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Current and projected impacts of renewable natural resources degradation on economic development in Uganda

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About this report

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Contents

1. Overview

Uganda's past impressive economic growth averaging 7% per year in the 1990s and 2000s was reliant on its natural resources base. As well as helping to determine the speed and magnitude of economic growth, natural resources underpin the livelihoods of the majority of Uganda's population (National Environment Management Authority (NEMA), 2016). Strong gains were made in poverty reduction up to 2013 due to agricultural growth income that benefitted poor households (World Bank, 2016).

Since 2010, Uganda's economic growth has slowed, with a growth rate of 3.5% in 2016/17. This has been attributed in part to the poor performance of the agricultural sector due to drought. Depletion of natural resources, particularly forests and wetlands, raises concerns that economic growth has been achieved at the expense of the environment and natural resources (Government of Uganda, 2017, p.16). Concurrently poverty has increased from 20% in 2012/13 to 27% in 2016/17 (Uganda Bureau Of Statistics (UBOS), 2017, p. 87). Future projections for economic growth are short-term in range. World Bank forecasts for 2020 predict growth will recover, reaching 6% in that fiscal year.

This report examines the current and expected future trends for the economic impact of environmental change and natural resources depletion/degradation in Uganda. It focuses on the agricultural sector, forests, fisheries and wetlands. Non-renewable extractive resource sectors including oil and mining are outside the scope of this report. Governance and regulatory frameworks are also outside the scope, although it is important to note that these are important both for economic development and natural resources management. A number of sources consulted for this report suggest possible future priority areas and these are presented in the final section of this report.

The vast majority of Uganda's population are dependent on natural resources (NEMA, 2016, p. 15). Some features of the connections between natural resources and the economy include:

- 80% of Ugandans rely directly on land, agriculture and fishing for their livelihoods (Failler, Karani & Seide, 2016).
- 90% of coffee in Uganda is produced by smallholder farmers (Jassogne et al., 2013)
- 80% of Ugandan fishers are artisanal (small scale fishers) (UNCTAD, 2017)
- 85% of the population live in rural areas (CIAT; BFS/USAID, 2017, p. 2).

Key findings about the economic impacts of natural resources degradation and environmental change include:

- **The importance of agriculture**: The agricultural sector is the mainstay of the Ugandan economy, contributing approximately 27% of GDP and 46% of exports and engaging 72% of the population. However, growth in the sector is low and productivity is below its potential (Fiala & Apell, 2017, p. 2). A range of measures are suggested in the literature for improving productivity as the sector is still key for economy development and underpins growth in other economic sectors. Two of the most cited measures are improved inputs and extension services.
- **Uganda's natural resource base is degraded:** approximately 41% of Uganda's total area is experiencing degradation, with soil erosion being the most common form of degradation (CIATet al., 2017, p. 3). This has both agricultural and ecosystem impacts.

- **Population growth:** Forest and wetlands encroachment is driven in part by population growth as land is cleared for agriculture or settlement. This encroachment has implications for ecosystem services, agricultural productivity and biodiversity.
- **Vulnerability:** The agricultural sector is vulnerable to both environmental degradation and climate change**.** Productivity in the sector is threatened by poor farming practices and soil erosion.
- **Forestry:** Uganda's deforestation rate is 2.4% annually, driven in part by the demand for energy. 90% of Uganda's energy needs are met by fuelwood (both charcoal and firewood). Illegal timber comprises 80% of the supply chain and is a driver of deforestation. A 2010 study of the forestry sector indicated that forestry may have contributed the equivalent of 8.7% of Uganda's GDP in 2010 (Ministry of Water and Environment (MWE), 2016, p. 53).
- **Fisheries:** Fisheries exports have been extremely important to Uganda. In 2009, fisheries were 3% of GDP. Export revenue has increased from USD109 million in 2009 to USD122 million in 2016[1]. However, fisheries total share of exports has reduced from 9% in 2009 to 5% in 2016[2]. Overfishing and ecological changes have resulted in decreasing fish catches). This report focuses on Lake Victoria's capture fisheries as they represent 50% of the total annual catch and have both livelihood and commercial importance. Collapse of Nile Perch stocks have been predicted if measures are not taken to preserve Lake Victoria's fisheries.
- **Emerging priority areas:** A number of potential priority areas appear repeatedly in the reviewed literature including: measures to increase agricultural productivity; climate change adaption measures; the problem of charcoal production and energy demand; and, tools to combat overfishing and ensure sustainability of Lake Victoria's fisheries.

Pressures affecting natural resources

Population growth: Uganda has one of the highest population growth rates in the world (UN Economic Commission for Africa (ECA), 2017: p.3). From 2000 onwards the population has grown at approximately 3.2% per annum (World Bank 2018a). The United Nations' Department of Economic and Social Affairs Population Division (2017) estimates that Uganda's population will be 64 million in 2030 and 106 million in 2050 (p. 27). The Government of Uganda's *Vision 2040* estimates that population growth will slow to an annual rate of 2.4%, resulting in a population of approximately 60 million by 2040 based on implementation of the national population policy (Government of Uganda, 2013, p. 27).

Population growth is a key driver of deforestation and encroachment on wetlands as land is cleared for agriculture, settlement and access to resources (NEMA, 2016, p. 118 & UNDP, 2016b, p. 4). As more land is opened up for agriculture, buffer zones between human settlement and protected areas are lost (NEMA 2016: p. 118). High population growth also places demand on natural resources for non-agricultural products including fuelwood, clay mining for bricks and other raw materials (UNDP, 2016b, p. 4). Migration from densely populated to sparsely populated areas, driven partly by the scarcity of arable land, is directly contributing to forest loss (NEMA,

[1] https://comtrade.un.org/labs/data-explorer/

[2] https://comtrade.un.org/labs/data-explorer

2016, p. 118-9). Conflict in northern Uganda and more recently South Sudan has led to displacement of populations and resettlement resulting in forest and wetland encroachment (NEMA, 2016, p. 118-9).

In 2014, 60% of Uganda's population was under 18 (NEMA, 2016, p. 34). This is both a challenge, due to the current high dependency ratio, and an opportunity once this generation reach their productive and reproductive years, provided there are adequate investments in education, health, agriculture and trade (NEMA, 2016, p. 34).

Refugees: Uganda is also host to an estimated 1.3 million refugees from current crises in South Sudan, DRC and Burundi as well as refugees from earlier conflicts in Rwanda[3]. Refugees are not generally included in studies by the Ugandan government on poverty and economic growth (e.g. UBOS, 2017). There is some evidence that refugee settlements have contributed to environmental degradation and increased competition for agricultural land, grazing land, water resources and forest resources, resulting in tensions with host communities in Southwest and Northern Uganda (e.g. UNHCR, 2018, p. 75 & AAH, 2017, p. 11).

Increasing urbanisation: Uganda's urban population is steadily increasing: from 15% in 2011 to 16.5% in 2016 (World Bank 2018b). In 2014, the date of the most recent census, the urbanisation rate was approximately 6.6% (UBOS, 2014). Kampala city is the most populous urban centre, with a population of approximately 1.5 million people (UBOS, 2014). Other, smaller urban centres are growing at an increasingly faster rate than they were in 2002 (UBOS, 2014)[4]. This places increasing demand on water resources and agriculture as well as increasing the potential for wetlands encroachment as people seek land for settlement and raw materials (NEMA, 2016, p. 33).

Industrialisation: Industrialisation is one of the key pillars for economic development in the Government of Uganda's *Vision 2040.* Low industrialisation has been identified as one of the reasons for non-inclusive growth, high youth unemployment and economic vulnerability in Uganda (UNECA, 2017, p. 1). The 2016/17 slowdown in the economy suggests to some sources that Uganda's current economic paradigm has 'run out of steam': industrialisation is the suggested solution (UNECA, 2017, p. vii). Industrialisation will be dependent on natural resources in a number of ways including: agro-based industries (e.g. food processing plants, coffee grinding plants), clearing of land for industrial parks, raw materials and land for commercial farming (NEMA, 2016, p. 23-34).

Strength of the evidence base

There is a wealth of evidence on natural resource degradation in Uganda, including particular resources and case studies of particular regions. The links between agriculture and economic growth are widely acknowledged in the literature and there is consensus amongst the sources consulted that agriculture can play an important role in economic development going forward.

[3] UNHCR figures consulted 12 May 2018, http://reporting.unhcr.org/node/5129

[4] Solid waste management is becoming an issue in urban centres, with environmental and public health implications (NEMA, 2016, p. 44-45). Whilst outside the scope of this study, it is an issue that may indirectly affect economic growth and livelihoods as it has implications for the health of the urban workforce. The *State of the Environment Report 2014* identifies emerging environmental issues as: solid waste management, water pollution, climate induced disasters, charcoal burning and industrialisation (NEMA, 2016, p.22).

Climate change is identified as a key issue and Uganda is already experiencing its effects. A large body of literature case studies crops, geographical areas and communities' vulnerabilities to climate change and possible adaption strategies. No long-term projections of economic growth in Uganda or the contribution of the agricultural sector could be found. Fisheries and deforestation also feature strongly in the literature reviewed.

Gender concerns are presented in a large portion of the literature referenced for this study. This includes women's lack of land ownership, role in the fisheries sector and vulnerability to climate change.

2. Agriculture sector

Economic importance

Agriculture is the mainstay of the Ugandan economy, contributing significantly to food production, export earnings, employment creation and livelihoods (IMF, 2017). Key features of the sector include:

- 46% of exports are agriculture based (e.g. coffee, tea, tobacco, fish and flowers), representing approximately 27% of GDP (CIAT et al., 2017, p. 2);
- Agricultural exports were US$1.3 billion in 2015 (Government of Uganda, 2017, p.25);
- The country is one of the leading producers of coffee and bananas in the world. It is also a major producer of tea, cotton, tobacco, cereals, livestock and fishing products among many others (Government of Uganda, 2013, p.45);
- 72% of the population engage in primary agricultural production (UBOS, 2014);
- 5.2 million households are engaged in agriculture: 97% of these in small holder farming **(**Government of Uganda, 2017, p.34);
- Commercialization in agriculture (e.g. mechanisation and large-scale farming) remains low: 2.3% of farming households (Government of Uganda, 2017, 34);
- Food crop production dominates the sector: only 1/3 of crop production is marketed and less than 7% is exported (CIAT et al. 2017: p.3).

Cultivated land has been steadily increasing since the 1960s (World Bank 2018c). In the last decade agricultural land has increased at 1% per annum (CIAT et al., 2017, p.3). In 2015, approximately 72% of Uganda's land area was agricultural land: 34% of land area was arable (World Bank 2018c). The agricultural sector is vulnerable to the effects of climate change and land degradation (Cesar & Wolf, 2013).

In 2016/17, Uganda's GDP growth dropped dramatically from historic highs of 7% to 3.5% (World Bank, 2017). This slowdown has in part been attributed to drought and adverse weather conditions (World Bank, 2017). Drought combined with a Fall Armyworm[5] attack resulted in severe crop failure and is estimated to have reduced growth by 0.5% in the first half of 2016/17 (IMF, 2017). This exposed 11 million Ugandans to food insecurity as food price inflation rose

[5] Fall Armyworm is an invasive crop pest.

from 5% year on year in September 2016 to 23.1% in May 2017: the government had to provide food relief in the affected districts (IMF, 2017).

However, overall average GDP growth had begun to slow around 2010, reflecting negative productivity growth in the agriculture and industrial sectors (IMF, 2017). Between 2000 and 2015, the agricultural sector's contribution to GDP grew at an annual rate of 2% from US$4.9 billion to US$5.9 billion (Fiala & Apell, 2017: p.2). This growth rate was exceeded by the population growth rate of 3.3%, raising the prospect of food insecurity (Fiala & Apell, 2017: p.5)[6]. Agriculture has been approximately 25% of GDP since 2002 (World Bank 2018d). However, the sector's contribution to the economy and to household welfare remains significant (NEMA, 2016, p. 69). The agricultural sector is still the largest earner of foreign exchange, contributing to about 53% of Uganda's total export revenues (NEMA, 2016, p. 69).

Productivity of most crops has declined over the last decade due to factors including: poor production techniques, the high costs of inputs; limited extension services; land tenure/ownership; and the limited application of technology (Government of Uganda, 2013, p.45). Uganda's GDP is still dominated by primary products with low value addition activities taking place (Government of Uganda, 2013,: p. 6). Only about 5% of products are processed (CIAT et al., 2017, p. 5).

Land is a key strategic asset, constituting over half of the value of the asset basket of poor Ugandans (Government of Uganda, 2017, p. 20). Ownership of land can determine livelihood options and control of agricultural income (NEMA, 2016, p. 36). Women are only 16.3% of total land owners, but 54% of the people engaged in agriculture (CIAT et al., 2017, p. 2). A lack of land ownership is a barrier to women's participation in long term investment on land (e.g. tree planting and high value crops) and a barrier to accessing credit (NEMA, 2016, p. 36)

Impacts of climate change

Uganda's favourable climate has contributed to economic growth and allowed families to depend on rain-fed agriculture (World Bank 2015: p. x, & NEMA 2016, p. 26). Good rainfall and prices can account for two-thirds of the growth in crop income of the bottom 40% from 2006 to 2012 (World Bank, 2016, p. x). The North and Northwest are traditionally warmer than the South, with the North being drier than other regions (CIAT et al., 2017, p. 6, & NEMA, 2016, p. 28). The South to central parts of the country have 2 rainy seasons (March- May and October-November), which allows for 2 crop growing cycles (NEMA, 2016, p. 28), while the North-east has one long rainy season (NEMA, 2016, p. 28).

Uganda's dependence on rain-fed agriculture and primary production means it is highly vulnerable to climate change and weather variability (Babel & Turyatunga, 2015, p.240, MWE 2015a, p.vi, & CIAT et al., 2017, p. 6). This is a risk to GDP growth, the income of the poor, and export earnings (World Bank, 2017). Current experiences of climate change, weather variability and shocks include:

[6] Food insecurity is still common in Uganda: 1 in 4 people are undernourished, with food insecurity being most prevalent in the Northern and Eastern regions (CIAT et al. 2017, p. 4). 59% of households in the Northeast consume only 1 meal a day (CIAT et al. 2017, p. 4). Food security projections predict the number of food insecure people will grow from 7 million (20% of the population) in 2015 to 30 million (60% of the population) in 2025 (CIAT et al., 2017, p. 4).

- Temperatures have increasing by 0.3 °C per decade since the 1960s (Babel & Turyatunga, 2015, p. 240) with increases in the frequency of hot days and decreases in cold days (CIAT et al., 2017, p. 6);
- Changes in the intensity and duration of rains (Government of Uganda, 2017, p.16);
- Intense and more frequent floods (Government of Uganda, 2017, p. 16);
- Emergence of malaria in previously mosquito free regions of Mount Elgon and Kabale (NEMA, 2016, p. 18).
- Declining water levels in Lake Victoria (Babel & Turyatunga, 2015, p. 240).

Changes in rainfall patterns affect agricultural incomes: a background paper prepared for the World Bank's poverty assessment found that a 10% drop in water availability due to reduced rainfall in the North reduced the crop income by 38.3% in the region (Hill & Mejia-Mantilla, 2017, p. 20). Drought has been identified by a number of sources as an important emerging issue (e.g. MWE, 2015a, p.vi). Recent increases in the frequency of droughts has affected production of maize, beans and bananas causing food shortages (Babel & Turyatunga, 2015, p. 240). Drought in 2010/11 caused economic losses of USD470 million in food crops, cash crops and livestock (Climate Change Department et al. 2016: p.11).

Predicted future climate change impacts include:

- Damage estimates of 2-4% of GDP between 2010 and 2050 in the agriculture, water, infrastructure and energy sectors (MWE, 2015b);
- The South-western part of the country becoming unsuitable for coffee production (Babel & Turyatunga, 2015, p.240);
- Vulnerability to droughts and floods in the Northern region and vulnerability to drought in the cattle corridor (CIAT et al., 2017,p. 6);
- Millions of people at greater risk of poverty and hunger due to their reliance on agriculture (CIAT et al., 2017, p. 5);
- Up to a 46% reduction in optimal banana yields due to soil moisture deficits within banana plantations (CIAT et al., 2017: p. 6);
- Migration to urban areas and slum formation as rural agriculture, forestry and fisheries decline (MWE, 2015a, p. vi).

Smallholder farmers in Uganda are highly vulnerable to climate change and studies have found that many households have low climate preparedness and/or few adaption strategies (see for example, Climate Change Department (Ministry of Water and Environment), Uganda National Meteorological Authority (UNMA), the CGIAR programme on Climate Change, Agriculture and Food Security (CCAFS) and World Food Programme (WFP) 2016).

Coffee: Coffee is an important cash crop and has contributed up to 20-30% of foreign exchange earnings in previous years (Jassogne, Laderach & van Asten, 2013, p. 2). The coffee industry employs over 3.5 million families through coffee related activities (Jassogne et al., 2013, p. 4). Farmers are already experiencing climate variability in terms of longer droughts and more erratic and shorter rainy seasons, as well as an increase in certain pests and diseases including leaf miners and leaf rust: these are already negatively impacting coffee yields (Jassogne et al., 2013, p. 2). Adaption measures are needed to ensure smallholder farmers who depend on coffee for their livelihoods do not fall further into poverty and to protect the Ugandan economy from financial impacts (Jassogne et al., 2013, p. 2).

Currently, Arabica coffee, which was approximately 40% of coffee export value in 2012, is grown in the highland areas of the slopes of Mount Elgon, the Rwenzori Mountains and Mount Muhabura by 500,000 small holder coffee farmers (Jassogne et al., 2013, p. 4). Projections based on climate change models for temperatures and rainfall changes in 2030 and 2050 predict that areas suitable for growing Arabica coffee will change drastically and production may need to move to higher elevations[7] (Jassogne et al., 2013, p. 2-4, & Ovalle-Riveria,Läderach Bunn, Obersteiner & Schroth, 2015). Elevations below 1400 metres will become unsuitable for growing Arabica coffee (Ovalle-Riveria et al., 2015). Future production losses are estimated to be tens of millions of US dollars (Jassogne et al., 2013, p.2).

Coffee is important for livelihoods in the Rwenzori Mountains: income generated by coffee is used for household needs, children's education and medical expenses (Jassogne et al., 2013, p. 12). The majority of smallholders do not have capital to reinvest in their coffee production activities (Jassogne et al., 2013, p. 12). If capital is available, it is often used for hiring casual labour, not agricultural inputs (Jassogne et al., 2013, p. 12).

Maize: Maize is the most widely grown crop in Uganda, an important staple food source and a secondary cash crop (Babel & Turyatunga, 2015, p. 240). Projections for maize yields under different climate change scenarios (range of temperature increases and range of decreases in rainfall in 2020s, 2050s and 2080s) relative to a base period of 1961-1990 predict that, without mitigation measures, yields could change dramatically (Babel & Turyatunga, 2015, p. 240). Modelling results suggest that:

- March to May season: yields may decrease by between a) 9.6-43.3% or b) 10.5-28.4%
- September to November: yields may increase by a) 8.1-9.6% or b) 8.6-10.2% (Babel & Turyatunga, 2015, p. 239).

Case study: Climate Change, Livelihoods and Food security in Karamoja, (adapted from Climate Change Department et al., 2016)

Karamoja, in the North-east, is the most impoverished part of Uganda and chronically food insecure (p.21). Its population are highly dependent on subsistence agriculture and particularly vulnerable to the impacts of climate change (p.20-21). The region is already experiencing rainfall variability and temperature rises (p. 8). These trends will affect agricultural productivity and livestock production exacerbating food insecurity (p. 8).

Adaption strategies and climate preparedness are low in Karamoja (p. 9-10). Current coping strategies identified through household surveys include: selling livestock; begging/borrowing and charcoal/firewood production (p.9).

The report's authors recommend improving access to climate information services**;** increasing membership of formal/informal groups; and household sensitisation; adaption strategies including water harvesting; and, mainstreaming gender as female headed households have less access to climate information services and group membership (p. 11-12).

[7] There are ecological barriers to this, including stony soils; social barriers, including areas already being cultivated for other crops; and political barriers, including higher elevation areas in Mount Elgon being under nature conservation protection (Jassogne et al., 2013, p. 5 & p. 18).

Impacts of environmental degradation

Aside from climate change, three main challenges to developing the agricultural sector are highlighted in the literature: pests and diseases; land degradation; and, governance and regulatory services. Pests and poorly functioning pest, vector and disease control have been a major cause of losses in the agricultural sector (CIAT et al., 2017, p. 5). For example, coffee wilt disease started in 1993 and destroyed 56% of old robusta trees, equivalent to USD170 million (CIAT et al., 2017, p. 5). New pests and increases in existing pests have been identified as a challenge by smallholder coffee farmers (Jassogne et al., 2013).

Widespread land degradation leads to soil erosion, which is costly for the agricultural sector (CIAT et al., 2017, p. 5). 41% of Uganda's total area is experiencing degradation, and 12% is in a severe state of degradation (CIAT et al., 2017, p. 3). Soil erosion is the most common form of degradation (found on 85% of degraded land) (CIAT et al., 2017, p. 3). Areas badly or severely affected by soil erosion include the highlands of Kabale, Kisoro, Mbale, Rakai and the cattle corridor districts (CIAT et al., 2017, p. 3).

Only one assessment of soil erosion across Uganda was found during the literature search for this report. It estimates that 80% of Uganda's total surface area is erosion-prone resulting in soil losses of approximately 62 million tonnes in 2014 (Karamage, Zhang, Tong, Maganda, & Isabwe, 2017). 39% of Uganda's erosion-prone lands were comprised of unsustainable soil loss rates (Karamage et al, 2017). Agricultural intensification without soil conservation practices can have significant detrimental effects on soil, including increased erosion, lower fertility, and lead to ground water pollution and eutrophication of rivers and lakes (Karamage et al., 2017). NEMA (2016) has called for expedited initiation of a national land use planning process and a soil mapping process (p. 18).

Soil fertility is decreasing due to nutrient loss (NEMA 2016: p.73, & Government of Uganda, 2017, p. 20). This affects the productivity of agricultural land (NEMA 2016: p. 73). Drivers include: current farming practices, high population growth and land clearance for agriculture (NEMA 2016: p. 73).

Challenges and opportunities for growth

A number of Ugandan government strategies including *Green Growth (*2017*)* and *Vision 2040*[8] (2013) identify agriculture as both a bottleneck to growth and an opportunity for growth[9]. Agriculture and forestry have been growing at a slower rate compared to other sectors of the economy (Government of Uganda, 2013, p.22). The dominance of subsistence farming and low productivity in the sector are bottlenecks (NEMA, 2016, p. 69). Reasons for low productivity include environmental pressures (e.g. declining soil fertility), poor farming practises (e.g. limited

[8] The Government of Uganda's Vision 2040 is to transform Uganda from a low income peasant society to a modern and prosperous upper middle income country within 30 years.

[9] Uganda's Green Growth Development Strategy (2017) identifies other challenges to development as climate change and deteriorating natural capital driven by falling forest and wetlands coverage as a percentage of total land area (p.12).

use of high yielding seeds, manure or fertilisers[10]), limited access to appropriate technologies, poor farm to market structure and exogenous factors, namely low prices and climate change (Government of Uganda, 2017, p.34).

However, government reports and strategies argue that agriculture has the potential to spur economic development (NEMA, 2016, p. 28). It also remains important as a basis for growth in other economic sectors (Government of Uganda, 2013,: p. 45). Development plans for the sector include conversion from subsistence to commercial agricultural (Government of Uganda, 2013, p. 45-6) and boosting production through modern farming methods (Fiala & Apell, 2017, p. 3). Measures to achieve this include:

- technological improvements (improved seeds and breeds, fertilisers etc);
- irrigation schemes (currently only 0.1% of cultivated land is irrigated (CIAT et al., 2017: p. 3));
- improving weather information systems, including dissemination to farmers;
- halting the decline in soil fertility (Government of Uganda, 2013:,p. 45-6).

Adopting modern technologies, including high-quality agricultural inputs (e.g. seeds, fertiliser) could increase average returns to smallholder farmers by 50% (World Bank, 2016, p. xi). Certification will be important to improve the quality of agricultural inputs and build trust amongst farmers (World Bank 2016, p. xi). Improvements in rural financial markets are needed so that farmers can access credit for purchasing agricultural inputs (World Bank, 2016, p. xi).

Climate smart agricultural (CSA) practices are being promoted to improve climate resilience (CIAT et al., 2017, p. 1). These include crop diversification, small-scale irrigation and conservation agriculture (CIAT et al., 2017, p. 1). Disseminating climate information including localised short-term forecasts and early drought warnings are important as transforming agricultural productivity will depend on the ability to predict and mitigate adverse weather patterns (Fiala & Apell, 2017, p. 4).

Some smallholder farmers are already utilising climate smart agricultural practices including intercropping and trees for shade (Jassogne et al., 2013, p.13). However, fewer than 30% of smallholder farmers have adopted CSA (CIAT et al., 2017, p. 7). Reasons for this include: dependence on traditional subsistence farming systems, limited extension services, inadequate knowledge, inadequate technology, labour and capital, inaccessible input markets and declining farm size (CIAT et al., 2017, p. 7).

The long term success of CSA will depend on availability and sustainability of finance (CIAT et al. 2017: p.19). Financial services and risk transfer mechanisms are limiting at farmer level, which is a barrier to CSA adoption (CIAT et al., 2017, p. 1). Initiatives such as crop and livestock index-based insurance have been introduced aimed at offsetting losses due to climate-related conditions, but more could be done to scale up access (CIAT et al., 2017, p. 1)

[10] Soil fertility is a key ingredient for improved agricultural production but use of agricultural inputs is low: in 2015: the proportion of farmers using modern farming methods was 25% for fertiliser, 15% for improved seed, 6.5% for both fertiliser and improved seed, and 1% for irrigation (Fiala & Apell, 2017, p.3).

3. Forestry sector

Economic importance

Uganda's forests contribute to GDP, employment, household incomes and livelihoods, as well as providing ecosystem services (MWE, 2016). The National Environment Management Authority (NEMA) valued the contribution of Uganda's forests to the national economy in 2010 as equivalent to 8.7% of GDP (MWE, 2016, p.53). Products which contribute to GDP by increasing export earnings include: fuelwood, timber and poles (Kilawe & Habimana, 2016, p. 10). The forestry sector employs approximately 1 million people formally and almost the same informally (Kilawe & Habimana, 2016).

Both privately and publicly owned forests play a pivotal role in the livelihood strategies of surrounding communities. This includes:

- Fuelwood and charcoal production;
- timber production;
- creation of new agriculture and pasture lands (Call, Mayer, Sellers, Ebanks, Bertalan, Nebie & Gray, 2017, p. 50);
- Other forest products (fibres, fruit, mushrooms, medicinal plants and products used for house construction). Low income households depend more on these than other households because they cannot afford alternatives (MWE, 2016).

79% of total wood production is characterised as fuelwood and charcoal production, whilst sawn timber contributes only 5% (Kilawe & Habimana, 2016, p. 10). Approximately one third of wood production was monetary directly contributing to national trade and household incomes, whilst the rest was non-monetary, generally meeting domestic energy needs (Kilawe & Habimana, 2016, p. 10).

Forests provide a range of ecosystem benefits including: watershed protection, biodiversity conservation and control of soil erosion (Kilawe & Habimana, 2016). MWE (2016) estimates the monetary value of forest nutrient protection through avoided soil erosion in the area under forest cover as USD291 million (p. 61). There has been no independent quantification or valuation of forestry hydrological or watershed services (MWE, 2016). But, some districts have reported reduced water quantity or quality because of deforestation (MWE, 2016).

Impacts of environmental degradation

Deforestation is estimated at 2.4% per year (Banana, Byakagaba, Russell, Waiswa, & Bomuhangi, 2014, p. 3). Uganda's forest estate has shrunk from 24% of total land area in 1990 to 9% in 2015 (MWE, 2016). In terms of acreage a total of 3.05 million hectares were lost between 1990 and 2015, with 2.2 million hectares lost from woodlands (MWE, 2016, p. 47). This translates to approximately half of unprotected forests (i.e. forests outside of Protected Areas) and 46% of protected woodlands (MWE, 2016, p.47-8).

Forest cover loss of about 25 million tons of wood consumed annually translates into 50% degradation of all tropical high forests on private land and 15% in forest reserves (CIAT et al., 2017, p. 3). 70% of Uganda's forests are privately owned and 30% are in the protected area network including national parks and forests reserves (Banana et al., 2014).

Demand for a variety of forestry resources is increasing (Kilawe & Habimana, 2016, p. 6). Continued forest degradation and loss will have a significant negative impact on people's livelihoods and the provision of ecosystem services (Banana et al. 2014). There is general agreement about the man-made drivers of deforestation:

- Land use change, mainly due to agriculture and indiscriminate cutting of trees for fuelwood (firewood and charcoal). Charcoal producers are responsible for the greatest loss of natural forests (USAID, 2015, p. 32);
- Rapid population growth, including rural-urban migration and increased demand for food, which requires opening up forest land for agriculture; rising urban demand for wood products; tropical high forests being converted into farmland; and weak restrictions on land use in most rural areas (Call et al., 2017, p. 50; MWE, 2016);
- Degradation in savannah woodlands is driven by better economic returns accruing to alternative land uses such as charcoal production, cattle farming, subsistence agriculture and commercial ranching (Banana et al., 2014);
- Subsistence farming by adjacent communities has placed pressure on government forests both for land cultivation as existing land becomes less productive due to overuse and also for forest products (Kilawe & Habimana, 2016);
- Causes of degradation include agricultural expansion in forested lands, charcoal production, uncontrolled firewood harvesting, livestock grazing, pit sawing and timber production, human settlement and urbanization (Kilawe & Habimana, 2016, p. 6).

Energy: Increased forest loss could lead to an energy crisis (USAID, 2015, p. 33). 96% of Ugandans rely on biomass for cooking and 90% of Uganda's energy requirements are supplied by fuelwood (firewood and charcoal) (MWE, 2016, p. 27 & p. 57). This includes household needs and small and medium size industries (USAID 2015: p. 32). In terms of household needs the distance travelled to collect fuelwood has increased from 0.73 km in 2000 to more than 1 km in 2007, and in some districts, including Kitgum, Nebbi and Lira, households travel more than 4 km (MWE, 2016, p. 57).

Fuelwood supplies have been rapidly decreasing due to population growth and agricultural expansion and most of the biomass sources on private and communal land have already been depleted (MWE, 2016; USAID, 2015, p. 32). Studies have suggested the rate at which wood is harvested for charcoal is unsustainable and if not addressed may lead to the total degradation of woodlands (USAID, 2015). The cattle corridor and the savannah woodlands of the northern region have been most affected as these are the main areas of charcoal production, supplying all urban centres as well as neighbouring countries (MWE, 2016, p. 26).

Recent estimates suggest Uganda has an annual biomass demand of 44 million tonnes (USAID, 2015: p.33). Uganda's available wood stock is estimated at 284.1 million tonnes with a potential sustainable biomass supply of 45 million tonnes (NEMA, 2016, p.111). But, accessible wood biomass supply stands at 26 million tonnes or 59% of the total demand (NEMA, 2016, p.111). Most of the rural biomass sources have already been depleted (NEMA, 2016, p.111). Increased demand for charcoal may lead to local extinction of the most highly sought after species of trees, including the shea tree, which could be important for export revenues through production of products including shea butter (USAID, 2015, p. 32). In Nakasongola District, nearly all shea trees have been cut for charcoal production (NEMA, 2016, p. 112).

The demand for charcoal is driven by the cost of modern cooking appliances and high electricity tariffs (MWE, 2016). Between 2009 and 2013 charcoal production increased from 7.97 million tonnes to 10.5 million tonnes (UBOS, 2014). Estimates based on population growth indicate growing production and trade in both volume and value (MWE, 2016). Approximately 70% of charcoal is consumed in urban areas and 30% in rural (MWE, 2016).

The charcoal sector employs an estimated 20,000 people in production and thousands more in the supply chain (MWE, 2016). Charcoal producers are amongst the poorest stakeholders in the forestry sector (MWE, 2016, p. 58). Charcoal burning in rural areas is more destructive than timber harvesting as it entails collection of saplings and juveniles (MWE, 2016).

Timber production: Sawn timber constitutes 5% of total wood production (Kilawe & Habimana 2016, p. 10). The Ugandan construction sector is booming and the main consumer of timber (MWE, 2016, p. 64). Demand for timber is increasing exponentially, leading to concerns about supply, including the need to maintain plantation establishment and expand processing (MWE, 2016, p. 64).

Domestic production from central forest reserves is declining, so the market is increasingly relying on production from public land and private forests, supplemented with imports of mahogany and other species from DRC (MWE, 2016, p. 64). Forecasts for timber demand include increases from 1.3 million cubic metres in 2008 to 1.7 million cubic metres in 2030 (MWE, 2016, p. 65). This demand is forecast to be met from unsustainable harvesting operations in natural forests, domestic plantations or imports (MWE, 2016, p.65). Timber prices have been rising due to the growing scarcity of traditional timbers including mahogany (MWE, 2016, p. 68).

Statistics on the timber trade are unreliable as there is no functioning system in place to capture trade data (MWE, 2016, p.67). Illegal timber comprises 80% of the supply chain (MWE 2016). Illegal logging is a key contributor to forest degradation and deforestation (MWE, 2016).

4. Fisheries sector

Economic importance

The Great Lakes account for the majority of capture fisheries[11] in Uganda, and Lake Victoria alone contributes about 50% to the annual capture fisheries production (Nakiyende, Mbabazi, Balirwa, Bassa, Muhumuza, Mpomwenda, Mangeni, Mulowoza, Mudondo P, Nansereko F, & Taabu, 2016). Lake Victoria is a transboundary waterbody, shared between Uganda, Kenya, and Tanzania. Overfishing, capture of immature fish and pollution in Lake Victoria have resulted in decreased fish stocks (UNCTAD 2017).

In 2009, the fisheries industry was the second largest foreign exchange earner for Uganda after coffee, contributing 3% of GDP and was important to the livelihoods of approximately 1.5million people (UNCTAD, 2017). The three most commercially important species are Nile Perch, Nile

[11] OECD define capture fisheries as the sum (or range) of all activities to harvest a given fish resource. It may refer to the location (e.g. Morocco, Georges Bank), the target resource (e.g. hake), the technology used (e.g. trawl or beach seine), the social characteristics (e.g. artisanal, industrial), the purpose (e.g., commercial, subsistence, or recreational) as well as the season (e.g. winter). This is opposed to aquaculture, which FAO, define as fish farming.

Tilapia and Dagaa/Mukene (LVFO Secretariat, 2015). Nile Perch accounted for 90% of official fish export earnings (UNCTAD, 2017).

Fisheries are also important for livelihoods: 80% of fishers are artisanal (UNCTAD, 2017). The lack of industrial fleets has been reported to be government policy to protect small scale fishers and their livelihoods (UNCTAD, 2017). Although, confirmation of this could not be found. The Lake Victoria Fisheries Organisation (2015) argues that the socio-economic importance of fisheries cannot be understated.

Impacts of environmental degradation

The ecological resilience of Lake Victoria is threatened by high population, unsustainable fishing practices, increased watershed degradation, pollution, conversion of sensitive shoreline wetlands to agricultural lands, reduced water inflows and the effects of climate change (LVFO Secretariat, 2015). Together, these factors result in declining fish stocks and diversity, the destruction of critical habitats (impacting breeding and nursery areas of fish) and threaten the regional economy and livelihoods (LVFO Secretariat, 2015: p.3).

Increasing fishing effort: Drivers of increased fishing effort include: population increases in lake-side communities and the lack of alternative livelihoods; a growing regional market for small, immature fish (illegal trade); and, weak delivery of fisheries management services, linked to governance issues (Indian Ocean Commission, 2015).

Increasing fishing effort is one of the biggest problems facing Lake Victoria (LVFO Secretariat 2015). Indicators of fishing effort (e.g. number of fishers, number of boats, fishing gear etc.) as well as illegal fishing gears have increased to levels considered unsustainable for the lake (Nakiyende et al., 2016). Between 2000 and 2014, the number of fishers increased by 85% (Nakiyende et al., 2016). The number of fishers is still growing and this undermines sustainable management as it is a sign of increasing fishing pressure (Ikwaput, 2015). The number of fishing boats has increased by approximately 82% (Nakiyende et al. 2016). The ratio of boats to owners demonstrates that some people own more than one boat (Ikwaput 2015).

Figure 1: Fishing effort 2000-2014

	2000	2014
Number of fishers	34,889	64,617
Number of Boats	15,544	28,239
Number of motorised boats	2,031	9,995
Number of owners	-	16,790
% of owners who are women	-	11.5

Source: Ikwaput (2015, p. 24-27 & p. 31)

The majority of boats are paddle operated (61.1%), implying that fishing effort is concentrated close to shore; this contributes to localised over-fishing (Ikwaput, 2015). Motorised boats almost exclusively target Nile Perch in deeper waters (Ikwaput, 2015). Illegal fishing nets, which target smaller size of Nile Perch increased dramatically between 2012 and 2014: beach and boat seines increased by 47.3% and monofilament gillnets by 43.9% (Ikwaput, 2015).

Declining fish catch: There has been an overall decline in the annual catch of the 3 commercially important species from 239,000 tonnes in 2005 to 149,000 tonnes in 2015 (Nakiyende et al., 2016). However, across the same period the beach value of the catch increased from 240billion Ugandan shillings (UGX) to 416 billion UGX (Nakiyende at al., 2016). The selling price of fish often increases as a result of scarcity and increased demand from domestic, regional and international markets (Indian Ocean Commission 2015).

Table 1: Trends in annual fish yield ("000" t) and beach value (Billion UGX) of catch of the major commercial fish species on Lake Victoria, Uganda 2005-2015.

	Nile perch		Tilapia		Daaga/Mukene		Other species		Overall	
Year	Catch	value	Catch	value	Catch	value	Catch	value	Catch	value
2005	95	183	29	28	106	21	8	8	239	240
2006	91	175	27	26	96	19	2	2	216	222
2007	87	147	24	26	114	19	3	2	227	194
2008	81	181	20	28	70	19	2	3	173	231
2010	85	297	17	37	59	16	2	4	163	355
2011	70	326	19	54	89	46	4	8	182	435
2014	67	362	21	90	166	93	15	39	270	584
2015	37	220	13	69	65	49	34	78	149	416

Source: Nakiyende et al. (2016: p.3)

Nile perch dominated the catch between 1980 and the late 1990s (Nakiyende et al., 2016). Catches of Nile Perch have declined since then due to fishing pressures and changes in fishing practice (Indian Ocean Commission, 2015). Mukene/Dagaa fishing is mainly conducted in shallow waters and as such also results in the cropping of juveniles of other species (Nakiyende et al., 2016).

Nile Perch: The Nile Perch fishery, across the whole of Lake Victoria, is currently overfished at a level approaching its biological safe limit (Indian Ocean Commission, 2015). Signs of vulnerability include: decline in stock abundance; dominance of juvenile fish; and decrease in length at maturity (Indian Ocean Commission, 2015). This could lead to stock collapse and a suboptimal economic contribution (Indian Ocean Commission, 2015, p.10).

The Lake Victoria Fisheries Organisation, a transboundary governance body, developed a Nile Perch Management Plan for 2009-2014, but failed to reverse over-fishing; a second plan has now been developed (Indian Ocean Commission, 2015).

The Nile Perch fishery is predominately a small-scale commercial fishery, employing approximately 166,000 people in Uganda (Indian Ocean Commission, 2015). Women play a

significant role in the fish trade as they comprise 36% to 80% of the labour force in different stages of the processing chain (Indian Ocean Commission, 2015).

Changing exports: The growing market for high-quality white fish in European markets led to the establishment of processing and exporting factories around the lake in the 1980s/90s (Indian Ocean Commission, 2015). It also propelled overfishing of Nile Perch (UNCTAD, 2017). Increases in fishing effort have resulted in declining Nile Perch catches (Nakiyende at al. 2016). Decreases in the average catch rate (catch/number of boats) indicate increased vulnerability and decreased profitability (Indian Ocean Commission, 2015).

The international export trade depends on larger fish class sizes (LVFO Secretariat, 2015). However, there has been a decline in large fish (UNCTAD, 2017). Only 5.9% of spawning age fish are above the lowest fish limit size (LVFO Secretariat, 2015). Increased competition for declining fish stocks contributes to illegal and often harmful fishing practices, including the capture of juvenile and immature fish, to obtain high catches of Nile Perch (UNCTAD, 2017).

The informal fish trade is hard to measure due to a lack of reliable data (Indian Ocean Commission, 2015). Under or over-sized fish is traded informally and regionally, so it is difficult to assess the quantity (Indian Ocean Commission, 2015). The Ugandan Department of Fisheries Resources estimated in 2011 that informal exports to neighbouring countries had increased from USD$60 million in the mid-2000s to close to USD$70 million in the late 2000s (UNCTAD, 2017).

The growing **fish maw** (swim bladder) trade threatens the Nile Perch fishery (Indian Ocean Commission 2015). The fish maw trade is being propelled by rising demand in Asia, particularly China (Nakaweesi, 2017). Uganda exported more than 500 tonnes of fish maw in 2015 with an export value of USD$35.5 million (Nakaweesi, 2017).

Commercial traders target large mature fish (which are substantial spawners) and only buy the fish maw; fishers dispose of the rest of the fish at local markets (Indian Ocean Commission, 2015). This reduces the supply of Nile Perch for regulated processing factories and export: in 2014 only 39% of the catch was processed by regulated factories as opposed to 60-80% at the end of the 2000s (Indian Ocean Commission, 2015). Fishers also catch juvenile fish, which decreases the potential number of future spawners, thus impacting fish replenishment rates (Indian Ocean Commission, 2015).

Competition for fish supply, from the fish maw trade amongst other factors, has led to around half of regulated processing factories across Lake Victoria (not just the Ugandan shore) closing in the last 10 years (Indian Ocean Commission, 2015). Factories that are still open are operating at one-third of capacity (Indian Ocean Commission, 2015).

Future economic impacts: Fisheries governance structures, including the Ugandan Department of Fisheries Resources, and fisheries dependent communities are concerned about the depletion of fish stocks and the potential impacts of climate change (e.g. LVFO Secretariat, 2015). No projections could be found on the future status of Lake Victoria fisheries if the current trends of resource depletion are not halted or reversed. However, the Indian Ocean Commission (2015) warns that the Nile Perch fishery could collapse if no mitigation measures are taken, which would result in an ecological, social, economic and political crisis (p. 2).

5. Wetlands

Economic Importance

Wetlands coverage decreased from 15% of land area in 1994 to 10% in 2014 (NEMA 2016, p. 139). Wetlands degradation has been quantified as costing Uganda about 2 billion UGX per annum (UNDP 2016a, p. 1).

Wetlands provide a range of ecological and socio-economic functions (UNDP, 2016b, p.2). Ecological functions include: erosion prevention, sediment traps, soil formation, flood control, water purification, water table maintenance and micro climate moderation (UNDP, 2016b, p.2 & Government of Uganda, 2017, p.37). Socio-economic functions include: food, medicines, water for domestic use and livestock, fisheries, dry season grazing for livestock and support for dry season agriculture (UNDP, 2016b, p. 2, & Government of Uganda, 2017, p. 37). Uganda has 12 RAMSAR sites, (wetlands designated of international importance), which it is committed to conserving (Government of Uganda, 2017, p. 37).

An assessment of the total economic contribution of wetlands in three agro-ecological zones (southwest farmlands, Lake Victoria crescent and the Kyoga plains) values them at between USD$10,300 and USD$11,300 per hectare (Kakuru, Turyahabwe, & Mugisha, 2013).

Table 2: Value of wetlands in three agro-ecological zones in Uganda

FUNCTION	BENEFIT	VALUE
Provisioning	Domestic water	US$ 34 million per annum
	Fish	US$ 0.49 per person
Regulating	Fish spawning	US$ 363,815 per year
	Gross annual value added by wetlands to milk production	US$ 1.22 million
	Flood control	US$ 1,702,934,880 per ha per year
	Water regulation and recharge	US$ 7,056,360 per ha per year
	Provision of grass for mulching	US$ 8.65 million per year
	Livestock pastures	US$ 4.24 million

Source: Kakuru et al. (2013)

Impacts of Environmental degradation

Wetlands are being lost at approximately 2% annually, with livelihood, economic and environmental impacts (UNDP, 2017). Degraded wetlands cannot fulfil their ecological functions, including purifying water, which will affect human health as well as livestock health (UNDP 2016a, p. 2). For example, the wetlands between Nakawa and Kireka and part of Nalukolongo are no longer able to purify wastewater of hazardous chemicals (UNDP 2016a, p. 3).

Pressure on wetlands is high in urban areas (NEMA, 2016, p. 139). For example, the Kinawataka wetland east of Kampala city centre has been degraded as a result of industrialisation and urbanisation (NEMA, 2016, p.139). This includes unplanned settlements, urban agriculture and the development of factories and warehouses (NEMA, 2016, p.139). Effluent is discharged

directly into the streams that flow into the wetland, before entering Lake Victoria's Murchison Bay (NEMA, 2016, p.139). This direct discharge escalates the pollution load beyond levels the wetland can realistically absorb and contributes to eutrophication in Lake Victoria (NEMA, 2016, p.139).

Between 1995 and 2010 the area of wetlands in Kampala, Mukno and Wakiso declined by 14% (UNDP, 2016a, p. 1). This escalating encroachment has created a management challenges related to flooding, agriculture and settlements (UNDP 2016a, p. 1). For example, encroachment in Wakiso wetland from dairy and crop farming and floriculture is contaminating the soil and water with agricultural chemicals (UNDP, 2016a, p. 1). Impacts of wetlands degradation is evident in damage to infrastructure, increase in deaths and communicable diseases and economic development impacts (UNDP, 2016a, p. 1).

Drivers of wetlands loss include:

- conversion to agriculture, human settlement or industrial development (NEMA 2016: p.139);
- population growth creating demand for land for settlement, agriculture and other resources (e.g. medicines, clay and sand mining for bricks etc.) (UNDP, 2016b, p. 4-5);
- Socio-economic pressures: the extent of wetlands encroachment has been linked to proximity to built-up areas and roads, population density, market accessibility and market influence: roads close to wetlands offer an easy means to transport wetlands' goods to market (UNDP, 2016b, p. 5);
- Road construction: for example the Kampala Northern Bypass Highway and the Kampala-Entebbe Expressway (under construction) have encroached on the Nsooba-Lubigi and the Nakivubo wetland ecosystems, affecting the main drainage systems out of the city (NEMA 2016: p.49).

The Government of Uganda has plans to restore/rehabilitate wetlands, including demarcating wetlands boundaries (NEMA 2016: p.141-2).

6. Emerging issues for future planning

Within the literature reviewed, including government strategies and reports, international organisation reports, bilateral donors' briefings and reports, and academic sources, a number of areas are highlighted. Poor natural resources governance, regulation and corruption are mentioned in a number of sources as a both a driver of environmental degradation and a challenge moving forward (see for example Banana et al., 2014, p.6 & p.12), but governance and regulation issues are outside the scope of this report.

Environmental and economic issues are interwoven in Uganda. For example, forest degradation in Mount Elgon National park is being driven in part by population pressures and low productivity of farming systems (Banana et al., 2014, p. 4). Deforestation in turn increases the area's vulnerability to climate change, including increased floods, landslides and increased soil erosion due to heavier rainfalls (Banana et al., 2014, p. 5).

The agricultural sector

There was consensus across a range of sources reviewed for this report that the key challenges facing the sector are: pests and diseases; land degradation; increasing productivity; and climate change adaptation and mitigation (see for example, Government of Uganda, 2013, p. 46). Growth in the agricultural sector is further limited by a lack of comprehensive land use planning and information on soil, which are key for guiding agricultural planning and decisions (NEMA, 2016, p.17).

Pests and disease control: Production statistics are greatly affected by crop diseases (NEMA, 2016, p. 94). Fall Armyworm has had economic impacts in Uganda as detailed earlier in this report (IMF, 2017). USAID has developed a manual for Fall Armyworm management as a first step in combatting the pest[12]. NEMA (2016) has called for intensified efforts to control pests, vectors and diseases, with specific attention towards coffee leaf rust and banana bacterial wilt (p. 77). The Government of Uganda is promoting investment in research in disease and pest free seeds (Government of Uganda, 2013).

Land degradation: The widespread degradation of land leads to soil erosion, which is costly for the agricultural sector (CIAT et al., 2017, p. 5). For example, in 2003 the annual cost of soil nutrient loss due primarily to erosion was estimated at approximately USD625 million per year, whilst productivity losses for maize have been estimated as 190kg per hectare (CIAT et al., 2017, p. 5).

Current farming practices have been identified as a threat to soil fertility as they result in soil nutrient loss (Government of Uganda, 2017, p. 20). The Government of Uganda states that environmental control measures need to be intensified to halt the decline in soil fertility (Government of Uganda, 2013, p.46). Land ownership has been identified as a barrier to sustainable farming practises (NEMA, 2016, p. 87-88). Other factors identified include: limited awareness of farming as a business and weak linkages of small farmers with value chain actors and rural financial institutions (Government of Uganda, 2017, p.22). The World Bank has supported land administration reform through its Competitiveness and Enterprise Development Project[13].

Increasing productivity: Extension services and improving agricultural inputs are frequently referenced in the literature reviewed. Extension services have been identified as important in both CSA and overall efforts to boost agricultural productivity (CIAT et al., 2017, p.1, & Fiala & Apell, 2017).

This includes research into and availability of improved seeds and fertilisers and farmer engagement programmes (NEMA, 2016, p. 77). An FAO (2018), overview of smallholder family farms in Uganda found that usage of seeds per hectare on total cropped area is high compared to other East African countries (91kg/ha) (p.2). Only 19% had access to improved seeds and only 4.4% used fertiliser (FAO, 2018, p.2). Around one-quarter of smallholders receive extension

[12] https://www.usaid.gov/sites/default/files/documents/1867/Fall-Armyworm-IPM-Guide-for-Africa-Jan_30-2018.pdf

[13] http://projects.worldbank.org/P130471/competitiveness-enterprise-development-project-cedp?lang=en

services (FAO, 2018, p.2). Irrigation is low in smallholder farmers: just 0.7% of the average households' farm land is irrigated (FAO, 2018, p.2).

The Agricultural Technology and Agribusiness Advisory Services project (2010-2018) funded by the World Bank, identifies 10 priority commodities (coffee, tea, maize, beans, cassava, rice, bananas, citrus, fish, meat and dairy)[14]. This project includes improving the performance of agricultural research and advisory systems; and, promoting the integration of smallholders in value chains by supporting collaboration between agribusiness, farmers, advisers and researchers[15].

The FAO's MAFAP programme has been undertaking research in conjunction with Uganda's Ministry of Agriculture, Animal, Industries and Fisheries into how to combine input subsides with agricultural extension services[16]. Initial analysis into expected effects and the effect of a combination of inputs and extension service on crop yields was presented at a March 2018 workshop in Uganda[17].

Climate Change adaptation and mitigation: Climate smart agriculture (CSA) and climate information systems are referenced throughout the literature as methods for building climate resilience amongst smallholder farmers and increasing climate change adaption in Uganda (see for example Climate Change Department et al, 2016, & CIAT et al., 2017).

Actors working on CSA including USAID through its Feed the Future Project[18]; the Uganda Faiths Network on Environment Action; and, Rural Enterprises Development Services through the Norwegian government funded Conservation Agriculture Regional Programme (CIAT et al., 2017, p.15). Past projects in this space have included an FAO project, which had farmer field schools as an extension services element[19]; and, a UNDP project in 5 districts on CSA[20]. USAID recommends that coordination is needed to avoid duplication (CIAT et al., 2017, p. 17).

[14] http://projects.worldbank.org/P109224/agricultural-technology-agribusiness-advisory-services?lang=en

[15] http://projects.worldbank.org/P109224/agricultural-technology-agribusiness-advisory-services?lang=en

[16] http://www.fao.org/in-action/mafap/highlights/highlights-archive/detail/en/c/1110347/

[17] http://www.fao.org/in-action/mafap/highlights/highlights-archive/detail/en/c/1110347/

[18] Uganda is a focus of the U.S. Government's global hunger and food security initiative**,** Feed the Future. Through Feed the Future, USAID investments focus on the three value chains—maize, coffee and beans—with the greatest market potential, nutritional benefits and income potential for farming households. Coffee is the country's most important export crop; maize will contribute to greater food security; and beans complement the maize to improve nutrition.

[19] http://www.fao.org/uganda/programmes-and-projects/project-list/en/

[20] http://www.ug.undp.org/content/uganda/en/home/operations/projects/SustainableInclusiveEconomicDevelopmentProgramme/EnhancingAdaptationtoClimateSmartAgriculturePracticesinthefarmingsystemsofUganda/

UNDP is active in the in the Climate Information Systems space, including a current project to establish a network of monitoring stations. The project focuses on Mbale region, Teso region, Northern and Western region.[21]

The forestry sector

At a media dialogue to mark the International Day of Forests in April 2018, a senior Ugandan forestry official stated that the demand for charcoal, fuelwood and industrial wood is forecast to grow by 70% by 2030[22]. Whilst no official projections could be found to collaborate this, it emphasises consensus within the literature that biomass energy production and the timber trade are key issues in the forestry sector.

Energy production: The reviewed literature predicts an energy crisis if Uganda's reliance on biomass is not addressed (e.g. NEMA, 2016, p. 111). Current efforts in this space have focused on energy efficient cooking stoves and more sustainable charcoal production techniques. The Government of Uganda's *Vision 2040* (2013) promoted rural electrification and alternative energy sources e.g. solar and biogas, as solutions. However, high electricity tariffs and the cost of cooking equipment are barriers to Ugandan's using alternative sources to charcoal and fuelwood (NEMA, 2016).

- ***Cooking stoves***: The Ministry of Energy and Mineral Development, in conjunction with GIZ, have promoted energy saving cooking stoves for domestic and institutional use (NEMA, 2016, p. 112). Between 2017 and 2019, as part of the GIZ funded *Promotion of Renewable Energy and Energy Efficiency Programme* (PREEEP), an estimated 550,000 people will access improved cooking stoves[23]. Production of improved cooking stoves also creates new jobs[24].

- ***Sustainable Charcoal Production:*** UNDP's 'The Green Charcoal Project' scheduled to finish September 2018, is promoting improved charcoal production techniques in four districts (Kiboga, Kiryandongo, Mubende and Nakaseke). This includes retort and casamance kilns, which use less wood than other charcoal production methods; and, promoting producers growing their own woodlots, instead of cutting down natural forest[25]. Available results suggest that 500 community members have been trained and supported to plant nearly 1 million trees[26].

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[21]http://www.ug.undp.org/content/uganda/en/home/operations/projects/SustainableInclusiveEconomicDevelopmentProgramme/StrengtheningClimateInformationandEarlyWarningSystemsforClimateResilientDevelopmentandAdaptationtoClimateChangeinUganda/

[22] http://www.fao.org/uganda/news/detail-events/en/c/1113812/

[23] https://www.giz.de/en/worldwide/19268.html

[24] https://www.giz.de/en/worldwide/19268.html

[25]http://www.ug.undp.org/content/uganda/en/home/operations/projects/SustainableInclusiveEconomicDevelopmentProgramme/TheGreenCharcoalProject-AddressingBarrierstoAdoptionofImprovedCharcoalProductionTechnologiesandSustainableLandManagementPracticesthroughanIntegratedApproach/

[26]http://www.ug.undp.org/content/uganda/en/home/operations/projects/SustainableInclusiveEconomicDevelopmentProgramme/TheGreenCharcoalProject-

Timber production: Commercial forestry plantations have been suggested as a solution to rising timber demand[27]. The FAO's Sawlog Production Grant Scheme Phase III runs to 2020 and is active in six clusters across Uganda including Albertine, Victoria, Mubende, Northern, Central and South Western. The project aims to establish commercial plantations as well as ensure downstream processing and efficient use of forest resources (e.g. timber, poles and biomass). The project also aims to increase rural incomes for those involved in the project.

The fisheries sector

As outlined above, a key challenge in Uganda's fisheries sector is overfishing, leading to declining fish stocks. Fisheries management agencies recommend that management efforts on Lake Victoria should be directed towards regulating fishing effort (e.g. Nakiyende et al., 2016, p. 4). Recent press reports suggest that the 2017 Status of Fish Stocks in Lake Victoria survey show some recovery of Nile Perch stocks due to strict enforcement measures halting illegal fishing (see for example Tajuba, 2017). This survey is prepared by fisheries research institutes in Uganda, Kenya and Tanzania. However, no publicly available copy of this Survey could be found.

Fisheries management agencies also recommend the development of aquaculture as a way to protect and relieve the pressure on capture fisheries and promote local livelihoods (NEMA, 2016, p. 78 & LVFO Secretariat, 2016, p. viii). In 2013, aquaculture production was estimated at 100,000 tonnes (LVFO Secretariat, 2016, p. 10). The LVFO Secretariat has initiated cage culture on a pilot basis with 1,323 cages in Uganda in 2013 (LVFO Secretariat, 2016, p. 10).

In addition to overfishing, water pollution in capture fisheries, including Lake Victoria, has been identified as a threat to the expansion of Uganda's fishing industry (UNCTAD, 2017). Eutrophication caused by wastewater discharges as well as the emergence of alien invasive species that have colonised significant parts of the water bodies are emergent challenges for fisheries management (NEMA, 2016, p.78). For example, Lake Kyoga has been colonised by the congress weed, posing a challenge both for fisher folk and the fisheries management authority (NEMA, 2016, p. 78).

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