Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda

February 2016 Prepared for TUOP by TEC
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Introduction

Tullow Uganda Operations Pty Ltd (TUOP), Total E&P Uganda (TEPU), and China National Offshore Oil Corporation (CNOOC) (the Companies) plan to develop oilfields within the Albertine Rift of western Uganda and are currently in a transition phase from exploration to production.

Assessment of impacts and dependencies associated with ecosystem services is in line with "international best practice" (ISO, 2014) and the IEA Performance Standards, which require the valuation and functionality of "priority" ecosystem services, and the benefits derived from them, to be maintained when projects are developed, operated and then closed. In consultation with its partners, TUOP commissioned a preliminary Ecosystem Service Review for the basin scale affected by their development activities. In line with good practice, this included areas outside their immediate to ensure that could be exposed to indirect effects.

This report presents the baseline situation for selected ecosystem services that will be affected by oil development. They were identified in partnership with institutional and local stakeholders in 2014 – 2015 because they are thought to be a particular priority in the area, requiring in-depth consideration. There are many other important ecosystem services that may also be affected and that should be considered when projects lead to environmental assessments are carried out. The dependence of multiple ecosystem services to meet their social needs also needs to be considered.

The approach was to present the stakeholders and the results in a clear and concise manner. The results are presented in a way that is accessible to stakeholders and the public and that can be used to inform decision-making processes.

The approach taken to generate the results in this report outlined in an assessing ecosystem services Method for Ecological Services Assessment of the World (TESE, 2015) and a detailed technical account is available from TUOP Ltd.

Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda
Overview

The Albertine Rift of Uganda supports biodiversity of national and global significance and many people who depend on ecosystem services to meet their basic requirements for life. Their ability to maintain a standard of living, adequate for health and well-being, and access to clean water and sanitation depend critically on ecosystem services that could be affected by oil development.

Oil development can affect the benefits that people are able to derive from ecosystem services, by changing:

- Ecosystem service supply (the state, health, productivity, and capacity of ecosystem services);
- Ecosystem service use (the skills of people to access them or to which patterns of use are attached);
- Ecosystem service benefit (whether the essential needs are met, given existing levels of supply and social potential effects from many drivers, sometimes also including changes in the natural environment and some local areas. In some cases, oil development can affect the quality and quantity of ecosystem services available for local communities, leading to a decline in the services provided by oil development itself.

Population growth is likely to increase competition for ecosystem services and resources, such as land, water, and energy. This could affect the ability of local communities to access ecosystem services, such as subsistence farming, which is crucial for maintaining their livelihoods.

Stakeholder Engagement

Stakeholder engagement was an essential part of this exercise. An expert panel of stakeholders from key stakeholder organizations met in November 2015 to discuss the approach and identify ecosystem service relationships in depth assessment. As well as the companies, representatives included NGOs, PFGUCA, GIA, NUS, Makerere University, EACNY, and UNESCO. During the meeting, further considerations were given to subsistence farming.

In addition to engagement with organizations involved in national-level planning, the state and national resource management, many local communities in the area of potential oil production were also involved. The results of this work are presented in the report and identified next steps to ensure that sustainable supplies of ecosystem services are maintained. On the basis of this meeting, further consideration was given to subsistence farming.

This report is a valuable resource for stakeholders and policymakers, providing insights into the potential impacts of oil development on ecosystem services and the steps that can be taken to ensure their sustainability.
Study Area

The Study Area includes the Albertine Rift oilfields and Lake Albert, the main water source for Lake Albert, and the adjacent protected area of the Murchison Falls Conservation Area. Some oil-related features in the study area extend beyond the limits of this area (possibly because of the omission of some very small, demographically significant sites) that are linked with oil development, but is within the area that has the most significant changes thought likely to occur and for which a reliable baseline is required.

The land use and land cover maps generated by the Murchison Conservation Strategy (MCS) for the MAKP were the most up-to-date source on ecosystem distributions and the study area was adjusted to match these to improve the satellite imagery and maps. An overview of the study area is shown in Figure 1.

The extent of the Study Area is 2,195,334 ha.

Ecosystems supplying services

Sustainable flow of ecosystem services requires ecosystem health, which leads to larger producing areas. The amount that can be taken from ecosystems is an important decision. Ecosystems, for example, have a range of capacity of fish that can be taken from a lake without reducing its ecological capacity. To ensure services supplied in the Albertine Graden, the ecosystems that supply them were mapped. These service uses results from a Landscape Land cover mapping exercise carried out by the Murchison Basin Project (MBP), based on satellite imagery from 2000.

Map 2. Distribution of “Natural” Ecosystems supplying services.

Map 3. Distribution of “Modified” Ecosystems supplying services.

Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda
Ecosystems supplying services

<table>
<thead>
<tr>
<th>Ecosystem Types</th>
<th>Current Extent (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Rain Forest</td>
<td>72,026</td>
</tr>
<tr>
<td>Subtropical Evergreen</td>
<td>31,212</td>
</tr>
<tr>
<td>Woodland</td>
<td>28,311</td>
</tr>
<tr>
<td>Savanna</td>
<td>181,305</td>
</tr>
<tr>
<td>Wooded grassland</td>
<td>232,215</td>
</tr>
<tr>
<td>Grassland</td>
<td>254,569</td>
</tr>
<tr>
<td>Wetland</td>
<td>41,823</td>
</tr>
<tr>
<td>Open water/Lake/Inland</td>
<td>526,616</td>
</tr>
<tr>
<td>Total extent of natural ecosystems</td>
<td>1,201,819</td>
</tr>
</tbody>
</table>

Ecosystem Service Benefits

Benefits from ecosystem services typically fall into the following categories (MA 2005):

- Basic material for a good life (e.g., secure and adequate livelihoods, enough food at all times, shelter, clothing, access to goods);
- Health (e.g., clean air and access to clean water);
- Security (e.g., secure access to natural and other resources, personal safety, security from natural and human-made disasters); and
- Good social relations (e.g., social cohesion, mutual respect, ability to help others).

They may be financial or take other forms, for example, benefits enjoyed in the study area included visitor satisfaction from wildlife viewing and strong cultural attachments to sacred sites.

The extent to which people rely on ecosystem services depends on the particular benefits they get from using them, and whether they can find other ways to secure these benefits. People's per-capita service values, levels of service derived from specific ecosystems, and services were not available for the study area. A series of focus group discussions and key informant interviews were therefore held to improve understanding of typical impacts of benefits derived from ecosystem services in the study area.

For more information, visit [www.itecmeasurement.org](http://www.itecmeasurement.org)
Ecosystem services do not exist without beneficiaries or users, based on review of literature, national policy consultations and those of group discussions, ecosystem services supplied by natural ecosystems in the circular fill were identified in Figure and Table D. Most ecosystems provide several services to people and most people use several different services to meet their needs, resulting in complex interactions.

### Ecosystem Services supplied and used

<table>
<thead>
<tr>
<th>Ecosystem Services</th>
<th>Naturalstone</th>
<th>Plantation</th>
<th>Riverine</th>
<th>Nothofagus</th>
<th>Scrub/Heath</th>
<th>Mixed forest</th>
<th>Gradual</th>
<th>Vegetable</th>
<th>Irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROVIDING</strong></td>
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<tr>
<td>Crop</td>
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<td>-</td>
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<td></td>
<td>-</td>
<td>-</td>
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<tr>
<td>Livestock services (large and medium cattle, sheep, goats)</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pasture farming</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Agro-ecology (crop-livestock)</td>
<td>-</td>
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<tr>
<td>Irrigation (crop-livestock)</td>
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<tr>
<td>Irrigation (crop-livestock)</td>
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</tr>
</tbody>
</table>

| **REGULATING** |              |            |          |            |             |             |         |           |           |
| Air quality regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quality regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quantity regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quality regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quantity regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quality regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quantity regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Water quality regulation | -            | -          | -        | -          | -           | -           |         | -         | -         |

| **CULTURAL** |              |            |          |            |             |             |         |           |           |
| Valuing and consumption | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Tourism potential | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Tourism potential | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Tourism potential | -            | -          | -        | -          | -           | -           |         | -         | -         |
| Tourism potential | -            | -          | -        | -          | -           | -           |         | -         | -         |
Declining extent of ecosystems indicates declining capacity to supply services. To establish a baseline, digital layers of the 22 vegetation communities described by Lugg et al. (2016) were translated into an updated habitat classification atlas for comparison with the present day.

Extent of natural ecosystems declined by 48% between 2007 and 2013, which can be expected to increase into reduced levels of supply of associated ecosystem services across the Study Area. Ecosystems declined at different rates (Table 3). Significant losses of woodland and grassland habitats at 33% and 99% respectively occurred and back-casting to 1990 shows that woodland extent has declined dramatically since the 1960s (Map 4, Figure 1). As well as being relevant to supply of fabric services, this significant loss of woodland and grassland from the Study Area has implications for sustainability of wildlife populations as well as access to open grazing for livestock’s reed/cborough, both necessary services. As mentioned previously, services also decline as a result of degradation of remaining ecosystems, so this is likely underdened in decline of associated ecosystem services. Here, the apparent decrease in swamp could be likely to represent an actual increase in extent, it is more likely that removal of or her natural vegetation has made an area more visible, or that imagery was used from the wet season in 2013, as in 2015, there was little evidence of wetland cover, primarily in the non-irrigated areas.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Area 2007 (ha)</th>
<th>Area 2013 (ha)</th>
<th>Change (ha)</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical high forest</td>
<td>121,969</td>
<td>101,768</td>
<td>-20,114</td>
<td>-16.4</td>
</tr>
<tr>
<td>Woodland</td>
<td>318,346</td>
<td>318,269</td>
<td>-77</td>
<td>0.0</td>
</tr>
<tr>
<td>Wooded grassland</td>
<td>181,069</td>
<td>173,943</td>
<td>-7,126</td>
<td>-3.9</td>
</tr>
<tr>
<td>Scrub/Thicket</td>
<td>192,904</td>
<td>187,016</td>
<td>-5,888</td>
<td>-3.0</td>
</tr>
<tr>
<td>Grassland</td>
<td>541,813</td>
<td>243,113</td>
<td>-298,700</td>
<td>-55.1</td>
</tr>
<tr>
<td>Swamp</td>
<td>60,017</td>
<td>78,915</td>
<td>18,898</td>
<td>31.4</td>
</tr>
<tr>
<td>Open water</td>
<td>552,407</td>
<td>552,407</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>1,444,779</td>
<td>1,433,943</td>
<td>-10,836</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

Table 3: Changes in extent of natural ecosystems.
Drivers of change

There are many pressures operating in the Study Area that could affect future supply of ecosystem services. These include:

- Population change (e.g., in-migration affecting size of land use change and demand of ecosystem services)
- Shifting and economic changes (e.g., increased demand for wood for improved household consumption)
- Changes in technology (e.g., rural electrification andshift from shallow wells to piped drinking water supplies, which improves access and benefit but may increase per capita water demand)
- Development of infrastructure (e.g., road networks or improvements to existing roads)
- Governance, tenure systems and regulations (e.g., extent to which access to protected areas is controlled, endangered commercial grading laws)

Ecosystem services provided by natural forests and woodlands:

- Growth and large-scale agriculture, e.g., rice, sugar, coffee
- Biodegradable materials for building
- Nuts and honey
- Wildlife recreation and tourism

State of natural forests and woodlands:

- Regulation and control of forest resources
- Regulation of water in the system
- Ecosystem health
- Cultural, educational and spiritual value
- Habitat and carbon for wildlife
- Indigenous cultural practices
- Water yield and ground water recharge

Population as a driver

Natural resource based livelihoods are prevalent, so population growth drives demand and a reasonable price for estimating level of use, particularly for provisioning services. Census data from 2002 and projections to 2025 show a 6% increase in population to approximately 37.6 million people within the study area. The growth rate of 0.4% per annum is slightly higher than the national average of 2.4% and gives a doubling time of 15 years. Map6 shows the population distribution in the Study Area.
Population growth and associated increases in demand for ecosystem services have increased the vulnerability of some ecosystems and levels of strain throughout the landscape.

Drivers of change

- Habitat threat: A given ecosystem's probability of different threats to its habitat, their proximity to sources of threats, and severity of legal protection. Habitat threat was modeled based on estimates of the likelihood of different habitats being affected by different threats, their proximity, and their availability outside the area. Habitat threat was calculated for each habitat within the study area. The magnitude of the threat was assessed using a combination of habitat threats, the proximity of habitat threats, and the severity of legal protection. Habitat threat was modeled using ESRI's ArcGIS software.

Priority Ecosystem Services

Some services are a particular "Priority" because they are highly valued by people, who depend on them to obtain essential benefits, for a healthy life, and are not easily accessible by any other means of service delivery. These "Priority" ecosystem services are identified through consultation with key stakeholders and are considered to be critical for maintaining the landscape's ecological integrity.

Dependence on ecosystem services is generally high throughout the study area. On the other hand, people also value ecosystem services that are not easy to access or that they do not have time to provide. Services that are not easily accessible or that people do not have time to provide are considered to be "Priority" ecosystem services. These services include food security, water security, and health care.

These services are not the only priority ecosystem services supplied in this landscape. They were selected for detailed assessment due to their particular importance. In this landscape, the ecosystem services are provided by individual ecosystems in a way that maximizes the overall benefit to the landscape. The ecosystem services are identified through consultation with key stakeholders and are considered to be critical for maintaining the ecological integrity of the landscape.

Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda

[Diagram showing ecosystem service supply, use, and benefits in the Albertine Rift of Uganda]

Priority Ecosystem Services

[Diagram showing priority ecosystem services in the Albertine Rift of Uganda]

[Legend:

- Lake Albert Capture Fishery
- Wetland biomes for fuel
- Wildlife populations for nature-based tourism
- Wildlife populations for bushmeat harvesting
- Livestock production and pastoral way of life
- Freshwater
- Food from Subsistence Farming]
Priority Ecosystem Services

Lake Albert supports the main capture fishery in the Study Area, but some fish are also taken from rivers and wetlands.

Socioeconomic

Lake Albert is a major focus of the Study Area (Map 9). Reptile-rodred, oarsmen and canoeists are important fish nursery areas. Supply of fish in the lake is also influenced by local use for home and intermediate livestock (cattle and sheep) and the floods associated with feeder-rivers. Forests and woodlands perform an important supporting function, providing shade to reduce evaporation and maintaining water quality, as well as providing water supply to the lake from the river catchment. Removal of these habitats may affect fish in the lake as well as sediment levels. Protracted removal of woody biomass from seine-rivers and swamps has potentially serious consequences, especially for fish species that rely on habitat and in shallow waters among the lakeshores.

Benefits

Lake Albert supports a nationally important capture fishery, targeted by the Ugandan government as a source of fish processing for export to the EU and other international markets. Outward is to Lagen and Zhe and are impacts would have a potential trans-boundary implication.

Fish are an essential source of protein and income. Most communities eat fish regularly when supplies are available and have local knowledge of fishing and associated livelihoods. When fish supplies are low, local economies grind to a halt and people go hungry. Many benefit areas are being below the poverty line, so large numbers of dependents on fishing as an alternative to fishing for food and income.

Decline in fish stocks are already affecting either from the lake, including a decrease in fish numbers and decrease in fish size. Average expenditure on food increased by a factor of at least 3 between 2000 and 2010. Fish is an important part of the diet, and households spend on average 10% of their income on fish. People who eat fish eat more fish than those who do not.

People unable to make living from fishing have a limited alternatives. In the past it was easier to move into farming as an alternative, but competition for fishing and farming is limited. Now prices for the fish are low, and the fish market is in decline. People are also moving to other livelihoods, such as agriculture, farming, or other activities.

Fish stock studies emphasise the need to improve landing site facilities as a measure of improving the situation for fishermen, but improved communication and road access to landing sites could have a more direct impact on fishing.

Baseline trends in supply and use

Supply of fish is based on the health and productivity of the Lake Albert ecosystem and the vitality and biomass of the fish stocks. The lake is a large system, with a large number of species and a large number of fishing methods. The lake is a key source of protein for the local population, and fishing is a major income-generating activity. The lake is a major source of protein for the local population and is an important source of income for the local communities.


Ecosystem Service Supply, Use and Benefits in the Albertine Rиф of Uganda
Sustainable production of fish from the Lake was estimated at 130,000 tons per year in 1980-1990, but has since declined. In the 1990s, potential yields of sustainable production were estimated at 110,000 tons of 1840 kg per year were met. These are the highest levels currently available to fishers, and are probably an overestimate, as overfishing reduces rates of reproduction and recruitment in adult populations, diminishing the productivity of the system.

The use of the fisheries is supported by "Fisheries Frame Surveys" for the National Fisheries Resources Research Institute. However, there is a lack of data on types of stocks, number of fish landing sites, fishing gear, and fish species. This information is critical for sustainable development and management of the Lake fisheries. The National Fisheries Resources Research Institute has conducted surveys to estimate total annual fish production from the Lake. These numbers and catch data are not complete, and the overfishing problem is likely underestimated. In this study, the total production of fish biomass was estimated at 110,000 tons per year. However, these numbers are not reported as the proportion sold through market outlets in Lira. The full impact of overfishing is unknown, and further research is needed.

Baseline Summary

Significantly more fish are harvested from the Lake than can be reproduced. This is due to overfishing. The catch per unit effort (CPUE) has declined, indicating that the fish population is declining. If the current rate of exploitation continues, the fish population will decline further. There is an urgent need for the development of management and harvesting strategies that can help sustain the fish population.

The fishing communities are very aware of the measures that need to be taken to control over-exploitation of the fisheries. Community-based management initiatives, including the establishment of fishing cooperatives, have been implemented. These initiatives aim to control overfishing and promote sustainable fishing practices.
Woody biomass for fuel (firewood and charcoal) was prioritised due to its prevalent use throughout the Study Area. Firewood is the dominant source of energy for cooking and firewood and charcoal generate income for many.

### Priority Ecosystem Services

#### Woody Biomass for Fuel

**Woody Biomass for Fuel**

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Standing Stock (Tonnes/ha)</th>
<th>Annual Yield (Tonnes/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical High Forest</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>Woodland</td>
<td>1.22</td>
<td>1.22</td>
</tr>
<tr>
<td>Maritime Forest</td>
<td>2.48</td>
<td>2.48</td>
</tr>
<tr>
<td>Other Forest</td>
<td>2.28</td>
<td>2.28</td>
</tr>
<tr>
<td>Total</td>
<td>5.8</td>
<td>5.8</td>
</tr>
</tbody>
</table>

**Benefits:**

- 15% of the energy consumption in Uganda is wood fuel (firewood and charcoal) and agricultural waste, and 90% of the wood supply is for energy consumption. Only 30% of the rural population has access to electricity. In the year 2000, 11% of the households used firewood for cooking and 1% for heating. In 2010, 8% of the households used firewood for cooking and 1% for heating.

- Women collecting firewood depend mainly on it for income. Households need 3-5 bundles of firewood for cooking and water and some will use as firewood for income. Household income needs to be reduced and the need to collect firewood for cooking and water is reduced.

- In the Study Area, women collecting firewood depend mainly on it for income. Households need 3-5 bundles of firewood for cooking and water. In the Study Area, 30% of the households use firewood for cooking and 1% for heating. In 2010, 8% of the households used firewood for cooking and 1% for heating.

**Table:** Woody Biomass for Fuel

**Source:**

- Wood biomass (Map 10) is provided by forests, woodlands, woodland savanna and savanna/habitats. Woody biomass in the Study Area, standing stock and annual yield are in Table 4 and Figure 4. Woody biomass in the Study Area is used for energy, charcoal production and charcoal burning.

- In the Study Area, woody biomass is used for energy, charcoal production and charcoal burning. Woody biomass in the Study Area is used for energy, charcoal production and charcoal burning.

**Regulations:**

- Women collecting firewood depend mainly on it for income. Women have to walk for up to 3 hours and spend up to 9 hours collecting wood at least twice per week, whereas in the past, they generally used to collect sufficient firewood for cooking and water 3 times a day. It is important that we consider this factor when planning interventions.

**Figure:** Woody Biomass for Fuel in the Study Area

**Map:** Woody Biomass for Fuel in the Study Area

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Standing Stock (Tonnes/ha)</th>
<th>Annual Yield (Tonnes/ha)</th>
</tr>
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<tbody>
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<td>2.28</td>
</tr>
<tr>
<td>Total</td>
<td>5.8</td>
<td>5.8</td>
</tr>
</tbody>
</table>

**Figure:** Woody Biomass for Fuel

**Map:** Woody Biomass for Fuel
A local case study at a local community study of the relationships between supply and demand reveals the availability of woody biomass within the “buffer” of a rural village, based on:

1. A 1.5 km buffer was drawn around the maximum distance women said they walk along the road from their forest, before turning off and walking a further 1 km to “collect.”
2. A 1 km buffer to quantify availability of woody biomass closer to households, within a more realistic walking distance.

Wood fuel demand was estimated from the approximate number of households (2,000) and assuming 3 people per household. From the 2011 census, increment forest cover rates in Map 2 show an annual yield of 1.5 km buffer. Ouganda’s Wildlife Reserve is also known. Woodfuel was estimated at 1 tonne per person per year, giving a total demand of 14,500 tonnes per annum. The sustainable ecosystem service supply required to be sourced from annual increment of woody biomass without affecting stock within a walking distance of 1 km, 14,500 tonnes are available unless woody biomass in the forest is included, in which case there are 42,500 tonnes. Current demand is therefore below the sustainability threshold unless wood from the protected areas, outside of 1 km, were harvested sustainably in 2013.

Within the 1 km buffer the situation is worse, with only 3600 tonnes per year increment available outside protected areas. This biomass was woody ecosystem renewal, improved from logging tradicional (fuel) and this biomass is less than 1% of estimated demand.

Gaps show areas where woodfuel-based 1 km buffer was estimated to increase ecosystem with less woody over 1.5 km. Scrubbi, shrubbi, unmanaged grassland, suboptimal farming. Some land conversion caused by woody biomass has taken place in Uganda’s wildlife reserve, and south of Haggis, partially cleared of woodland outside of 1 km, and in Masaka raised by partly cleared in the north, the areas represent the only area not available for exploration. People from Haggis to the north also have to use woody biomass from this area. The rest is competition.

Ecosystem Service Supply, Use and Benefit in the Albertine Rift of Uganda

Ecosystem Service Supply, Use and Benefit in the Albertine Rift of Uganda
Priority Ecosystem Services

Wildlife populations for nature-based tourism

- Wetland grassland
- Grassland
- Woodland
- Open Water
- TropicalRain Forest
- Savanna Woodland

Benefits

Stakeholder workshops confirmed strong national pride in Ugandan wildlife and espoused that population should be conserved. Uganda's national parks and conservation areas, such as the Albertine Rift, are the focal point for nature-based tourism. The parks provide a number of benefits, including:

1. **Sightseeing**: Visitors can observe wildlife in their natural habitats.
2. **Economic benefits**: Wildlife tourism generates income for local communities and supports conservation efforts.
3. **Environmental conservation**: Protecting wildlife helps maintain biodiversity.
4. **Education**: Visitors learn about the importance of conserving wildlife and ecosystems.

Ecosystem Service Supply, Use, and Benefits in the Albertine Rift of Uganda

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Wildlife populations for nature-based tourism

as the country attempts to diversify its economy by promoting wildlife tourism. The benefits include:

- **Economic benefits**: Increased revenue for local communities.
- **Environmental conservation**: Protection of wildlife and ecosystems.
- **Cultural values**: Preservation of local cultures and traditions.
- **Educational opportunities**: Learning about wildlife and ecosystems.

Ecosystem Service Supply, Use, and Benefits in the Albertine Rift of Uganda

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Priority Ecosystem Services

Wildlife populations for nature-based tourism

Baseline Summary

In terms of tourism based on wildlife populations, this is a thriving industry that has been seeing growth over the last 10 years and generates considerable income. In the absence of full development this industry is expected to continue, provided that hunting, encroachment and uncontrolled burning do not depress populations to the point where viewing opportunities suffer. On the whole, however, it is not possible to predict the trend in the future for this industry and the impacts of such activities on the wildlife populations as well as potentially reducing wildlife populations in the area.

Ecosystem Service Systems

Ecosystems outside of protected areas are significantly degraded and, as such, the management of such areas is critical. The protection of wildlife and ecosystems is not only maintained in protected areas, but also in buffer zones and other areas where wildlife and ecosystems are not protected but are affected by human activities. The protection of such areas is essential to ensure that wildlife populations are maintained, that habitat degradation is minimized, and that significant threats are managed effectively.

Benefit

It is difficult to discuss “benefits” from an illegal activity such as trade in bushmeat and wildlife. The fact that the trade in bushmeat has been illegal for a prolonged period of time makes it very important to assess and manage these illegal activities in order to minimize their impact on the future sustainability of the service.

Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda

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The diet of the households featured in the study shows that, on average, households in Uganda depend on bush meat, which accounts for about 4% of their daily protein intake. However, the consumption of bush meat is declining, and there is a shift towards domestic meat. This shift is driven by an increase in the availability of cattle and small ruminants, which are more readily accessible and cheaper than bush meat.

Baseline Summary

In the context of bush meat hunting and consumption, it may be that the traditional reliance on bush meat is declining due to a combination of factors, including changing dietary preferences, increased availability of other protein sources, and changes in availability of bush meat. The declining consumption of bush meat is likely to have implications for wildlife populations and their habitats, as well as for human health and nutrition. Therefore, it is important to understand the factors driving this change and to develop strategies to ensuring sustainable and equitable access to protein sources.

References

Priority Ecosystem Services

Access to open grazing land

Ecosystem Service Supply, Use and Benefits in the Albertine Riff of Uganda

Some very vulnerable people rely on livestock production from an access grazing land for their livelihoods and will lose those linkages. People employed as cattle herders, who are paid very low wages and have little access to alternatives, often have a strong cultural attachment to keeping cattle and see them as an important form of capital and savings. Grazing lands are also important for the livelihoods of pastoralists and could be further fragmented by oil-related development, especially in the Greater Sabin stretch.

Benefits, dependence and alternatives

Some very vulnerable people rely on livestock production from an access grazing land for their livelihoods and will lose those linkages. People employed as cattle herders, who are paid very low wages and have little access to alternatives, often have a strong cultural attachment to keeping cattle and see them as an important form of capital and savings. Grazing lands are also important for the livelihoods of pastoralists and could be further fragmented by oil-related development, especially in the Greater Sabin stretch.

Native Ecosystems

Ecosystems providing open grazing for livestock are primarily grassland, wooded grassland and savanna (Map 10 and Figure 10). Though herders are now also losing agricultural lands and innovative forests due to overgrazing, including within protected areas.

Figure 10: Native ecosystems for grazing

Map of the distribution of grazing ecosystems

Grassland
Wooded grassland
Savanna
Barro

Figure 11: Access to open grazing land

Map of grassland changes

Grassland

Figure 12: Access to open grazing land

Map of grassland changes

Grassland

Ecosystem Service Supply, Use and Benefits in the Albertine Riff of Uganda

Many people rely on their cattle to provide milk and milk for income to purchase other food. Cattle are also seen as “insurance” against famine, to save for the future and earn income for buying clothes or building materials, or accessing medical care. They have not been used for meat to any significant degree until recently, and being regarded more as a form of capital. Milk was traditionally given to the herders as part of their pay. This has changed since development of a milk refrigeration unit in Buloba that has provided facilities for a milk producer cooperative to purchase milk from cattle owners and export it to large dairy companies based in Kampt. Some households believe that purchasing alternative sources of protein, such as fish, reduces the incentive to compensate for the loss of their purchasing power in the event of a milk to sal. Now the milk now goes to the foragers, as a result of the reduction in the price of milk. Some cattle owners have reduced their herd size because of the loss of interest in maintaining them. Herders must be considered a vulnerable group due to their extremely low levels of pay and the fact that they are usually in poor health and have limited access to health care.

Baseline trends in supply and use

Notions used for grazing (primarily grassland, perennial, woodlands and savannas) have been declining in use and suitable of Forested Areas since the 1960s. There are...
Priority Ecosystem Services

Access to open grazing land

Ecosystem Service Supply, Use and Benefits in the Albertine Rиф of Uganda


**Priority Ecosystem Services**

**Access to open grazing land**

<table>
<thead>
<tr>
<th>Grazing Habitats (ha)</th>
<th>2007</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>20km buffer representing minimally &quot;unrestricted&quot;</td>
<td>16,319</td>
<td>15,980</td>
</tr>
<tr>
<td>Anti-erosion due to lack of Town Council grazing legislation</td>
<td>0</td>
<td>-290</td>
</tr>
<tr>
<td>Anti-erosion due to fencing (Fugura/10m)</td>
<td>0</td>
<td>152</td>
</tr>
<tr>
<td>Available grazing land</td>
<td>18,319</td>
<td>15,980</td>
</tr>
<tr>
<td>Territorial land area (all ecosystems)</td>
<td>42,761</td>
<td>42,761</td>
</tr>
<tr>
<td>No decline in available grazing 2007-13</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

**Baseline Summary**

Available grazing areas have declined due to infrastructure footprint, conversion of land for farming, and inappropriate urbanization. Quality of grazing has declined due to over-stocking, with carrying capacity exceeded. Access to grazing has declined due to encroachment of grazing from areas (change in access) and land use changes. Based on indicators such as condition of cattle production of milk, the relationship between supply and use became unsustainable in 2004. People are unable to take their cattle for longer distances than they are able to stay in their homesteads. These areas are already over-grazed within protected areas. Benefits for some people, particularly the small-scale herders and inadequate and increased market value for milk, have increased poverty and malnutrition. In the group of owners are earning milk for sale. Many are undernourished and are often unable to meet their needs, as well as having trained or old and sick cattle. An increase in livestock numbers will result in substantial improvements in nutrition methods. Access to productive grazing cannot be considered sustainable.

**Source Ecosystems**

Water is obtained from lakes and Lake Albert (Map 18) and groundwater, the latter being the major source for communities, through hand dug wells and boreholes. Groundwater is not conventionally considered to be an ecosystem and does not appear in the ecosystem classification although groundwater recharge depends on water balance from precipitation, evapotranspiration and surface water "yield" (Figure 24). Several ecosystems provide the intermediate terrestrial (see Annex E). Lake Albert provides water for livestock communities, water for livestock, land, and drinking and is thus directly related to Lake Albert, from some rivers and streams and principally from community wells, springs, and streams and the Lake. It is also used as a source for livestock. Runoff from urban catchments flows through perennial streams into Lake Albert. Intermediate services provided by ecosystems in the upper catchments of these rivers and streams (mostly woodland, forests and wetlands) are important for maintaining flows and maintaining water quality in these watercourses as it enters the Lake. Map 23 gives the distribution of public water sources in the area and part of the study area, and is based on water availability data collected during the field survey.

**Figure 3| Water Yield**

Ecosystem Service Supply, Use and Benefits in the Albertine RRI of Uganda

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Ecosystem Service Supply, Use and Benefits in the Albertine RRI of Uganda
Fresh water for drinking is a fundamental ecosystem service. On 28 July 2008, through the Global Water Partnership (GWP), the Ugandan government signed an agreement with the United Nations Development Programme (UNDP) to improve water supply and sanitation in the capital city of Kampala. The agreement aims to achieve universal access to safe water and sanitation by 2015. However, the lack of access to safe water and sanitation continues to be a major concern in the country. In 2010, the United Nations Children’s Fund (UNICEF) reported that only 22% of the population had access to improved sanitation facilities, and 55% of the population did not have access to improved water sources. The government has set a target of providing access to safe water and sanitation to 95% of the population by 2030.

In addition to the lack of access to safe water and sanitation, the Ugandan government has faced challenges in ensuring the quality of water sources. The country has a limited capacity to treat and filter water, leading to the contamination of water sources with pathogens and other contaminants. The government has invested in the construction of water treatment plants and the implementation of water quality monitoring programs to address these challenges.

The benefits of improved water supply and sanitation include reduced waterborne diseases, improved livelihoods, and increased economic growth. Additionally, the government has recognized the importance of water resources in the country’s development and has integrated water resources management into the national development policy. The government has established a National Water Resources Management Authority (NWAMA) to coordinate and manage water resources across the country.

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Priority Ecosystem Services

Fresh water

To the water to human accessible water available, the model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity). The Study Area. The model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity). The Study Area. The model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity).

Baseline Summary

In the current situation, water consumption is thought to represent a small proportion of the water yield in the Lake Albert catchment at 2.2%, which is relatively high. Although the current situation is relatively high, it is important to note that the situation is likely to vary spatially and temporally due to differences in land use, climate, and human activities. The model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity). The Study Area. The model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity). The Study Area. The model is watered in the priority ecosystem service (water yield) and the the effective use (water scarcity).
Priority Ecosystem Services

Food from Subsistence Farming

Baseline trends in supply and demand

In Uganda as a whole, the total agricultural land increased from 47% of the country’s land area in 1965 to 55% between 1986 and 2009. The year-round farming shows that 75% of the land is under permanent crops, and the rest is under land that is cultivated. The government has prioritized the development of agricultural land to ensure food security for the population. The agricultural sector is crucial for the country’s economy, as it provides employment, income, and food security. However, the sector faces challenges such as limited access to inputs, infrastructure, and markets, which hinder its growth. To address these challenges, the government has implemented various policies and programs to support the agricultural sector. These include the Uganda National Agricultural Development Plan (UNAPD), which focuses on increasing productivity and enhancing the contribution of the agricultural sector to the country’s economy. The UNAPD aims to increase the productivity of the agricultural sector by providing inputs, improving infrastructure, and enhancing market access. The government has also launched the Agricultural Modernization Program (AMP), which focuses on modernizing the agricultural sector by improving the supply chain, enhancing farmer capacity, and promoting value addition. The AMP seeks to increase productivity, reduce post-harvest losses, and enhance the competitiveness of the agricultural sector in the global market. The government has also launched the agricultural extension program, which aims to provide technical support and training to farmers to improve their productivity and income. The program focuses on providing farmers with access to inputs, training, and markets, which will help them increase their productivity and income. The government has also launched the agricultural credit program, which provides farmers with access to credit to finance their agricultural activities. The program seeks to increase access to credit for farmers, especially smallholder farmers, which will help them increase their productivity and income. The government has also launched the agricultural value chain program, which aims to promote value addition in the agricultural sector. The program seeks to increase the value of agricultural products by promoting processing, packaging, and marketing, which will help farmers increase their income. The government has also launched the agricultural research program, which focuses on improving the productivity of the agricultural sector through research and development. The program seeks to develop new technologies, improve crop and livestock production, and enhance the competitiveness of the agricultural sector in the global market. The government has also launched the agricultural policy program, which focuses on developing a conducive policy environment for the agricultural sector. The program seeks to develop policies that will promote investment in the agricultural sector, enhance the contribution of the agricultural sector to the country’s economy, and improve access to markets and finance.
that can be brought into production without causing other priority ecosystem services to decline further. If there is little wildlife left that can be brought into production to increase supplies of food, the only other ways to enhance production are intensively. During the same period, new areas came into subsistence farming as a means to maintain supplies of food and income from the ecosystem services (Map 22).

Already by 2050, UNCCD acknowledged the concerns ofDegradation in the district is very worrying, with a lot of eroding by both the domestic and wild animals. There is too much pollution along the lake shores where people have built up to a distance of five meters from the lake. In the meanwhile, there are no serious efforts being put in place to avoid pollution in the district. The same report concluded: "There were no established recovery led for trees, though it’s very clear that some of the trees in the district that supplies of timber are being used unsustainably."

Ecosystem Service Supply, Use and Benefits in the Albertine Rift of Uganda

Conclusions

Of the priority ecosystem services reviewed in this report, the least sustainable supply-use relationships are the timber, wood (timber for fuel and livestock’s production from open access grazing). The services are likely to have unsustainable supply-use relationships unless action is taken to safeguard viable populations (wildlife-based tourism and livelihoods). Access to wildlife based tourism and the benefits derived from it could be threatened by all-related activity. One has a sustainable relationship between supply and use, but poor access to resources of adequate quality. Freshwater for domestic use and finally, it is likely that subsistence farming is also falling to keep up with increasing demand from a growing population. Throughout this study area, people will likely be more challenge to access to services that they need and depend on. Because many ecosystems have unsustainable supply-use, it is service to switch to alternative services and becoming more limited. The fact that there is growing signals of fresh and income inequality makes it important to take action to resource supplies of priority services to already livelihood strategies to safeguard access to priority services for vulnerable groups.
Conclusions

Of the priority ecosystem services reviewed in this report:

- **Lake Albert Fishery**
  - Use exceeds sustainable supply, maximum potential production.
  - Ecosystem services are not sustained, the authentic role and benefits are already compromised for the majority of users/beneficiaries.
  - Urgent intervention is needed to improve the state of the ecosystem and its productive capacity, combined with measures to ensure that people have access to alternative sources of benefit while recovery takes place, e.g., through closed fishing periods.

- **Wood biomass for fuel**
  - Use exceeds sustainable supply, annual yield.
  - Ecosystem service use currently depends on unsustainable use of stocks of woody biomass. The source ecosystems are not regenerating.
  - Benefits are compromised for some users and an increasing number of users/beneficiaries will be affected, with new options developing in the next 5-20 years.
  - Urgent intervention is needed to grow stocks of woody biomass (including trees that produce) and to ensure people have access to alternative means of cooking and heating water while recovery takes place.

- **Fish populations for food**
  - This is a declining industry that has been shrinking over the last 30 years and generates considerable revenue.
  - In the absence of development, this could be expected to continue, provided that hunting, collection, and controlled fishing do not decline populations of fish. In areas where hunting opportunities within and that increasing harvest numbers do not decline fish populations significantly (if they are not known).
  - There are information gaps that make it impossible to establish the relationship between supply, and benefit in this baseline situation and to determine whether fish populations are being used to the extreme possibilities.
  - Reserves in different basins, and the level of dependence on fish is not known. Even in detail, the baseline is not sufficiently well established to implement early action to be quantified. Further investigation is needed to ensure that any management solutions address supply and demand, and help ensure that the fish stock and its beneficiaries and their just targets of access for local fishers.

- **Freshwater**
  - Supply of freshwater in the baseline situation is sustainable.
  - Levels of access to freshwater supplies adequate due to poor infrastructure and sanitation facilities.
  - Lack of access to water results in non-beneficial, unsanitary facilities to deliver clean and improved sanitary supplies can be provided to a significant degree without compromising supply.
  - However, land use changes in the Study Area are thought to be reducing water supply capacity and flows in rivers and this could have adverse consequences for some users of surface water as well as for the fishery of the Lake Albert ecosystem.

- **Food from subsistence farming**
  - Supply of land suitable for subsistence farming is declining, and is expected to continue in the Study Area and there is increased dependence on off-farm sources.
  - Supply of food from subsistence farming will decline with increased investment in agroforestry.
  - Supply of this service per ha and per capita is declining, and there is insufficient suitable land to bring into production to compensate for this. Other means of increasing supply will be needed to maintain benefits.

<table>
<thead>
<tr>
<th>Priority Service</th>
<th>Summary of baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife population for hunting</td>
<td>Illegal hunting is taking place within the reserve and has been widespread throughout the area. Uncontrolled hunting is known to be a major threat to wildlife populations and has been reported outside protected areas in the baseline situation. The illegal hunting is done for subsistence and commercial purposes, with the stock of game being reduced.</td>
</tr>
<tr>
<td>Livestock production from open access grazing</td>
<td>This ecosystem service is unsustainable in the baseline situation due to declining supply, declining access and use of land that is a significant factor in the reduction of resources and the loss of biodiversity and the loss of livelihoods.</td>
</tr>
<tr>
<td>Freshwater</td>
<td>Supply of freshwater in the baseline situation is sustainable. Levels of access to freshwater supplies adequate due to poor infrastructure and sanitation facilities. Lack of access to water results in non-beneficial, unsanitary facilities to deliver clean and improved sanitary supplies can be provided to a significant degree without compromising supply. However, land use changes in the Study Area are thought to be reducing water supply capacity and flows in rivers and this could have adverse consequences for some users of surface water as well as for the fishery of the Lake Albert ecosystem.</td>
</tr>
<tr>
<td>Food from subsistence farming</td>
<td>Supply of land suitable for subsistence farming is declining, and is expected to continue in the Study Area and there is increased dependence on off-farm sources. Supply of food from subsistence farming will decline with increased investment in agroforestry. Availability of new lands, reducing. Conversion of land to subsistence farming, reduces availability of land for pastoral/farming. Supply of this service per ha and per capita is declining, and there is insufficient suitable land to bring into production to compensate for this. Other means of increasing supply will be needed to maintain benefits.</td>
</tr>
</tbody>
</table>
### Potential indicators for assessment and monitoring

Based on the baseline established for the priority services described within this report, the following indicators could be used to assess and monitor impacts, whether through further bioassessment results or at a Priority 3 level, ensuring consistency in approach.

#### Priority Ecosystem Service

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Use</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lakebill hygiene</strong></td>
<td>Non-compliance with hygiene guidelines</td>
<td>Number of landing sites, number of craft registered, catch rate, and effort; numbers of boats fishing, financials or transactions each week; numbers of meals with dry meals included per person per week; total income from fishing, fishing or stated activity (hospitalization consultations)</td>
</tr>
<tr>
<td><strong>Waste biomass for firewood</strong></td>
<td>Number of cooked meals, meals based on coal, waste biomass within defined areas</td>
<td>Distance walked to collect biomass; amount of biomass collected per week; waste biomass within defined areas</td>
</tr>
<tr>
<td><strong>Waste biomass for charcoal</strong></td>
<td>Number of trees included in production potential</td>
<td>Numbers, type and size of trees included in production potential; number of bags of wood produced per month</td>
</tr>
<tr>
<td><strong>Vadose populations for nature-based tourism</strong></td>
<td>Number of species, locations; number of species identified; number of people observing; number of species identified by specific group</td>
<td>Level of satisfaction from observation; wildlife census; size of faunal surveys</td>
</tr>
<tr>
<td><strong>Vadose populations for hunting</strong></td>
<td>Number of species, number of hunting observations; number of species identified; number of species identified by specific group</td>
<td>Satisfaction from hunting; knowledge of species; number of species identified by specific group</td>
</tr>
<tr>
<td><strong>Open access grazing</strong></td>
<td>Number of grazing sites; condition of livestock; average weight and milk yields per animal</td>
<td>Income (in U.S. dollars); number of meals with milk per week; number of meals with milk per week; average weight and milk yields per animal</td>
</tr>
<tr>
<td><strong>Freshwater</strong></td>
<td>Proximity to water bodies</td>
<td>Proximity to water bodies; water quality; water bodies; water bodies; water bodies; water bodies; water bodies; water bodies</td>
</tr>
<tr>
<td><strong>Food from subsistence farming</strong></td>
<td>Land use for subsistence farming</td>
<td>Land use for subsistence farming; number of days and small livestock products</td>
</tr>
</tbody>
</table>

### References and Sources of Information

[References and Sources of Information Section]

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[Ecotrophic Service Supply, Use and Benefits in the Albertine Rift of Uganda 2021-2022]

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