Food and Agriculture Organization of the United Nations

AFRICA SUSTAINABLE LIVESTOCK 2050

Livestock and environment spotlight

UGANDA

Cattle and poultry sectors

The Republic of Uganda

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Livestock and Environment Spotlight
Cattle and poultry in Uganda

1. Introduction

Livestock, while producing valuable food and services for human beings, generate solid, liquid and gaseous 'by-products', which have an impact on the environment. Animals rely on land and water for the provision of feed, thereby determining land use with further environmental consequences.

This brief provides evidence of the correlation between livestock and the environment in pastoral, agro-pastoral and semi-intensive cattle systems, and in free range, semi-intensive and intensive poultry systems of Uganda. These systems were characterized by stakeholders, including the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the Ministry of Water and Environment (MoWE), the Ministry of Health (MoH) and the Office of the Prime Minister (OPM), as part of the implementation of a One Health approach aimed at assessing the current and long-term impact of livestock on the economy and people's livelihoods, on public health and on the environment.

Cattle and poultry affect the environment through releasing dung, droppings, medicines (e.g. used for curative purposes) in soil and water, overgrazing, as well as through greenhouse gas (GHG) emissions from enteric fermentation. Cattle and poultry production also impact on the environment indirectly through feed production, processing and transporting of livestock and animal source foods, and through reducing biodiversity. There is little systematic data available to comprehensively assess how livestock, and cattle and poultry in particular, affect the environment in Uganda. In this brief. we rely on the Global Livestock Environmental Assessment Model (GLEAM) model developed by the FAO to estimate how cattle and poultry production systems contribute to GHG emissions, and on Mekonnen and Hoekstra (2012) to estimate their green, blue and grey water footprint. We review the available literature to provide some evidence on the impact of cattle and poultry on grasslands and biodiversity.

2. Cattle, poultry and greenhouse gas emissions

Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century (IPCC, 2014). In 2010, agriculture, forestry and other land use (AFOLU) generated approximately one quarter of total global GHG emissions[1] (IPCC, 2014).

In Uganda, GHG emissions are estimated in 36.5 million tonnes of carbon dioxide per year, accounting for about 0.01 percent of global emissions. On a per-capita basis, greenhouse gas emissions are estimated at 1.39 tonnes of carbon dioxide, far below the global per capita average of 7.99 tonnes of carbon dioxide. GHG emissions are projected to raise to approximately 77.3 $MtCO_2$ by 2030, and will also be affected by the coming growth and transformation of livestock, which currently contribute about 19 percent to the national greenhouse gas emissions (MWE, 2015).

To quantify GHG emissions from livestock, and cattle and poultry systems in particular, we use data from the Global Livestock Environmental Assessment Model (GLEAM). GLEAM is a Geographic Information System framework that simulates the bio-physical processes and activities along livestock

[1] This estimate does not include the CO_2 that ecosystems remove from the atmosphere by sequestering carbon in biomass, dead organic matter, and soils, which offset approximately 20 percent of emissions from this sector.

supply chains through a life cycle assessment approach. It quantifies production and use of natural resources in the livestock sector and measures GHG emissions from the sector, with the objective to assess the effectiveness of alternative adaptation and mitigation options that support a sustainable livestock development trajectory. GLEAM identifies three main groups of emissions. Upstream emissions from feed production, processing and transportation. Animal production emissions from enteric fermentation, manure management and on-farm energy use. Downstream emissions from processing and post-farm transport of livestock commodities. GLEAM allows estimating emissions of three gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). All emissions are converted into CO_2 eq. using the latest available global warming potential from IPCC (2014) (298 for N_2O and 34 for CH_4). It builds on 2010 data for animal numbers and distribution, herd parameters, feed yields and rations, and manure management systems.

Table 1 shows total emissions from the cattle sector in Uganda, which amount to 13.9 million tonnes of CO_2 eq. Enteric fermentation explains 79 percent of the total GHG emissions and manure management about 19 percent. Agro/pastoral systems contribute 55 percent of the total GHG emissions, while pastoral systems around 33 percent. Ranching and semi-intensive systems represent 8 and 3 percent of the total GHG emissions respectively. However, semi-intensive systems contribute the most to GHG emission on a per head basis, with each cattle emitting an estimated 3.11 tonnes of CO_2 eq. per year. Pastoralist systems contribute the least (1.67 tonnes of CO_2 eq. per year).

Figure 1. Total emissions from beef cattle by production system, Mt CO_2 equivalent

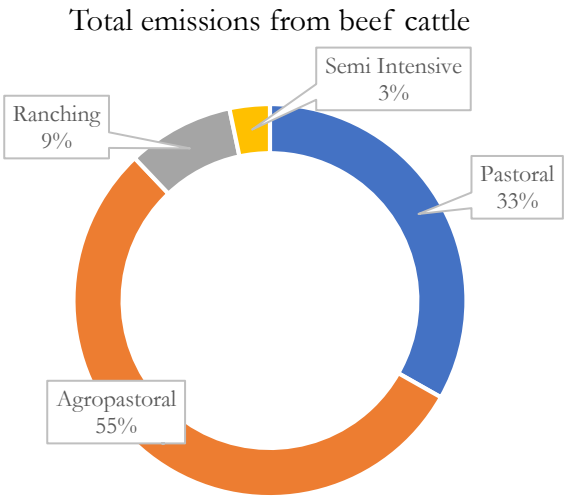


Table 1. Total emissions from beef cattle in Uganda, by group of emissions (tonnes of CO_2 eq / year)

	Tonnes of CO_2 eq/year
Enteric fermentation, CH_4	11 035 195
Manure management, CH_4	2 665 005
Manure management, N_20	173 599
Feed emission, N_20	13 004
Feed emission, CO_2	12 492
TOTAL CO_2	**13 899 295**

Table 2. Emissions from beef cattle per head, by production system (tonnes CO_2 eq / year / per head)

	Tonnes CO_2 eq/head
Pastoralism systems	1.67
Agro-pastoralist systems	2.29
Ranching system	2.38
Semi-intensive systems	3.11

Table 3 shows total emissions from the poultry sector, excluding layers farms, which however represent a very minor share of the poultry sector in Uganda. Total GHG emissions from poultry are estimated at 355 784 CO_2 eq. tonnes per year. They are largely (69.1 percent) explained by emissions from feed production, including from imported feed. Manure management follows, contributing about 19 percent of the total GHG emissions from the poultry sector. About three quarter or 71 percent of all emissions originate in intensive poultry production systems, where birds are regularly and properly fed. For this reason, the intensive system also contributes the most to GHG emissions on a per-bird basis: each chicken in intensive system emits 0.05 tonnes of CO_2 eq. per year, while in semi-intensive and free-range system each bird emits 0.01 and 0.00 tonnes of CO_2 eq. per year, respectively.

Figure 2. Total emission from the poultry sector by production system, Mt CO_2 equivalent

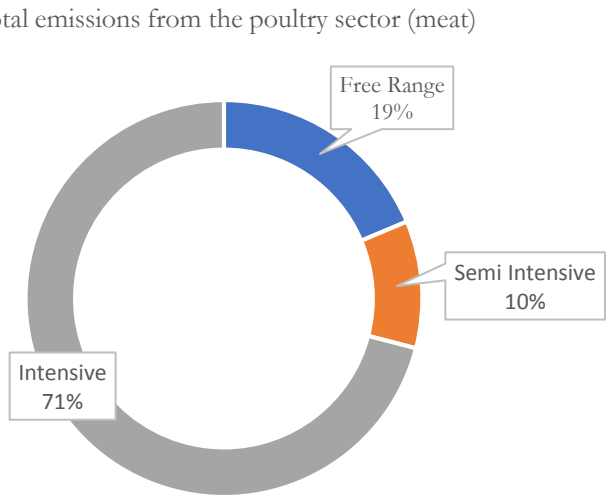


Table 3. Total emissions from poultry in Uganda, by group of emissions (tonnes of CO_2 eq / year)

	Tonnes of CO_2 eq/year
Applied manure, N_20	20 644
Crop residues, N_20	15 403
Feed, CO_2	245 810
Manure management, CH_4	6 289
Manure management, N_20	67 639
TOTAL CO_2	**355 784**

Table 4. Emissions from poultry per bird, by production system (tonnes CO_2 eq / year / per head)

	Tonnes CO_2 eq/head
Free range poultry systems	0.00
Semi-intensive poultry systems	0.01
Intensive poultry systems	0.05

3. Cattle, poultry and water use

Livestock production draws on water resources as drinking water, water to produce feed and water for cleaning and processing. The amount of drinking water used varies from 5–50 litres per Tropical Livestock Unit per day and depends on the species, dry matter intake, composition of the feed, water content of the feed, live weight of the animal, level of milk and meat production, physiological status of the animal and the climate in which the livestock is managed. In general, the water required to produce daily feed for livestock is about 100 times the actual daily requirements for drinking water.

Mekonnen and Hoekstra (2012) conducted a global assessment of the water footprint of farm animal products by production system and source of water, including blue, green and grey water. A blue water footprint refers to the amount of water consumed from surface and groundwater along the value chain of a product, that is evaporated after withdrawal. Green water refers to rainwater consumption. The grey water footprint refers to the volume of freshwater needed to assimilate the load of pollutants emitted. The study examines data from 1996 to 2005. The water footprint of a live animal consists of direct consumption via drinking and service water and indirect consumption through the water used for feed production (Chapaign and Hoekstra, 2003, in Mekonnen and Hoekstra, 2012). Table 5 presents estimates of the water footprint of cattle and poultry in different production systems as measured in cubic meters (m^3) per live cattle and live bird. In Uganda, both cattle and chicken largely rely on green water, with rainfall being the major source of water for drinking and producing feed. The level of green water use decreases with level of intensification, because of higher level of efficiency in resource use in industrial or intensive systems. There water footprint in terms of blue and grey water is currently low, because of limited intensification of both cattle and poultry production systems.

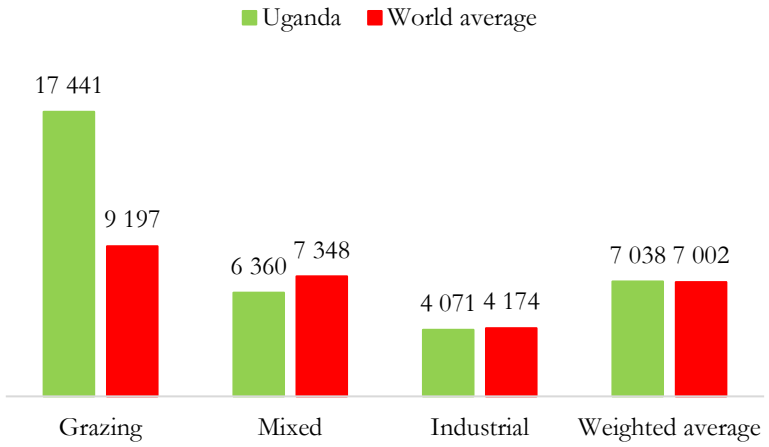
In absolute numbers, in Uganda, cattle in grazing systems use more green water than the world average (Figure 3) and all the poultry production systems use more green water than the world average (Figure 4).

Table 5. Green, blue and grey water footprints of cattle and poultry by production system in Uganda, m^3 per tonne of live animal

	Cattle			
	Pastoralist - agropastoralism	**Semi-intensive**	**Intensive**	**Average**
Green	17 441	6 360	4 071	7 038
Blue	135	143	125	142
Grey	2	2	3	2
	Poultry			
	Free range	**Semi-intensive**	**Intensive**	**Average**
Green	11 776	6 994	3 660	7 173
Blue	103	65	34	66
Grey	40	24	12	24

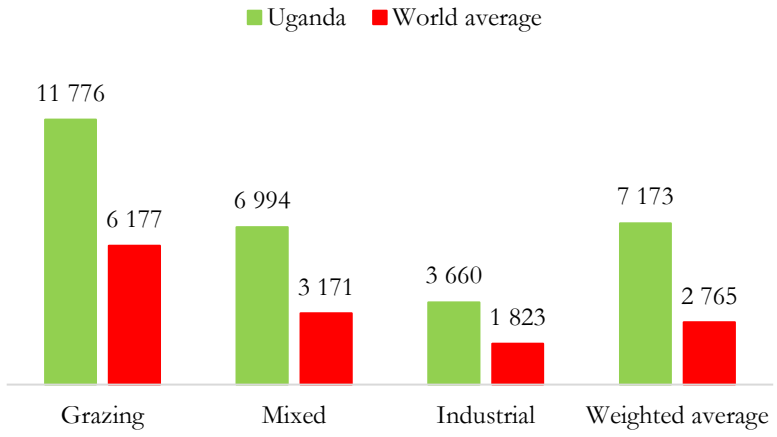
Source: Mekonnen and Hoekstra (2012).

Figure 3. Green water footprint of live cattle in Uganda and world average



Source: Mekonnen and Hoekstra (2012)

Figure 4. Green water foodprint of live poultry in Uganda and world average



Source: Mekonnen and Hoekstra (2012)

In spite of the use of grey water is still limited in Uganda, there is evidence that the concentration of animals around water points, particularly in pastoral areas, might facilitate the spread of certain diseases (Njeru *et al.*, 2016); that beef and chicken production systems affect the quality of water through contamination by run-off manure from farms, slaughter places, chicken houses or pesticides and chemicals used during the production processes (for example, chemicals like acaricides might find their way to water reservoirs that are used by both animals and farming communities); that nutrient overloadings in water contribute to the growth of algae, which can produce toxins potentially harmful to human and ecological health. However, accurate data are not yet available in Uganda to investigate in detail the linkages and consequences of water contamination from livestock.

4. Livestock, grasslands degradation and biodiversity loss

The loss of large areas of tropical grasslands is a major concern at global level. In Uganda, over the past century, a substantial amount of grasslands (rangelands) has been affected livestock grazing across much of the cattle corridor (Government of Uganda, 1998). The State of Environment Report (2006/07) of Uganda estimated that about 21 percent of the total land in Uganda was covered with grasslands, with an

estimated annual loss around 9 percent since then. Kyenkya *et al.* (2014) conduced and assessment of livestock management in pastures in Nakasongola: they found that, between 1986 and 2013, grasslands decreased by 96.1 percent while open bare ground increased by over 210 percent. According to Byenkya *et al.* (2014, p.1013), "*land use and cover changes have delineated mobility as a coping strategy to drought, contributed to degradation of rangelands, reduced the resilience of pastoral systems to drought and increased their vulnerability to climate change*".

Livestock concentration is often associated with biodiversity loss. Tushabe *et al.* (2006) estimated that the rate of biodiversity loss in Uganda is 10-11 percent per decade or 1 percent per annum. The loss mainly emanates from habitat conversion, high population growth rate, climate change, poverty, and poor farming practices. Pomeroy *et al.* (2017) estimated that, between 1975 and 1995, Uganda lost about half of its biodiversity value, and that areas under agriculture witnessed an increase in species diversity between 2000 and 2015. In particular, as livestock move from place to place, they move along with both plant and animal species, leading to colonization of new areas by new species. At the same time, however, However, losses of wildlife in African grasslands are increasingly and primarily attributed to encroachment of agriculture and competition with livestock (Caro, 2008; Ogutu et al., 2009; Ogutu et al., 2016). Driven by rapid human population growth, the former leads to the reduction of grassland areas and their fragmentation while the latter accelerates grassland degradation (Ogutu et al., 2016). These effects are exacerbated by increased spatial and temporal variability of rainfall and increased frequency of droughts, and could be exacerbated by a growing livestock population, production intensification, and novel interactions between domesticate animals and wildlife As the long-term security of many ecosystem functions and services – especially in changing environments – is likely to depend upon local biodiversity and local population extinctions are thus more significant than global extinctions for local livelihoods. Importantly, the impact of biodiversity loss on any single ecosystem process is nonlinear and saturating, such that change accelerates as biodiversity loss increases.

5. Conclusions

Uganda is expected to undergo major transformations in the upcoming decades. On one hand, population growth and the demand of animal source food are expected to increase. On the other, UN Habitat (2009) reminds about expected changes in climatic patterns and the environment (rainfall is expected to increase to up to 20 percent over most of the country with a decrease expected over the semiarid cattle corridor). The Government of Uganda is managing and monitoring the environment status through yearly policies and reporting systems, such as the National Environment Policy and Strategy and the State of the Environment Report.

Cattle and poultry have major impact on the environment in Uganda: they generate more than 14.2 million CO_2 tonnes eq. per year, are major users of water, and there is evidence of their negative impact on water quality, grasslands as well as biodiversity. The livestock development trajectory, therefore, will strongly influence the status of the environment in Uganda. Policy makers should start exploring in details how livestock mith impact on the environment in the medium to long-term and take actions now to ensure the livestock sector grows along a sustainable development trajectory, from an environmental but also social and public health perspective.

February 2018. This brief has been written by Gerald Nizeyimana (FAO), Ana Felis (FAO) and Alessandra Falcucci (FAO), under the guidance of the Uganda ASL2050 Steering Committee members. ASL2050 is a USAID-funded policy initiative that is implemented under the umbrella of the FAO Emerging Pandemic Threat Program.

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Annexes

Table A1. Cattle (beef) production systems in Uganda

Ranching	In ranching system, farmers keep large number of animals (500 – 3 000 per holding) in perimeter fencing, paddocked structures and grazing fields. They keep a mixture of indigenous, cross and exotic beef animals and make substantial investment in animal health management, the purpose of ranching system being the production and marketing of beef, with milk being a by-product. This system is prevalent in the Southwest and the Central 2 sub-regions.
Pastoral	In pastoral or free grazing systems, farmers move cattle from place to place in search of pastures and water. They keep indigenous breeds, with herd size ranging from few to 100 heads. Main products include beef, milk, blood, hides, manure and horns. This system is dominant in the Northeastern sub-region.
Agro Pastoral	Farmers graze largely indigenous cattle in both private and public pastures and also feed them with crops by-products. Cattle produce beef and milk, hides, manure and horns and also provide draught power. Investments in improved husbandry practices, including animal health, are none to minimal. This system is present in the Eastern, Central 2, Western, North and West Nile Sub-regions.
Semi-intensive	Farmers keep cattle, mainly cross-bred, confined in kraals, paddocks and cattle barns/stalls and feed them with compound feed. They also make significant investments in animal health, such as in vaccination and deworming. Cattle produce milk and beef. This system is mainly found in Central 1 and 2 and the Southwest sub-regions.

Source: FAO ASL2050 (2017), based on National expert consultation

Table A2. Poultry (meat) production systems in Uganda

Free Range	Farmers keep flocks from a few to a dozen indigenous chickens, which are left to roam around and scavenge for food. Birds are dual purpose, producing both eggs and meat. Live birds are well valued in the market because of consumers preferring their organoleptic characteristics over those of exotic breeds. This system is present across the country, both in rural and urban areas, and particularly pervasive in the West Nile and Southwest sub-regions.
Semi-Intensive	Farmers in semi-intensive poultry systems keep flocks of hundreds birds and are commercially oriented, producing either meat or eggs for the market. They keep birds in permanent structures in deep litter systems and feed them with compounds. Semi-intensive poultry farms are mainly located in peri-urban areas, and predominantly in the East Central and Central 2 sub-regions.
Intensive	In intensive systems, farmers keep thousands of exotic birds of one species, producing either meat or eggs for the market. Housing structures are permanent and feeding is by deep litter system, with maize being the main feed. This system is dominant in Central 1 and 2 and East Central sub-regions, with farms mainly located peri-urban areas.

Source: FAO ASL2050 (2017), based on National expert consultation

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