and depth by the river. During the rainy season the plains of this belt are often swampy and completely covered with luxuriant growth of tall grasses. Species composition and biomass is closely linked to soil type and degree of inundation. The tall grasses are dominated by *Phragmites*, *Sorghum*, *Hyparrhenia* and *Setaria spp* as well as *Oryza* and *Echinochloa*. Two grassland types are recognized. These are wild rice grassland dominated by *Oryza longistaminata* and *Echinochloa* grassland dominated by *Echinochloa pyramidalis*. Sedges, herbs and other grasses such as *Sporobolus pyramidalis* associate with the *Oryza* grassland. It is the most productive grassland type in terms of year-round grazing for livestock and wildlife because of the high protein content of dead materials of wild rice grass. The *Echinochloa* grassland associates with *Oryza* and legumes like *Desmodium hirtum*.

Within the toich there are many small seasonally flooded pools that support a variety of plants at different times of the year. They are dominated by grasses and herbs during the dry season, semi-woody herbs (*Sesbania rostrata*) in the early wet season, and floating and submerged aquatic plants during the remaining part of the rainy season. When the rivers flood, the pools are colonized by green algae (desmids and filamentous) and Cyanobacteria which themselves are replaced by euglenophytes and dinoflagellates following evaporative concentration and nutrient enrichment from cattle and bird feeding. These pools are sources of water for domestic, livestock and wildlife use as well as fish and pasture during the dry season.

(iv) *Rain-flooded grasslands*: These are seasonally inundated grassland or rain-fed wetlands. They occur on seasonally waterlogged clay soil which in part is heavily used by livestock. It is made up of a comparatively well drained portion dominated by *Echinochloa haploclada*, heavily grazed grassland dominated by *Sporobolus pyramidalis*, *Phragmites*, *Sorghum* and a high biomass but nutrient poor *Hyparrhenia ruffa* grassland in areas that are inundated by rain water and sheet flow. These grasslands act as a source of string and grass for thatching.

(v) *Floodplain scrubland (Woodland)*: It is quite distinct from the grass plains being higher in level. It is the well-drained areas around the floodplains. This rain fed belt is an open mixed *Acacia* forest supporting several species of trees and shrubs and a luxuriant growth of grasses. The tree vegetation is dominated by *Acacia seyal*, *Acacia sieberiana* and *Balanites aegyptiaca*. The tree vegetation is an important source of firewood and building poles.

Balanites has additional food and medicinal values. It is the most utilized ecotype for settlement, crop production and wet season grazing

3.3. Current Land Uses

The areas surrounding the Sudd wetland (the catchment) are heavily utilized for wet season grazing and crop production. They also form the major settlement areas and contain trading centers like Bor town. Most of the tribes living within the Sudd catchment are nomadic and move with their large herds of cattle in response to the annual discharge of Bahr el Jebel and rainfall. Fishing is the second most important occupation of the inhabitants of the wetlands especially the Shilluk and Nuer. Subsistence hunting is another activity by the Nilotes of the Sudd catchment. Crop production is not an important occupation of the Nilotes though some subsistence agriculture is carried out in the highland area during the wet season. Agricultural potential of the area is limited by the vagaries of the climate, soil fertility, pests, weeds and diseases.

The Sudd wetland serves a number of functions, the most notable ones, as stated in Moghraby et al. (2006), being:

1. Communal grazing: This is the major land use practice that the wetland supports. In the 1980s, the number of livestock using the floodplains of the wetland during the dry season was estimated to be 700,000ha (Howell *et al*, 1985).
2. Fishing: Is the second most important practice of the Nilotes of the Sudd region. Traditionally it is an important occupation of the Shiluk and Nuer. The Dinka also fish during the dry season. Commercial fishing has also become progressively an important economic activity of the wetland.
3. Hunting: Subsistence hunting is practiced by the inhabitants of the Sudd wetland. Of late however, poaching using automatic rifles has led to a decrease in the number of wildlife in the area. In the 1980s, the biomass of wild herbivores using the wetland during the dry season was estimated to be 1000kg/m² (Howell *et al.*, 1985).
4. Agriculture: During the rainy season, crop cultivation on a small scale is practiced by the Nilotes of the Sudd wetland on the higher grounds surrounding the floodplain. Major crops grown include sorghum (*Sorghum spp*), maize (*Zea mays*), cowpeas (*Vigna unguiculata*), groundnuts (*Arachis hypogaea*), sesame (*Sesamum indicum*), pumpkin (*Cucurbita maxima*), okra (*Hibiscus esculentus*) and

tobacco (*Nicotiana tabacum*). Although crop production does not depend on the wetland, hundreds of thousands of seed eating birds especially *Quelea quelea* that breed in the wetland are a major threat to agricultural development and their control a major threat to nontargeted species.

5. Preservation of biodiversity: There are three protected areas (comprising about one fifth of the wetland's area) within the Sudd wetland, namely, Shambe National Park, Zeraf Game Reserve and Fanyikang Game Reserve.

Figure 3. 3: Zeraf Game Reserve in the Sudd Wetland



Source: www.travelosudan.com

6. Navigation: Although the Sudd wetland is an obstacle to navigation between Malakal and Juba, many traditional and commercial boats and steamers as well as canoes use the channels within the wetland for fishing and transport.

4. METHODOLOGY

4.1. Sources of Data

For the successful accomplishment of the stated objectives, both primary and secondary data were collected and analyzed. Wetland related policies in particular and environmental related policies, strategies, and plans in general were reviewed and incorporated in this report to understand the enabling policies and strategies on the environment and to implement wetland conservation activities and to support integrated development decisions. Given the benefit transfer approach is one of the plausible options considering the circumstances of the study site; much information was extracted from secondary sources and literatures. The existing TEEB reports and valuation studies will be good asset for this purpose. Population data of the wetland site and national level, activities performed in and around the wetland, benefits obtained from the wetland area, challenges of the wetland and related information were generated from secondary sources. Statistical bulletins, published and unpublished materials about these issues were consulted in this regard. Two consultative meetings were held in Kampala and Juba to solicit primary information on the different aspects of the wetland. The Kampala meeting was to validate the inception reports and it was held with technical reviewers for this purpose and the exercise has helped us to improve our inception report and pave the path for the remaining part of our work. The Juba meeting was more of a consultative workshop with stakeholders at Federal, State and Local levels. Different questions were prepared for the Juba meeting that helped us to solicit information on different issues of this study. These meetings provided us vital information that could help us in understanding the local contexts, and to develop possible scenarios for wetland conservation options and to value the wetland ecosystem services.

4.2. Key Informant Interviews (KIIs)

KIIs were carried out with selected experts at different levels of the administrative and institutional hierarchy to solicit information on the wetland using a checklist that is prepared as a guide for interviewing and consultation process. Indeed, we conducted KII in Juba as consultation workshop, in August 2019. The list of the consultation meeting participants is annexed in this report. In addition, information about the existing situation of the wetland, stakeholders impacted by the wetland, wetland conservation options given the local circumstances, viability of the different wetland conservation options, socioeconomics and biophysical characteristics of the wetland area, current estimates of costs and benefits from alternative wetland conservation options (if any), expert

outlooks of the state of the wetland and other information were outlined and obtained from the KIIs exercise. The Key informant checklists and potential stakeholders that were involved in the KII exercise are annexed in the appendix (See Annex II and Annex IV), respectively.

4.3. Focused Group Discussions (FGDs)

Again, more qualitative information was solicited and explored through the focused group discussions participants of our consultative meeting in Juba, particularly the target groups of different stakeholders that have better information about the wetland issues in the local community. The lists of guiding questions that are used during our consultation meeting for the focus group discussions with potential stakeholders are presented in the appendix (see Annex III and Annex IV, respectively).

4.4. Assessing ecosystem services and trends

We combined available remote-sensing data and GIS approach and ecosystem models to be considered as analytical methods. As well, available natural resource and biodiversity inventories, indicators of ecosystem conditions, and socioeconomic data as data sources were consulted. The ecosystem services covered in this study were the provisioning services, biodiversity, regulating and cultural services. These services were selected based on the consultations held in the Kampala and Juba meetings as well as consulting the available literature. From these exercises, the ecosystem services that are widely prevalent in the Sudd wetland are the following.

Provisioning services: are ecosystem services that describe the material or energy outputs from ecosystems. The provisioning services provided by the Sudd wetland includes fuelwood, charcoal, agricultural crops, water for domestic consumption by households, communal grazing, water for livestock, fish, vegetation, natural medicines, papyrus and crafts from papyrus. The beneficiaries of the provisioning service from the wetland are local communities, states, South Sudan as a country and neighboring countries. The following table provides the provisioning ecosystem services, the proposed valuation method, data requirement, model to be estimated and sources of data for each service.

Table 4. 1: Potential Valuation Method - Sources of Required Data for Estimating Values of Provision Ecosystem service in the Sudd Wetland

Product/service	Valuation Method	Data needs	Model ¹	Model explanation	Sources of data	Remark
Fuelwood	Market price and value transfer	Potential Production Volume (M ³), estimated cost of production (variable and fixed cost)	$T_v = (Q_i * P_i) - C_i$	Where, T_v is the economic value of the product/output, Q_i is the quantity of good/product; P_i is farm gate price of the product, C_i is the cost of production,	State level reports, South Sudan Bureau of Statistics	The required data were not obtained – value transfer applied
Agricultural crops	Market prices	Production volume, local units and conversion, cost of production, and Market prices	$T_v = (Q_i * P_i) - C_i$	T_v is the economic value of the product/output, Q_i is the quantity of good/product; P_i is farm gate price of the product, C_i is the cost of production. The value of costs and benefits will be calculated per hectare to develop the enterprise budget	Local market prices and quantity supplied, South Sudan Bureau of Statistics, District level responsible offices, literature and annual reports	The size of agricultural land and the per hectare value of agricultural crops were obtained and utilized for the valuation
Domestic water supply	Market price	Number of households whose water source is from the wetland Average water use per household Water use price	$V_w = l * m * n * 365$ day	l = Households dependent on wetlands for water supply m = Average use of water per household n = Market price per m ³ (US\$) V_w = Gross annual value of water for domestic consumption (US\$)	South Sudan Bureau of Statistics, state and national level reports	Estimated number of households obtained and unit value transfer applied
Communal grazing	Market price	Number of cattle which graze from the wetland	$V_g = o * p * 365$ Adopted from (Kakuru et al., 2013)	V_g = value of grazing o = Number of cattle raised in wetlands p = Average value of pasture consumed per day per animal (US\$)	Review of existing literature, national and state level reports	Estimated value of livestock obtained and value transfer applied

¹ The equations are adopted from (Langat & Cheboiwo 2010)

Livestock watering	Market price	Number of cattle which drink water from the wetland, average amount of water consumed per head per day	$V_l = p * q * r * 365$ Adopted from (Kakuru et al., 2013)	$V_l =$ value of livestock grazing $p =$ Number of cattle obtaining water from wetlands $q =$ Amount of water consumed per day per head of cattle $r =$ Cost of water per 20 liters (US\$)	Local market price, national and state level reports	Same as above
Fish	Market price	Amount of fish extracted per annum, cost of fish extraction, price of fish	$V_f = (Q_f * P_f) - C_f$	$V_f =$ Value of fish $Q_f =$ Quantity of fish harvested $P_f =$ Price of fish, say, per tonne $C_f =$ cost of extracting fish, say, per tonne	Local market prices, literature, reports at federal & state levels, South Sudan Bureau of Statistics	Area of fish harvest obtained and value transfer applied
Natural medicines	Market price	Number of people treated by natural medication Average estimated cost of medication	$T_m = (Q_m * P_m)$	$T_m =$ the economic value of medication $Q_m =$ number of people treated by natural medication $P_m =$ estimated price of medication	Existing literature, South Sudan Bureau of Statistics	Area where natural medicine could be extracted obtained and value transfer applied
Vegetation	Market price and value transfer	Potential Production Volume (M^3), estimated cost of production (variable and fixed cost)	$T_v = (Q_i * P_i) - C_i$	Where, T_v is the economic value of the product/output, Q_i is the quantity of good/product; P_i is farm gate price of the product, C_i is the cost of production,	State level reports, South Sudan Bureau of Statistics	Area of the wetland where vegetation can be collected and value transfer applied
Mulch	Market price and value transfer	Amount of grass converted to mulch, Cost of conversion	$V_g = o * p * n$ Adopted from (Kakuru et al., 2013)	$V_g =$ value of mulch $o =$ size of land treated with mulch $n =$ number of times, per year, mulch is applied	Review of existing literature, national and state level reports	Size of grass land obtained and value transfer applied

Regulating services: Regulating Services are the services that ecosystems provide by acting as regulators; e.g. regulating the quality of air and soil or by providing flood and disease control. The Sudd wetland provides regulating services such as microclimate regulation, water regulation, and flood control. The regulating services from the wetland benefits local, regional and global agents. The following table provides the valuation method, model to be estimated, data requirements and their potential sources.

Table 4. 2: Potential Valuation Method and Sources of Required Data for Estimating Values of Regulating Ecosystem Services in the Sudd Wetland

Product/service	Valuation Method	Data needs	Model ²	Model explanation	Sources of data	Remark
Microclimate regulation	Market prices and value transfer	Above ground Biomass (AGB), Below ground biomass) (BGB, Soil biomass), international voluntary carbon market, total area under vegetation, IPCC carbon default values	- $V_R = (Q_r * P_c * S_r) - (Q_d * P_c * S_d)$ This is adapted from InVEST model	V_R =the carbon sequestration value of conservation transition; Q_r =carbon sequestration (CO ₂) in restored area; P_c =the international carbon sequestration price; S_r = the area restored (ha); Q_d is the carbon sequestration (CO ₂) in degraded area; S_d is the area degraded (ha)	Existing literature on estimated CO ₂ sequestration at local or regional level, IPCC reports Reports on National and/or regional and/or local level carbon sequestration levels	Value transfer
Water regulation	Market price and/or avoided cost	Number of Households around the wetland, estimated cost that would have been incurred for water purification, water attenuation	$V_w = A * B$ Adapted from (Merriaman, 2016)	V_w - value of water regulation A- Total household likely damaged by disaster without wetland ecosystem B- Estimated cost of water purification or storm surge protection or wave attenuation	Lite literature	Value . T
Flood control	Avoided cost	-cost saved for building water ways (canals) infrastructure or expenditures for similar infrastructures	$V_k = K * G \sum_{i=1}^n S_i * (d_i - d_0)$	Where V_k is the economic value of soil-erosion regulation; -K is the cost of a ton of sediment removal;	Literature, reports from Ministry of Water Resources & Irrigation, South Sudan National Lands Commission, and State Lands	Value transfer

² The equations are adopted from (Langat & Cheboiwo 2010)

				<p>-S_i is the area of forest-vegetation types in hectares; -G is the ratio of sediment entering rivers or reservoirs to total soil lost; -d_i is the erosivity of non-restored land (tons/ha); and d_o is the erosivity of restored land (tons/ha).</p>	<p>Commissions, National and/or regional and/or local level soil maps</p>	
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Cultural services: though cultural services include ecosystem services such as transport, tourism and recreational, educational, and spiritual services, for this study only transport service will be considered due to the local conditions the other services are not widely practiced. Hence market price method will be applied to estimate the transportation services service of the wetland

Table 4. 3: Potential Valuation Method Sources of Required Data for Estimating Values of Transport Services in the Sudd Wetland

Product/service	Valuation Method	Data needs	Model ³	Model explanation	Sources of data	Remark
Transport	Market price	Kilometer of the transportation, cost of transport	$T_v = (Q_i * P_i) - C_i$	T_v is the economic value of the product/output, Q_i is the quantity of good/product; P_i is farm gate price of the product, C_i is the cost of production	Annual reports, household interview, market information, literature	Value transfer

Biodiversity services: as stated above in the Sudd wetland there are reserved areas and it is considered as biodiversity hub. Such services of the wetland benefit both local, regional and global actors. The valuation method and the data requirement are shown in the below table.

Table 4. 4: Potential Valuation Method and Sources of Required Date for Estimating Values of Supporting Service in the Sudd Wetland

Product/service	Valuation Method	Data needs	Model	Model explanation	Sources of data	Remark
Biodiversity	Revealed price and/or value transfer	Expenditures (budget allocated) for biodiversity conservation by national and international actors (agents)	NA	NA	National budget allocation, budget set by international actors and NGOs, annual reports and literature	Value transfer

4.5. Assessing Costs and Benefits of alternative wetland interventions

Cost benefit analysis is an economic technique applied to public decision-making that attempts to quantify the advantages (benefits) and disadvantages (costs) associated with a particular impact, intervention, policy or action. CBA seeks to measure the benefit and costs of policy measures,

³ The equations are adopted from (Langat & Cheboiwo 2010)

interventions, projects and programs and it adopt various decision rules. We will conduct a well-executed CBA that requires a logical sequence of the following steps:

Step 1: Specify the set of wetland conservation and integrated development decision making options

In wetland intervention, the first step is to set conservations transitions (options) for different land uses. The main activities to be done at this stage are:

- Where are the degraded areas (identifying degraded land areas)? For this study, this can be done using avail remote sensing information on land use and land cover.
- What are the major reasons for land degradation?
- What are current uses of the target conservation areas?
- What kind of conservation is appropriate (identifying conservation options to improve land productivity)?
- What are enabling environment and potential challenges to the conservation of the wetland? Identifying degraded land uses.

Step 2: Decide whose costs and benefits count (identifying stakeholders and mapping of stakeholders) in wetland conservation efforts and development options

Conservations options create impact at different institutional and spatial scales. It is vital to count the costs and benefits to all people residing in the area. From the literature, an attempt has been made to identify potential stakeholders in the wetland conservation and development decision making process. More importantly who will invest the proposed conservation actions? Who will be affected by the proposed conservation interventions? What is the interest of different stakeholders by the proposed interventions? What are the likely impacts of wetland degradation? The execution of this activity will help us answer the first specific objective which is to investigate beneficiaries of the Sudd wetland.

Step 3: Identify the impacts of selected wetland conservation opportunities

Identify the full range of impacts of each of the conservation options. It is important to identify the incremental costs and benefits for each conservation options, relative to the base scenario (which will normally be 'what would happen if the current arrangements were to continue?'). All the effects

of proposed wetland conservation interventions that are considered desirable by those affected are benefits; all undesirable effects are costs.

The parameters for the cost and benefit analysis for each conservation activity will be created from published enterprise budgets and/or using a combination of peer-reviewed data and Delphi process. A site level budgeting approach will be applied to value the costs of degraded land use and conservation activity. Due to limited resources and time to conduct rigorous empirical analysis, we will employ Delphi process (Macmillan and Marshall, 2005). The parameters for the cost benefit analysis for each conservation activity will be created as enterprise budget⁴. The enterprise budget will be prepared per hectare level (for one hectare) for identified and potential wetland conservation options using both peer-reviewed data and experts' knowledge (Verdone, 2015).

Costs

Detailed checklist key categories of costs and benefits of wetland conservation interventions to be considered: potential costs in the form of implementation cost, opportunity cost, transaction cost and potential benefits for each conservation interventions to improve the degraded wetland areas will be conducted to identify and map expected costs and benefits of wetland conservation.

Opportunity cost: This are the benefits foregone by investing in degraded landscape activities through transition environmental enhancing land use options that was normally generated from the degraded landscape such as crop yields, timber revenue etc. As well, foregone migratory labor income; foregone income from previous (often) unsustainable activities (for example, fishing, logging, fuel-wood collection, unsustainable agricultural practices, overgrazing of animals, etc.)

Transaction costs: These are costs incurred that support the transition of conservation activities, including daily labor, experts' time, development agents and etc. In wetland conservation, the commonly transaction costs are related to search costs: identifying program participants, identifying funding sources, etc. Bargaining cost: time spent at informal and formal meetings and communications; monitoring and enforcement costs.

Implementation costs: These are the cost incurred in the transition conservation activities, including seedling cost, water use, input, land rent/purchase, compensation, fertilizer, equipment

⁴ Experiment for enterprise budget for selected wetland conservation options are presented in this inception report to develop per hectare level cost and benefit streams (i.e. Tables 7 at the annex)

and etc. For example: capital expenditures on equipment and infrastructure; annual operations and maintenance costs; and labor costs for administration and implementation.

Benefits

The ecological and institutional dimension of ecosystem service benefits should be defined. The benefits of wetland conservation to enhance ecosystem services affect stakeholders at different institutional levels. Knowing and identifying stakeholders that are benefited from and where they are located help us to understand the impacts of the wetland conservation interventions. For example, wetland conservation intervention will benefit the local people through benefiting improved ecosystem services, maintaining micro-climate and can be considered as livelihood improvement; the national government will be benefited to achieve the target set in NAPA or National Development Strategy; the global community benefited from conservation interventions that support the regulation of global climate (e.g. global warming, and carbon emissions). Note also that Sudd is a registered Ramsar convention site which could have huge potential for tourism activities and can be considered as a national pride to own Sudd.

Measuring the physical impacts

The Millennium Ecosystem Assessment (MA, 2005) categorizes ecosystem services into: regulating services, supporting services, provisioning services and cultural services. The different ecosystem services affect stakeholders at different scale. Measuring the physical impact will involve definition of the ecological scales for each impacted ecosystem services in physical units with a time dimension to reflect the fact that ecosystem services provide benefit over time. For example, crop production ($\text{t ha}^{-1}\text{yr}^{-1}$), timber production ($\text{m}^3 \text{ yr}^{-1}$), fuel wood production ($\text{m}^3 \text{ yr}^{-1}$), crop yields ($\text{t ha}^{-1}\text{yr}^{-1}$) prevention of erosion ($\text{t ha}^{-1}\text{yr}^{-1}$), carbon sequestration ($\text{t ha}^{-1}\text{yr}^{-1}$), water attenuation, water flow regulation, and water purification.

Key questions

- What are the likely impacts of the conservation interventions on individual, local, (community), regional, national and global level?
- Who are the stakeholders that will be impacted most?
- What are the indicators to measure the impacts?

- What are the costs and benefits of undertaking the conservation intervention (opportunity costs, transaction costs, implementation costs)?
- What costs and benefits are accrued by different stakeholders-typology of stakeholders and costs and benefits associated with conservation interventions?

Step 4: Predict the impacts over the life of the proposed conservation opportunities

We will follow a framework of ecosystem to services; services to value; value to institution; and institution to decision to indicate how ecosystem services are integrated with decision makings. It will help us to understand the proposed conservation intervention impacts over the proposed time interval. To quantify the benefits (impacts) of the proposed conservation intervention, biological production function will be applied. Biological productions functions relate the structure of ecosystem to outputs of goods and services. For example, crop production is a function of or related to the quantities and quality of the various inputs (e.g. seeds, labor, chemicals, irrigation). As well, carbon sequestration and water flow regulation are related to the area of forest and/or landscape restored. However, due to rareness of data and limited research on relationship between conservation and changes in ecosystem services in South Sudan, specifically to get location specific parameters, we will apply benefit transfer approach by conducting extensive review of peer-reviewed and grey literature. The TEEB database could be great help in this regard.

Value Transfer/benefit transfer

Value transfer involves the adaptation of existing valuation information to new program contexts where valuation data is absent or limited. Although data limits could be a challenge for value transfer, it has become an increasingly practical way to inform decision-makers in the presence of budget and time constraint, and when expected payoffs to original research are small (Troy & Wilson 2006). We will follow Troy & Wilson (2006) approach, a decision framework for mapping ecosystem service values at different scales. This will enable us to map economic value of ecosystem services at local scale. Mapping the ecosystem of the area will help us to determine the current value of the wetland biodiversity and ecosystem services which will partly address the second specific objective this assignment.

The followings are the core steps in mapping ecosystem service values:

1. Study area delineation: Spatial designation of the extent of the study area. It will have a significant impact on the final results when estimating the economic value of ecosystem services.
2. Typology development: establishment of a land use and land cover (LULC) typology. This step starts with a preliminary survey of available cite level data with GIS to determine the current LULC. We will explore the available LULC and GIS information from each land use to identify the major LULC classes of the sites. To ease the process of the LULC classification validation, we will align the LULC classes/types with the NBI LULC classification for the Nile basin. To conduct the LULC analysis for the site, one potential source of LULC data is [the Global Land Service of Copernicus](https://www.copernicus.eu/en/global-land-service), the Earth Observation programme of the European Commission. The data is available from 2009-2018 for South Sudan, it has a horizontal spatial resolution of 250m and the data can be developed for the wetland site. It can be downloaded from FAO WaPOR (water productivity) product <https://wapor.apps.fao.org/home/1>. We will also further explore if we can get a higher resolution satellite images or remotely-sensed data, during detail methodology development. The analysis will be done using ARCGIS software and some graphs will be done by R programming language or excel.
3. Meta-analysis of peer-reviewed valuation literature to link per unit (area) coefficients values to available LULC types. Preliminary review of economic valuation studies to determine whether the ecosystem service coefficients value have been documented for the LULC types in a relatively similar context. But this is usually very limited in developing countries, however, we will use both the global TEEB and the NBI-TEEB assessment data base of ecosystem service-related valuation studies as well as KII information to obtain per Hectare values for identified wetland ecosystem services values in the area.
4. Total value calculation: calculation of the total Ecosystem Services Value (ESV) and break down by LULC types.
5. Geographic summaries: Tabulation and summary of ESVs by relevant management geographies.
6. Scenario development or change analysis: This analysis can be conducted by changing the inputs in step 4 and 5, to highlight the different changes in conservation and how it impacts on ecosystem services in the area. The proposed scenarios are between the status quo and improved utilization/management of the wetland as well as green development versus the status quo. The scenarios will have their own implication in terms of trade-offs in agricultural land use versus floodplain (woodland), settlement versus vegetation cover, as well as livestock versus biodiversity.

The indicators for the scenarios are water volume, water quality, vegetation cover, species diversity, size of the wetland, livelihood (income, food security, asset building) and perception towards the wetland (a qualitative indicator) which has implication in willingness to participate and pay. Improved wetland utilization/management scenario will result in improvements in wetland ecosystem services indicators with higher or better parameters than the business as usual practices. The different land use and land cover (LULC) provide and support different wetland ecosystem services. Wetland ecosystem services change depends on the existing LULC. Thus, wetland ecosystem services change scenarios will be developed by considering the temporal and spatial dimension of the LULC changes that have a direct impact on wetland ecosystem services. We will develop two/three different periods (with a minimum of five years interval) of LULC change of the wetland and analyze changes in wetland ecosystem services.

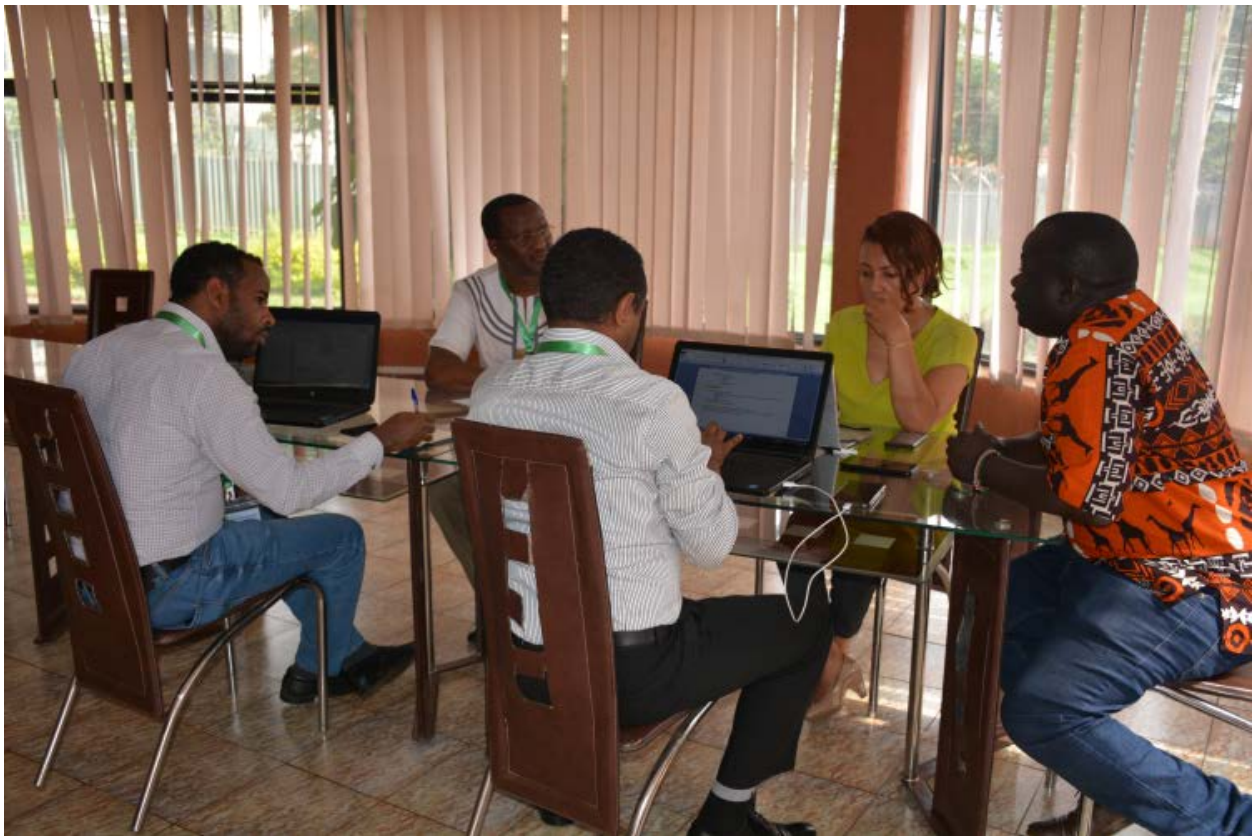


Figure 4. 1: Nile Basin TEEB: Valuation Studies Technical Meeting meeting– Sudd wetland consultants and the TEEB technical reviewers group discussion – Kampala, Uganda

Step 5: Monetize (place monetary values on) impacts

At this stage, monetary valuation of conservation impacts will be conducted. Monetary values for marketed goods and services can be estimated from observed behavior. We can measure the value people place on something by observing how much they actually pay for certain goods or services, and the quantities of those goods and services that are consumed (i.e., using market price and information). A summary of methods, data and estimation techniques to estimate the value of estimated streams of costs and benefits for each wetland conservation options will be included in the detailed methodology phase of this assignment. In some cases, monetization can be difficult because impacts are sometimes uncertain, some are difficult to value in monetary terms, and some are both uncertain and difficult to value. Some environmental goods and services are typical examples of this case. To address such challenge, an attempt will be made, when necessary, to complement this effort with qualitative analysis that is most appropriate in place of monetary values.

Step 6: Reach a conclusion and provide recommendations

The output of the work will support to identify the most appropriate wetland conservation option. The results of CBA help to identify the cost and the benefits of alternative conservation options. As well results from economic analysis will be used to explore potential financing options and investments for alternative wetland conservation interventions.

At the end, the proposed methods above enable us to conduct the ecosystem status and trend, to assess the socio-economic contribution of the wetland ecosystem services, to estimate the cost and benefits associated with alternative wetland conservation efforts and to analyse trade-off and synergies in wetland management for alternative land and other natural resource use in the Sudd wetland. In effect, all the specific objectives shall be answered at this stage.

5. STAKEHOLDER IDENTIFICATION AND MAPPING

This part covers the results and discussion of the study. It starts with stakeholder mapping and analysis where the different stakeholders are identified and analyzed in their importance in the wetland decision making and management. Then the different restoration options and their respective implication are discussed followed by the discussion on land use and land cover changes.

5.1. Stakeholder on the Sudd wetland and their respective roles and interests

Stakeholders are persons, groups or institutions with interests in a policy, programme or project. Their involvement may be critical in fully understanding the problem and implementing solutions, they may represent a possible barrier or threat, or they may simply have a democratic right to be involved because decisions will affect them. Researchers in natural resource management consistently find that stakeholders should be included in solution-finding in order to facilitate negotiation and mutual learning; reduce conflict; and increase support and actor buy-in for decisions made (e.g. Grimble and Wellard, 1997; Ravnborg and Westermann, 2002; Dougill *et al.*, 2006). Different approaches have been applied to identify the stakeholders for the Sudd wetland and it includes consultative meetings in Kampla and Juba as well as literature review. From these exercises, the stakeholders identified are Ministry of Environment and Forestry; Ministry of Water Resources and Irrigation; Ministry of Wildlife Conservation and Tourism; Ministry of Livestock and Fisheries; Ministry of Transport; Ministry of Agriculture and Food Security; Ministry of Finance, Commerce and Economic Planning; Ministry of Land Housing and Physical Planning; Ministry of Petroleum, Mining and Industry; Ministry of Foreign Affairs and International Cooperation; the respective State and local level government units; Universities and Research Centers; NGOs; CSO; Community Based Organizations (CBOs); local communities; aid agencies; Nile Basin Initiative (NBI); International organizations that advocate wetland conservation and neighboring countries.

We can classify the stakeholders as global, national, state and local level. The global stakeholders refer to the external agents that are directly or indirectly contributing and thereby making impact on the wetland. These can also be referred as external stakeholders. The national, state and local level stakeholders are all internal stakeholders but differ in the level and scope of involvement in matters of the wetland. The national level stakeholders are engaged in broader contexts and mainly focus on formulating policies and regulations for wetlands and other resources of the nation; allocate budget;

negotiate and approve global and regional treaties; monitor the implementation of policies and regulations; prioritize budgeting for different activities; attract funding from donors; and design and approve projects related to wetlands among others. The Ministry of Environment and Forestry is in charge with the protection and conservation of the environment and the sustainable utilization of environmental resources which includes wetlands among others. The Directorate of Wetland and Biodiversity under the Ministry is also tasked with drawing policy and strategies which helps to apply not only domestically but also conventions signed by the government to conserve the wetlands of the country. For example, South Sudan is a signatory of the Convention on Biological Diversity (CBD); the UN Convention to Combat Desertification (UNCCD) and Ramsar Convention (John, 2015). These and other agreements on related issues are the results of combined efforts of different Ministerial offices; that is, while the Ministry of Foreign Affairs and International Relations is the political body for such agreements, the Ministry of Environment and Forestry is the technical body which drafts the different agreements (UNEP, 2016). Some of the Universities and Research Institutes in the country include Dr. John Gerang University of Science and Technology, The Upper Nile University, the Padak Fisheries Training Centre and the Kagelu Forestry Training Centre. Such institutions, while building the capacity of the bureaucracy through different formal and informal trainings, are also sources of knowledge base and research on the potential, degradation, challenges, and alternative interventions of the wetland.

The external stakeholders play vital role in the providing different funding for the protection and conservation of different natural and environmental resources, capacity building initiatives, and conducting different studies among others. For example, UNEP is the major donor in regard to environmental and climate change programming where integrated water resources and wetland management is one of the activities by the same. South Sudan joined the GEF in April 2013 and was to engage in working on GEF enabling activities (to fully qualify for funding from GEF), including a NAPA, National Biodiversity Strategy and Action Plan (NBSAP) and country self-assessment. In total, it was allocated USD 3,700,000 for climate change projects, USD 2,220,000 for biodiversity, and USD 1,000,000 for land degradation (management). Among the bilateral donors the Netherlands, for example, support relevant projects in South Sudan in the areas of sustainable and equitable access to water, operationalizing IWRM approach, developing IWRM capacity among to mention some (MoFA, 2018).

Table 5. 1: Stakeholders on Sudd wetland and its respective roles and interests

Scale	Name of Institution	Role and interest
Global	UNEP, GEF, GIZ, CIDA, DfID, African Water Facility, Netherlands Ministry of Foreign Affairs, Nile Basin Initiative	<ul style="list-style-type: none"> - Development and implementation of environmental improvement projects, including building resilience of communities to climate change and other natural disasters, such as floods, extreme weather and desertification. - Conservation of biodiversity by strengthening both wildlife conservation programs and protected area management initiatives. - Integrated water resource and wetlands management. - Wider stakeholder engagement in forest resource management and utilization through the up-scaling of community management of natural forests on communal lands. - Capacity building at different scale - Data collection and database creation
National level	Ministry of Environment and Forestry - the Directorate of Wetlands and Biodiversity	<ul style="list-style-type: none"> - Mandated with the protection and conservation of the environment and sustainable utilization of environmental resources. - Protection, conservation of and management of biodiversity. - Keeping environmental data and information. - Tasked with developing policy and regulatory frameworks on environment and forestry. - Draw policy and strategies which helps to apply international conventions signed by the government to conserve the wetlands. - Environmental and social impact assessment and environmental baseline assessment are required before the development of each energy project.
	Ministry of Foreign Affairs and International Cooperation	<ul style="list-style-type: none"> - It is in charge of international environmental conventions and treaties (UNEP, 2016). - South Sudan is signatory to the Montreal Protocol to the Vienna Convention on Substances that Deplete the Ozone Layer; the United Nations Framework Convention on Climate Change (UNFCCC); the Kyoto Protocol; the Convention on Biological Diversity (CBD); the UN Convention to Combat Desertification (UNCCD) and Ramsar Convention (John, 2015).
	Ministry of Finance, Commerce and Economic Planning	<ul style="list-style-type: none"> - Allocate and approve budget requested for wetland related projects - Administer and follow-up budget contributed from government as well as donor countries and agencies for wetland related projects
	Ministry of Petroleum, Mining and Industry	<ul style="list-style-type: none"> - The development, promotion and management of the mineral resources in sustainable way in order to foster the economic growth of the country.
	Ministry of Transport	<ul style="list-style-type: none"> - Resolving infrastructure (roads) bottlenecks to enable access to markets and distribution systems and implementing market-based measures to promote the country's competitiveness. - Policies aimed at sustainable infrastructure design and construction.
	Ministry of Land Housing and Physical Planning - Land commission	<ul style="list-style-type: none"> - Entertain claims, arbitration and mediation, enforcement of law, accept references and assess compensation. - Land allocation & mapping; Land measurement and quality evaluation; Land classification; Design land use and approval; Land record and statistics and registration; Land valuation; Assign land use

		right; Issue land Title deeds; Regulate land transfer and land lease; Control and protect land use; Protect customary land rights; regulate withdrawal or requisition.
	Ministry of Agriculture and Food Security	<ul style="list-style-type: none"> - Design and formulate policies aimed at achieving food security and efficient utilization of resources in the sector. - Build adaptive capacity by identifying drought - and flood resistant seed varieties, and the 2015 draft Disaster Risk Management Policy, - Proposes strategies to adapt to potential flooding, such as building dykes, but has yet to incorporate those that build resilience to droughts
	Ministry of Water Resources and Irrigation	<ul style="list-style-type: none"> - Provide mechanisms to protect water sources from pollution, erosion or any other adverse effects by creating protected zones within a catchment draining to, or above, any water facility forming part of a water supply or any catchment, lake, reservoir, aquifer, wetland, spring, or any other source of water. - Conserve available water resources, to manage water quality and to prevent pollution of ground and surface waters; manage floods and droughts, and mitigate water-related disasters and establish appropriate management structures, including mechanisms for inter-sectoral coordination and stakeholder participation.
	Ministry of Wildlife Conservation and Tourism	<ul style="list-style-type: none"> - Design coping strategies to address the impacts of climate change on habitats and populations of wildlife species.
	Ministry of Livestock and Fisheries	<ul style="list-style-type: none"> - Provides a framework to manage fisheries resources to maximize production and avoid overfishing and to prevent destruction of wetlands and promote their conservation.
	Universities and Research Centers	<ul style="list-style-type: none"> - Source of knowledge, research base information regarding wetland degradation, challenges, trends and assessment of wetland ecosystem services and alternative ways of intervention. - Create awareness for the local community about the impacts of wetland degradation and on alternative ways of wetland conservation intervention
State	Respective State institutions	<ul style="list-style-type: none"> - Implement state policies - Implement sectoral laws (national or state laws) - Approval of development activities - Approval of projects at state level
District	Respective district level institutions and NGOs	<ul style="list-style-type: none"> - Implement local orders on locality natural resources - Implement state laws - Mobilize local communities - Submit requests for development activities

5.2. Stakeholders for each ecosystem services from the Sudd wetland

The above table shows the different stakeholders on the Sudd wetland in general terms; that is, without referring to specific ecosystem service. Since this study follows an ecosystem approach for the valuation of the wetland at stake. Hence, it is also necessary to show the stakeholders for the different ecosystem services identified for this study. Local communities are the immediate consumers of the goods and services from the wetland. The local communities that directly benefit from the wetland are the Dinka, Shiluk, Nuer, Mundari, and Bari. They also depend for livelihood on the wetland. The local communities are also the immediate guardian of the wetland since they contribute their indigenous knowledge and labor in conserving and protecting the wetland. Notable traditional regulations, among the local communities, are an obligation to return any small fish caught to the water, regulations on the use of forest fires and protection of certain wildlife and tree species (USAID, 2016).

Both states and the federal government are consumers of the goods and services from the wetland as well as generate income in the form of tax. Formulation of different policies and regulations, designing different projects and approving budget for such projects is among the tasks for these stakeholders. Neighboring countries are also among the beneficiaries of the wetland as they consume the goods and services from the wetland and they also make a living since they generate income in cross-border trading. The regulating ecosystem services benefit local, regional and global agents. The local communities benefit in the form of regulated microclimate, reduced soil degradation and purified water for household consumption and livestock. The Sudd is pivotal in regulating weather patterns in the Sahel, Horn of Africa and greater East Africa region. It also acts as a barrier to the southward encroachment of the Sahara Desert; its preservation is consequently expected to be South Sudan's most significant contribution to buffering against climate change impacts at the regional level (UNEP, 2018). There are many traditional and commercial boats and steamers as well as canoes that use the channels within the wetland for fishing and transport helping local communities to generate income and employment from the exercise. Sudd is considered as a biodiversity hub as there are different reserved areas within the wetland which serve for preservation of biodiversity. Table 5.2 shows the different ecosystem services, stakeholders on these services and their role and interest.

Table 5. 2: Stakeholder mapping and analysis for each ecosystem service from the wetland

Ecosystem service	Functions	Stakeholders	Role and interest
Provisioning	Fuelwood, agricultural crops, domestic water consumption, livestock watering, communal grazing, fish, medicine, papyrus, papyrus crafts	Local communities	<ul style="list-style-type: none"> - Consumption - Generate income (livelihood) - Conservation
		States	<ul style="list-style-type: none"> - Consumption - Generate income (tax) - Policy formulation - Project design & approval - Budget allocation
		South Sudan as a nation	<ul style="list-style-type: none"> - Generate income (tax) - Policy formulation - Project design & approval - Budget allocation
		Neighboring countries	<ul style="list-style-type: none"> - Consumption - Generate income
Regulating	Microclimate regulation, water regulation, flood control	Local	<ul style="list-style-type: none"> - Microclimate regulation - Consumption (water and soil) - Conservation
		Regional	<ul style="list-style-type: none"> - Regional climate regulation - Water flow regulation
		Global	<ul style="list-style-type: none"> - Climate change reduction
Cultural	Transport	Local communities	<ul style="list-style-type: none"> - Transportation - Generate income
		States	<ul style="list-style-type: none"> - Transport - Generate income - Policies and regulations - Project design and approval
		National	<ul style="list-style-type: none"> - Policies and regulations - Project design and approval - Budget allocation and follow-up
Biodiversity	Different flora and fauna, biodiversity hub, different reserved areas	Local	<ul style="list-style-type: none"> - Generate income - Conservation
		Regional	<ul style="list-style-type: none"> - Financing of biodiversity projects (conservation) - Research - Capacity building
		Global	<ul style="list-style-type: none"> - Financing of biodiversity projects (conservation) - Capacity building - Database and research

The relationship among the stakeholders can be summarized using the diagram below. The different ministries formulate different policies and regulations, design projects and development interventions which will be forwarded to the states to customize them and thereby for implementation. The districts in collaboration with the Community Based Organizations (CBOs) mobilize the community under their jurisdiction to execute the projects. Feedback and information goes back from the communities to the ministries for follow-up and project design at national level.

The institutions stated at the peripheries provide support on the process of project formulation and execution at different levels. The supports provided are funding, capacity building, follow-up, reporting and advise from designing projects to execution and reporting. For example, UNEP is financing the conservation of biodiversity by strengthening both wildlife conservation programs and protected area management initiatives; integrated water resource and wetlands management programs; and wider stakeholder engagement in forest resources and utilization through the upscaling of community management of natural resources on communal lands among others. The Netherlands government is funding projects on sustainable and equitable access to water; operationalizing an IWRM approach; developing IWRM capacity; and developing value chains and marketing among the list of interventions. Regional actors like NBI are also conducting inventory of the regional wetlands and Sudd is among the wetland of such exercise. GIZ is financing this study and the wetland inventory project which has tremendous importance for decision making and knowledge base. GEF in total has allocated USD 2,220,000 for biodiversity, and USD 1,000,000 for land degradation (management) projects (MoFA, 2018). The Sudd Institute has been one of the implementors of the project on 'Strategies and Technologies to Build Resilience Against Droughts and Floods' while Agriteam Canada was the implementor of the 'Building Resilient Agricultural Production' project (USAID, 2016).

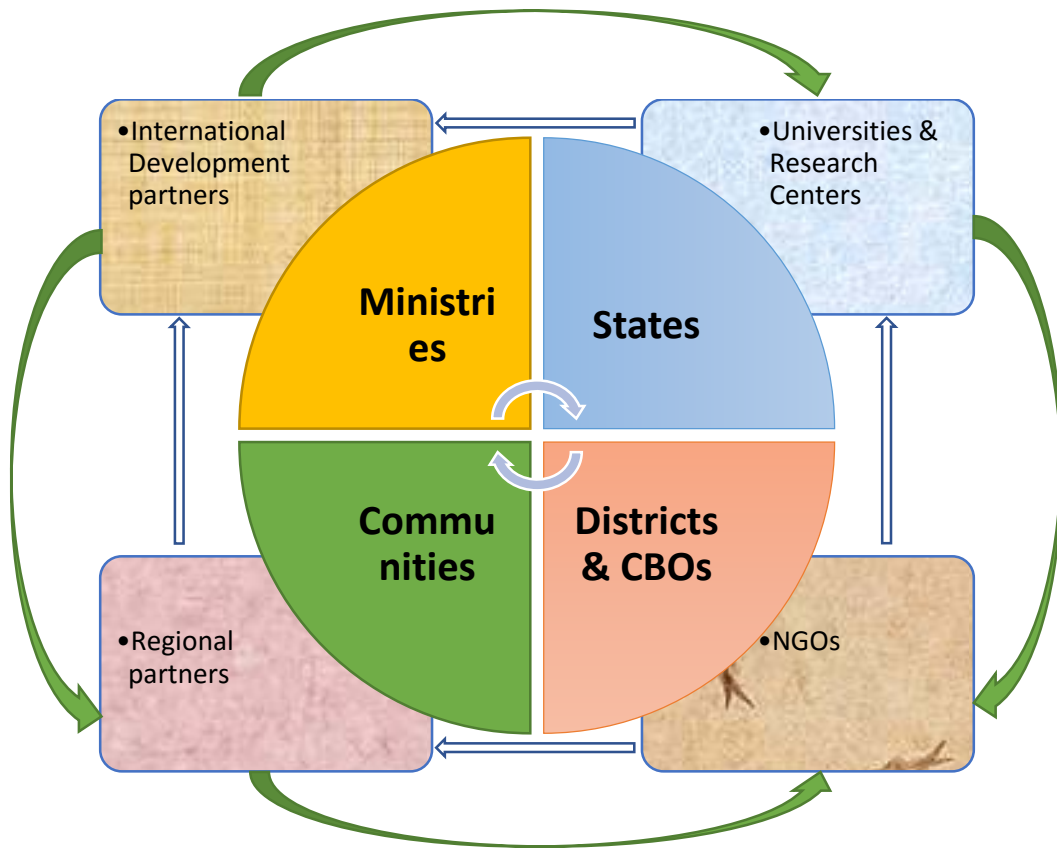


Figure 5. 1: The relationship among stakeholders of the Sudd wetland

Generally, the stakeholders' interest ranges from livelihood, socio-economic activities, protection, management, and to conservation. These interests are not stable, however, as they vary depending on the season which significantly affects the size of the wetland. It's been highlighted that any degradation on the wetland affects all the stakeholders though it could be in different magnitude. The major challenges facing the wetland include population growth, urbanization, recurrent conflict and competition for resources, oil spillage, over exploitation, agricultural expansion, wild fire during the dry season, infrastructure development encroachment, migration, flooding, pollution, and climate change. There is also conflict of interest among the different stakeholders due to lack of demarcation on fishing and grazing rights as well as competition over the use of land. Poor coordination among the stakeholders, lack of transparency and accountability are also among the reasons for the conflict of interest among the stakeholders.

6. LAND USE AND LAND COVER CHANGE OVER SUDD WETLAND OF SOUTH SUDAN: A REMOTE SENSING AND GIS PERSPECTIVE

6.1. Introduction

Land use and land cover change (LULCC) is one of the critical drivers of global environmental change. Monitoring land use land cover change is vital for a number of environmental monitoring applications, including carbon emission estimation, biodiversity conservation and land degradation mitigation (De Sherbinin *et al.*, 2002). LULCC is the essential human perturbation on natural ecosystems (Goldewijk, 2017) and one of the main drivers of climate change (Alkama and Cescatti, 2016). This report aims to assess the LULC dynamics and its change at Sudd wetlands of South Sudan using the climate change initiative land cover (CCI-LC) for the year 1995, 2005 and 2015 and MODIS land cover product of year 2009, 2013 and 2018 within a GIS environment. Meanwhile a simple scenario year assessment of LULC for the year 2025, 2035 using CCI-LC and for year 2023 and 2028 using Moderate Resolution Imaging Spectro radio Meter (MODIS) had been analyzed.

6.2. Location of the Study Area

The SUDD wetland located at the central parts of South Sudan, the wetland extent touches four South Sudan states, Unity, Lakes, Jonglei and Central Equatorial. It is located at an altitude of 378 -458 meters above mean sea level. The total areas delineated is estimated to be about 32,000 km², lying in between 29° 00' 00" to 33° 00' 00" E longitude and 5°00' 00" to 10°00' 00" N latitude, (Figure 6.2).

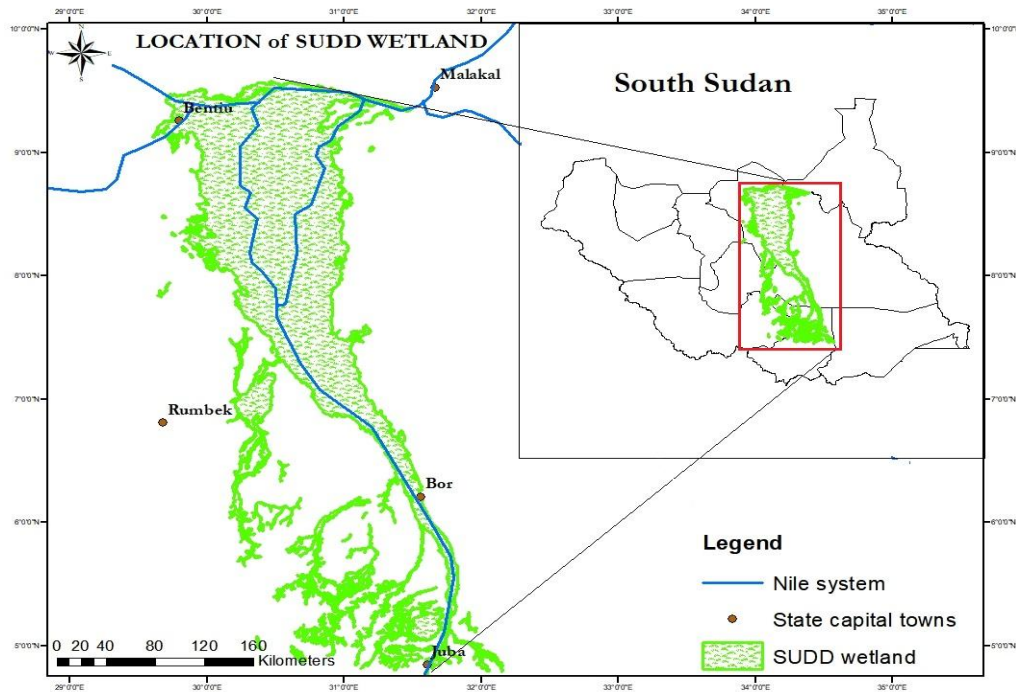


Figure 6. 1: Location of the Sudd Wetland in South Sudan

6.3. Data and Methods

6.3.1. Land cover data

The ESA-CCI-LC product (version 1.4 available at <http://maps.elie.ucl.ac.be/CCI/viewer/> and the data products can be downloaded from <http://maps.elie.ucl.ac.be/CCI/viewer/download.php>) is derived combining remotely sensed surface reflectance and ground-truth observations at 300-m resolution (Alkama and Cescatti, 2016), the land use land cover classes are based on the United Nation Land Cover Classification System (LCCS). The annual land cover map examined in this report is the land cover map for the years 1995, 2005 and 2015.

Meanwhile, a second dataset from MODIS land cover had been used for the year 2009, 2013 and 2018. The MODIS data can be downloaded from <https://earthexplorer.usgs.gov/>. The available document for classification schemes is also available at <https://yceo.yale.edu/modis-land-cover-product-mcd12q1>. The dataset has 500m resolution. A land

Remote Sensing (RS) data and Geographical Information System (GIS) techniques were used for extraction of the study area, preprocessing, analysis and spatiotemporal assessment of the Sudd wetlands. The LULC classification of GIS methodology helped in the identifying, delineating and mapping of the land use/land cover into several classes.

6.3.2. Study Area Data Sources

The location data of the Sudd wetland had been collected from the Nile Basin Initiative (NBI) Uganda Entebbe Office. The data (shape file of the wetland) was released recently at 2019; it is an official SUDD wetland document and assumed to reflect the current SUDD wetland representation. Multiple preprocessing of the SUDD shape file had been done using GIS for smoothing, visualization and delineation of the area. Table 6.1 revises the used main input data of the analysis for SUDD wetland

Table 6. 1: Review of data sources

	Items	Data Source
1	SUDD Wetland shape file	NBI Entebbe, Uganda
2	Land cover	ESA- CCI LC
3	Land cover	USGS- MODIS

6.4. Results and Discussion

6.4.1. Multi- Temporal Land use Landover of Sudd Wetland

The Land use/ land cover mapping of SUDD watershed was carried out using satellite data of the year 1995, 2005 and 2015. The classes identified include cropland, herbaceous cover, tree cover, grassland, tree cover flooded, shrub land, herbaceous cover flooded, built up areas, bare areas and water bodies, figure2. The changes in the land use/land cover classes were mapped; quantified and slight precision assessment was done for all the three years. The slight precision assessment had been carried out using land cover Atlas of the republic of South Sudan from FAO and Google Earth satellite images. The FAO Atlas maps were produced by a group of people from FAO in 2011 and it is available at <http://www.fao.org/3/a-be895e.pdf>. A simple inspection e and LULC overlay technique were applied to compare our result with Google Earth satellite images and the FAO Atlas products and it shows agreement for LULC classification over shrub land, cropland, herbaceous cover and tree cover areas. Figure 6.2, below indicates a multi-temporal LULC of SUDD wetland for the year 1995, 2005 and 2015.

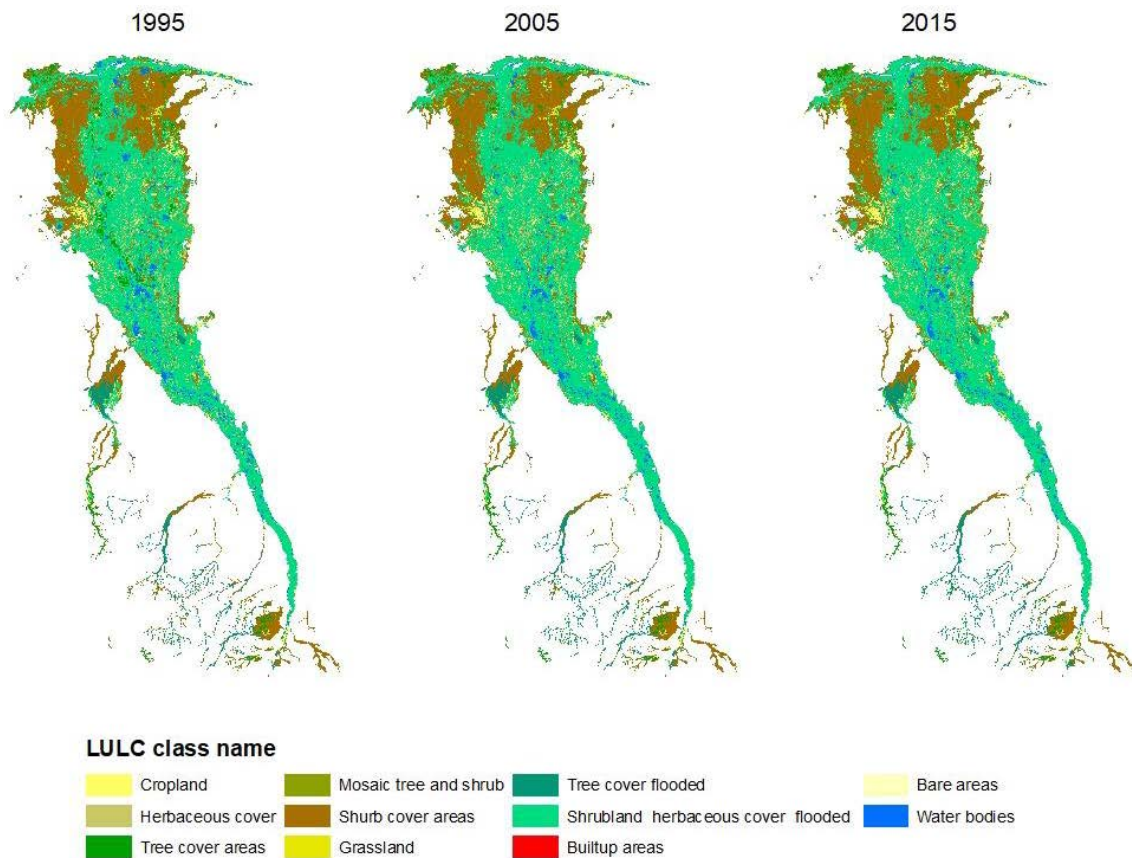


Figure 6. 2: Multi-temporal Land use/ Land cover of Sudd wetland

The statistical analysis of the multi-temporal land use/land cover maps of the Sudd wetland reveal that few tremendous changes have taken place mainly on Shrub land herbaceous cover flooded classes from 1995 to 2015. Table: 6.2a and Table 6.2b provide statistical results of changes of land use/land cover of Sudd wetland and percentage of change on each land use land cover for the year 1995, 2005, and 2015. Conversely, the growing conflict has not significantly altered the natural landscape Land use change over time, a study made at Imatang mountains of South Sudan indicates while armed conflict generally has a negative impact on the immediate environment, the absence of people due to war can be beneficial to local ecosystems and wildlife (Virginia *et al.*, 2013), based on less human needs in the area, the Land cover has not modified the physical environment significantly, this has been also demonstrated also in a study of South Sudan (Virginia *et al.*, 2013). Consequently, there is a reservation of shrub land herbaceous covers flooded and shrub cover areas as about 80 % of the Sudd area is covered with this two LULC classes, this is probably the availability of the national parks and protected areas in the wetland.

Table 6. 2a: Land use / Land cover change analysis, 1995-2015

Class Name LULC	Area in (Km2) 1995	Area Percent t (%)	Area in (Km2) 2005	Area Percent t (%)	Area in (Km2) 2015	Area Percent t (%)	Change Rate between (2015 - 1995) in (km2)
Shrub land herbaceous cover flooded	16237.98	50.64	16943.2	52.84	16892.7	52.68	654.75
Shrub cover areas	9073.26	28.30	8848.44	27.60	8770.95	27.35	-302.31
Tree cover areas	1493.64	4.66	1035.72	3.23	1117.08	3.48	-376.56
Herbaceous cover	1465.83	4.57	1382.40	4.31	1382.94	4.31	-82.89
Cropland	1248.03	3.89	1310.04	4.09	1311.12	4.09	63.09
Tree cover flooded	1170.72	3.65	1260.63	3.93	1314.81	4.10	144.09
Water bodies	1064.07	3.32	936.99	2.92	893.52	2.79	-170.55
Mosaic tree and shrub	165.06	0.51	180.54	0.56	209.79	0.65	44.73
Grassland	143.55	0.45	164.43	0.51	169.20	0.53	25.65
Built-up areas	1.53	0.00	1.71	0.01	1.71	0.01	0.18
Bare areas	0.00	0.00	0.18	0.00	0.45	0.00	0.45
Total Areas (km2)	32064.30	100.00	32064.3	100.00	32064.3	100.00	

Table 6.2b: Percentage Change of Land use Land cover, 1995 - 2015

	Percentage of Change		
	2005 Vs. 1995	2015 Vs. 2005	2015 Vs. 1995
Shrub land herbaceous cover flooded	2.20	-0.16	2.04
Shrub cover areas	-0.70	-0.24	-0.94
Tree cover areas	-1.43	0.25	-1.18
Herbaceous cover	-0.26	0.00	-0.26
Cropland	0.19	0.00	0.20
Tree cover flooded	0.28	0.17	0.45
Water Bodies	-0.40	-0.14	-0.53
Mosaic tree and shrub	0.05	0.09	0.14
Grassland	0.07	0.01	0.08
Built up areas	0.00	0.00	0.00
Bare areas	0.00	0.00	0.00

The conversion of land from one use to other has put a wide range of negative effects as far as overall health of the ecosystem will be influenced (Sun *et al.*, 2018), land use change in the process of urbanization has a significant impact on the value of ecosystem services (Sun *et al.*, 2018), and the spatial and temporal differences in ecosystem services value are influenced by regional differences in per capita GDP, population density and urbanization rate (Xu *et al.*, 2019). Additionally, the values of land use and regional economic development affect each other and have a well correlated, harmonious relationship (Chen *et al.*, 2018). The changes in land use/land cover are the consequence of many activities and it is summarized that, the Sudd wetland shrub land herbaceous cover flooded Shrub cover areas has increased (50.64% - 52.68%), shrub cover areas decreased (28.3 % to 27.35%), tree cover areas has decreased (4.66% - 3.48%), herbaceous cover has decreased (4.57% - 4.31%), cropland has increased (3.89% - 4.09%), tree cover flooded has increased (3.89 to 4.09), water bodies has decreased (3.32% - 2.79%), mosaic tree and shrub has increased (0.51%- 0.65%), grassland (0.45% to 0.53%), built-up areas has increased (0.00% - 0.01%) and bare area has increased (0.00% - 0.45%), The figure 6.3 below represents the schematic results of the distribution of the LULC of SUDD wetland.

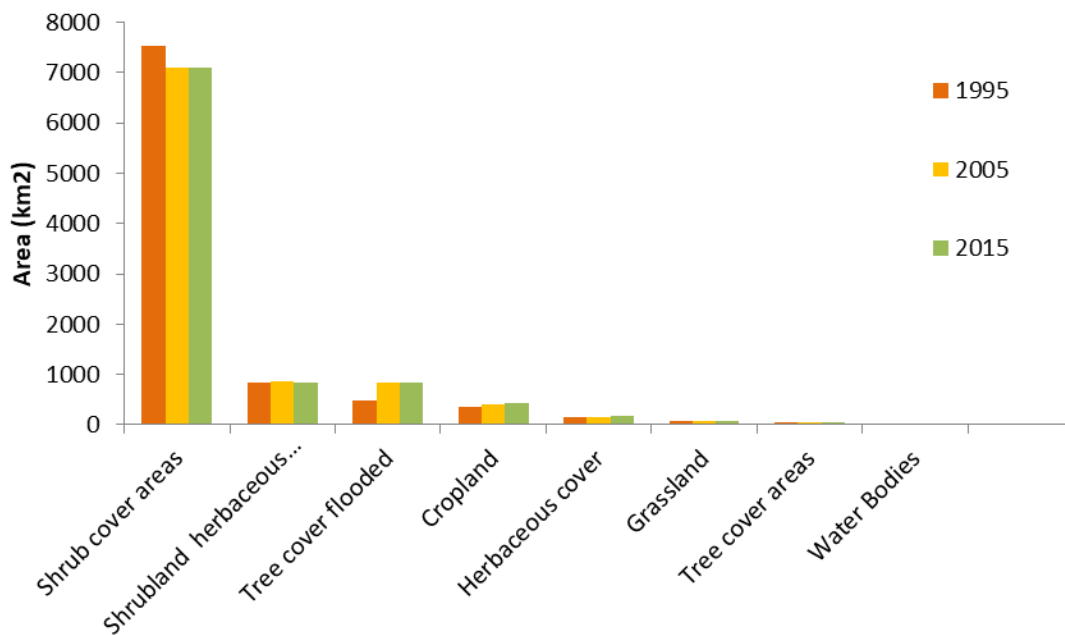


Figure 6. 3: Variations of Land Use / Land cover in three decades

6.4.2. Land Use Land Cover Change Detection of SUDD Wetland

The current scientific technology of remote sensing and visual image interpretation is extremely useful in periodic assessment of the land use land cover changes and to analyze and formulate for the

better management (Remi *et al.*, 2007). Land use land cover mapping serves as a basic inventory of land resources for all levels of government environmental agencies and private industries throughout the world (Schuck *et al.*, 2003). The spatial distribution of the land cover change had been done using image analysis methods of GIS environment from 1995 to 2015. Figure 6.4 represents the spatially distributed post classification change to map of Sudd wetland and Figure 6.5 displays the distribution of LULCC categories between 1995 and 2015 of Sudd Wetland. The result shows there were relatively high tree cover areas converted to shrub land (2.58%), shrub land or tree cover areas converted to cropland (0.66%), this result was expected and it is consistent with several other studies that have been conducted in other parts of Africa (Rukundo, 2013) this is due to the increase of population in the area tends to expands the cropland, meanwhile croplands to tree covers (0.65%) shows these were a probably displacement of population from that area into another places due to conflict or war. Other changes observed are less than 0.5% and considered insignificant. Meanwhile majority of changes are observed around the main rivers of Sudd wetland. However, the overall result indicates that the about 95% of the pixels had resulted no change within year 1995 to 2015.

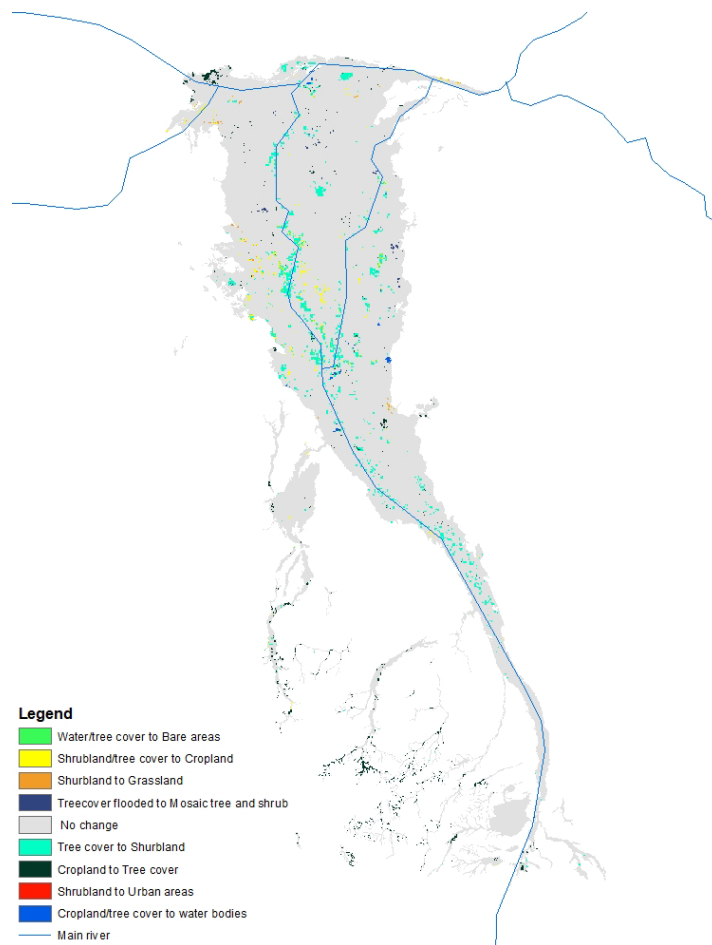


Figure 6. 4: Post-classification "change-to "map of Sudd Wetland

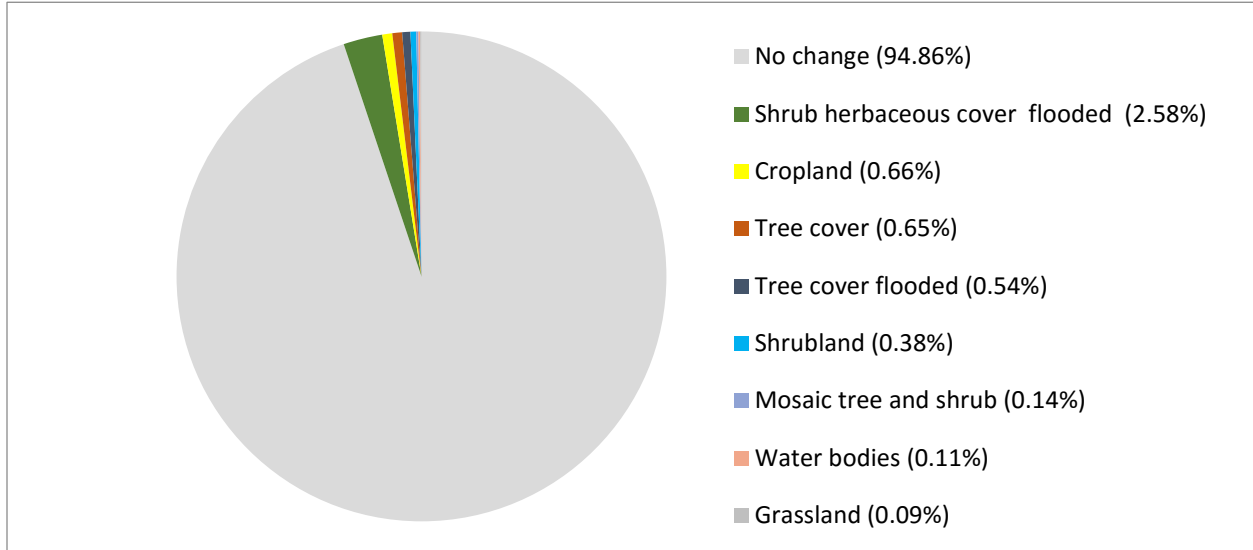


Figure 6. 5: Distribution of LULCC categories between 1995 and 2015 of Sudd Wetland

6.4.3. Recent Year Multi- Temporal Land use Landover of Sudd Wetland

In order to help us see the recent year LULC dynamics with five-year intervals of the LULC of the wetland, we used another dataset of LC from MODIS. The MODIS LC dataset classified SUDD wetland in eight major classes ever green broad leaf forest, mixed forest, grasslands, deciduous broad leaf forest, savannas, permanent wetlands and water bodies. Figure 6.6 indicates the multi- temporal land use land cover of SUDD wetland for the year 2009, 2013 and 2018. As can be seen from the below figure majority of the wetland is covered by savanna tree, grassland is also resulted relatively high.

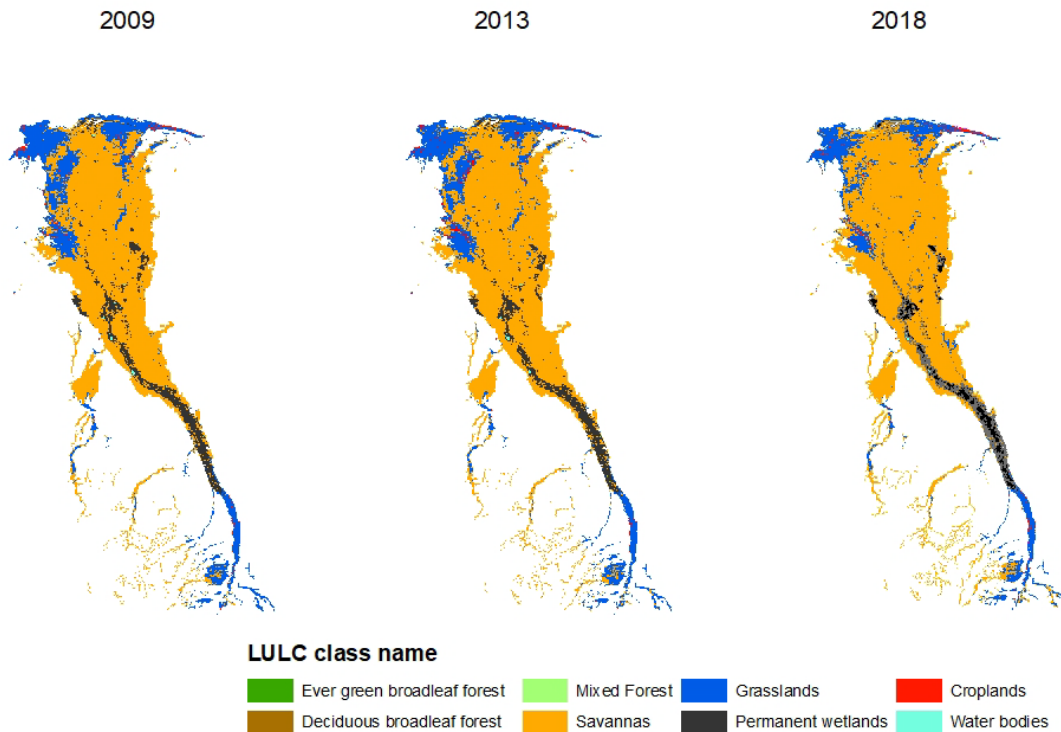


Figure 6. 6: Multi-temporal Land use/ Land cover of SUDD wetland using MODIS Data

The table 6.3a and figure 6.7 below shows the LULC in percent of the Sudd wetland from year 2009-2018 and comparisons of the three-year numerical LULC respectively. Generally, the Savanna, permanent wetlands, croplands, deciduous broadleaf forest results in an increase and grassland, water bodies and ever green broadleaf forest results in a decrease. The substantial conversion of grassland to savanna is probably due to the protection of the area with national parks and conservation of the wetlands. Meanwhile Table 6.3b revises the percent of change of each land use land cover between year 2009, 2013, and 2018.

Table 6. 3a: Land use / Land cover change analysis, 2009-2018

LULC Classes	Area in (Km2) 2009	Area Percent (%)	Area in (Km2) 2013	Area Percent (%)	Area in (Km2) 2018	Area Percent (%)	Change Rate between
							(2009 -2018) in (km2)
Savannas	22152.90	69.09	22359.67	69.73	23678.22	73.85	1525.32
Grasslands	6970.69	21.74	6846.95	21.35	5233.28	16.32	-1737.41
Permanent wetlands	2535.24	7.91	2429.30	7.58	2757.56	8.60	222.31
Croplands	345.03	1.08	376.11	1.17	349.53	1.09	4.50

Water bodies	58.90	0.18	46.43	0.14	42.13	0.13	-16.77
Deciduous broadleaf forest	1.02	0.00	3.68	0.01	2.45	0.01	1.43
Ever green broadleaf forest	0.41	0.00	2.05	0.01	0.20	0.00	-0.20
Mixed Forest	0.41	0.00	0.41	0.00	1.23	0.00	0.82
Sum	32064.60	100.00	32064.60	100.00	32064.60	100.00	

Table 6.3b Percentage Change of Land use Land cover

	Percentage of Change		
	2005 Vs. 1995	2015 Vs. 2005	2015 Vs. 1995
Savannas	0.64	4.11	4.76
Grasslands	-0.39	-5.03	-5.42
Permanent wetlands	-0.33	1.02	0.69
Croplands	0.10	-0.08	0.01
Water bodies	-0.04	-0.01	-0.05
Deciduous broadleaf forest	0.01	0.00	0.00
Ever green broadleaf forest	0.01	-0.01	0.00
Mixed Forest	0.00	0.00	0.00

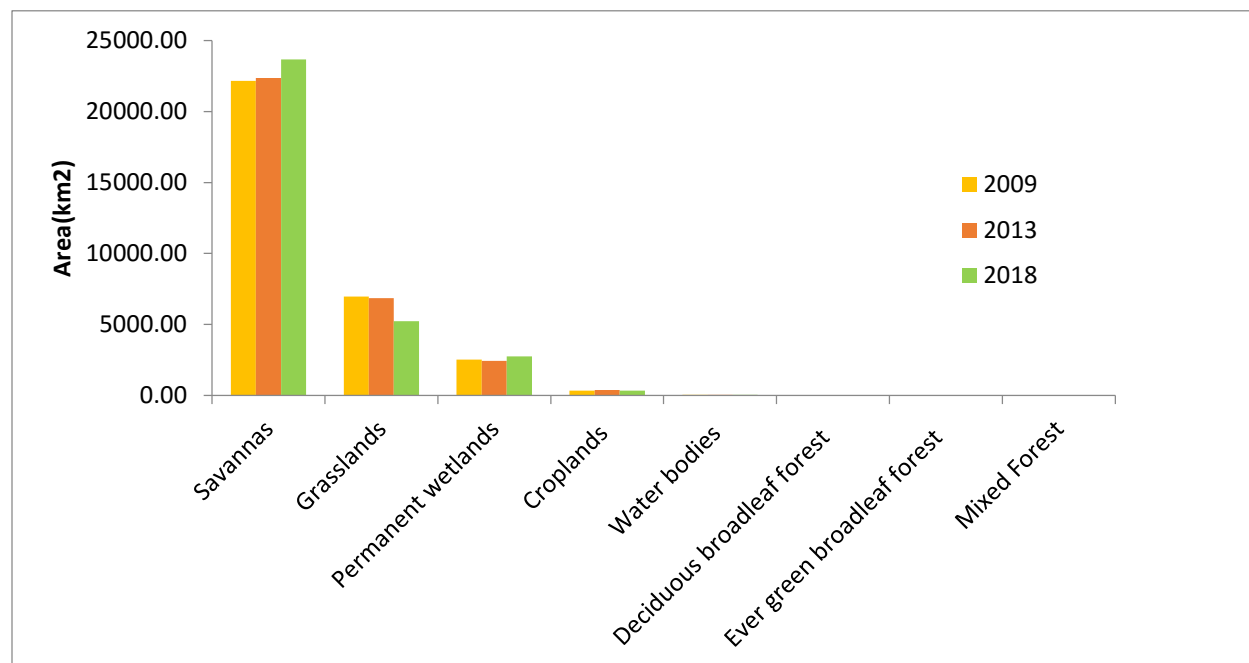


Figure 6. 7: Variations of Land Use / Land cover from 2009 to 2018

6.4.4. Scenarios Development of SUDD LULC

The prediction of LULC had been done using a trend analysis of the historical year LULC. The approach was trend analysis of the ESA CCI land cover were used to produce for the year 2025 and 2035 and MODIS land cover to build on the scenario of the years 2023 and 2028. The following figure 8 and 9 indicates results of four scenario development using these two datasets. The selection of the scenario years is based on the historical period gaps of LULC where the ESA spans ten years difference while the recent year data of MODIS LULC spans five years. Therefore, the following four scenarios were developed using these two datasets by conducting modest trend analysis.

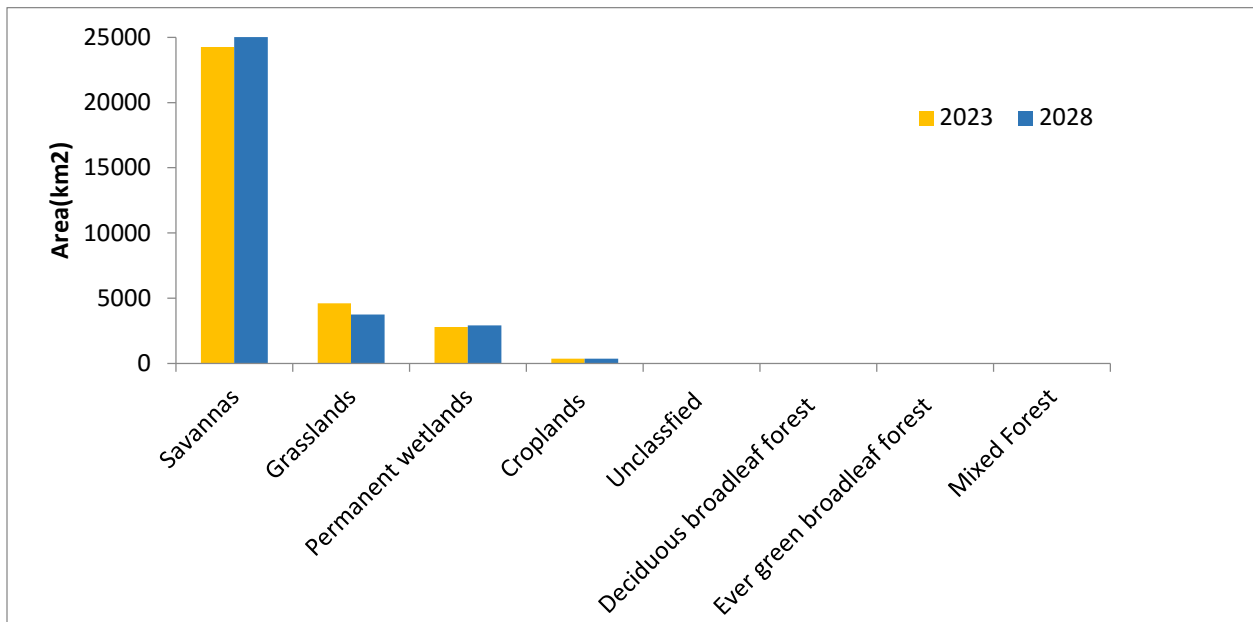


Figure 6. 8: Variations of Land Use / Land cover from 2023 to 2028

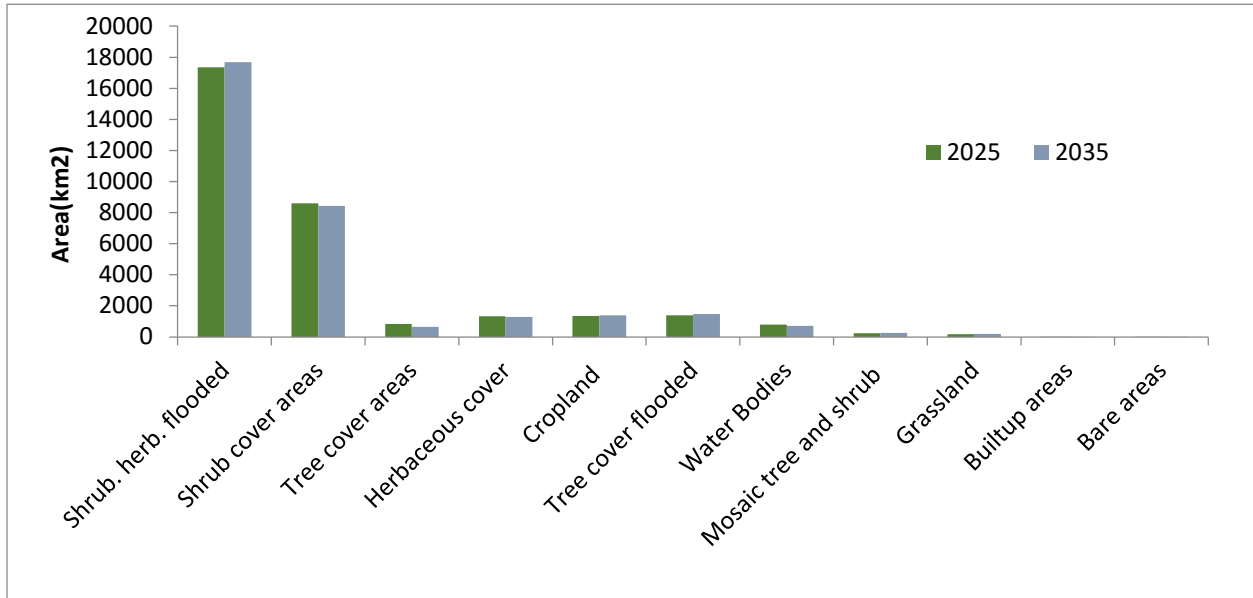


Figure 6. 9: Variations of Land Use / Land cover from 2025 to 2035

7. THE TOTAL ECONOMIC VALUE OF THE WETLAND

We proposed to use different approaches of valuation for the different ecosystem services. Accordingly, we planned to use market price approach for the provisioning services and value transfer for regulating and cultural services. Unfortunately, it was not possible to generate enough information for the application of market price approach for the provisioning services. Our attempt to do so has generated only partial information on some of the provisioning services while we were not able to get information on the other provisioning services. Due to shortage of time, we applied the value transfer approach to estimate the total economic value of the wetland. However, we used the information we obtained for the market valuation approach to complement the discussion of the results obtained using the value transfer approach. There are two approaches for the application of value transfer to value resources. They are the unit value transfer, the value function transfer and meta-analytic transfer approach. The unit value transfer is an approach where a constant value per unit of ecosystem service is applied to estimates of supply (or a constant value per unit area of ecosystem is applied to the area of ecosystem as a proxy of supply). The unit value approach has been the predominant methodology used for valuing ecosystem services within the value-mapping literature (Sen *et al.*, 2013). In the value function transfer instead of transferring the point value estimates from the original study site, transfers the whole benefit function estimated in the study site. Then the average characteristics of the policy site are plugged into the benefit function to obtaining the new values to be transferred. Meta-analysis summarizes information from several valuation studies averaging their values expecting that this procedure will provide more accuracy than simple unit value transfer. The function is estimated from the results of multiple primary valuation studies, which increases the scope for including additional spatial variables that might not be feasible within a single primary valuation study (e.g. crowdedness, accessibility, fragmentation, scarcity).

We have reviewed different studies to select the best policy site that can be used for the application of the unit value transfer. However, we couldn't find any valuation study in South Sudan that can help us in such exercise. We found a study by Kakuru *et al.* (2013) that was conducted in Uganda which valued the total economic values of eight wetlands in three agroecological zones in the country very valuable for the unit value transfer exercise. First, the study was conducted in the neighboring country Uganda which has tremendous similarity with South Sudan. Second, the study selected wetlands from different agro-ecological zones. Last, but not least, the study provides a detailed analysis of the values for the different ecosystem services from the wetlands which helps us to

reciprocate for our study. However, when the ecosystem service from Sudd wetland is not included in Kakuru *et al.*'s study, other related studies preferably in Africa are considered.

Moreover, due to lack of data it was necessary to make various assumptions about the levels of use and sustainability for the various ecosystem services provided by the wetland. And that the exact biophysical relationships between wetland extent and quality, and regulating services, are not yet fully understood or proven. In calculating the different scenarios as well, only changes in land use were considered again due to lack of appropriate data for the exercise. However, this in no way undermines the importance or credibility of the report's findings, it just underlines that there remain many data gaps at the present time.

7.1. Provisioning Ecosystem Services

Dinka, Nuer, and Shilluk pastoralists use the Sudd and the surrounding areas extensively. Livestock and rain-fed agriculture are the dominant means of support for the largely rural population for which the seasonal flooded grasslands along the Sudd provides valuable grazing lands (Baecher, 2000). Among the ecosystem services obtained from the wetland are food, fodder, fish, water, fuelwood, papyrus among others which constitute the provisioning services from the wetland. The value of each of these services, the source of data for the service and the valuation approach is shown in Table 7.1 below. Note that each value is multiplied by 0.913 to account for income differences between South Sudan and Uganda. From the table showing the LULC, the size of the crop land is more than 131 thousand hectares and the WB (2012) report states that the estimated amount of value of crop produced per hectare is \$299. Accordingly, the total value of crop from the wetland is more than \$35 million per annum while the per annum value of the fish harvested from the wetland is about \$6 million. The low value for the crops is due to the low average value for crops in South Sudan. WB (2012) estimates show that South Sudan's average value is less than half of the value in Uganda (\$665) and about a third of the value in Ethiopia (\$917). Moreover, the value for crop production from the wetland is significantly lower than the estimate by the WB (2012). The total crop value for the five states that the Sudd wetland is crossing is estimated to be \$307 million and if we consider that 30 percent of people residing in these states are using the wetland for crop cultivation, the value will be \$92 million. The same logic applies to the value of fish harvested from the wetland. The value is by far lower than the estimates of the WB (2012).

With regard to papyrus, about 481 thousand hectares of the wetland is assumed to be covered by papyrus which is derived from the area of Lake Victoria Crescent and the per hectare value from the

same is \$19.5. Hence, the annual value from the papyrus collection from the wetland stands at above \$8 million while the value from crafts made of papyrus is more than \$21 million per annum. From the group discussion held in Juba, the participants estimated that about 200 thousand households live around Sudd wetland. The WMD *et al.* (2009) estimated that 80 percent of the inhabitants depend on the wetland for domestic household consumption and we applied the same estimate. Kakuru *et al.* (2013) has estimated \$35.3 per annum at household level consumption of water for domestic use. Accordingly, the total annual value of water for domestic use is more than \$5 million. From the WB (2012) data an estimated 17.86 million livestock is found in the five regions the Sudd is crossing. If we assume that 10 percent of these depend on the wetland for water, then the number of livestock getting water from the wetland will be 1,786,336. It is also estimated that, on average, a livestock needs two 20-liter jerricans of water per day and the price of each jerrican of water is estimated at \$0.04. As a result, the total value of water for livestock watering is more than \$47 million. The value of livestock grazing stands at about more than \$119 million per annum.

Fuelwood, charcoal, natural medicine, vegetation and mulch are also among the ecosystem services that the Sudd wetland is offering to the local communities and beyond. The unit values for both fuelwood and natural medicines are derived from Schuijt (2002) which are \$4.58 and \$0.91 per hectare annually. Accordingly, the total value for fuelwood and natural medicines are \$1.1 and \$2.48 million, respectively. Adkins (2015) has stated that medicinal uses of the forest are myriad, including several decoctions used to treat malarial symptoms and skin ailments. Additionally, cultural significance is imbued to certain trees in the forest, especially utilizing large forest trees to mark special events or community meetings. From the FGD, an estimated 5000 households are involved in charcoal making and Barbelet *et al.* (2012) found that each household can process 50kg sack of charcoal per week. Considering 52 weeks in a year, the total value of charcoal processed from the wetland is about \$3.5 million. The total economic value of vegetation and mulch from the wetland are \$583,532 and above \$2.1 million, respectively.

The total provisioning service from the wetland is more than \$253 million. Of the different provisioning ecosystem services provided by the wetland, livestock grazing stood first in total value terms (more than \$119 million) followed by livestock watering. From the FGD, the participants iterated that the major ecosystem services derived from the wetland, from the local community perspective, are livestock grazing and fishing. So, the result is consistent with this assertion and South Sudan is one of the countries where the number of its livestock is greater than its human population. Livestock watering stood second which again confirms the prevalence of large number of livestock

around the wetland. The third highest value comes from the crop production service and this is not surprising as crop production is not the dominant livelihood practice in and around the wetland.

Table 7. 1: Total economic value of provisioning services from Sudd wetland

Ecosystem services	Size (ha) or population	Unit value \$ (ha) or per capita value	Total Value ⁵	Source of data and explanation
Crop	131,112	299	35,793,576	WB (2012)
Fish	89,352	77.8	6,347,100	Unit value: (\$77.8 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
Papyrus	480,965	19.5	8,563,269	Unit value: (\$19.47 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); 15 percent of the wetland is assumed to be covered by Papyrus
Papyrus crafts	480,965	47.95	21,056,857	Unit value: (\$47.95 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
Domestic water supply	160,000	35.3	5,156,870	Unit value: (\$35.3.2hh ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); from FGD an estimated 200000 HHs in the wetland; 80% assumed to depend on the wetland
Livestock watering	1,786,336	2	47,625,271	Unit value: (2 jerrican (20 liter) livestock ⁻¹ day ⁻¹) and (\$0.04 price jerrican ⁻¹) based on Kakuru et al. (2013); WB (2012): 17,863,360 livestock in the five states; 10% assumed to depend on the wetland
Livestock grazing	1,786,336	0.2	119,063,178	Unit value: (\$0.2 livestock ⁻¹ day ⁻¹) based on Kakuru et al. (2013); WB (2012); WB (2012): 17,863,360 livestock in the five states; 10% assumed to depend on the wetland
Fuelwood	264,168	4.58	1,104,681	Unit value: (\$4.58 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
Natural medicine	2,985,750	0.91	2,480,769	Unit value: (\$0.91 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
Charcoal	5,000	0.3	3,560,870	Group discussion: 5,000 households involved in charcoal production; Barbelet et al. (2012): 50kg hh ⁻¹ week ⁻¹ and 52 weeks in a year
Vegetation	1,141,263	0.56	583,532	Unit value: (\$0.56 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
Mulch	16,920	140	2,162,817	Unit value: (\$140.0 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
Total provisioning services			253,498,790	

7.2. Cultural Services

Though cultural services include tourism, education, and transportation among others, from the FGD it has been highlighted that due to the recurrent conflict and poor infrastructure, the first two are almost non-existent. Hence, we focused on the transportation services of the wetland to value the cultural services. For many years the swamp, and especially its thicket of vegetation, proved an impenetrable barrier to navigation along the Nile (Dumont, 2009). Schuijt (2002) estimated \$1.82

⁵ Each value is multiplied by 0.913 to account for income differences between the countries.

per hectare value for the transportation service for Chilwa wetland in Malawi. The reason we used Schuijt's value is that Kakuru et al.'s study did not consider transportation value in its valuation of Uganda's wetlands. From the land use land cover map of the Sudd wetland, the water body covers 89,352 ha. Hence, the total transportation service value, after accounting for income differences, stood at \$148,480. George from Hydroc, during the Juba meeting, highlighted that sedimentation is becoming a challenge for navigation. Due to the sedimentation, the water in Malakal is clear.

Table 7. 2: Total economic value of cultural services

Ecosystem service	Size (ha) or population	Unit value \$ (ha) or per capita value	Total Value ⁶	Source of data and explanation
Transport	89,352	1.82	162,621	Unit value: (\$1.82 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
Total cultural service			148,480	

7.3. Regulation Service of the Wetland

Among the regulating services provided by the wetland are the regulation of microclimate, flood control and water regulation. Hydrologically the Sudd plays an important role in storing floodwaters and trapping sediments from the Bahr al Jabal. Roughly 55 percent of water entering the area is lost to evaporation (Baecher, 2000). The Sudd is also pivotal in regulating weather patterns in the Sahel, Horn of Africa and greater East Africa region. The Sudd acts as a barrier to the southward encroachment of the Sahara Desert; its preservation is consequently expected to be South Sudan's most significant contribution to buffering against climate change impacts at the regional level (USAID, 2016).

The unit value transfer for the regulation services were derived from Kakuru *et al.* (2013) where the annual per hectare value for microclimate regulation is \$265, \$723.89 for flood control, and \$30 for water regulation service of the wetland. Accordingly, the total value of the microclimate regulation service of the wetland, after accounting for income differences, is more than \$744 million while for that of flood control the value is above \$971 million. The items that will be damaged due to flooding are such as livestock, crops, and infrastructure. The local communities in Sudd area are more of pastoralists that are moving from place to place depending on the season. Agriculture is not the dominant practice in the wetland while the available infrastructure is not that developed. Hence, the flood control value is not expected to be as high as the policy site. Normally, the flood control value

⁶ Each value is multiplied by 0.913 to account for income differences between the countries.

can be estimated either by applying the avoided damage costs or mitigative expenditures. Hence to account for such differences, an attempt is made to develop an index of infrastructure for South Sudan in comparison to Uganda. We considered infrastructural coverage for drinking water, sanitation and roads and the infrastructural coverage of South Sudan is about 48 percent of that of Uganda. Hence, the flood control value is adjusted to account such differences in infrastructure and other activities at the policy and study sites. The water regulation/recharge service of the wetland is above \$84 million. The total regulating service of the wetland is, hence, about \$1.8 billion per annum.

Table 7. 3: Total economic value of regulating services from the wetland

Ecosystem service	Size (ha) or population	Unit value \$ (ha) or per capita value	Total Value ⁷	Source of data and explanation
Microclimate regulation	3,075,102	265	744,040,984	Unit value: (\$265.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
Flood control	3,075,102	723.89	971,519,357	Unit value: (\$723.89 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); based on literature, South Sudan's infrastructure coverage (drinking water, sanitation, and roads) stood to be about 48 percent of that of Uganda.
Water regulation	3,075,102	30	84,231,055	Unit value: (\$30.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
Total regulating services				1,799,791,396

7.4. Biodiversity Services of the Wetland

The wetland is known to be a habitat for different flora and fauna species and there are many reserved parks and game reserves which have significant importance for conservation of biodiversity. Including several diverse aquatic habitats like swamps, lakes, channels and floodplains, the Sudd is rich in fish. Some 70 species have been recorded, including marbled lungfish, Senegal bichir, African arowana, *Mormyrus caschive*, Nile carp, Nile tilapia, mango tilapia, Nile perch, *Distichodus rostratus*, elongate tigerfish, African tetras, African sharptooth catfish, *Synodontis frontosus*, *S. schall* and others (Green and El-Moghraby, 2009). Over 400 species of bird are found in the Sudd, including shoebills (a stronghold for the species with several thousand individuals), great white pelicans, and black crowned cranes. The Sudd provides food and water to large populations of migrating birds. As the surrounding landscape is a large swath of dry Sahel across Africa, the swamp is also a haven for migrating mammals, especially antelopes, such as the bohor reedbeek, sitatunga (the most aquatic antelope of the Sudd, mostly inhabiting permanent swampland), the endangered

⁷ Each value is multiplied by 0.913 to account for income differences between the countries.

Nile lechwe (not in permanent swampland, but generally near the water's edge and often walking in shallow water), and the white eared kob (further away from the permanent swampland) (Green and El-Moghraby, 2009). White-eared kob, tiang and Mongalla gazelle take part in one of the largest mammal migrations on Earth, numbering about 1.2 million individuals in total (National Geography, 2007; Furniss, 2011). The shallow water is frequented by Nile crocodiles and hippopotamuses. In more upland areas the Sudd was known as an historic habitat for the endangered painted hunting dog, which however may have been exterminated in the region (C. Michael, 2009). Kakuru *et al.* (2013) estimated a \$439 per hectare value annually for the biodiversity services of wetlands in Uganda. Considering this unit value and accounting for income differences between the two countries, the total biodiversity services of the wetland are estimated to be more than \$1.2 billion. The biodiversity service of the wetland stood second in terms of total value; next to the regulation services. Given the size of the wetland, which is one of the largest in the world, and the number of different reserved areas, this value is not overstated.

Table 7. 4: Total economic value of biodiversity services from the wetland

Ecosystem service	Size (ha) or population	Unit value \$ (ha) or per capita value	Total Value⁸	Source of data and explanation
Biodiversity	3,075,102	439	1,232,581,102	Unit value: (\$439.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
Total biodiversity service			1,232,581,102	

Hence from Table 7.5 and Figure 7.1 below, it is evident that the regulation service of the wetland stood first (55%) in total economic value terms followed by the biodiversity and then the provisioning ecosystem services. The provisioning service account only 8 percent of the total economic value while the transport service is very minimal in relative terms though. The regulation and biodiversity services are not only benefiting local communities and South Sudan as a country but also it has its own implication for the region. Hence, the actors for the preservation of these services should not be only South Sudanese but also other neighboring countries should devise mechanisms whereby they can contribute for the improvement of these services or at least for their continuation.

⁸ Each value is multiplied by 0.913 to account for income differences between the countries.

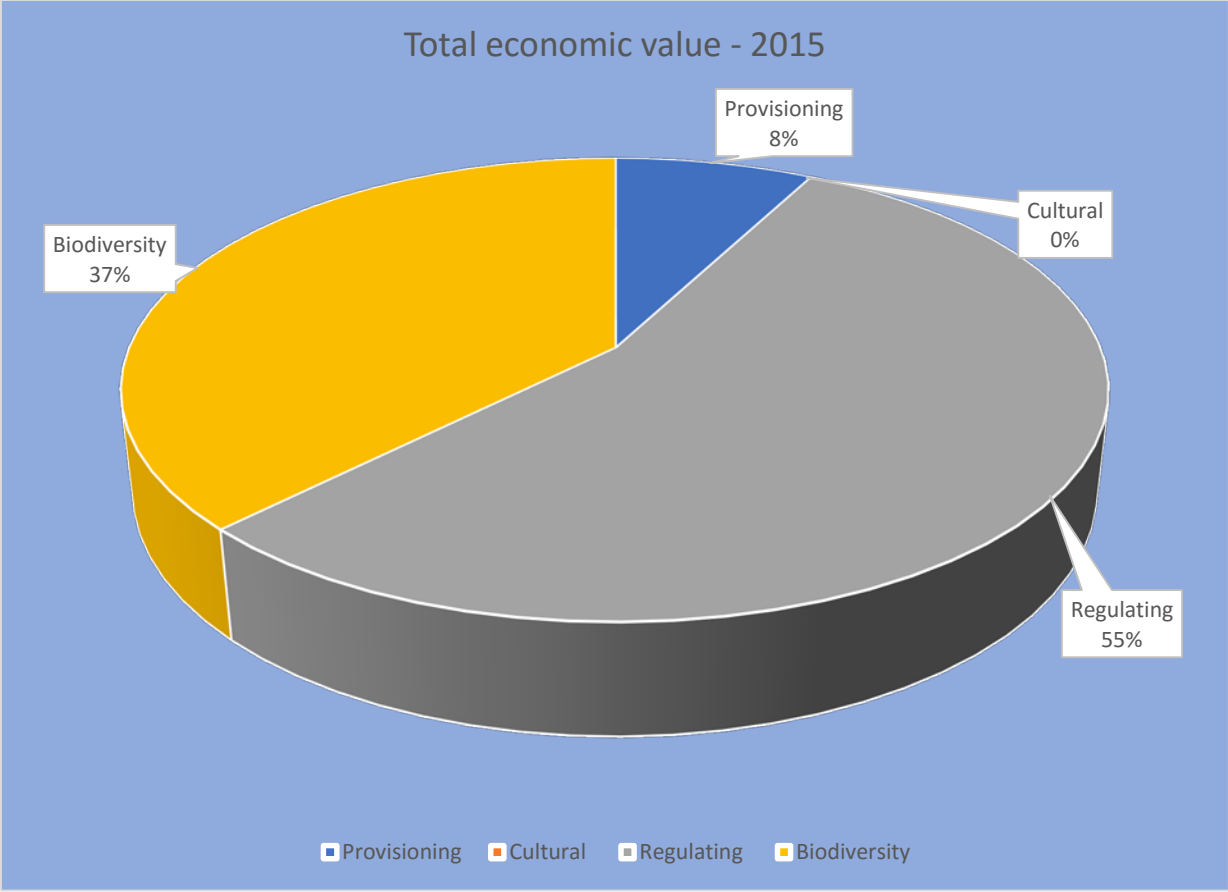


Figure 7. 1: Total economic value of the wetland (in percentage)

Table 7. 5: Total economic valuation of the different ecosystem services of the Sudd wetland

Ecosystem services		Indicator	Size (ha) or population	Unit value \$ (ha) or per capita value	Total Value ⁹	Valuation method	Source of data and explanation
Provisioning	Crop	Value of crop produced per year	131,112	299	35,793,576	Market price and value transfer	WB (2012)
	Fish	Value of fish harvested per year	89,352	77.8	6,347,100	Market price and value transfer	Unit value: (\$77.8 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
	Papyrus	Value of papyrus harvested from the wetland	480,965	19.5	8,563,269	Market price and Value transfer	Unit value: (\$19.47 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); 15 percent of the wetland is assumed to be covered by Papyrus
	Papyrus crafts	Value of mats and crafts made of papyrus	480,965	47.95	21,056,857	Market price and Value transfer	Unit value: (\$47.95 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)
	Domestic water supply	Value of water supplied to households	160,000	35.3	5,156,870	Market price and Value transfer	Unit value: (\$35.32hh ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); from FGD an estimated 20000 HHs in the wetland; 80% assumed to depend on the wetland
	Livestock watering	Value of water consumed by livestock	1,786,336	2	47,625,271	Market price and value transfer	Unit value: (2 jerrican (20 liter) livestock ⁻¹ day ⁻¹) and (\$0.04 price jerrican ⁻¹) based on Kakuru et al. (2013); WB (2012): 17,863,360 livestock in the five states; 10% assumed to depend on the wetland
	Livestock grazing	Value of livestock grazing	1,786,336	0.2	119,063,178	Market price and value transfer	Unit value: (\$0.2 livestock ⁻¹ day ⁻¹) based on Kakuru et al. (2013); WB (2012); WB (2012): 17,863,360 livestock in the five states; 10% assumed to depend on the wetland
	Fuelwood	Value of fuelwood collected from the wetland	264,168	4.58	1,104,681	Value transfer	Unit value: (\$4.58 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
	Natural medicine	Value of natural medicine from the wetland	2,985,750	0.91	2,480,769	Value transfer	Unit value: (\$0.91 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)
	Charcoal	Value of charcoal from the wetland	5,000	0.3	3,560,870	Market price and value transfer	Group discussion: 5,000 households involved in charcoal production; Barbelet et al. (2012): 50kg hh ⁻¹ week ⁻¹ and 52 weeks in a year

⁹ Each value is multiplied by 0.913 to account for income differences between the countries.

	Vegetation	Value of vegetation (reeds, bamboo)	1,141,263	0.56	583,532	Value transfer	Unit value: (\$0.56 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)	
	Mulch	Value of grass for mulching from the wetland	16,920	140	2,162,817	Value transfer	Unit value: (\$140.0 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)	
Total provisioning services								253,498,790
Cultural	Transport	Value of transportation using the open water of the wetland	89,352	1.82	162,621	Value transfer	Unit value: (\$1.82 ha ⁻¹ yr ⁻¹) based on Schuijt (2002)	
Total cultural service								148,480
Regulating	Microclimate regulation	Value of microclimate regulation service of the wetland	3,075,102	265	744,040,984	Value transfer	Unit value: (\$265.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)	
	Flood control	Value of flood controlling service of the wetland	3,075,102	723.89	971,519,357	Value transfer	Unit value: (\$723.89 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013); based on literature, South Sudan's infrastructure coverage (drinking water, sanitation, and roads) stood to be about 48 percent of that of Uganda.	
	Water regulation	Value of water regulation service of the wetland	3,075,102	30	84,231,055	Value transfer	Unit value: (\$30.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)	
Total regulating services								1,799,791,396
Biodiversity	Biodiversity	Value of biodiversity (habitat/refugia) service of the wetland	3,075,102	439	1,349,969,778	Value transfer	Unit value: (\$439.00 ha ⁻¹ yr ⁻¹) based on Kakuru et al. (2013)	
Total biodiversity service								1,232,581,102
Total (Provisioning + Cultural + Regulation + Biodiversity)								3,286,019,767

The figures are depicted in the diagram below which shows the total economic value of the Sudd wetland.

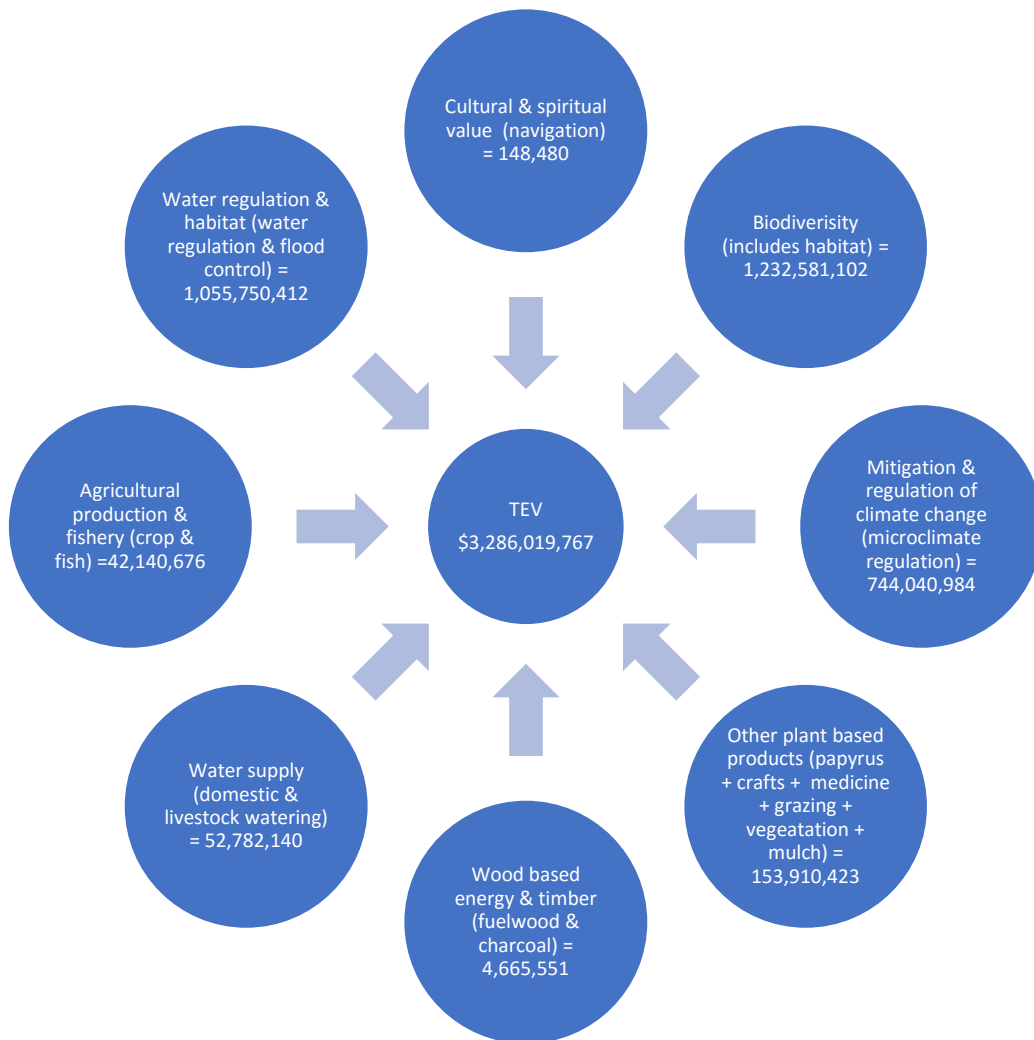


Figure 7. 2: The total economic value (TEV) of the ecosystem services of the Sudd wetland¹⁰

¹⁰ Note: a) the explanations in parenthesis represent the ecosystem services from the Sudd wetland that are included for each service in the infographics.

b) no recreation service was considered for the Sudd wetland due to the local circumstances in the country.

7.5. Scenarios on the Total Economic Value of the Wetland

Table 7.6 and Figure 7.2 below depicts the change in the total economic value of the different ecosystems from the wetland if the current land use and land cover change prevails. In computing these values, we didn't take into account other changes such as population, livestock, prices and income. We only considered changes in the land use and land cover. The main reason for this is, since we were constrained by data and since we run out of time while devoting our effort on the possibility of executing primary data collection, we were not able to model or predict changes on other variables other than the land use and land cover changes.

Provisioning Services

From table there is an increase in cropland of the wetland and the resultant value from crop production. As the water body of the wetland is predicted to decline and with the total value from fishing also declines. Other provisioning services predicted to decline from 2015 to 2025 and then to 2035 are fuelwood, vegetation while natural medicine and mulch are expected to increase. The net effect on the total economic value of the provisioning services is an increase of it by more than \$755 thousand from 2015 to 2025. Furthermore, the provisioning services is expected to rise by about \$910 thousand from 2015 to 2035. This is a clear sign that the pressure in the wetland for its resources will increase in the coming years. Despite the predicted land use land cover changes, the return of the country's citizens to their original settlement could also increase the pressure on the wetland.

Cultural Services

As highlighted earlier, only transportation is considered among the cultural services of the wetland. As the water body of the wetland is predicted to decline according to the trend on land use land cover changes, other things remaining the same, the transportation services are expected to decline. The total economic value of the transportation service declines from more than \$148 thousand in 2015 to less than \$132 thousand and then to \$117 thousand in 2025 and 2035, respectively.

Regulating Services

The land use land cover predicts a decline in the vegetation cover of the wetland, in the water body and an increase in cropland and grass land. Such dynamics has resulted in a decline in all kinds of the

regulating ecosystem services. The total economic value of the regulating services declines by more than \$2.4 million from 2015 to 2025. It further declines by about \$4.3 million from 2015 to 2035 of this about \$1.9 million is a decline from 2025 to 2035.

Biodiversity Services

Similar to the cultural and regulating services, a decline is predicted in the biodiversity services of the wetland under the current land use patterns. Specifically, the decline in biodiversity services are predicted to be about \$1.6 million from 2015 to 2025 and by more than \$1.3 from 2025 to 2035.

The total economic value of the wetland is also predicted to decline under the current land use land cover changes. About \$3.3 million decline is expected from 2015 to 2025 while another \$3.1 million decline is expected from 2025 to 2035. However, the decline could be worse than this given the potential dynamics in the country and the poverty situation of its population. This requires serious interventions to curb the current trend on land use land cover changes.

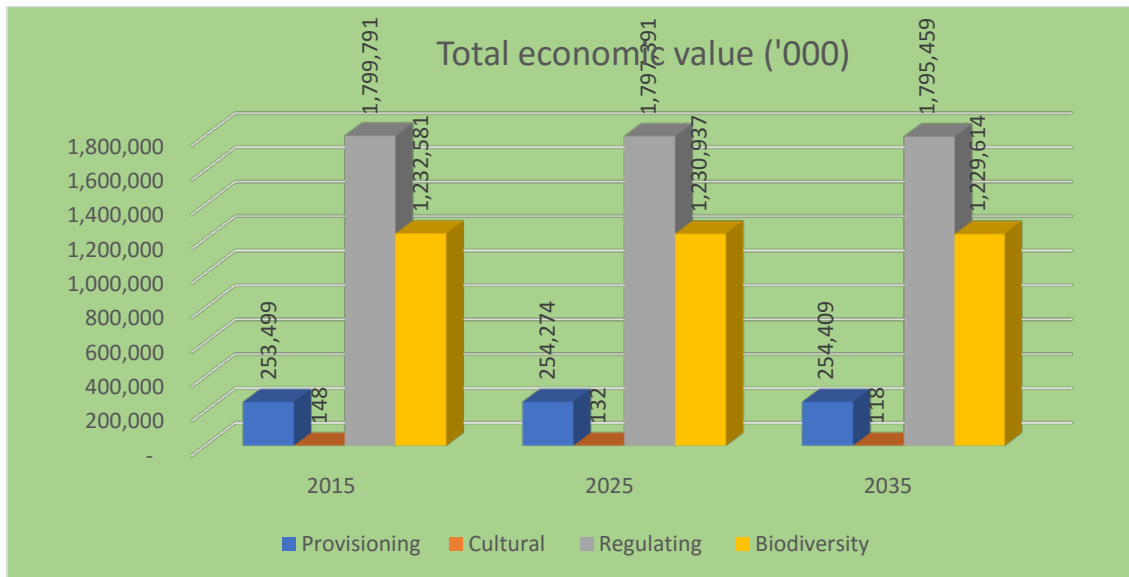


Figure 7. 3: Total economic value of the wetland for three periods

Table 7. 6: Change in total economic values of different ecosystem services with change in land use land cover

Ecosystem service	2015	2025	2035	Change		
	Total Value	Total Value	Total Value	2015 to 2025	2015 to 2035	2025 to 2035
Crop	35,793,576	36,936,900	37,783,200	1,143,324	1,989,624	846,300
Fish	6,347,100	5,640,162	5,036,366	(706,938)	(1,310,734)	(603,796)
Papyrus	8,563,268	8,563,268	8,563,268	-	-	-
Papyrus crafts	21,056,857	21,056,857	21,056,857	-	-	-
Domestic water supply	5,156,870	5,156,870	5,156,870	-	-	-
Livestock watering	47,625,271	47,625,271	47,625,271	-	-	-
Livestock grazing	119,063,178	119,063,178	119,063,178	-	-	-
Fuelwood	1,104,682	1,029,544	989,818	(75,137)	(114,864)	(39,727)
Natural medicine	2,480,769	2,485,629	2,489,950	4,861	9,181	4,321
Charcoal	3,560,870	3,560,870	3,560,870	-	-	-
Vegetation	583,533	565,349	552,771	(18,184)	(30,762)	(12,578)
Mulch	2,162,817	2,590,000	2,530,957	427,183	368,139	(59,043)
Total provisioning	253,498,789	254,273,897	254,409,374	775,108	910,585	135,477
Transport	148,480	131,942	117,817	(16,538)	(30,662)	(14,125)
Microclimate regulation	744,040,984	743,048,478	742,250,022	(992,506)	(1,790,962)	(798,457)
Flood control	971,519,357	970,223,409	969,180,838	(1,295,948)	(2,338,520)	(1,042,572)
Water regulation	84,231,055	84,118,696	84,028,304	(112,359)	(202,750)	(90,391)
Total regulating service	1,799,791,396	1,797,390,583	1,795,459,164	(2,400,813)	(4,332,232)	(1,931,419)
Biodiversity	1,232,581,102	1,230,936,913	1,229,614,187	(1,644,189)	(2,966,915)	(1,322,726)
Grand total	3,286,019,767	3,282,733,336	3,279,600,542	(3,286,431)	(6,419,224)	(3,132,793)

8. ALTERNATIVE DEVELOPMENT OPTIONS FOR SUDD WETLAND

Wetland ecosystems support a diverse natural biota and provide vital services to people, such as freshwater and food, water purification, and flood prevention. Humans have been using such services for millennia for agriculture, aquaculture, and urban development, among other activities, which often led to widespread wetland degradation. Although wetland restoration is valued and practiced in many regions, conflicts between economic interests of stakeholders, such as developers and conservationists, often hamper restoration progress. Some of the principles for best wetland restoration practices, from different case studies and experience include: 1) to help better define goals of restoration, reference baselines can be identified using paleoecological, historical, and long-term ecological records on multiple organisms and their relationships with the natural environment; 2) to define meaningful and shifting restoration targets, it is important to model future scenarios of wetland social-ecological systems, taking into account long-term environmental changes that are often non-linear; 3) restoration planning must address conflicts between competing needs of human and biological communities and would benefit from more input from social science researchers and stakeholders; 4) wetland management plans can encompass the needs of humans for sustainable agriculture, aquaculture, and eco-tourism, as well as support biodiversity conservation and wise use of resources. It requires that independent mediators, or wetland restoration brokers, be nominated by independent bodies to help settle conflicts among stakeholders and between stakeholders and the environment, especially in economically important regions with tensions between different socio-economic interests. Wetland restoration activities must ultimately benefit indigenous/non-indigenous human communities and as many species as possible whilst taking into account all ecosystem services, including wetlands' existence value (Marazzi *et al.*, 2018).

Marazzi *et al.* (2018) further stated that restoration projects often fail, stall, or underachieve when they (i) narrowly focus on a few environmental, cultural, and socio-economic benefits; (ii) lack clearly identified or have static targets; or (iii) promise more than what technology, funding, and management options realistically allow. A better incorporation of stakeholder needs into restoration actions might increase the chances of success in wetland restoration.

For this study, we proposed two scenarios; that is, wise utilization of the wetland versus the status quo and between the status quo and green development. These scenarios were selected based on the consultation held in Kampala with the technical reviewers assigned for this assignment. Each

scenario in turn has its own activities to be performed for the materialization of the indicators for the scenario.

8.1. The Status Quo Versus Wise Management and Utilization of the Wetland

The total economic valuation of the wetland was conducted based on the status quo situation of the wetland and it can be clearly noticed that most of the total economic value was due to the regulation and biodiversity services of the wetland which may not have immediate benefit to the local community in particular. Actually, the provision service from the wetland is just about 8 percent of the total economic value which shows that the wetland is not that much directly benefiting the local community. Some of the reasons could be i) the low density of the population in the wetland and in the country in general; ii) millions of the country's population are still residing in neighboring countries due to the recurrent civil war and lack of peace – according to the FAO and WFP (2019) report, since the conflict started in mid-December 2013, population size and geographical distribution have significantly changed. According to UN/OCHA and UNHCR, by December 2018, over 4 million people were forced to flee their homes due to insecurity, including 1.87 million IDPs (with about 195 000 people in UNMISS Protection of Civilians sites across the country) and 2.27 million people that fled into neighboring countries (Uganda, the Sudan, the Democratic Republic of the Congo, Ethiopia and Kenya); iii) the low and poor infrastructure availability which hinders easy movement of people as well as goods and services.

Hence, this trend has to change so that it is possible to boost the provisioning services of the wetland which entails that the status quo has to change with wise management and utilization of the wetland. Different scenarios are proposed that will enhance the ecosystem services of the wetland while at the same time maintaining the health of the wetland.

8.1.1. Wise Utilization of the Wetland

Under the wise utilization scenario, the aim is to restore, rehabilitate and conserve the biodiversity and ecosystem services of the Sudd wetland. Hence it is necessary to focus on activities that will help achieve these objectives and the activities may include the development of integrated land use planning, landscape restoration and rehabilitation, species and habitat conservation, ecosystem-based adaptation, and sustainable livestock production. The Ministry of Natural resources and Tourism of the Republic of Tanzania (2017) has estimated the conservation costs of these activities for Mara wetland to be about \$1980 per square km. If we could apply this unit value for the Sudd

wetland, the total cost required for the wise utilization scenario will be \$63,487,314. If we assume the government and other stakeholders are willing to conserve 20 percent of the wetland in the coming three years, then the cost required for the same will be \$12,697,463. During the meetings in Juba and Kampala, however, currently due to the recurrent conflict in the country, no budget is allocated for conservation of the wetland and other relevant resources. Hence, unless a peace deal is reached in the country, the status quo will continue to prevail and hence the degradation of the wetland.

8.1.2. Sustainable and Climate Resilient Local Livelihood

It has been highlighted that the local communities highly depend on the wetland for their livelihood fishing and grazing being the most two common practices among the residents. Hence it is important to ensure the sustainable utilization of the wetland while keeping the provision of these services to the community as well. Some of the interventions in this regard include the provision of support for agroforestry and tree-based businesses, developing sustainable fish farming and capture fisheries, enhancing beekeeping technique and markets, practicing climate-smart agriculture, promoting energy saving practices and technologies, addressing local vulnerabilities to climate change and disaster risk among others. For Mara wetland such practices are estimated to cost \$6060 per square km. Applying the unit value transfer to the Sudd wetland, the estimated costs for the sustainable and climate resilient livelihood intervention could cost more than \$194 million. Even if the estimated benefits from these interventions are not readily available for now, it can be shown that it will have tremendous benefits than the costs.

For example, by increasing the productivity in the agricultural sector alone, the country can reap significant benefits. It has been shown that both the total value of the crop production and fishing from the wetland is low compared to its size. WB (2012) estimates show that South Sudan's average per hectare crop value is less than half of the value in Uganda (\$665), about a third of the value in Ethiopia (\$917) and roughly a fifth of the value in Kenya (\$1,405). The same logic applies to the value of fish harvested from the wetland. Looking at the states where the Sudd wetland is crossing, except Central Equatoria (\$653) and Lakes (\$574) states, the other three states (Upper Nile \$358, Jongeli \$385, and Unity \$263) have value of crop per household which is less than the national average (\$473). This shows that crop productivity is lower in the three of the five states.

Hence, one way to improve the benefits from the wetland is to increase the agricultural productivity. This is specially very important given the future prospect for peace and the return of refugees to their

original settlement which increases the pressure on the wetland for different livelihood options. The FAO and WFP (2019) shows that there is progress in this regard. In the last quarter of 2018, the number of refugees appreciably declined for the first time since the start of the conflict in 2013, decreasing by about 10 percent.

According to the WB (2012) estimate, increasing cropland from the current 4 percent of total land area to 10 percent of total land area under a modest cropland expansion scenario would lead to a 2.4-fold increase in the value of total agricultural output relative to the current level (i.e., to approximately US\$2 billion versus the current US\$808 million). If coupled with a 50 percent increase in per capita yields, this cropland expansion would lead to a 3.5-fold increase in the value of total agriculture output (i.e., to US\$2.8 billion) and would also increase the value of crop production per ha from US\$227 to US\$340. If per capita yields double, the value of total agriculture production under a modest cropland expansion scenario would increase to US\$3.7 billion, and would outstrip the current value of agricultural production in neighboring Uganda. Increasing productivity threefold would increase the value of agricultural production to US\$5.5 billion.

Currently, South Sudan imports significant amounts of maize from Uganda and sorghum from Sudan (FAO and WFP, 2019). Hence increasing its agricultural productivity not only enables the country to be food self-sufficient but also can generate forex from the export of different cereals. This again helps the country's oil dependent economy to diversify. Growth of the agricultural sector can also have better trickle-down effect since it can help the broad sector of the society to come out of poverty. Hence this measure, while improving the livelihood of the community, reduces the pressure on the wetland resources.

However, we are not endorsing significant increase of agricultural land expansion into the wetland. Rather, we wanted to highlight how increasing agricultural productivity significantly improves the crop production level and thereby contributing to the food security and improved livelihood situation of the residents. Moreover, apart from the absolute benefits of improving the crop productivity by itself, the increment in productivity partially mitigates the demand for land and other resources of the wetland with the return of refugees to their original settlement. A reduced demand on other resources of the wetland again contributes for the wise management and utilization of the wetland.

8.1.3. Community Water, Sanitation and Hygiene

The aim of this intervention could be to improve water quality and sustain a healthy wetland adjacent population. Being one of the least developed and poor countries, a great proportion of South Sudan's population do not have access to clear and safe drinking water. Hence, securing clean domestic water supplies, planning and establishing solid waste disposal and collection points, developing improved sanitation and hygiene practices and facilities, and building capacity and know-how among village health workers key in this regard among other things. Doing so will enable that all segments of the wetland community are able to access sufficient clean and regular water supplies, decrease land and water pollution in natural wetland areas as well as in and around human settlement. The focus is on reducing pressure on the wetland environment, decreasing women's labor burden, and enhancing households' access to clean, regular water supplies. An additional concern is to ensure conservation and maintenance of the natural ecosystems that provide important water regulation services. Maintaining ecosystem health also contributes to the overall health of the wetland which again affects the water quality. This again contributes for less processing and purification facilities and infrastructure hence helping the availability of water for a great proportion of the wetland communities with less budget.

For Mara wetland in Tanzania, the costs for community water, sanitation and hygiene are estimated to be about \$4920 square km. Applying the same unit value for the Sudd wetland and assuming that the government invests in 5 percent of the wetland every year for the next five years, the total annual cost required for such investment will be above \$780 million. This amount seems a bit higher given the current economic situation of the country. However, part of the finance could be solicited from development partners and lenders. The returns from such investments is tremendous and contributes both to the health of the wetland and the community. A healthy community invests less in medication and related costs and it could also increase the community's' productivity. The benefits of these investments specially on the rural poor are very crucial. Poor people, especially in rural areas, generally rely on ecosystem services directly for subsistence and income generating activities or to obtain water and medicines because of lack of affordable alternatives (Wetlands Management Department, Ministry of Water and Environment, Uganda *et al.*, 2009).



Figure 8. 1: Components of the wise management and use approach and the respective objectives
8.2. The Status Quo Versus the Green Development Path

Being one of the least developed countries, South Sudan is one of the poorest countries in multiple dimensions. The country has a very poor infrastructure and the economy is highly dependent on its oil resource. This could be partly a blessing in disguise as the country can follow the green infrastructure development path in its effort to develop and thereby improve the wellbeing of its population. This is particularly true given the current trend in climate variability and climate change.

High dependence on ecosystem services combined with few assets and capabilities make poor people particularly vulnerable to ecosystem degradation (MA, 2005). Consequently, the condition of wetlands and the way they are managed can have a disproportionate impact on the well-being of poor families (Maclean *et al.*, 2003). Hence, we need not to continue with the status quo management and utilization of the wetland as the country strives to develop its economy. On the one hand, the country needs to balance its ecosystem conservation and development needs and the best way to achieve this is to rely on green development approach which is getting wider acceptance throughout the globe. This approach, in addition to helping the country to achieve sustainable development, can

also pave the way to secure funding from different development partners and aid agencies which the country is badly in need of it.

8.2.1. Building Institutions, Capacity and Conservation Awareness

In the second chapter, it has been highlighted that there are different laws, regulations and conventions with the aim of protecting the wetland and other environmental and natural resources. However, due to the recurrent war and lack of peace many legislations are yet to be approved by the parliament. Hence, despite the few attempts at early stage of the country's independence, there still remains much to be done for the successful formulation and approval of the different laws and regulations aimed at environmental and natural resources regulations. More than anything else, the youngest county in the world has huge limitations in terms of funding for protecting its resources and during the Juba meeting issues of capacity limitations were boldly highlighted. Lack of integration among the different sectors, conflict over use of the resources, and poor awareness on the benefits of conserving the resources of the wetland were also raised as some of the problems facing the wetland.

It is, thus, necessary to build effective, inclusive and sustainable systems for wetland management and use. To achieve this fostering sectoral, spatial and stakeholder cooperation in integrated wetland management; enhancing institutional capacity and accountability to address wetland conservation and climate issues; and raising community awareness, support and management for wetland conservation and wise use are very crucial, among others, in this component of the green development. Doing so will enable to strengthen wetland governance structures while building awareness and capacity at the sometime among the different stakeholders. There is also a need for government, community and the private sector cooperating and working together to conserve and sustainably manage the wetland for the better outcomes of efforts exerted on the wetland.

8.2.2. Green Infrastructure Development

The biggest challenge to the Sudd the construction of the Jongeli canal which results in serious environmental and social consequences. The complex environmental and social issues involved include the collapse of fisheries, dying of grazing lands (Koang, 2010), a drop of groundwater levels, and a reduction of rainfall in the region (De Villiers, 2001). The draining of the Sudd is likely to have environmental effects comparable to the dying of Lake Chad or the draining of the Aral Sea. The surprising fact is that the canal's benefits would be shared by Egypt and Sudan with the expected

damage falling on South Sudan. Hence, any decision to restart the construction of the Canal would have detrimental effect on the wetland and its ecosystem, the wetland community and the country at large.

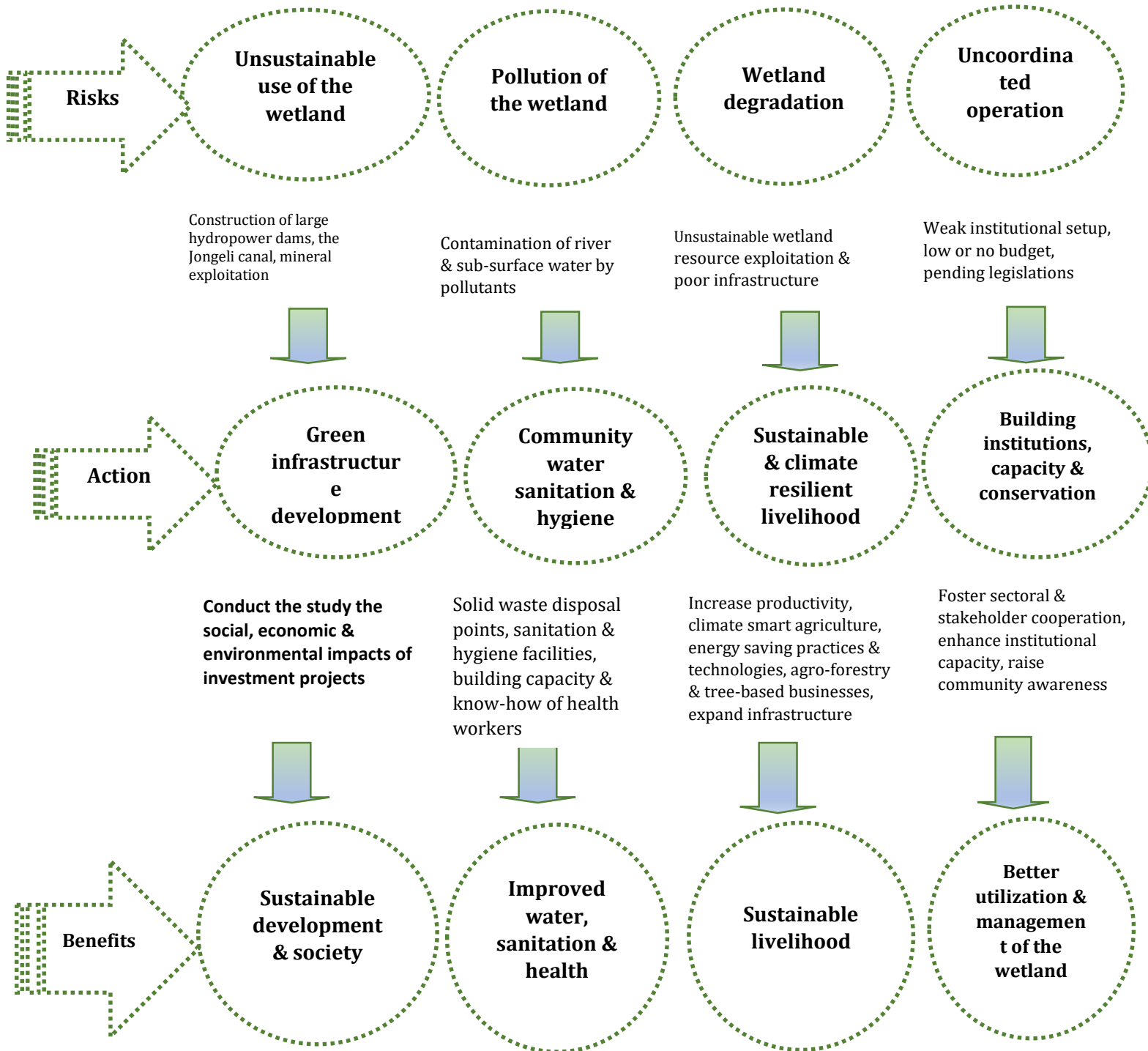
The Sudd wetland is also threatened with pollution and eutrophication as a result of either oil spillage during oil exploration or overuse of agrochemicals during agricultural production. Mineral exploitation without adequate mitigating measures (particularly oil exploration in wetlands such as the Sudd wetlands) has been also highlighted as one of the major challenges. All these would severely affect wetland biodiversity including fish which is a critical resource for the communities living in the area. South Sudan is already experiencing the impacts of climate change and more is anticipated if the current trend of global warming continues. Some of the direct impacts include changes in weather patterns as manifested in decreasing rainfall, increased temperatures and higher evapotranspiration rates, especially at the Sudd wetlands (MoE and UNDP, 2012; MoE, 2015).

These facts call for the country to adopt green infrastructure development if the country has to achieve sustainable development. The infrastructure of the country has to be built considering the natural and environmental resources which once lost could be difficult to recover, if possible, at all. The application of integrated soil management and the practice of organic agriculture could partly reduce the pollution from the application of chemical fertilizer. Putting in place laws and regulations that compel polluters to internalize the pollution damage as a result of their activities is important. Indulging in afforestation, reforestation and related activities could reap additional source of income to the local community while directly also benefiting from conserving nature at the same time.

Sudd wetland registered as wetland of international importance by the Ramsar Convention and the wide availability of flora and fauna could be a great potential for promoting the tourism business. The country needs really to count on this aspect of the wetland and tourism considered to be smokeless business and promotes the development of other sectors as well. However, doing so requires the country be at peace and the construction of standard roads and other tourism related services.

The information above can be captured by the infographics for the Sudd wetland which is depicted below. It shows the risks to the wetland, actions needed to mitigate those risks and then the benefits from the proposed actions.

Figure 8. 2: Infographics for Sudd Wetland



9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

This study was motivated by the unavailability of previous attempts to estimate the total economic value of the Sudd wetland which can guide policy makers for development decision making. Hence the broad aim of the study was to conduct economic valuation of biodiversity and ecosystem services of the Sudd wetland to inform green infrastructure planning and development in the face of in situ and ex-situ development interventions. To this end, different sources of information have been consulted and the results have been based on the interviews and discussions conducted at the study country as well as available literature.

Sudd is one of the largest wetlands in the world and as a result it affects different stakeholders; local to global actors. Local communities are both the immediate beneficiaries as well as conservation actors of the wetland. It serves them as a means of livelihood and source of income while they also contribute their labor and knowledge in the conservation and protection of the wetland. The state and federal governments in addition to formulating policies, laws and regulations and enforcing them they also allocate budget for the law enforcement and conservation of the wetland. Regional and global actors also allocate some funding for capacity building and conservation of the wetland. However, it has been noticed that, even if there have been some attempts to legislate different policies and legislations, many of them are yet to be approved.

The total economic value of the wetland was estimated at about \$3.3 billion annually. However, most of this benefit emanates from the regulation service followed by the biodiversity services. The total value of the provision service from the wetland is the third highest, exceeding only the cultural service. Unless a mechanism is set to increase the benefits from the provisioning services, the status quo may not be sustainable. Because, both the regulating and biodiversity services have a public good character which may not be the immediate reasons for the protection of the wetland. The government of South Sudan and other development partners should also seek how the local community would be compensated from the regulating and biodiversity of the wetland.

Two alternative approaches have been proposed to change the status quo approach and thereby increase the overall wellbeing of the wetland and the wetland community. The first scenario is the wise management and utilization of the wetland. Under this scenario, wise use of the wetland

requires the development of integrated land use planning, landscape restoration and rehabilitation, species and habitat conservation, ecosystem-based adaptation, and sustainable livestock production. The sustainable and climate resilient local livelihood, another component of this scenario, proposes the provision of support for agroforestry and tree-based businesses, developing sustainable fish farming and capture fisheries, enhancing beekeeping technique and markets, practicing climate-smart agriculture, promoting energy saving practices and technologies, addressing local vulnerabilities to climate change and disaster risk among others. The last component in the first approach is the community water, sanitation and hygiene emphasize the importance of the wetland on water provision and sanitation and hygiene services and vice versa. The second scenario is the green development approach where the country has to balance between its development aspiration and its natural resources in general and that of Sudd in particular. Specially building institutions and their capacity as well as awareness creation on conservation practices is crucial for the sustainable development of the country. Given the country is one of the least developed in terms of infrastructure and other development indicators, it is necessary for the country to follow the green infrastructure path than the business as usual approach. The Jongeli canal and the oil refiners should be areas to watch while the promotion of tourism could yield tremendous benefits.

9.2. Recommendations

Sudd is one of the biggest wetlands in the world and it provided different ecosystem services to the local community and beyond. Especially, the regulating and biodiversity services of the wetland are big while the provisioning services is very promising. The study has proposed two development options for the wetland each with different sub-activities to be performed. The first is the wise management and utilization of the wetland while the second is the green development path which demands a balance between the development needs of the country and the protection of its ecosystem and biodiversity. Based on the findings of this study, the following recommendations are forwarded:

- ✚ Strong institutions are very crucial in efficiently conserving and managing the wetland. Hence, in addition to the establishing institutions with such mandates, the parliament need to approve the different pending legislations with the aim of protecting the natural resources of the country. This is the least commitment the government can prove its greater ambition for protection and conservation of the country's resources. Enhance the capacity of the

different workers in different institutions through formal education and informal on the job trainings.

- ✚ Allocate budget which is necessary for the execution of the institutions' mandate. It has been highlighted that budget for issues directly addressing matters of the wetland are almost non-existent. Even if this is understandable for now, with restoration of peace and normal life in the country, adequate budget should be allocated for managing and conserving the wetland. The government should also take the initiative to solicit finance from foreign sources aimed at conservation of the wetland.
- ✚ Aim for green development and the construction of green infrastructure. It has been shown that the wetland has serious challenges which could significantly jeopardize the livelihood of the local community and hence the country at large. It is also understandable that the country has serious demands for development. However, care should be taken to balance the development needs of the country with the protection and conservation of its ecosystem. The best approach is to follow green the development path where economic growth is should not be against the resource endowment of the country.
- ✚ Promote tourism using the Sudd wetland. Sudd is a wetland of international importance and rich in flora and fauna which can be regarded as good potential for tourism. Currently, tourism is almost non-existent and this trend should not continue. The country, once comes to peace terms, should advocate tourism and Sudd could be one of the best endowments in this regard.
- ✚ The government should work to secure additional source of financing from local and international actors; say in the form of climate financing. From afforestation and reforestation measures, the local community could benefit additional source of income. The pollution from the oil spillage is also affecting the wetland. Hence, those polluting the wetland should internalize the cost of pollution and in such effort additional finance could be secured that may be utilized for conservation of the wetland.

10. REFERENCES

- Adkins, B. (2015): Forestry and Prospects for Stability, Livelihood and Peace-Building in the Equatoria States of South Sudan. USAID South Sudan.
- AEO (2013): Africa Environment Outlook 3: Summary for policy makers. A publication of the United Nations Environment Program.
- Agimass, F., and Mekonnen, A. (2011): Low-income fishermen's willingness-to-pay for fisheries and watershed management: An application of choice experiment to Lake Tana, Ethiopia. *Ecological Economics*, 71, 162-170.
- Azab, A. M. (2017): Economic Valuation of Wetlands Ecosystems for Wise Use - Review and Case Studies from the Nile Basin. A Nile Eco-VWU Project presented at the 5th Nile Basin Development Forum, 23 - 25 October, 2017, Kigali.
- Baecher G. 2000. The Nile Basin – Environmental transboundary opportunities and constraint analysis. USAID PCE-I-00-96-00002-00.
- C. Michael, H. (2009): Painted Hunting Dog: *Lycaon pectus*.
- Dessu, S.B., Melesse, A.M., Bhat, M.G., McClain, M.E. (2014): Assessment of water resources availability and demand in the Mara River Basin. *Catena*, 115, 104–114.
- Diaz, S., Demissew, S., Carabias, J., et al., (2015): The IPBES Conceptual Framework – connecting nature and people. *Curr. Opin. Environ. Sustain.* 14, 1–16.
<http://dx.doi.org/10.1016/j.cosust.2014.11.002>.
- Daily, G.C., Matson, P.A. (2008): Ecosystem services: from theory to implementation. *Proc. Natl. Acad. Sci. USA* 105 (28), 9455–9456.
- De Villiers, M. (2001): *Water: The Fate of our Most Precious Resource*. Mariner Books.
- Dumont, H.J. (2009). "A Description of the Nile Basin, and a Synopsis of Its History, Ecology, Biogeography, Hydrology, and Natural Resources". In H.J. Dumont (ed.). *The Nile. Monographiae Biologicae* 89. Springer.
- FAO (2017): Regional Analysis of the Nationally Determined Contributions of Eastern Africa: Gaps and opportunities in the agriculture sectors. Environment and Natural Resources Management Working Paper 67.
- FAO and WFP (2019): Special report on crop and food security assessment mission to South Sudan.
- Furniss, C. (2010): "Draining Africa's Aden. Geographical.
- Gafta, D., Akeroyd, J. (2006): *Nature Conservation. Concepts and Practice*. Springer, Berlin, New York.
- Green, J., El-Moghraby, A.I. (2009): "Swamps of the Upper White Nile". In H.J. Dumont (ed.). *The Nile*.
- Hein L., van Koppen, K., de Groot, R.S, and van Ireland, E.C. (2006): Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics*, 57, 209-228.
- ISSC I. (2015): Review of the Sustainable Development Goals: The Science Perspective. International Council for Science (ICSU) - Paris.
- Koang, T.J. (2006): "Jongeli Canal Project is a Looming Catastrophe". Gurtong.
- Kakuru, W., Turyahabwe, N., and Mugisha, J. (2013): Total Economic Value of wetlands Products and Services in Uganda. *The Scientific World Journal*, Volume 2013, Article ID 192656, 13 pages <http://dx.doi.org/10.1155/2013/192656>.
- Langat, D., and Cheboiwo, J. (2010): TO CONSERVE OR NOT TO CONSERVE: A CASE STUDY OF FOREST VALUATION IN KENYA. *Journal of Tropical Forest Sciences*, 22, 5-12.
- Maclean, M.D., Tinch, R., Hassall, M., Boar, R. (2003): Towards Optimal Use of Tropical Wetlands: An Economic Valuation of Goods Derived from Papyrus Swamps in Southwest Uganda. CSERGE Working Paper ECM 03-10.

- Marazzi, L., Finlayson, C.M., Peter, A.G., Paul, J., John S.K., Evelyn, E.G. (2018): Balancing wetland restoration benefits to people and nature. *The Solutions Journal*, Volume 9, Issue 3.
- Millennium Ecosystem Assessment (MA) (2005): *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
- Ministry of Environment (MoE) (2015): The Republic of South Sudan – Fifth National Report to the Convention on Biological Diversity. Republic of South Sudan, Juba.
- Ministry of Environment (MoE) and UNDP (2012): Environmental Impacts, Risk and Opportunities Assessment: Natural resources management and climate change in South Sudan.
- Moghraby, A. I., Faisal, A. S., Khalid M. R., Bojoi, M. R. (2006): Information Sheet on Ramsar Wetlands. Key Document of the Ramsar Convention.
- Mohamed, Y. A., Savenije, H. H., Bastiaanssen, W. G., and van den Hurk, B. J. (2005): New lessons on the Sudd hydrology learned from remote sensing and climate modeling. *Hydrol. Earth Syst. Sci.*, 10, 507–518.
- Mulatu, D.W., Oel, P.R., Odongo, V. and Veen, A. (2018): Fishing community preferences and willingness to pay for alternative developments of ecosystem-based fisheries management (EBFM) for Lake Naivasha, Kenya. *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*.
- Mulatu, D.W., van der Veen, A., and van Oel, P.R. (2014): Farm households' preferences for collective and individual actions to improve water-related ecosystem services: the Lake Naivasha basin, Kenya. *Ecosystem Services*, 7, 22-33.
- Pandeya, B., Buytaert, W., Zulkafli, Z., Karpouzoglou, T., Mao, F., Hannah, D.M. (2016): A comparative analysis of ecosystem services valuation approaches for application at the local scale and in data scarce regions. *Ecosystem Services* 22: 250–259.
- Riak, M.K. (undated): Sudd Area as a Ramsar Site: Biophysical Features.
- Schuijt, K. (2002): Land and Water Use of Wetlands in Africa: Economic Values of African Wetlands. Interim Report, IR-02-063. International Institute for Applied Systems Analysis, Austria.
- Schuyt, K.D. (2005): Economic consequences of wetland degradation for local populations in Africa. *Ecological Economics*, 53, 177-190.
- Sen, A., Harwood, A.R., Bateman, I.J., Munday, P., Crowe, A., Brander, L.M., Raychaudhuri, J., Lovett, A.A., Foden, J. and Provins, A. (2013): Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. *Environmental and Resource Economics*, Volume 57, Issue 2, pp 233–249. DOI 10.1007/s10640-013-9666-7.
- Skourtos, M.S., Troumbis, A.Y., Kontogianni, A., Langford, I.H., Bateman, I.J. and Georgiou, S. (2003): An Ecological and socio-economic Evaluation of Wetland Conservation Scenarios. In: *Managing Wetlands: An ecological Approach*, (ed. Turner RK, van den Bergh, J.C., Brouwer, R.). Edward Elgar Cheltenham, pp. 198-222.
- Tallis, H., and Polasky, S. (2009): Mapping and valuing ecosystem services as an approach for conservation and natural-resource management. *Ann. New Y. Acad. Sci.* 1162 (1), 265–283.
- TEEB, (2010): In Kumar, P. (Ed.), *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. Earthscan, London and Washington DC.
- Troy, A., and Wilson, M.A. (2006): Mapping ecosystem services: Practical challenges and opportunities in linking GIS and value transfer. *Ecological Economics*, 60, 435-449.
- UNDG (2015): Introduction to post-2015 agenda: Origins and process. United Nations Institute for Training and Research.
- UNEP (2018): South Sudan First State of Environment and Outlook Report 2018.
- UNEP (2015): The Economic, Cultural and Ecosystem Values of the Sudd Wetland in South Sudan: An Evolutionary Approach to Environment and Development.
- USAID (2016): Climate Change Profile of South Sudan. Country fact sheet.

Wetland Management Department, Ministry of Water and Environment, Uganda; Uganda Bureau of Statistics; International Livestock Research Institute; and World resource Institute (2009): Mapping a Better Future: How Spatial Analysis Can Benefit Wetland and Reduce Poverty in Uganda. Washington D.C. and Kampala: World Resource Institute.

World Bank (2012): Agricultural potential, rural roads, and farm competitiveness in South Sudan.

11. ANNEXES

Annex-I. Required Information Data Source, and Analytical Method to Assess the Ecosystem Condition

Type of information required	Data sources or analytical models								
	Remote sensing and GIS	Natural resource and biodiversity	Socioeconomic data	Ecosystem models	Indicators of ecosystem condition	Indigenous and traditional knowledge	KII and focus group data	Quick house hold survey	Case studies of ecosystem response
Current spatial extent and condition of ecosystem	x	x			x			X	
Quality, quantity and spatial distributions of services provided by system		x		x					
Human populations residing in and deriving livelihoods from system			x			x	x		x
Trends in ecosystem conditions and services	x	x		x	x	x	x	x	x
Future treats for further degradation of the wetland							x	x	x
Response of ecosystem condition and services to drivers				x	x	x			x
Current conservation program which undertaken by different stack holders							x	x	
alternative options of conservation program							x	x	

Annex-II. Key Informant Checklist for Economic Valuation and Conservation Opportunities for Sudd Wetland, South Sudan

Hello. My name is _____. We are conducting a study on behalf of a team of consultants, that are hired by NBI, that will be used to evaluate the total economic value of the Sudd Wetland in South Sudan and to propose conservation options for the Wetland. You have been chosen because of the knowledge and information you have about the Sudd wetland and your overall expertise on wetlands. We would like to ask you some questions about the topic of study. All of the answers you give will be confidential and will not be shared with anyone other than members of the consultancy team and the information will be used only for the purpose of this study. Hence, your sincere response and cooperation is very important towards contributing to the quality of the findings of this study. We rally thank you in advance for your willingness to participate in this survey.

1. Name of the interviewee: _____
2. Sex of the respondent (observe): _____
3. Current responsibility (position) of the respondent: _____
4. How long have you been in this position? _____
5. Education level of the respondent: _____
6. Specialization (area of expertise): _____
7. How big is the Sudd wetland? (if possible, ask its size as defined by responsible office of the country).
8. How many biophysical categories are there in the wetland? What are the criteria for such classification? What is the size of each biophysical category?
9. How many people live in and around the Sudd wetland? (if possible, ask the number by ethnicity and/or clan).
10. How do you describe the availability of livestock in the wetland? (If possible, could you provide us data on the different types and number (if no official data is available, your expert guess is welcome) of livestock and other animals found in the wetland.
11. What are the major benefits derived from the Sudd wetland for the local community in particular and the country (South Sudan) in general? (if possible, list them by ecosystem services such as provisioning services, cultural services, regulating services and biodiversity services). (Refer table 2 below)
12. Could you explain the trend of the wetland in terms of degradation and improvement situations? That is; whether it is improving over time or not. What are the degradation and improvement factors?
13. What are the major challenges facing the wetland? Please elaborate in detail.
14. Are there situations that could be regarded as positive potential for improving the situation of the wetland (enabling conditions for wetland conservation)?
15. What are the most appropriate conservation options for the wetland? (if possible, propose conservation options for each biophysical category).

Table 1: Appropriate conservation options as proposed by the interviewee

No.	Conservation options	Benefits	Costs		
			Transaction costs	Opportunity costs	Implementation costs
1	Biophysical category one				
2	Biophysical category two				
3	Biophysical category three				
4	Biophysical category four				

16. Are there any existing conservation programs underway in or around the wetland? Who is the owner or initiator of such programs?

17. Could you please explain the process of identifying and implementing conservation programs? Include also the role of the local community in such process.

18. What is the future prospect of the wetland? Why?

Table 2: List of ecosystem services that could be potentially provided by Sudd wetland

No.	Questions and filter	Coding categories		
11	Which of the following ecosystem services do you get from the wetland? RATE THEM IN ORDER OF IMPORTANCE			
11a	A) Provisioning	Yes	No	Order of importance
	i. Timber	1	2	
	ii. Fuelwood	1	2	
	iii. Agricultural crops	1	2	
	iv. Domestic water supply	1	2	
	v. Grazing	1	2	

	vi. Livestock watering	1	2	
	vii. Fish	1	2	
	viii. Hunting	1	2	
	ix. Wild fruits and vegetables	1	2	
	x. Natural medicine	1	2	
	xi. Honey	1	2	
	xii. Fodder	1	2	
11b	B) Cultural services	Yes	No	Order of importance
	i. Transport	1	2	
	ii. Cultural	1	2	
	iii. Educational	1	2	
	iv. Tourism	1	2	
11c	C) Regulating services	Yes	No	Order of importance
	i. Carbon sequestration	1	2	
	ii. Water attenuation	1	2	
	iii. Water purification	1	2	
	iv. Soil protection (protection from soil erosion	1	2	
11d	D) Support services	Yes	No	Order of importance
	i. Biodiversity services	1	2	
	If you believe there are other major ecosystem services that are provided by Sudd wetland but not mentioned in the above list, you may mention them		1. _____	
			2. _____	
			3. _____	

19. We would like to estimate the enterprise budget for different wetland conservation options. As an expert on the area, we believe you have better ideas on the following issues and we would appreciate for patiently completing the table below.

No.	RESOURCE CHARACTERISTICS									
	Resource name	Unit of measurement	volume harvested (household/person/day)	Volume consumed (%)	Volume sold (%) quantities	Seasonal variation		Trends/changes over years		
						high	low	increased	decreased	no change
1	Land for greazing									
2	Palm (Hyphenethebica)									

3	Hay									
4	Bricks									
5	Charcoal production									
6	Water for livestock									
7	Water for personal demand									
8	Natural medicine									
9	Honey									
10	Agriculture production on flood plain area									
11	Demand trees for timber									
12	Fishing									
13	Hunting									
14	Wild fruit consumption									
15	Grass to build your house									
16	Papyrus to make mats or anything									
17	Fodder									
18	Fuel									
19	Spiritual service									
20	Tourism									
21	Transport									
22	Educational									

Regulation Service

	Regulation Service	Information required	
22	Carbon sequestration	Could you list the nature of tree, bush and grass species widely available in the wetland? If possible, could provide the carbon sequestration capacity and area coverage of each species?	
23	Water attenuation	How much cost, do you guess, have been incurred had the Sudd wetland was not in place (or how much cost is avoided due to the Sudd wetland in terms of water reservation infrastructure)?	
24	water purification	How much cost, do you guess, have been incurred had the Sudd wetland was not in place (or how much cost is avoided due to the Sudd wetland in terms of water purification activities)?	
25	Soil protection (prevented soil erosion)	How does the wetland prevent soil erosion? Can you guess the monetary value of such service from the wetland?	

Supporting Service

Product/service	
Biodiversity	<p>On average how much annual budget is allocated for conservation of biodiversity by:</p> <p>a) Government of the Republic of South Sudan (Federal government) _____</p> <p>b) States the Sudd wetland is available _____</p> <p>c) Non-governmental organization _____</p> <p>d) International agencies _____</p>

Thank you again!

Annex-III: Focused Group Discussion Guide for Economic Valuation and Conservation Opportunities for Sudd Wetland, South Sudan

Hello. My name is _____. We are conducting a study on behalf of a team of consultants, that are hired by NBI, that will be used to evaluate the total economic value of the Sudd Wetland in South Sudan and to propose conservation options for the Wetland. You have been chosen to participate in this discussion because of the knowledge and information you have about the Sudd wetland. We would like to ask you some questions about the topic of study. All of the answers you give will be confidential and will not be shared with anyone other than members of the consultancy team and the information will be used only for the purpose of this study. Hence, your sincere response and cooperation is very important towards contributing to the quality of the findings of this study. We rally thank you in advance for your willingness to participate in this discussion.

1. Name and responsibility of the participants (the size of an FGD should not exceed 8 individuals)

No.	Name of the participant	Gender	Sub-location	Responsibility	Main occupation
1					
2					
3					
4					
5					
6					
7					
8					

2. How big is the Sudd wetland? (if possible, ask its size as defined by responsible office of the country).
3. How many biophysical categories are there in the wetland? What are the criteria for such classification? What is the size of each biophysical category?
4. How many people live in and around the Sudd wetland? (if possible, ask the number by ethnicity and/or clan).
5. How do you describe the availability of livestock in the wetland? (If possible, could you list the different types of livestock and other animals found in the wetland).
6. What are the major benefits derived from the Sudd wetland for the local community in particular and the country (South Sudan) in general? (if possible, list them by ecosystem services such as provisioning services, cultural services, regulating services and biodiversity services). (Refer table 2 below)

7. Could you explain the trend of the wetland in terms of degradation and improvement situations? That is; whether it is improving over time or not. What are the factors/reasons for degradation and improvement?
8. What are the major challenges facing the wetland? Please elaborate in detail.
9. Are there situations that could be regarded as positive potential for improving the situation of the wetland (enabling conditions for wetland conservation)?
10. What are the most appropriate conservation options for the wetland? (if possible, propose conservation options for each biophysical category).

Table 1: Appropriate conservation options as proposed by FGD participants

No.	Conservation options	Benefits	Costs		
			Transaction costs	Opportunity costs	Implementation costs
1	Biophysical category one				
2	Biophysical category two				
3	Biophysical category three				
4	Biophysical category four				

11. Are there any existing conservation programs underway in or around the wetland? Who is the owner or initiator of such programs?
12. Could you please explain the process of identifying and implementing conservation programs? Include also the role of the local community in such process.
13. What is the future prospect of the wetland? Why?

Table 2: List of ecosystem services that could be potentially provided by Sudd wetland

No.	Questions and filter	Coding categories		
6	Which of the following ecosystem services do you get from the wetland? RATE THEM IN ORDER OF IMPORTANCE			
6a	A) Provisioning	Yes	No	Order of importance
	i. Timber	1	2	
	ii. Fuelwood	1	2	
	iii. Agricultural crops	1	2	
	iv. Domestic water supply	1	2	
	v. Grazing	1	2	
	vi. Livestock watering	1	2	

	vii. Fish	1	2	
	viii. Hunting	1	2	
	ix. Wild fruits and vegetables	1	2	
	x. Natural medicine	1	2	
	xi. Honey	1	2	
	xii. Fodder	1	2	
6b	B) Cultural services	Yes	No	Order of importance
	i. Transport	1	2	
	ii. Cultural	1	2	
	iii. Educational	1	2	
	iv. Tourism	1	2	
6c	C) Regulating services	Yes	No	Order of importance
	i. Carbon sequestration	1	2	
	ii. Water attenuation	1	2	
	iii. Water purification	1	2	
	iv. Soil protection (protection from soil erosion	1	2	
6d	D) Support services	Yes	No	Order of importance
	i. Biodiversity services	1	2	
	If you believe there are other major ecosystem services that are provided by Sudd wetland but not mentioned in the above list, you may mention them	4. _____		
		5. _____		
		6. _____		

Thank you again!

Annex IV: Current and Projected Total Economic Value of the Wetland and its Changes over Time

Ecosystem service	2015			2025			2035			Change 2015 to 2025	Change 2015 to 2035	Change 2025 to 2035
	size (ha)	Unit value \$ (ha)	Total Value	size (ha)	Unit value \$ (ha)	Total Value	size (ha)	Unit value \$ (ha)	Total Value			
Crop	131,112	299	39,202,488	135,300	299	40,454,700	138,400	299	41,381,600	1,252,212	2,179,112	926,900
Fish	89,352	77.8	6,951,586	79,400	77.8	6,177,320	70,900	77.8	5,516,020	(774,266)	(1,435,566)	(661,300)
Papyrus	480,965	19.5	9,378,818	480,965	19.5	9,378,818	480,965	19.5	9,378,818	-	-	-
Papyrus crafts	480,965	47.95	23,062,272	480,965	47.95	23,062,272	480,965	47.95	23,062,272	-	-	-
Domestic water supply	160,000	35.3	5,648,000	160,000	35.3	5,648,000	160,000	35.3	5,648,000	-	-	-
Livestock watering	1,786,336	2	52,161,011	1,786,336	2	52,161,011	1,786,336	2	52,161,011	-	-	-
Livestock grazing	1,786,336	0.2	130,402,528	1,786,336	0.2	130,402,528	1,786,336	0.2	130,402,528	-	-	-
Fuelwood	264,168	4.58	1,209,889	246,200	4.58	1,127,596	236,700	4.58	1,084,086	(82,293)	(125,803)	(43,510)
Natural medicine	2,985,750	0.91	2,717,033	2,991,600	0.91	2,722,356	2,996,800	0.91	2,727,088	5,324	10,056	4,732
Charcoal	5,000	0.3	3,900,000	5,000	0.3	3,900,000	5,000	0.3	3,900,000	-	-	-
Vegetation	1,141,263	0.56	639,107	1,105,700	0.56	619,192	1,081,100	0.56	605,416	(19,915)	(33,691)	(13,776)
Mulch	16,920	140	2,368,800	18,500	140	2,590,000	19,800	140	2,772,000	221,200	403,200	182,000
Total provisioning			277,641,531			278,243,792			278,638,838	602,261	997,307	395,046
Transport	89,352	1.82	162,621	79,400	1.82	144,508	70,900	1.82	129,038	(18,113)	(33,583)	(15,470)
Microclimate regulation	3,075,102	265	814,902,030	3,071,000	265	813,815,000	3,067,700	265	812,940,500	(1,087,030)	(1,961,530)	(874,500)
Flood control	3,075,102	723.89	1,064,045,010	3,071,000	723.89	1,062,625,639	3,067,700	723.89	1,061,483,775	(1,419,372)	(2,561,236)	(1,141,864)
Water regulation	3,075,102	30	92,253,060	3,071,000	30	92,130,000	3,067,700	30	92,031,000	(123,060)	(222,060)	(99,000)
Total regulating service			1,971,200,100			1,968,570,639			1,966,455,275	(2,629,462)	(4,744,826)	(2,115,364)
Biodiversity	3,075,102	439	1,349,969,778	3,071,000	439	1,348,169,000	3,067,700	439	1,346,720,300	(1,800,778)	(3,249,478)	(1,448,700)
Grand total			3,598,974,030			3,595,127,939			3,591,943,451	(3,846,091)	(7,030,579)	(3,184,488)
Grand total after income adjustment			3,286,019,767			3,282,508,118			3,279,600,542			

Annex V: List of participants during the Juba consultative meeting

No	Name	City	Organization	Position	Telephone	E-mail
	OUTSIDE JUBA					
1	Mr. Chuol Lual Nyagwok	Maiwut	Physical Infrastructure	Deputy Director	+211 925800001	
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44	Mr. Vukeni Christopher		South Sudan Wildlife Society (SSWS)	Conservation Officer	+211923419563; +211923536745	yukenichris170@gmail.com
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	TEEB					

48	Dr. Dawit Woubishet Mulatu	Addis Ababa	Environment and Climate Research Center (ECRC), Policy Studies Institute (PSI)	Researcher	+251911603699	dawitwmulatu@gmail.com
49	Dr. Jemal Ahmed	Addis Ababa	Addis Ababa University (Consultant)	Consultant & Assistant Professor	251,936,690,260	jemu122@gmail.com
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	ENTRO					
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Annex VI: Technical Note for the NBI- Writeshop Meeting on TEEB for wetlands in Nile River Basin case studies, July 22-23, 2019: Kampala, XANADU Hotel



Prepared by: Dawit W. Mulatu (TEEB Consultant)

Day-I: July 22, 2019

The meeting started by welcoming address from Nile-Sec (Leonard Akwaney) and introduction, the objective of the meeting, presentation & discussion of case study objectives and methodologies were presented by Lucy. Followed by, each wetland case studies presentations. Expected to each case studies to have a detailed methodology at the end of the Writeshop workshop:

1. Preparatory desk review- expected output will be inception report
 2. Field scoping exercise- expected output will be detailed methodology
 3. Data collection- expected output will be mid-term report
 4. Analysis and reporting- expected output will be technical reports
- Purpose, scope , focus and methods should be cleared
 - Foster peer review and exchange from within the panel
 - Expected output of the assignment for Sudd and Machar wetlands is to provide Input for economic value wetland and water-related ecosystem services into integrated wetland management planning and Overall River planning and development decision making.
 - The other three case studies focus is to contribute for wetland conservation plan
 - The sources of finance for conservation efforts (GCF)
 - Refine the focus!!!!

Reflection on Machar Marshes:

- ❖ We need to add objective on how to make it usable this document and for whom
- ❖ Knowing where are we going?
- ❖ Most suitable valuation method: consider accessibility, community, available resources (time, budget and other resources)
- ❖ Expected products (like report, paper, policy brief)
- ❖ Products for whom?
- ❖ The team is seriously ambitious is one of the comments from the technical reviewers, which is taken as positive, starting in broad will benefit to synthesise the report,
- ✓ Distribution of key features
- ✓ Per hectare value need area identification for different interventions and wetland settings
 - Clearly articulate the objectives (but they were taken from the ToR)
 - Agree on the wetland area/delineation due to its variability/fluctuation
 - Improve the flow and consistency, this reflection is well taken.
- Consult with hydrology experts to understand the dynamic of the area that has vibrant hydrological system,

Proposed Method will be:

1. Identify and mapping of stakeholders (whose costs and benefits, interest, influence, expected role and power)
2. List potential Ecosystem Services(ES),(if possible trends and status)
3. Conduct LULC analysis (with agreed LULC classifications)
4. Identify alternative restoration options, impact and implications
5. Value transfer/benefit transfer (due to the existing challenges to conduct SP method, detail review to conduct benefit transfer)
6. Develop future scenarios of LULC change and impact on wetland ES
7. Analyse the different scenarios
8. Provide policy implications
9. Main Deliverables of this assignment (expected outputs and for whom?)

Tailoring the case studies:

- ❖ Increasing the policy impact of ES assessment and valuation (recent GIZ document)
- ❖ *To bring the economic value of wetlands and water-related ecosystem services into integrated wetland management planning and overall River planning and development decision making.*
- ❖ Policy questions Vs Research questions
- ❖ The research questions demand a rigorous/technical process/language Vs policy questions that demand quick response/simple/explanatory

Discussion points on how to influence decision makers and the line of argument for Machar Marshes Wetlands:

What decision making process does the case study seek to guide or influence?

- ❖ Policy formulation
- ❖ *Integrated development decision making.*

In which way:

- ❖ Cost benefit analysis (CBA); Demonstrate the value of these wetlands (+ve and -ve externalities of these values)
- ❖ Distributional effects (e.g how many people are benefited?)

Who are the main decision makers?

Ministry of Finance
Ministry of Environment and Forest
Ministry of Water
Ministry of Petroleum
Ministry of Dams and energy
Ministry of wildlife and Tourism
State Governments (Counties)

Target Audience: local community, NGOs, research institutes

The overall policy questions:

Why investing in wetland restoration options?

What will be the likely impact of the wetland restoration option on local communities?

The story line of argument

Machar Marshes wetlands in Nile basin are highly degraded,

These wetland treats emanate from both internal and externalidentifying potential Interventions to conserve the wetland are vital....we conducted the CBA of these interventions should be valued with BAU and alternative restoration options.....we highlighted the implication of these intervention and required investment....thus, it demand policy decision and finance allocation for implementation and implement additional instruments and incentive mechanisms (like PES)

Sequence of research questions:

- ❖ What are the current challenges and drivers of these challenges the wetlands?
- ❖ Who are the beneficiaries and losers?
- ❖ What are the current investments?
- ❖ What are the other optional investments?
- ❖ How best can influence policy and planning?

Comments for the line argument: Target audience (people who do you want to influence? Or users of this information), Line of reasoning.... and additional instruments and incentives, PES....leveraging private sector investment can be considered in policy implication part of the report

Day-II: July 23, 2019

The meeting started with a re-cap of the first day and presentation on what needs to be valued and the day activities continue with two round case study team with technical reviewers discussions/group meetings.

I. Determining what need to be valued?

What ES to be value for and for whom; in light of the limited time and resources.

What are the most relevant from the list of ecosystem services?

- ❖ Identify and assess ES v
- ❖ Estimate and demonstrate
- ❖ Capture the value of the ES and seek solutions

Identify and balancing

- ❖ Dependencies
- ❖ Impacts
- ❖ Risks
- ❖ Opportunities

Discussion Points Machar Marshes Wetland-I:

- ✓ Which ES are most relevant?
 - Machar Marshes wetland: Provisioning services, Biodiversity, the green infrastructure via maintaining the regulating services (water-related ecosystem services, and local climate)
 - Note! Be clear on either measuring the resource stock or the resource flow!
 - TEV, the direction is to highlight the Total Economic Value of the ES (TEVES)
 - Aim and why these ES are selected
- ✓ Which groups, sectors and sites?
 - Local community, the delineated wetland (Identified spatial scale), local/state government counties, national, Nile-basin region countries , and global community (carbon and biodiversity),
- ✓ Which values will be considered and distributional aspect?
 - TESV
 - PS= Market value,
 - RS=ESV with benefit transfer,
 - CS=TCM or value transfer
 - Biodiversity= Estimated and potential investment to conserve via Value transfer
- ✓ Distributional aspects: Incentive, PES, tax, and fees

II. Dealing with time and change, refining scenarios to be modelled?

- ❖ Spatial,
- ❖ Temporal
- ❖ Connectivity
- ❖ Causality and complexity
- ❖ Risk and uncertainty
- ❖ Trade-offs and synergies

Discussion Points for Machar Marshes Wetland-II:

Which trade-off or change?

- ❖ There could be a trade-off agricultural land use Vs wetland (depending on the type of crops cultivated)
- ❖ There could be a trade-off settlement Vs vegetative cover
- ❖ There could be a trade-off grazing land (livestock) Vs species diversity/richness
- ❖ There is a trade-off wetland Vs accelerated water-flow (i.e through canal development)

Which scenario?

- ❖ The status-quo
- ❖ Improved management of the wetlands
- ❖ Green development initiatives
 - We proposed potential restoration options from our review but these will be refined through KII and FGDs that is planned next month in Juba.

Which parameter or conditions?

- ❖ More or less the parameters or conditions are linked with identified indicators
- ❖ i.e. the indicators are changing in a positive directions

Which indicators?

- ❖ Water volume and water quality
- ❖ Species richness
- ❖ Vegetation cover
- ❖ Wetland cover (size)
- ❖ Livelihood (Household income, number of household, food security, and asset building)
- ❖ Qualitative indicators: Perceptions related to the value of wetland, willingness to participate and willingness to pay)

III. Elaborating the information to be generated, methods to be applied and data needs/sources?

Matrix:

- ❖ List of ES
- ❖ Valuation method
- ❖ Key data needs,
- ❖ Info. on biophysical linkage/causality

IV. Work plan and methodology revisions and next steps!

- ❖ **Way forward:**
 - ✓ Work on the new reflections
 - ✓ Concretize the ideas,
 - ✓ The ToR and timeline still alive
 - ✓ Tap available resources and data

End of the workshop

Annex V: Notes and Reflections in Juba Meeting:
South Sudan National Wetlands Consultation Workshop: Building Knowledgebase and Capacities for Wise Use of South Sudan Wetlands for Healthy River Nile - Grand Juba Hotel, Asmara Hall, Juba, South Sudan



Prepared by: Dawit W. Mulatu and Jemal Ahmed (TEEB consultant)

Day I – 27 August 2019

The workshop is planned to be held for three days. The workshop organized with theme on “**South Sudan National Wetlands Consultation Workshop**”. The first two days organized to share the Sudd wetland base line studies and the third day organized for Sudd and Machar Marshes wetlands TEEB case studies. The workshop started at about 9:30 A.M. with a speech delivered by three officials from two ministry offices. Among the speeches that capture our attention was the one made by Peter and he iterated that “if you want to go fast, move alone; and if you want to go far, move in a group”. He raised this idea to emphasize on how working in a group or in a team allows sustainable results/produces than other setups. Then, he also quotes Ms. Michelle Obama, the former first lady of U.S.A., said that ‘if want to solve a problem, come as a community’. When you come as a community, you will find that the person you are looking for to solve the problem, which is the community itself. Following Peter, Joseph delivered his speech and he highlighted that conducting Environmental and Social Impact Assessment is mandatory according to the interim constitution of South Sudan. Finally, Mr. David emphasized in his speech on some of the challenges and problems the country are facing regarding its wetlands and integrated development. Particularly, he stated that Water hyacinth is becoming a major problem on the Sudd wetland and conflicts over the river Nile is becoming a challenge on South Sudan wetland areas. He also added that limited research and knowledge development related to socio-economic component of the wetlands in South Sudan, and pointed that more research should be conducted for better decision making.

Following this, Leonard, from NBI-Nile Sec, presented the NBI wetlands and workshop objectives. Leonard presentation focus on NBI-wetland program: The presentation emphases on various themes mainly include: NBI-wetland program objectives, NBI Nile basin wetland best practices, biodiversity conservation and sustainable utilization of wetland ecosystem services, Nile basin wetlands work force, regional wetlands status report, on-going wetlands portfolio work, wetlands knowledge base development, wet (peat) land, wetland management plan, networking and capacity building, and wetland engagement platforms (presented by Leonard Akwaney, NBI). Subsequently, Titus from Wetland International (WI) Kenya Office and a focal person of WI for South Sudan, presented project objectives, tasks, timelines and cooperation need among others. Particularly his presentation focus on on wetland challenges, environmental threats, management plan, ecosystem services, and capacity building (presented by Titus Wamae, WI)

The presentation continued by Dr. Georg Petersen from HYDROC. His presentation concentrations was on project objectives, tasks, timelines, work packages and cooperation need of HYDROC for the assignment with the following major **Work Packages (WP)**: **WP1**-wetland mapping (The 2018 LULC analysis, the vegetation class considered are open water, reeds, papyrus, and wetland grass); wetland inventory: about 68 wetlands in Nile river basin, wetland atlas; **WP2**: wetland modelling; **WP3**: Ecosystem services (Regulating ES: climate regulation, bioclimatic services; Provisioning ES: food, water for direct consumption and non- consumption uses, transport; Cultural ES); **WP4**: Biodiversity assessment; **WP5**: environmental flow assessment; **WP6**: Wetland policy choices and assessment framework; **WP7**: Draft framework wetland management plan (presented by Dr. Georg Petersen).

Georg, from HYDROC, presented six of the eight work package tasks and needs during the first day. One of the points raised during his presentation was the wetland units. There are different wetland units; namely: vegetation cover, geology, flood, water sources, landscape, and

ecosystem. However, vegetation cover is the important one and it can lead to see the others. A question was asked on the Sudd's link to ecology in wetland modeling. Georg explained that the Sudd wetland soil is black soil with cracks and it's like a plastic layer. Hence, compared to evapotranspiration, infiltration is very minimal for the modeling project (it may not be the exact words and we stated this the way we understood). As well, the water in Malakal is clear due to the sedimentation and navigation is becoming difficult due to the expansion of the sedimentation.

The issues of Sudd wetland boundaries on inflow and outflow was raised, and George stated that inflow at Mangala and outflow at Malakal are the major ones and the others are smaller in volume inflow and outflow. One important point that strikes us is Georg pointed out that pollution is consumption. In his presentation of work package 4 which deals with biodiversity assessment, Georg stated that, so far, they have identified a total of 675 species in this regard of which 4 are at critical stage, 5 endangered, 17 near endangered, 15 vulnerable and 8 are conservation dependent species, there was productive discussion regarding biodiversity aspects of Sudd wetlands in the middle of the presentation. The final activity of the day was participants to break-up in to groups to discuss based on the presented work packages.

End of Day I

Day II – 28 August 2019

The day activity started with brief highlight by the moderator to re-cap of the first day meeting and setting the stage for the second day (Mr. Leonard lead this session). Particularly, what was learnt from the first day activities, expectation of the second day, what should be the major points during the first day were the main re-cap themes of the dialogue. Then, the groups continue their discussion to finalize their dialogue and prepare a report for presentation focusing of the first six work packages. The groups presented their discussion major points to participants on policy related challenges, and what should be done to address the challenges.

Presentation of the HYDROC continued by Georg and presented **WP7**: the presentation focus on draft framework wetland management plan on elements, objectives, trade-off, and synergies (presented by Dr. Georg Petersen). The participants again break out in a group to discuss in WP7. Groups presented back with different themes of discussion: definition of involved parties: listing specific stakeholders; implementation guidance for the wetland framework plan; policies and strategies; wetland resources and ecosystems; and stakeholder's role, interest, capacity and decision making power.

Presentation continues on highlights on HYDROC **WP8**: Discussion on Sudd diagnostic analysis: consultation, stakeholder identification, policy understanding, and wetland management scenarios. This theme focus on diagnosis analysis of the Sudd that has the following three pillars::

- a. Stakeholders and counterparts
- b. Sustainability
- c. Implementation and capacity

The remaining time of the day was used for group discussion and presentations which were an interactive and productive session. Finally, the participants raised and reflect on the work packages: the work packages are exhaustive, and required involvement of many stakeholders

on the ground, field work should be conducted for biophysical measurements and socioeconomic information gathering and validation, and bear in mind that the Sudd wetland is dynamic in terms of hydrology, economy, population and biodiversity aspects.

End of Day II

Day III: 29 August 2019

South Sudan National Wetlands consultation workshop and the Nile Basin Wetland TEEB: Case studies on Sudd and Machar Marshes Wetland Economic Valuation (29, August, 2019)

Mr. Leonard gave brief information on the day's activities. Then, Dr. Dawit (consultant for Sudd and Machar Marshes wetland TEEB study) delivered his presentation for both Sudd and Machar Marshes wetlands. The presentation focused on setting the context for the evaluation of the two wetlands, brief introduction on the wetlands, methods to be used among others. After the presentation, one participant stated that Bagara is not among the communities in the Machar wetland and they are not South Sudanese. However, the other participants explained that they used to cross from Sudan and live there. Following this, Dawit gave briefing on the activities to be performed for the day. Accordingly, the participants were divided into four groups (two on each wetland). The groups were formed as:

1. One group composed of individuals that came from the Sudd wetland area alone (Sudd states)
2. One group comprising individuals that came from Machar Marshes wetland area alone (Machar states)
3. The experts that came from the federal bureaus and other offices, they were split into Machar and Sudd groups which was done randomly.

Then each group was informed to work on the first two parts of the KII instrument that was distributed to the participants. The participants started discussing with groups and the consultants (Dawit and Jemal) were moving around to follow, guide, and observe the discussion and to elaborate some of the issues when the need arises. The group discussion continued after the health break. Then groups started presenting the results of their discussion and the first two groups presented before the lunch break.

The remaining two groups presented the discussion points after lunch. Then, the participants went to group discussion on the 3rd and 4th sessions/parts of the guide questions. The groups were informed to spend an hour to discuss the issues at stake due to shortage of time. Also, instead of making each group discuss all the parts, the task was divided in to two and each task was discussed by two groups. After discussing for an hour, we noticed that they still need additional minutes or hours to discuss the questions. Hence, instead of making them present what they have discussed so far, it was better to give them more time to discuss and the discussion continued until 5 P.M. The power-point slides of each group were then collected for further references. The participants were given a chance to reflect on the last day's exercise. They highlighted on the importance of modifying and simplifying the language use, the allotted time was limited compared to the task, and make the questions specific. Dawit, then, gave

concluding remark and in his speech, he thanked the participants for their patience, time, and active participation.

In general, day three presentation session's theme was on Nile Basin Wetland TEEB: Case studies on Sudd and Machar Marshes Wetland Economic Valuation of Biodiversity and Ecosystem Services for Green Infrastructure Planning and Development. The presentation focused on the objective of the project, the expected deliverable from the participants, and the day activities, including the discussion guide instruments (i.e the focus group discussion (FGD) and Key informant Interview (KII) instruments).

The participants conducted two round group discussions and presented by the group major themes of discussion. The participants discussed general themes and stakeholder mapping exercise in the first round. Regarding wetland ecosystem services and wetland conservation options, they discussed in the second round. The discussion note and presentation slides are collected for input to develop the reports.

Finally, the participants made a final remark and reflection about the day: They mentioned the importance of the TEEB study in South Sudan, It is the first of its kind to explore TEEB in South Sudan wetlands, the time limit to discuss thoroughly the proposed TEEB issues, the participants propose it would much manageable if it was a two day exercise, they propose to send such TEEB instrument in advance and participants will get enough time to read, practice and understand the guiding questions, such material would also be great if it is supported by video, media and other communication schemes, the organizers should consider media people invitation to outreach and disseminate the idea to a broader community and stakeholders through news, TV broadcast. The communication and response issues have been raised up; creating smooth communication and timely response are required from all stakeholders for further meetings and consultations to advance in preparation and participation in workshops.

Notes: All group discussion points, notes and presentations are collected and compiled by Nile-Sec.

End of the workshop.

Annex VII: Technical Note on the Juba Validation Workshop as workshop report for South Sudan's Wetlands Economic Valuation of Biodiversity and Ecosystem Services for Green Infrastructure Planning and Development

On 12 March 2020, the morning session was allotted for South Sudan's wetlands Economic Valuation of biodiversity and ecosystem services for Green Infrastructure planning and development. The two wetlands are Sudd and Machar Marshes wetland. The morning session started with brief given to the participants what is expected from this validation workshop by Mr. Leonard from NBI. Followed by Dr. Dawit presentation on the major findings of both *Machar Marshes and Sudd Wetland Economic Valuation of Biodiversity and Ecosystem Services for Green Infrastructure Planning and Development*.

Points raised for Machar Marshes wetland ecosystem services and biodiversity valuation presentation:

- What is the implication of having 98% of the local community depend on the forest resources of the wetland as energy source, which have a direct impact on forest resources? Propose some actions/interventions to overcome the challenge in energy sources?
- Value of the tourism not yet captured, what is the reason and even if currently zero visit to the area, how we can capture the tourism potential
- No-institutional arrangement, what will be the potential enforcement mechanism to implement well-functioning institutional system,
- How about considering the UNECA-Natural capital account (NCA) to capture the value of the wetland ecosystem in the economy using SEEA,
- There is a new developed National Biodiversity action plan (NBAP), which we requested the participant to share us and will include it in the report
- The methodology should have a clarity on the assumptions and based on realistic approach to justify the findings,
- Better to add in the recommendation to consider Agroforestry and Forest and Landscape restoration approach, protected area management as potential intervention,
- Better to re-check the considered 8% of the household for fishery,
- Clarify what do we mean by SS with limited resources? (both the human capacity and other resources)
- Potentially to include the soil contribution for house construction and bricks makings, the soil capacity to sink carbon,
- When mapping the stakeholders, account the interest behind the stakeholders to engage in wetland conservation and utilization of the wetland resources,

The points are well taken and addressed in the development of the final Machar Marshes wetland report.

After tea break (11:30 to 1 PM), the time was allotted for the presentation and discussion of the "Total Economic Valuation of Ecosystem Services of the Sudd Wetland for Green Infrastructure Planning and Development". Dr. Jemal presented the major findings of this report. The presentation took about 45 minutes and the remaining time was used for question and answer session. Among the questions asked during the discussion session are: Why not studies in South Sudan are not considered? Why tourism is not included in the valuation exercise? Why a study from Uganda is used as a policy site? There are stakeholders that are not mentioned in the

study; If we would like know the total economic value of charcoal consumption in Juba, how do we do that? Why navigation is considered as cultural service than provisioning?

An explanation was given to the satisfaction of the participants. On the issue of why studies in South Sudan were not considered, it has been explained that there are no similar valuation studies in the country and the reason the study on Uganda was considered as policy site is that the study covers eight wetlands in different agroecological zones, there are many similarities between the two countries, an adjustment was made for infrastructural and income differences between the two countries. While we acknowledge that there are stakeholders on the Sudd wetland that were not listed in the study, we also believe that it is not possible to list all the stakeholders. But we tried our best to include the major ones. On the issue of tourism, though Sudd can be considered as huge potential for tourism activities, currently there are little or no tourism activities in and around the wetland. Since we are evaluating what is currently existing, it was not necessary to include tourism for now. If sufficient information is readily available, the best way to evaluate the value of charcoal use in Juba is to apply the market price approach. And, on the issue of navigation, its true that some authors include it under provisioning service while others in cultural services. So, the categorization is not a big deal. The above raised pointes are well taken and incorporated in the development of the final report.

Day III, March 13,2020:

Household level questionnaire training:

Friday afternoon (15/03/2020), our team presented the household survey instrument (the household survey questionnaire) to all the participants and an explanation was provided on each part of the questionnaire. Special focus was given for the issue of contingent valuation part of the questionnaire and an elaborated explanation was provided on how to conduct the bidding process and the initial bidding. Afterward, the participants were split into four groups to discuss and fill the questionnaire and to conduct a form of pilot testing of the questionnaire. The main objective of these exercises is to understand the household level questionnaire is manageable or not, particularly to accommodate the local context of South Sudan in the questionnaire. About an hour was allotted for the exercise and each group presented its discussion and comments for the whole participants.

Some of the comments and questions raised during the group presentations and discussions include:

- ✓ For the education level of the respondent, instead of asking the years of schooling, it is better to list the education level as primary, secondary, and so on.
- ✓ Since some people could be willing to contribute not in cash but in kind (labor) it is good to include that possibility.
- ✓ Use sub-village, village, county and state instead of sub-village, village, district, and state.
- ✓ Include gum Arabic among list of the provisioning services.
- ✓ Better to state as randomly selected than you are selected by chance.
- ✓ Better to put ranges for age, income, and distance from the wetland and nearest market of the respondent.
- ✓ Better to say traditional than clan conflict mechanism.

And, finally, three groups proposed the amount of money they proposed is better for the initial bidding process.

Group I: SSP 250 per month or 3000 per year

Group II: SSP 1000 per year

Group III: SSP 3700 per year

Group IV: didn't reach to that part of the questionnaire during the group discussion session. We evaluated the minimum bid and indeed, most of the comments are noted and incorporated in the final version of the household questionnaire. For the initial bidding amount, an average of the three groups is calculated and that is considered as the initial bidding in the final version of the questionnaire. It is estimated an average of about 200 SSP per month to be set as an initial bid for the contingent valuation exercises. After the household questionnaire training and presentation, Mr. Leonard presented the major practices undertaken in wetland peatland studies in South Sudan and participants reflected on the presentation.

Finally, the way forward on the 2nd South Sudan wetland consultation workshop is undertaken and the following major points are raised:

- Strengthen the coordination of this effort and engage other potential stakeholders, not to miss their role and contribution,
- Participatory mechanism to engage more,
- Sharing all the available information through available mechanism, and invite media people for communication outreach,
- Ensure the community leader's engagement in further consultations,
- Venue, time plan and arrangement of the facility room of the workshop,
- Consider the new institutional structure of South Sudan,
- Training and capacity building on wetland management plan and institutional arrangements, economic valuation of wetland ecosystem services, basic concept of wetland, importance of wetland, on how to collect data related to wetlands, modeling, linkage between wetland and climate change, concept of RS and GIS, on how to conduct surveys, and early warning systems,
- Align the above demand that is proposed as training and capacity building with project resources and NBI context
- Having a national level wetland related consultation committee/ working group to ease the process and facilitation of activities related to wetlands
- There was an initiative to have SS National level wetland and biodiversity working group is not progress well, due to the link with specific project and does not have a plan on how to sustain it. It is recommended to follow and apply international experiences to address these challenges (like the Ramsar convention). Better also to share regional experiences from neighboring countries on how they manage in sustaining the wetland and biodiversity working group.
- Tentative team members established to work on as SS wetland and biodiversity working group

End of the presentation and discussion session



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